

FIG. 1

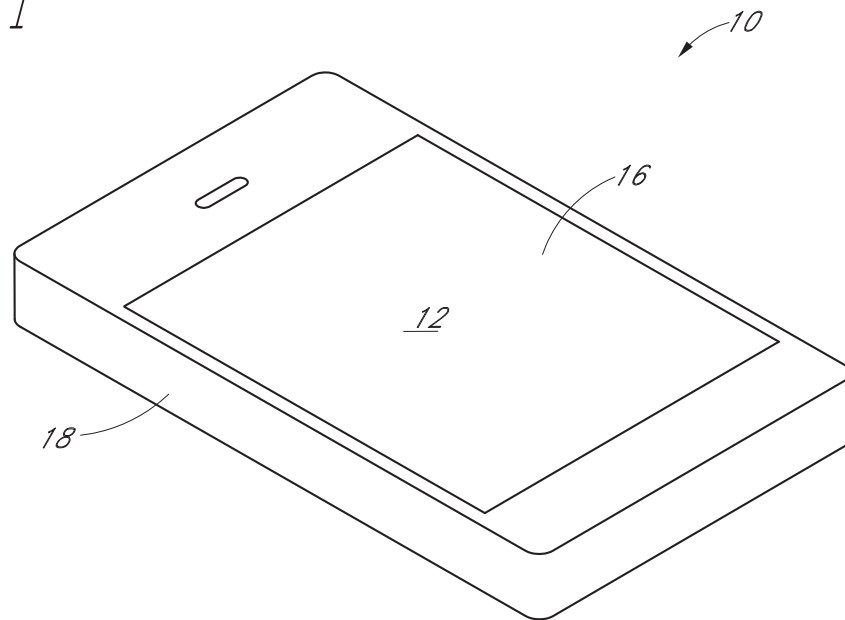


FIG. 2

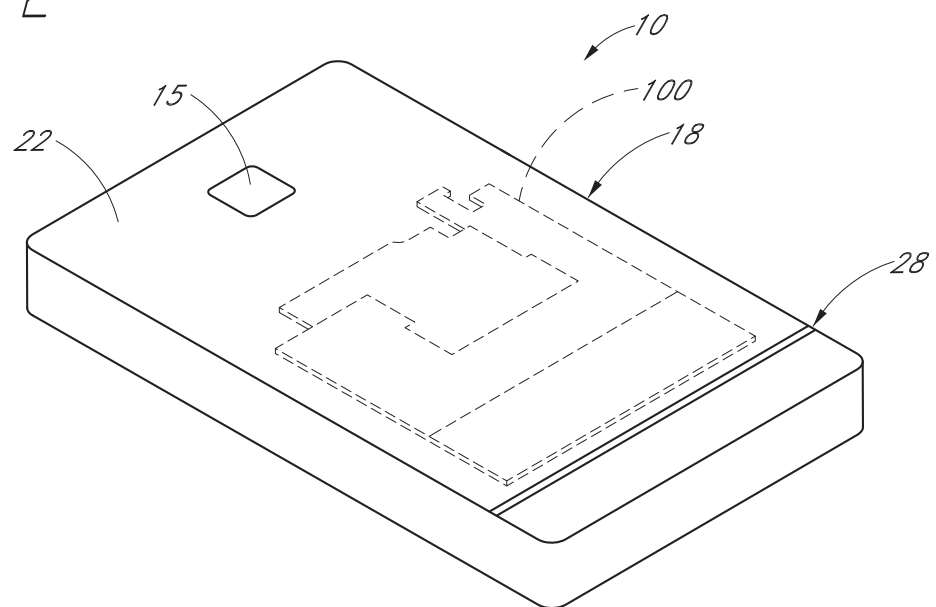
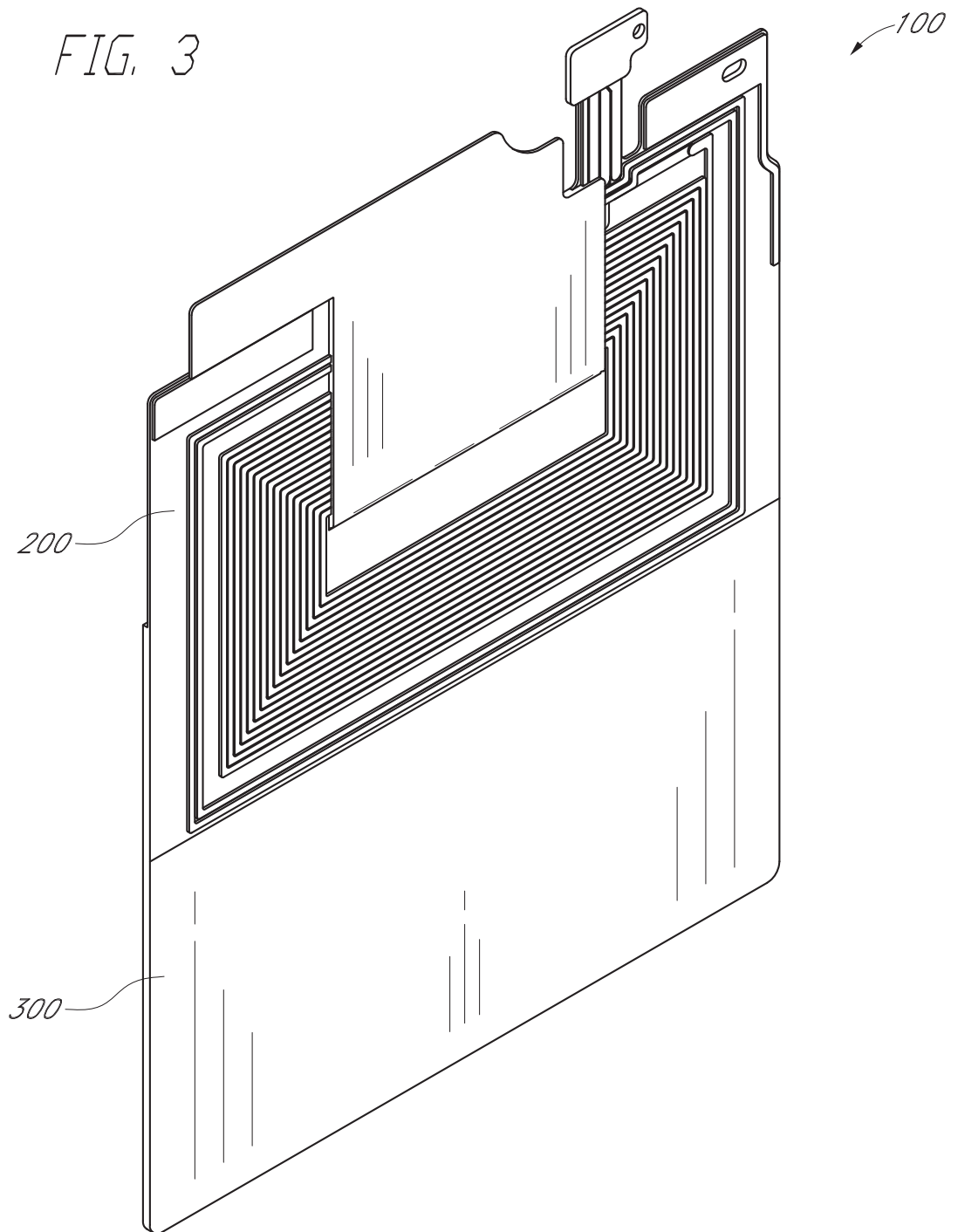


FIG. 3



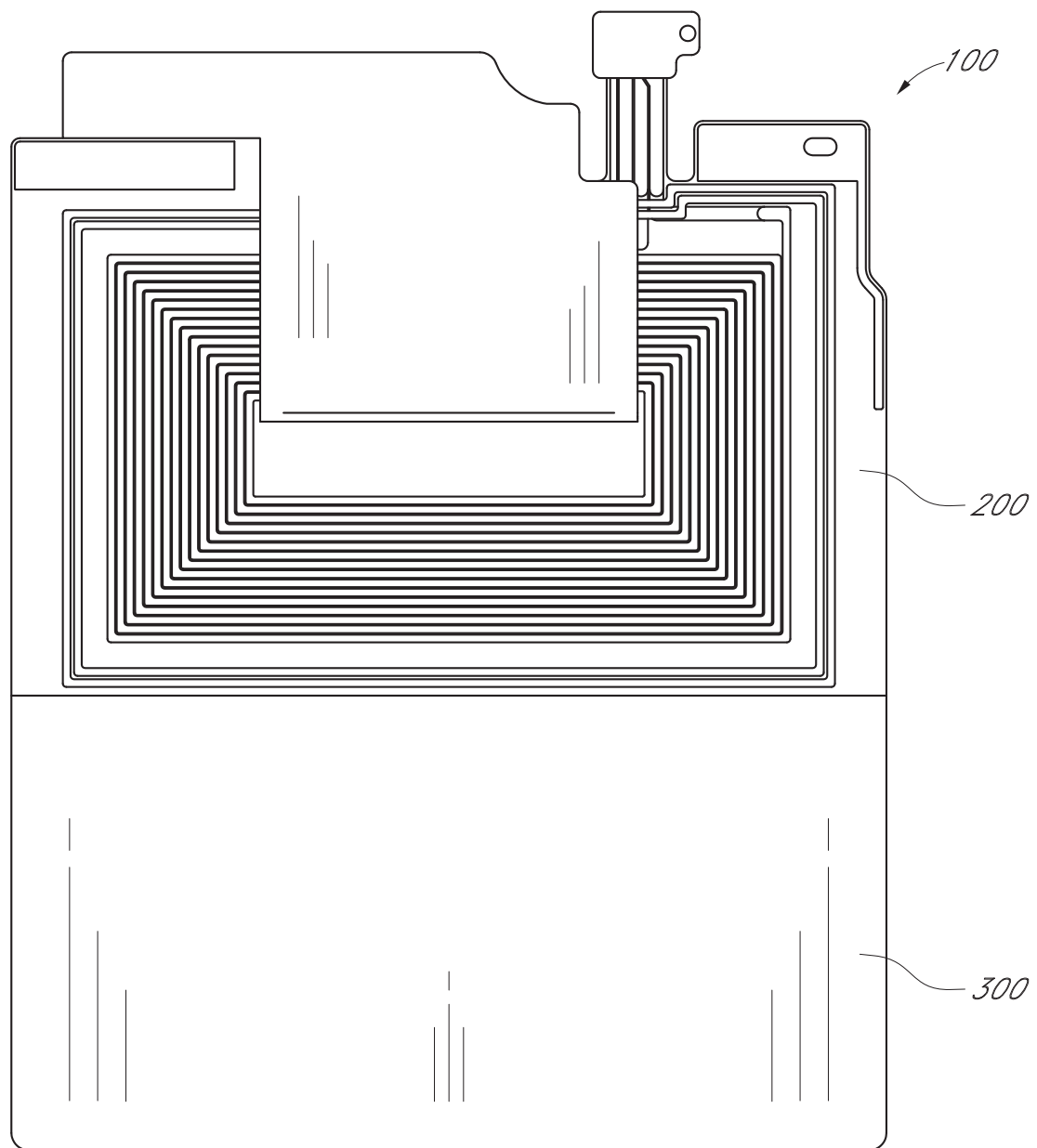


FIG. 4

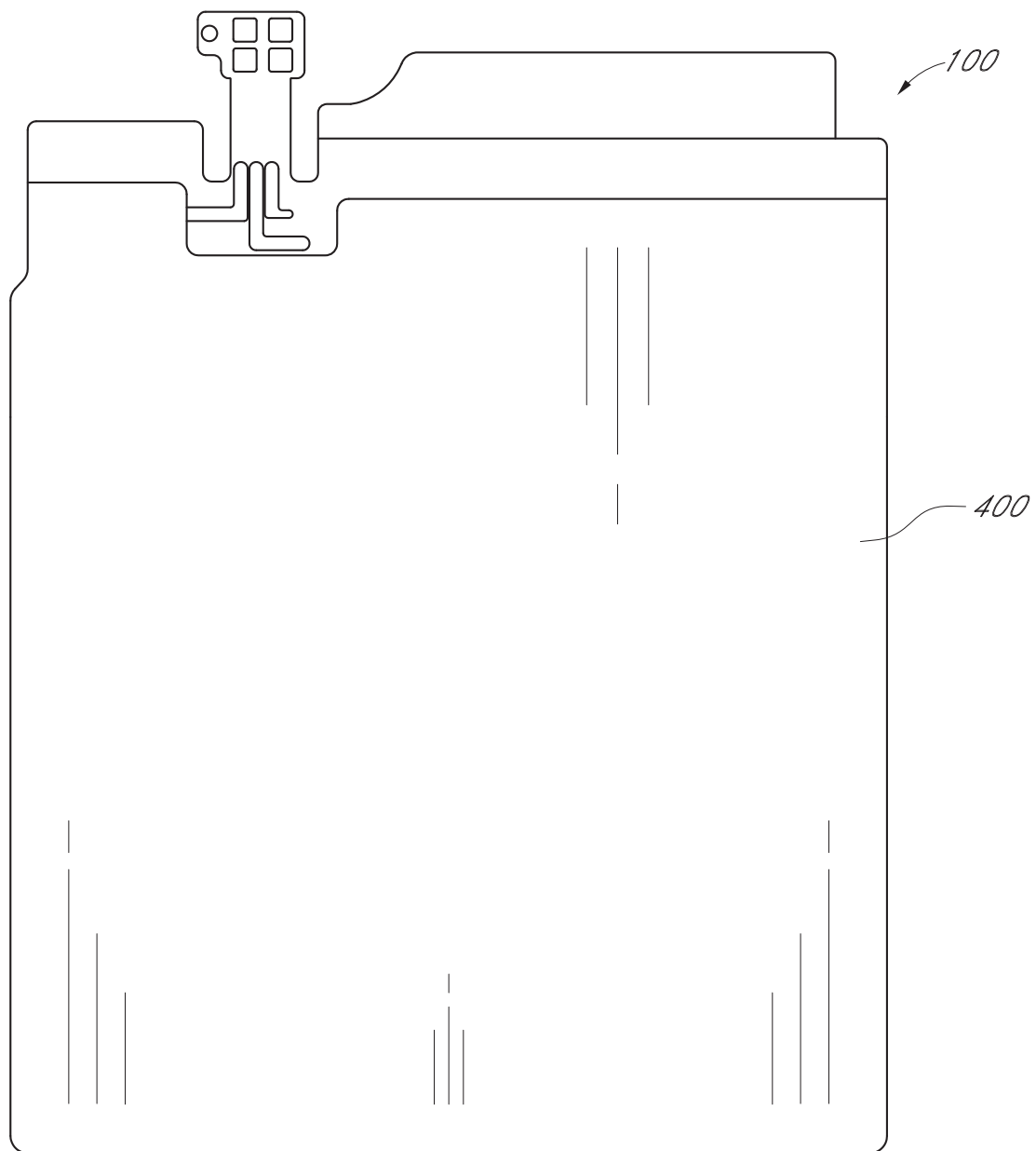


FIG. 5

FIG. 6

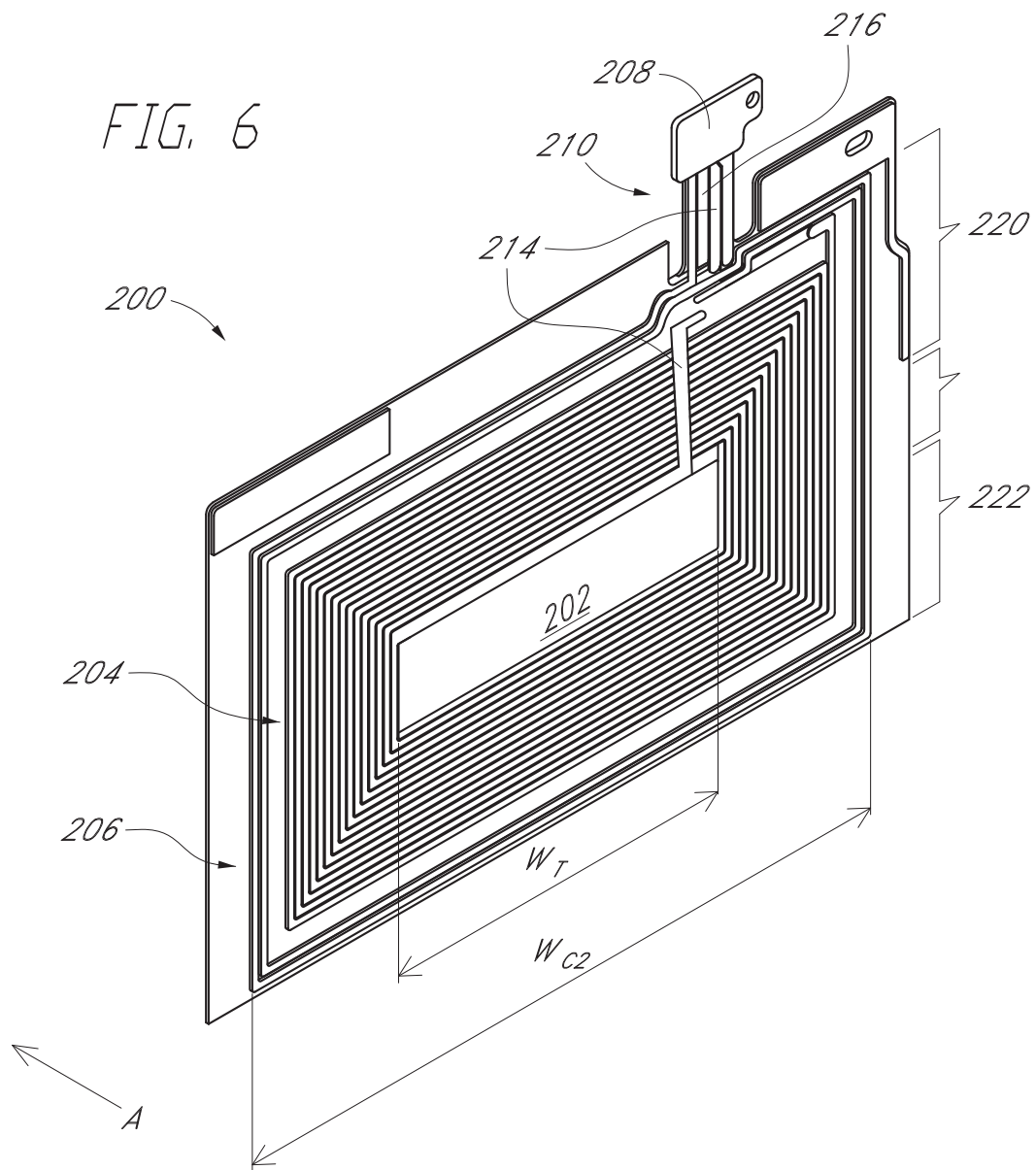


FIG. 7

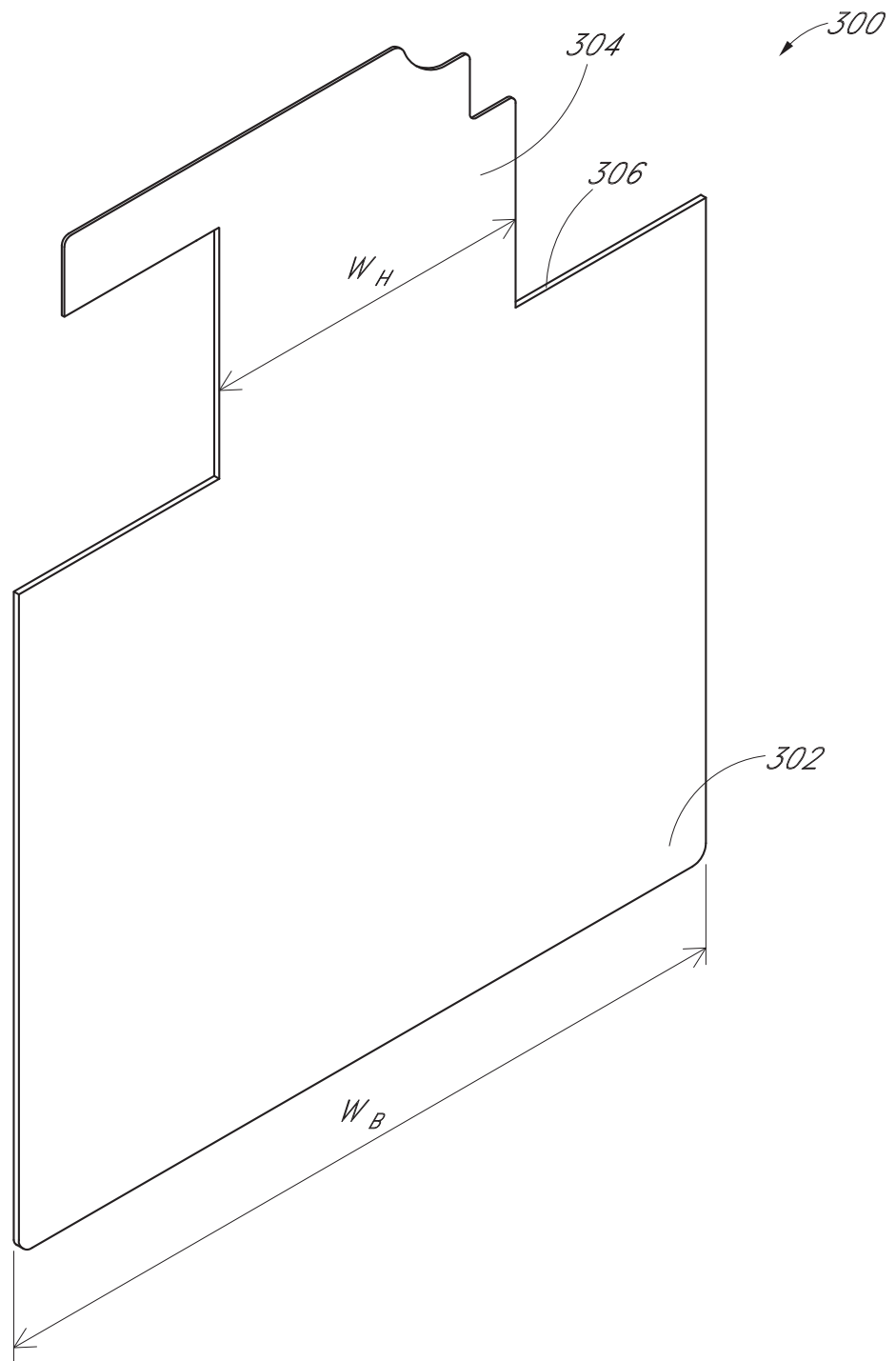
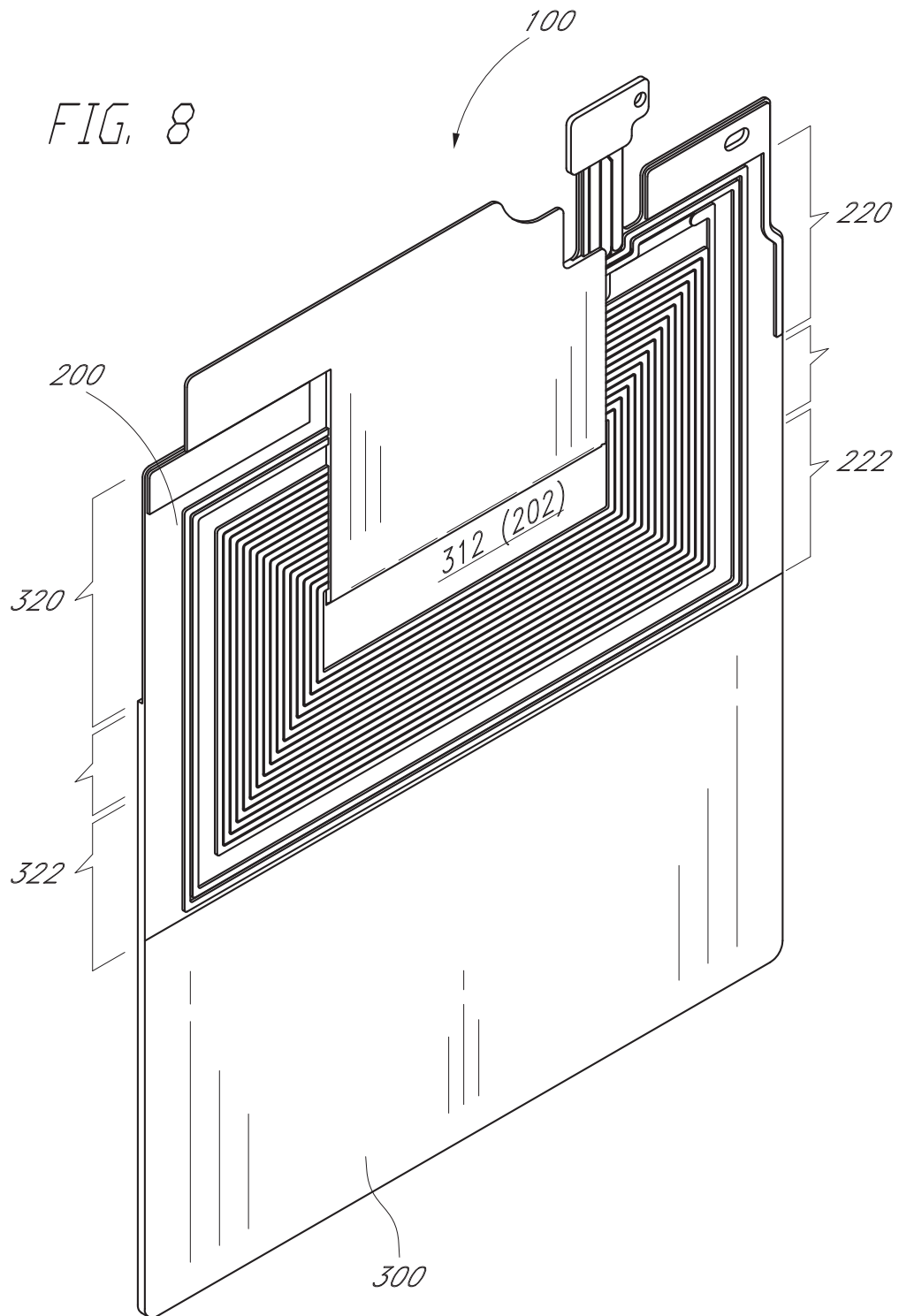


FIG. 8



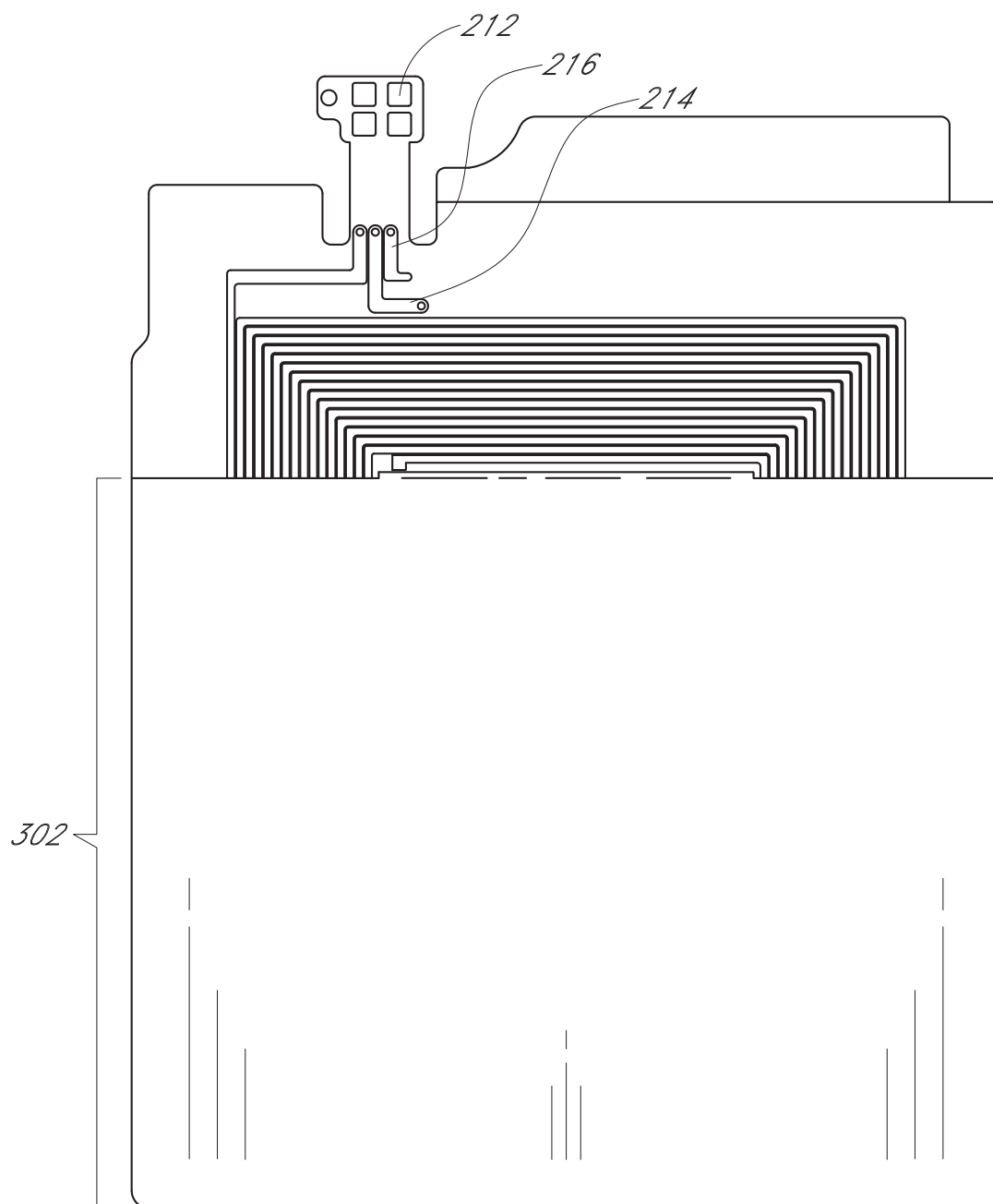


FIG. 9

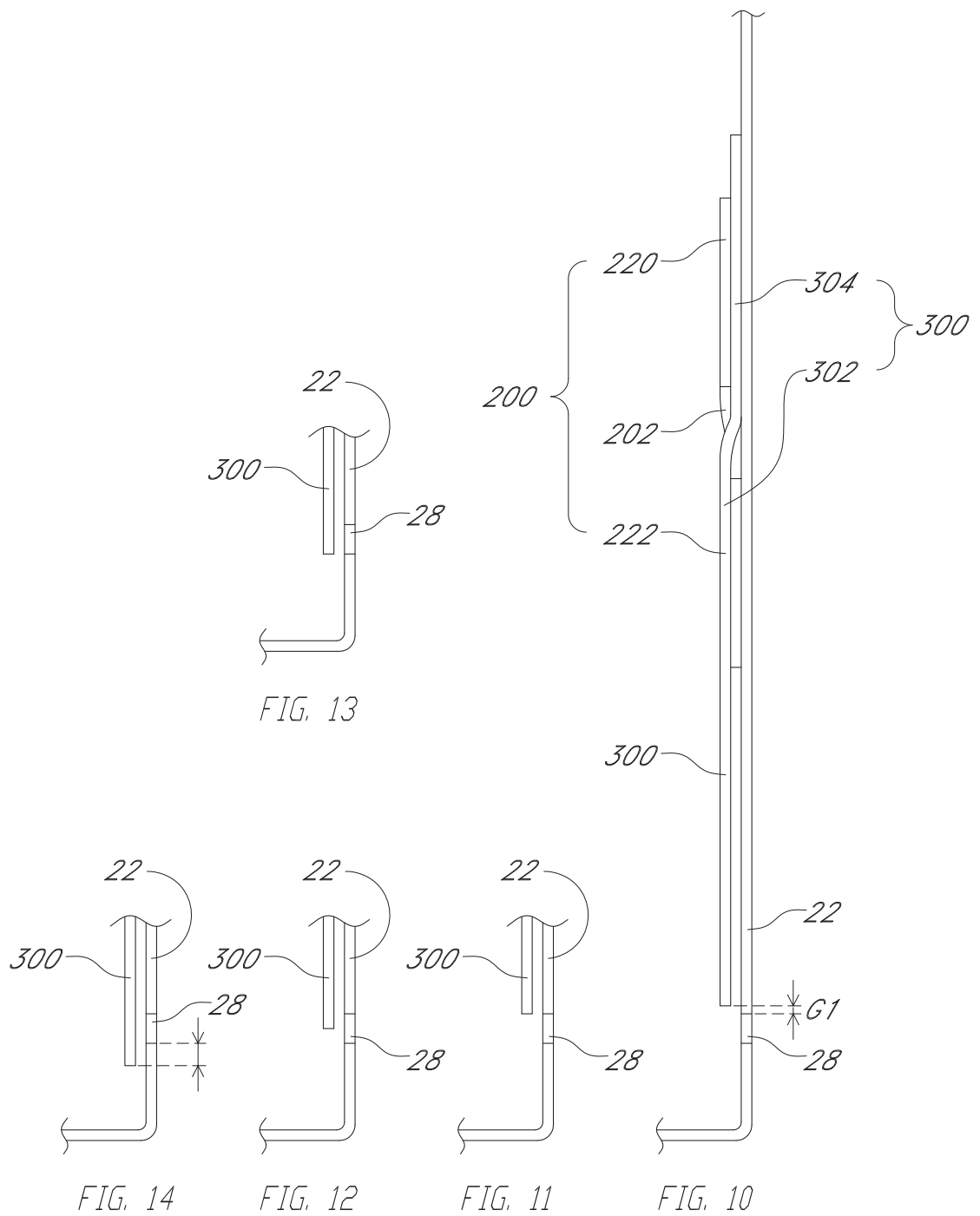


FIG. 15

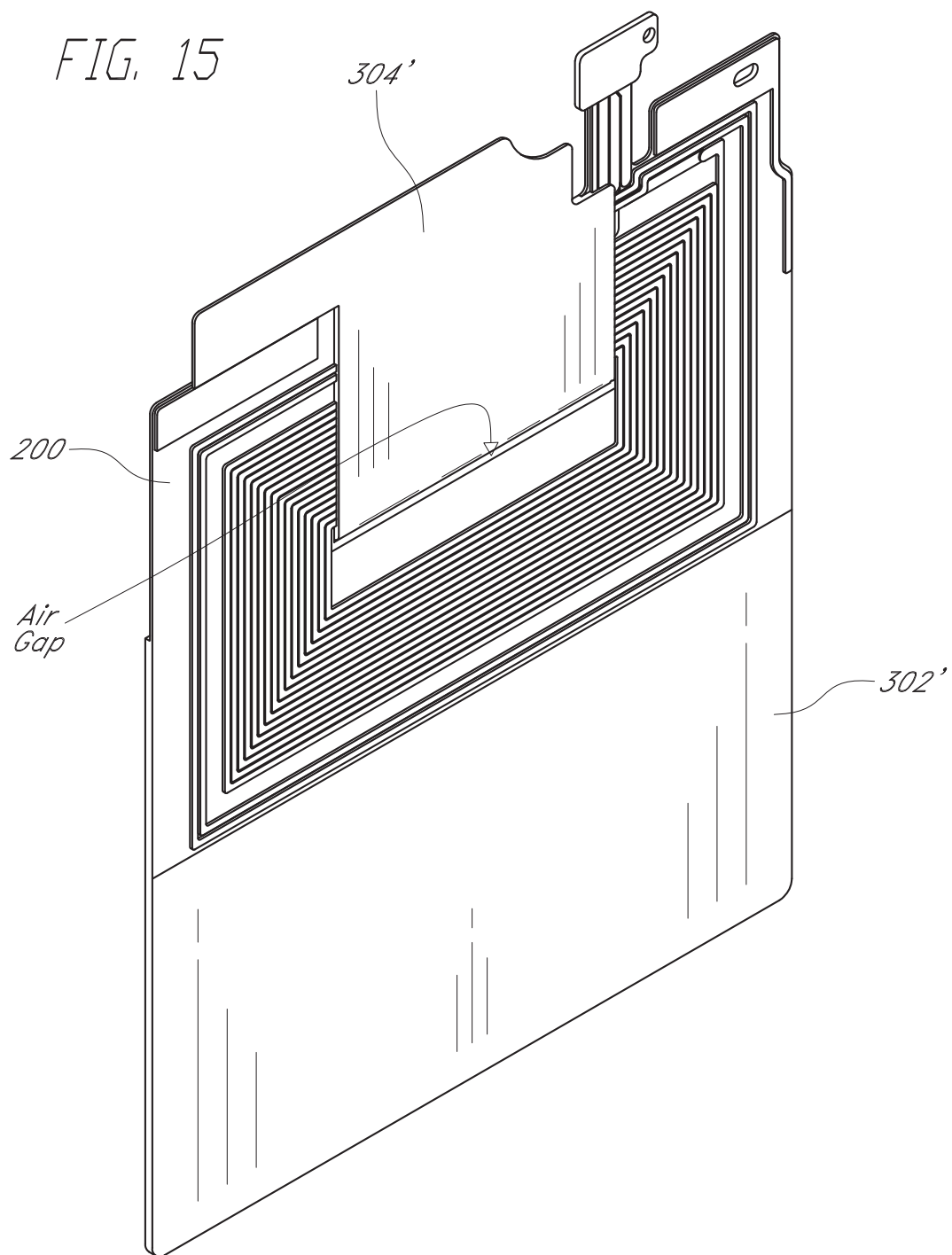
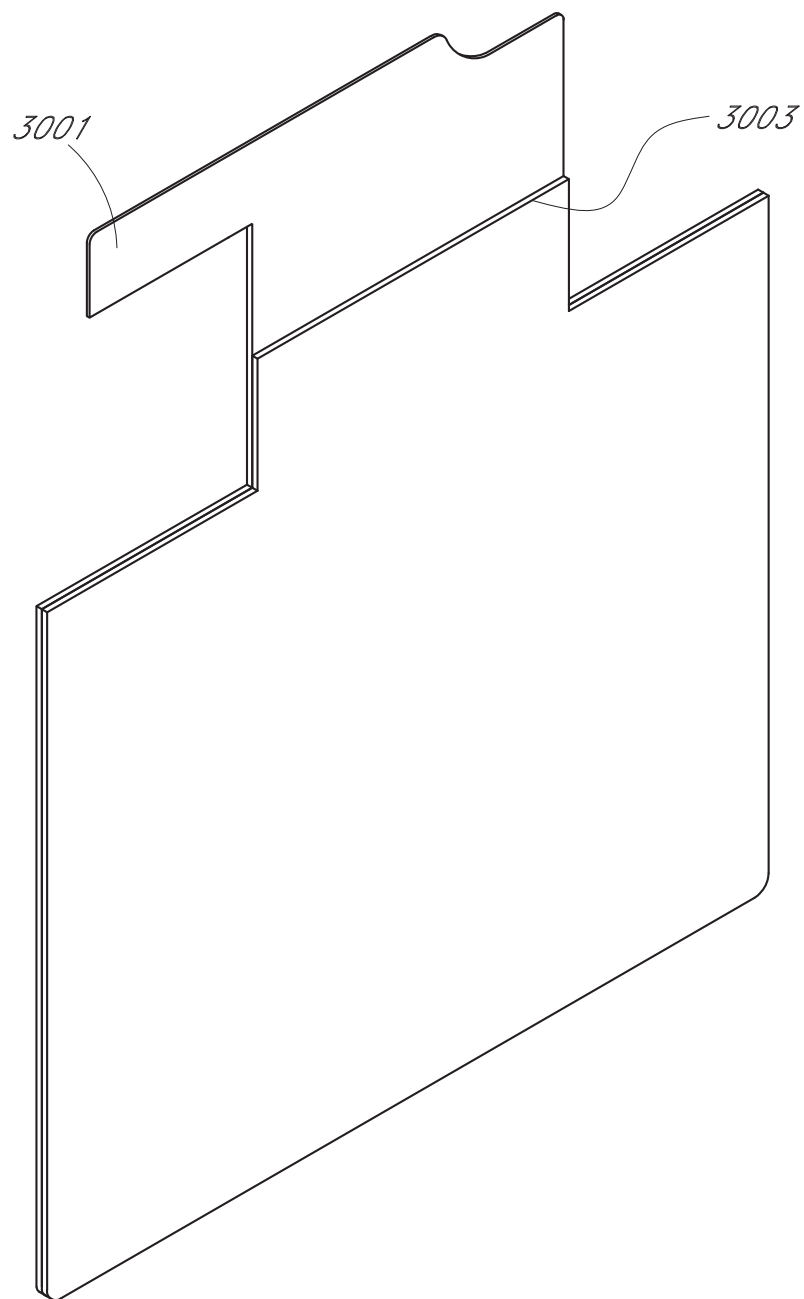


FIG. 16



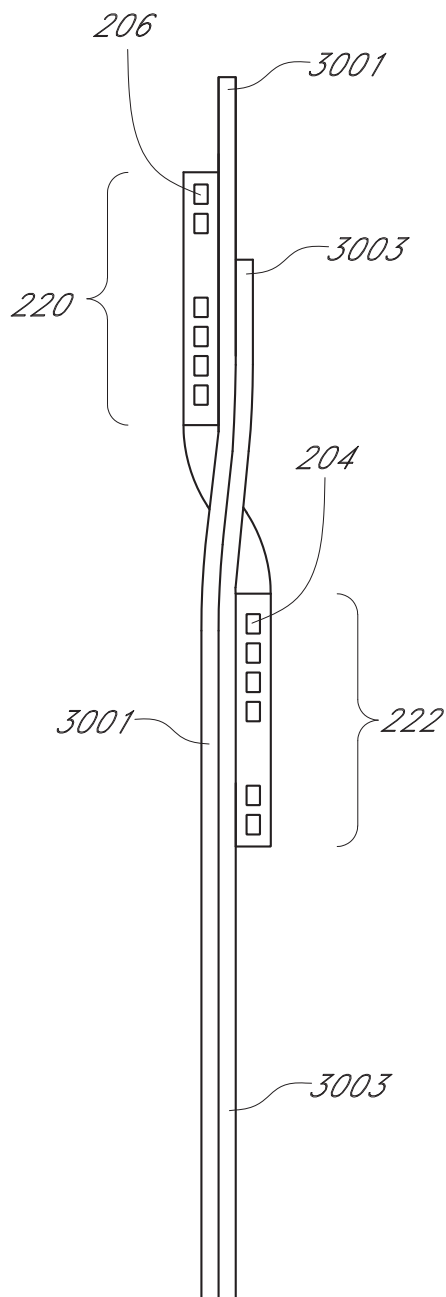


FIG. 17

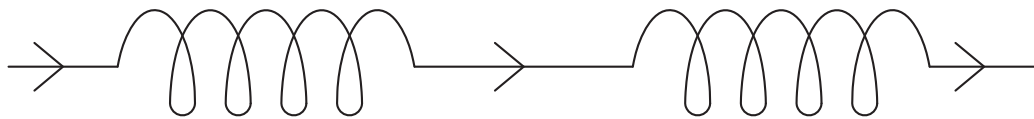


FIG. 18A

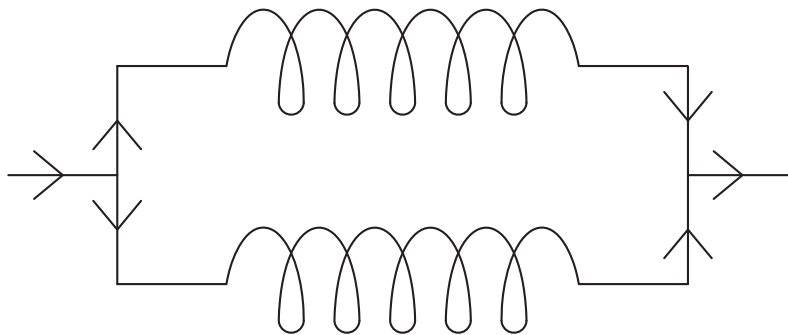
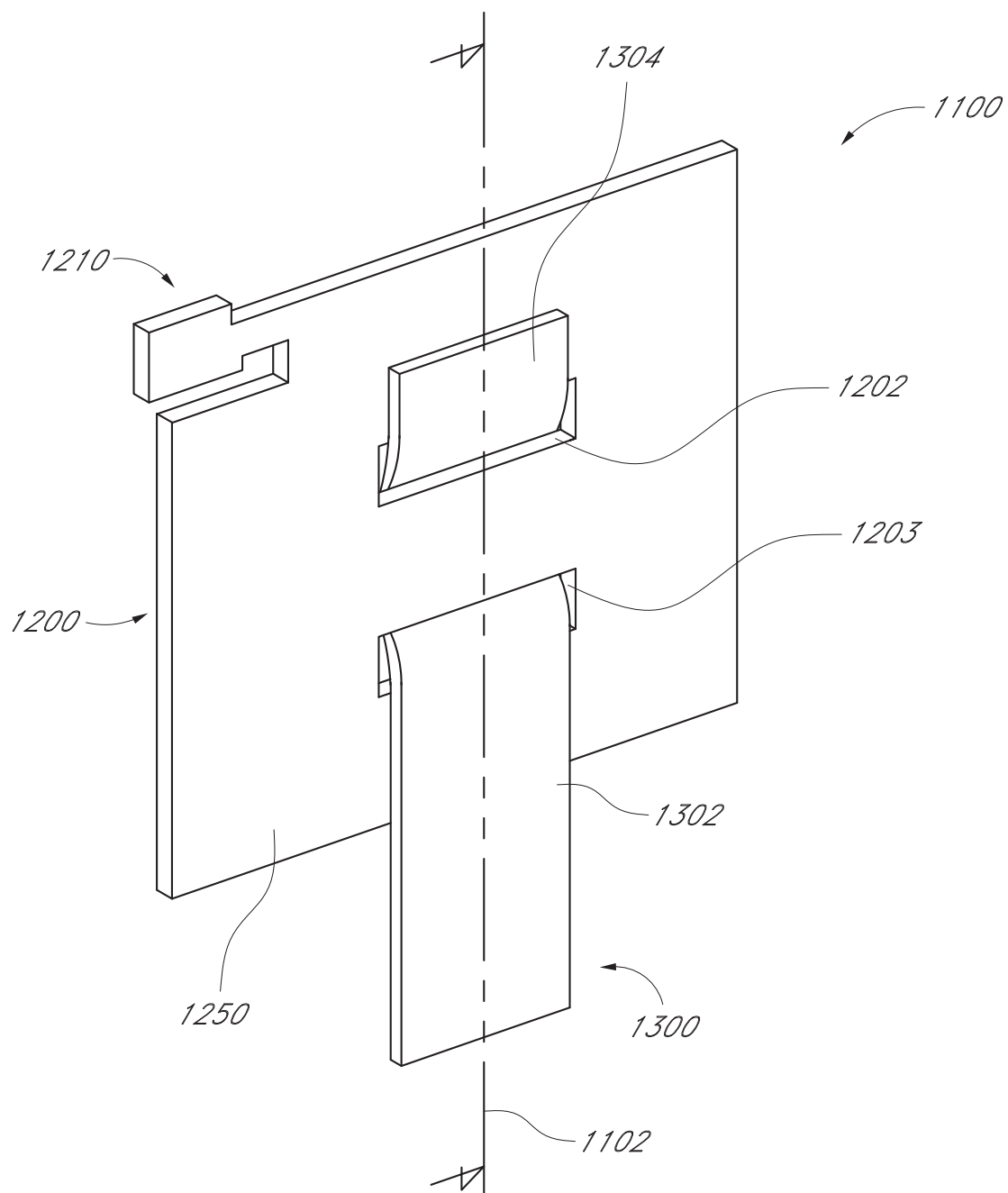


FIG. 18B

FIG. 19



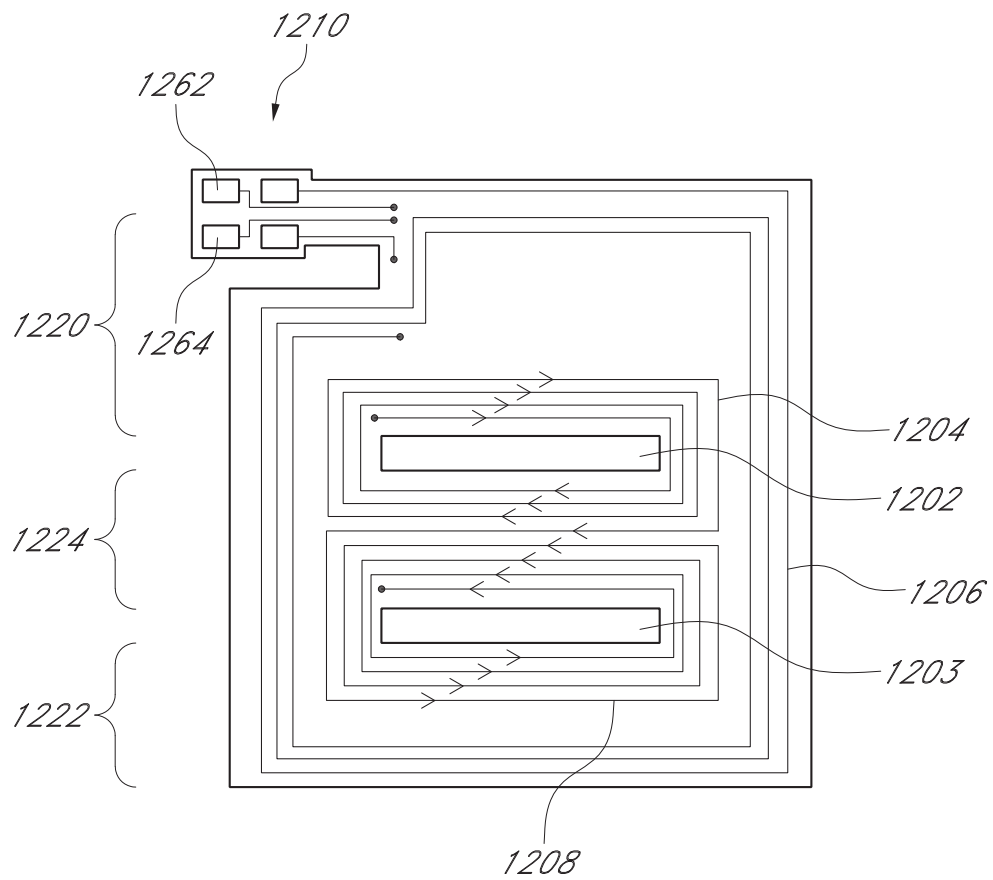


FIG. 20

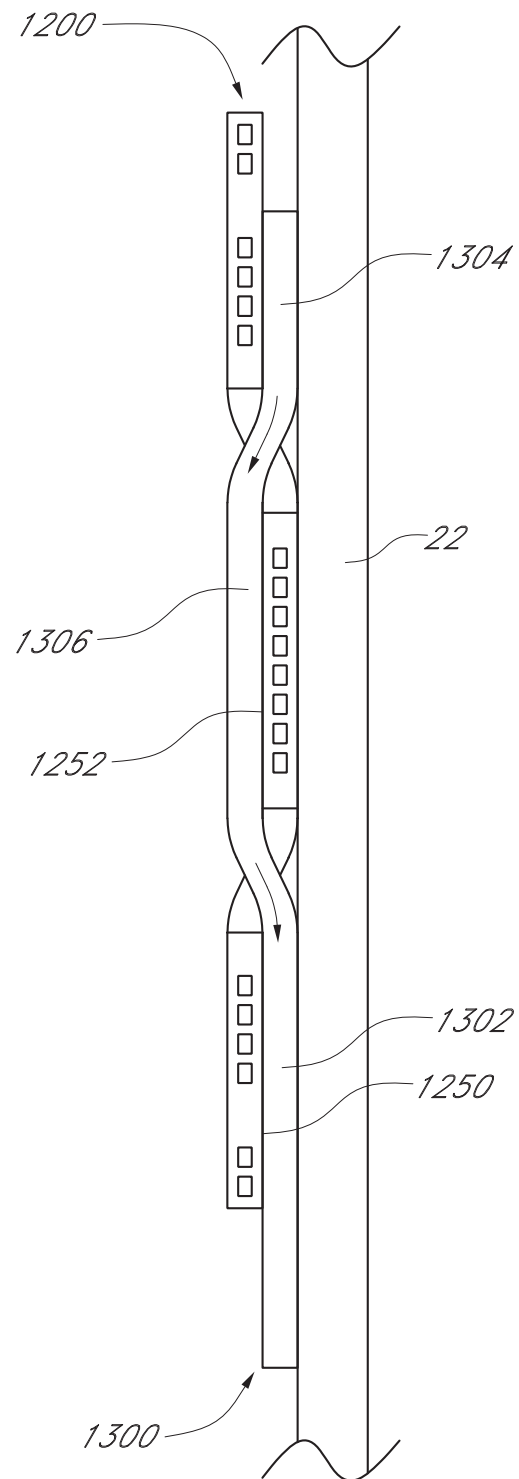


FIG. 21

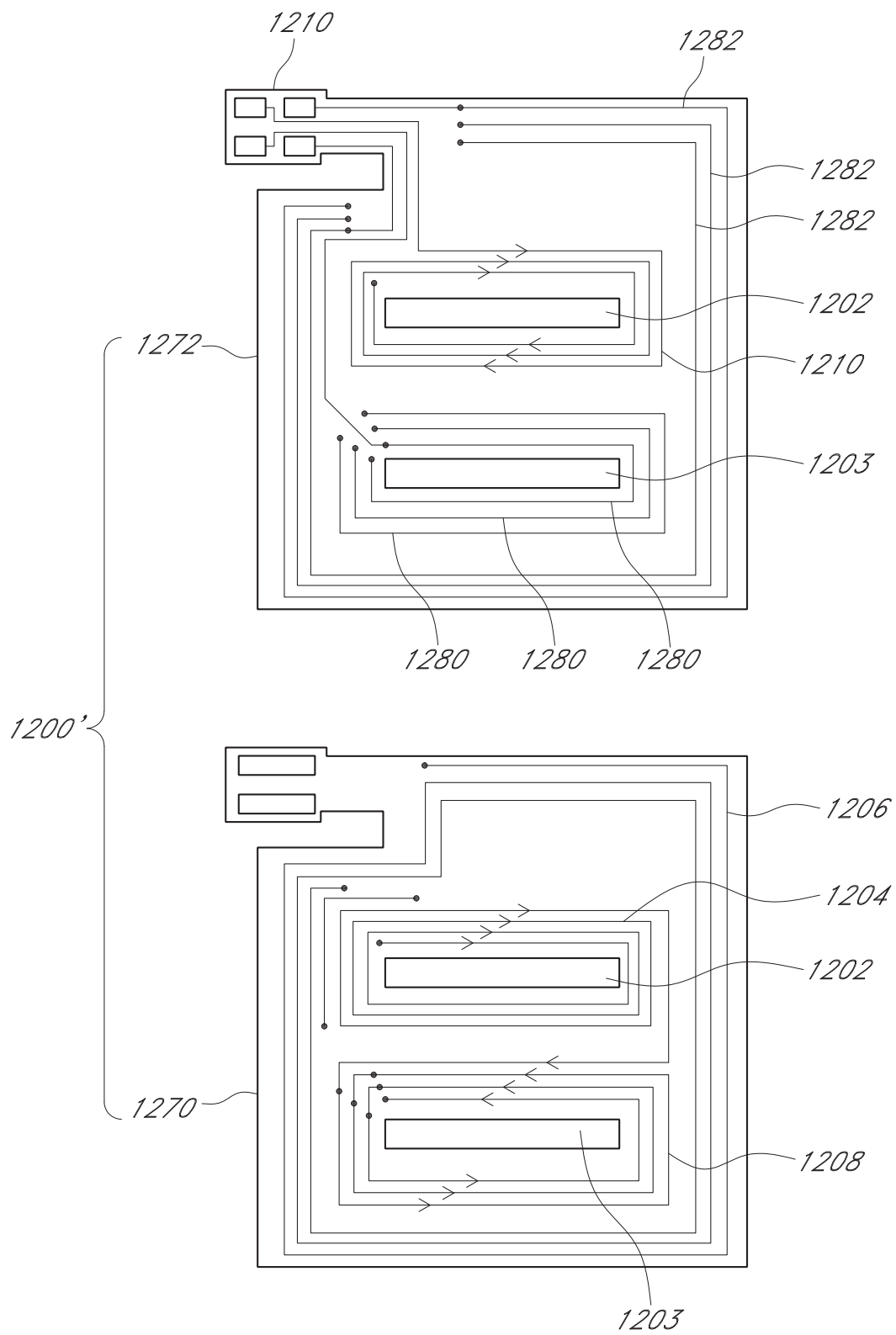


FIG. 22

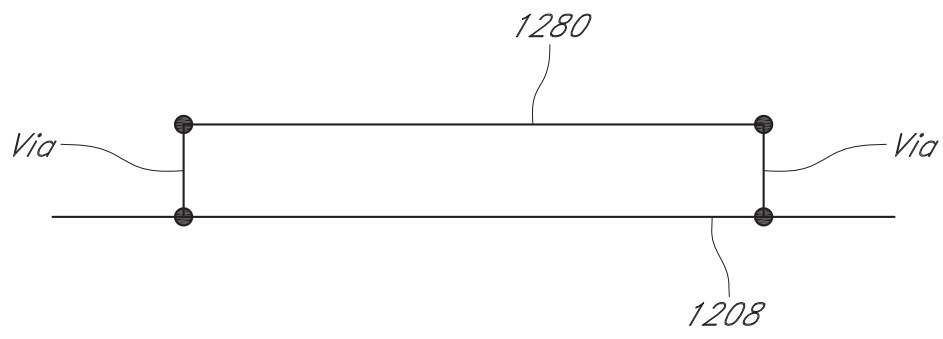


FIG. 23A

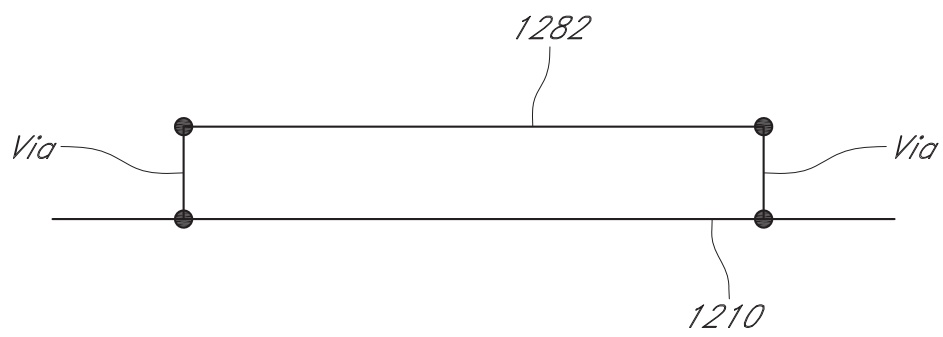
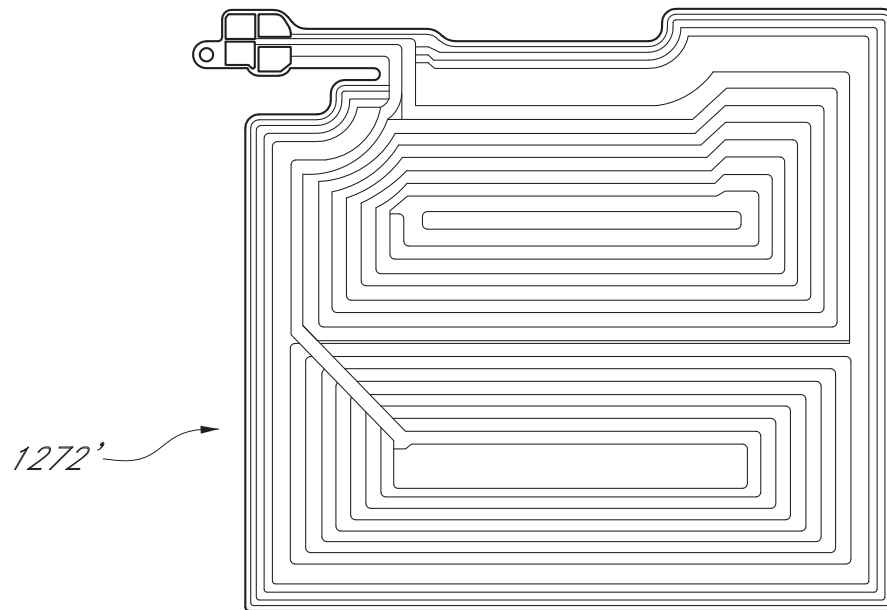
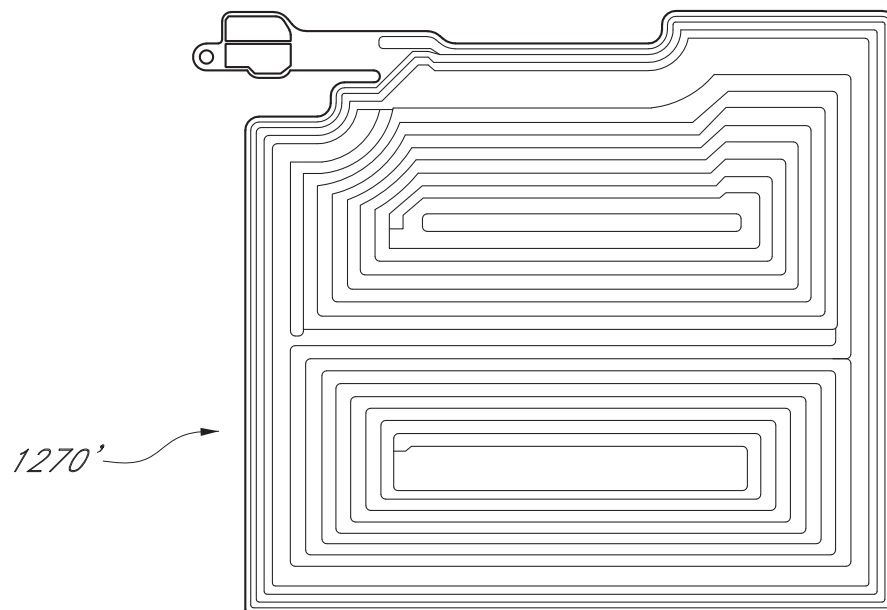


FIG. 23B

FIG. 24



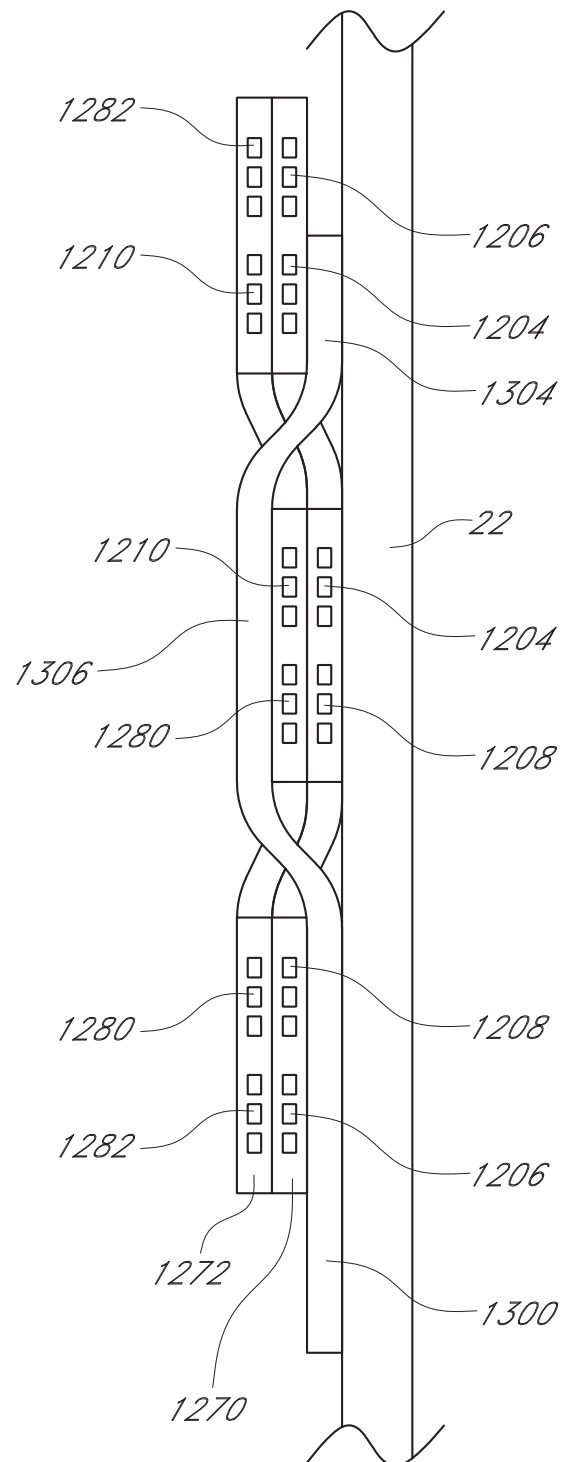
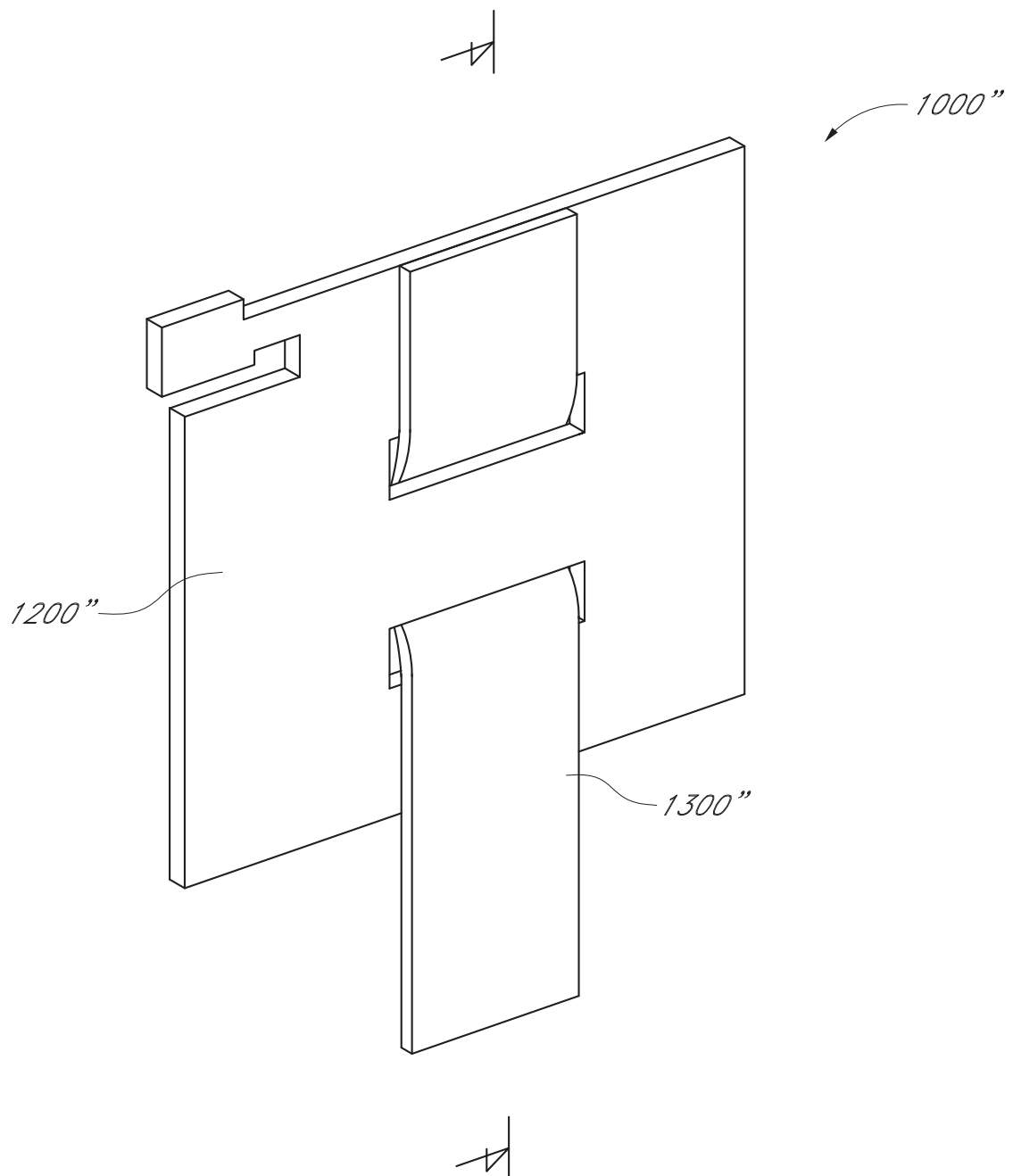


FIG. 25

FIG. 26



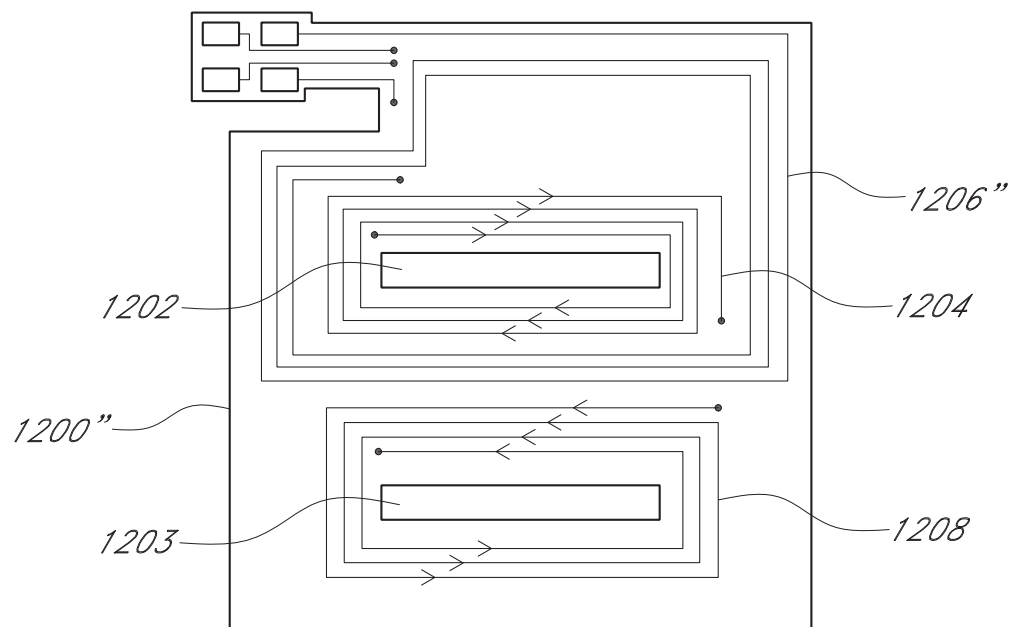


FIG. 27

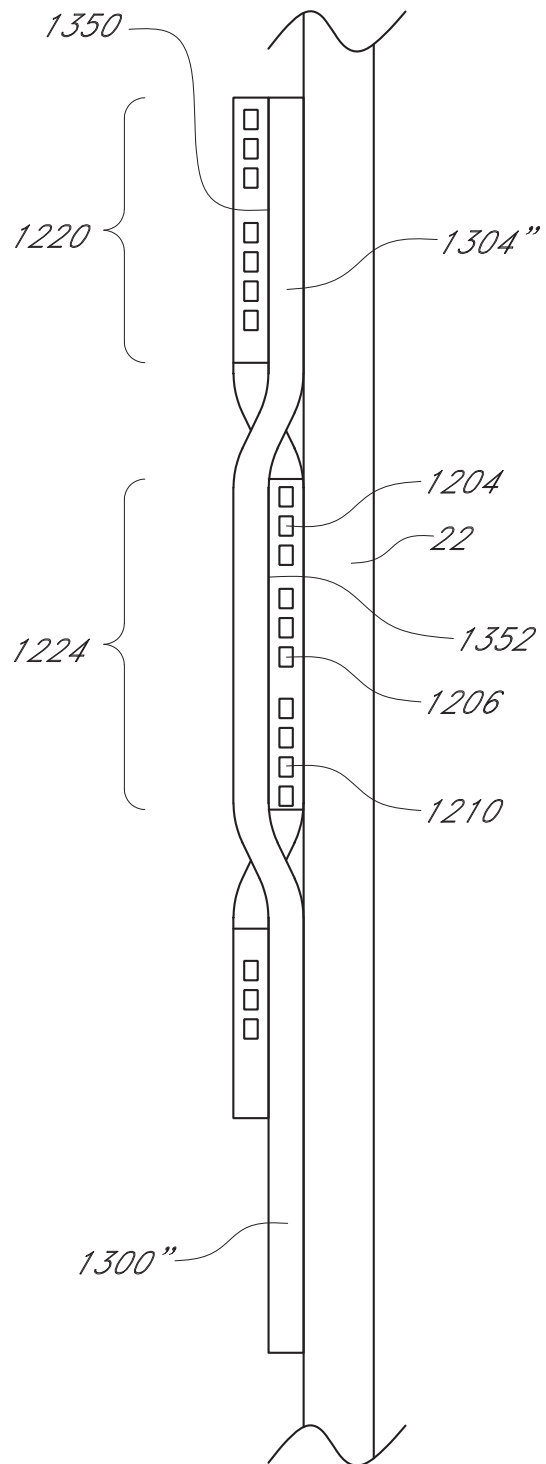


FIG. 28

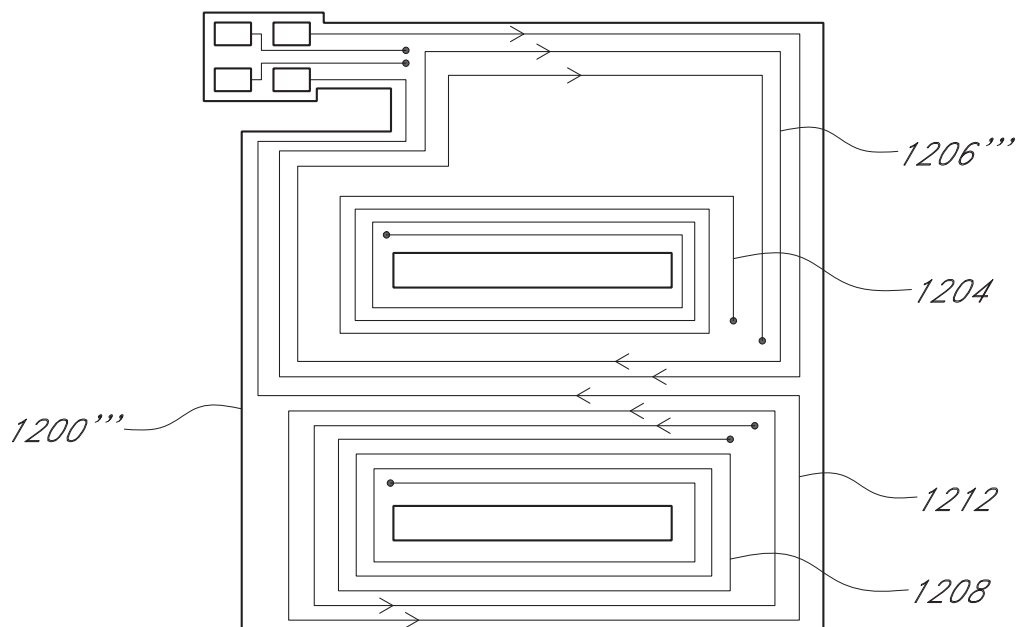


FIG. 29

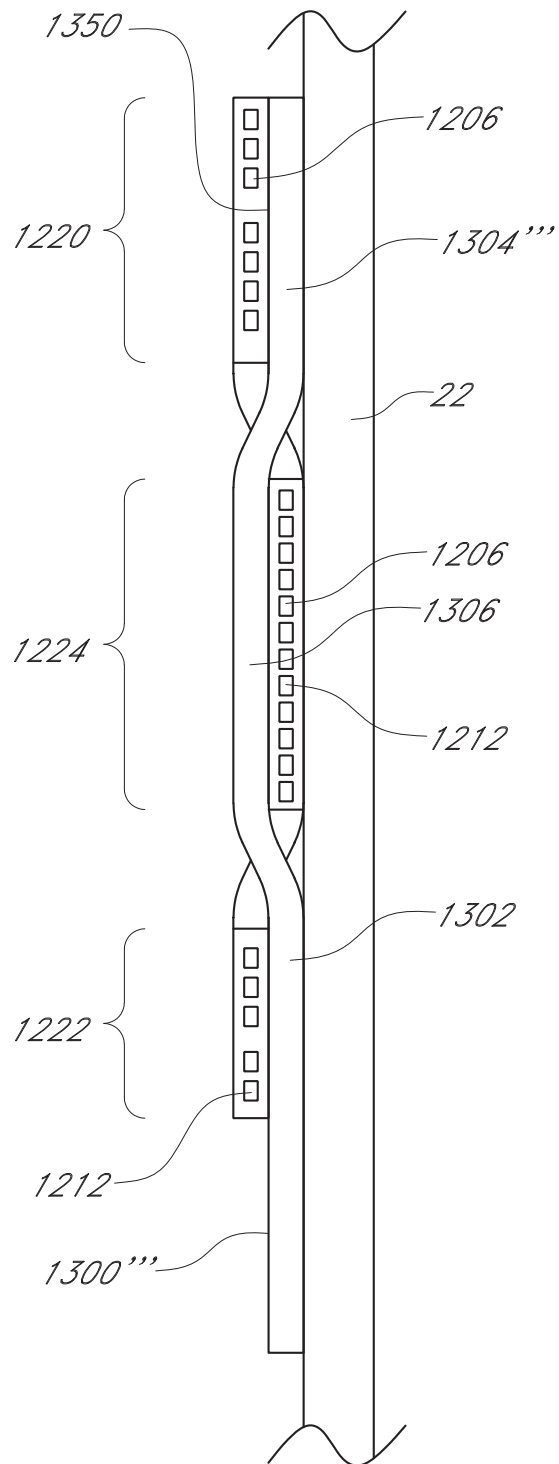
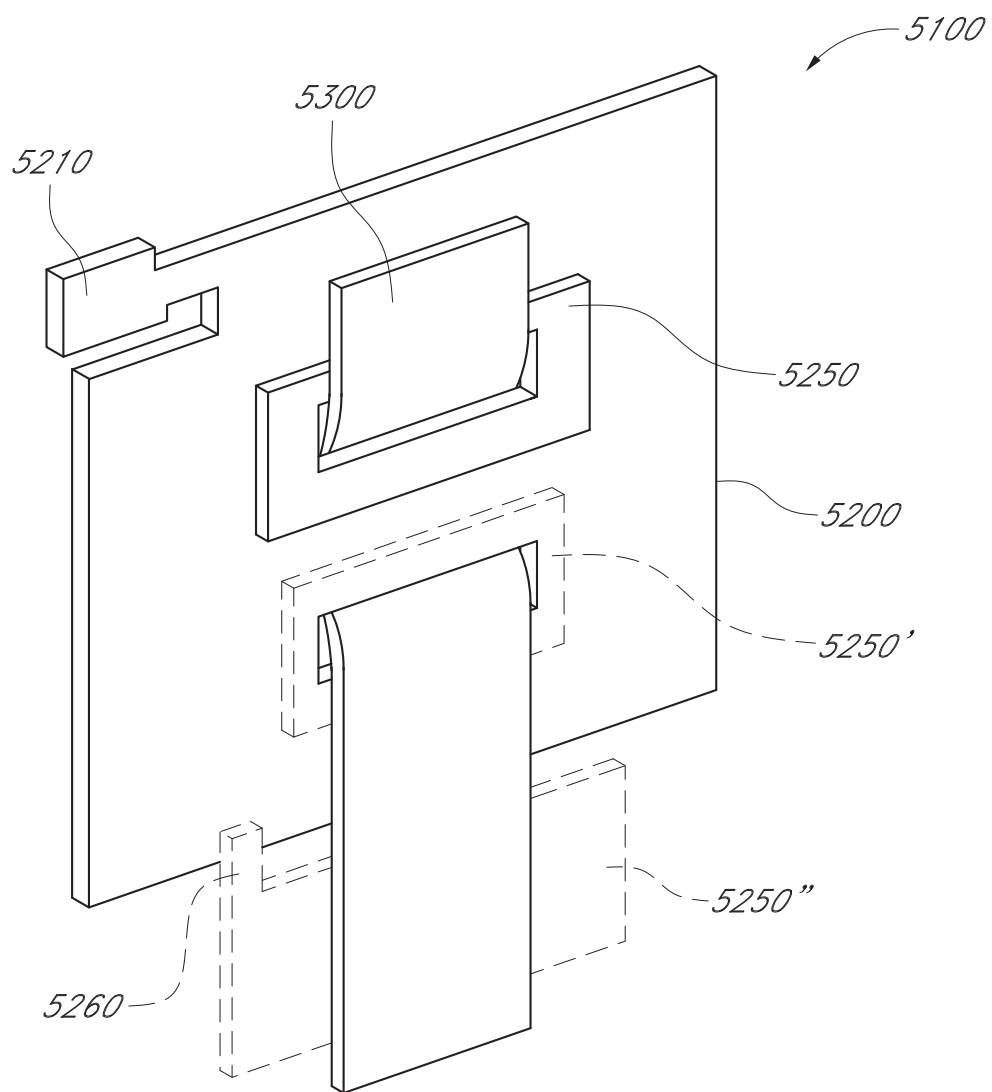


FIG. 30

FIG. 31



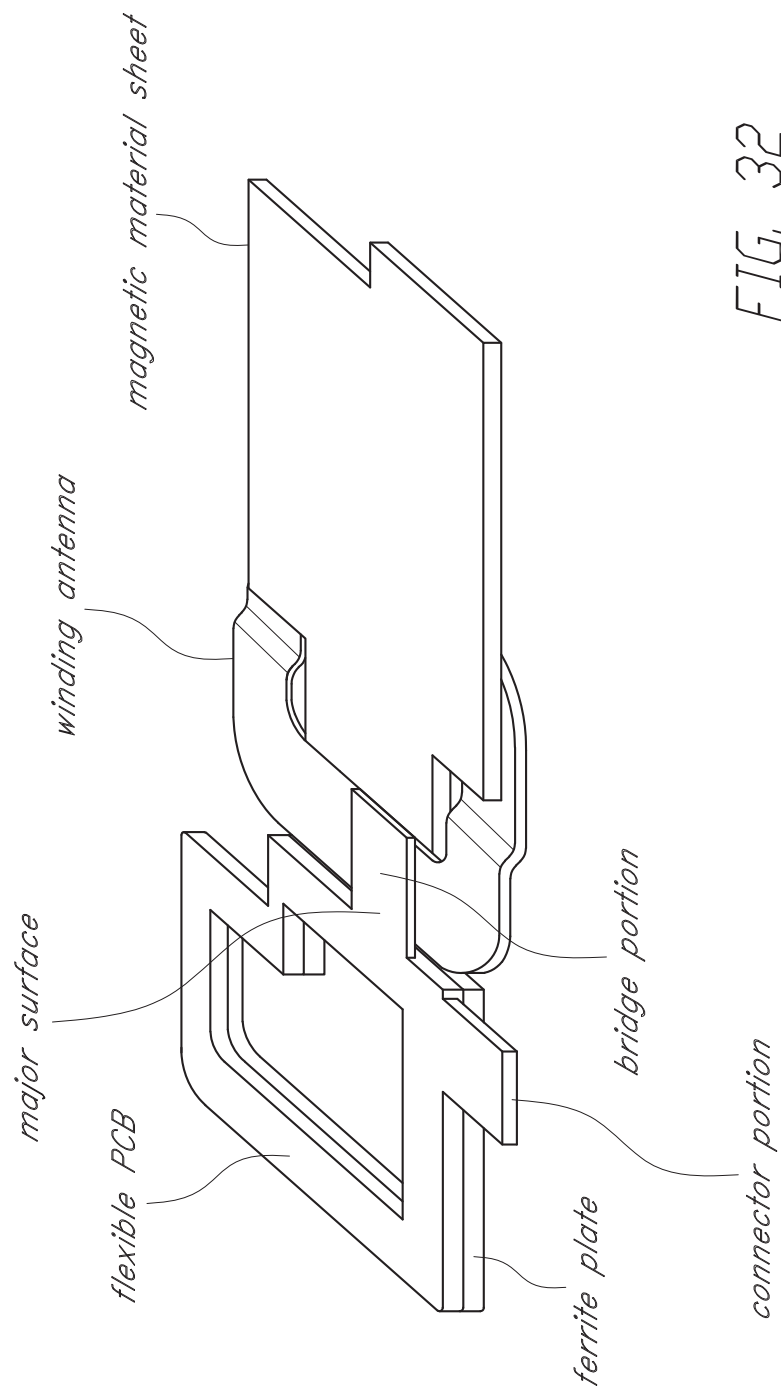


FIG. 32

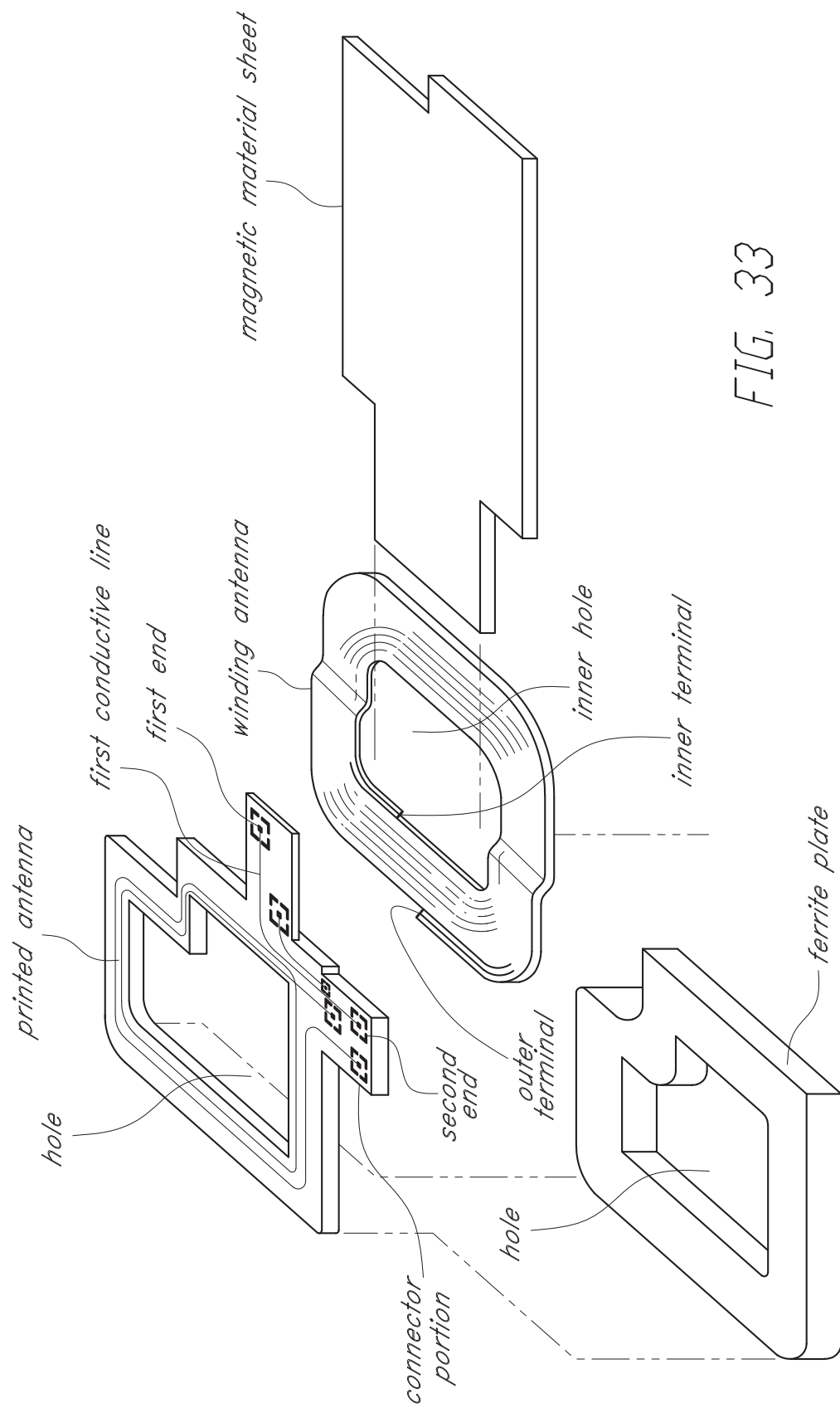


FIG. 33

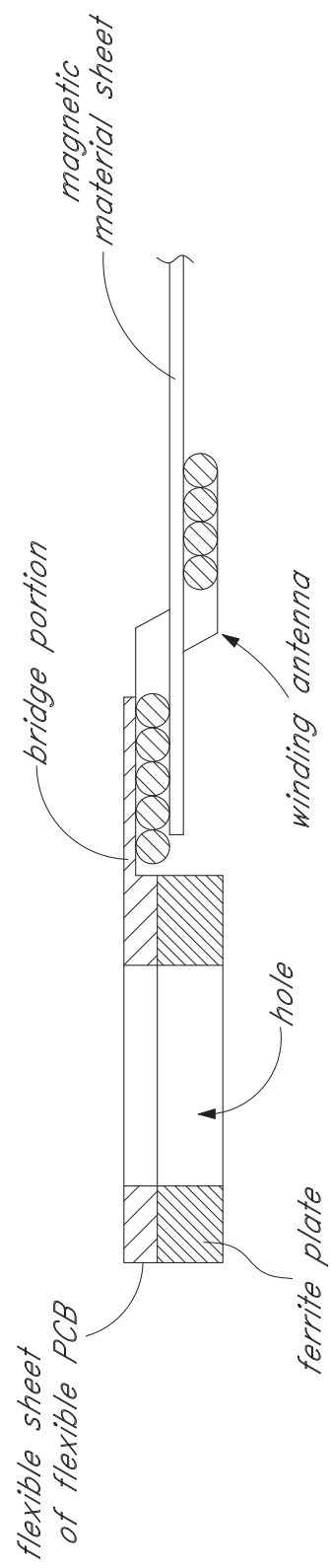


FIG. 34

FIG. 35

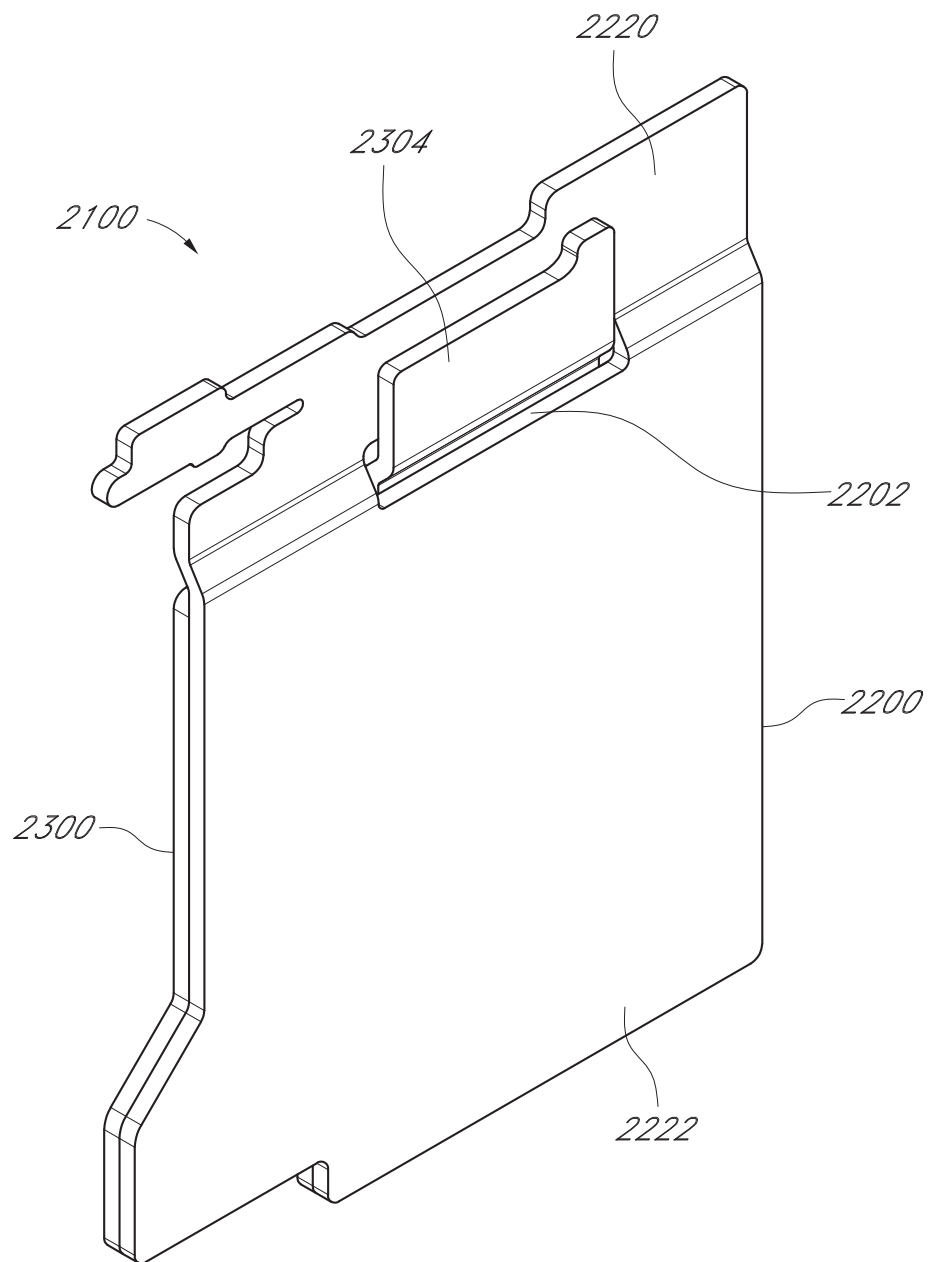


FIG. 36

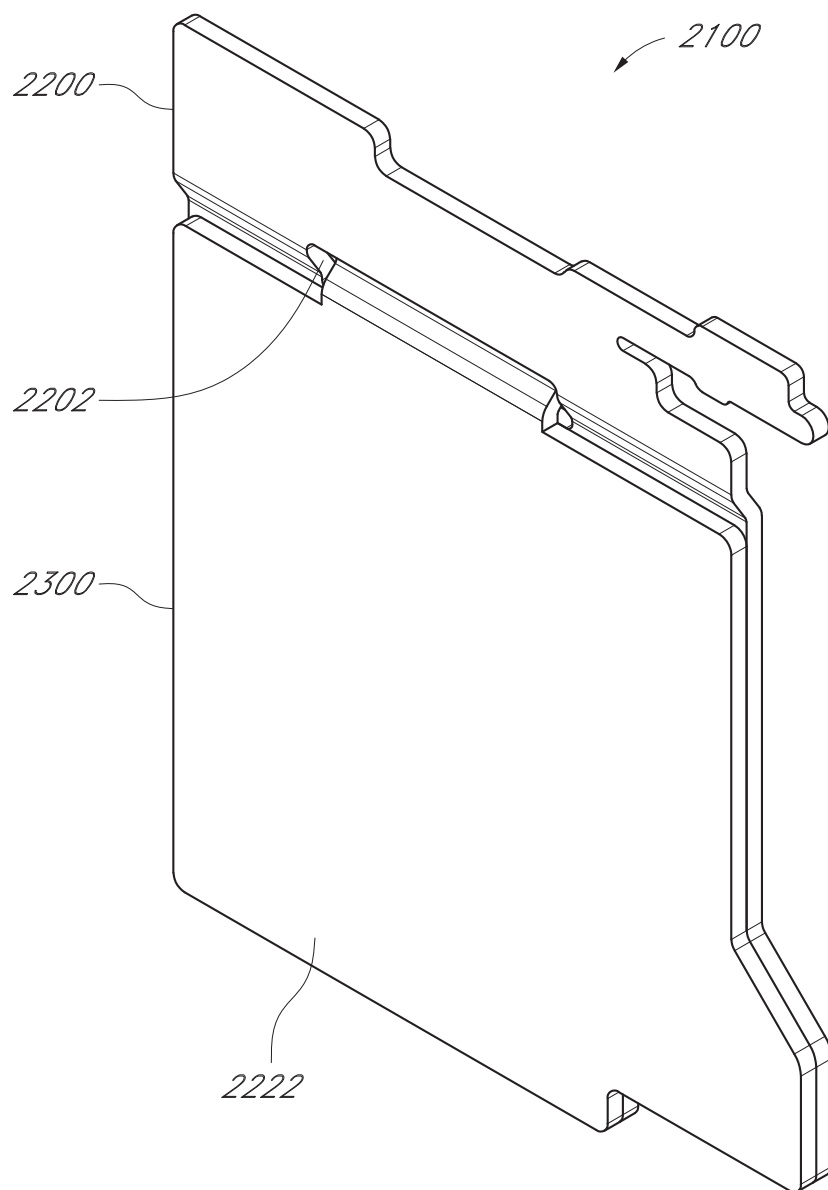


FIG. 37

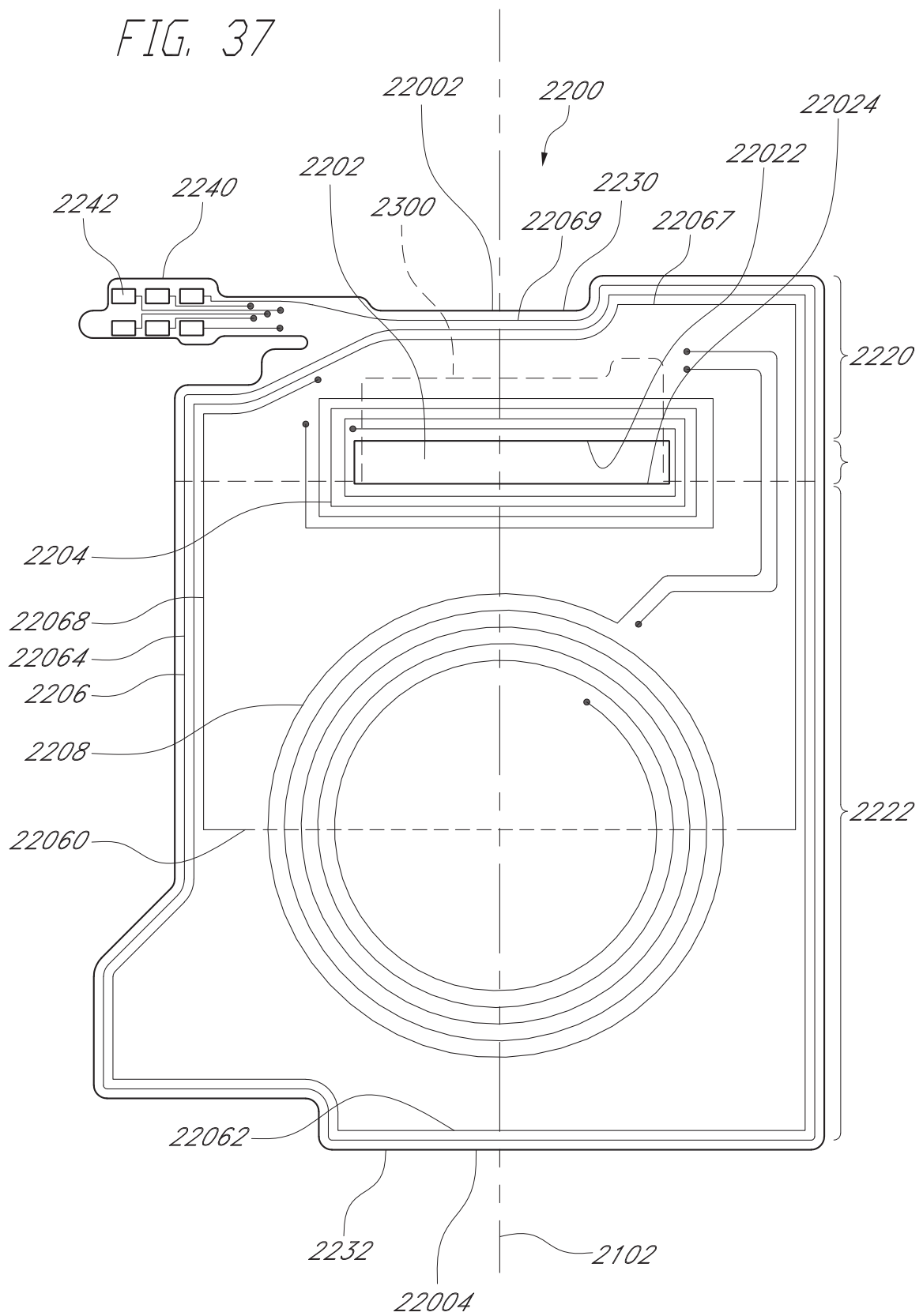


FIG. 38

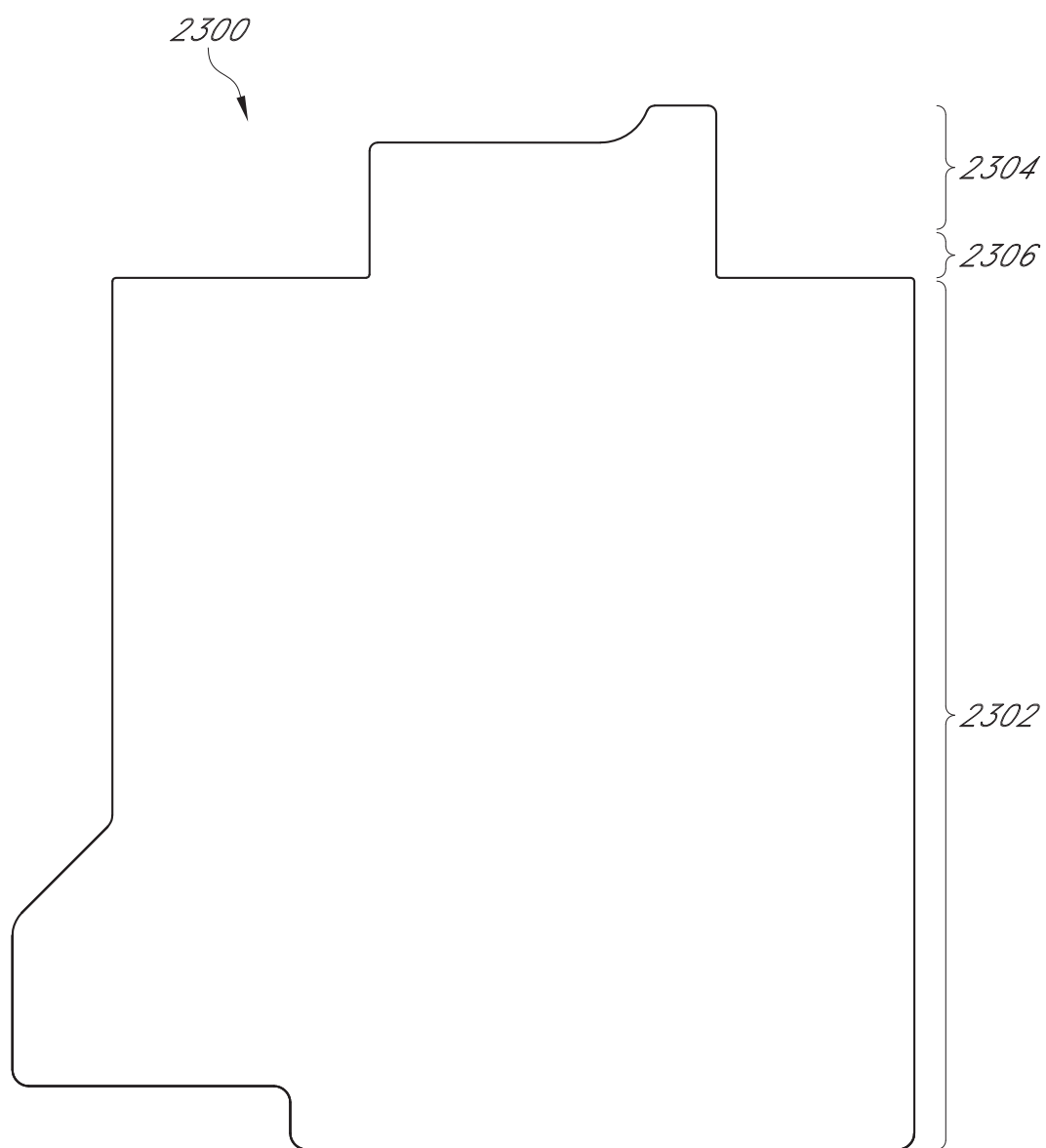


FIG. 39

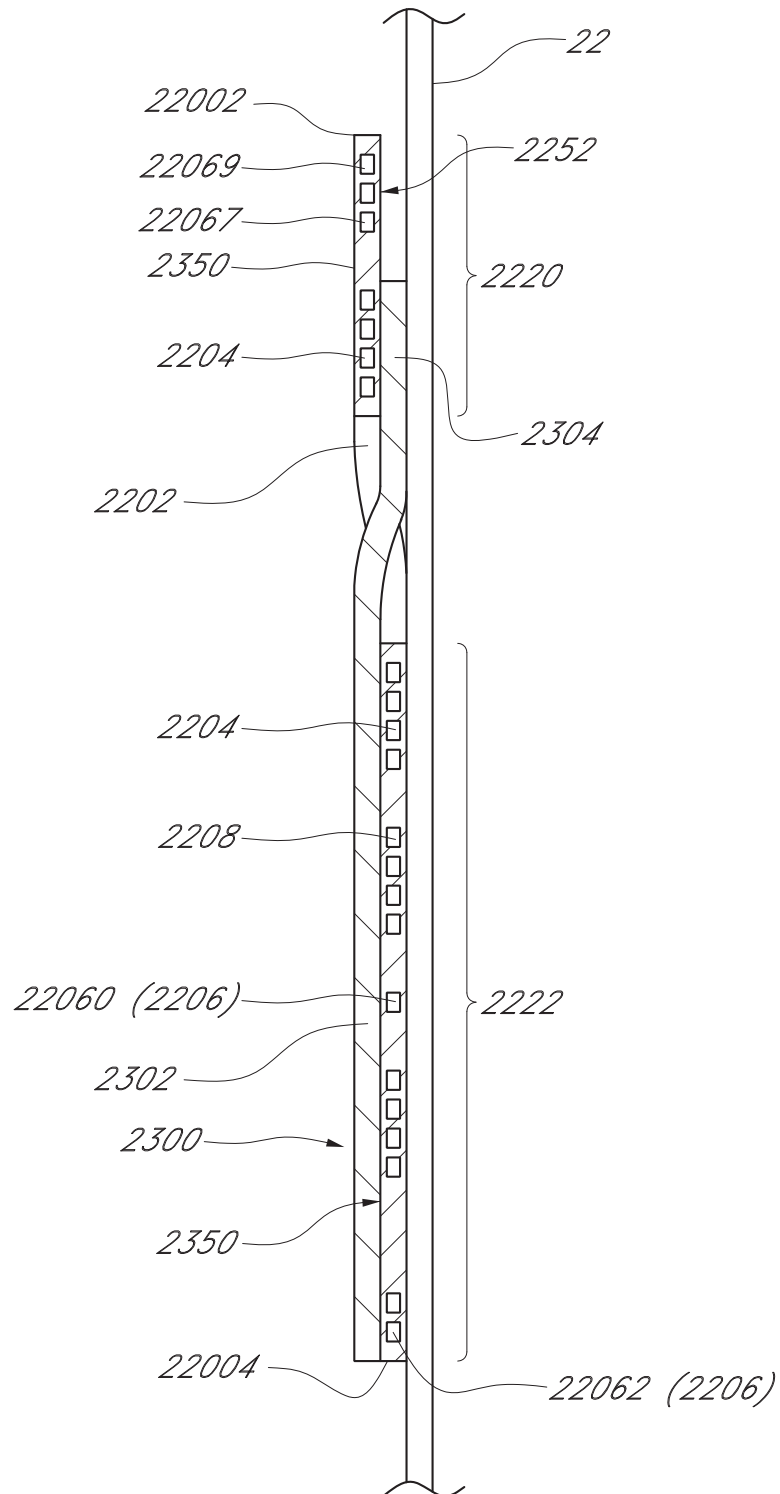


FIG. 40

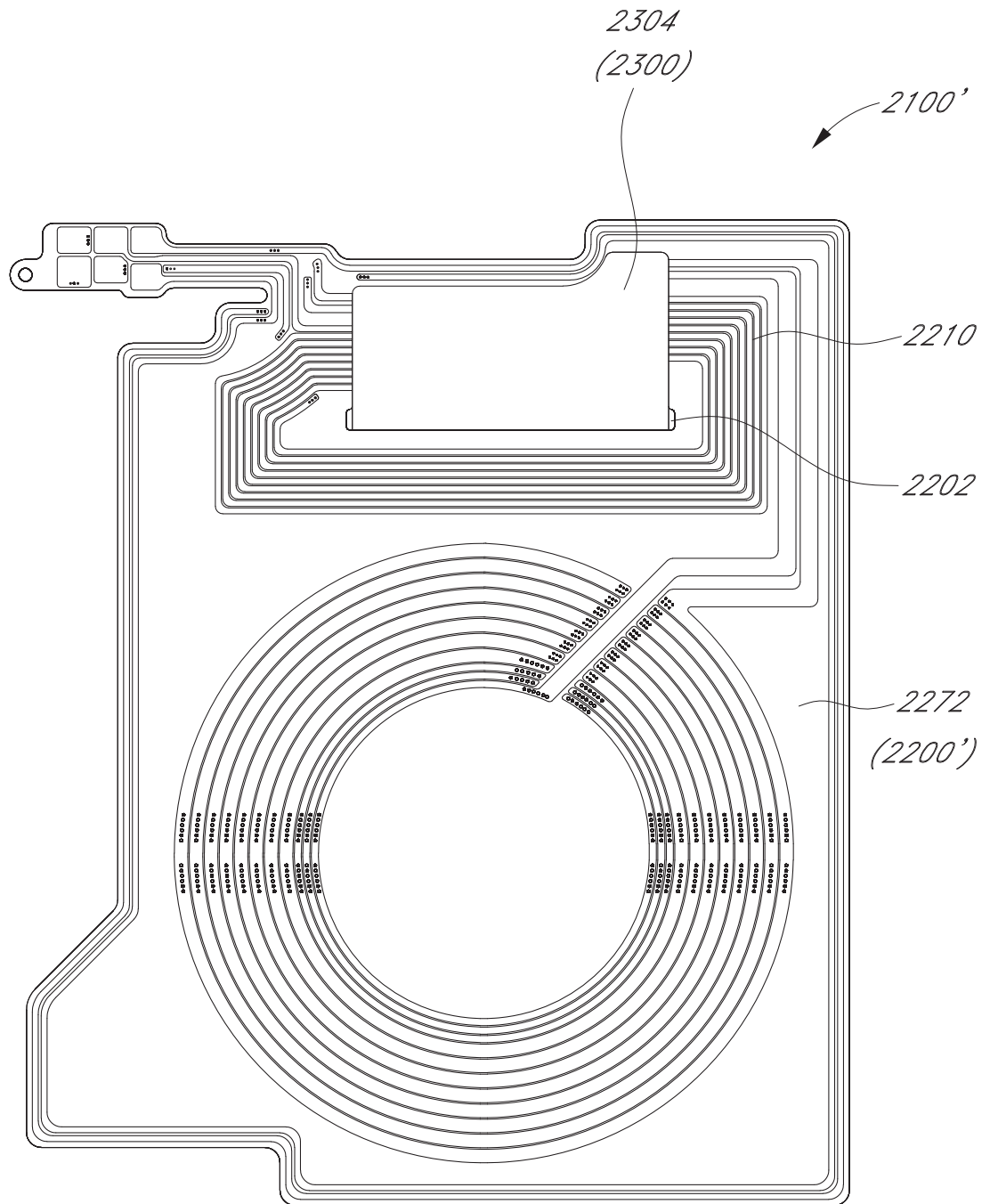


FIG. 41

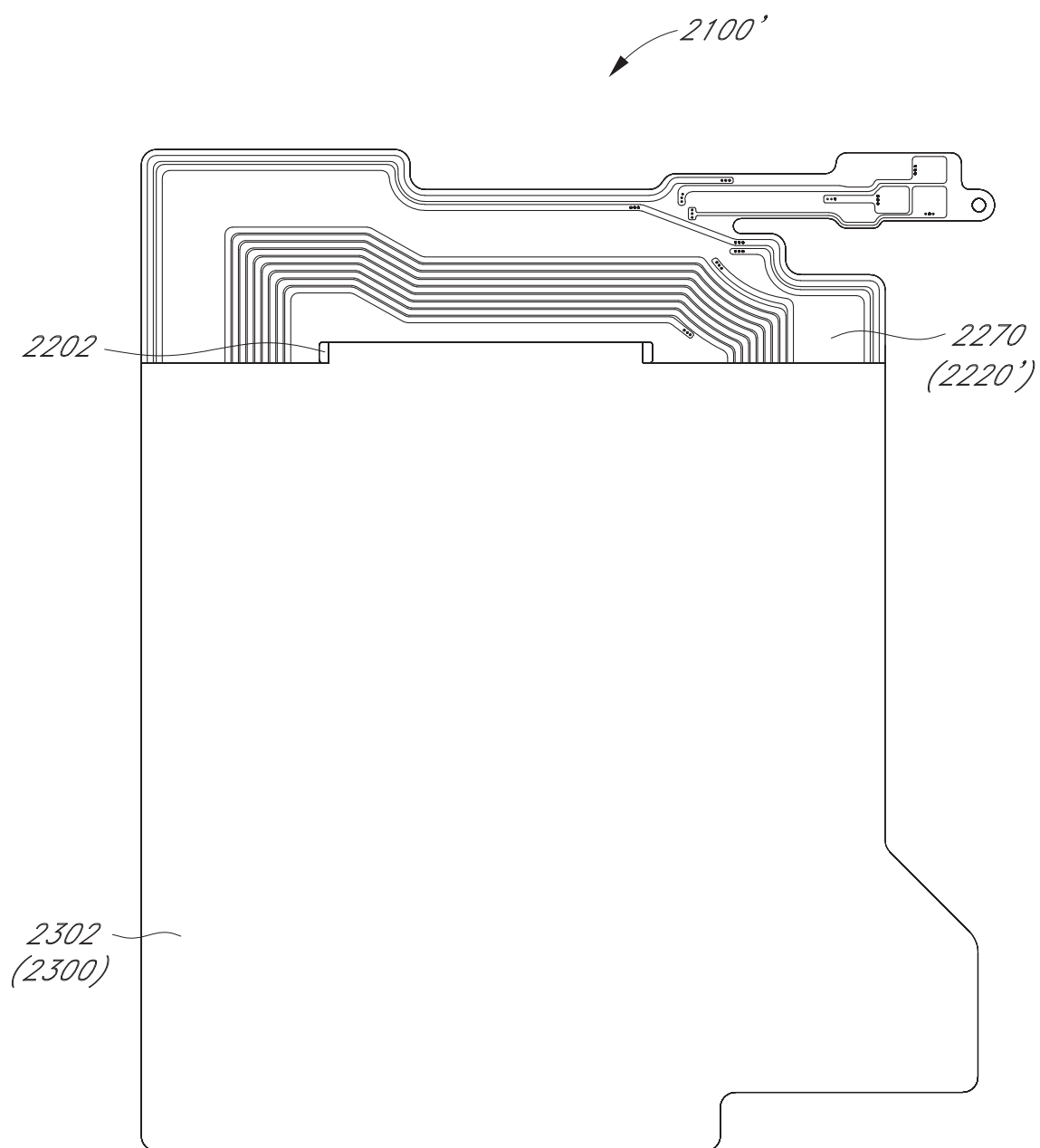


FIG. 42

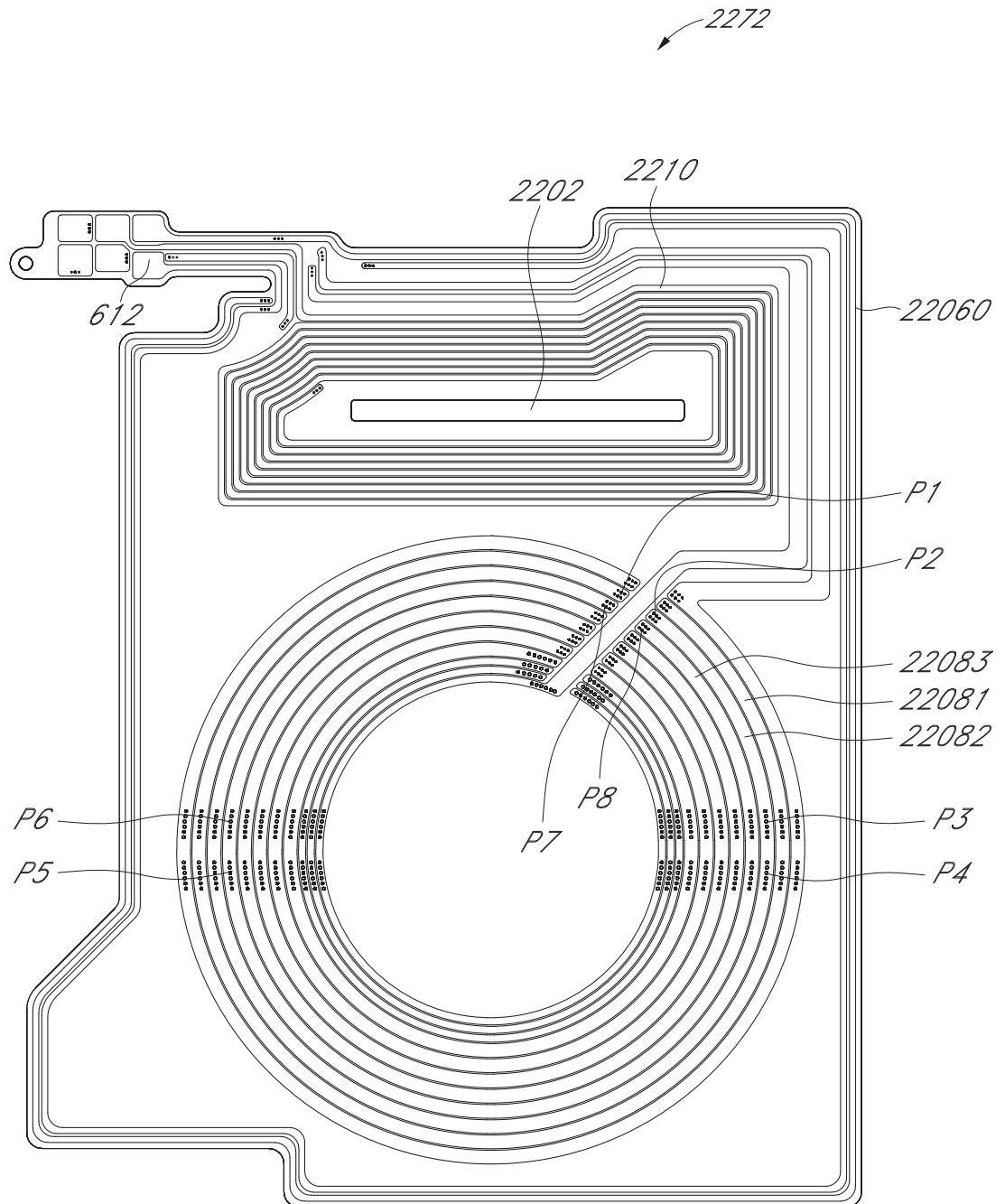
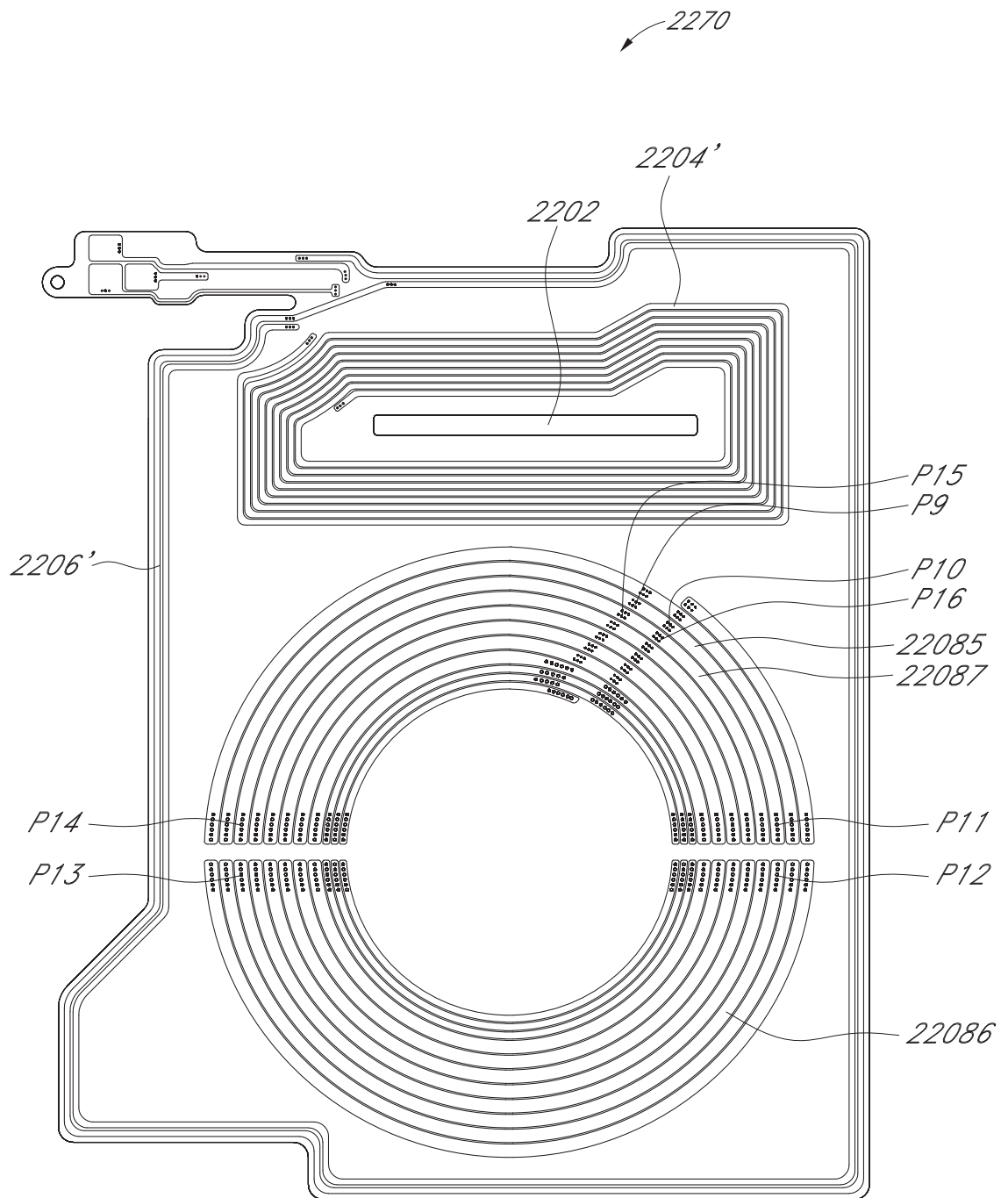


FIG. 43



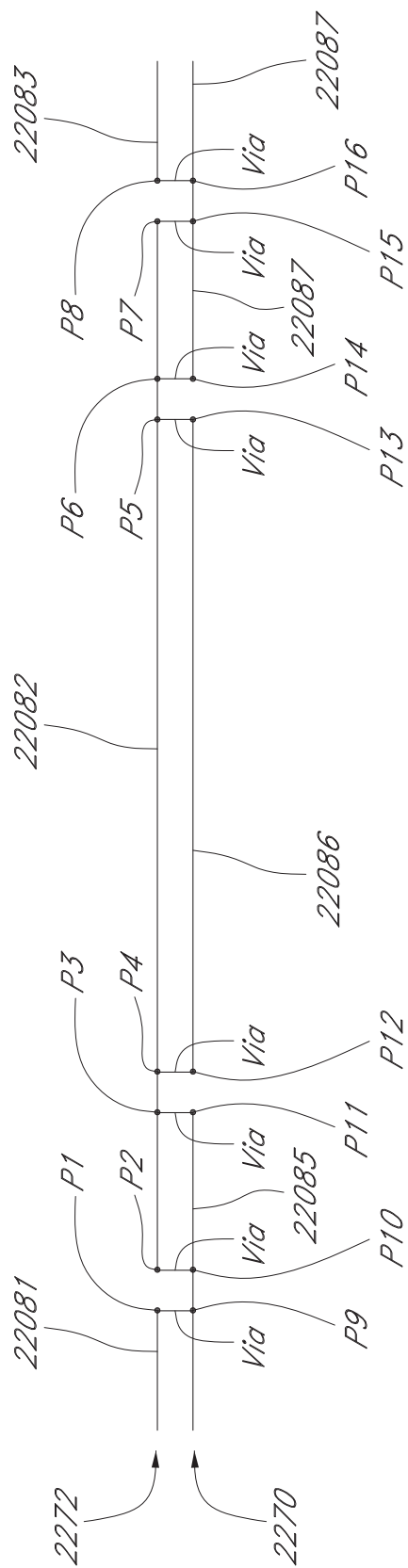


FIG. 44

FIGURE 45

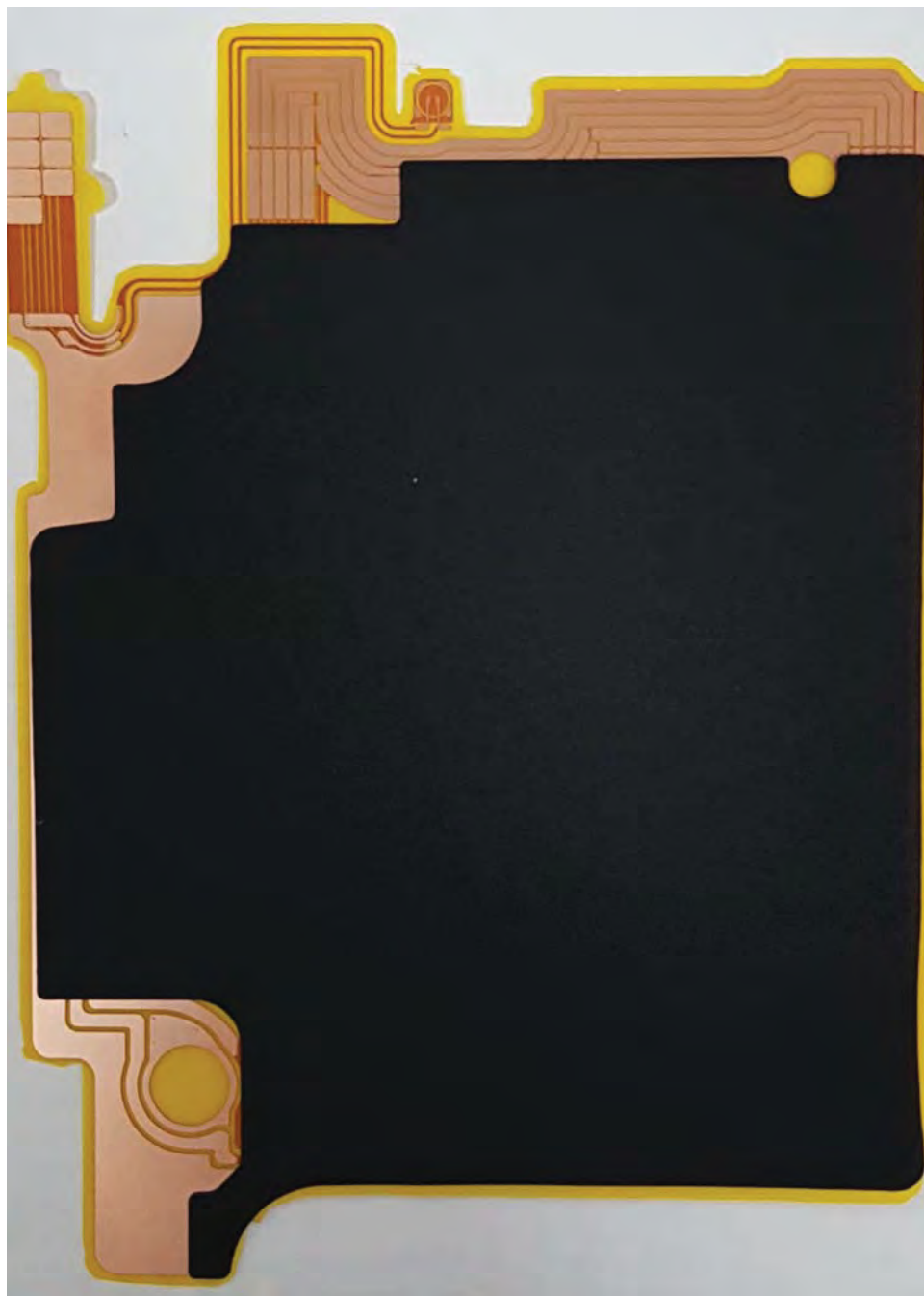


FIGURE 46

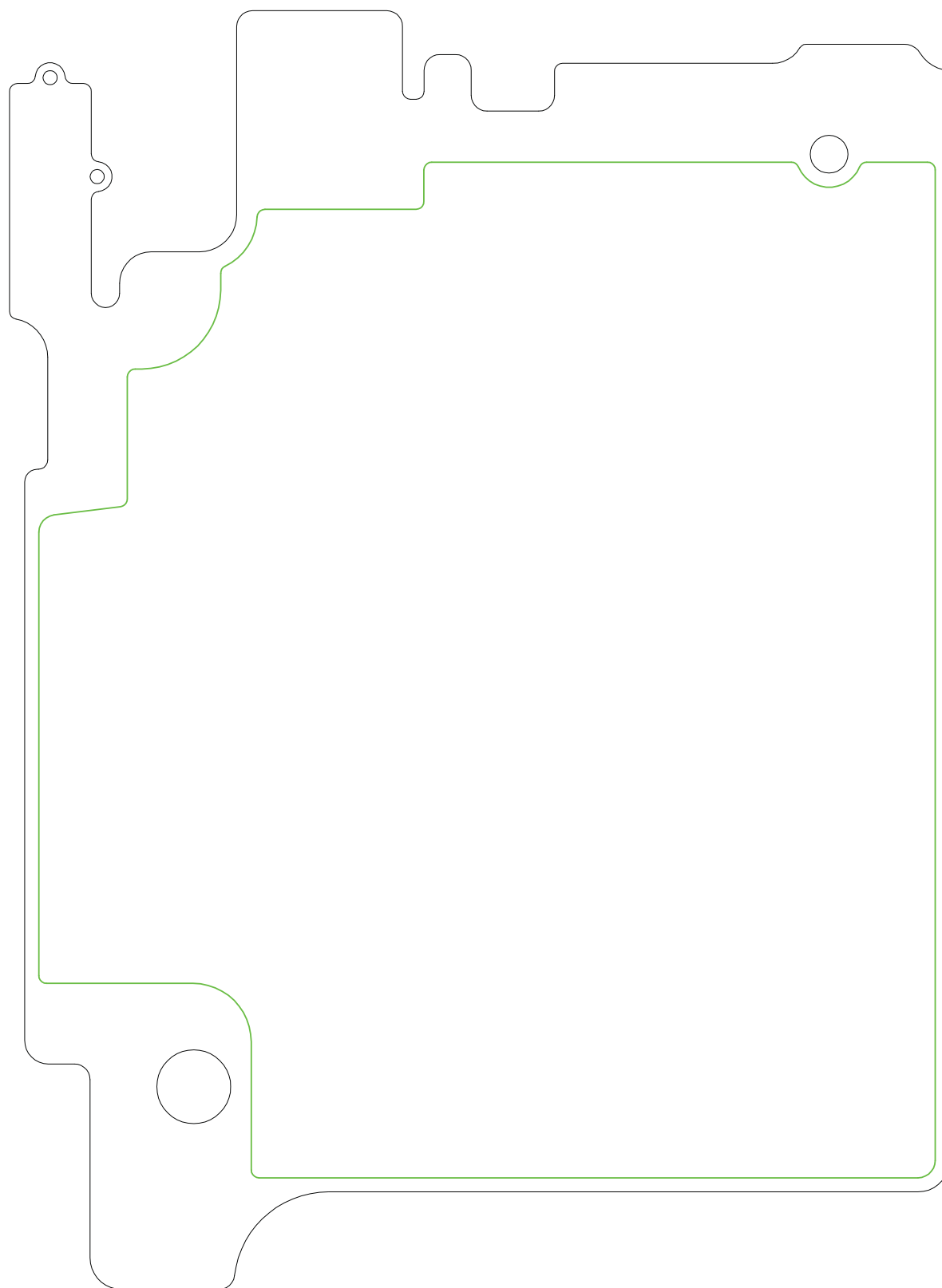


FIGURE 47

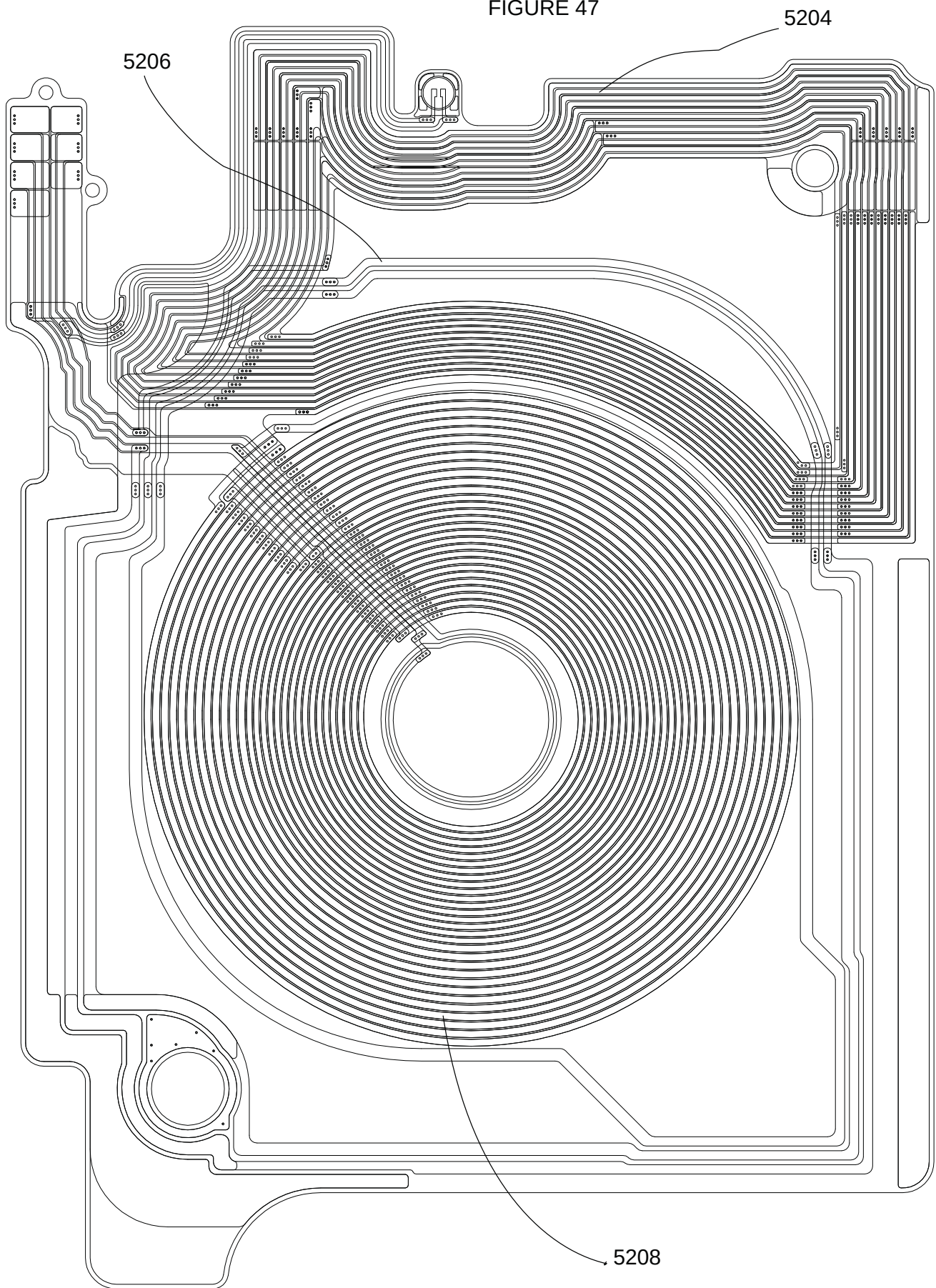


FIGURE 48

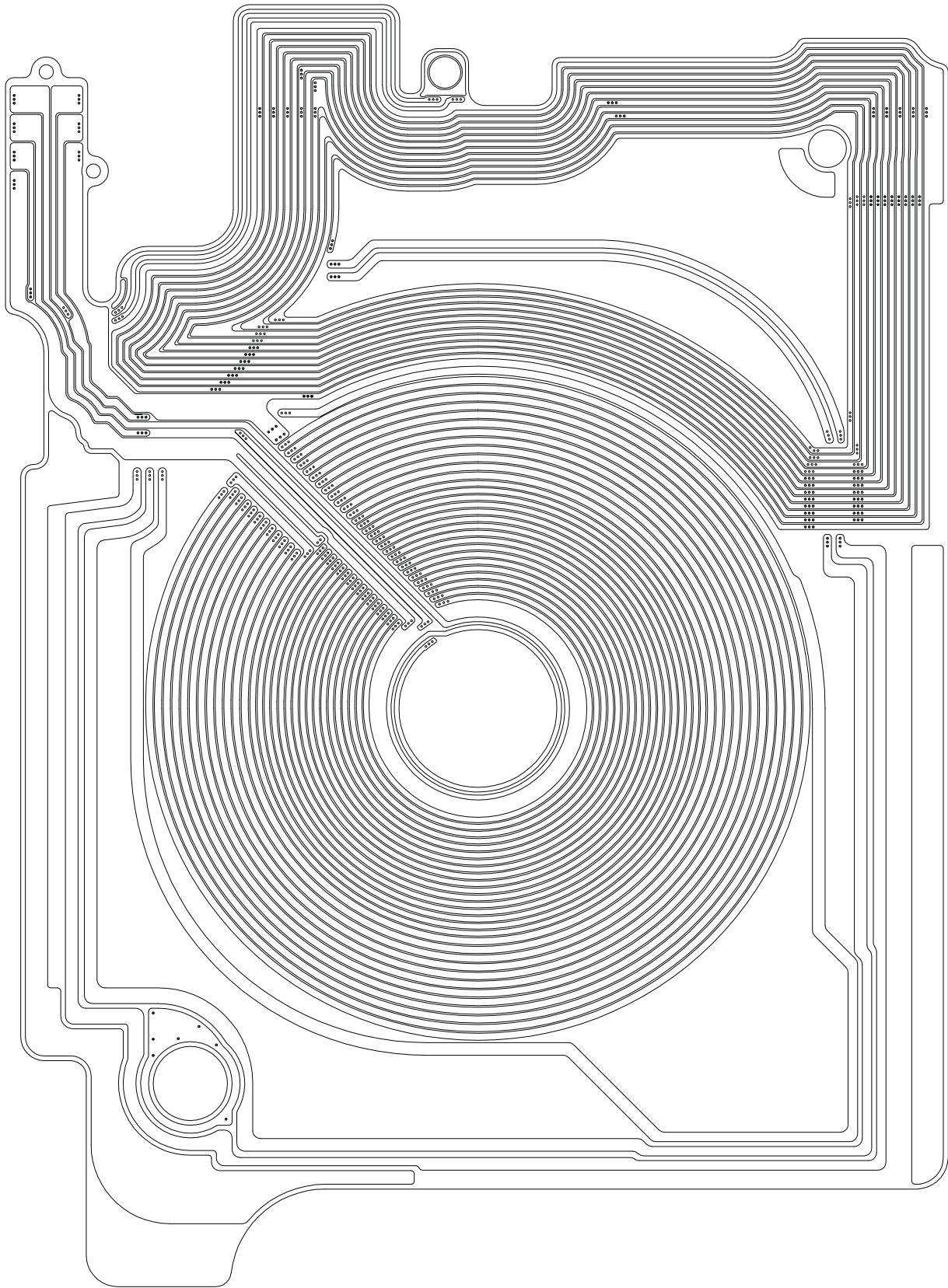


FIGURE 49

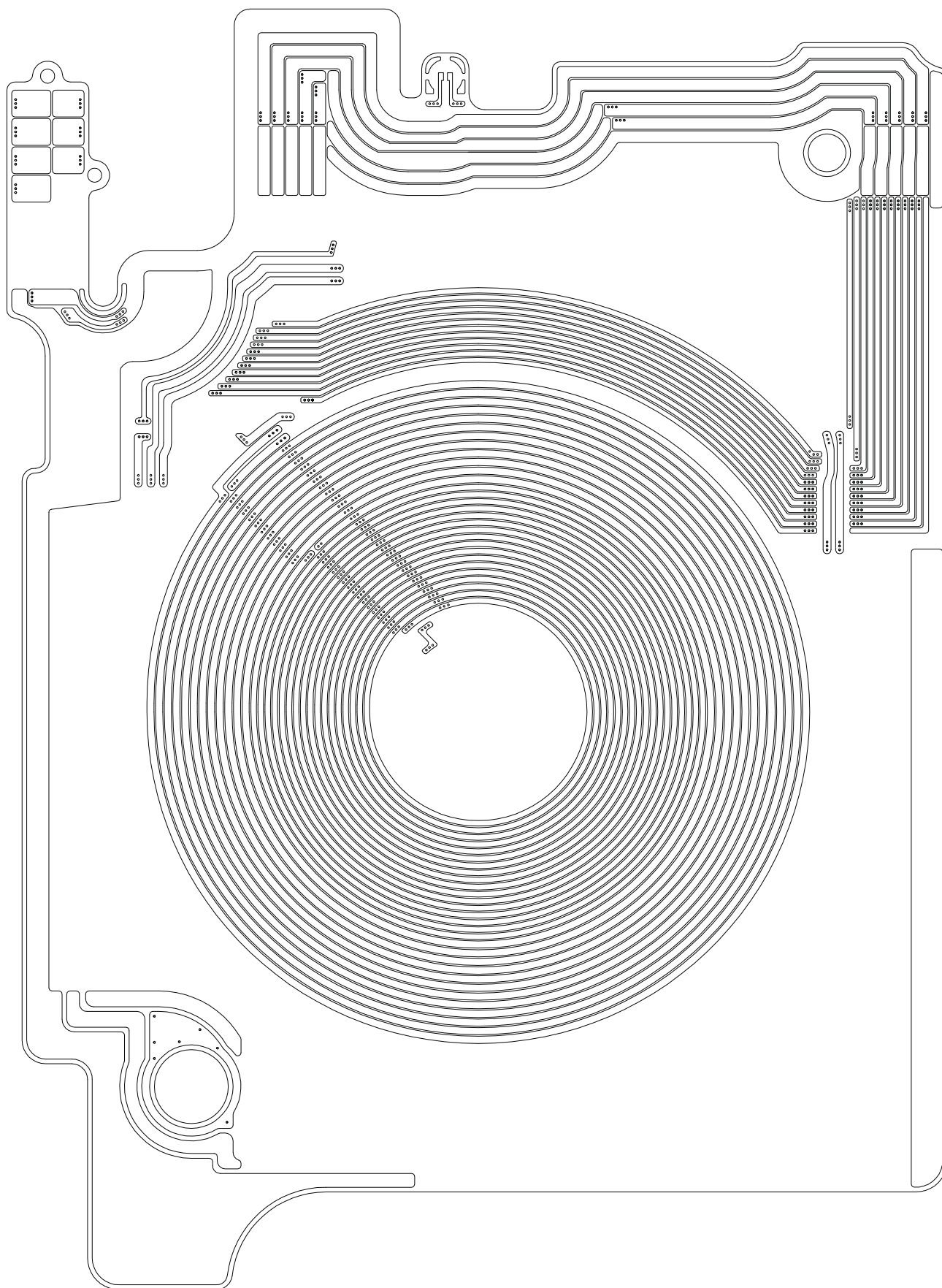


FIGURE 50

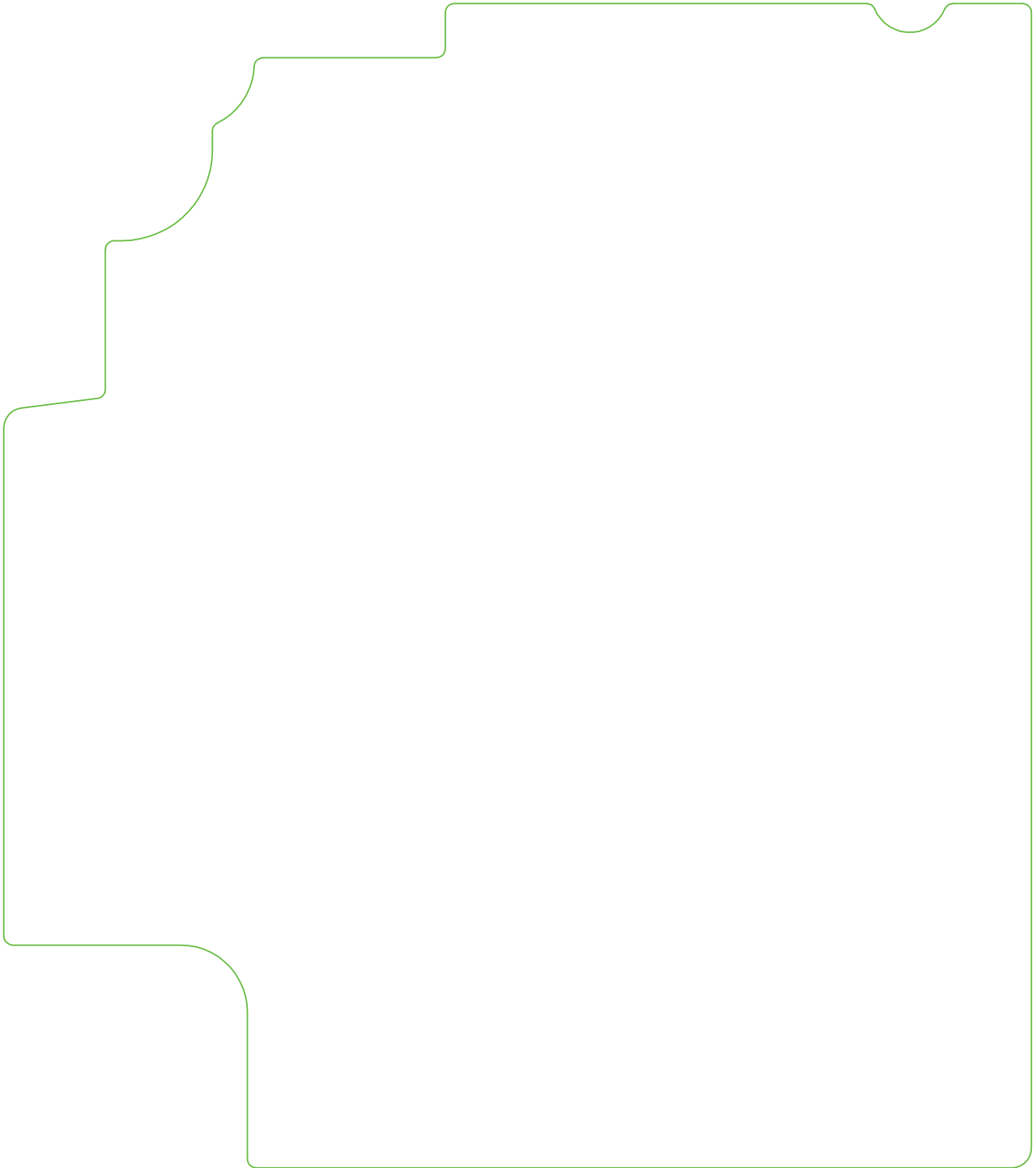
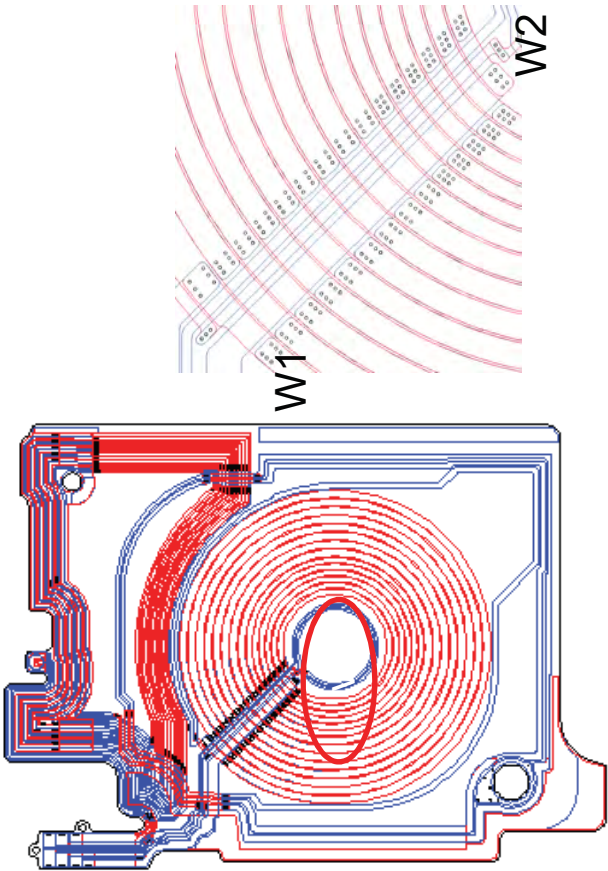
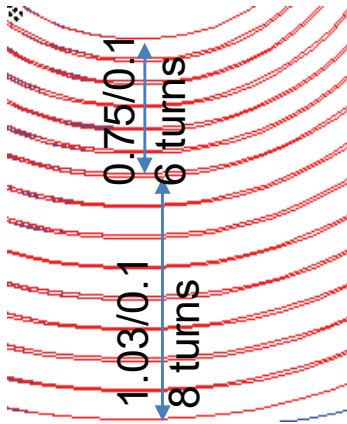


FIGURE 51

Examples of sheet-like smartphone antenna with different WPC coil design

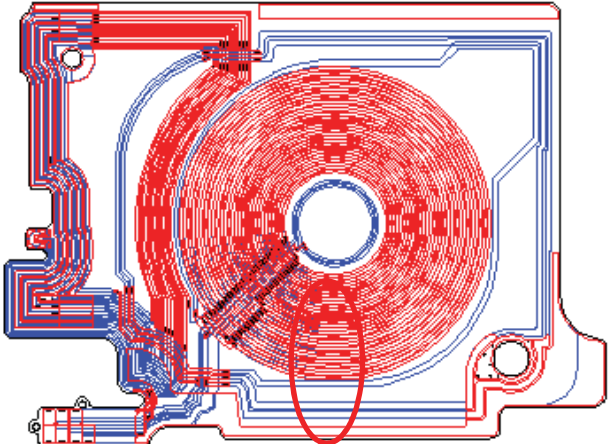
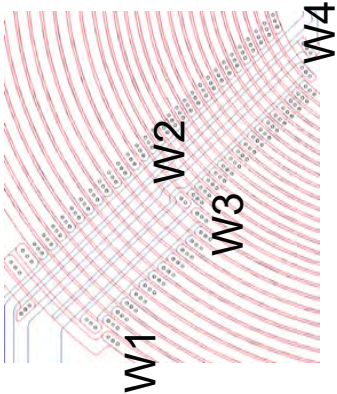
<Example of non-parallel-coil design>



Total 14 turns (9.35uH / 0.27 Ω)

(a)

<Example of parallel-coil design>



<Outer coil>

line width 0.45 mm

12 turns

space 0.1mm

<Inner coil>

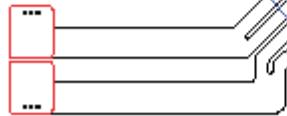
line width 0.35mm

17 turns

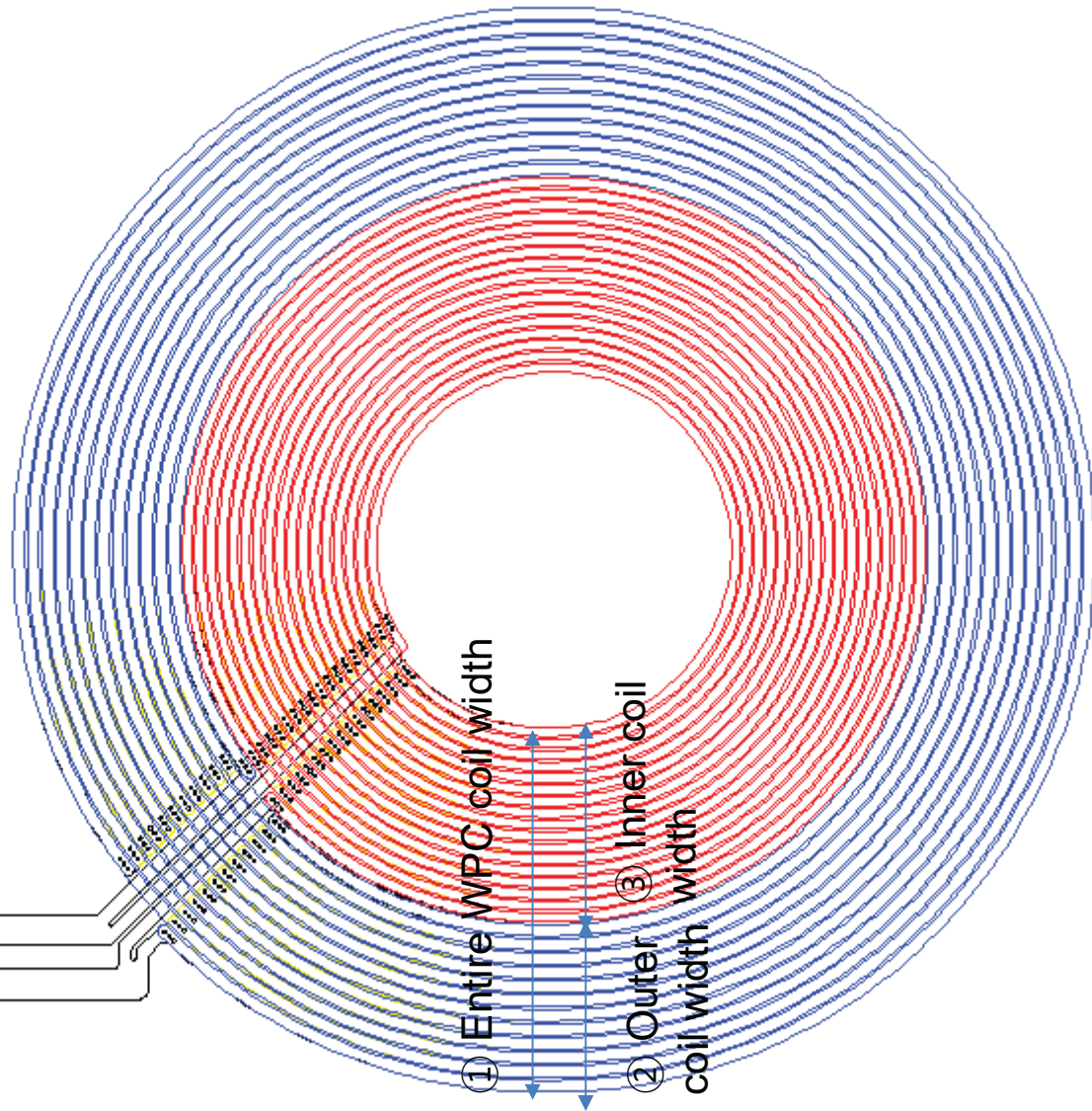
space 0.1mm

Total 29 Turns (10.52uH / 0.3 Ω)

(b)



Example of calculation of coil width ratio



- ① Entire WPC coil width : 14.15mm (100%)
- ② Outer coil width: : 6.5mm (46%) = line width 0.45 mmX12 turns + space between lines 0.1mmX11
- ③ Inner coil width: 7.55mm (53%) = line width 0.35mmX17 turns + space between lines 0.1mmX16

FIGURE 52

Examples of WPC coil – outer diameter: 42ø, inner diameter: 14ø

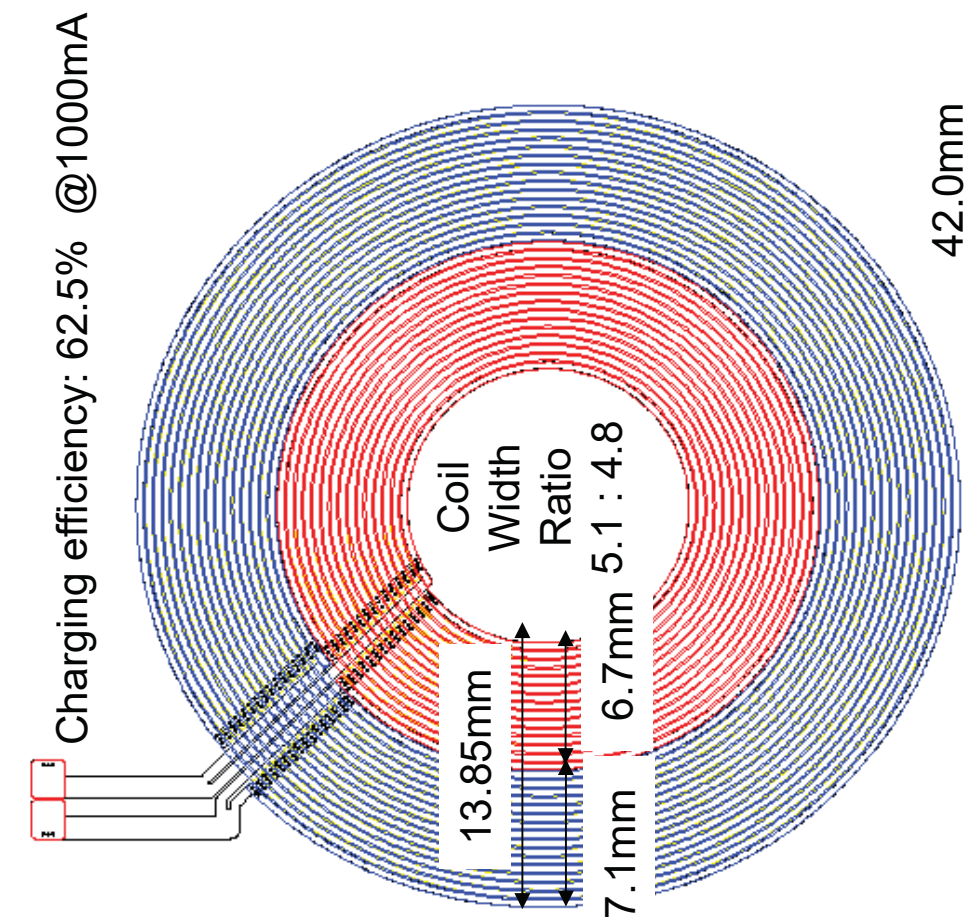


FIGURE 53A

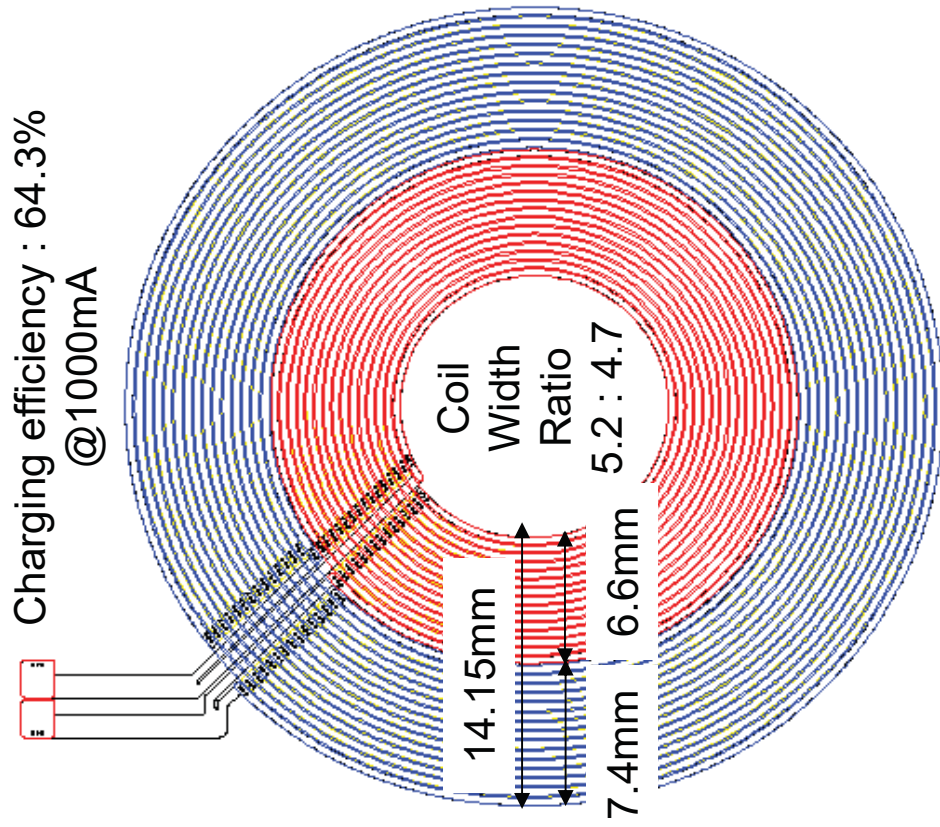


FIGURE 53B

Example of WPC coil – outer diameter: 42Ø, inner diameter: 14Ø

Charging efficiency: 66.0% @1000mA

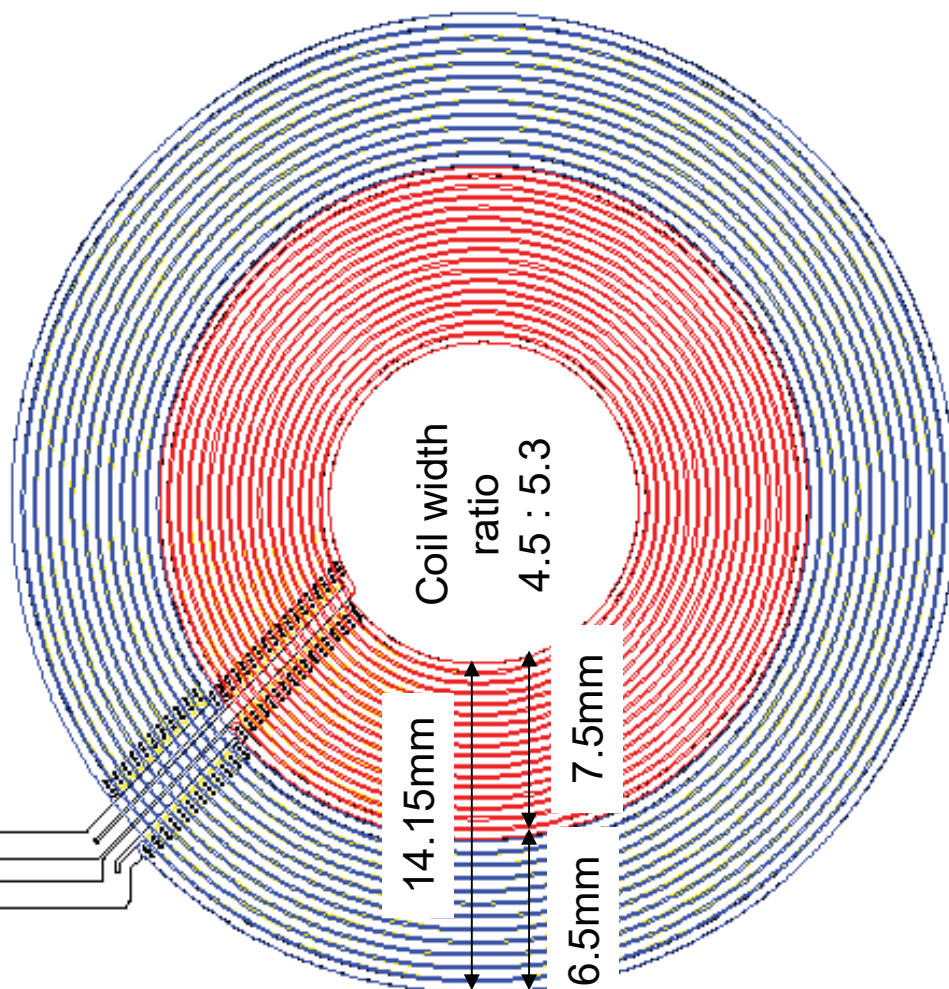


FIGURE 53C

Examples of WPC coil – outer diameter: 42ø, inner diameter: 9ø

Charging efficiency: 63.7%
@1000mA

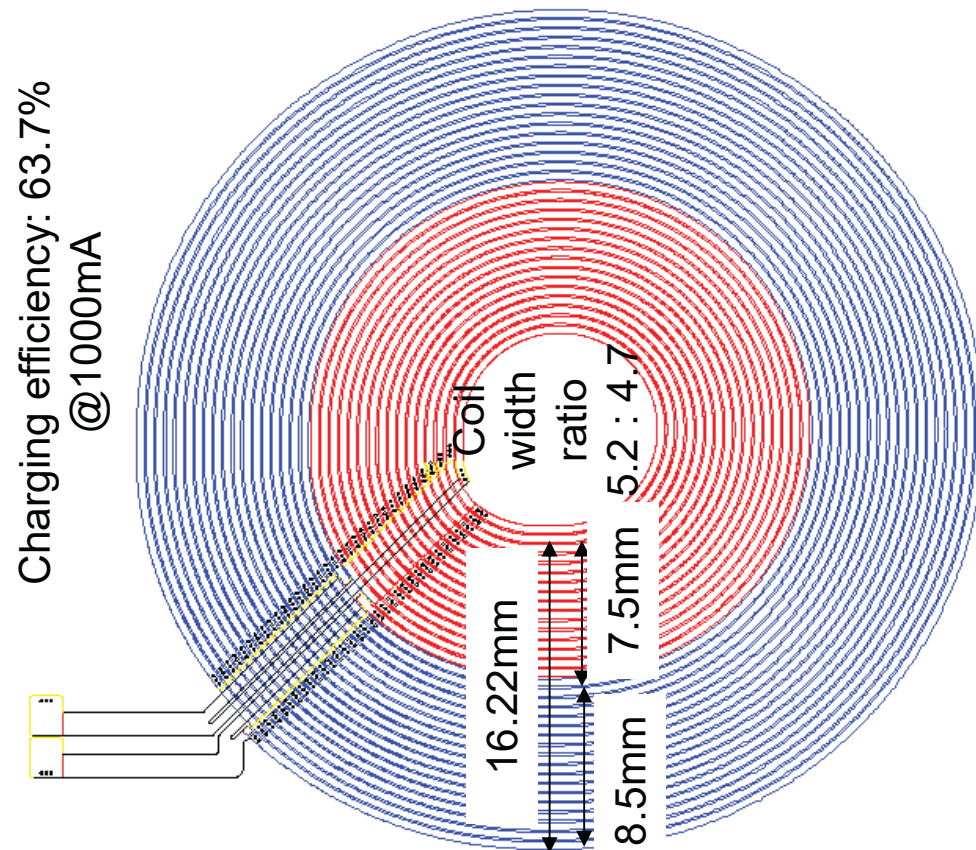


FIGURE 54A

Charging efficiency: 62.9%
@1000mA

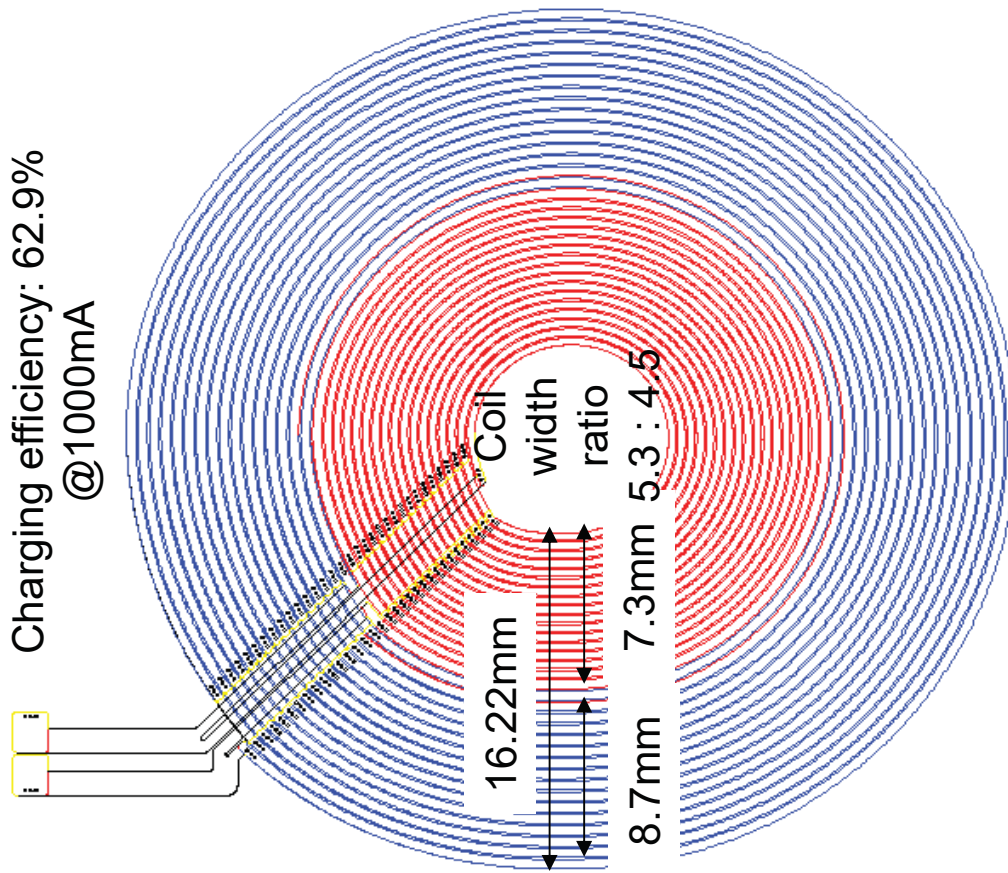


FIGURE 54B

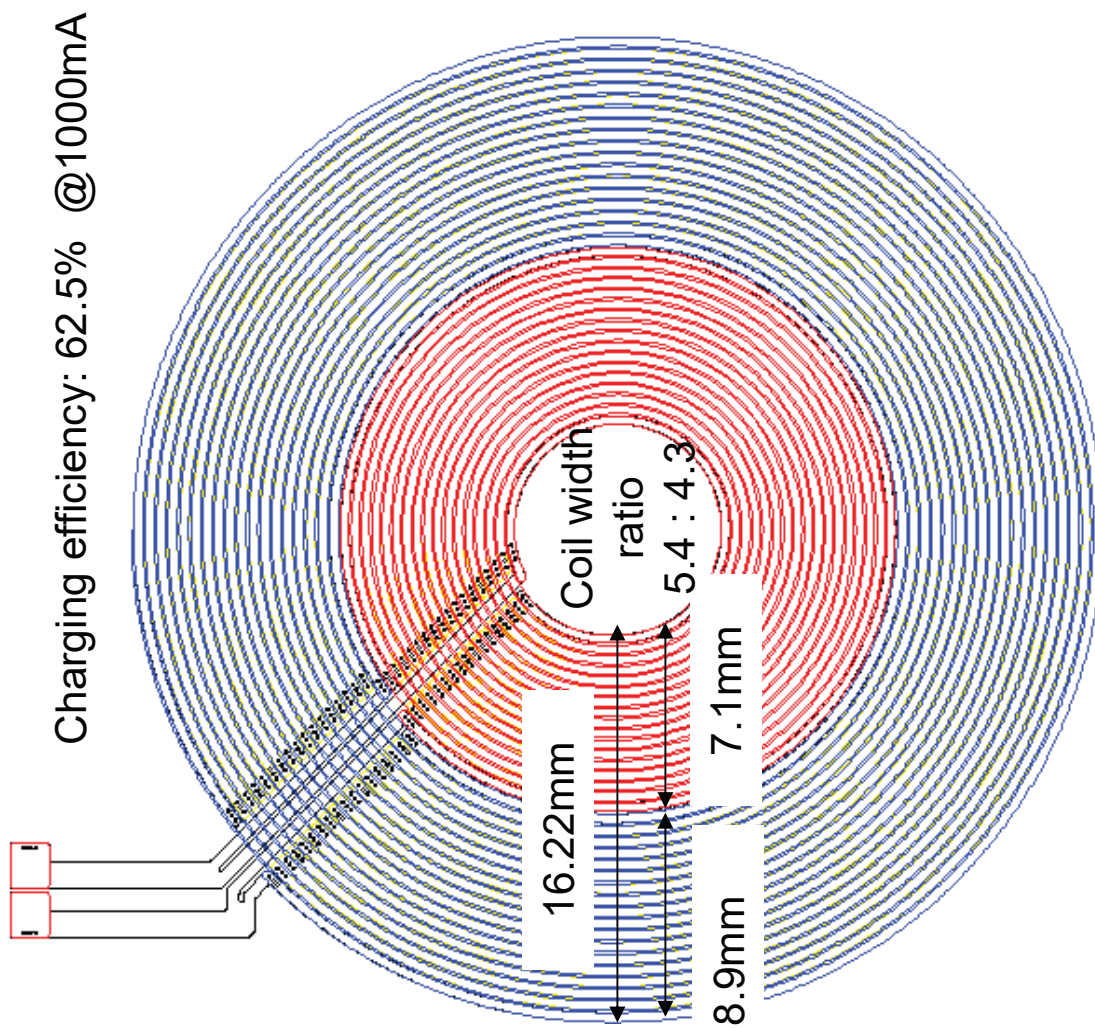


FIGURE 54C

FIGURE 55

Charging efficiencies of WPC coil depending on coil width ratio

RX Current	0.6A	0.7A	0.8A	0.9A	1.0A
2:8* 6** / 23***	58.7%****	59.6%	59.1%	57.9%	57.3%
3:7 9 / 20	68.5%	68.5%	67.0%	64.5%	62.7%
4:6 12 / 17	70.9%	70.3%	69.6%	67.0%	65.6%
5:5 15 / 14	69.2%	68.0%	67.5%	64.8%	62.9%
6:4 17 / 12	63.6%	64.1%	63.3%	61.2%	60.4%

* Coil width ratio (outer coil width : inner coil width)

** number of lines of outer coil

*** number of lines of inner coil

**** Charging efficiency = RX power / TX power

= (RX voltage X RX current) / (TX voltage X TX current)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Sang Hoon Lee
App. No.	:	Not Yet Assigned
Filed	:	Herewith
Examiner	:	Not Yet Assigned
Art Unit	:	Not Yet Assigned
Conf No.	:	Not Yet Assigned

COVER LETTER

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450
Dear Sir:

The following are submitted for this patent application:

1. Application Data Sheet
2. Specification
3. Drawings
4. Information Disclosure Statement and PTO/SB/08a Form
5. Copy of Combined Declaration and Assignment filed in the parent application
6. Rescission of Any Prior Disclaimers and Request to Revisit Art
7. Power of Attorney
8. Fees to be paid via EFS Web.

If there are any additional fees, such will be paid later. **The USPTO is NOT authorized to charge additional fees to K&L Gates' deposit account.**

Respectfully submitted,
K&L GATES, LLP

Dated: September 28, 2022

By: /Mincheol Kim/
Mincheol Kim
Registration No. 51,306
Attorney of Record
Customer No. 45,200
(949) 623-3611

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1959706.00056/AQCRP.41C3
		Application Number	
Title of Invention	SMARTPHONE ANTENNA IN FLEXIBLE PCB		
<p>The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.</p> <p>This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.</p>			

Secrecy Order 37 CFR 5.2:

☐	Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)
--------------------------	---

Inventor Information:

Inventor	1				Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Sang Hoon		LEE		
Residence Information (Select One) US Residency ☒ Non US Residency Active US Military Service					
City	Suwon-si		Country of Residence ⁱ	KR	

Mailing Address of Inventor:

Address 1	130, Wellbeing town-ro, #8903-303				
Address 2	Yeongtong-gu				
City	Suwon-si, Gyeonggi-do		State/Province		
Postal Code	16224	Country ⁱ	KR		

Inventor	2				Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Kyoung Jun		CHOI		
Residence Information (Select One) US Residency ☒ Non US Residency Active US Military Service					
City	Seoul		Country of Residence ⁱ	KR	

Mailing Address of Inventor:

Address 1	Wolgye Jugong 2 Danji Apt. 215-1009				
Address 2	Wolgye 2-dong, Nowon-gu				
City	Seoul		State/Province		
Postal Code		Country ⁱ	KR		

Inventor	3				Remove
Legal Name					

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1959706.00056/AQCRP.41C3
		Application Number	
Title of Invention	SMARTPHONE ANTENNA IN FLEXIBLE PCB		

Prefix	Given Name	Middle Name	Family Name	Suffix
	Sae Rom		LEE	
Residence Information (Select One) US Residency ☒ Non US Residency Active US Military Service				
City	Incheon	Country of Residence ⁱ	KR	

Mailing Address of Inventor:				
Address 1	135, Jaeneomi-gil, #108-102, Nam-gu			
Address 2				
City	Incheon	State/Province		
Postal Code		Country ⁱ	KR	
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button. Add				

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).			
☐ An Address is being provided for the correspondence information of this application.			
Customer Number	45200		
Email Address	ocpatents@klgates.com	Add Email	Remove Email

Application Information:

Title of the Invention	SMARTPHONE ANTENNA IN FLEXIBLE PCB		
Attorney Docket Number	1959706.00056/AQCRP.41C3	Small Entity Status Claimed	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	52	Suggested Figure for Publication (if any)	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country ⁱ

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1959706.00056/AQCRP.41C3
		Application Number	
Title of Invention	SMARTPHONE ANTENNA IN FLEXIBLE PCB		

Publication Information:
☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

Request Not to Publish. I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	☒ Customer Number	☐ US Patent Practitioner	☐ Limited Recognition (37 CFR 11.9)
Customer Number	45200		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending	Remove			
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
	Continuation of	17864078	2022-07-13		
Prior Application Status	Patented	Remove			
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
17864078	Continuation of	17546893	2021-12-09	11437712	2022-09-06
Prior Application Status	Patented	Remove			
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
17546893	Continuation of	17105012	2020-11-25	11303011	2022-04-12
Prior Application Status	Expired	Remove			
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
17105012	Claims benefit of provisional	62941636	2019-11-27		

Samsung

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1959706.00056/AQCRP.41C3
		Application Number	
Title of Invention	SMARTPHONE ANTENNA IN FLEXIBLE PCB		

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

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Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)ⁱ the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

			Remove
Application Number	Country ⁱ	Filing Date (YYYY-MM-DD)	Access Code ⁱ (if applicable)
Additional Foreign Priority Data may be generated within this form by selecting the Add button.			Add

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.

NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1959706.00056/AQCRP.41C3
		Application Number	
Title of Invention	SMARTPHONE ANTENNA IN FLEXIBLE PCB		

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

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NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1959706.00056/AQCRP.41C3
		Application Number	
Title of Invention	SMARTPHONE ANTENNA IN FLEXIBLE PCB		

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant	1	Remove
<p>If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.</p> <p style="text-align: right;">Clear</p>		
☒ Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
Person to whom the inventor is obligated to assign.		Person who shows sufficient proprietary interest
If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:		
<div style="border: 1px solid black; height: 20px; width: 100%;"></div>		
Name of the Deceased or Legally Incapacitated Inventor: <div style="border: 1px solid black; height: 20px; width: 100%;"></div>		
If the Applicant is an Organization check here. ☒		
Organization Name	AQ CORPORATION	
Mailing Address Information For Applicant:		
Address 1	230, Pangyoyeok-ro, Bundang-gu	
Address 2	#B-703	
City	Seongnam-si, Gyeonggi-do	State/Province
Country	KR	Postal Code
Phone Number		Fax Number
Email Address		
Additional Applicant Data may be generated within this form by selecting the Add button. Add		

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1959706.00056/AQCRP.41C3
		Application Number	
Title of Invention	SMARTPHONE ANTENNA IN FLEXIBLE PCB		

Assignee 1				
Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.				
<input type="button" value="Remove"/>				
If the Assignee or Non-Applicant Assignee is an Organization check here. ☐				
Prefix	Given Name	Middle Name	Family Name	Suffix
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Mailing Address Information For Assignee including Non-Applicant Assignee:				
Address 1		<input type="text"/>		
Address 2		<input type="text"/>		
City	<input type="text"/>	State/Province	<input type="text"/>	
Country ⁱ	<input type="text"/>	Postal Code	<input type="text"/>	
Phone Number	<input type="text"/>	Fax Number	<input type="text"/>	
Email Address	<input type="text"/>			
Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. <input type="button" value="Add"/>				

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). However, if this Application Data Sheet is submitted with the **INITIAL** filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Mincheol Kim/		Date (YYYY-MM-DD)	2022-09-28
First Name	Mincheol	Last Name	Kim	Registration Number
				51,306
Additional Signature may be generated within this form by selecting the Add button. <input type="button" value="Add"/>				

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1959706.00056/AQCRP.41C3
		Application Number	
Title of Invention	SMARTPHONE ANTENNA IN FLEXIBLE PCB		

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The information provided by you in this form will be subject to the following routine uses:

- 1 The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
- 2 A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
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- 6 A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
- 7 A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
- 8 A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
- 9 A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

SMARTPHONE ANTENNA IN FLEXIBLE PCB**INCORPORATION BY REFERENCE TO ANY PRIORITY APPLICATIONS**

[0001] Any and all applications for which a foreign or domestic priority claim is identified in the Application Data Sheet as filed with the present application are hereby incorporated by reference under 37 CFR 1.57.

BACKGROUNDField

[0002] The present disclosure relates to a smartphone antenna module for use in a smartphone and further relates to a smartphone having the antenna module.

Discussion of Related Technology

[0003] Recently, smartphones include a circuit and an antenna for enabling near field RF communication (NFC). Also, some smartphones include other wireless communication circuits and antennas for use in transactions and payments in stores and restaurants with smartphones. For example, a circuit and an antenna for magnetic secure transmission (MST) are applied to some smartphones. However, wireless communication circuits and components for providing various kinds of wireless communications (e.g., LTE communication, Wi-Fi communication and Bluetooth communication) are already housed in smartphones, and various antennas are also mounted in smartphones. In addition, smartphones also have components that may affect the wireless communication, such as a battery. Accordingly, spaces for installing an NFC antenna or MST antenna are limited. This requires additional efforts for designing antennas' structures and layout of components in smartphones.

[0004] The foregoing discussion in this section is to provide general background information and does not constitute an admission of prior art.

SUMMARY

[0005] In one aspect of the invention provides a smartphone antenna module, which may comprise:

- a flexible PCB comprising a sheet-like body with a first major surface and a second major surface facing away from the first major surface;
- the flexible PCB further comprising a first hole and a second hole formed through the sheet-like body, wherein the flexible PCB comprises a first PCB section, the first hole, a second PCB section, the second hole, and a third PCB section consecutively arranged along an axis such that the axis passes the first PCB section, the first hole, the second PCB section, the second hole, and the third PCB section;
- the flexible PCB further comprising a first coil, a second coil and a third coil formed in the sheet-like body between the first and second major surfaces,
- the first coil surrounding the first hole and comprising a first coil segment located in the first PCB section and a second coil segment located in the second PCB section;
- the second coil surrounding the second hole and comprising a second coil segment located in the second PCB section and a third coil segment located in the third PCB section;
- a magnetic sheet comprising a first sheet portion, a second sheet portion and a third sheet portion, the second sheet portion interposed between the first and third sheet portions,
- wherein the magnetic sheet engaged with the flexible PCB through the first and second holes such that:
 - the first sheet portion is located on the side of the first major surface and overlaps the first coil segment of the first coil, in which at least one line of the first coil segment of the first coil overlaps the first sheet portion,
 - the second sheet portion interposed between the first and third sheet portions is located on the side of the second major surface and overlaps both the second coil segment of the first coil and the second coil segment of the second coil, in which each line of the second coil segment of the first coil

overlaps the second sheet portion and each line of the second coil segment of the second coil overlaps the second sheet portion, and

- the third sheet portion is located on the side of the first major surface and overlaps the third coil segment of the second coil, in which each line of the third coil segment of the second coil overlaps the third sheet portion.

[0006] In the foregoing smartphone antenna module, the third coil may surround both the first and second coils, wherein the third coil comprises a first coil segment located in the first PCB section and a third coil segment in the third PCB section, wherein the first coil segment of the third coil does not have a line overlapping the first sheet portion, wherein the third sheet portion overlaps the third coil segment of the third coil, in which each line of the third coil segment of the third coil overlaps the third sheet portion. In the foregoing antenna module, the third coil may surround the first coil, but does not surround the third coil, wherein the third coil comprises a first coil segment located in the first PCB section and a second coil segment in the second PCB section, wherein the first sheet portion overlaps the first coil segment of the third coil, in which at least one line of the first coil segment of the third coil overlaps the first sheet portion, wherein the second sheet portion overlaps the second coil segment of the third coil, in which each line of the second coil segment of the third coil overlaps the third sheet portion.

[0007] Still in the foregoing smartphone antenna module, the magnetic sheet does not include a portion extending from the first sheet portion beyond an edge of the flexible PCB that overlaps the first PCB section. Each line of the first coil segment of the first coil may overlap the first sheet portion. The magnetic sheet may include a portion extending from the third sheet portion beyond an edge of the flexible PCB that overlaps with the third PCB section. The magnetic sheet may continuously extend from the first sheet portion to the third sheet portion via the second sheet portion without an air gap between the first sheet portion and the second sheet portion and without air gap between the second sheet portion and the third sheet portion.

[0008] Yet in foregoing smartphone antenna module, the first coil may comprise two non-overlapping coil segments that do not overlap the magnetic sheet at all, wherein the first coil segment, one of the two non-overlapping coil segments, the second coil segment, the other non-overlapping coil segment of the first coil are arranged in order surrounding the first hole. The second coil may comprise two non-overlapping coil segments that do not overlap the magnetic sheet at all, wherein the second coil segment, one of the two non-overlapping coil segments, the

third coil segment, the other non-overlapping coil segment of the second coil are arranged in order surrounding the second hole.

[0009] Further in the foregoing smartphone antenna module, the first coil and the second coil may be electrically connected to each other in the flexible PCB to form a combined coil antenna having two end terminals, wherein the flexible PCB further comprises a PCB connector for electrically connecting the first and second coils to a counterpart connector of a smartphone, wherein the PCB connector is electrically connected to the two end terminals. The first and second coils are connected in series to each other such that when current flows from one of the two end terminals toward the other end terminal through the first and second coils, the current flows in the first coil in a first rotational direction around the first hole and further flows in the second coil in a second rotational direction around the second hole when viewed in a viewing direction perpendicular to the first major surface, in which the second rotational direction is opposite to the first rotational direction. The first and second coils are connected to each other in series such that when current flows from one of the two end terminals toward the other end terminal through the first and second coils, the current flows in lines of the second coil segment of the first coil in a linear direction and the current flows in lines of the second coil segment of the second coil in the same linear direction. The third coil surrounds the first coil and the second coil, wherein the flexible PCB further may comprise connection lines interconnecting the two end terminals of the combined coil antenna and the PCB connector, wherein one of the connection lines crosses over the third coil when viewed in a viewing direction perpendicular to the first major surface. The first coil and the second coil may be electrically connected to each other in series.

[0010] Still further in the foregoing smartphone antenna module, wherein the flexible PCB may comprise a first layer and a second layer stacked over each other, wherein the first layer comprises the first and second coils, and the second layer comprises a fourth coil that surrounds the first hole, wherein the fourth coil comprises a first coil segment located in the first PCB section and a second coil segment located in the second PCB section, wherein the first sheet portion overlaps the first coil segment of the fourth coil, in which at least one line of the first coil segment of the fourth coil overlaps the first sheet portion, wherein the second sheet portion overlaps the second coil segment of the fourth coil, in which each line of the second coil segment of the fourth coil overlaps the second sheet portion. The first, second and fourth coils may be electrically connected to one another in series in the flexible PCB to form a combined coil antenna having two

end terminals, wherein the flexible PCB further comprises a PCB connector for electrically connecting the first, second and fourth coils to a counterpart connector of a smartphone, wherein the PCB connector is electrically connected to the two terminals. The first, second and fourth coils are connected in series such that when current flows from one of the two end terminals toward the other end terminal through the first, second and fourth coils, the current flows in the first and fourth coils in a first rotational direction around the first hole and further flows in the third coil in a second rotational direction around the second hole when viewed in a direction perpendicular to the first major surface, wherein the first rotational direction is opposite to the second rotational direction. The first, second and fourth coils are connected in series such that when current flows from one of the two end terminals toward the other end terminal through the first, second and fourth coils, the current flows in lines of the second coil segment of the first coil in a linear direction, the current flows in lines of the second coil segment of the second coil in the same linear direction, and the current flows in lines of the second coil segment of the fourth coil in the same linear direction.

[0011] Still further in the smartphone antenna module, the third coil may surround the first coil, but does not surround the third coil, wherein the flexible PCB further may comprise a fifth coil that surrounds the second coil, wherein the first and second coils are connected to each other for providing a combined coil antenna and the third and fifth coils are connected to each other in the flexible PCB for providing another combined coil antenna.

[0012] Another aspect of the invention provides a smartphone, which may comprise: a display module comprising a display surface; one of the foregoing smartphone antenna modules; and a rear wall facing away from the display surface and made of a non-magnetic material, wherein the magnetic sheet is arranged generally parallel to the rear wall.

[0013] In the foregoing smartphone, at least part of the first sheet portion and at least part of the third sheet portion may be interposed between the rear wall and the first PCB section while at least part of the second PCB section is interposed between the rear wall and the second sheet portion. The first and second coils may be electrically connected to each other in the flexible PCB and connected to a first smartphone circuit for magnetic secure transmission (MST) using a frequency range of 85-100 KHz, wherein the second coil is connected to a second smartphone circuit for near field communication (NFC) using 13.56 MHz.

[0014] Still another aspect of the invention provides a smartphone antenna module which may comprise:

- a magnetic sheet comprising a first magnetic sheet portion, a second magnetic sheet portion and a third magnetic sheet portion interposed between the first and second magnetic sheet portions;
- a flexible PCB comprising a first coil antenna (e.g., coil A) and a second coil antenna (e.g., coil B); and
- a through hole formed through the flexible PCB such that the flexible PCB comprises a first PCB section and a second PCB section located on an opposite side of the first PCB section across the through hole,
- wherein, when viewed in a thickness direction of the flexible PCB, the first coil antenna surrounds the through hole, and the second coil antenna surrounds the first coil antenna,
- wherein no electrical connection is formed between the first coil antenna and the second antenna coil within the flexible PCB,
- wherein the flexible PCB and the magnetic sheet are integrated in a single, flexible body, in which the flexible PCB and the magnetic sheet are arranged relative to each other such that: at least part of the third magnetic sheet portion passes the through hole, the first magnetic sheet portion is placed over the first PCB section and overlaps a first coil portion of the first coil antenna formed in the first PCB section of the flexible PCB, and the second magnetic sheet portion is placed under the second PCB section and overlaps a second coil portion of the first coil antenna formed in second PCB section of the flexible PCB.

[0015] In the foregoing antenna module, the first magnetic sheet portion placed over the first PCB section further may overlap a first coil portion of the second coil antenna that are formed in the first PCB section. The first magnetic sheet portion placed over the first PCB section may extend in a direction away from the second magnetic sheet portion beyond the first coil portion of the second coil antenna. The first magnetic sheet portion placed over the first PCB section may extend in a direction away from the second magnetic sheet portion beyond an edge of the flexible PCB that overlaps with the first PCB section.

[0016] Still in the foregoing antenna module, the first coil antenna may comprise a third portion that does not overlap the magnetic sheet at all. The first coil antenna may comprise a

fourth portion that does not overlap the magnetic sheet at all, wherein the first, third, second and fourth portions of the first coil antenna are arranged in order surrounding the through hole. The second coil antenna may comprise a third portion and fourth portion that do not overlap the magnetic sheet at all, wherein the first, third, second and fourth portions of the second coil antenna are arranged in order surrounding the through hole.

[0017] Yet in the foregoing antenna module, the second magnetic sheet portion placed under the second PCB section further may overlap a second coil portion of the second coil antenna that are formed in the second PCB section. The first magnetic sheet portion placed over the first PCB section may further overlap a first coil portion of the second coil antenna that are formed in the first PCB section. The first magnetic sheet portion may have a first width for passing through the through hole without bending thereof whereas the second magnetic sheet portion has a second width for not passing through the through hole without bending thereof. The through hole may have a maximum linear length of an opening thereof, wherein the first magnetic sheet portion has a first width smaller than the maximum linear length whereas the second magnetic sheet portion has a second width larger than the maximum linear length.

[0018] Further in the foregoing antenna module, the through hole may have a maximum linear length of an opening thereof, wherein the first magnetic sheet portion has a first width larger than the maximum linear length whereas the second magnetic sheet portion has a second width larger than the maximum linear length. The through hole may have a maximum linear length of an opening thereof, wherein the first magnetic sheet portion has a first width smaller than the maximum linear length whereas the second magnetic sheet portion has a second width smaller than the maximum linear length.

[0019] Still further in the foregoing antenna module, the first coil antenna may comprise a first inner terminal and a first outer terminal, wherein the flexible PCB may further comprise a PCB connector for electrically connecting the first coil antenna to a first counterpart connector of a smartphone, wherein the PCB connector is electrically connected to the first inner terminal and the first outer terminal. The flexible PCB may further comprise a connection line interconnecting the first inner terminal and the PCB connector, wherein the connection line crosses over the first coil antenna and the second coil antenna. The second coil antenna comprises a second inner terminal and a second outer terminal, wherein the PCB connector is also for electrically connecting the second coil antenna to a second counterpart connector of the smartphone, wherein

the PCB connector is also electrically connected to the second inner terminal and the second outer terminal. The smartphone antenna module may further comprise a third coil antenna that is not part of the flexible PCB.

[0020] Yet another aspect of the invention provides a smartphone, which may comprise: a display module comprising a display surface; the foregoing smartphone antenna module; and a rear wall facing away from the display surface and made of a non-magnetic material, wherein the magnetic sheet is arranged generally parallel to the rear wall.

[0021] In the foregoing smartphone, at least part of the first magnetic sheet portion may be interposed between the rear wall and the first PCB section whereas at least part of the second PCB section is interposed between the rear wall and the second magnetic sheet portion. The first coil antenna may be connected to a first smartphone circuit for magnetic secure transmission (MST) using a frequency range of 85-100 KHz, wherein the second coil antenna is connected to a second smartphone circuit for near field communication (NFC) using 13.56 MHz. The antenna module may further comprise a third coil antenna that is not part of the flexible PCB.

[0022] Still another aspect of the invention provides a smartphone antenna module, which may comprise:

- a flexible PCB comprising a first coil antenna and a second coil antenna that are not electrically connected with each other within the flexible PCB;
- a through hole formed through the flexible PCB such that the flexible PCB comprises a first PCB section and a second PCB section located on an opposite side of the first PCB section across the through hole, wherein when viewed in a thickness direction of the flexible PCB, the first coil antenna surrounds the through hole and the second coil antenna surrounds the first coil antenna;
- a first magnetic sheet placed under or over the first PCB section and overlapping a first coil portion of the first coil antenna that are formed in the first PCB section, the first magnetic sheet comprising a first edge;
- a second magnetic sheet placed under or over the second PCB section and overlapping a second coil portion of the first coil antenna that are formed in the second PCB section located on an opposite side of the first PCB section across the through hole, the second magnetic sheet comprising a second edge,

- wherein the first magnetic sheet and the second magnetic sheet are arranged such that the first edge of the first magnetic sheet overlaps the second magnetic sheet or that the first edge and the second edge are in proximity with each other with a gap therebetween,
- wherein the flexible PCB, the first magnetic sheet and the second magnetic sheet are integrated in a single, flexible body.

[0023] In the foregoing antenna module, the gap may be greater than 0 mm and less than a distance in a range of 0.1 mm to 3 mm.

[0024] A further aspect of the invention provides a smartphone, which may comprise: a display module comprising a display surface; the foregoing smartphone antenna module; and a rear wall facing away from the display surface and made of a non-magnetic material, wherein the magnetic sheet is arranged generally parallel to the rear wall.

[0025] In the foregoing smartphone, the first coil antenna is connected to a first smartphone circuit for magnetic secure transmission (MST) using a frequency range of 85-100 KHz, wherein the second coil antenna is connected to a second smartphone circuit for near field communication (NFC) using 13.56 MHz.

[0026] Still a further aspect of the invention provides a smartphone antenna module comprising:

- a magnetic sheet comprising a first sheet portion, a second sheet portion and a third sheet portion, the second sheet portion interposed between the first and third sheet portions;
- a flexible PCB comprising a first coil (coil A) and a second coil (coil C), wherein when viewed in a thickness direction of the flexible PCB, the first and second coils are arranged side by side;
- a first through hole formed through the flexible PCB and surrounded by the first coil when viewed in the thickness direction;
- a second through hole formed through the flexible PCB and surrounded by the second coil when viewed in the thickness direction; and
- the flexible PCB comprises a first PCB section, a second PCB section and a third PCB section, the second PCB section interposed between the first and second

through holes, wherein the first and second PCB sections are located opposite to each other across the first through hole and the second and third PCB sections are located opposite to each other across the second through hole such that the second PCB section is located between the first and third PCB sections,

- wherein the flexible PCB and the magnetic sheet are integrated in a single, flexible body, in which the flexible PCB and the magnetic sheet are arranged relative to each other such that:
 - the first sheet portion is placed over the first PCB section and overlaps a first coil portion of the first coil formed in the first PCB section of the flexible PCB,
 - the second sheet portion is placed under the second PCB section, overlaps a second coil portion of the first coil formed in the second PCB section and further overlaps a first coil portion of the second coil formed in the second PCB section,
 - the magnetic sheet comprises a first intermediate sheet portion connecting the first and second sheet portions and passing through the first through hole,
 - the third sheet portion is placed over the third PCB section and overlaps a second coil portion of the second coil formed in the third PCB section of the flexible PCB, and
 - the magnetic sheet comprises a second intermediate portion connecting the second and third sheet portions and passing through the second through hole.

[0027] One aspect of the invention provides a smartphone antenna module which may comprise the following:

- a flexible PCB comprising a sheet-like body with a first major surface and a second major surface facing away from the first major surface;
- the flexible PCB further comprising a through-hole formed through the sheet-like body, wherein the flexible PCB comprises a first PCB section, the through-hole and a second PCB section arranged along an axis such that the axis passes the first PCB section, the through-hole and the second PCB section in order;

- the flexible PCB further comprising a first coil, a second coil and a third coil formed in the sheet-like body between the first and second major surfaces;
- the first coil comprising a first coil segment located in the first PCB section and a second coil segment located in the second PCB section;
- the second coil comprising a first coil segment located in the first PCB section and a second coil segment located in the second PCB section;
- the third coil located in the second PCB section;
- the second coil surrounding the first coil, the through hole and at least a portion of the third coil; and
- a magnetic sheet comprising a head portion, a base portion and a neck portion interposed between and interconnecting the head and base portions,
- wherein no electric connection is formed between any two coils of the first, second and third coils in the flexible PCB,
- wherein the magnetic sheet is engaged with the flexible PCB:
 - such that the head portion is located on the side of the first major surface and overlaps the first coil segment of the first coil, in which the head portion overlaps at least one line of the first coil segment of the first coil while the head portion does not overlap any line of the first coil segment of the second coil,
 - such that the neck portion passes through and overlaps the through-hole; and
 - such that the base portion is located on the side of the second major surface and overlaps the third coil, the second coil segment of the first coil and the second coil segment of the second coil, in which the base portion overlaps each line of the second coil segment of the first coil, each line of the second coil segment of the second coil and each line of the third coil and the entire portion of the third coil,
- wherein the magnetic sheet overlaps each line of the second coil segment of the second coil whereas the magnetic sheet does not overlap any line of the first coil segment of the second coil.

[0028] In the foregoing smartphone antenna module, the third coil may be located between the second segment of the first coil and the second segment of the second coil, wherein the second coil surrounds the entire third coil. The second coil segment of the second coil may comprise a plurality of lines generally perpendicular to the axis, wherein the plurality of lines comprises a first line and a second line located inside the first line, wherein the second line crosses the third coil when viewed in a thickness direction of the flexible PCB whereas a first line does not cross the third coil such that the entire portion of the third coil is located between the second line and the second segment of the first coil. The second coil may comprise two or more turns that comprises a first turn and a second turn, wherein the first turn surrounds entire portion of the third coil whereas the second turn surrounds a portion of the third coil and comprises a line crossing the third coil when viewed in a thickness direction of the flexible PCB.

[0029] Still in the foregoing module, each of the first, second and third coils may comprise a printed wire that is coiled to form one or more turns in a spiral shape when viewed in a thickness direction of the flexible PCB. The printed wire may comprise a first wire segment and a second wire segment formed in different layers of the flexible PCB and connected through a connection via. Each line of the second coil segment of the first coil may comprise a linear extension along a direction perpendicular to the axis, wherein the base portion overlaps the entire portion of the linear extension of the first coil along the direction, wherein each line of the second coil segment of the second coil comprises a linear extension along a direction perpendicular to the axis, wherein the base portion overlaps the entire portion of the linear extension of the second coil along the direction.

[0030] Yet in the foregoing module, each line of the first coil segment of the first coil may comprise a linear extension along a direction perpendicular to the axis, wherein the head portion overlaps the at least one line of the first coil segment such that only a central portion of the linear extension of the at least one line overlaps the head portion with non-overlapped portions at both ends of the central portion. The magnetic sheet may include a portion extending from the base portion beyond an edge of the flexible PCB that overlaps with the second PCB section. The first coil antenna may comprise third and fourth coil segments that do not overlap the magnetic sheet at all, wherein the first, third, second and fourth coil segments of the first coil are arranged in order surrounding the through hole. The second coil antenna may comprise third and fourth coil segments that do not overlap the magnetic sheet at all, wherein the first, third, second and fourth

coil segments of the second coil are arranged in order surrounding the through hole. The head portion may have a first width for passing through the through hole without bending thereof whereas the base portion has a second width for not passing through the through hole without bending thereof. The base portion may have a width greater than that of the neck portion, and the head portion has a width equal to or smaller than that of the neck portion. The neck portion may have a width smaller than those of the head portion and the base portion.

[0031] Further in the foregoing module, the through-hole may have a maximum linear length of an opening thereof, wherein the head portion has a first width smaller than the maximum linear length whereas the base portion has a second width larger than the maximum linear length. Each of the first, second and third coils may comprise an inner terminal and an outer terminal, wherein the flexible PCB further comprises a PCB connector for electrically connecting each coil to a counterpart connector of a smartphone, wherein the PCB connector is electrically connected to the inner terminal and the outer terminal. The flexible PCB further may comprise a connection line interconnecting the inner terminal of the first coil antenna and the PCB connector, wherein the connection line crosses over the first coil antenna and the second coil antenna without electric connection with the second coil in the flexible PCB. The flexible PCB may further comprise a fourth coil formed in a layer different from that of the first coil, wherein the fourth coil surrounds the through-hole, wherein the fourth coil is coiled in a rotational direction opposite that of the first coil when viewed in a thickness direction of the flexible PCB, wherein the first coil and the fourth coil are electrically connected in series. The flexible PCB may further comprise a fourth coil formed in a layer different from that of the first coil, wherein the fourth coil surrounds the through-hole, wherein the first and fourth coils are coiled in the same rotational direction when viewed in a thickness direction of the flexible PCB, wherein the first coil and the fourth coil are electrically connected in parallel. The flexible PCB may further comprises a fourth coil formed in a layer different from that of the first coil, wherein the fourth coil surrounds the through-hole, wherein the fourth coil comprising a first coil segment located in the first PCB section and a second coil segment located in the second PCB section such that the first coil segment of the fourth coil overlaps the head portion while the second coil segment of the fourth coil overlaps the base portion.

[0032] Another aspect of the invention provides a smartphone which may comprise a display module comprising a display surface; the foregoing smartphone antenna module; and a rear wall facing away from the display surface and made of a non-magnetic material, wherein the

magnetic sheet is arranged generally parallel to the rear wall. In the foregoing smartphone, at least part of the base portion may be interposed between the rear wall and the second PCB section whereas at least part of the first PCB section is interposed between the rear wall and the head portion. The first coil antenna may be connected to a first smartphone circuit and configured for magnetic secure transmission (MST) using a frequency range of 85-100 KHz, wherein the second coil antenna is connected to a second smartphone circuit and configured for near field communication (NFC) using 13.56 MHz, wherein the third coil antenna is connected to a third smartphone circuit and configured for wireless charging of the smartphone.

[0033] Still another aspect of the invention provides a smartphone antenna module which may comprise:

- a magnetic sheet comprising a first magnetic sheet portion, a second magnetic sheet portion and a third magnetic sheet portion interposed between the first and second magnetic sheet portions,
- a flexible PCB in form of a sheet having a thickness, the flexible PCB comprising a first coil antenna and a second coil antenna; and
- a through hole formed through the thickness of the sheet of the flexible PCB such that the flexible PCB comprises a first PCB section and a second PCB section located on an opposite side of the first PCB section across the through hole,
- wherein, when viewed in a thickness direction of the flexible PCB, the first coil antenna comprises two or more turns turning around the through hole, and the second coil antenna comprises two or more turns turning around the first coil antenna and the through hole,
- wherein no electrical connection is formed between the first coil antenna and the second coil antenna within the flexible PCB,
- wherein the flexible PCB and the magnetic sheet are integrated in a single, flexible body, in which the flexible PCB and the magnetic sheet are arranged relative to each other such that:
 - at least part of the third magnetic sheet portion passes the through hole,
 - the first magnetic sheet portion is placed over the first PCB section and overlaps, when viewed in the thickness direction, a first coil portion of the

first coil antenna formed in the first PCB section of the flexible PCB while not overlapping, when viewed in the thickness direction, a second coil portion of the first coil antenna formed in the second PCB section that is placed across the through hole,

- the second magnetic sheet portion is placed under the second PCB section and overlaps, when viewed in the thickness direction, the second coil portion of the first coil antenna formed in the second PCB section of the flexible PCB while not overlapping, when viewed in the thickness direction, the first coil portion of the first coil antenna formed in the first PCB section placed across the through hole, and
- the second magnetic sheet portion further overlaps, when viewed in the thickness direction, a second coil portion of the second coil antenna formed in the second PCB section while not overlapping, when viewed in the thickness direction, a first coil portion of the second coil antenna formed in the first PCB section that is placed across the through hole.

[0034] Yet another aspect of the invention provides a smartphone antenna module which may comprise:

- a magnetic sheet comprising a first magnetic sheet portion, a second magnetic sheet portion and a third magnetic sheet portion interposed between the first and second magnetic sheet portions,
- a flexible PCB in form of a sheet having a thickness, the flexible PCB comprising a first coil antenna, a second coil antenna and a third coil antenna; and
- a through hole formed through the thickness of the sheet of the flexible PCB such that the flexible PCB comprises a first PCB section and a second PCB section located on an opposite side of the first PCB section across the through hole,
- wherein, when viewed in a thickness direction of the flexible PCB, the first coil antenna comprises two or more turns turning around the through hole, and the second coil antenna comprises two or more turns turning around the first coil antenna, the third coil antenna and the through hole,

- wherein no electrical connection is formed between the first coil antenna and the second coil antenna within the flexible PCB, no electrical connection is formed between the third coil and the first coil antenna within the flexible PCB, and no electrical connection is formed between the third coil and the second coil antenna within the flexible PCB,
- wherein the flexible PCB and the magnetic sheet are integrated in a single, flexible body, in which the flexible PCB and the magnetic sheet are arranged relative to each other such that:
 - at least part of the third magnetic sheet portion passes the through hole,
 - the first magnetic sheet portion is placed over the first PCB section and overlaps, when viewed in the thickness direction, a first coil portion of the first coil antenna formed in the first PCB section of the flexible PCB while not overlapping, when viewed in the thickness direction, a second coil portion of the first coil antenna formed in the second PCB section that is placed across the through hole,
 - the second magnetic sheet portion is placed under the second PCB section and overlaps, when viewed in the thickness direction, the second coil portion of the first coil antenna formed in the second PCB section of the flexible PCB while not overlapping, when viewed in the thickness direction, the first coil portion of the first coil antenna formed in the first PCB section that is placed across the through hole, and
 - the second magnetic sheet portion further overlaps, when viewed in the thickness direction, a second coil portion of the second coil antenna formed in the second PCB section while not overlapping, when viewed in the thickness direction, a first coil portion of the second coil antenna formed in the first PCB section that is placed across the through hole.

[0035] A further aspect of the invention provides a smartphone antenna module that may comprise:

- a flexible PCB comprising a sheet-like body with a first major surface and a second major surface facing away from the first major surface;

- the flexible PCB further comprising a first hole and a second hole formed through the sheet-like body, wherein the flexible PCB comprises a first PCB section, the first hole, a second PCB section, the second hole, and a third PCB section arranged along an axis such that the axis passes the first PCB section, the first hole, the second PCB section, the second hole, and the third PCB section in order;
- the flexible PCB further comprising a first coil, a second coil and a third coil formed in the sheet-like body between the first and second major surfaces;
- the first coil surrounding the first hole and comprising a first coil segment located in the first PCB section and a second coil segment located in the second PCB section;
- the second coil surrounding the second hole and comprising a second coil segment located in the second PCB section and a third coil segment located in the third PCB section;
- the third coil surrounding all of the first coil, the first hole, the second coil and the second hole and comprising a first coil segment located in the first PCB section and a third coil segment located in the third PCB section; and
- a magnetic sheet comprising a first sheet portion, a second sheet portion and a third sheet portion, the second sheet portion interposed between the first and third sheet portions,
- wherein the magnetic sheet engaged with the flexible PCB through the first and second holes:
 - such that the first sheet portion is located on the side of the first major surface and overlaps the first coil segment of the first coil, in which the first sheet portion overlaps at least one line of the first coil segment of the first coil while the first sheet portion does not overlap any line of the first coil segment of the third coil,
 - such that the second sheet portion interposed between the first and third sheet portions is located on the side of the second major surface and overlaps both the second coil segment of the first coil and the second coil segment of the second coil, in which the second sheet portion overlaps each

line of the second coil segment of the first coil and each line of the second coil segment of the second coil, and

- such that the third sheet portion is located on the side of the first major surface and overlaps the third coil segment of the second coil and the third coil segment of the third coil, in which the third sheet portion overlaps each line of the third coil segment of the second coil and each line of the third coil segment of the third coil,
- wherein the magnetic sheet overlaps each line of the third coil segment of the third coil whereas the magnetic sheet does not overlap any line of the first coil segment of the third coil.

[0036] Still a further aspect of the invention provides a smartphone antenna module that may comprise:

- a flexible PCB comprising a sheet-like body with a first major surface and a second major surface facing away from the first major surface;
- the flexible PCB further comprising a first hole and a second hole formed through the sheet-like body, wherein the flexible PCB comprises a first PCB section, the first hole, a second PCB section, the second hole, and a third PCB section arranged along an axis such that the axis passes the first PCB section, the first hole, the second PCB section, the second hole, and the third PCB section in order;
- the flexible PCB further comprising a first coil, a second coil, a third coil and a fourth coil formed in the sheet-like body between the first and second major surfaces, wherein the sheet like body comprises a first layer and a second layer stacked over the first layer, wherein the first and second coils are formed in the first layer while the fourth coil is formed in the second layer;
- the first coil surrounding the first hole and comprising a first coil segment located in the first PCB section and a second coil segment located in the second PCB section;
- the fourth coil surrounding the first hole and comprising a first coil segment located in the first PCB section and a second coil segment located in the second PCB section;

- the second coil surrounding the second hole and comprising a second coil segment located in the second PCB section and a third coil segment located in the third PCB section;
- the third coil surrounding all of the first coil, the fourth coil, the first hole, the second coil and the second hole and comprising a first coil segment located in the first PCB section and a third coil segment located in the third PCB section; and
- a magnetic sheet comprising a first sheet portion, a second sheet portion and a third sheet portion, the second sheet portion interposed between the first and third sheet portions,
- wherein the magnetic sheet engaged with the flexible PCB through the first and second holes:
 - such that the first sheet portion is located on the side of the first major surface and overlaps the first coil segment of the first coil and the first coil segment of the fourth coil, in which the first sheet portion overlaps at least one line of the first coil segment of the first coil and at least one line of the first coil segment of the fourth coil while the first sheet portion does not overlap any line of the first coil segment of the third coil,
 - such that the second sheet portion interposed between the first and third sheet portions is located on the side of the second major surface and overlaps the second coil segment of the first coil, the second coil segment of the second coil and the second coil segment of the fourth coil, in which the second sheet portion overlaps each line of the second coil segment of the first coil, each line of the second coil segment of the second coil and each line of the second coil segment of the fourth coil, and
 - such that the third sheet portion is located on the side of the first major surface and overlaps the third coil segment of the second coil and the third coil segment of the third coil, in which the third sheet portion overlaps each line of the third coil segment of the second coil and each line of the third coil segment of the third coil,

- wherein the magnetic sheet overlaps each line of the third coil segment of the third coil whereas the magnetic sheet does not overlap any line of the first coil segment of the third coil,
- wherein each of the first, second and fourth coils comprises an inner terminal and an outer terminal, wherein the first coil is coiled about the first hole from the inner terminal of the first coil to the outer terminal of the first coil in a first rotational direction, the second coil is coiled about the second hole from the inner terminal of the second coil to the outer terminal of the second coil in a second rotational direction that is opposite to the first rotational direction, the fourth coil is coiled about the first hole from the inner terminal of the fourth coil and the outer terminal of the fourth coil in the second rotational direction, and the first, second and fourth coils are connected to each other to form a serial connection such that, when current flows through the first, second and fourth coils, the current flows in the same direction in each line of the second coil segments of the first, second and fourth coils.

BRIEF DESCRIPTION OF THE DRAWINGS

[0037] Figure 1 is a perspective view of a smartphone according to embodiments of the present invention, showing a front side of the smartphone.

[0038] Figure 2 is a perspective view of the smartphone shown in Figure 1, showing a backside of the smartphone with an antenna module inside the smartphone according to an embodiment of the invention.

[0039] Figure 3 is a perspective view of an antenna module according to an embodiment of the invention.

[0040] Figure 4 is a front view of the antenna module shown in Figure 3.

[0041] Figure 5 is a rear view of the antenna module shown in Figure 3.

[0042] Figure 6 is a perspective view of a flexible PCB according to an embodiment of the invention.

[0043] Figure 7 is a perspective view of a magnetic sheet according to an embodiment of the invention.

[0044] Figure 8 is a perspective view of an assembly of the flexible PCB of Figure 6 and the magnetic sheet of Figure 7 according to an embodiment.

[0045] Figure 9 is a rear view of the assembly shown in Figure 8.

[0046] Figure 10 is a sectional view of a rear cover of a smartphone and an antenna module according to an embodiment of the invention, showing locational relationship between the rear cover and the antenna module.

[0047] Figures 11-14 are partial sectional views of a rear cover of a smartphone and an antenna module, each showing locational relationship between the rear cover and the antenna module according to various embodiments of the invention.

[0048] Figure 15 is a perspective view of an assembly of a flexible PCB and multiple magnetic sheet pieces according to another embodiment of the invention.

[0049] Figure 16 is a perspective view of two overlapping magnetic sheets according to a further embodiment of the invention, in which the two overlapping magnetic sheets have different sizes and different materials.

[0050] Figure 17 is a sectional view of an assembly of a flexible PCB and the two overlapping magnetic sheets shown in Figure 16.

[0051] Figures 18A and 18B show examples of electrical connection of two coils, in which Figure 18A shows a series connection and Figure 18B shows a parallel connection.

[0052] Figure 19 is a perspective view of the antenna module according to an embodiment of the invention.

[0053] Figure 20 is a front view of a flexible PCB of the antenna module shown in Figure 19, schematically showing a pattern of coils, conductive lines and terminal pads in the flexible PCB.

[0054] Figure 21 is a sectional view of the antenna module shown in Figure 19, in which a rear cover of a smartphone is partially illustrated as well.

[0055] Figure 22 shows front views of bottom and top layers of a flexible PCB according to an alternative embodiment of the antenna module shown in Figure 19, schematically illustrating patterns of coils, conductive lines and terminal pads in the top and bottom layers of the flexible PCB.

[0056] Figures 23A and 23B show examples of parallel connections between coils in the bottom layer of the flexible PCB shown in Figure 22 and conductive line segments in the top layer.

[0057] Figure 24 is a computer design printout of patterns of coils, conductive lines and terminal pads of the bottom and top layers of the flexible PCB.

[0058] Figure 25 is a sectional view of the antenna module with the flexible PCB shown in Figure 22, in which a rear cover of a smartphone is partially illustrated as well.

[0059] Figure 26 is a perspective view of an antenna module according to another embodiment of the invention.

[0060] Figure 27 is a front view of a flexible PCB of the antenna module shown in Figure 26, schematically showing a pattern of coils, conductive lines and terminal pads in the flexible PCB.

[0061] Figure 28 is a sectional view of the antenna module with the flexible PCB shown in Figure 27, in which a rear cover of a smartphone is partially illustrated as well.

[0062] Figure 29 shows a front view of a flexible PCB according to an alternative embodiment of the antenna module shown in Figure 26, schematically illustrating schematically showing a pattern of coils, conductive lines and terminal pads in the flexible PCB.

[0063] Figure 30 is a sectional view of the antenna module with the flexible PCB shown in Figure 29, in which a rear cover of a smartphone is partially illustrated as well.

[0064] Figure 31 is a perspective view of an antenna module according to a further embodiment of the invention.

[0065] Figure 32 is a perspective view of a smartphone antenna module and shows another embodiment of the invention.

[0066] Figure 33 is an exploded view of the smartphone antenna module shown in Figure 32.

[0067] Figure 34 is a sectional view of the smartphone antenna module shown in Figure 32.

[0068] Figure 35 is a perspective view of a smartphone antenna module and shows yet another embodiment of the invention.

[0069] Figure 36 is another perspective view of the smartphone antenna module shown in Figure 35.

[0070] Figure 37 is a front view of a flexible PCB of the smartphone antenna module shown in Figure 35.

[0071] Figure 38 is a front view of a magnetic sheet of the smartphone antenna module shown in Figure 35.

[0072] Figure 39 is a sectional view of the smartphone antenna module shown in Figure 35, showing a state in which the smartphone antenna module is installed in a smartphone.

[0073] Figure 40 is a front view of a smartphone antenna module according to a further embodiment.

[0074] Figure 41 is a rear view of the smartphone antenna module shown in Figure 40.

[0075] Figure 42 is a front view of a top layer of a flexible PCB of the smartphone antenna module shown in Figure 40 and Figure 43 is a front view of a bottom layer of a flexible PCB of the smartphone antenna module shown in Figure 40.

[0076] Figure 44 shows connection of lines formed in multiple layers of the flexible PCB.

[0077] Figures 45-52 show a smartphone antenna module and its components according to additional embodiments of the invention, and Figures 53A, 53B, 53C, 54A, 54B and 54C show various design examples of a wireless charging coil antenna in the smartphone antenna module and Figure 55 shows charging efficiencies of the various examples.

DETAILED DESCRIPTION OF EMBODIMENTS

[0078] Embodiments of the invention are now described with reference to the accompanying drawings. The terminology used in the description presented herein is not intended to be interpreted in any limited or restrictive manner, simply because it is being utilized in conjunction with a detailed description of certain specific embodiments of the invention.

Various components in smartphone

[0079] In embodiments, referring to Figures 1 and 2, a smartphone 10 includes components which include circuits, a display 12, a battery, a camera 15, communication modules and the like. The components are densely integrated in a housing 18 of the smartphone. Recently, for various reasons, the housing of the smartphone tends to be made of a metal. However, the metal

housing may significantly affect operations of various antennas in the smartphone. Even in smartphones using non-metallic housing, due to the high degree of compactness, internal components such as a battery may also significantly affect the operations of the antennas.

NFC antenna and MST antenna

[0080] In embodiments, a smartphone can include an NFC antenna and an MST antenna. The NFC antenna and the MST antenna, among the antennas, use a considerably low frequency band and handle wireless signals of considerably long wavelengths as compared with other wireless antennas, it is typical that the NFC antenna and the MST antenna have sizes greater than those of other antennas. Accordingly, the location of the NFC antenna and the MST antenna overlap with the location of the metal housing, the battery or the like more than those of the other antennas. This requires improvements in the structures of the NFC antenna and the MST antenna and further requires improved layout arranging the NFC antenna and the MST antenna. In embodiments, referring to Figure 2, a flexible antenna module or apparatus 100 is included in the smartphone.

Flexible antenna module

[0081] In embodiments, referring to Figures 2-5, a flexible antenna module or apparatus 100 is formed in a single, thin, flexible body in which coil antennas for providing an MST antenna and an NFC antenna are integrated. The flexible antenna module includes a flexible PCB 200 with coil antenna (coil A) 204 and coil antenna (coil B) 206 for providing the MST antenna and the NFC antenna and further includes a magnetic sheet 300 which is engaged with the flexible PCB 200. The flexible PCB 200 and the magnetic sheet 300 are integrated with each other to form the single, thin, flexible body. In embodiments, additional protective and insulating coatings 400 may be coated over surfaces of the single body (see Figure 5).

Flexible PCB

[0082] In embodiments, referring to Figures 3-6, 8, and 9, the flexible PCB 200 has a rectangular sheet shape with a through hole 202 at its center. The flexible PCB 300 includes two coil antennas 204, 206 and coatings coated over the coil antennas to form the sheet shape. Each coil antenna includes a printed wire coil. The two coil antennas include a first coil antenna 204

which functions as an MST antenna and a second coil antenna 206 which functions as an NFC antenna.

First coil antenna and second coil antenna

[0083] In embodiments, referring to Figures 3-6, 8, and 9, the first coil antenna 204 surrounds or encircles the through hole 202 and the second coil antenna 206 surrounds encircles the first coil antenna 204 and the through hole 202. In embodiments, the first coil 204 may include 6, 7, 8, 9, 10, 11 or 12 turns coiled to turn around the through hole 202, but the invention is not limited thereto. The second coil 306 may include 2, 3, 4, 5 or 6 turns coiled to turn around the first coil 204 and the through hole 202, but the invention is not limited thereto. The number of turns of each coil may be modified or adjusted to provide an antenna length for a specific antenna function. In embodiments, the first coil antenna 204 includes turns more than that of the second coil antenna 206.

PCB connector portion

[0084] In embodiments, referring to Figures 3-6, 8, and 9, the flexible PCB 200 includes a PCB connector portion 208 for connecting the coil antennas 204, 206 to a counterpart connection terminal of a smartphone 10. The connector portion 208 includes an extension 210 located outside the second coil antenna 206 and four connector terminal pads 212 (see Figure 9) formed in an end portion of the extension 210. Each coil antenna includes an inner terminal and an outer terminal. In an embodiment, the first coil antenna 204 includes a first inner terminal located in its inner portion and a first outer terminal located in its outer portion. Likewise, the second coil antenna 206 includes a second inner terminal located in its inner portion and a second outer terminal located in its outer portion. Each of the first and second inner terminals and the first and second outer terminals 204 and 206 is connected to one of the four terminal pads 212 via one or more connector lines.

Location of connector portion

[0085] In the embodiments illustrated in Figures 3-6, 8, and 9, the connector portion 208 includes the extension 210 extending from an upper edge of the flexible PCB. In some embodiments, the extension 210 may extend from a side of the flexible PCB 200 as shown in Figure 19. Further, in other embodiments, may extend from a lower edge of the flexible PCB. In

the discussion of embodiments, the terms “upper” and “lower” do not refer to their absolute location. In some circumstances, for example, an item labeled with the term “upper” may be located lower or under an item labeled with the term “lower.”

Connector lines

[0086] In embodiments, referring to Figures 3-6, 8, and 9, the flexible PCB 200 includes connector lines interconnecting between four terminal pads 212 and the terminals of the coil antennas, respectively. Connector lines include printed conductive lines. For example, a connector line 214 connects the inner terminal of the first coil antenna and one of the terminal pads 212. The connector line 214 extends from the inner portion of the first coil antenna 204 and the outer portion of the second coil antenna 206 (see Figures 6 and 9), while crossing lines of the first and second coil antennas 204 and 206 when viewed in a viewing direction along an arrow A shown in Figure 6 and while extending over the front side of the first coil antenna 204 and the rear side of the second coil antenna 206. (Throughout the discussion of embodiments in the specification, the viewing direction is defined as a thickness direction of the flexible PCB generally perpendicular to a major flat surface of the flexible PCB. In some instances, the viewing direction may also be the same as a thickness direction of the magnetic sheet generally perpendicular to a major flat surface of the magnetic sheet. In other instances, the viewing direction may also be the same as a direction generally perpendicular to a major flat surface of the rear cover or rear wall of the smartphone when the antenna module is assembled in the smartphone.) Another connector line 216 among the connector lines connects the outer terminal of the first coil antenna 204 and one of the terminal pads 212. In embodiments, the connector lines may be formed in a layer of the flexible PCB that is different from another layer in which the first and second coils are formed.

Width and thickness of connector lines

[0087] In embodiments, the connector line has a width greater than that of a line in the first coil antenna 204 and has a thickness smaller than that of the line in the first coil antenna 204. This configuration can reduce or minimize overall thickness of the antenna module when the coil antenna and the connector line are overlaid. The connector line 216 extends from the inner portion of the second coil antenna 206 and the outer portion of the first coil antenna 204, while crossing lines of the second coil antenna 206 when viewed in the viewing direction and while extending

over the rear side of the second coil antenna 206. In the flexible PCB 200, the connector lines are insulated from the coil antennas 204 and 206 that they are crossing via insulation layers.

No electrical connection between first coil antenna and second coil antenna

[0088] In embodiments, referring to Figures 3-6, 8, and 9, there is no electric connection between the first coil antenna 204 and the second coil antenna 206 in the antenna module. Specifically, the first coil antenna 204 and the second coil antenna 206 are spaced apart from each other while the second coil antenna 206 surrounds or encircles the first coil antenna 204. Further, each of the connector lines is also spaced from other connector lines. One or more insulation layers are interposed between the first or second coil antenna and the connector lines crossing the first or second coil antenna. Also, each of the four connector terminal pads is apart from other connector terminal pads.

Magnetic sheet

[0089] In embodiments, referring to Figures 3-5, and 7-9, the magnetic sheet 300 includes a generally rectangular base portion 302 and a head portion 304 extending from an edge 306 of the base portion 302. The head portion is contoured and sized to pass through the through hole 202 and has a width smaller than that of the base portion. In embodiments discussed above and below, the magnetic sheet may function as a magnetic core when the magnetic sheet passes through a through hole that a coil surrounds or the magnetic sheet is placed adjacent a coil.

Material of magnetic sheet

[0090] In embodiments, the magnetic sheet 300 contains magnetic material which is referred to as soft magnetic material or ferromagnetic material having a high magnetic permeability and a low coercive force. For example, ferrite or ferromagnetic metal or alloy can be used. In embodiments, the magnetic sheet is entirely made of the magnetic material. In other embodiments, the magnetic material powder or particles are dispersed in a plastic resin matrix of flexible sheet shape.

Ferrite magnetic sheet

[0091] In embodiments, the magnetic sheet 300 includes ferrite material. In one embodiment, ferrite magnetic material powder or particles are prepared and sintered to make the ferrite magnetic material sheet.

Nanocrystal magnetic sheet

[0092] In embodiments, the magnetic sheet 300 includes a laminate of plural nanocrystal sheets or layer. In one embodiment, each nanocrystal sheet or layer contains an alloy including or essentially consisting of iron (Fe), silicon (Si) and boron (B). Additionally, a small amount of copper (Cu), molybdenum (Mo), niobium (Nb) and nickel (Ni) may be added to the alloy. Typically, each nanocrystal sheet or layer is made thin, and thus, plural nanocrystal sheets (e.g., four or more nanocrystal magnetic sheets) are laminated to form the magnetic sheet 300.

Assembled state of flexible PCB and magnetic sheet

[0093] In embodiments, referring to Figures 6-9, the flexible PCB 200 and the magnetic sheet 300 may be assembled as shown in the drawings. When assembled, the head portion 304 of the magnetic sheet 300 passes through the through hole 202. The head portion 304 has a first sheet portion 320 placed over a first PCB section 220 of the flexible PCB while the base portion 302 has a second sheet portion 322 placed under a second PCB section 222 of the flexible PCB. The second PCB section 222 is located on an opposite side of the first PCB section 220 across the through hole 202.

Coils and magnetic sheet

[0094] As a result, in embodiments, the first sheet portion 320 overlaps coil portions of the first coil antenna 204 which are located in the first PCB section 220. Further, the first sheet portion 320 further overlaps coil portions of the second coil antenna 206 which are located in the first PCB section 220. Similarly, the second sheet portion 322 overlaps coil portions of the first coil antenna 204 which are located in the second PCB section 222. Further, the second sheet portion 322 further overlaps coil portions of the second coil antenna 206 which are located in the second PCB section. In other embodiments, the first sheet portion does not overlap the coil portions of the second coil antenna 206 which are located in the first PCB section 220 while the first sheet

portion 320 further overlaps coil portions of the second coil antenna 206 which are located in the first PCB section 220.

Through hole and magnetic sheet

[0095] In embodiments, referring to Figure 8, the magnetic sheet 300 further includes an intermediate sheet portion 312 overlapping the through hole 202. The intermediate sheet portion 312 interconnects the first sheet portion 320 and the second sheet portion. In one embodiment, the intermediate sheet portion 312 may be a portion of the head portion 304. In another embodiment, the intermediate sheet portion 312 may be a portion of the base portion 302. In other embodiments, the intermediate sheet portion 321 may include both a portion of the head portion 304 and a portion of the base portion 302.

Assembling flexible PCB and magnetic sheet

[0096] In embodiments, referring to Figures 6-9, when assembling, the head portion 304 is inserted through the through hole 202 and passes the through hole 202 until the edge 306 contacts the flexible PCB. Then, the base portion 302 is attached to the second PCB section 222 by using, for example, an adhesive. In other embodiments, the head portion 304 is attached to the first PCB section 220.

Sizes of portions of flexible PCB and the portions of magnetic sheet

[0097] In embodiments, referring to Figures 6, 7 and 8, the head portion 304 (the first sheet portion 320) has a width W_H smaller than that W_T of the through hole 202 such that the head portion 304 passes through the through hole without bending the magnetic sheet 300. Further, the base portion 302 (the second sheet portion 322) has a width W_B greater than that W_T of the through hole 202 such that the head portion 304 cannot pass through the through hole without bending the magnetic sheet 300. Additionally, the base portion 302 (the second sheet portion 322) has a width W_B greater than that W_{C2} of the second coil antenna 206. However, the invention is not limited thereto. In another embodiment, the base portion 302 (the second sheet portion 322) has a width W_B smaller than that W_T of the through hole 202. In a further embodiment, the head portion 304 (the first sheet portion 320) has a width W_H greater than that W_T of the through hole 202 such that the head portion 304 passes through the through hole with bending the magnetic sheet 300. In other

embodiments, the head portion 304 (the first sheet portion 320) has a width W_H substantially the same as that W_B of the base portion 302 (the second sheet portion 322).

Single body of flexible antenna module

[0098] Over surfaces of the assembly of the flexible PCB and the magnetic sheet, in embodiments, protective and insulation coatings are further coated to complete making the single body of the flexible antenna module.

Flexible antenna module in smartphone

[0099] In embodiments, referring to Figures 2 and 10, the flexible antenna module 100 is attached to the smartphone's rear cover 22. The connector terminal pads 212 of the connector portion 208 are electrically connected to circuits in the smartphone 10.

Coil antenna for MST antenna

[0100] In embodiments, the inner and outer terminals of the first coil antenna may be connected to an MST circuit in the smartphone 10 such that the first coil antenna functions as an MST antenna or MST inductor. Magnetic secure transmission (MST) is also referred as magnetic stripe transmission or magnetic secure transmission as disclosed in US 2016/0180120 A1 entitled "MAGNETIC SECURE TRANSMISSION DEVICE HARDWARE," the entire disclosure of which is incorporated by reference herein. In other embodiments, however, the second coil antenna may function as an MST antenna.

Coil antenna for NFC antenna

[0101] In embodiments, the inner and outer terminals of the second coil antenna 206 are connected to an NFC circuit in the smartphone 10 such that the second coil antenna functions as an NFC antenna. Near Field Communication (NFC) is a standard allowing wireless communication in a Radio Frequency (RF) band between portable devices, such as smartphones, or between a portable device and a fixed device (an NFC terminal). In other embodiments, however, the first coil antenna may function as an NFC antenna.

Operation of first and second coil antennas

[0102] In embodiments, the smartphone with the antenna module has a controller which operates the first and second coils as an MST antenna and an NFC antenna, respectively.

The controller can operate the antenna coils such that the first coil antenna does not operate as an MST antenna while the second coil is operating as an NFC antenna. Similarly, the controller operates the antenna coils such that the second coil antenna does not operate as an NFC antenna while the first coil is operating as an MST antenna. In some embodiments, the antenna module may have three or more coil antennas and the controller operates the three or more coil antennas such that only one coil antenna among the three or more coil antennas is operating and the other coil antennas is not working. In embodiments, the controller does not allow two coil antennas among the three or more coil antennas to work at the same time.

One coil antenna functioning as two different antennas

[0103] In embodiments, one of the coil antennas in the antenna module can function as both the MST antenna and the NFC antenna according to control signals from the controller of the smartphone. In one embodiment, the first coil antenna may function as the MST antenna in one period of time and the NFC antenna in another period of time. The second coil antenna may function as another antenna, for example, a wireless power charging antenna.

Smartphone's rear cover and antenna module

[0104] In embodiments, referring to Figures 2 and 10, the antenna module 100 is attached to the smartphone's rear cover 22 such that the head portion 304 is interposed between the first PCB section 220 and the rear cover or rear wall 22 while the second PCB section 222 is interposed between the base portion 302 and the rear cover 22. However, the invention is not limited thereto. In other embodiments, the base portion is interposed between the second PCB section and the rear cover while the first PCB section is interposed between the head portion and the rear cover.

Material of rear cover

[0105] In embodiments, referring to Figures 2 and 10, the smartphone 10 includes a rear cover 22. The rear cover can be made of non-metal material, for example, a plastic resin. Generally, non-metal rear covers do not interfere with wireless communications between antennas inside the smartphone and devices outside the smartphone. In other embodiments, the rear cover can be made of a metal which is electrically conductive and non-magnetic. For example, copper or aluminum may be used for the rear cover. Generally, metal rear covers can interfere with

wireless communications between antennas inside the smartphone and devices outside the smartphone.

Metal rear cover of smartphone

[0106] In embodiments, referring to Figures 2 and 10, when the rear cover 22 is made of a metallic material, a smartphone 10 has a non-metal strip portion 28 in the rear cover and the antenna module is located with respect to the non-metal strip portion 28 to reduce or minimized interference caused by the metallic rear cover.

Locational relationship between magnetic sheet and non-metal portion of rear cover

[0107] In embodiments, referring to Figure 10, the magnetic sheet 300 has a lower end and the antenna module is located in the smartphone such that the lower end of the magnetic sheet 300 is sufficiently close to the non-magnetic strip portion 28. This configuration allows the electromagnetic signals generated from the first coil antenna 204 or the second coil antenna 206 to be transmitted through the non-magnetic strip portion 28. In other embodiments, as shown in Figures 11-14, the antenna module is attached to the rear cover such that the magnetic sheet 300 partially or completely overlaps or covers the non-magnetic strip portion 28.

Other embodiments of magnetic sheet

[0108] In embodiments, the head portion has a width greater than that of the through hole. In this configuration, the head portion is bent when passing through the through hole. The magnetic sheet further includes a neck portion between the base portion and the head portion. The neck portion has a width smaller than that of the through hole.

Two or more magnetic sheet pieces

[0109] In embodiments, instead of the magnetic sheet 300 discussed in the above, two or more magnetic sheet pieces can be used. In embodiments, referring to Figure 15, the two or more magnetic sheet pieces include a first magnetic sheet piece 304' and a second magnetic sheet piece 302'. In one embodiment, the first magnetic sheet piece 304' can have substantially the same size and shape as the head portion 304 of the magnetic sheet 300 shown in the drawings. Further, the second magnetic sheet piece 302' can have substantially the same the same size and shape as the base portion 302 of the magnetic sheet 300 shown in the drawings. As shown in Figure 15, the

first magnetic sheet piece 304' and the second magnetic sheet piece 302' are slightly spaced from each other and have an air gap therebetween.

Gap between two magnetic sheet pieces

[0110] As shown in Figure 15, in embodiments, the first magnetic sheet piece 304' includes a first edge and the second magnetic sheet piece 302' includes a second edge which is opposing the first edge. The first and second magnetic sheet pieces 304' and 302' are slightly spaced from each other to form a gap. The size of the gap (distance between the first edge and the second edge) can be at or about 0.05 mm, 0.1 mm, 0.15 mm, 0.2 mm, 0.25 mm, 0.3 mm, 0.35 mm, 0.4 mm, 0.45 mm, 0.5 mm, 0.6 mm, 0.7 mm, 0.8 mm, 0.9 mm, 1 mm, 2 mm, 3 mm or 4 mm. In embodiments, the size of air gap may be within a range formed by selecting any two numbers listed in the immediately previous sentence, e.g., between about 0.05 mm and about 0.5 mm or between about 0.3 mm and about 1 mm. However, the invention is not limited thereto. In another embodiment the first edge contacts the second edge. In other embodiments, the first magnetic sheet piece 304' and the second magnetic sheet piece 302' can slightly overlap each other in the through hole of the flexible PCB.

Material of first and second magnetic sheet pieces

[0111] In embodiments, the first and second magnetic sheet pieces 304' and 302' together provide path for magnetic flux. Thus, like the magnetic sheet 300, the first and second magnetic sheet pieces 304' and 302' are made of soft magnetic material. Both the first and second magnetic sheet pieces are made of the same magnetic material. In other embodiments, the first magnetic sheet piece is made of a material different from that of the second magnetic sheet piece. For example, the first magnetic sheet piece is made of a ferrite magnetic sheet and the second magnetic sheet piece is made of a laminate of nanocrystal magnetic layers, or vice versa.

Two or more stacked magnetic sheets

[0112] In embodiments, rather than using a single magnetic sheet 300 as shown in Figure 7, two or more overlapping magnetic sheets can be used. In one embodiment, as shown in Figure 16, the two or more overlapping magnetic sheets include a first magnetic sheet 3001 and a second magnetic sheet 3003. The first magnetic sheet 3001 is made of a material different from that of the second magnetic sheet 3003. For example, the first magnetic sheet 3001 is made of the

ferrite magnetic sheet discussed above and the second magnetic sheet 3003 is made of a nanocrystal magnetic sheet laminate discussed above. In some embodiments, more than two of the ferrite magnetic sheets and more than two of the nanocrystal magnetic sheet laminates are alternatingly stacked. The two or more overlapping magnetic sheets can be bonded to each other to form a single body. In other embodiments, the two or more magnetic sheets are not bonded until the flexible PCB and the magnetic sheets are made into a single body of the flexible antenna module as discussed below.

Operation of plural magnetic sheets

[0113] The ferrite magnetic sheet and the nanocrystal magnetic sheet laminate may have different magnetic properties or characteristics. Generally, the nanocrystal magnetic sheet laminate has permeability greater than that of the ferrite magnetic sheet. For this reason, the ferrite magnetic sheet shows performance higher than the nanocrystal magnetic sheet laminate when working with an NFC antenna which works at a frequency greater than that of an MST antenna. On the other hand, the nanocrystal magnetic sheet laminate shows performance higher than the ferrite magnetic sheet when working with an MST antenna. Thus, the overlapping structure of different magnetic sheets works effectively when the first coil antenna and the second coil antenna work for different antenna functions, for example, an MST antenna and an NFC antenna as discussed below.

Locational relationship between coil portions and magnetic sheets

[0114] In embodiments, referring to Figures 6 and 22, when the first coil 204 is used for an MST antenna and the second coil 206 is used for an NFC antenna, both a ferrite magnetic sheet 3001 and a nanocrystal magnetic sheet laminate 3003 that are stacked can be used. In one embodiment, the ferrite magnetic sheet and the nanocrystal magnetic sheet have the same shape and the same size such that they completely overlap each other, and the magnetic sheet assembly works as a single magnetic sheet shown in Figure 7. In other embodiments, referring to Figures 16 and 17, the ferrite magnetic sheet is longer than the nanocrystal magnetic sheet laminate in the magnetic sheet assembly. When assembled with the flexible PCB, the ferrite magnetic sheet 3001 overlaps coil portions of the second coil antenna 206 which are located in the first PCB section 220 whereas the nanocrystal magnetic sheet laminate 3003 does not overlap the coil portions of

the second coil antenna 206 which are located in the first PCB section 220, when viewed in the viewing direction. However, the invention is not limited thereto. In embodiments, when the first coil 204 is used for an NFC antenna and the second coil 206 is used for an MST antenna, the ferrite magnetic sheet is shorter than the nanocrystal magnetic sheet laminate such that the ferrite magnetic sheet does not overlap coil portions of the second coil antenna 206 which are located in the first PCB section 220 whereas the nanocrystal magnetic sheet laminate overlaps the coil portions of the second coil antenna 206 which are located in the first PCB section 220 when viewed in the viewing direction.

Modification of embodiments shown in Figures 3-17

[0115] The embodiments discussed above can be modified in various ways. In modified embodiments, the first coil antenna includes two or more coils electrically connected to each other in series or in parallel in the flexible PCB. In one modified embodiment, the two or more coils of the first coil can be arranged side by side. In another modified embodiment, the two or more coils are arranged to overlap each other when viewed in the viewing direction. Likewise, the second coil antenna may include two or more coils electrically connected to each other in series or parallel in the flexible PCB.

Further modification of embodiments shown in Figures 3-17

[0116] In one modified example, a smartphone antenna module includes a magnetic sheet and a flexible PCB. The magnetic sheet includes a first sheet portion, a second sheet portion and an intermediate portion located between and connecting the first and second sheet portions. The flexible PCB includes a first coil, a second coil and a third coil. When viewed in the viewing direction, the first and third coils are arranged side by side and the second coil surrounds both the first and third coils. The flexible PCB has a first core area that the first coil surrounds when viewed in the viewing direction and a second core area that the third coil surrounds when viewed in the viewing direction. A through hole is formed in the first core area through the flexible PCB. The flexible PCB includes a first PCB section, a second PCB section and a third PCB section. The second PCB section is interposed between the first and third PCB sections. The first and second PCB sections are located opposite to each other across the first core area, and the second and third PCB sections are located opposite to each other across the second core area. No electrical

connection is formed between the first coil and the second coil within the flexible PCB and no electrical connection is formed between the second coil and the third coil in the flexible PCB. The flexible PCB and the magnetic sheet are integrated in a single, flexible body, in which the flexible PCB and the magnetic sheet are arranged relative to each other such that: the first sheet portion is placed over the first PCB section and overlaps a first coil portion of the first coil formed in the first PCB section; the second sheet portion is placed under the second PCB section, overlaps a second coil portion of the first coil formed in the second PCB section and further overlaps a first coil portion of the third coil formed in the second PCB section, and at least part of the intermediate portion passes through the first through hole. Further, the second sheet portion is placed under the third PCB section and overlaps a second coil portion of the third coil formed in the third PCB section. The first and third coils may be connected in the antenna module either in series or parallel. The current in the first coil and the current in the third coil flow either in the same rotational direction or in the opposite rotational directions.

Other embodiments of flexible PCB

[0117] In embodiments discussed above, the antenna module includes two coils in which one coil surrounds the other. The invention is not limited thereto. In some embodiments, the antenna module includes three or more coils. In one embodiment, two coils among the three or more coils are arranged side by side. In another embodiment, one of the three or more coils surrounds another coil that surrounds one or more coils.

Electrical connection between multiple coils

[0118] In embodiments, each coil is electrically decoupled or disconnected from other coils in the same antenna module, and each coil is used for a specific antenna function different from the antenna functions of the other coils. For example, a first one of the multiple coils is used as an MST antenna, a second one of the multiple coils is used as an NFC antenna and a third one of the multiple coils is used as a wireless power charging antenna. In another embodiment, two coils among the multiple are electrically connected in the same antenna module. For example, to form a serially connected coil antenna as shown in Figure 18A the two coils may be connected in series. To form a connected-in-parallel coil antenna as shown in Figure 18B the two coils may be connected in parallel. In embodiments, the two coils connected to each other can be used as a

single antenna. For example, in an antenna module that includes coil A, coil B and coil C, coil A and coil C are connected to each other and can be used as an MST antenna while coil B is decoupled from coil A and coil C and can be used as an NFC antenna. Details of configurations and functions of multiple coils in a single antenna module are further discussed below.

Coil A, coil B and coil C in the same flexible PCB

[0119] In embodiments, referring to Figures 19-21, an antenna module 1100 includes a flexible PCB 1200 and a magnetic sheet 1300. The antenna module 1100 further includes coil 1204 (coil A), coil 1206 (coil B) and coil 1208 (coil C) in the flexible PCB 1200. Coil A 1204 and coil C 1208 are arranged side by side while coil B 1206 surrounds or encircles both coil A and coil C. The flexible PCB 1200 includes an upper edge and a lower edge. The flexible PCB includes an upper through-hole 1202 that coil A 1204 surrounds and a lower through-hole 1203 that coil C 1208 surrounds or encircles. The upper hole is located between the upper edge and the lower hole, while the lower hole is located between the upper hole and the lower edge. The flexible PCB 1200 includes an upper PCB section 1220 located between an upper edge 1232 and the upper hole 1202, a lower PCB section 1222 located between the lower edge 1232 and the lower hole 1203 and an intermediate PCB section 1224 located between the upper and lower holes. Referring to Figures 19-21, in embodiments, the upper PCB section 1220, the first hole 1202, the intermediate PCB section 1224, the second hole 1203, and the lower PCB section 1222 are consecutively arranged along an axis 1102 such that the axis 1102 passes the upper PCB section 1220, the first hole 1202, the intermediate PCB section 1224, the second hole 1203, and the lower PCB section 1222.

Coiling direction of coil A and coil C

[0120] In one embodiment, as shown in Figure 20, the conductive line of coil A 1204 is coiled in a first coiling direction, for example, clockwise direction as shown in Figure 20. The conductive line of coil B 1206 is coiled in a second coiling direction that is opposite to the first coiling direction. The conductive line of coil C 1208 is coiled in the first coiling direction. However, the invention is not limited thereto. In another embodiment, coil B may be coiled in the first coiling direction. Coil A may be coiled in the second coiling direction. In this disclosure, the coiling direction is determined as a rotational direction when the conductive line is coiled from its inner terminal to its outer terminal.

Number of turns of each coil

[0121] In embodiments, coil A 1204 includes one or more turns coiled to encircle or turn around the upper hole 1202 and coil C 1208 includes one or more turns coiled to encircle or turn around the lower hole 1203. Coil B 2206 includes one or more turns coiled to encircle or turn around the upper hole 1202, coil A 1204, the lower hole 1203 and coil C 1208. In embodiments, the number of turns of coil A 1204 may be the same as that of coil A 204 shown in Figure 6. In embodiments, the number of turns of coil B 1206 may be the same as that of coil B 206 shown in Figure 6. Further, the number of turns of coil C 1208 may be the same as that of coil A 1204. However, the invention is not limited thereto. The number of turns of each coil may be modified or adjusted to provide an antenna length required for a specific antenna function.

Assembled with magnetic sheet

[0122] In embodiments, referring to Figures 19 and 21, a magnetic sheet 1300 includes a base portion 1302, a head portion 1304 and a neck portion 1306 connecting the base portion 1302 and head portion 1304. When assembled with the flexible PCB 1200, the head portion 1304 overlaps the upper PCB section 1220, the base portion 1302 overlaps the lower PCB section 1222 and the neck portion 1306 overlaps the intermediate PCB section 1224. Referring to Figures 19-21, when assembling the magnetic sheet 1300 with the flexible PCB 1200, in one embodiment, the neck portion 1306 and the head portion 1304 go through the lower hole 1203, and then the head portion 1304 further goes through the upper hole 1202. Thus, when assembled, the head portion 1304 and the base portion 1302 are placed on a side of a major surface 1250 of the flexible PCB 1200 while the neck portion 1306 is placed on a side of a major surface 1252 of the flexible PCB that faces away from the first surface 1250.

Locational relationship of magnetic sheet and coil A and coil C

[0123] In the assembled configuration, in embodiments, the conductive line portions of coil A 1204 that are in the upper PCB section 1220 overlap the head portion 1304 when viewed in the viewing direction. The conductive line portions of coil C 1208 that are in the lower PCB section 1222 overlap the base portion 1302 when viewed in the viewing direction. The conductive line portions of coil A 1204 that are in the intermediate PCB section 1224 overlap the neck portion 1306 when viewed in the viewing direction. The conductive line portions of coil C 1208 that are

in the intermediate PCB section 1224 also overlap the neck portion 1306 when viewed in the viewing direction. In the illustrated embodiments, coil B 1206 does not include a conductive line portion that overlaps the head portion 1220 while coil B 1206 includes conductive line portions that are in the lower PCB section 1222 and overlap the base portion 1302 when viewed in the viewing direction. When the antenna module 1100 is assembled in a smartphone 10 as shown in Figure 21, the antenna module 1100 is arranged such that the first surface 1250 of the flexible PCB 1200 faces a rear cover 22 of the smartphone. Thus, the head portion 1304 is located between the rear cover 22 and the upper PCB section 1220 and the base portion 1302 is located between the rear cover 22 and the lower PCB section 1222. Since the neck portion 1306 is located over the second surface 1252, the intermediate PCB section 1224 includes a portion located between the rear cover 22 and the neck portion 1306. However, the invention is not limited thereto. When the antenna module 1100 is arranged such that the second surface 1252 of the flexible PCB 1200 faces the rear cover 22 of the smartphone, the neck portion may be located between the intermediate PCB section 1224 and the rear cover 22.

Size and shape of magnetic sheet

[0124] In the embodiments in Figures 19 and 21, the head portion 1304, the neck portion 1306 and the base portion 1302 have substantially the same width. However, the invention is not limited thereto. In another embodiment, the head portion has a width (measured in horizontal direction) the same as that of the neck portion, but smaller than that of the base portion. In another embodiment, each of the base, neck and head portions has a width different from those of the others.

Series connection and current direction

[0125] In embodiments shown in Figure 20, coil A 1204 and coil C 1208 are electrically connected to each other. For example, the outer terminals of coil A 1204 and coil C 1208 are connected while the inner terminal of each of coil A 1204 and coil C 1208 is connected to one of terminal pads 1262 and 1264 in a connector portion 1210 of the flexible PCB 1200. This connection configuration provides a series circuit of coil A and coil C as shown in Figure 18A. When the conductive lines of coil A and coil C are coiled in the same coiling direction as shown in Figure 20 and coil A and coil C are further connected in series as illustrated in Figure 18A, the

current signal of coil A 1204 flows in a first rotational current direction while the current signal of coil C 1208 flows in a second rotational current direction that is opposite to the first rotational current direction. For example, as indicated in Figure 20 using arrowheads, the current of coil A 1204 flows in the clockwise direction while the current of coil C 1208 flows in the counterclockwise direction when viewed in the viewing direction. In this current flow configuration, in conductive line portions of coil A 1204 and coil C 1208 which overlap the neck portion 1306 of the magnetic sheet, the current flows in the same linear direction as shown in Figure 20.

Magnetic flux in magnetic sheet

[0126] The current flow as discussed above and shown in Figure 20 would generate magnetic flux that extends from the head portion 1304 to the base portion 1302 via the neck portion 1306 of the magnetic sheet 1300 as indicated as arrows. Further, the density of the magnetic flux generated in the magnetic sheet would be sufficient such that the smartphone wirelessly communicates with an outside device via an antenna having coil A and coil C. If the current of coil A and coil C flows in the same rotational direction, the current flow of conductive line portions of coil A that overlap the neck portion would be in a linear direction opposite to another linear direction of current flow of the conductive line portions of coil C that overlap the neck portion, and then, the magnetic flux generated in the head and base portions would extend out of the neck portion toward air.

Other embodiments of coiling direction and current direction

[0127] In alternative embodiments, the coiling direction of coil A is different from that of coil C. In this embodiment, the outer terminal of coil A is connected to the inner terminal of coil C. The inner terminal of coil A and the outer terminal of coil C are connected to terminal pads of the connector portion, respectively. This connection configuration can ensure that the current of coil A flows in a rotational current direction opposite to that of coil C.

Coil A and coil C for MST antenna and coil B for NFC antenna

[0128] In embodiments illustrated in Figures 19-21, coil A 1204 and coil C 1208 form a single coil antenna functioning as an MST antenna while coil B 1206 functions as an NFC

antenna. In one embodiment, the magnetic sheet may include both a nanocrystal magnetic sheet laminate and a ferrite magnetic sheet.

Additional coil in different layer of flexible PCB

[0129] In embodiments, the flexible PCB may include two or more layers, each of which includes at least one coil. For example, referring to Figures 19, 22 and 23, the antenna module 1100 includes a flexible PCB 1200' which includes a bottom layer 1270, a top layer 1272 over the bottom layer 1270 and an insulation layer interposed therebetween. In embodiments, the top layer 1272 is placed over the bottom layer 1270 such that the upper holes 1202 of the upper and lower layers are aligned and the lower holes 1204 of the upper and lower layers are aligned. The bottom layer 1270 includes coil 1204 (coil A), coil 1206 (coil B) and coil 1208 (coil C), and the top layer 1272 includes coil 1210 (coil D). In embodiments, the coiling direction and the current flow direction of coil A, coil B and coil C illustrated in Figure 22 are the same as those in the embodiments illustrated in Figure 20. Further, as shown in Figure 25, the locational relationship between the magnetic sheet 1300 and each of coil A 1204, coil B 1206 and coil C 1208 is the same as the locational relationship illustrated in Figure 21. In the discussion of embodiments, the terms "top" and "bottom" do not refer to their absolute location. In some circumstances, for example, an item labeled with term "top" may be located lower or under an item labeled with the term "bottom."

Coil D of top layer

[0130] As shown in Figure 22, the top layer 1272 includes coil D 1210 surrounding the upper hole 1202. As shown in Figure 22, coil D 1210 is coiled in the second coiling direction, for example, counterclockwise direction, which is opposite to the coiling direction of coil A and coil B. The outer terminal of coil D 1210 is connected to one of the terminal pads of the connector portion 1210. The inner terminal of coil D 1210 is connected to the inner terminal of coil A 1204. As shown in Figure 22, the top layer 1272 further includes a plurality of conductive line segments 1280 and 1282. Two end terminals of each conductive line segment 1280 are connected to coil C 1208 to form a parallel connection between coil C 1208 and each of the conductive line segment 1280 as shown in Figure 23A. Two end terminals of each conductive line segment 1282 are connected to coil B 1206 to form a parallel connection between coil B 1206 and each of the conductive line segment 1282 as shown in Figure 23B. The connection of conductive line segments

can reduce resistance in coil B 1206 and coil C 1208. Figure 24 shows an example of a conductive line pattern design of the top layer 1272' and bottom layer 1270' to form coil A, coil B, coil C and coil D and conductive line segments.

Locational relationship between coil D and magnetic sheet

[0131] In embodiments, referring to Figure 25, when the magnetic sheet 1300 is assembled with the flexible PCB 1200', the conductive line portions of coil D 1210 that are in the upper PCB section 1220 overlap the head portion 1304 when viewed in the viewing direction. The conductive line portions of coil D 1210 that are in the intermediate PCB section 1224 overlap the neck portion 1306 when viewed in the viewing direction. The relationship between the magnetic sheet 1300 and each of coil A, coil B and coil C 1204, 1206 and 1208 is the same as that of the embodiments illustrated in Figures 20 and 21.

Series connection and current direction

[0132] In embodiments shown in Figure 22, coil A 1204, coil C 1208 and coil D 1210 are electrically connected to each other in series. The inner terminal of coil A 1204 is connected to the inner terminal of coil D 1210 through a via. The current flows from a terminal pad to another terminal pad of the connector portion 1210 via coil D 1210, coil A 1204 and coil C 1208 in turn. In one embodiment, the current of coil A 1204 and coil D 1210 flows in a first rotational current direction, while the current of coil C 1208 flows in a second rotational current direction that is opposite to the first rotational current direction. For example, as indicated in Figure 22 using arrowheads, the current signal of coil A and coil D flows in the clockwise direction while the current signal of coil C 1208 flows in the counterclockwise direction. This current flow configuration shown in Figure 22 would cause the magnetic flux direction the same as that caused by the current flow configuration shown in Figure 20; however, its density would be greater than the density in the antenna module shown in Figure 21. In embodiments, when coil A, coil C and coil D form an antenna functioning as an MST antenna, since coil D 1210 is formed in the top layer, the antenna module can provide the antenna length for the MST antenna while having a reduced or compact size.

Other embodiments shown in Figures 26-28

[0133] In the embodiments discussed above, coil B surrounds coil C, but the invention is not limited thereto. In some embodiments illustrated in Figures 26-28, an antenna module includes coil 1204 (coil A), coil 1206'' (coil B) and coil 1208 (coil C), and coil B 1206'' and coil C 1208 are arranged side by side while coil B 1206'' surrounds coil A 1204. Referring to Figures 26-28, between coil A and coil C 1204 and 1208, the conductive line portions of coil B 1206'' extend, while coil A and coil C are connected to each other via a connector line formed in another layer which is different from a layer in which coil A, coil B and coil C are formed. In embodiments, the coiling direction and the current direction of coil A, coil B and coil C shown in Figure 25 are the same as those shown in Figure 20.

Locational relationship of coils and magnetic sheet shown in Figures 26-28

[0134] In embodiments, referring to Figures 27 and 28, coil B 1206'' includes the conductive line portions that are in the upper PCB section 1220 and overlap the head portion 1304''. Further, coil B 1206'' includes conductive line portions that are in the intermediate PCB section 1224 and overlap the neck portion. The locational relationship of the magnetic sheet and coil A and coil C are the same as that of the embodiments illustrated in Figures 19-21. In the embodiments illustrated in Figures 26 and 28, the head portion 1304'' of the magnetic sheet 1300'' is located close to or adjacent the conductive line portions of coil B 1206'' that are in the upper PCB section 1220. This configuration would be advantageous to generate magnetic flux with a higher density in the magnetic sheet by current applied to coil B 1206'' than when the magnetic sheet is distant from conductive line portions of coil B that are in the upper PCB section 1220. In the embodiments shown in Figures 26-28, the conductive line portions of coil B 1206'' in the upper PCB section 1220 are over a first surface 1350 of the magnetic sheet while the conductive line portions of coil B 1206'' in the intermediate PCB section 1224 are over a second surface 1352 of the magnetic sheet 1300''. This configuration would ensure that the magnetic flux generated in the magnetic sheet 1300 by current of coil B 1206'' extends from the head portion toward the base portion via the neck portion.

Embodiments shown in Figures 26, 29 and 30

[0135] In embodiments, referring to Figures 26, 29 and 30, an antenna module includes coil 1204 (coil A), coil 1206''' (coil B), coil 1208 (coil C) and coil 1212 (coil E). Coil A and coil C 1204 and 1212 are arranged side by side as like embodiments shown in Figures 20, 22 and 27. In the embodiments illustrated in Figure 29, however, coil B 1206''' surrounds coil A 1202, but does not surround coil C 1208. Coil E 1212 surrounds coil C 1208. Coil B 1206''' and coil E 1212 are arranged side by side. In the embodiments illustrated in Figure 29, the electrical connection, coiling direction and current direction of coil A and coil C 1204 and 1208 are the same as those in embodiments illustrated in Figure 27. Coil B 1206''' and coil E 1212 are electrically connected to each other in series as shown in Figure 18A. The conductive lines of coil B and coil E are coiled in the same coiling direction, for example, the counterclockwise direction. Further, the inner terminals of coil B and coil E are connected to each other via a connector line formed in a layer different from another layer in which coil B and coil E are formed. In this connection configuration, the current of coil B 1206''' flows in a rotational current direction opposite that of the current flow of coil E 1212. Thus, in conductive line portions of coil B and coil E which overlap the neck portion 1306 of the magnetic sheet 1300''' when viewed in the viewing direction, the current flows in the same linear direction as shown in Figure 29.

Locational relationship of coils and magnetic sheet shown in Figures 29 and 30

[0136] In embodiments, referring to Figures 26, 29 and 30, coil B 1206''' includes the conductive line portions that are in the upper PCB section 1220''' and overlap the head portion 1304''', and further includes conductive line portions that are in the intermediate PCB section 1224 and overlap the neck portion 1306. Similarly, coil E 1212 includes the conductive line portions that are in the intermediate PCB section 1224 and overlap the neck portion 1306, and further includes conductive line portions that are in the lower PCB section 1222 and overlap the base portion 1302. The locational relationship of the magnetic sheet 1300''' and coil A and coil C are the same as that of the embodiments illustrated in Figures 21, 25 and 28. In the embodiments illustrated in Figures 29 and 30, when the current of coil B 1206''' flows in the clockwise direction the magnetic flux in the magnetic sheet extends from the head portion to the neck portion. Further, since the current of coil E 1212 flows in the counterclockwise direction, the magnetic flux in the magnetic sheet 1300''' extends from the neck portion 1306 to base portion 1302. As a result, the

above current flow configuration would ensure that the magnetic flux generated in the magnetic sheet by current of coil B and the magnetic flux generated in the magnetic sheet by current of coil E extend in the same directions, for example, from the head portion to base portion via the neck portion. Also, the head portion 1304''' of the magnetic sheet is located close to or adjacent the conductive line portions of coil B that are in the upper PCB section.

Usage of coil A, coil B, coil C and coil E shown in Figures 29 and 30

[0137] Similarly to embodiments discussed above, coil A and coil C 1204 and 1208 of the flexible PCB 1200''' can be used as an MST antenna. In the embodiments shown in Figures 29 and 30, coil B 1206''' and coil E 1212 can be used as an NFC antenna. In the embodiments, discussed above, coil A and coil C 1204 and 1208 are connected to each other in series, and coil B 1206''' and coil E 1212 are connected to each other in series. However, the invention is not limited thereto. For example, to provide a proper length of antennas, the connections may be modified to parallel connections. Further, the number of turns of each coil may be modified or adjusted. In other embodiments, coil A and coil C may be used as an NFC antenna and coil B and coil E may be used as an MST antenna.

Modification to embodiments shown in Figures 29 and 30

[0138] Embodiments shown in Figures 29 and 30 may be modified. In the modified embodiments, the antenna module further includes coil D and coil F formed in a bottom layer of the flexible PCB whereas coil A, coil B, coil C and coil E are formed in a top layer which is disposed over the bottom layer. The structure of coil D and its connection with coil A and coil C are the same as those in the embodiments illustrated in Figures 22-25. Coil F is formed over coil B and coiled in a coiling direction opposite to the coiling direction of coil B when viewed in the viewing direction. Coil B, coil E and coil F are connected in series, and the current of coil B and coil F flows in the same rotational direction when viewed in the viewing direction. This addition of coil D and coil F would be able to increase the density of magnetic flux generated in the magnetic sheet and further increase the strength of antenna signals. But, the invention is not limited to the above embodiments. For example, coil A and coil C may be connected to each other in parallel as shown in Figure 18B. Coil A and coil D may be connected to each other in parallel.

Similarly, coil B and coil E may be connected to each other in parallel. Coil B and coil F may be connected to each other in parallel.

Decoupled multiple coils

[0139] In the embodiments discussed above, two or more coils are connected to each other in the antenna module either in series or parallel. However, the invention is not limited thereto. In alternative embodiments, the coils are decoupled from one another, and each coil functions as an antenna different from antennas that the other coils function as when assembled in a smartphone and connected to circuits in the smartphone. Each coil can be used as one of an MST antenna, an NFC antenna and other antenna that uses a coil antenna, such as wireless charging antenna.

Coil antenna for wireless power charging antenna

[0140] In embodiments, one of coils may be connected to a wireless power charging circuit in the smartphone such that the coil functions as a wireless power charging antenna or wireless power charging inductor. In embodiments, the wireless power charging circuit and the coil antenna may form a wireless power charging system according to the standard under Wireless Power Consortium (WPC). In other embodiments, the wireless power charging circuit and the coil antenna may form a wireless power charging system according to the standard under Power Matters Alliance (PMA).

Modification of embodiments shown in Figures 19-30

[0141] The embodiments discussed above can be modified various ways. In the embodiments shown in Figures 19-30, the head portion of the magnetic sheet is placed over the upper PCB section of the flexible PCB, the neck portion is placed under the intermediate PCB section, and the base portion is placed over the lower PCB section. In the modified example, the base portion may be placed over the lower PCB section, while the head portion is placed over the upper PCB section and the neck portion is placed under the intermediate PCB section. In this modified example, the lower hole is not provided at the second core area that coil C surrounds while the upper hole is provided at the first core area that coil A surrounds when viewed in the viewing direction.

Separate coil outside flexible PCB

[0142] In the embodiments discussed above, the coils are formed in one flexible PCB. However, the invention is not limited thereto. An antenna module may include one or more coils that are not part of the flexible PCB. The one or more coils comprise coil G that is not part of the flexible PCB and placed over the magnetic sheet. In one embodiment, the portion of coil G when viewed in the viewing direction. Coil G may be placed partially or entirely over the magnetic sheet and may include at least a portion that is interposed between the magnetic sheet and the rear cover of the smartphone when assembled in the smartphone. In the other embodiment, coil G is placed to overlap both the flexible PCB and the magnetic sheet. Further, in one embodiment, coil G may be a winding antenna as shown in Figures 32-34. Coil G may be disposed in a side-by-side relationship with the coils in the flexible PCB, and the flexible PCB may further include, for example, a bridge portion as shown in Figures 32-34 for providing an electrical connection between coil G and a connector portion of the flexible PCB.

Two flexible PCBs

[0143] In embodiments, the antenna module includes a first flexible PCB and a second flexible PCB. The first flexible PCB includes multiple coils, for example, coil A and coil B as in embodiments discussed above, and the second flexible PCB includes a further coil (coil G). When making the antenna module, in embodiments, the first flexible PCB and the magnetic sheet are assembled as in the embodiments discussed above, and the second flexible PCB is placed over or engaged with the magnetic sheet, and then, the first and second flexible PCBs and the magnetic sheet are integrated into a single body of the antenna module.

Locational relationship between second flexible PCB and first flexible PCB

[0144] In embodiments, the second flexible PCB includes a central portion that coil G surrounds. The second flexible PCB 5250 may have a hole at the central portion as shown in Figure 31. In one embodiment, the second flexible PCB 5250 is placed over the first flexible PCB 5200 such that substantially the entire portion of the second flexible PCB 5250 overlaps the first flexible PCB 5200. In the embodiment shown in Figure 31, the magnetic sheet 5300 passes through the holes of the first and second flexible PCBs. In another embodiment, as illustrated using dotted lines in Figure 31, the second flexible PCB 5250' is placed over the first flexible PCB and its hole

overlaps another hole of the first flexible PCB 5200. In the other embodiments, as illustrated using dotted lines in Figure 31, the second flexible PCB 5250'' is placed over the magnetic sheet and does not overlap the first flexible PCB 5200 when viewed in the viewing direction. However, the invention is not limited thereto. In alternative embodiments, the second flexible PCB is placed over the magnetic sheet to partially overlap the first flexible PCB when viewed in the viewing direction. In the embodiments shown in Figure 31, the second flexible PCB 5250'' is located under the base portion of the magnetic sheet. However, the invention is not limited thereto. In one embodiment, the second flexible PCB 5250'' may be located over the base portion of the magnetic sheet. In another embodiment, the base portion of the magnetic sheet passes through the hole of the second flexible PCB 5250''.

Connection between first and second flexible PCB

[0145] In embodiments, referring to Figure 31, the first flexible PCB 5200 includes a connector portion 5210 and the second flexible PCB 5250'' includes a bridge portion 5260. The connector portion 5210 extends from a body portion of the first flexible PCB. The connector portion includes a plurality of terminal pads formed at an end portion of the connector portion 5210. In embodiments, the connector portion includes three or more pairs of the terminal pads. A first pair of terminal pads among the plurality of terminal pads are connected to the inner and outer terminals of coil A of the first flexible PCB via connector lines. A second pair of terminal pads among the plurality of terminal pads are connected to the inner and outer terminals of coil B of the first flexible PCB via connector lines. The bridge portion is located at a location close to or overlapping the first flexible PCB. The bridge portion includes two terminal pads which are connected to the inner and the outer terminal of coil G of the second flexible PCB. A third pair of terminal pads in the connector portion 5210 is connected to the terminal pads contacting the terminal pads of the bridge portion via connector lines formed in the first flexible PCB. When the second flexible PCB is placed over the assembly of the first flexible PCB and the magnetic sheet, in one embodiment, each terminal pad of the first flexible PCB contacts and bonded to the corresponding terminal pad of the bridge portion of the second flexible PCB for allowing electrical connection therebetween. They are bonded to each other by welding or soldering. The contact and electrical connection between the terminal pads of the first flexible PCB and the terminal pads of the bridge portion can be maintained after the first and second flexible PCBs and the magnetic

sheet are integrated into a single body. In another embodiment, the bridge portion is formed in the first flexible PCB rather than the second flexible PCB. In embodiments, when assembled in the smartphone, the terminal pads of the connector portion 5210 are connected to counterpart connection terminals of the smartphone circuit for electrically connecting coil A, coil B and coil G to the smartphone circuit.

Usage of coils in first and second flexible PCBs

[0146] In the embodiments discussed above, coil A, coil B and coil G are used as an MST antenna, an NFC antenna and a wireless power charging antenna, respectively. However, the invention is not limited thereto. In embodiments, when the antenna module is assembled in a smartphone, each of coil A, coil B and coil C is used as either one of the MST antenna, the NFC antenna and the wireless power charging antenna. In one example, coil B antenna functions as an MST antenna, coil G antenna functions as an NFC antenna and coil A functions as a wireless charging transformer. In another example, when the antenna module is assembled in a smartphone, coil G antenna functions as an MST antenna, coil A functions as an NFC antenna and coil B antenna functions as a wireless power charging transformer. When coil G antenna is used as a wireless charging antenna, in embodiments, coil G is placed over the magnetic sheet and the magnetic sheet does not pass through a hole that coil G surrounds.

Coil U, coil W and coil V in the same flexible PCB

[0147] In embodiments, referring to Figures 35-39, an antenna module 2100 includes a flexible PCB 2200 and a magnetic sheet 2300. The antenna module 2100 further includes coil 2204 (coil U), coil 2206 (coil W) and coil 2208 (coil V) in the flexible PCB 2200. The flexible PCB 2200 includes a through-hole 2202. The through-hole 2202 is located between the upper edge 22002 and the lower edge 22004. The flexible PCB 2200 includes an upper PCB section 2220 located between an upper edge 2230 and the through-hole 2202, and a lower PCB section 2222 located between the lower edge 2232 and the through-hole 2202. Referring to Figures 35-39, in embodiments, the upper PCB section 2220, the through-hole 2202, and the lower PCB section 2222 are arranged along an axis 2102 such that the axis 2102 passes the upper PCB section 2220, the through-hole 2202, and the lower PCB section 2222 in order.

Coil U

[0148] In embodiments, coil U 2204 is formed of a printed electrically conductive wire and coiled to surround or turn around the through-hole 2202. Coil U 2204 may have one or more turns that completely turn around the through-hole 2202. Referring to Figure 37, coil U 2204 includes four turns; however, the invention is not limited thereto. In another embodiment, coil U may have 1, 2, 3, 5, 6, 7, 8 and 9 turns. In embodiments, coil U 2204 may have the same configuration as those of coils 204 and 1204 shown in Figures 6 and 26. In one embodiment, the coiled conductive wire of coil U 2204 may be printed in a single layer of the flexible PCB. In other embodiments, the coiled conductive wire of coil U 2204 may include wire portions printed in multiple layers of the flexible PCB and vias connecting the wire portions printed in multiple layers.

Coil V

[0149] Referring to the embodiment of Figure 37, coil U 2204 and coil V 2208 are located by side by side. In one embodiment, coil V 2208 is located in the lower PCB section 2222 and does not extend beyond the lower PCB section 2222. In the illustrated embodiments, coil V does not include a portion overlapping coil U 2204. Coil V 2208 is formed of a printed electrically conductive wire. As shown in Figure 37, coil V 2208 is coiled in a circular-spiral shape. Coil V 2208 has one or more turns. In one embodiment, the coiled conductive wire of coil V 2208 may be printed in a single layer of the flexible PCB. In other embodiments, the coiled conductive wire of coil V 2208 may include wire portions printed in multiple layers of the flexible PCB and vias connecting the wire portions printed in multiple layers.

Coil W

[0150] In embodiments, coil W 2206 is formed of a printed electrically conductive wire. Referring to Figure 37, two outer turns 22064 of coil W 2206 extend along the periphery of the flexible PCB 2200. An inner turn 22068 of coil W 2206 includes a line segment 22060 that crosses coil V as shown in Figure 37. In one embodiment, the line segment 22060 passes through the center of coil V 2208 and extends generally perpendicular to the axis 2102. The line segment 22060 is insulated from coil V 2208. In embodiments, coil W 2206 may have the same configuration as those of coil 1206 shown in Figure 20. In one embodiment, the coiled conductive wire of coil W 2206 may be printed in a single layer of the flexible PCB. In other embodiments,

the coiled conductive wire of coil W 2206 may include wire portions printed in multiple layers of the flexible PCB and vias connecting the wire portions printed in multiple layers. Although Figure 37 shows that two outer turns 22064 extend along the periphery of the PCB, the invention is not limited thereto. The entire turns of coil W may have a shape different from that of the periphery of the PCB 2200.

Coil W surrounding through-hole, coil U and coil V

[0151] In embodiments, coil W 2206 includes one or more turns that surround or turn around all of coil U 2204, the through-hole 2202 and coil V 2208, as shown in Figure 37. Coil V 2208 is located between coil U 2204 and line portions 22062 adjacent the lower edge of the flexible PCB. In the illustrated embodiment, two turns 22064 of coil W 2206 extend along the periphery to surround or turn around all of the through-hole 2202, the entire turns of coil U 2204 and the entire turns of coil V 2208. Coil W 2206 further include a single inner turn 22068 that surrounds or turns around both the through-hole 2202 and the entire turns of coil U. However, one half of coil V 2208 is surrounded by the single inner turn 22068 and the other half of coil V 2208 is located outside the single inner turn 22068.

Shape of magnetic sheet

[0152] In embodiments, referring to Figures 35-39, a magnetic sheet 2300 includes a base portion 2302, a head portion 2304 and a neck portion 2306 connecting the base portion 2302 and head portion 2304. In the embodiment illustrated in Figure 38, the head portion 2304 has a width as measured in a horizontal direction the same as that of the neck portion 2306, and the magnetic sheet 2300 does not a structure dividing the head portion and the neck portion. The base portion 2302 has a width greater than those of the head and neck portions. In other embodiments, the head portion has a width greater than that of the neck portion. The head portion may have a width even greater than that of the through-hole such that the head portion is deformed for inserting the head portion through the through-hole. In one embodiment, the head portion has a width smaller than that of the neck portion. In another embodiment, the base, neck and head portions have the same width.

Assembly of magnetic sheet and flexible PCB including coils U, V and W

[0153] When engaged or assembled with the flexible PCB 2200, the head portion 2304 overlaps the upper PCB section 2220; the base portion 2302 overlaps the lower PCB section 2222; and the neck portion 2306 overlaps the through-hole 2202. When assembling the magnetic sheet 2300 with the flexible PCB 2200, in one embodiment, the head portion 2304 go through the through-hole 2202 from the side of a surface 2350 of the flexible PCB 2200 to the side of the opposite surface 2252 of the flexible PCB 2200 that faces away from the surface 2350. When assembled, the base portion 2302 is placed on the surface 2350 of the flexible PCB 2200 while the head portion 2302 is placed on the opposite surface 2252 of the flexible PCB. In Figures 35-39, the flexible PCB and the magnetic sheet are shown to be thicker than actual products for the sake of illustration; however, the invention is not limited to the thickness shown in the drawings.

Locational relationship of components of antenna module when assembled in a smartphone

[0154] Referring to Figure 39, when the antenna module 2100 is installed in a smartphone 10, the surface 2252 of the flexible PCB 2200 faces a rear cover 22 of the smartphone. Thus, the head portion 2304 is located between the rear cover 22 and the upper PCB section 2220. Since the base portion 2302 is located on the surface 2350, the lower PCB section 2222 is located between the rear cover 22 and the base portion 2302. However, the invention is not limited thereto. When the antenna module is arranged such that the surface 2350 of the flexible PCB 2200 faces the rear cover 22 of the smartphone, the base portion may be located between the lower PCB section 2222 and the rear cover 22.

Locational relationship of magnetic sheet and coil U

[0155] Referring to Figure 37, coil U 2204 includes, for example, four conductive lines that are located in the upper PCB section 2220 and extend along an upper edge 22022 of the through-hole 2202. In the illustrated embodiment, each of the four lines of coil U in the upper section 2220 overlaps the head portion 2304. But, the invention is not limited thereto. In another embodiment, at least one of the four lines of coil U does not overlap the head portion 2304. Coil U 2204 further includes four lines that are located in the lower PCB section 2222 and extend along a lower edge 22024 of the through-hole 2202. In the illustrated embodiment, each of the four lines of coil U in the lower PCB section 2222 overlaps the base portion 2304.

Locational relationship of magnetic sheet and coil V

[0156] Referring to Figures 37 and 39, the entire turns of coil V 2208 are located in the lower PCB section 2222 and overlap the base portion 2302 when viewed in the viewing direction. In Figure 38, the entire portion of coil V 2208 is located between the base portion 2302 and the rear cover 22 of the smartphone.

Locational relationship of magnetic sheet and coil W

[0157] Referring to Figures 37 and 39, coil W 2206 includes three lines 22069 that are located in the upper PCB section 2220 and extend along the upper edge 22002 of the flexible PCB. In embodiments, none of the three lines of coil W 2206 in the upper PCB section 2220 overlaps the head portion 2304. But, the invention is not limited thereto. In other embodiments, at least one of the three lines of coil W 2206 in the upper PCB section 2220 overlaps the head portion 2304. Referring to Figure 37, coil W 2206 further includes three lines 22062 and 22060 that are located in the lower PCB section 2222. In one embodiment, each of the three lines of coil W located in the lower PCB section 2222 overlaps the base portion 2308 when viewed in the viewing direction. In another embodiment, the entire portions of coil W that are located in the lower PCB section 2222 overlap the base portion 2302.

No electric connection among coils U, V and W of flexible PCB

[0158] In embodiments, referring to Figure 37, there is no electric connection among coil U 2204, coil W 2206 and coil V 2208 in the flexible PCB. Specifically, each of coil U 2204, coil W 2206 and coil V 2208 has an inner terminal and an outer terminal. Each of the inner and outer terminals of coil U 2204, coil W 2206 and coil V 2208 is connected to a corresponding one among connector terminal pads 2242 formed in a connector portion 2240 of the flexible PCB 2200.

Magnetic flux in magnetic sheet

[0159] Referring to Figure 37, when current flows through coil U 2204, magnetic flux are generated to generally extend from the head portion 2304 to the base portion 2302 via the neck portion 2306 of the magnetic sheet 2300. In embodiments, when current flows through coil V 2208, magnetic flux are generated to generally extend radially from the peripheral area of the base portion to the central portion of coil V 2208.

Coil U for MST antenna, coil V for wireless charging and coil W for NFC antenna

[0160] In embodiments, when the antenna module is installed in a smartphone, coil U 2204 is connected to an MST circuit in the smartphone and functions as an MST antenna. Coil V 2208 is connected to a wireless charging circuit for charging a battery in the smartphone and functions as a wireless charging antenna. Coil W 2206 is connected to an NFC circuit in the smartphone and functions as an NFC antenna. In embodiments, the smartphone includes a controller which operates coil U, coil V and coil W as an MST antenna, a wireless charging antenna and an NFC antenna, respectively. The controller can operate coils U, V and W such that coil U and coil W does not operate while coil V is operating as a wireless charging antenna. Similarly, the controller operates coils U, V and W such that coil W and coil V do not operate while coil U is operating as an MST antenna. The controller can also operate coil U, V and W such that coil U and coil V does not operate while coil W is operating as an NFC antenna.

Coils printed in multiple layers of flexible PCB

[0161] The flexible PCB may include two or more layers. For example, a coil (at least one turn of printed line) is formed in one layer, and another coil is formed in another layer. Further, another coil may be formed in another layer of the two or more layers. One or more vias interconnect these coils such that these coils form a serial connection for providing a serially connected coil antenna. In other embodiment, two or more coils of different layers are connected by parallel connection to provide two more coil antennas that are parallel connected. In one embodiment, a coil is formed in each of the two or more layers. In another embodiment, at least one layer of the flexible PCB does not include a coil.

Printed coil segments

[0162] In embodiments, at least one of the multiple layers contain a printed line (or printed coil segment) that does not form a turn. The printed coil segment of a layer may be connected to another coil segment of another layer or to a coil of another layer via one or more vias.

Embodiments shown in Figures 40-44

[0163] For example, referring to Figures 40-44, an antenna module 2100' includes a flexible PCB 2200' which includes a bottom layer 2270, a top layer 2272 and an insulation layer

interposed therebetween. In embodiments, the top layer 2272 is placed over the bottom layer 2270 such that the through-holes 2202 of the top and bottom layers are aligned. The bottom layer 2270 includes coil 2204' (coil U), coil 2206' (coil W), and line segments of coil V (for example, line segments 22085, 22086 and 22087 of coil V shown in Figures 43 and 44). The top layer 2270 includes coil 2210 (coil X), line segments for coil W, and line segments of coil V (for example, line segments 22081, 22082 and 22083 shown in Figures 42 and 44). In the discussions of embodiments illustrated in Figures 40-44, the terms "top" and "bottom" do not refer to their absolute location. In some circumstances, for example, an item labeled with term "top" may be located lower or under an item labeled with the term "bottom." The locational relationship between the magnetic sheet 2300' and each of coil U, coil W and coil V is the same as the locational relationship illustrated in Figures 37 and 39.

Connections of coils in multiple layers in Figures 40-44

[0164] In embodiments, coil U and coil X are connected to each other in series likewise coils 1204 and 1210 of the embodiments shown in Figure 22. Referring to Figures 42-44, line segments 22081, 22082, 22083, 22085, 22086 and 22087 are connected via vias to form coil V. Each via connects corresponding two points, among the points P1-P16. In embodiments, line segments 22060 formed in the top layer are connected to coil 2206' (coil W) formed on the bottom layer via vias likewise coil 1206 and line segments of the embodiments shown in Figures 22 and 23B. In the embodiments illustrated in Figures 40-44, coil W does not include a line segment that crosses coil V, but not limited thereto. In embodiments, the magnetic sheet 2300' shown in Figures 40 and 41 is the same as that shown in Figure 38.

Configuration of coils and magnetic sheets

[0165] In the embodiments illustrated in Figures 35-44, the configuration of coils and the magnetic sheet can be replaced with that of coils and magnetic sheet discussed above with reference to Figures 1-40. For example, a magnetic sheet shown in Figure 17 can be used as the magnetic sheet shown in Figure 38 or the magnetic sheet shown in Figure 19.

Additional Embodiments

[0166] Embodiments shown in Figures 32-34 provides following features. One embodiment provides a smartphone antenna module for use in a smartphone comprising:

- a winding antenna comprising a winding of at least one wire with an inner terminal and an outer terminal, the inner terminal being located in an inner portion of the winding and the outer terminal being located in an outer portion of the winding;
- a flexible PCB (printed circuit board) comprising a thin flexible body comprising a printed antenna portion, a bridge portion and a connector portion;
- the printed antenna portion comprising a printed antenna in the flexible PCB;
- a first conductive line formed in the flexible PCB and extending between a first end and a second end, the first end and at least part of the first conductive line formed in the bridge portion;
- the connector portion accommodating at least part of the connection terminals for the printed antenna and the winding antenna for connecting to a counterpart connection terminal of a smartphone; and
- the bridge portion extending across the winding such that the bridge portion and a portion of the winding overlap when viewed in a viewing direction perpendicular to a major surface of the bridge portion and further such that the first end of the conductive line reaches the inner portion of the winding for electrical connection with the inner terminal of the winding antenna, the major surface being the most wide surface of the bridge portion,
- wherein a thickness of the bridge portion in the viewing direction including the first conductive line integrated therein is smaller than a thickness of the at least one wire in the viewing direction.

[0167] In the smartphone antenna module of proceeding embodiment, the printed antenna portion including the printed antenna is at least in part thicker than the bridge portion including the first conductive line. In the smartphone antenna module of proceeding embodiments, the thickness of the bridge portion at any point thereof is smaller than a thickness of the printed antenna portion in the viewing direction. In the smartphone antenna module of any one of the preceding embodiments, the printed antenna and the winding antenna are arranged generally side by side such that the printed antenna and the winding antenna do not overlap when viewed in the viewing direction. In the smartphone antenna module of any one of the preceding embodiments, the antenna module further comprises a second conductive line extending in the bridge portion and

comprising a third end and a fourth end, wherein the third end is connected to the outer portion of the winding for electrical connection with the outer terminal of the winding antenna. In the antenna module shown in Figures 32-34, there is no electric connection between the winding antenna and the coil antenna in the flexible PCB.

[0168] In the smartphone antenna module of any one of the preceding embodiments, each of the first and second conductive lines has a thickness substantially smaller than its width (e.g., width at least 3 times thickness). In the smartphone antenna module of any one of the preceding embodiments, one of the first and second conductive lines has a thickness substantially smaller than its width. In the smartphone antenna module of any one of the preceding embodiments, the flexible PCB and the winding antenna are arranged generally side by side such that the printed antenna portion and the winding antenna do not overlap when viewed in the viewing direction.

[0169] In the smartphone antenna module of any one of the preceding embodiments, the printed antenna and the winding antenna are electrically decoupled within the smartphone antenna module. In the smartphone antenna module of any one of the preceding embodiments, the second end is formed in the connector portion. In the smartphone antenna module of any one of the preceding embodiments, the antenna module further comprises a second conductive line formed in the flexible PCB extending between a third end and a fourth end. In the smartphone antenna module of any one of the preceding embodiments, the third end is formed in the bridge portion, and the fourth end is formed in the connector portion.

[0170] In the smartphone antenna module of any one of the preceding embodiments, the connector portion is referred to as a first connector portion, the antenna module further comprises a second connector portion, wherein the third end is formed in the second connector portion, and the fourth end is formed in the first connector portion. In the smartphone antenna module of any one of the preceding embodiments, the connector portion is referred to as a first connector portion, wherein the antenna module further comprises a second connector portion and a third connector portion, wherein the third end is formed in the second connector portion, and the fourth end is formed in the third connector portion. In the smartphone antenna module of any one of the preceding embodiments, each of the first, second, third and fourth ends comprises a contact terminal pad.

[0171] In the smartphone antenna module of any one of the preceding embodiments, the contact terminal pads of the first and third ends face in a first direction wherein the contact

terminal pads of the second and fourth ends face in a second direction opposite to the first direction. In the smartphone antenna module of any one of the preceding embodiments, the contact terminal pads of the first, second, third and fourth ends face in the same direction. In the smartphone antenna module of any one of the preceding embodiments, the connection terminals for the winding antenna comprise the second end of the first conductive line and the fourth end of the second conductive line.

[0172] In the smartphone antenna module of any one of the preceding embodiments, the printed antenna comprises a coil of a printed wire. In the smartphone antenna module of any one of the preceding embodiments, each of the first and second ends comprises a contact terminal pad. In the smartphone antenna module of any one of the preceding embodiments, the connection terminals for the printed antenna comprise first and second connection terminals connected to first and second ends of the printed wire, respectively, wherein each of the first and second connection terminals comprises a contact terminal pad, wherein the contact terminal pads of the first and second connection terminals and the contact terminal pads of the first end of the first conductive line face the same direction.

[0173] In the smartphone antenna module of any one of the preceding embodiments, the printed antenna comprises a coil of a printed wire, wherein the flexible PCB comprises a hole surrounded by the coil of the printed wire. In the smartphone antenna module of any one of the preceding embodiments, the coil of the printed wire comprises 2-7 turns, in one embodiment, 3-5 turns. In the smartphone antenna module of any one of the preceding embodiments, a thickness of the printed antenna portion including the printed antenna is about 100-140 μm , in one embodiment, about 120 μm , wherein a thickness of the bridge portion including the first conductive line is about 40-80 μm , in one embodiment, about 60 μm . In the smartphone antenna module of any one of the preceding embodiments, the module further comprises a magnetic material plate attached to the flexible PCB. In the smartphone antenna module of any one of the preceding embodiments, the magnetic material plate comprises a ferrite plate which comprises a hole aligned with the hole of the flexible PCB.

[0174] In the smartphone antenna module of any one of the preceding embodiments, the winding antenna comprises a coil of an insulation-coated wire. In the smartphone antenna module of any one of the preceding embodiments, the at least one wire comprises an enamel-coated wire, wherein the winding has a single layer of the enamel-coated wire such that the layer of the

coil of the coated wire has a thickness substantially same as the diameter of coated wire. In the smartphone antenna module of any one of the preceding embodiments, the enamel-coated wire has a thickness about 100-140, in one embodiment, 120 μm . In the smartphone antenna module of any one of the preceding embodiments, the at least one wire comprise two or more wires, each of which comprises the inner terminal and the outer terminal, wherein the inner terminals of the two or more wires are attached to the contact terminal pad of the first end of the first conductive line and the outer terminals of the two or more wires are attached to the contact terminal pad of the third end of the second conductive line such that the two or more wires are electrically connected to each other in parallel. In the smartphone antenna module of any one of the preceding embodiments, the inner end of the wire is welded to the contact terminal pad of the first end of the first conductive line. In the smartphone antenna module of any one of the preceding embodiments, the outer end of the wire is welded to the contact terminal pad of the third end of the second conductive line. In the smartphone antenna module of any one of the preceding embodiments, each of the two or more wires has about 16-20 turns, in one embodiment, about 18 turns.

[0175] In the smartphone antenna module of any one of the preceding embodiments, the number of two or more wires is 2 as shown in Figure 16, wherein the inner ends of the two wires are attached to the contact terminal pad of the first conductive line, wherein the outer ends of the two wires are attached to the contact terminal pad of the second conductive line, wherein the two wires are connected to each other in parallel. In the smartphone antenna module of any one of the preceding embodiments, the number of two or more wires is 3 or 4.

[0176] In the smartphone antenna module of any one of the preceding embodiments, the winding antenna does not comprise a portion of the wire which crosses the winding when viewed in the direction. In the smartphone antenna module of any one of the preceding embodiments, the winding antenna comprises an inner hole, wherein the smartphone antenna module comprises a magnetic material sheet extending through the inner hole.

[0177] In the smartphone antenna module of any one of the preceding embodiments, the magnetic material sheet comprises a neck extending through the inner hole and surrounded by the winding and a body connected to the neck and extending from the neck and away from the flexible PCB. In the smartphone antenna module of any one of the preceding embodiments, the magnetic material sheet is flat and the winding antenna is stepped for allowing the magnetic material sheet to extend through the inner hole without substantial deformation of the magnetic

material sheet. In the smartphone antenna module of the foregoing embodiment, the printed antenna is for near field communication (NFC), wherein the winding antenna is for magnetic secure transmission (MST). In the smartphone antenna module of any one of the preceding embodiments, the printed antenna is configured to emit signals having about 13.56 MHz, and the winding antenna is configured to emit signals having about 85-100 KHz.

[0178] Other embodiments provide a smartphone comprising:

- a display disposed at the front side of the smartphone;
- a housing comprising a rear cover with a camera hole;
- the smartphone antenna module housed in the housing;
- a camera module comprising a lens aligned with the camera hole;
- the smartphone antenna module of any one of the preceding embodiments; and
- a smartphone circuit module housed in the housing and comprising a connector portion which comprises terminals for electrically connecting with at least one terminal of the smartphone antenna module,
- wherein the smartphone antenna module is arranged within the housing such that the printed antenna portion of the smartphone antenna module surrounds the camera module when viewing in a direction perpendicular to the rear cover.

[0179] In the smartphone of proceeding embodiment, the rear cover comprises a metal plate and a plastic plate arranged in order along a longitudinal direction of the rear cover, wherein the metal plate is substantially longer than the plastic portion in the longitudinal direction, wherein the metal plate overlaps the flexible PCB and the winding antenna when viewed in the viewing direction. In the smartphone of any one of the preceding embodiments, the smartphone further comprises a magnetic material sheet comprising a main body and an insertion portion, wherein the magnetic material sheet is arranged with the smartphone antenna module such that the insertion portion is inserted into a central opening of the winding antenna and the main body extends in a direction away from the flexible PCB, wherein the metal plate overlaps the flexible PCB, winding antenna and the magnetic material sheet.

[0180] In the smartphone of any one of the preceding embodiments, the metal plate comprises an edge contacting, overlapping or neighboring the plastic plate, wherein the main body of the magnetic material sheet extends to or near the edge of the metal plate. In the smartphone of

any one of the preceding embodiments, the metal plate comprises an edge contacting, overlapping or neighboring the plastic plate, wherein the main body of the magnetic material sheet extends to the plastic plate. In the smartphone of any one of the preceding embodiments, the metal plate extends at least three quarter the length of the rear cover in the longitudinal direction of the smartphone.

[0181] In the smartphone of any one of the preceding embodiments, the flexible PCB is disposed between the metal plate and the ferrite plate. In the smartphone of any one of the preceding embodiments, the magnetic material sheet is substantially parallel to the rear surface of the rear cover. In the smartphone of any one of the preceding embodiments, the metal portion comprises a non-magnetic metal which is electrically conductive. In the smartphone of any one of the preceding embodiments, the metal portion is made of aluminum.

[0182] In the smartphone of any one of the preceding embodiments, the smartphone further comprises a plastic sheet disposed between the smartphone antenna module and the rear cover. In the smartphone of any one of the preceding embodiments, the smartphone further comprise another plastic sheet disposed between the smartphone antenna module and the smartphone circuit.

[0183] In embodiments, referring to Figures 32-34, when the winding antenna is assembled in a smartphone, the winding antenna can be used for wirelessly charging a battery in the smartphone. The smartphone has a controller to control a charging circuit in the smartphone to operate the winding antenna as a transformer coil for wirelessly charging a battery when the smartphone is placed close to a wireless charger. In one embodiment, the entire portion of the magnetic sheet may be placed under the winding antenna coil.

[0184] One or more features of each of the embodiments discussed above may be replaced by one or more features included in the other embodiments discussed above. For example, the magnetic sheet 300 of the embodiment shown in Figure 3 can be replaced with the magnetic sheet 1300 of the embodiment shown in Figure 19. Further, one or more features of one embodiment discussed above may be added to the other embodiments. For example, the fourth coil 1210 of the embodiment shown in Figure 22 can be added to the flexible PCB of the embodiment shown Figure 6 such that the fourth coil overlaps the first coil when viewed in the viewing direction and is connected to the first coil in series. In a further example, the conductive

line segments 1280 and 1282 shown in Figures 22, 23A and 23B can be added to all the other embodiments.

[0185] In embodiments, the antenna module illustrated in Figures 1-49 may further include a protective or covering sheet placed over and attached to the assembly of the flexible PCB and magnetic sheet. Further, for facilitating to assembling the antenna module in the smartphone the antenna module further includes a step-compensation sheet placed over and attached to the assembly of the flexible PCB and magnetic sheet for reducing or minimizing steps that may be resulted from the assembly of the flexible PCB and the magnetic sheet having different sizes and shapes. This step-compensation sheet may be tailor-made or customized to fit a space required by the assembly of the flexible PCB and the magnetic sheet. These can be made of a plastic resin material.

[0186] In the foregoing discussions, the antenna module according to embodiments are used as a smartphone antenna module that is to be installed in the smartphone. In the foregoing discussions, the smartphone may include any mobile device that can provide voice communication and data communication through wireless networks. In embodiments, the antenna modules discussed in the above can be used in a laptop computer, a slate computer, a personal digital assistant, a portable multimedia player, a navigation device, a wearable device, etc.

[0187] Figure 45 is a photograph of a smartphone antenna module according to embodiments of the invention. Similar to other embodiments discussed above, the smartphone antenna module includes a flexible PCB and a magnetic sheet attached to the flexible PCB. Figure 46 shows contours of the flexible PCB and the magnetic sheet as attached to each other.

[0188] Figures 47-49 show wire patterns formed in the flexible PCB. Figure 48 shows top patterns of the flexible PCB, and Figure 49 shows bottom patterns of the flexible PCB. To show three complete coil antenna patterns, in Figure 47, the top and bottom wire patterns are shown as overlapped. The three coil antenna patterns include an MST coil antenna 5204, a wireless charging coil antenna 5208, and an NFC coil antenna 5206.

[0189] Referring to Figures 47 and 48, the MST coil antenna 5204 is located close to a top edge of the flexible PCB. Referring to Figures 47 and 49, the circular wireless charging coil antenna 5208 is disposed at a location spaced from the MST coil antenna and located between the MST coil antenna and a bottom edge of the flexible PCB. As shown in Figure 47, the NFC coil antenna 5206 is located to surround the wireless charging coil antenna 5208 and overlaps the MST

coil antenna when viewed in the thickness direction of the flexible PCB. The MST coil antenna does not overlap the wireless charging coil antenna. The top and bottom patterns of each of the MST coil antenna, NFC coil antenna and wireless charging coil antenna are electrically connected each other through a plurality of vias.

[0190] Figure 50 shows a magnetic sheet.

[0191] Figure 51 shows (a) a smartphone antenna module with a wireless charging coil antenna of non-parallel coil design and (b) a smartphone antenna module with a wireless charging coil antenna with parallel coil design. Referring to (b) of Figure 51, the wireless charging coil antenna includes two circular coils which are connected each other in parallel as shown in Figure 18B.

[0192] The two circular coil of the wireless charging coil antenna includes an inner coil and an outer coil. The inner coil has the number of turns which is different from that of the outer coil. The inner coil includes a wire line having a width different from that of a wire line of the outer coil. In the embodiment illustrated in (b) of Figure 51, the line width of the inner coil, e.g., 0.35 mm, is smaller than the line width of the outer coil, e.g., 0.45 mm. The number of turns of the inner coil, e.g., 17 turns, is greater than the number of turns, of the outer coil, e.g., 12 turns. But the invention is not limited thereto. Further, as show in Figure 52, the entire coil width of the inner coil, e.g., 7.55 mm, is greater than the entire coil width of the outer coil, e.g., 6.5 mm.

[0193] Figures 53A, 53B, 53C, 54A, 54B and 54C show various examples of the wireless charging coil antenna of the smartphone antenna module. The wireless charging coil antennas in these figures are different from each other in the aspect of the ratio of an outer coil width and an inner coil width, i.e., the outer coil width : the inner coil width. Figure 55 shown the charging efficiencies depending on the ratio.

[0194] Although embodiments of the invention have been described above, those skilled in the art may understand that configurations of the various embodiments described above may be changed without departing from the spirit of the invention. It will be also understood that the changes fall within the scope of the invention.

What Is claimed Is:

1. A smartphone antenna module comprising:
 - a substrate having a first major surface and a second major surface facing away from the first major surface;
 - a first antenna pattern formed on the first major surface and comprising an inner coil and an outer coil surrounding the inner coil;
 - a second antenna pattern formed on the second major surface and comprising an inner antenna pattern, and an outer antenna pattern;
 - the inner antenna pattern comprising a plurality of concentric circular lines and defining a radially-extending inner gap into which the plurality of concentric circular lines of the inner antenna pattern does not extend, wherein at least part of the concentric circular lines of the inner antenna pattern overlaps the inner coil formed on the first major surface and is connected to the inner coil through vias; and
 - the outer antenna pattern comprising a plurality of concentric circular lines and defining a radially-extending outer gap into which the plurality of concentric circular lines of the outer antenna pattern does not extend, wherein at least part of the concentric circular lines of the outer antenna pattern overlaps the outer coil formed on the first major surface and is connected to the outer coil through vias,
 - wherein at least part of the concentric circular lines of the outer antenna pattern generally surround at least part of the concentric circular lines of the inner antenna pattern,
 - wherein the radially-extending outer gap and the radially-extending inner gap are connected and aligned in a direction.
2. The smartphone antenna module of Claim 1, further comprising:
 - an inner extension line formed on the second major surface and extending through the radially-extending outer gap and further through at least part of the radially-extending inner gap; and
 - an outer extension line formed on the second major surface and extending through at least part of the radially-extending outer gap.

3. The smartphone antenna module of Claim 2, wherein the inner extension line and the outer extension line extend generally in parallel, and wherein each of the inner extension line and the outer extension line formed on the second major surface comprises a portion that overlaps the outer coil formed on the first major surface.

4. The smartphone antenna module of Claim 2, wherein the inner extension line is electrically connected to a terminal of the inner coil, wherein at least part of the concentric circular lines of the inner antenna pattern is in a C shape.

5. The smartphone antenna module of Claim 2, wherein the outer extension line is electrically connected to a terminal of the outer coil, wherein at least part of the concentric circular lines of the outer antenna pattern is in a C shape.

6. The smartphone antenna module of Claim 2, wherein at least one of the inner extension line and the outer extension line is electrically connected to the first antenna pattern formed on the first major surface through at least one via.

7. The smartphone antenna module of Claim 2, wherein the inner extension line is referred to as a first inner extension line and is electrically connected to a first terminal of the inner coil, wherein the smartphone antenna module further comprises a second inner extension line formed on the second major surface, wherein the second inner extension line is electrically connected to a second terminal of the inner coil and extends through at least part of the radially-extending outer gap.

8. The smartphone antenna module of Claim 1, wherein the inner coil and the outer coil are electrically connected in parallel.

9. The smartphone antenna module of Claim 1, wherein the inner coil includes a wire line having a width different from that of a wire line of the outer coil, wherein the inner coil has a first number of turns, and the outer coil has a second number of turns, wherein the first number of turns is greater than the second number of turns.

10. The smartphone antenna module of Claim 1, further comprising two additional extension lines formed on the second major surface and extending through both the radially-extending inner gap and the radially-extending outer gap.

11. The smartphone antenna module of Claim 10, wherein the second antenna pattern formed on the second major surface comprises a third antenna pattern generally surrounded by the inner antenna pattern, wherein each of the two additional extension lines is electrically connected to a terminal of the third antenna pattern.

12. The smartphone antenna module of Claim 10, wherein the second antenna pattern formed on the second major surface comprises a third antenna pattern generally surrounded by the inner antenna pattern, wherein at least one of the two additional extension lines contacts the third antenna pattern on the second major surface.

13. A smartphone comprising:

a display module comprising a display surface;

a rear cover comprising a rear surface facing away from the display surface;

a battery placed between the display module and the rear cover; and

the smartphone antenna module of Claim 2 placed between the battery and the rear cover, wherein at least one of the inner coil and the outer coil are configured for wireless battery charging.

14. The smartphone of Claim 13, wherein the inner extension line is electrically connected to a terminal of the inner coil, wherein at least part of the concentric circular lines of the inner antenna pattern is in a C shape.

15. The smartphone of Claim 13, wherein the outer extension line is electrically connected to a terminal of the outer coil, wherein at least part of the concentric circular lines of the outer antenna pattern is in a C shape.

16. The smartphone of Claim 13, wherein the inner coil and the outer coil are electrically connected in parallel.

17. The smartphone of Claim 13, wherein at least one of the inner extension line and the outer extension line is electrically connected to the first antenna pattern formed on the first major surface through at least one via.

18. The smartphone of Claim 13, wherein the inner extension line is referred to as a first inner extension line and is electrically connected to a first terminal of the inner coil, wherein the smartphone antenna module further comprises a second inner extension line formed on the second major surface, wherein the second inner extension line is electrically connected to a second terminal of the inner coil and extends through at least part of the radially-extending outer gap.

19. The smartphone of Claim 13, wherein the inner coil includes a wire line having a width different from that of a wire line of the outer coil, wherein the inner coil has a first number of turns, and the outer coil has a second number of turns, wherein the first number of turns is greater than the second number of turns.

20. The smartphone Claim 13, further comprising two additional extension lines formed on the second major surface and extending through both the radially-extending inner gap and the radially-extending outer gap.

21. The smartphone of Claim 20, wherein the second antenna pattern formed on the second major surface comprises a third antenna pattern generally surrounded by the inner antenna pattern, wherein each of the two additional extension lines is electrically connected to a terminal of the third antenna pattern.

22. The smartphone of Claim 20, wherein the second antenna pattern formed on the second major surface comprises a third antenna pattern generally surrounded by the inner antenna pattern, wherein at least one of the two additional extension lines contacts the third antenna pattern on the second major surface.

ABSTRACT OF DISCLOSURE

A thin, flexible antenna module is provided for use in a smartphone. When the antenna module is assembled in the smartphone, the antenna module provides an MST antenna and an NFC antenna. For this, the antenna module includes a flexible PCB containing coils and further includes a magnetic sheet engaged with flexible PCB. The flexible PCB and the magnetic sheet are attached to each other to form a single body.

FIG. 1

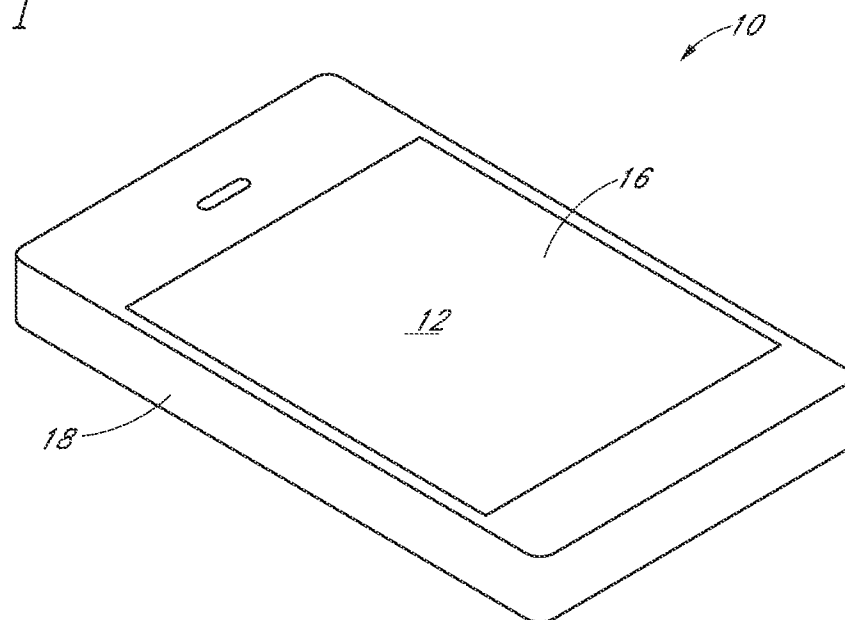


FIG. 2

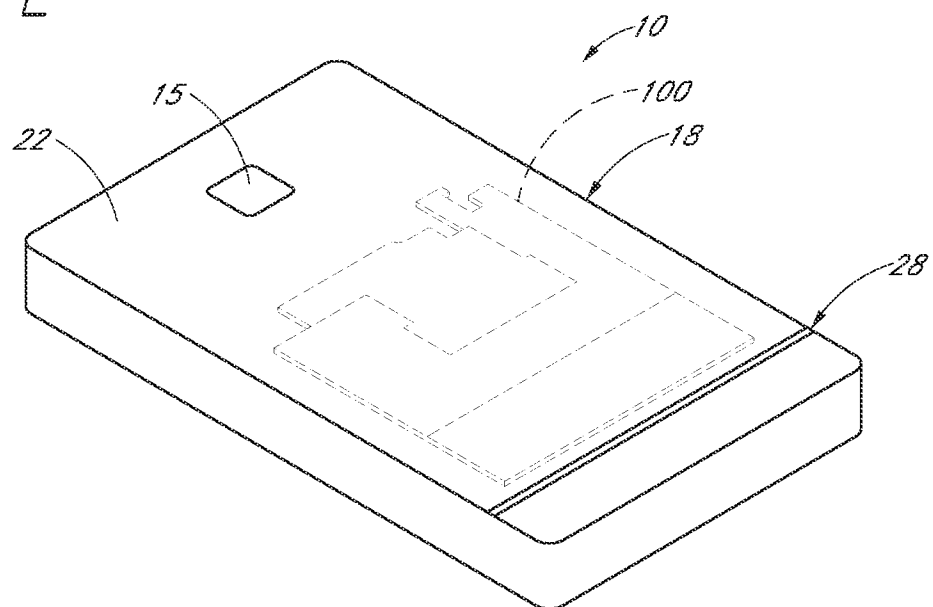
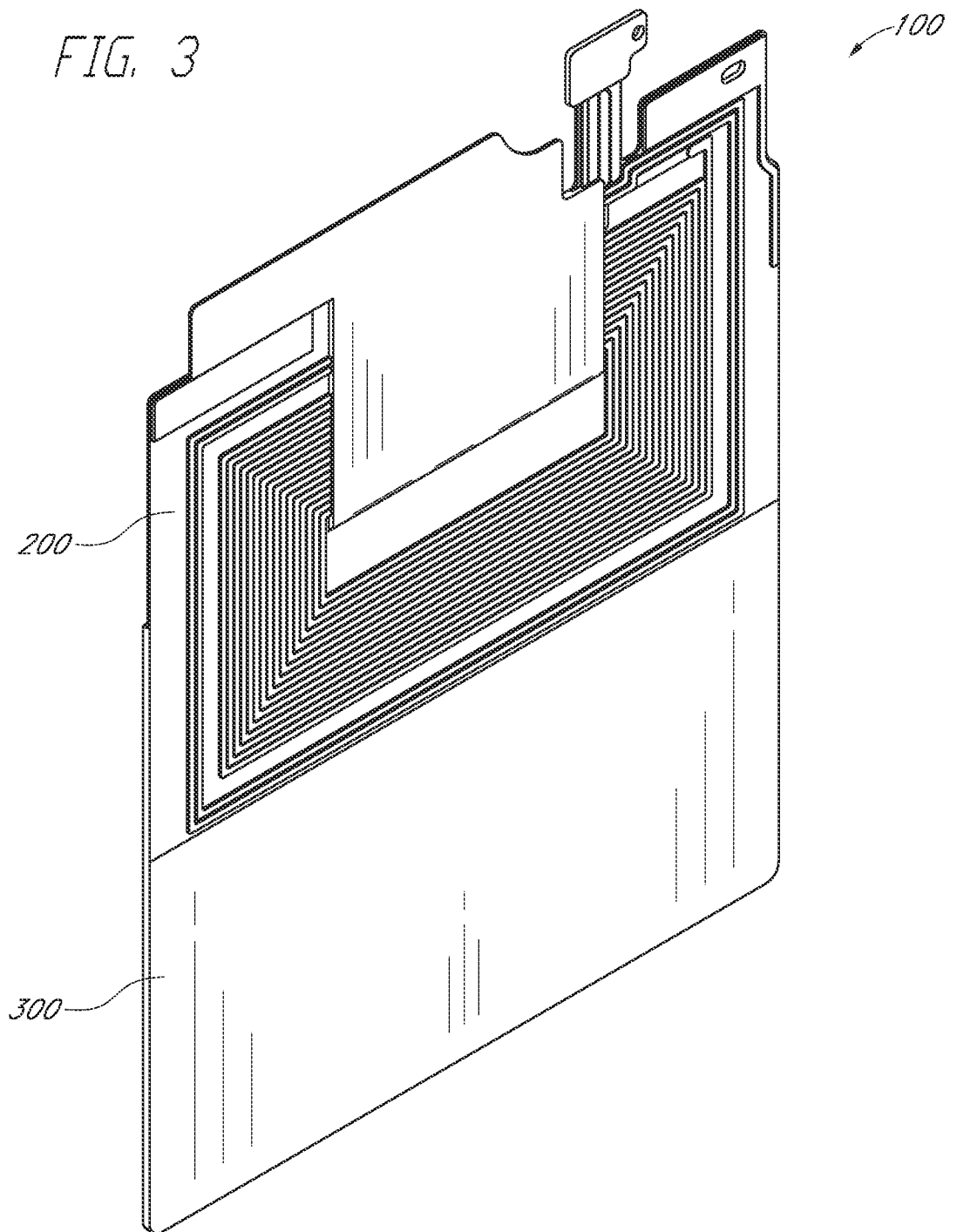


FIG. 3



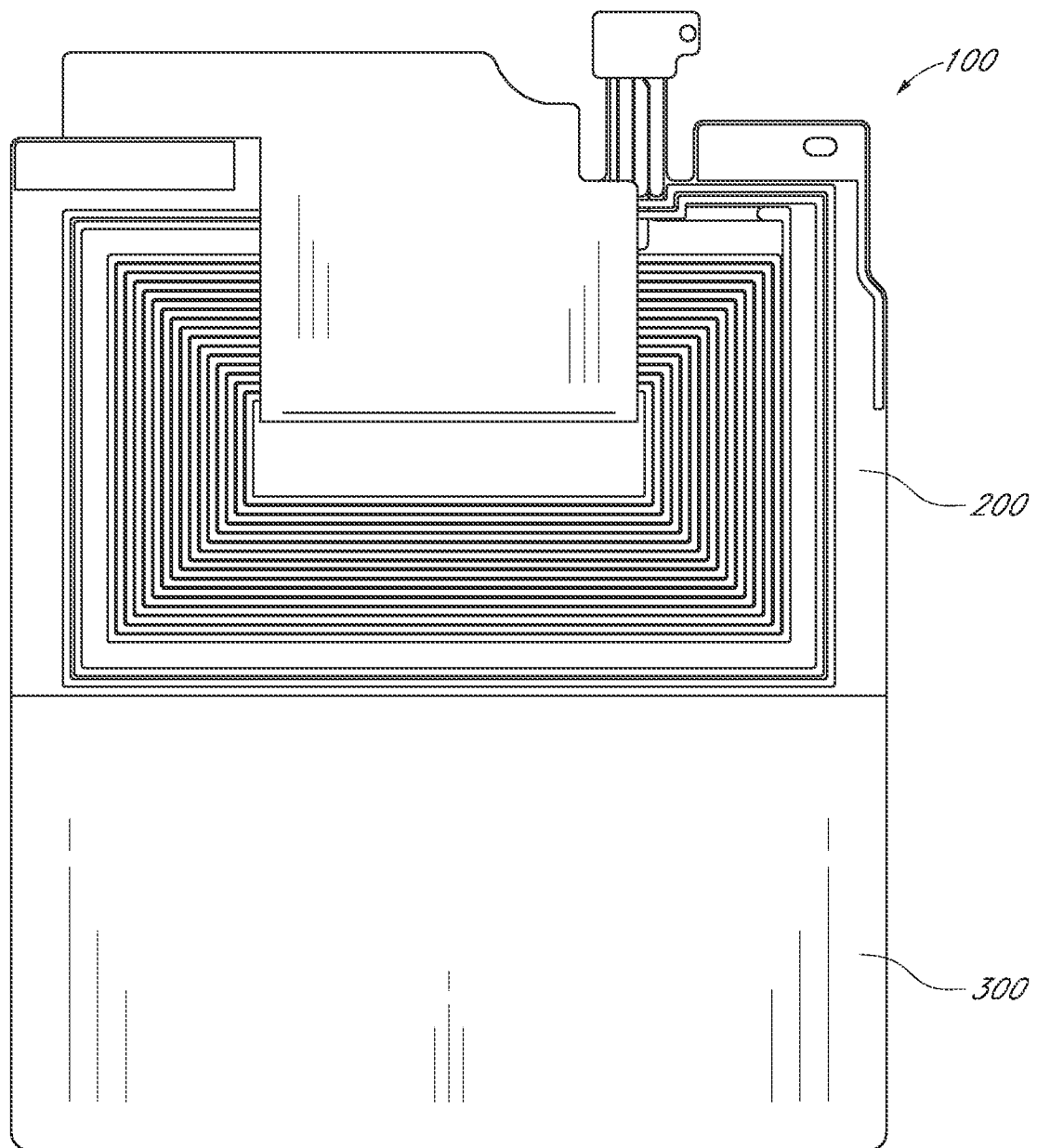


FIG. 4

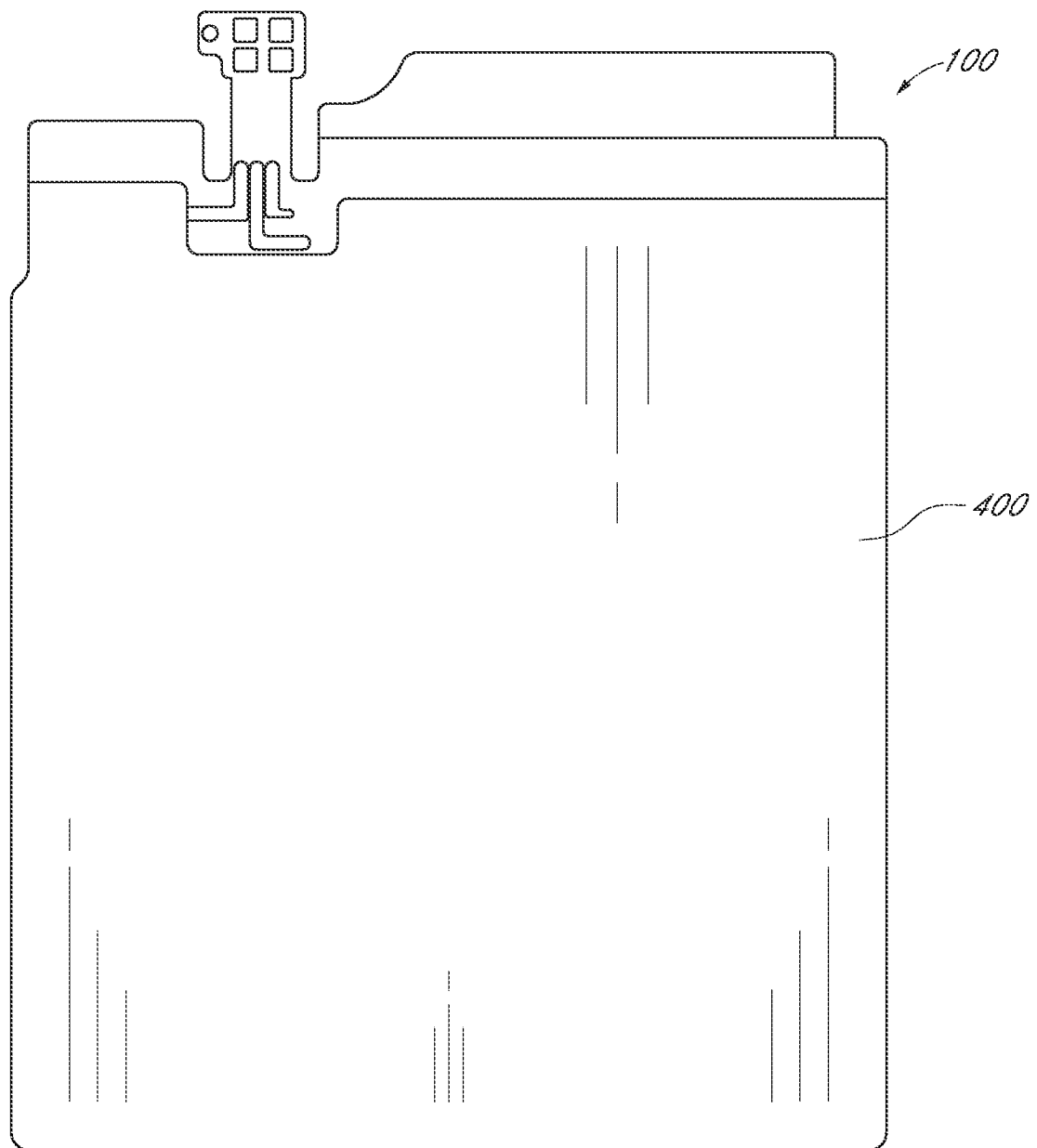


FIG. 5

FIG. 6

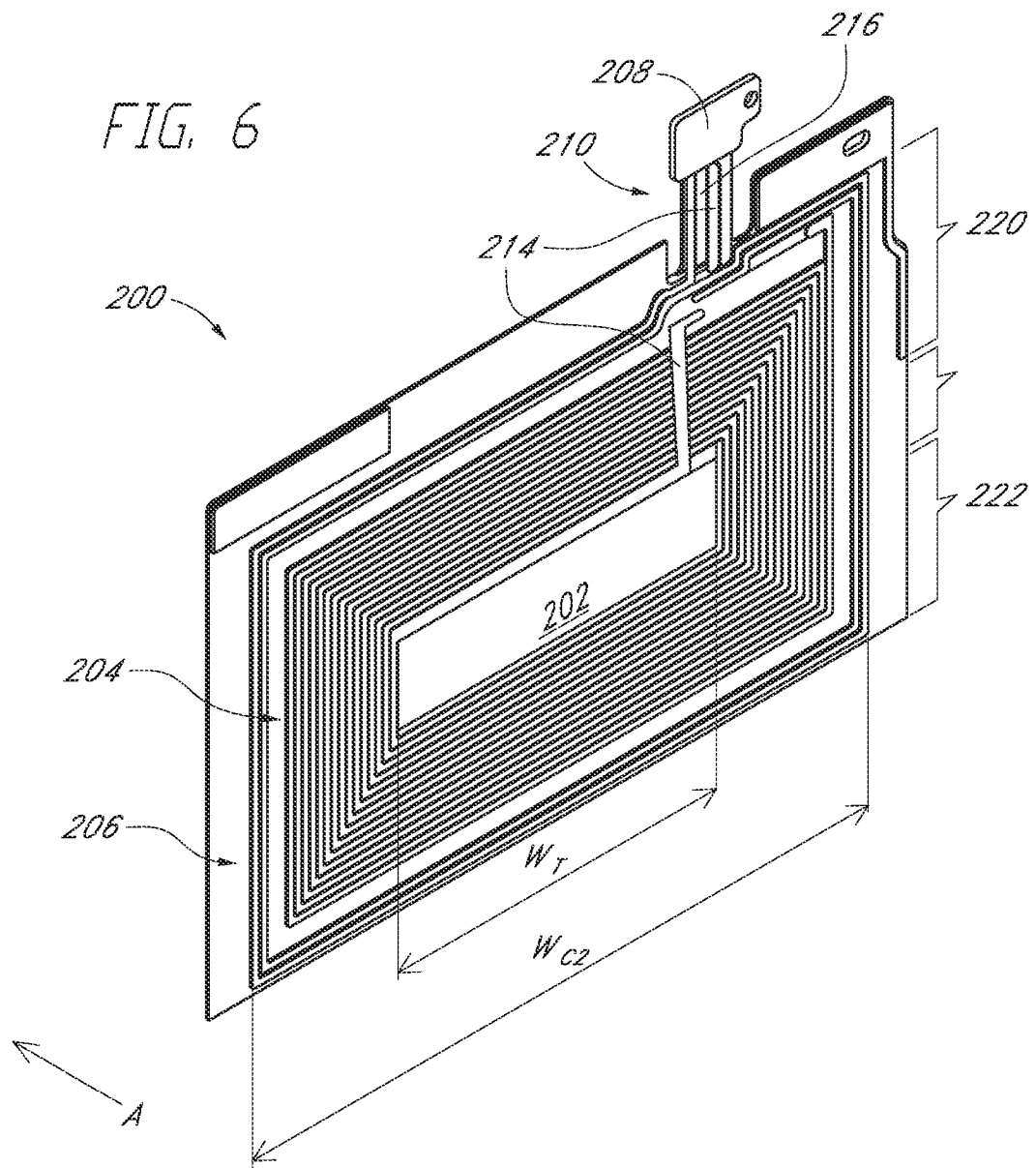


FIG. 7

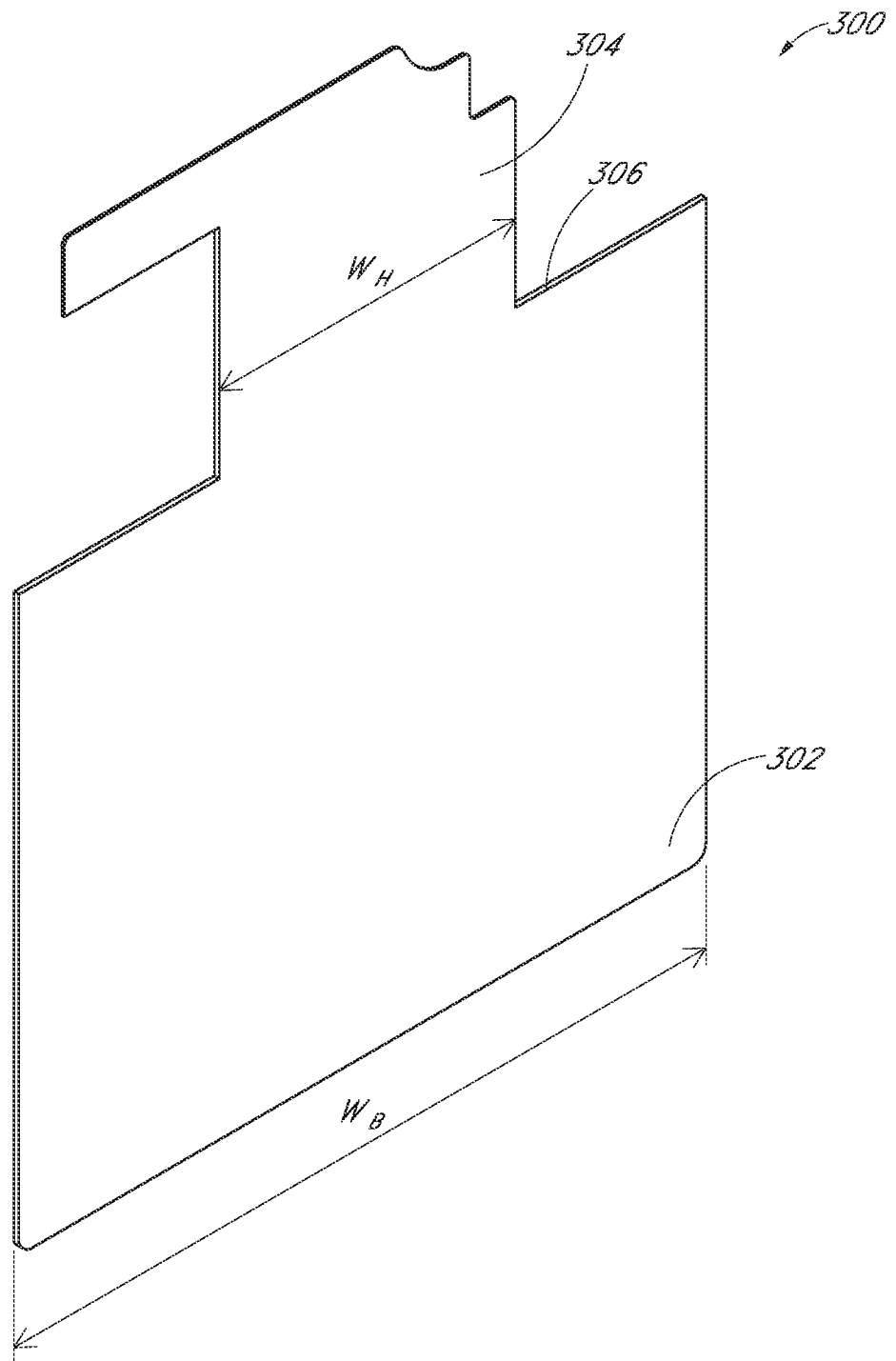
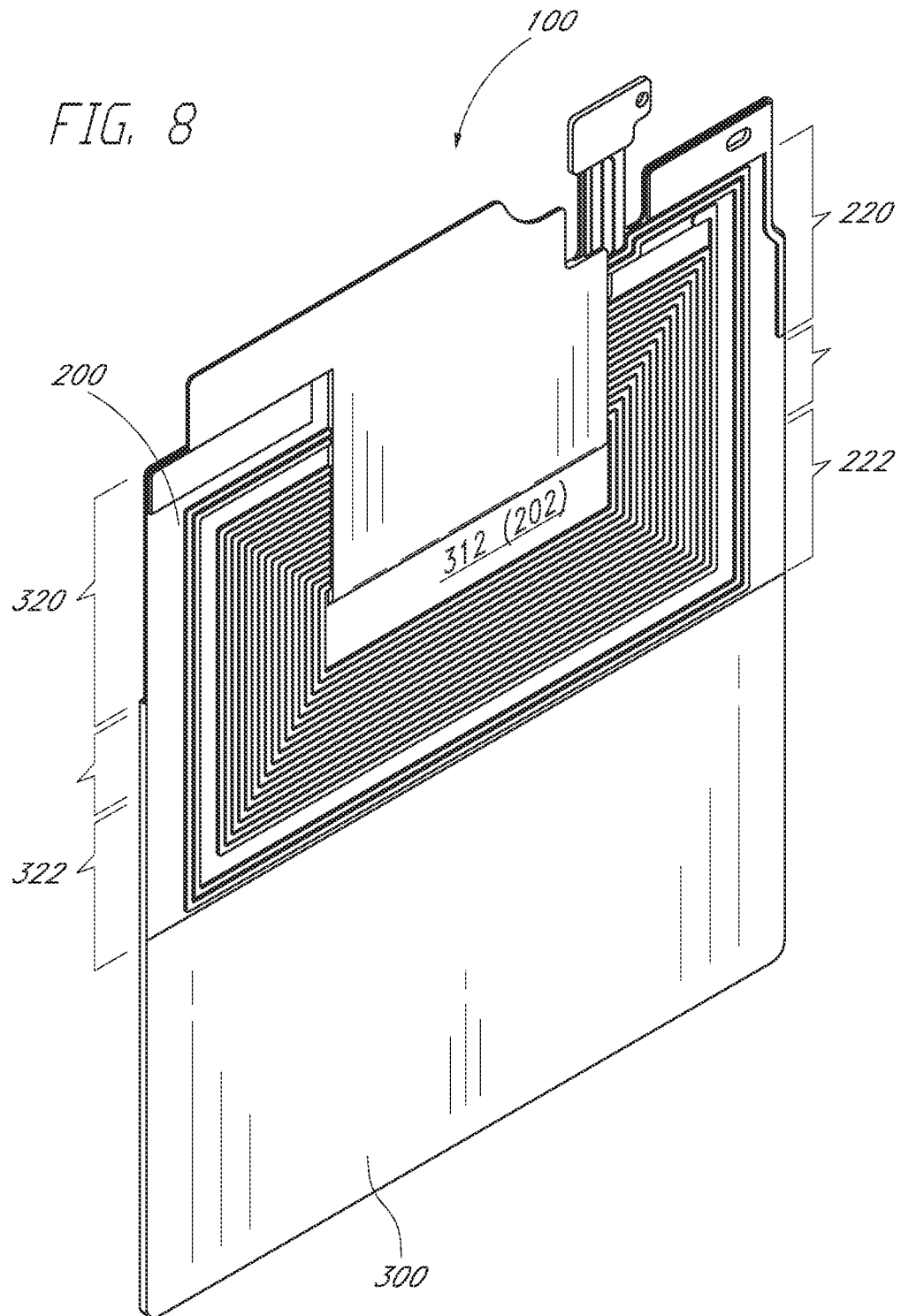


FIG. 8



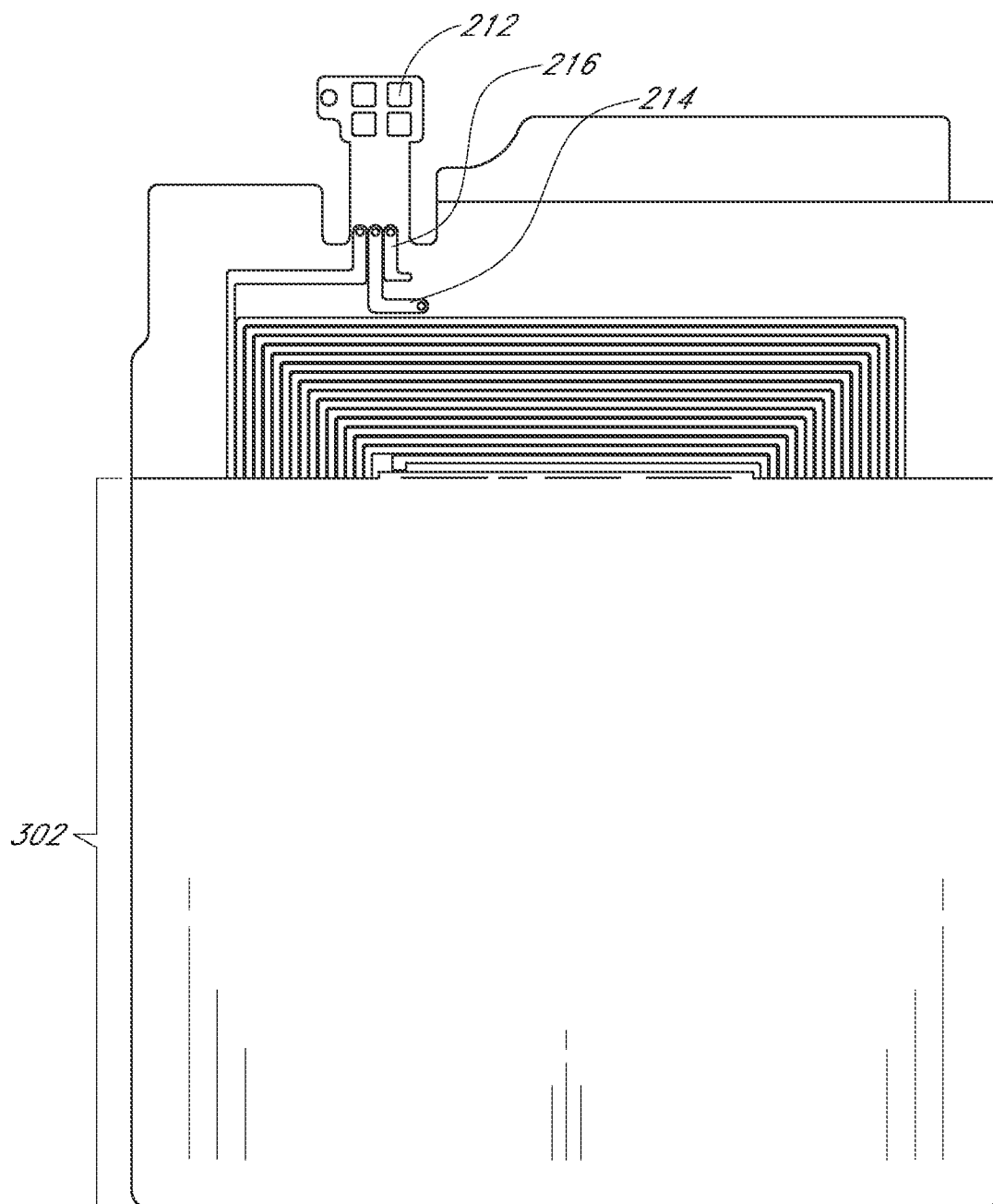


FIG. 9

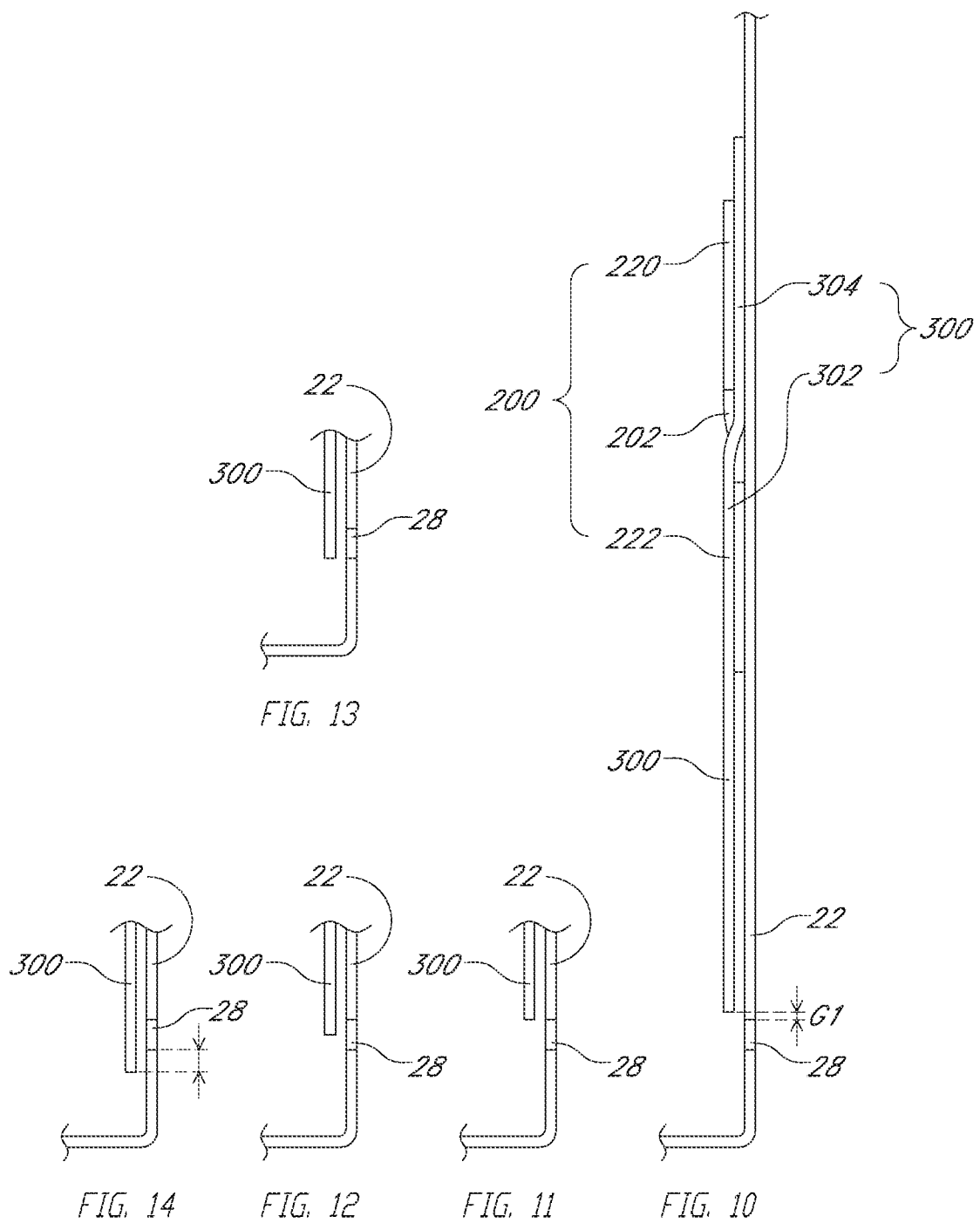


FIG. 15

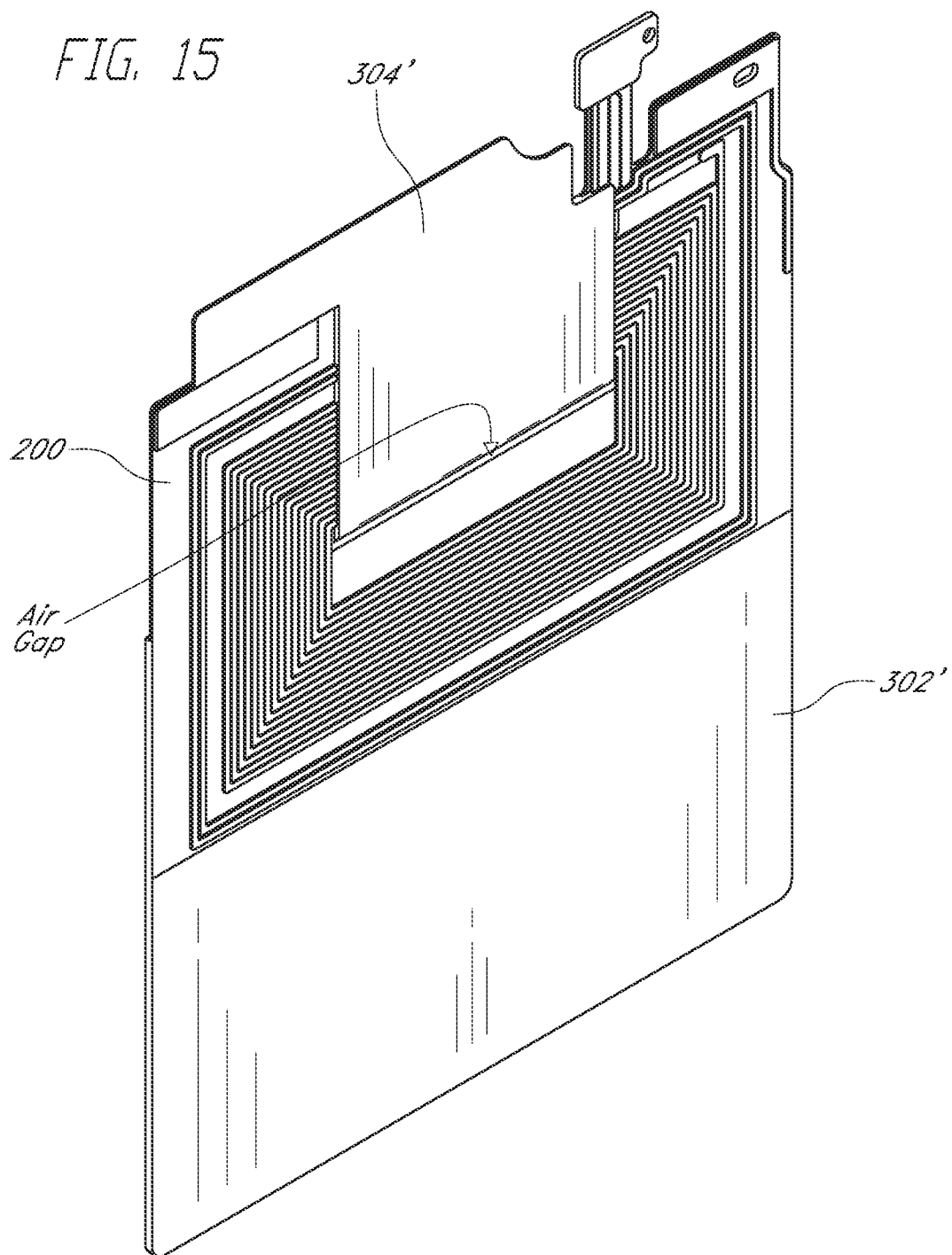
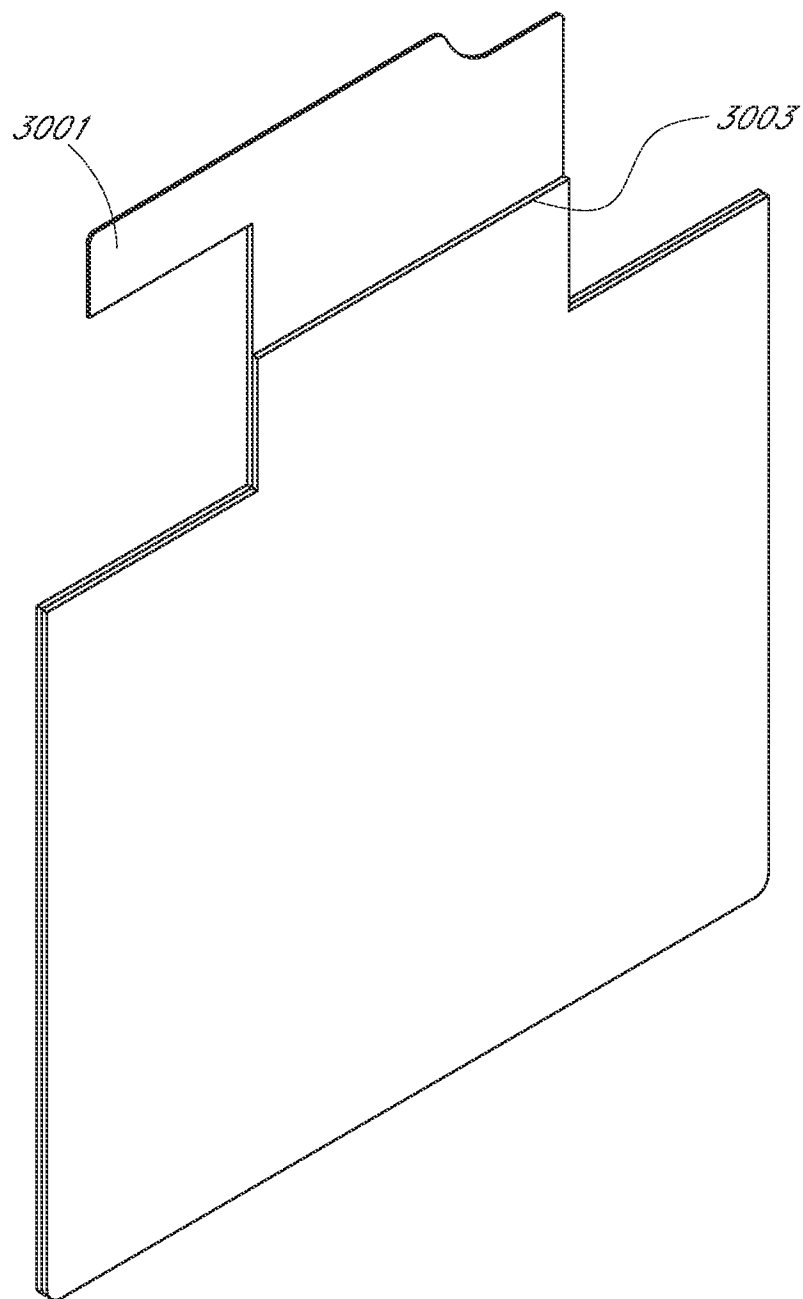


FIG. 16



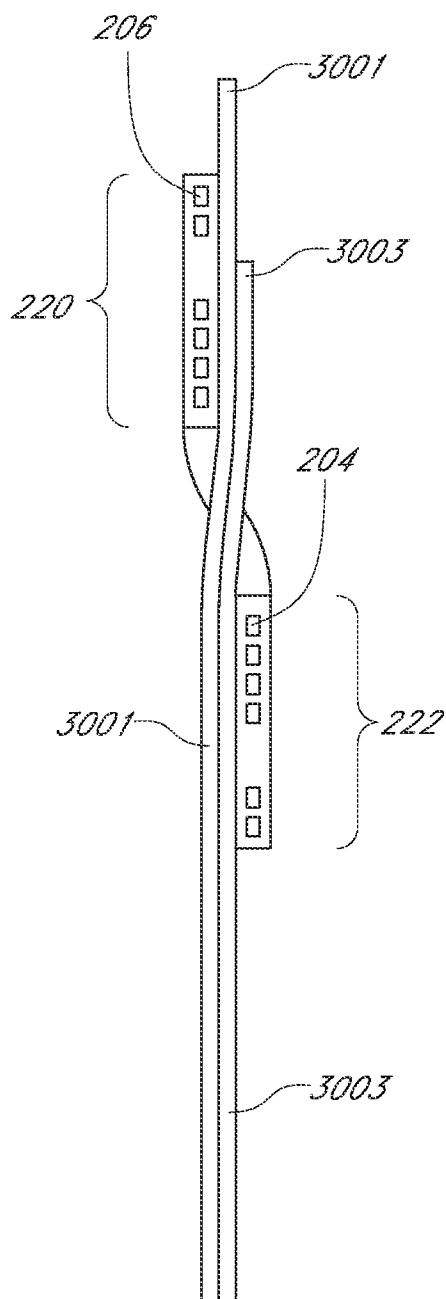


FIG. 17

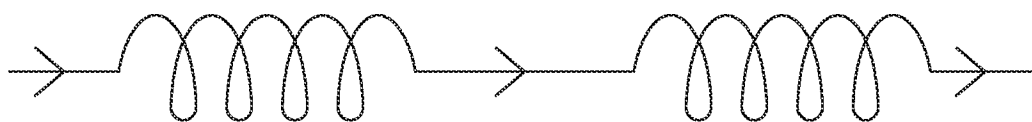


FIG. 18A

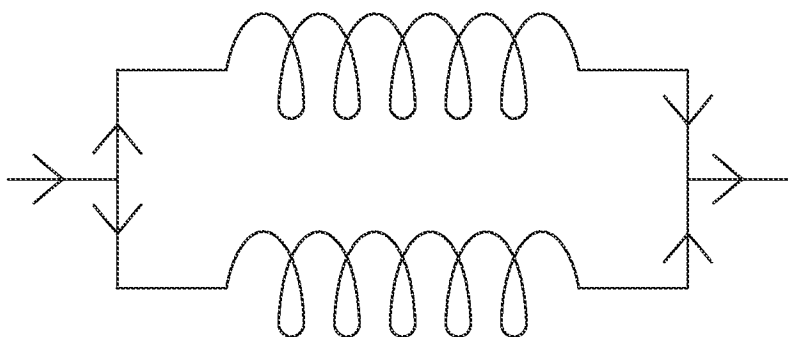
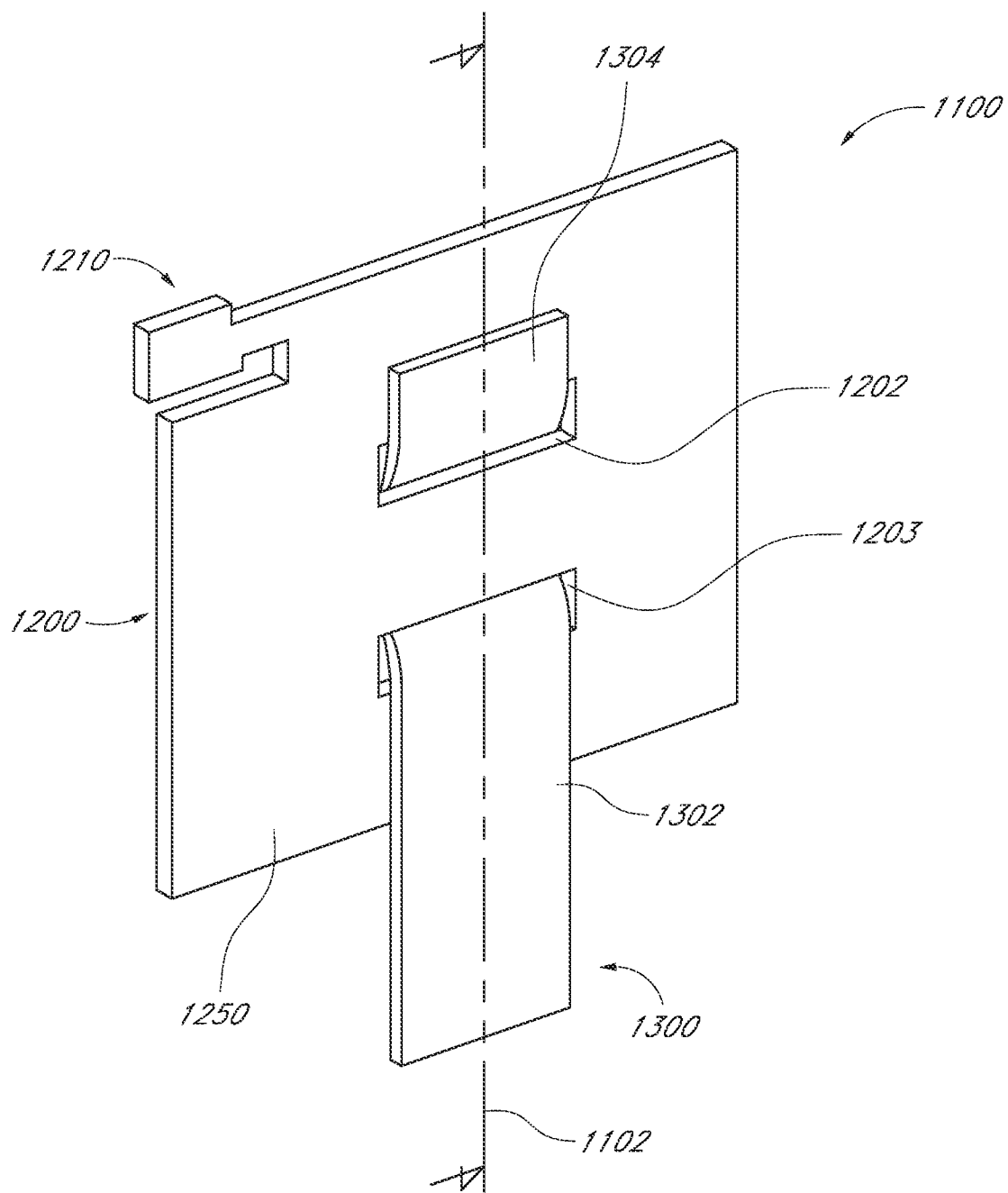


FIG. 18B

FIG. 19



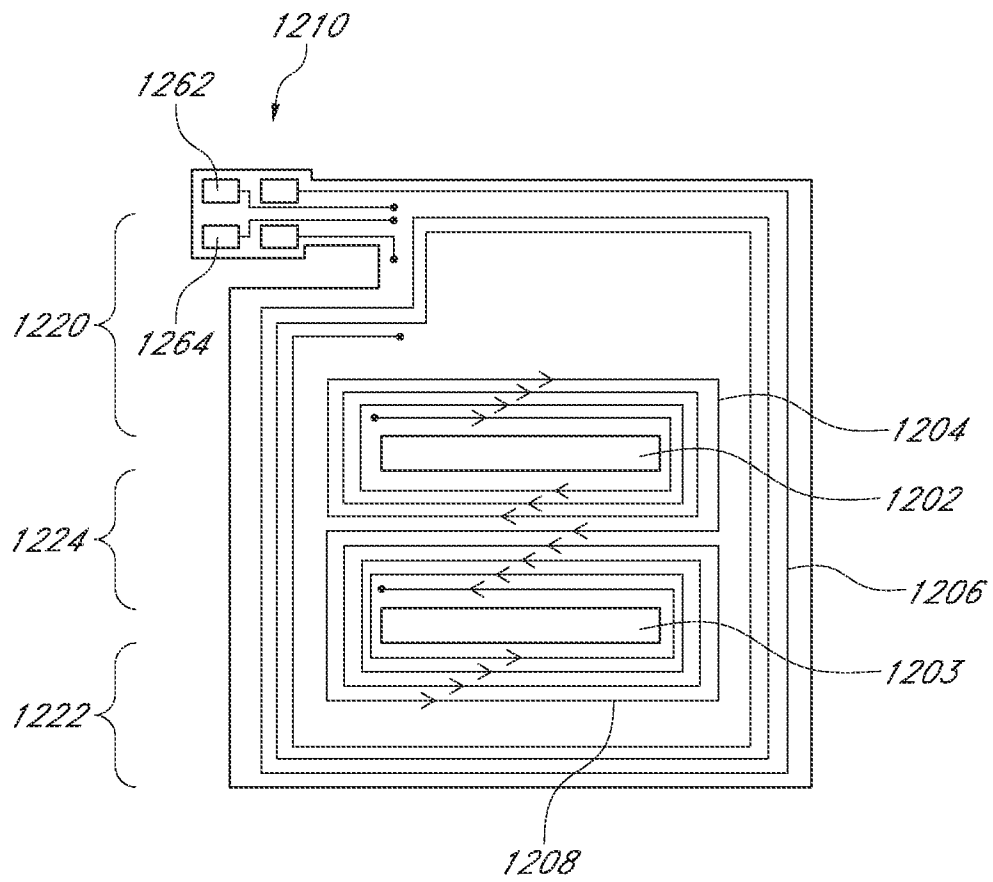


FIG. 20

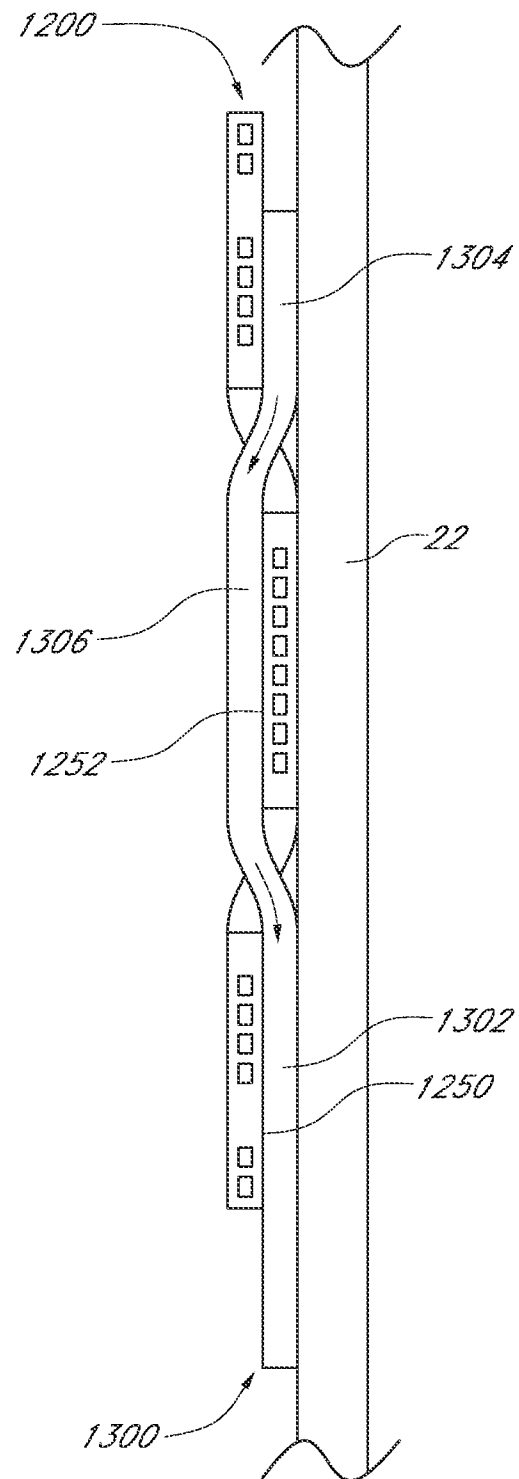


FIG. 21

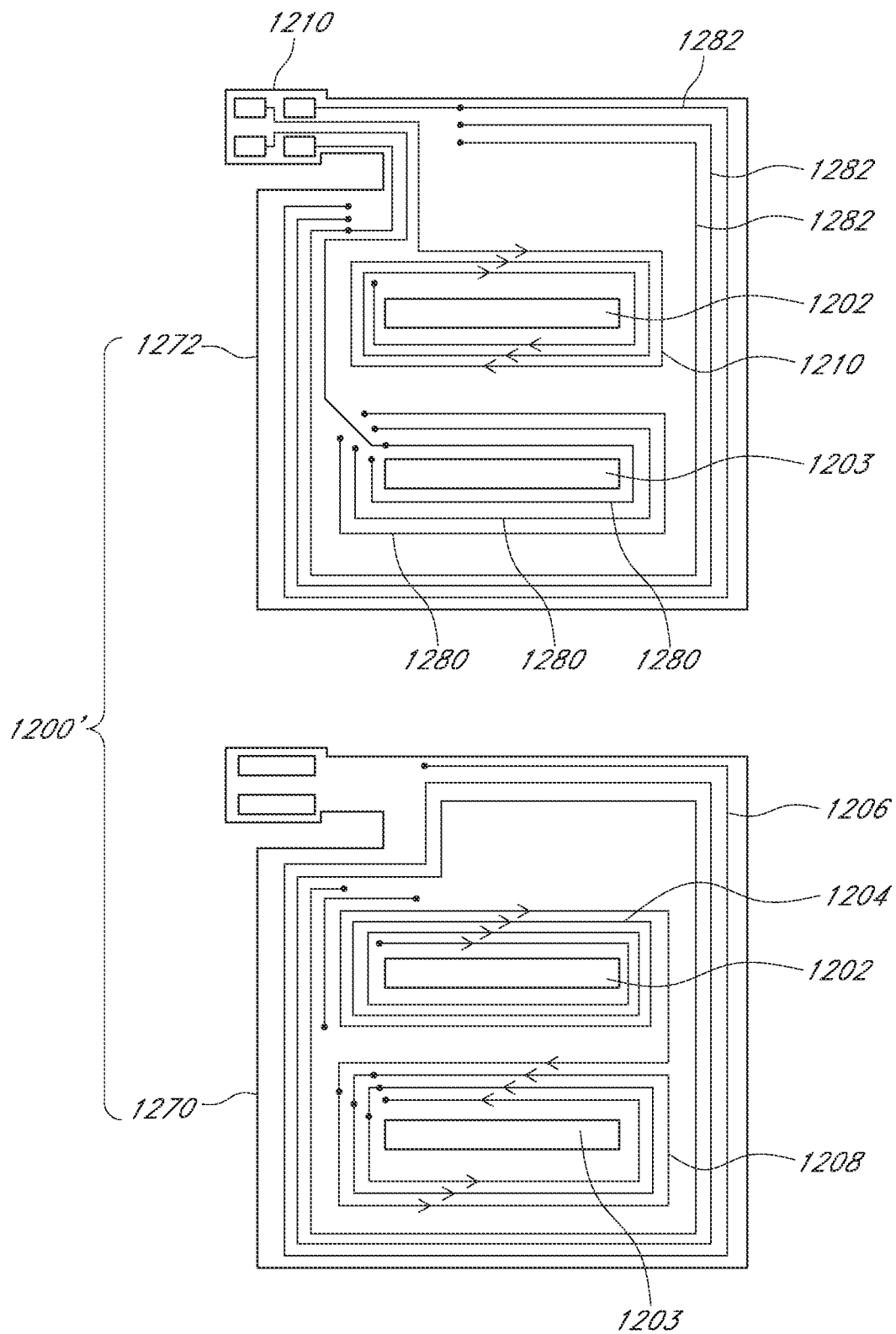


FIG. 22

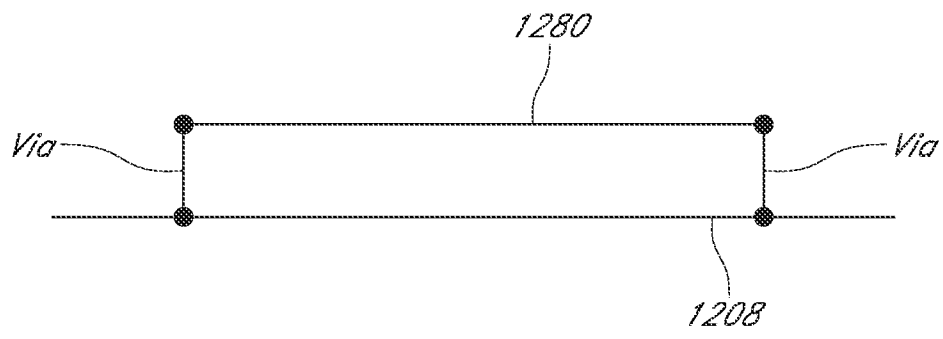


FIG. 23A

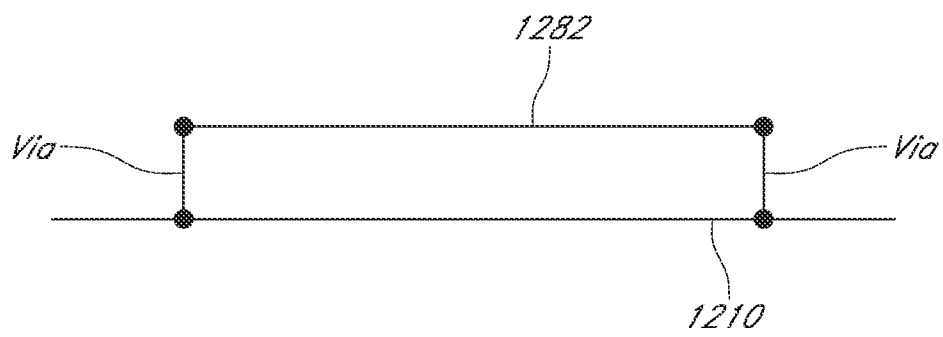
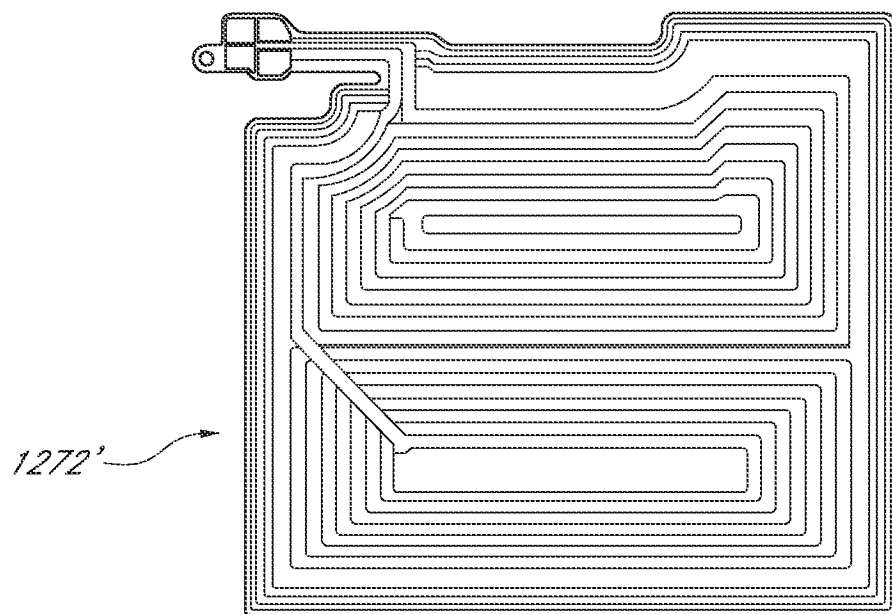
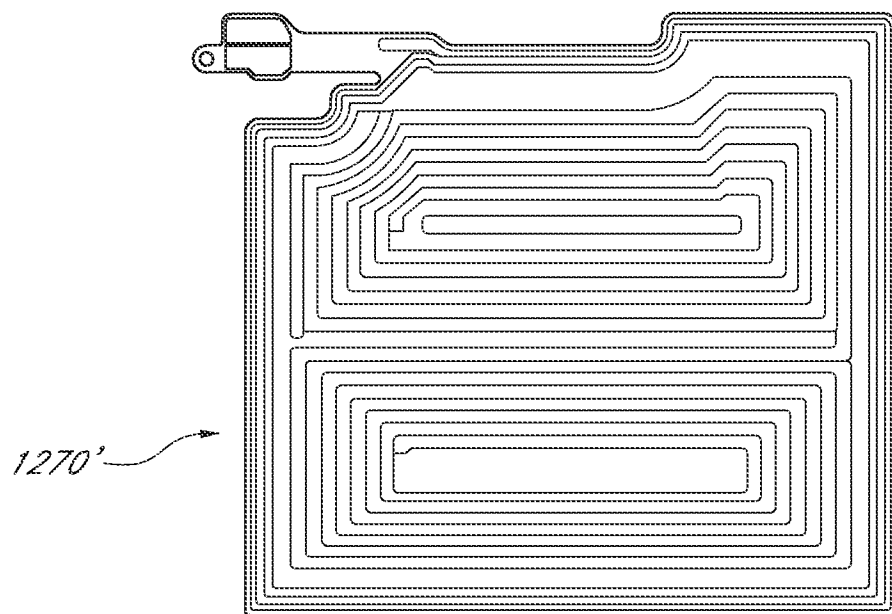


FIG. 23B

FIG. 24



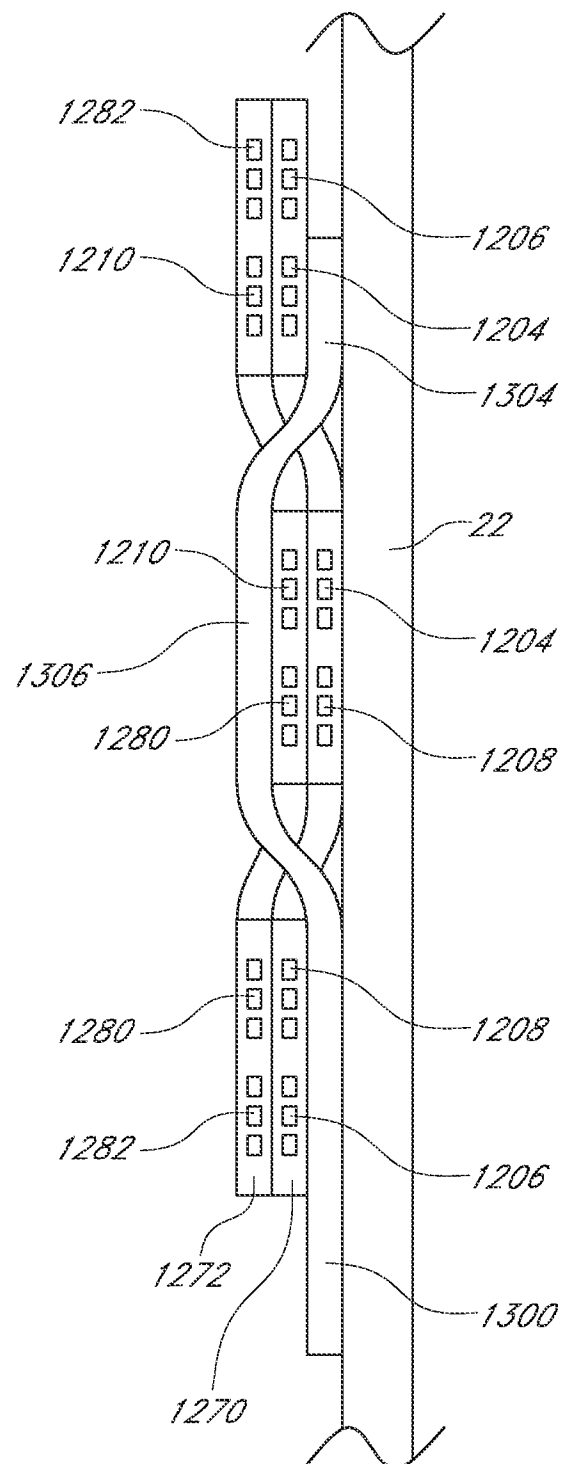
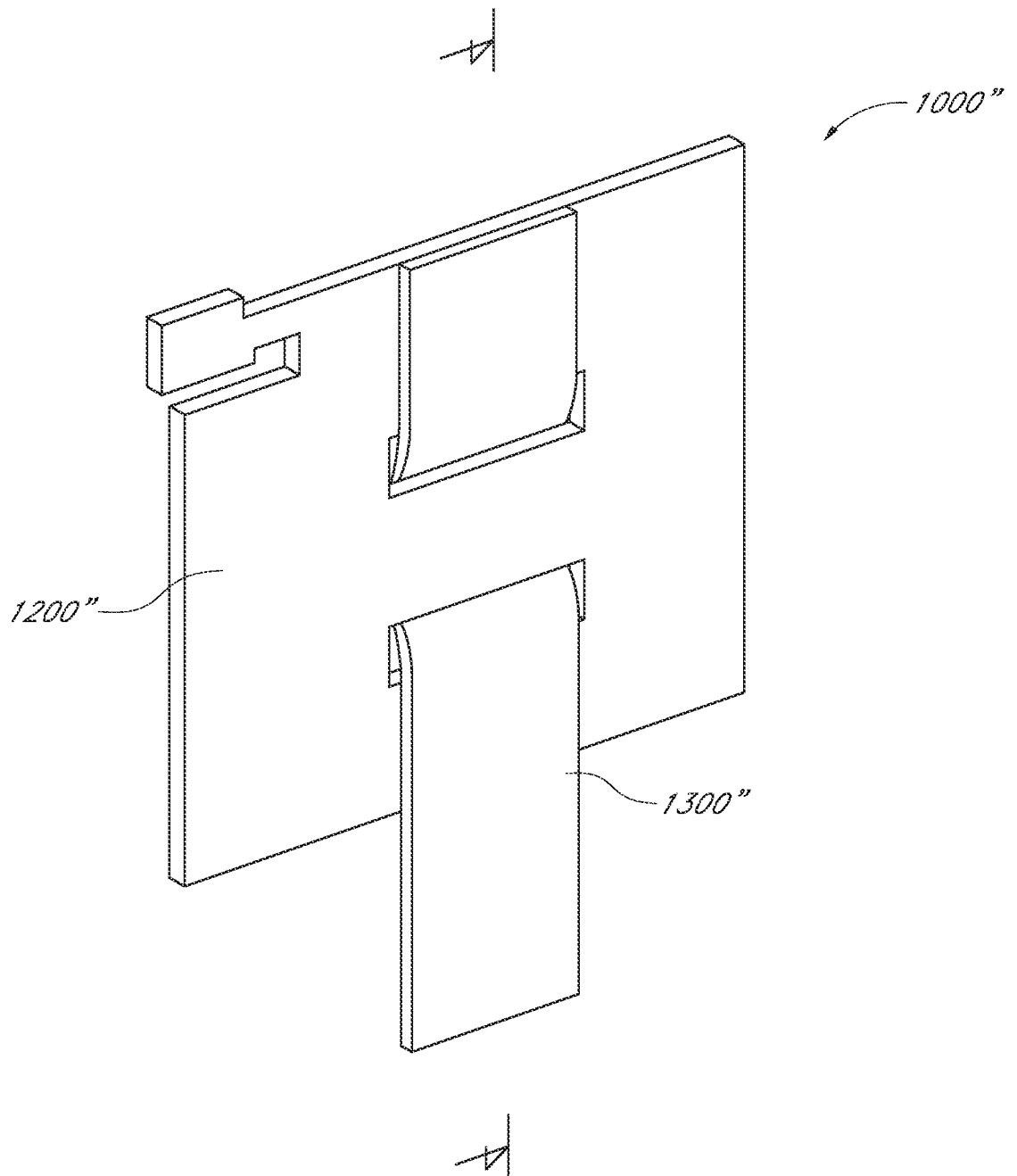


FIG. 25

FIG. 26



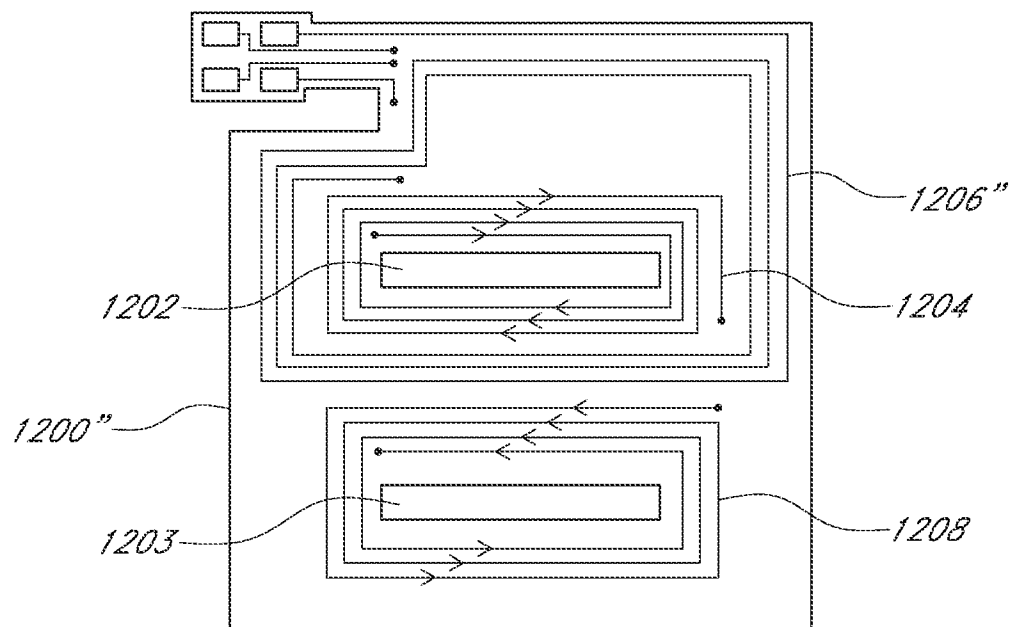


FIG. 27

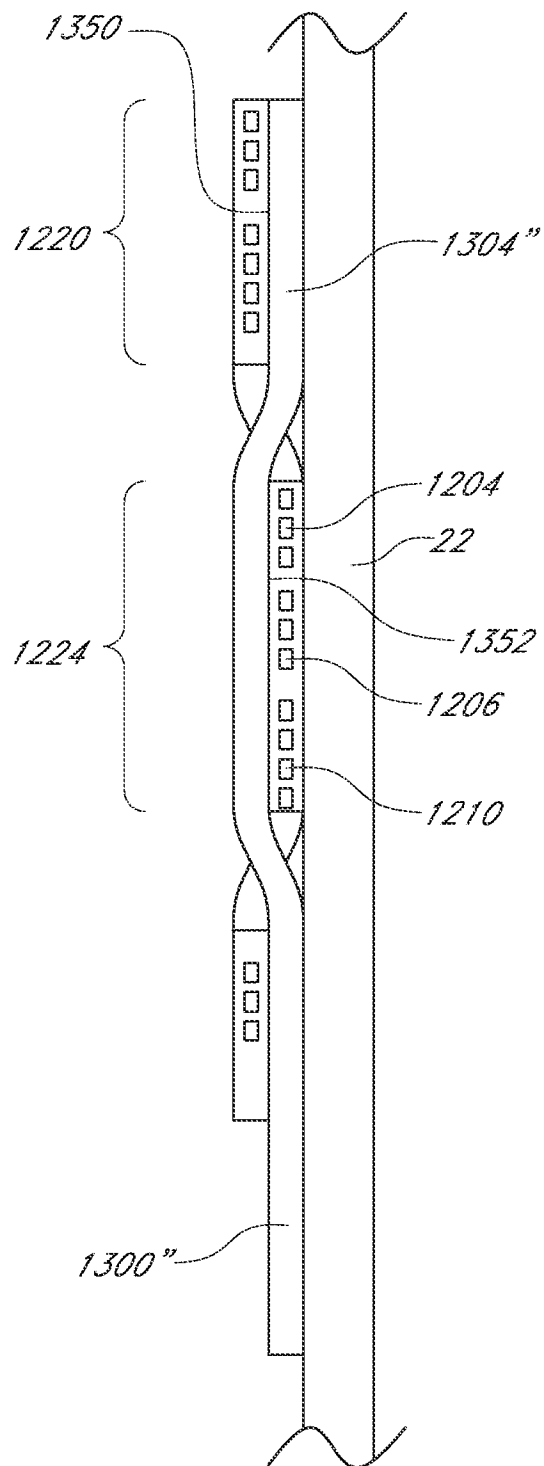


FIG. 28

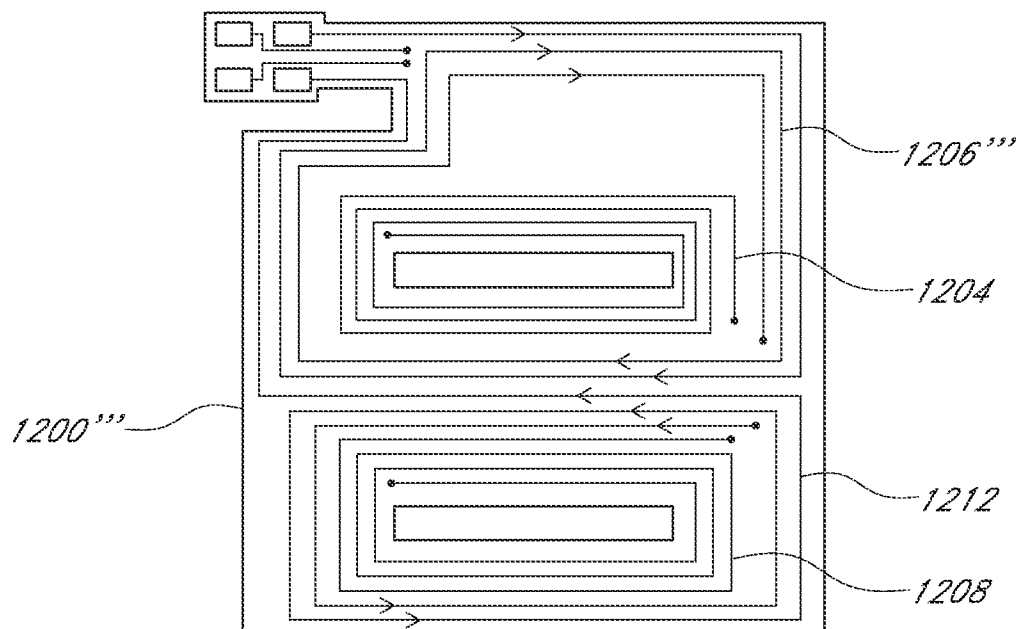


FIG. 29

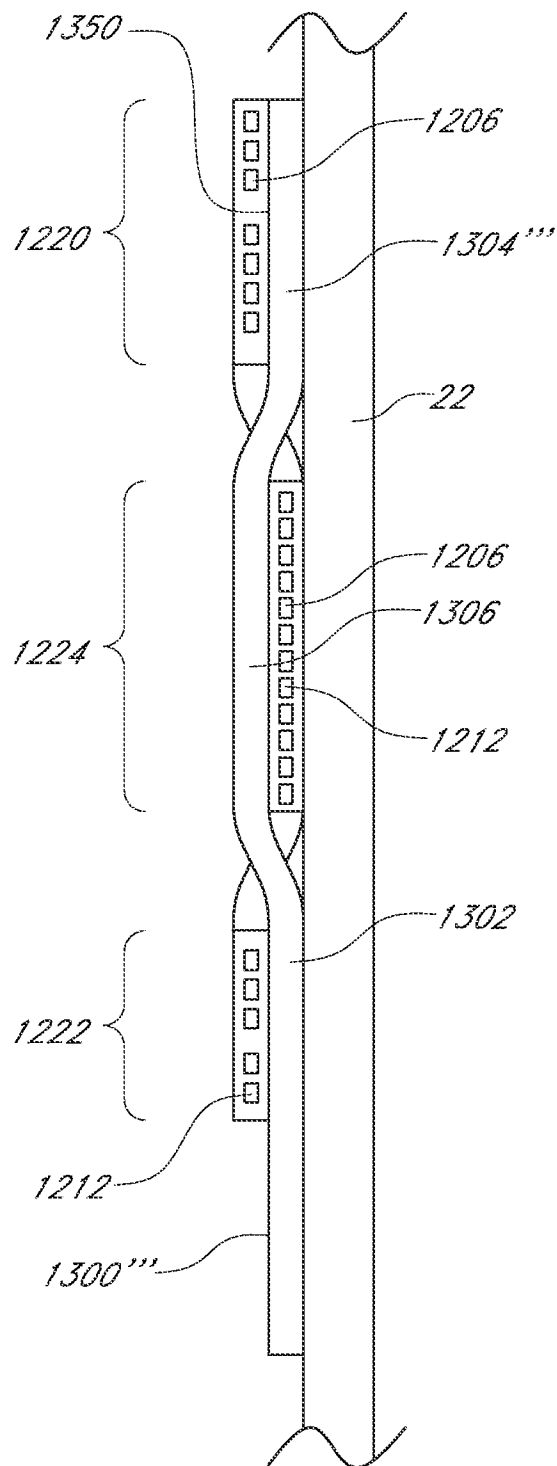
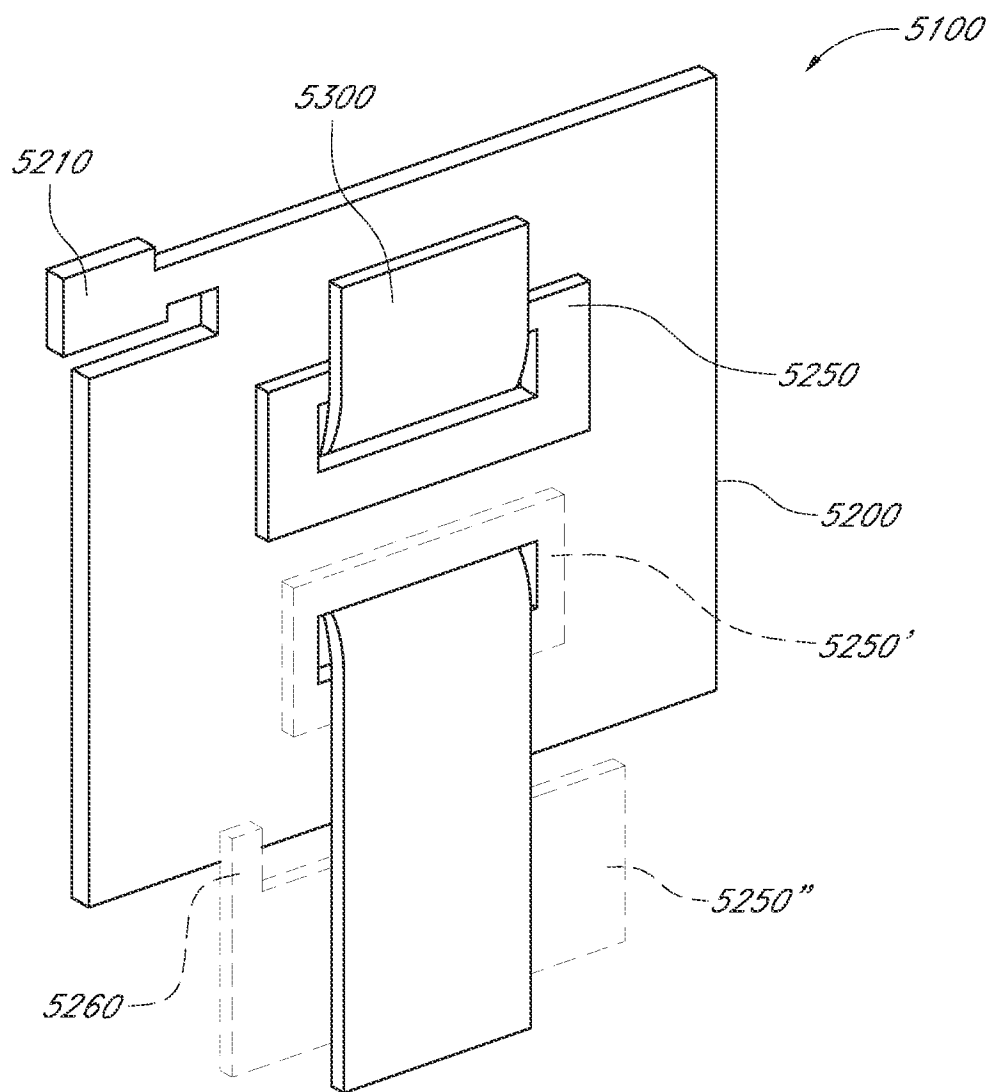


FIG. 30

FIG. 31



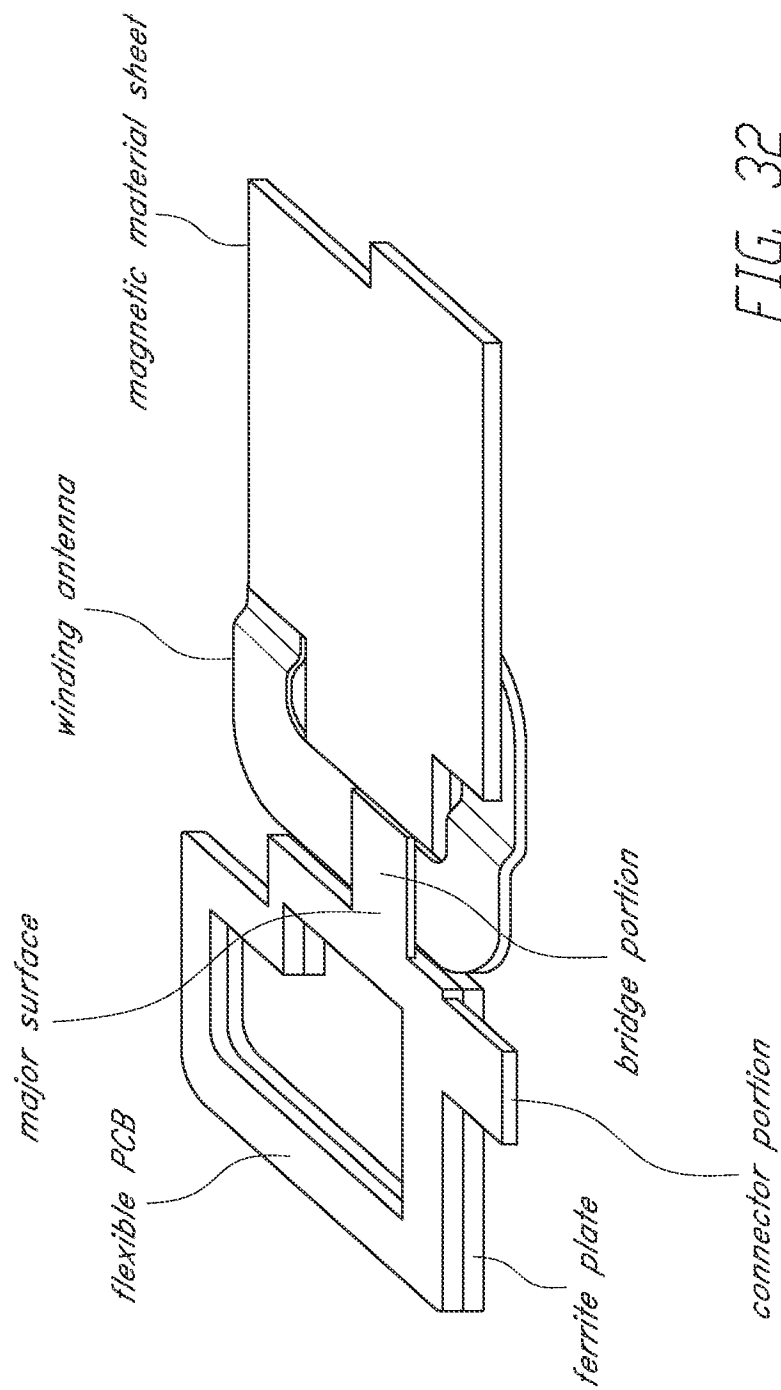


FIG. 32

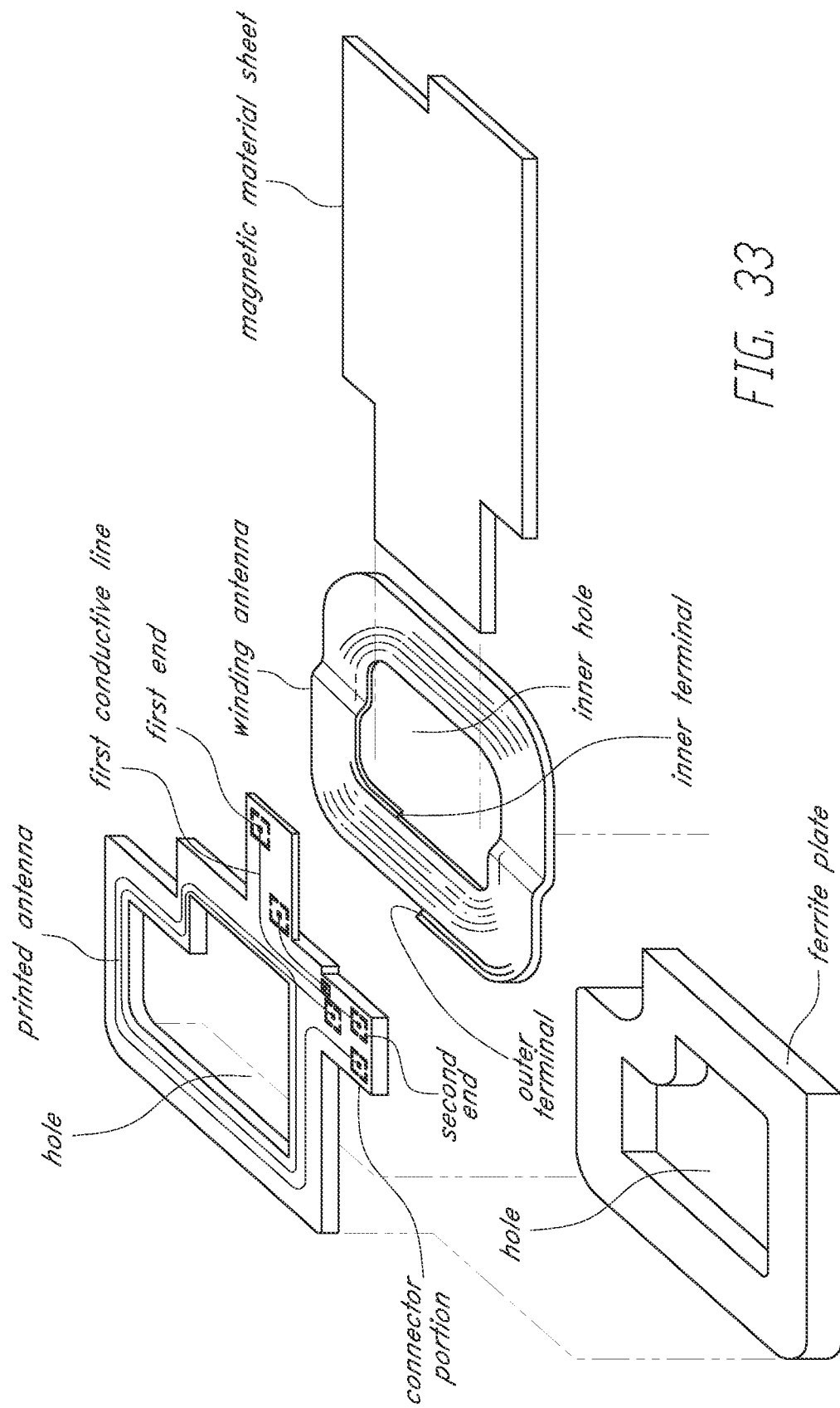


FIG. 33

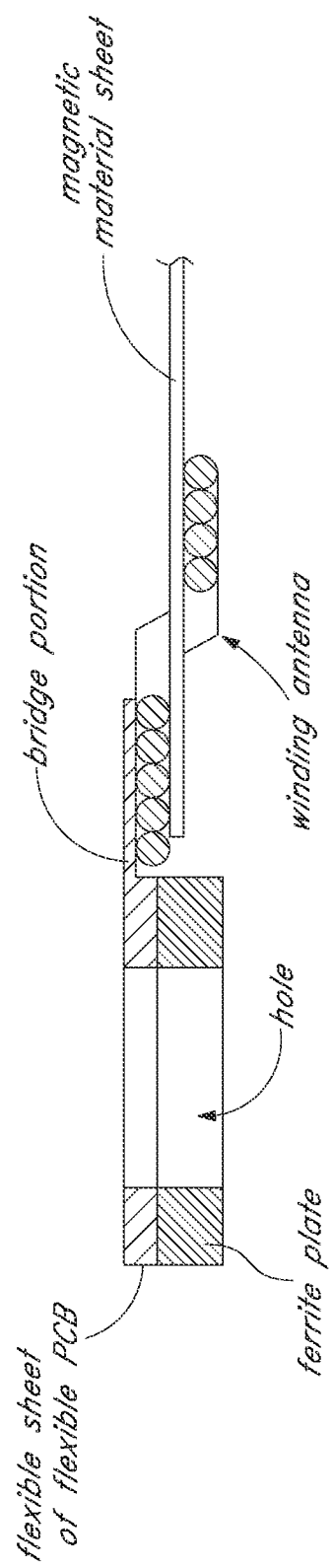


FIG. 34

FIG. 35

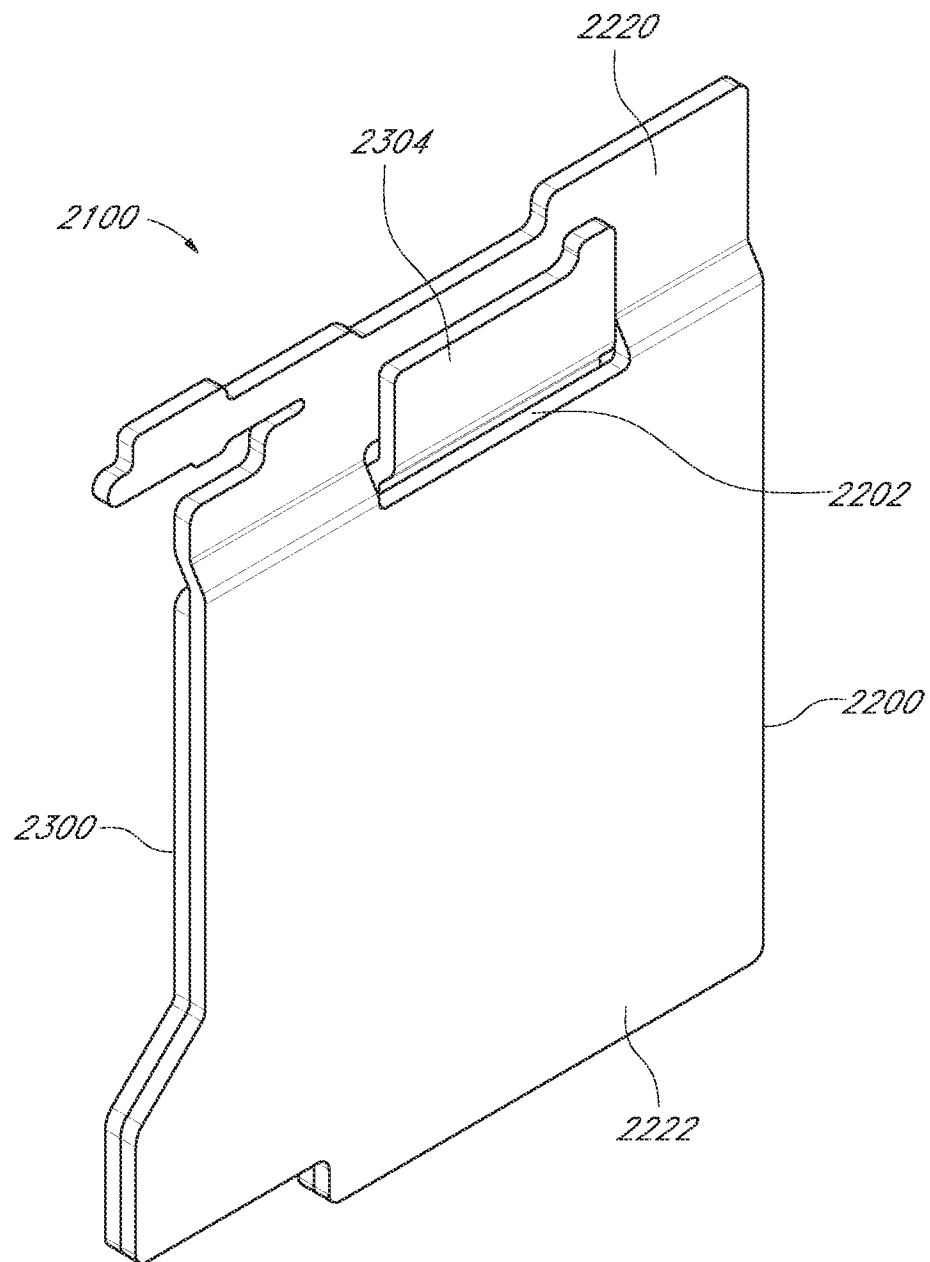


FIG. 36

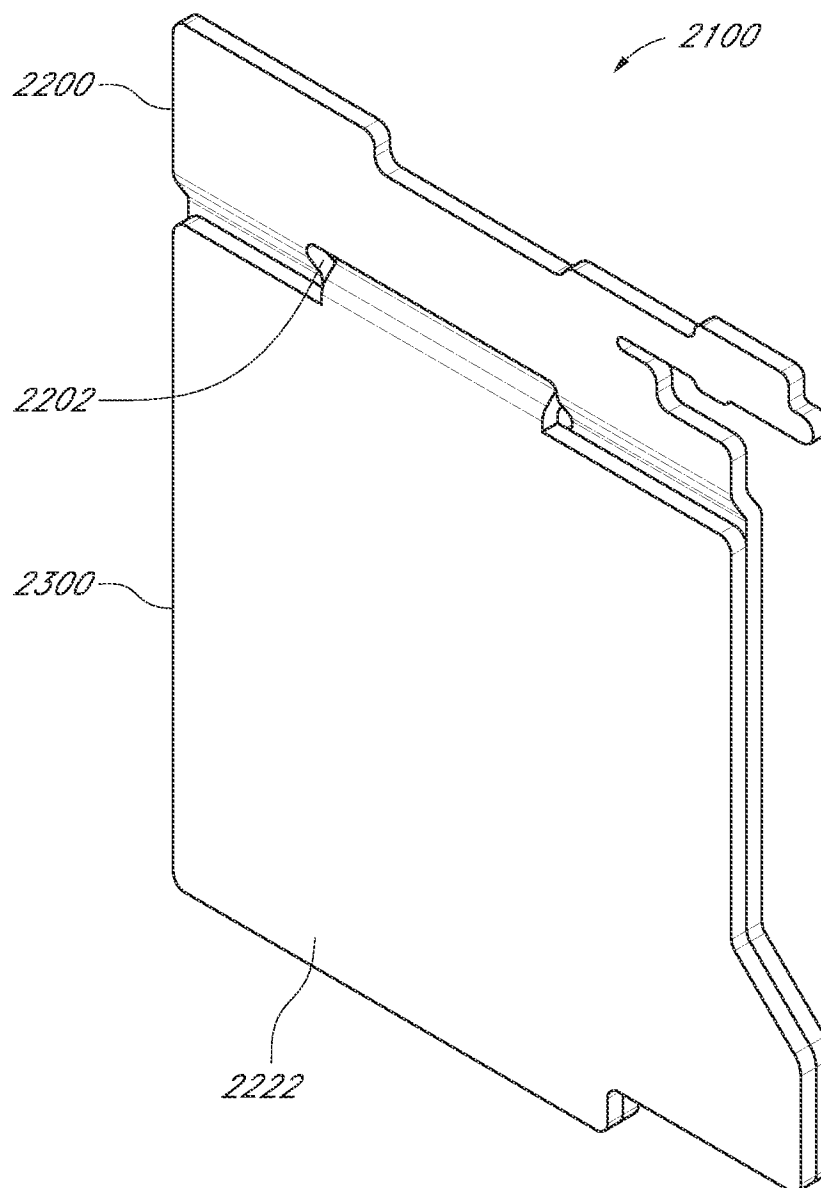


FIG. 38

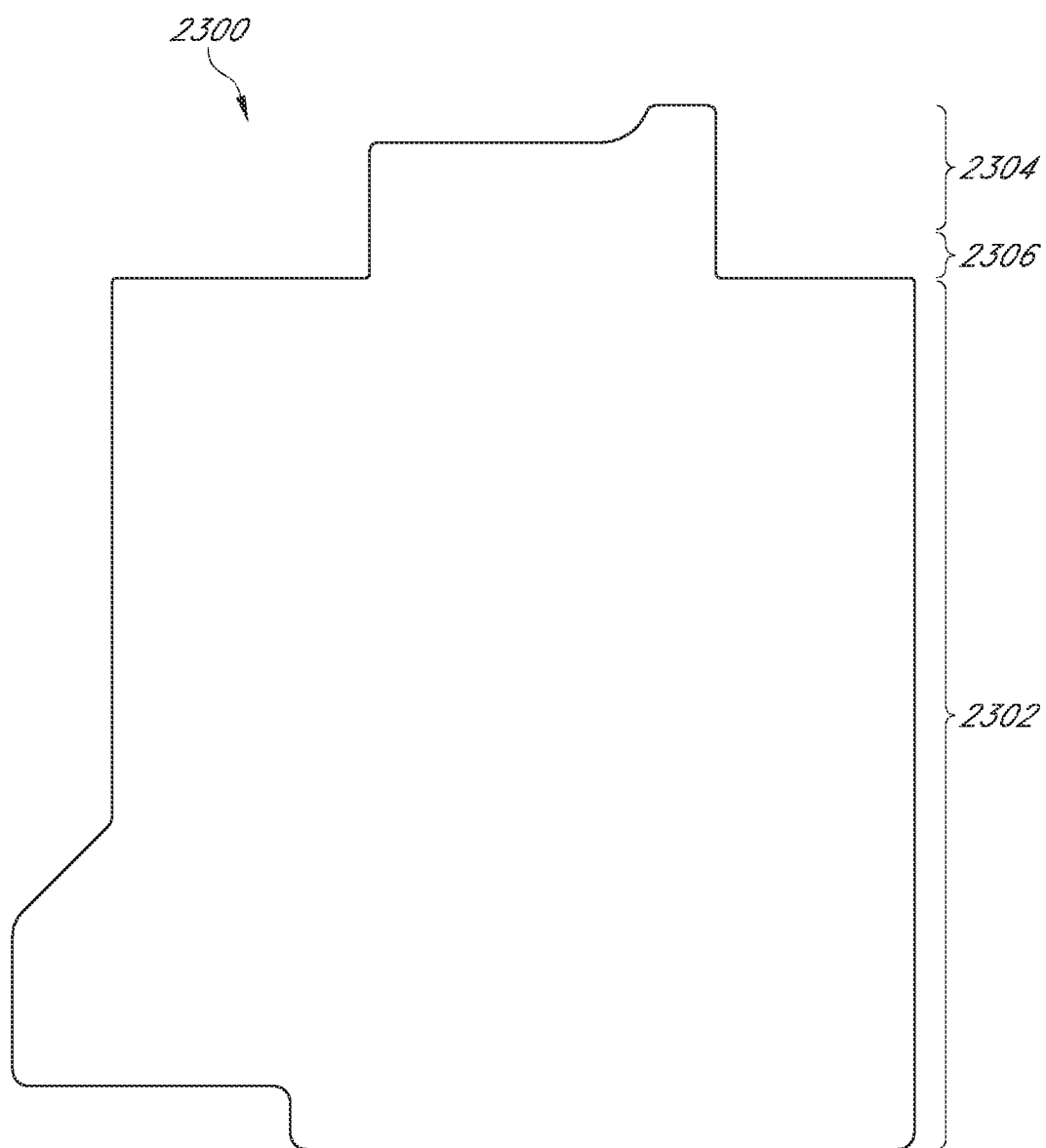


FIG. 39

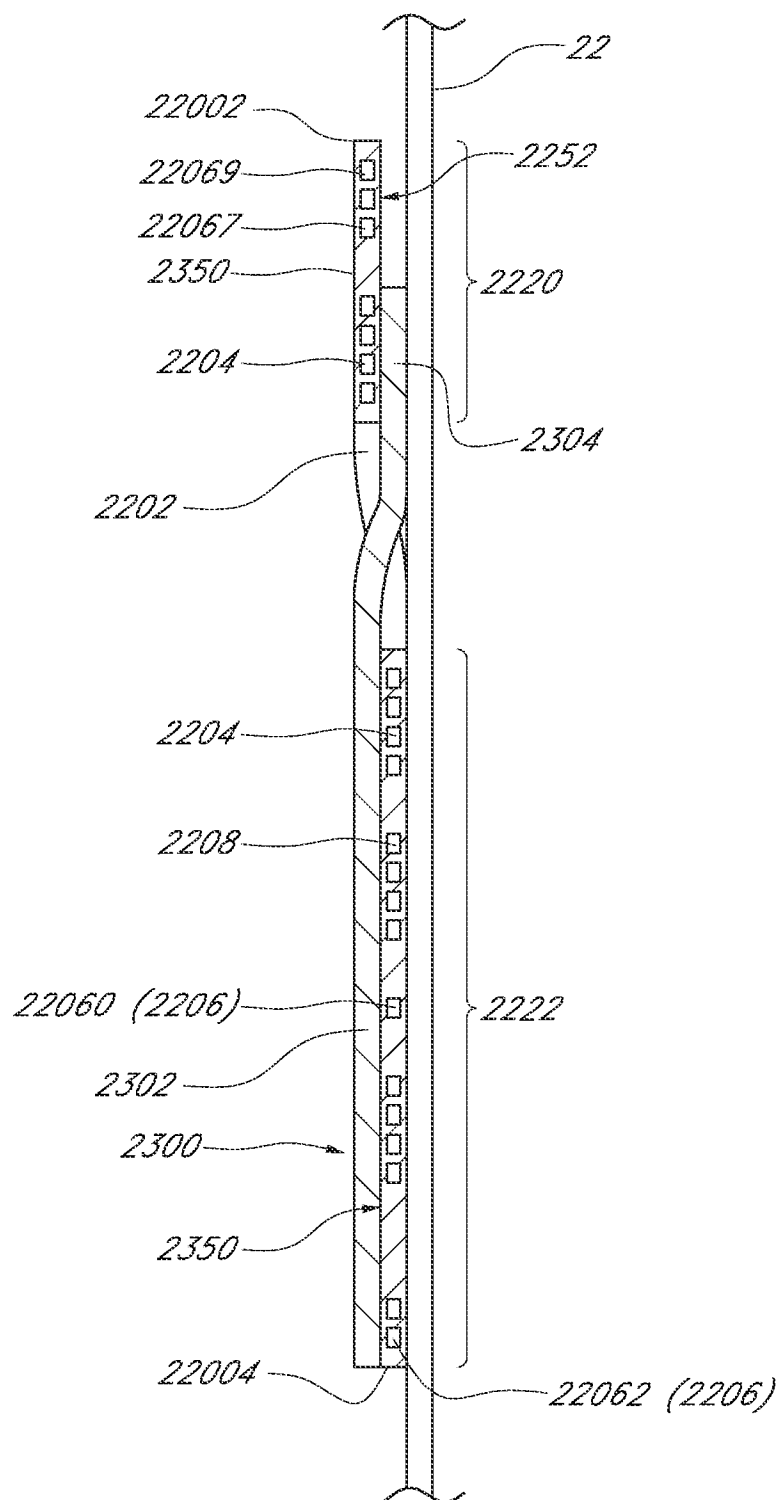


FIG. 40

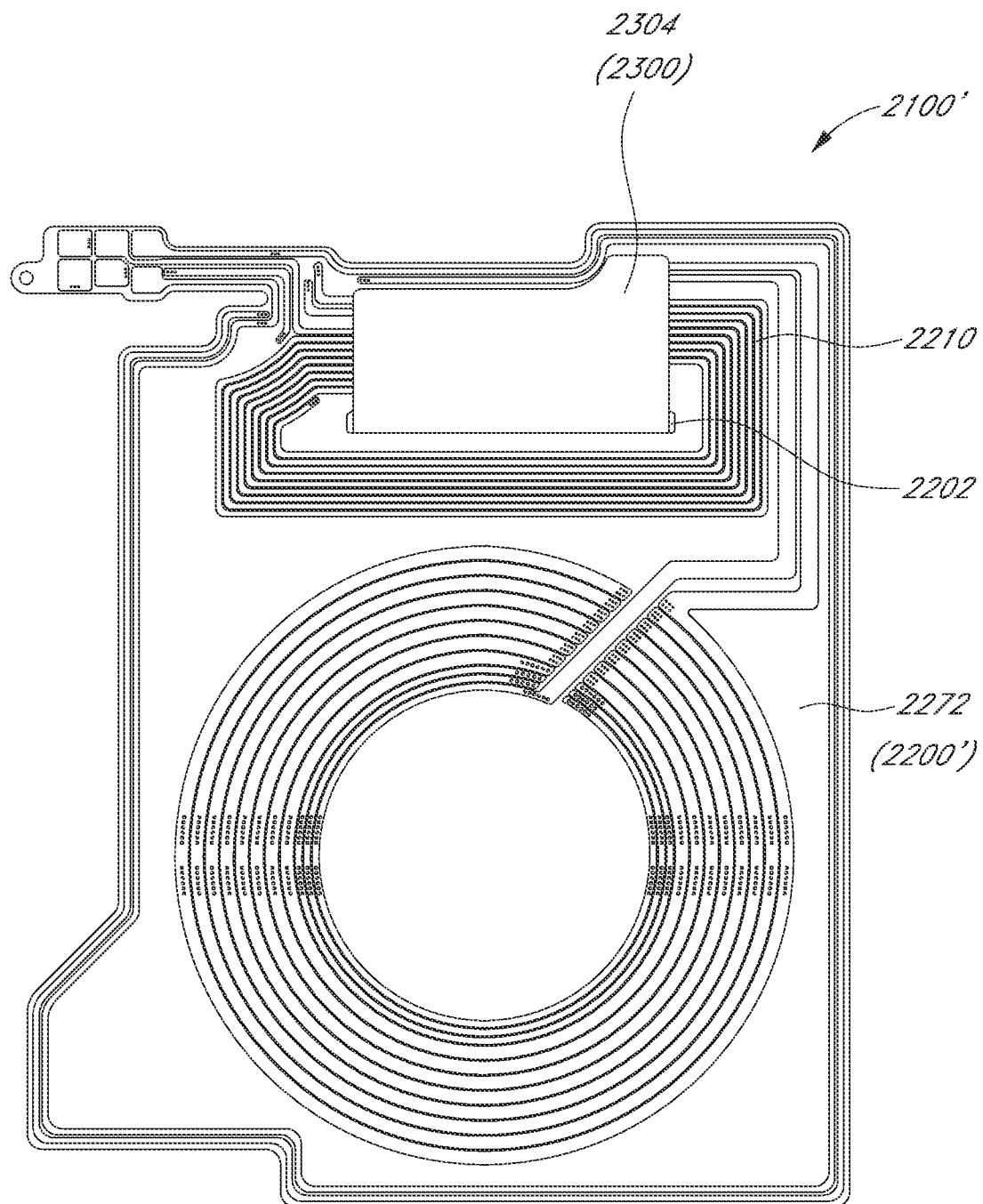


FIG. 41

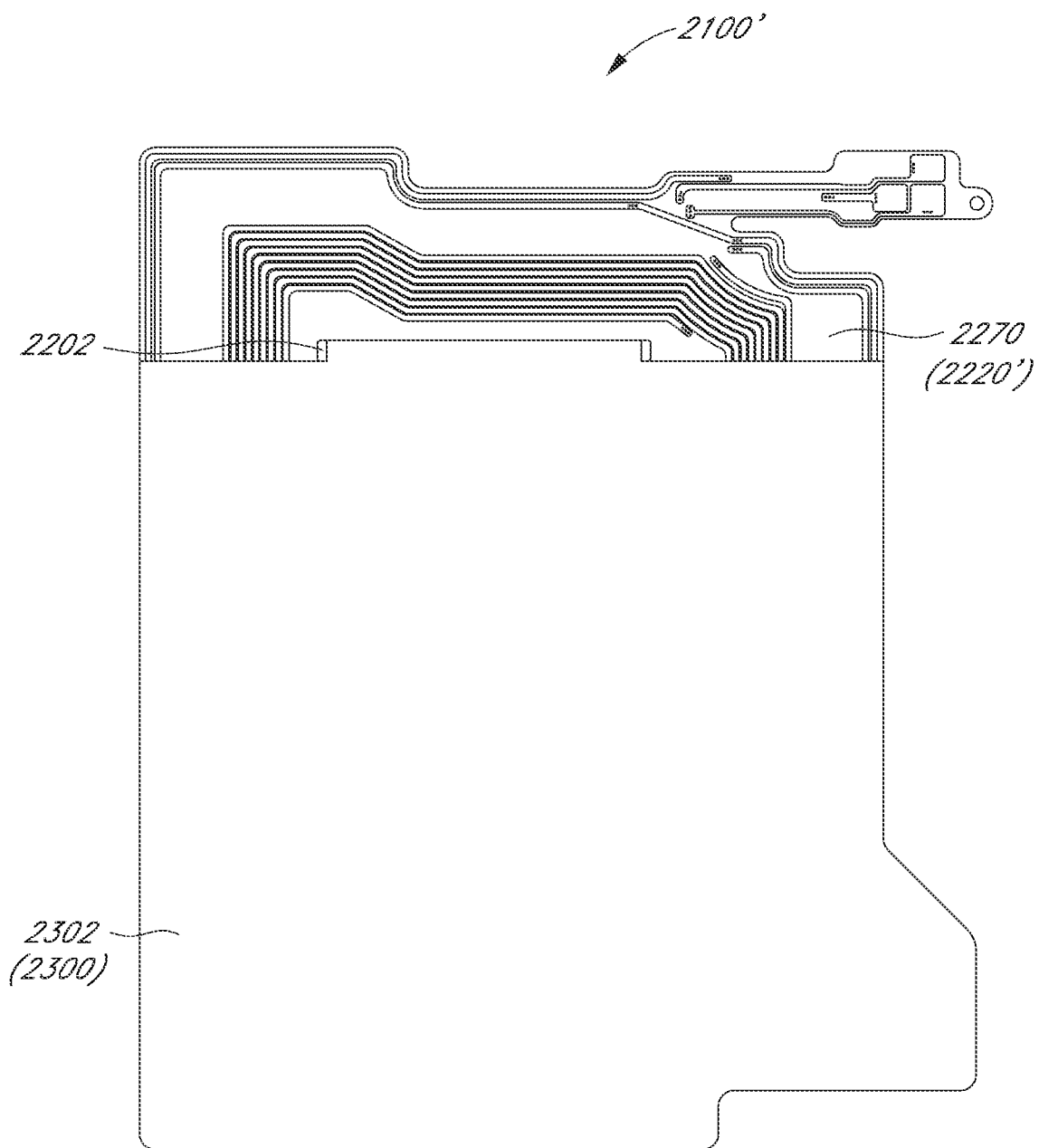
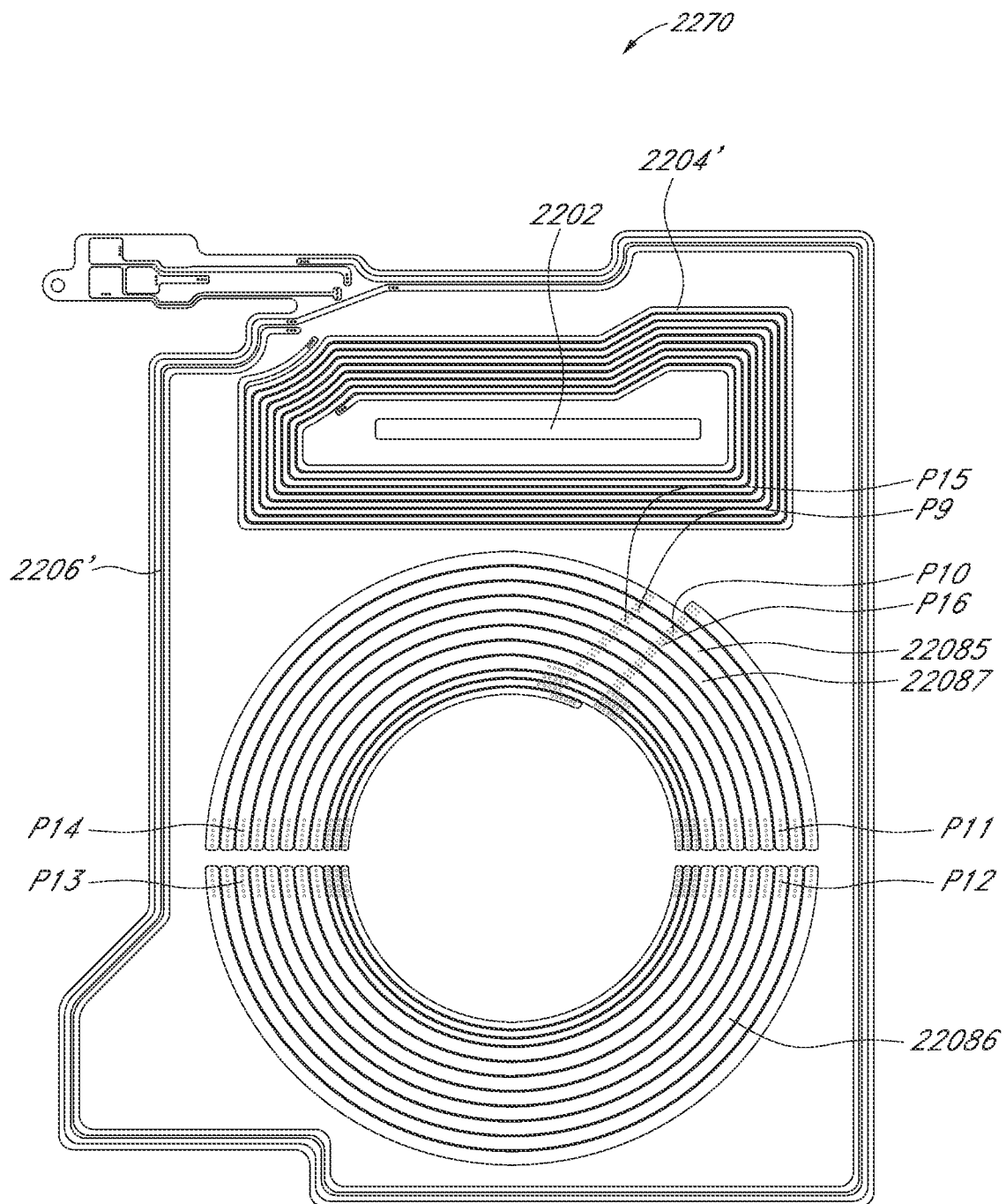


FIG. 43



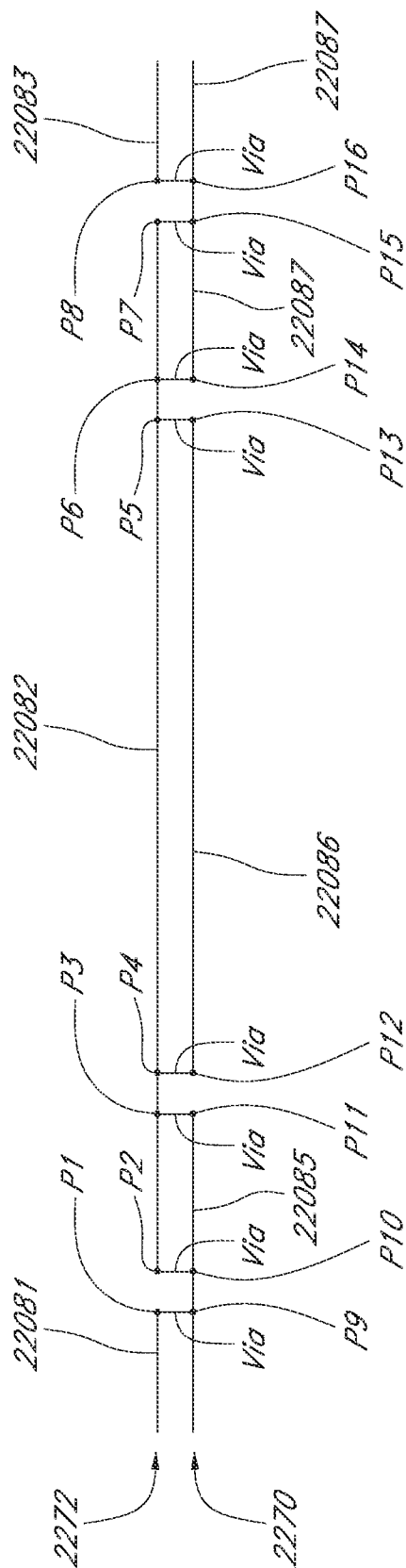


FIG. 44

FIGURE 45

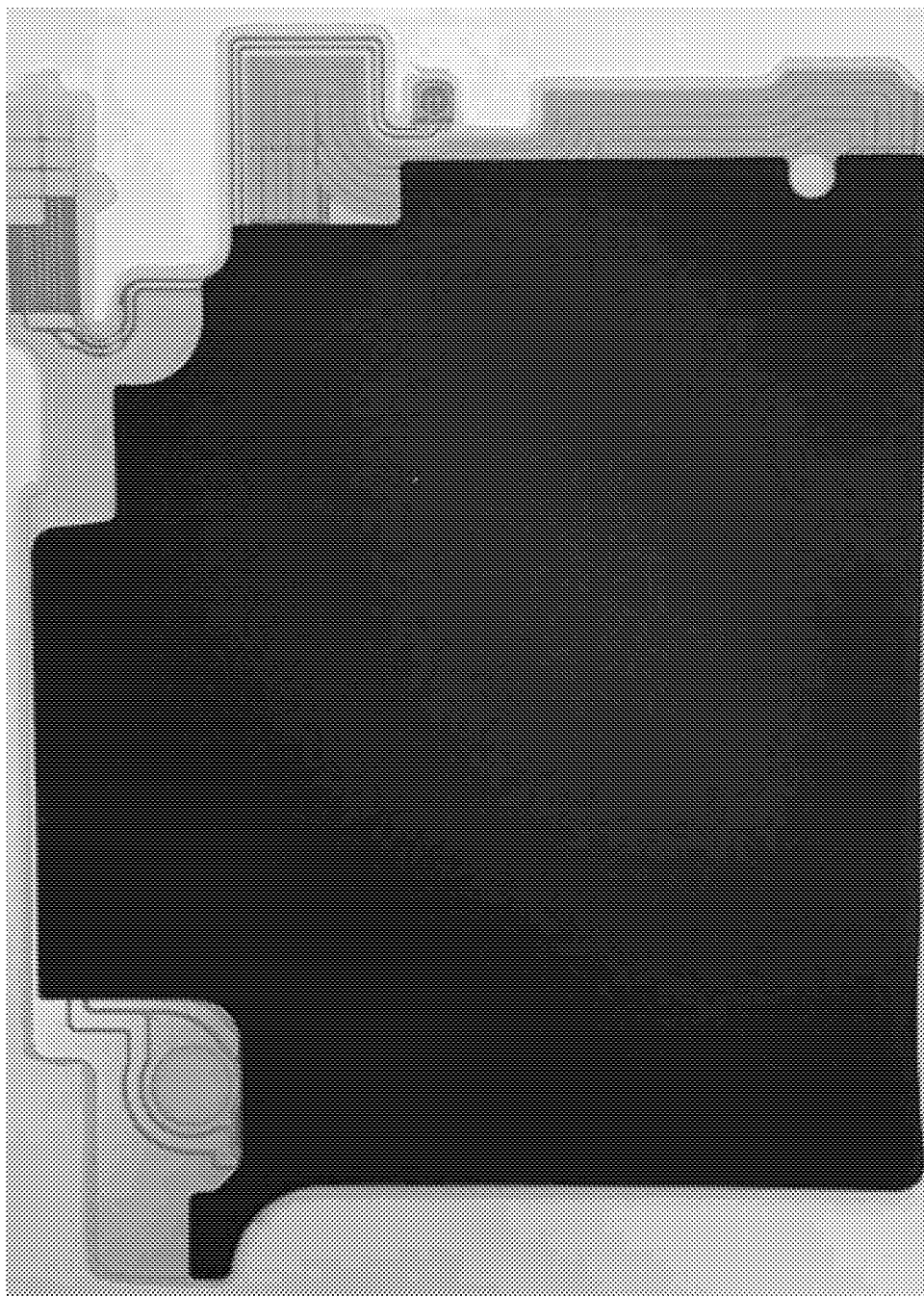


FIGURE 46

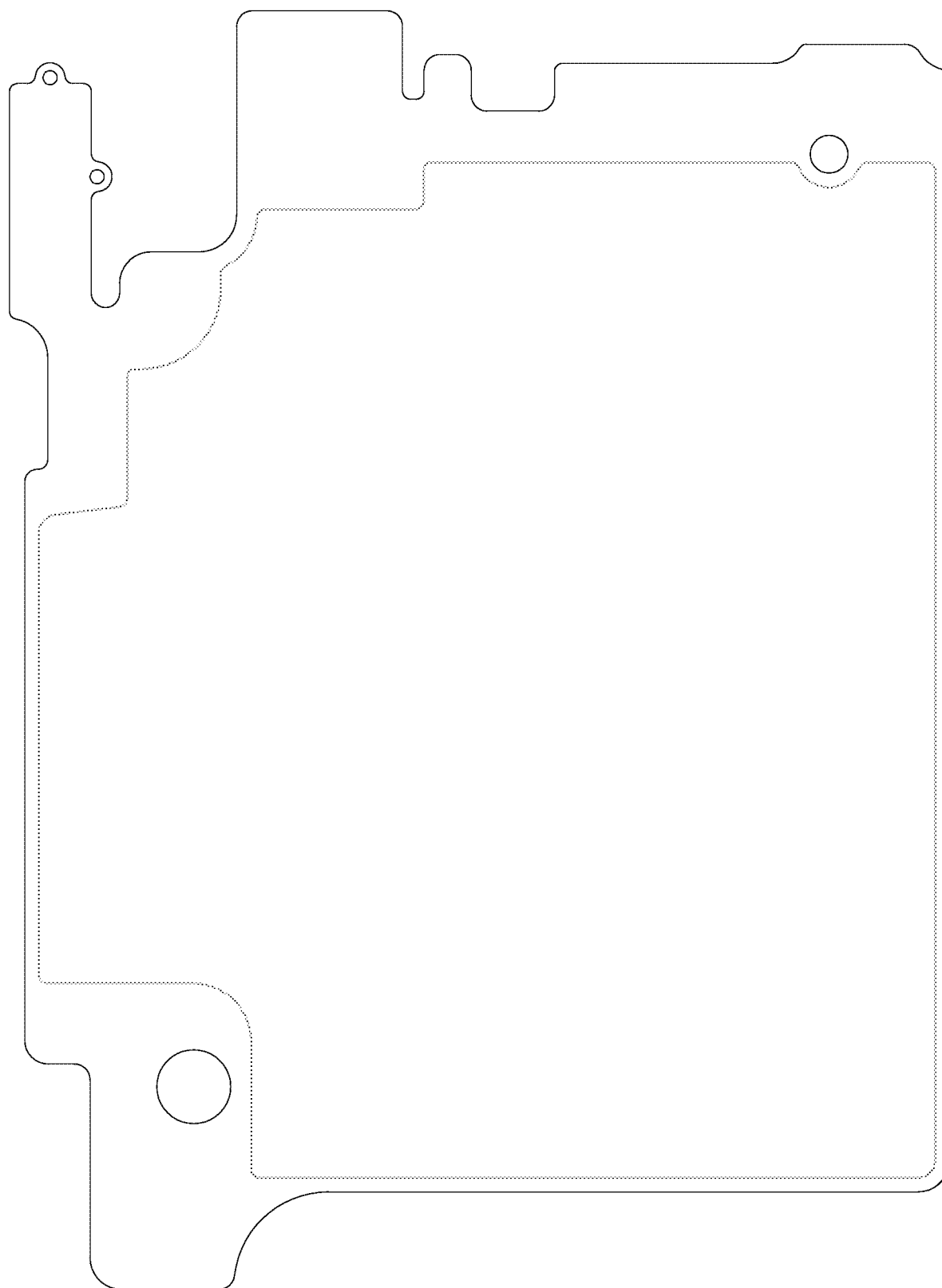


FIGURE 47

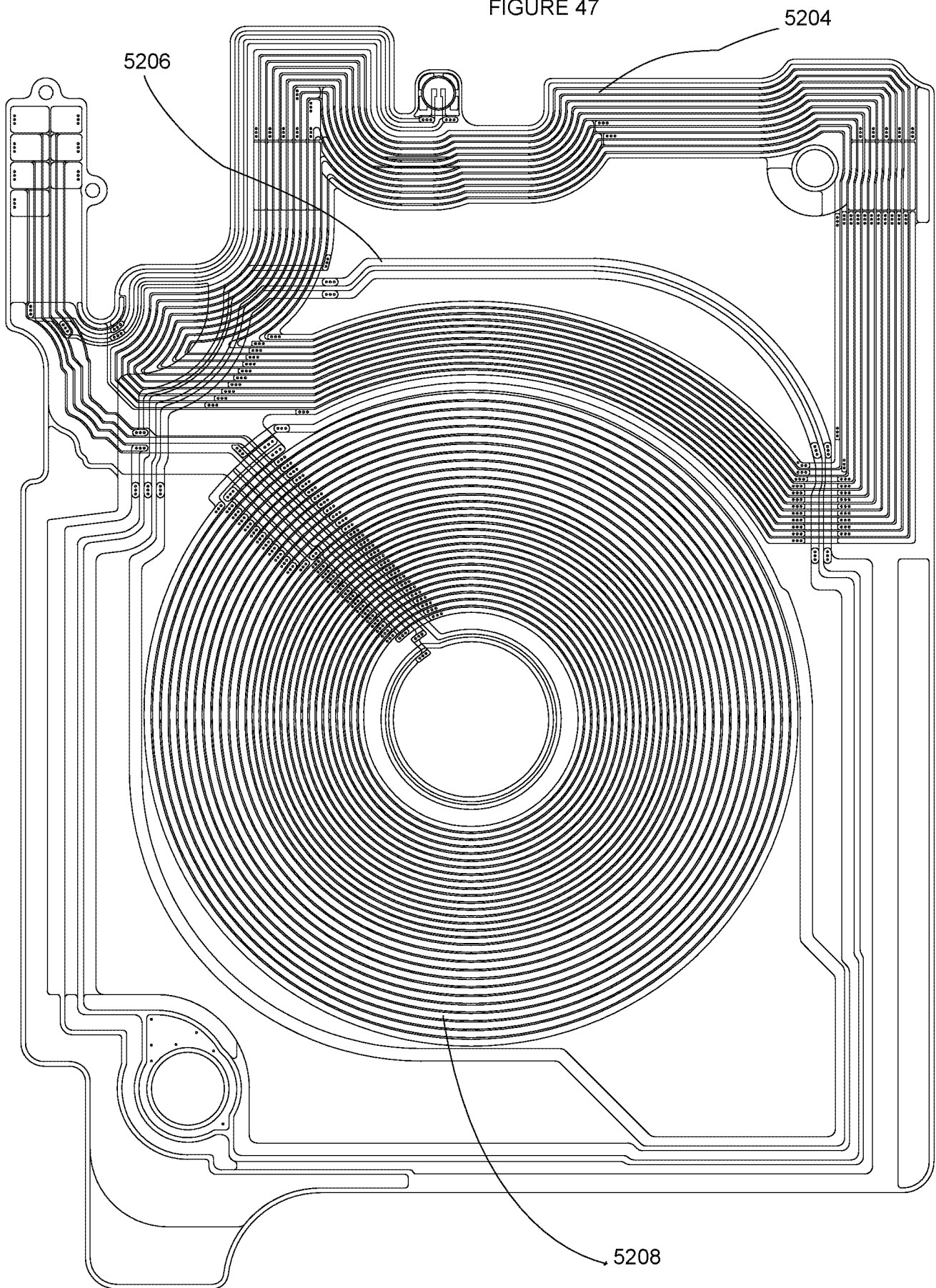


FIGURE 48

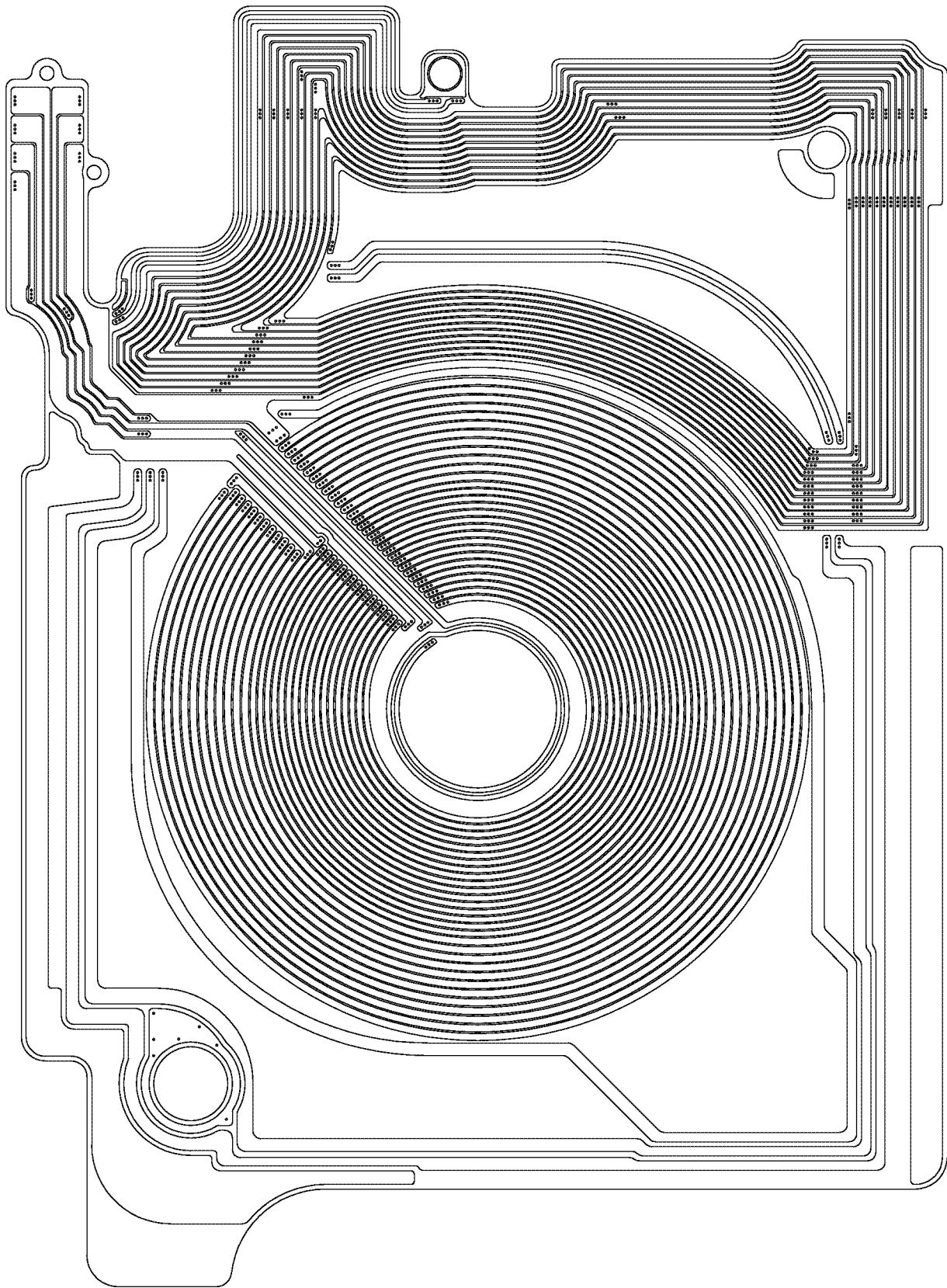


FIGURE 49

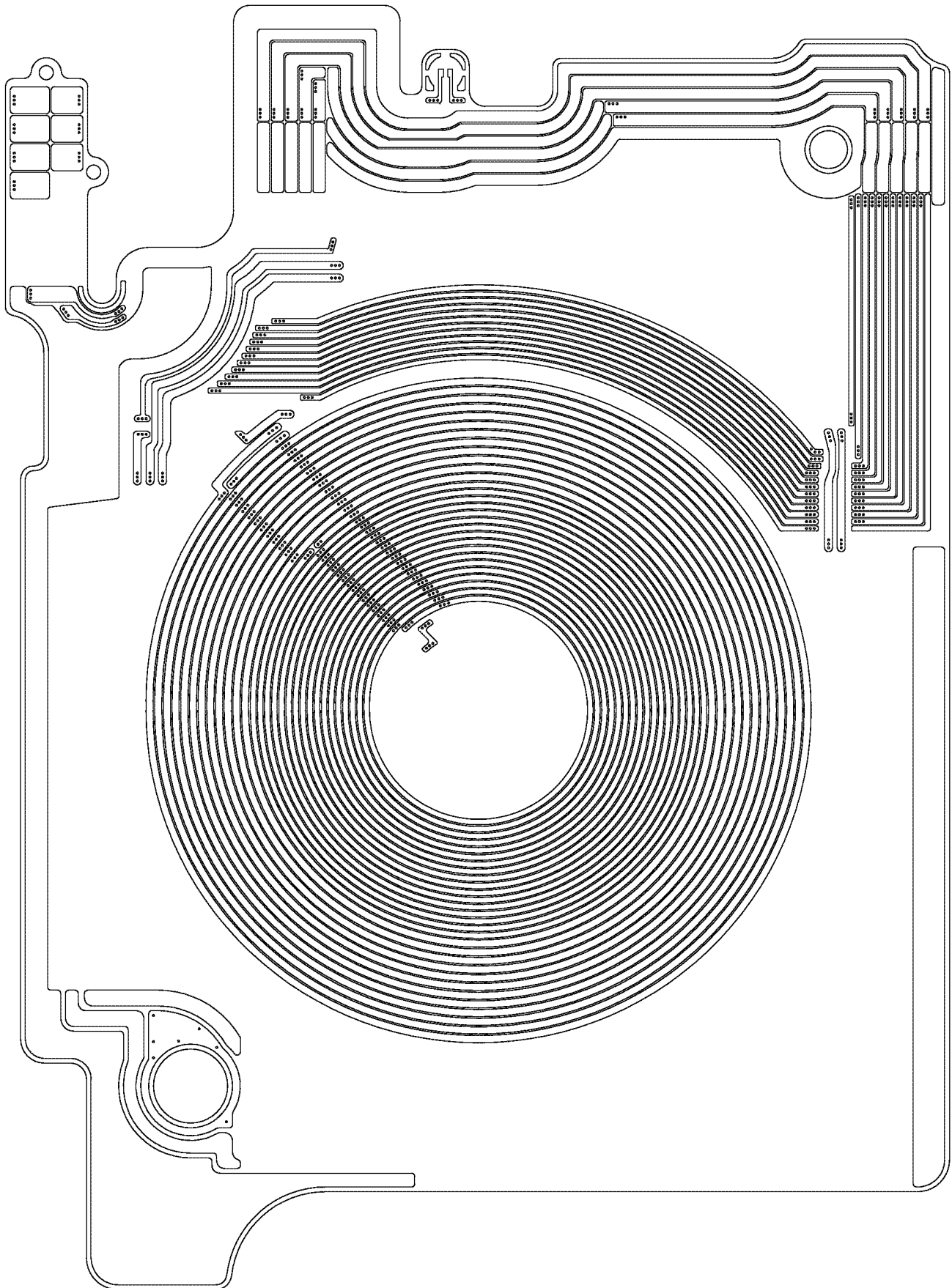


FIGURE 50

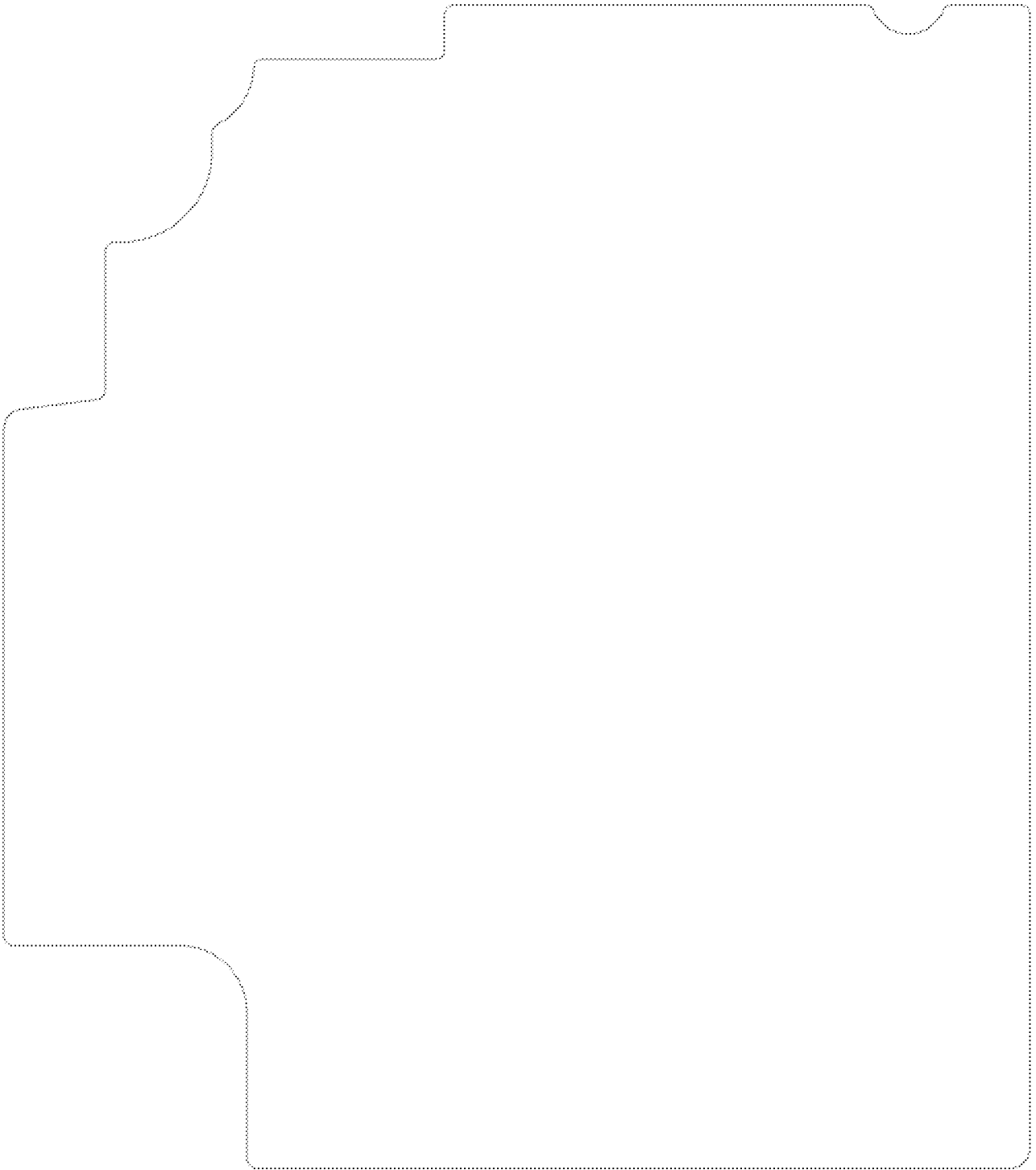
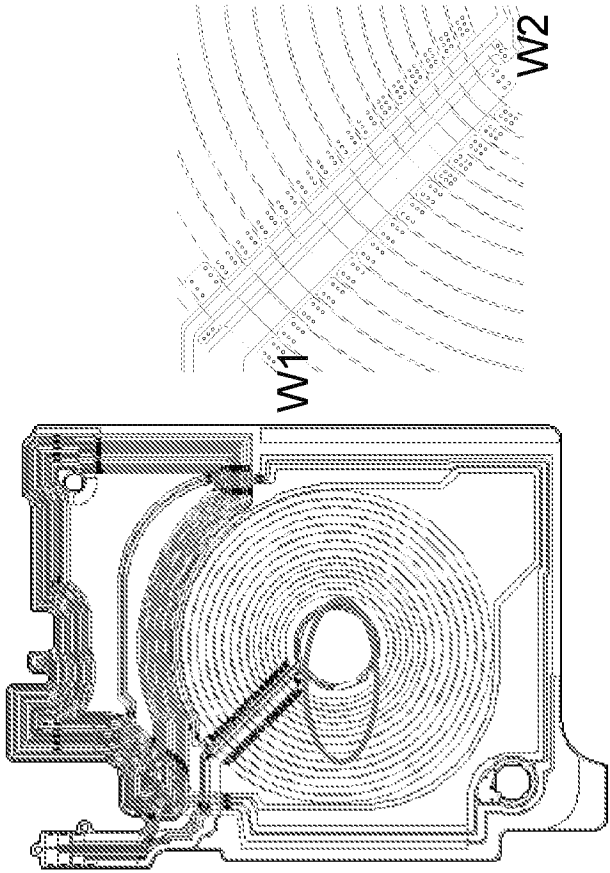
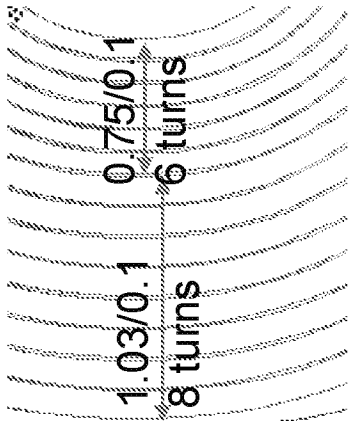


FIGURE 51

Examples of sheet-like smartphone antenna with different WPC coil design

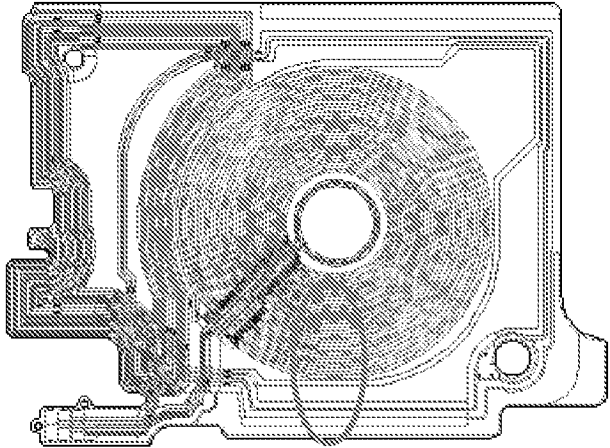
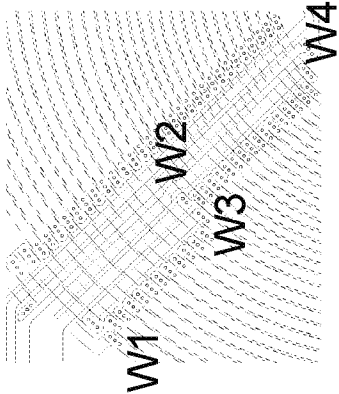
<Example of non-parallel-coil design>



Total 14 turns (9.35uH / 0.27Ω)

(a)

<Example of parallel-coil design>



<Outer coil>

line width 0.45 mm
12 turns

space 0.1mm

<Inner coil>

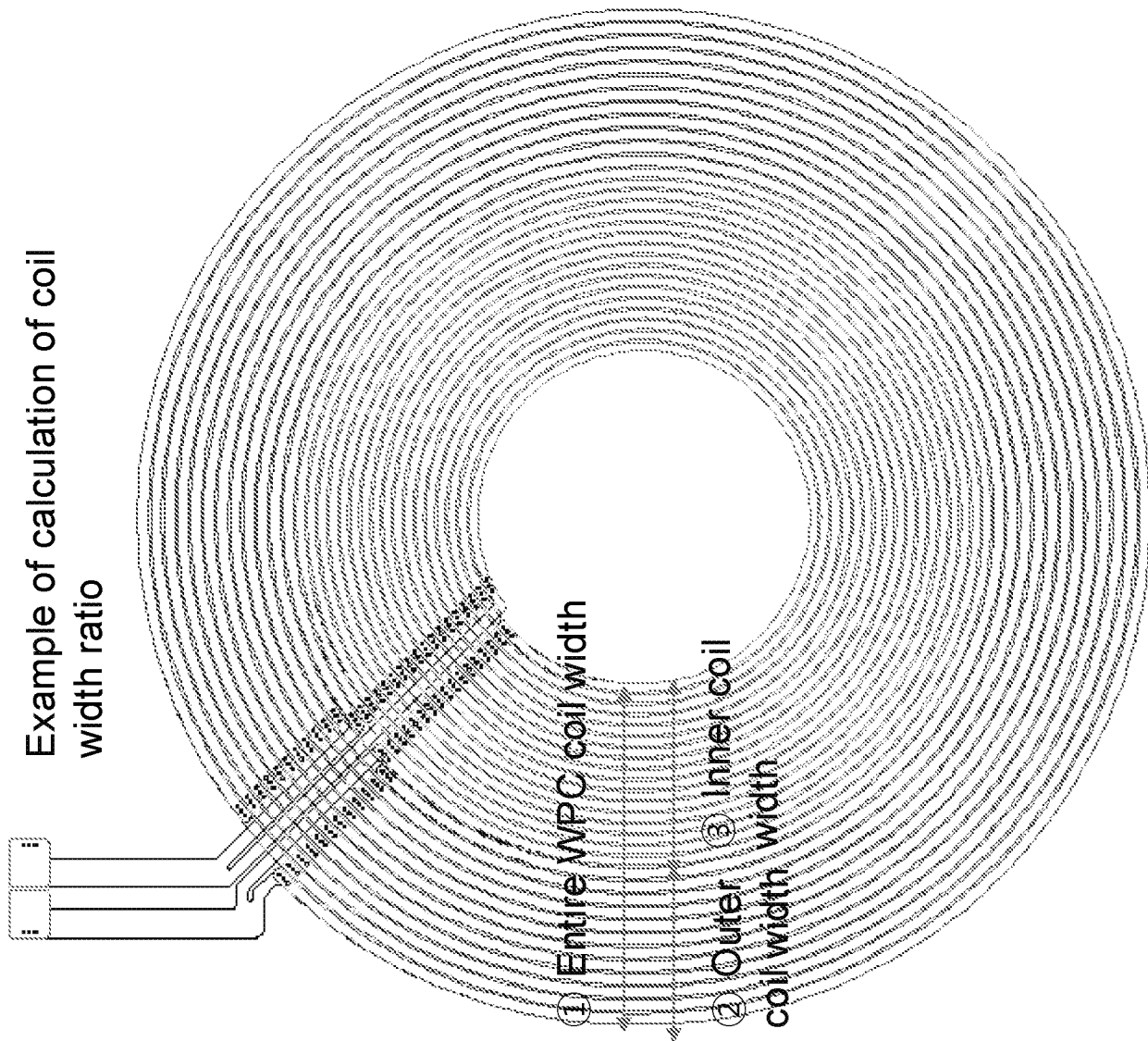
line width 0.35mm
17 turns

space 0.1mm

Total 29 Turns (10.52uH / 0.3Ω)

(b)

Example of calculation of coil width ratio



- ① Entire WPC coil width : 14.15mm (100%)
- ② Outer coil width: : 6.5mm (46%) = line width 0.45 mmX12 turns + space between lines 0.1mmX11
- ③ Inner coil width: 7.55mm (53%) = line width 0.35mmX17 turns + space between lines 0.1mmX16

FIGURE 52

Examples of WPC coil – outer diameter: 42Ø, inner diameter: 14Ø

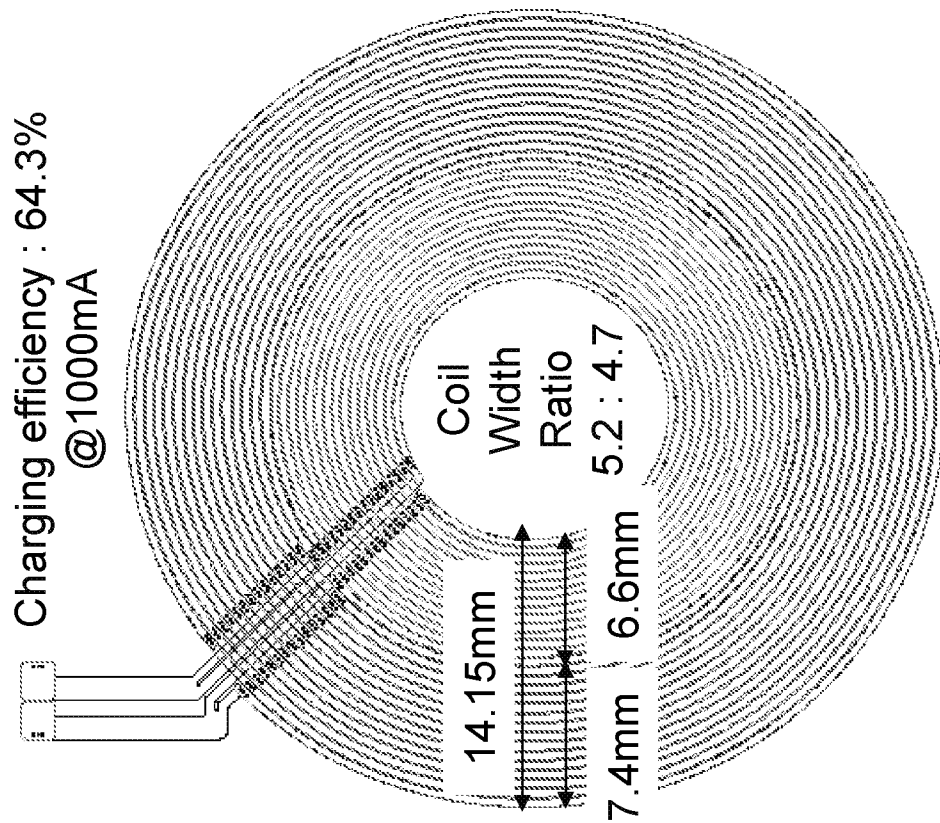


FIGURE 53B

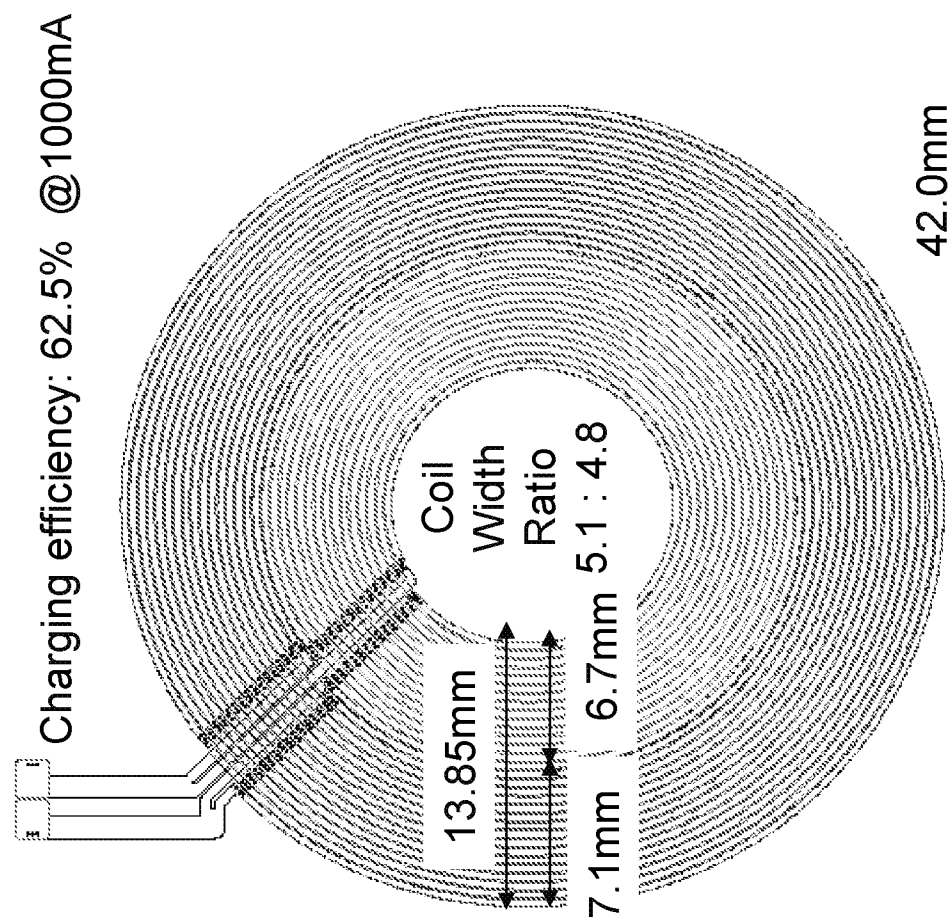


FIGURE 53A

Example of WPC coil – outer diameter: 42Ø, inner diameter: 14Ø

Charging efficiency: 66.0% @1000mA

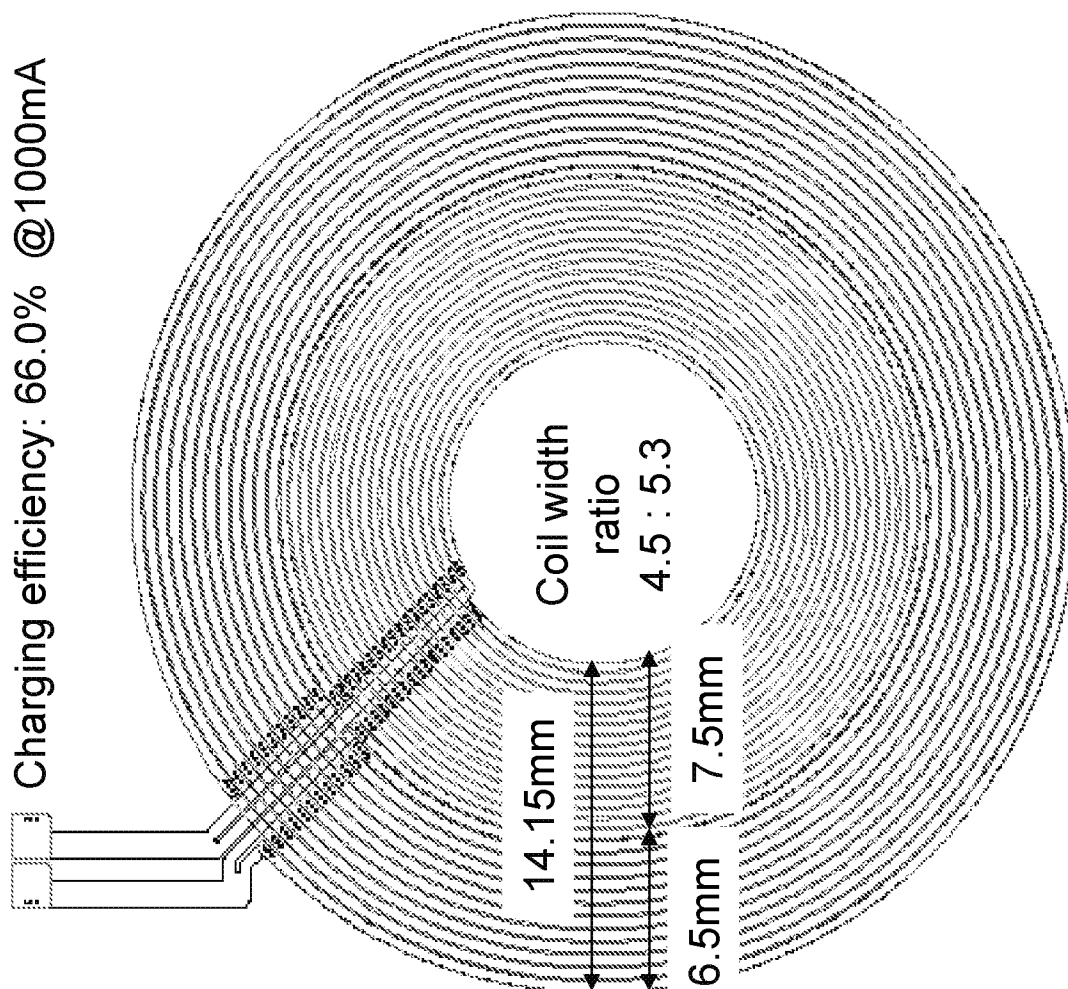


FIGURE 53C

Examples of WPC coil – outer diameter: 42ø, inner diameter: 9ø

Charging efficiency: 63.7%
@1000mA

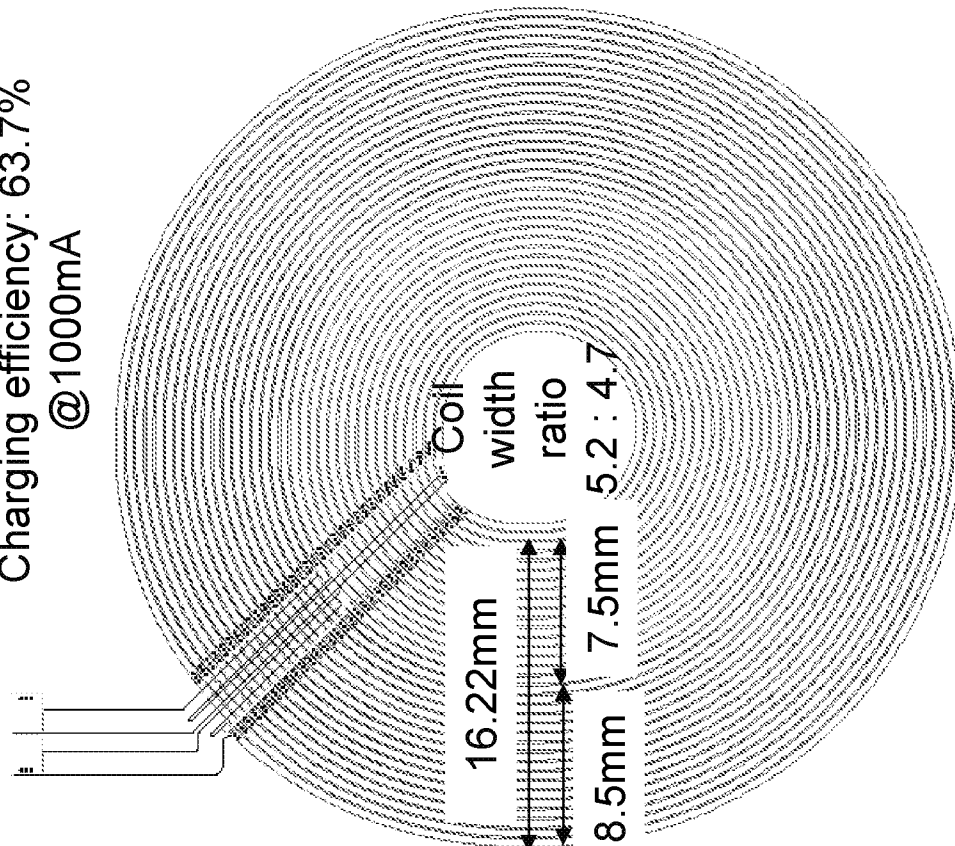


FIGURE 54A

Charging efficiency: 62.9%
@1000mA

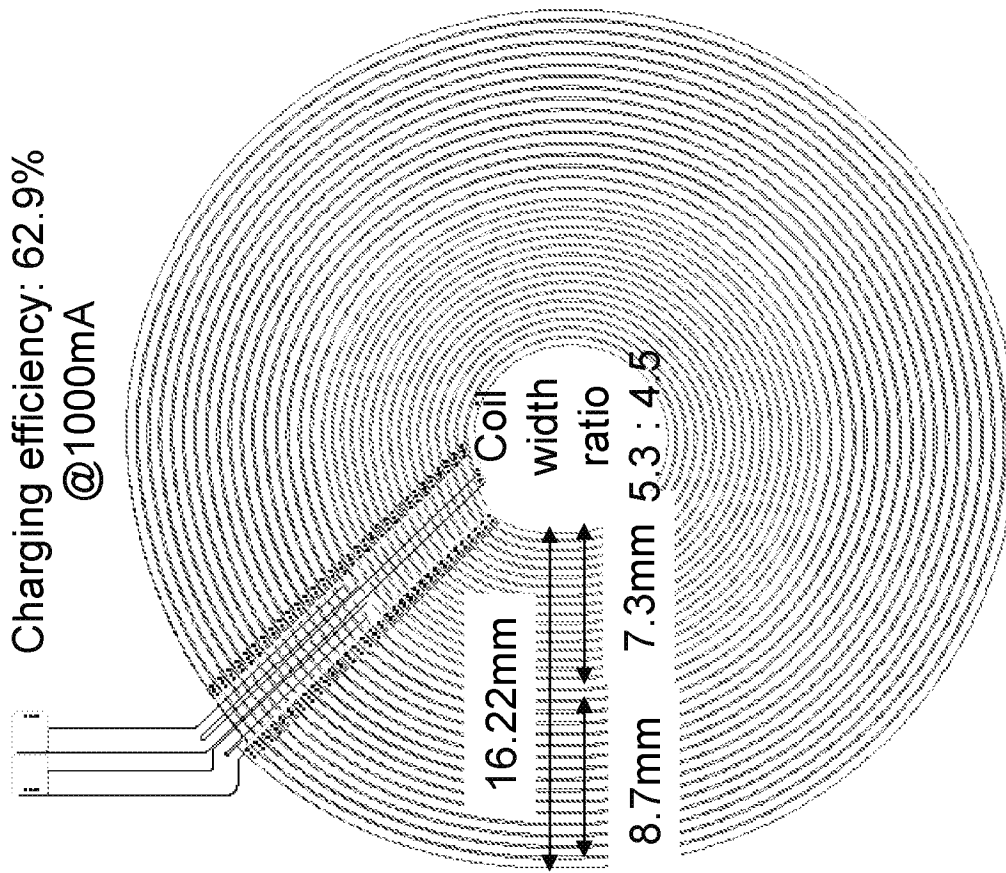


FIGURE 54B

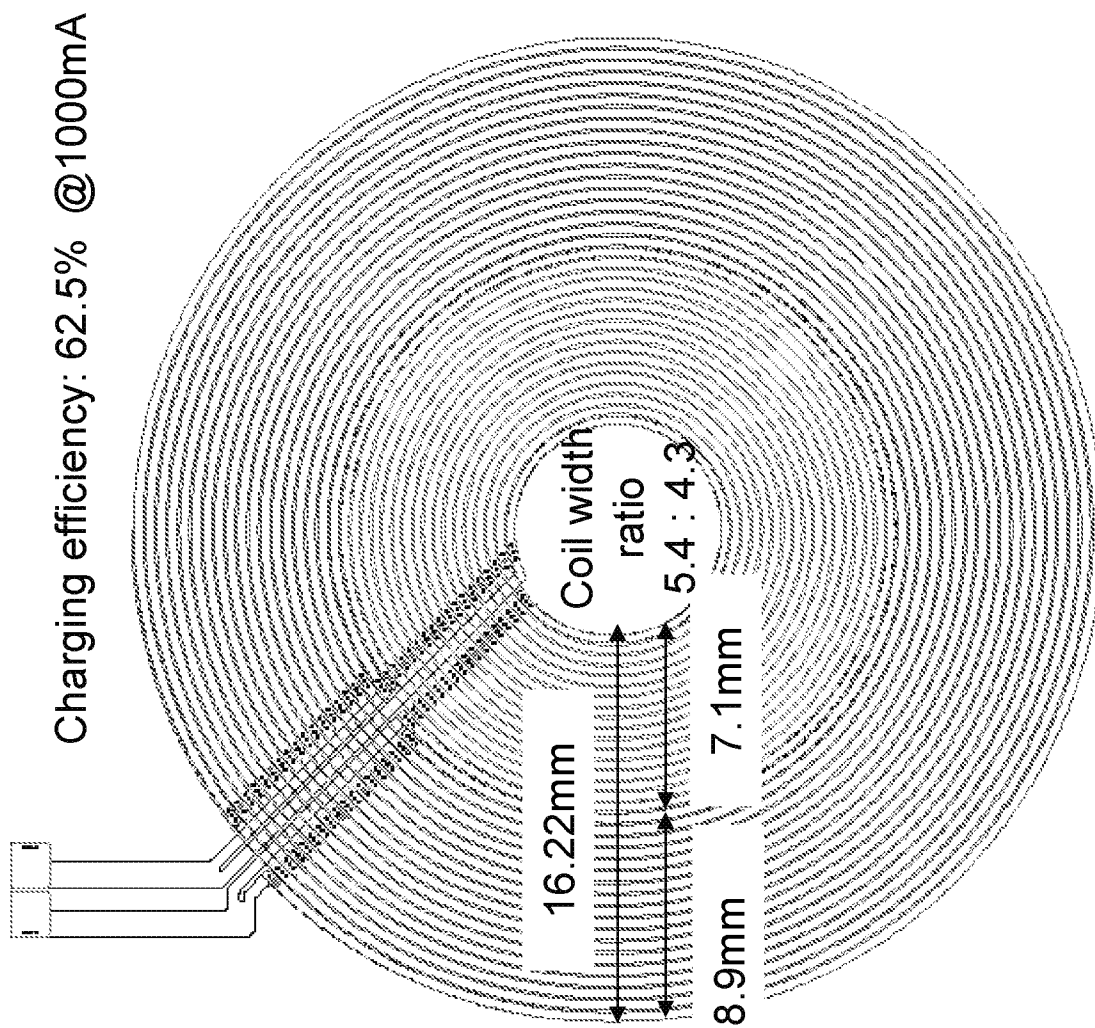


FIGURE 54C

FIGURE 55

Charging efficiencies of WPC coil depending on coil width ratio

RX Current	0.6A	0.7A	0.8A	0.9A	1.0A
2:8* 6** / 23***	58.7%****	59.6%	59.1%	57.9%	57.3%
3:7 9 / 20	68.5%	68.5%	67.0%	64.5%	62.7%
4:6 12 / 17	70.9%	70.3%	69.6%	67.0%	65.6%
5:5 15 / 14	69.2%	68.0%	67.5%	64.8%	62.9%
6:4 17 / 12	63.6%	64.1%	63.3%	61.2%	60.4%

* Coil width ratio (outer coil width : inner coil width)

** number of lines of outer coil

*** number of lines of inner coil

**** Charging efficiency = RX power / TX power
= (RX voltage X RX current) / (TX voltage X TX current)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Sang Hoon Lee
App. No.	:	Not Yet Assigned
Filed	:	Herewith
Examiner	:	Not Yet Assigned
Art Unit	:	Not Yet Assigned
Conf No.	:	Not Yet Assigned

INFORMATION DISCLOSURE STATEMENT

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Dear Sir:

Enclosed is a PTO/SB/08A Form listing references that were previously disclosed to or cited by the Patent and Trademark Office in the prosecution of the parent application, Application No. 17/864,078. Copies of the foreign patent documents and non-patent literature documents that were previously disclosed or cited are not submitted pursuant to 37 C.F.R. §1.98(d).

Respectfully submitted,

K&L GATES, LLP

Dated: September 28, 2022

By: /Mincheol Kim/
Mincheol Kim
Registration No. 51,306
Attorney of Record
Customer No. 45,200
(949) 623-3611

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		
	Filing Date		
	First Named Inventor	Sang Hoon LEE	
	Art Unit		
	Examiner Name		
	Attorney Docket Number	1959706.00056/AQCRP.41C3	

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Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	3017633	A	1962-01-16	Marston et al.	
	2	5808587	A	1998-09-15	Shima	
	3	5929825	A	1999-07-27	Niu et al.	
	4	7000837	B2	2006-02-21	Akiho et al.	
	5	7712672	B2	2010-05-11	Takahashi et al.	
	6	8294629	B2	2012-10-23	Yosui et al.	
	7	8422190	B2	2013-04-16	Ito et al.	
	8	8436780	B2	2013-05-07	Schantz et al.	

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Attorney Docket Number	1959706.00056/AQCRP.41C3	

9	8604992	B2	2013-12-10	Kobayashi et al.	
10	8638268	B2	2014-01-28	Yosui et al.	
11	8680960	B2	2014-03-25	Singh et al.	
12	8698591	B2	2014-04-15	Singh et al.	
13	8710948	B2	2014-04-29	Singh et al.	
14	8855786	B2	2014-10-07	Derbas et al.	
15	9001001	B2	2015-04-07	Nakano et al.	
16	9300046	B2	2016-03-29	Singh et al.	
17	9543655	B2	2017-01-10	Lee et al.	
18	9627762	B2	2017-04-18	Ito	

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	1	20070069961	A1	2007-03-29	Akiho et al.	
	2	20090189729	A1	2009-07-30	Kubo et al.	
	3	20100309081	A1	2010-12-09	Kobayashi et al.	
	4	20120081258	A1	2012-04-05	Yosui et al.	
	5	20130134225	A1	2013-05-30	Teshima	
	6	20140049436	A1	2014-02-20	Kubo et al.	
	7	20140071011	A1	2014-03-13	Yosui et al.	
	8	20140139380	A1	2014-05-22	Ouyang et al.	
	9	20140184462	A1	2014-07-03	Yosui	
	10	20140339915	A1	2014-11-20	Kanno et al.	

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11	20150077296	A1	2015-03-19	An et al.	
12	20150145742	A1	2015-05-28	Cao	
13	20160132865	A1	2016-05-12	Park et al.	
14	20160149305	A1	2016-05-26	Jeon et al.	
15	20160180120	A1	2016-06-23	Wallner	
16	20160254589	A1	2016-09-01	Ju et al.	
17	20160261026	A1	2016-09-08	Han et al.	
18	20160336645	A1	2016-11-17	Orihara et al.	
19	20170005399	A1	2017-01-05	Ito et al.	
20	20170054213	A1	2017-02-23	Singh et al.	
21	20170133744	A1	2017-05-11	An et al.	

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22	20180301790	A1	2018-10-18	Kim et al.
23	20220085489	A1	2022-05-17	Nam et al.

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	1	2003-022912	JP	A	2003-01-24	Mitsubishi Materials Corp.		×
	2	2006-195802	JP	A	2006-07-27	Fuji Electric Holdings		☒
	3	2006-270681	JP	A	2006-10-05	Sony Corporation		☒
	4	2010-278518	JP	A	2010-12-09	Sony Corporation		☒
	5	2012-209619	JP	A	2012-10-25	Toyota Central Research & Development et al.		☒
	6	2013-013144	JP	A	2013-01-17	Panasonic Corp.		☒
	7	2013-038821	JP	A	2013-02-21	Murata Manufacturing Co., Ltd.		☒

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8	2013-055637	JP	A	2013-03-21	Murata Manufacturing Co., Ltd.	☒
9	2013-121247	JP	A	2013-06-17	Panasonic Corp.	☒
10	2014-64284	JP	A	2014-04-10	Panasonic Corp.	☒
11	5360202	JP	B2	2013-12-04	Murata Manufacturing Co., Ltd.	☒
12	10-1185503	KR	B1	2012-09-24	AQ Co. Ltd.	☒
13	10-1210941	KR	B1	2012-12-11	AQ Co. Ltd.	☒
14	10-1282268	KR	B1	2013-07-10	AQ Co. Ltd.	☒
15	10-1339020	KR	B1	2013-12-09	AQ Co. Ltd.	☒
16	10-2003-0076039	KR	A	2003-09-26	Sangshin Elecom Co., Ltd. et al.	☒
17	10-2006-0008332	KR	A	2006-01-26	Sony Corporation	☒
18	10-2007-0006702	KR	A	2007-01-11	Omron Teteisi Electronics Co.	☒

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19	10-2008-0008687	KR	A	2008-01-24	LG Electronics Inc.	☒
20	10-2010-0005071	KR	A	2010-01-13	Nokia Corporation	☒
21	10-2012-0099131	KR	A	2012-09-06	Murata Manufacturing Co., Ltd.	☒
22	10-2015-0051739	KR	A	2015-05-13	AQ Co. Ltd.	☒
23	10-2018-0033104	KR	A	2018-04-02	Amotech Co. Ltd.	☒
24	10-2018-0047823	KR	A	2018-05-10	Amotech Co. Ltd.	☒
25	2011/062238	WO	A1	2011-05-26	Murata Manufacturing Co., Ltd.	☒
26	2013/019455	WO	A1	2013-02-07	Brady Worldwide Inc.	☒
27	2013/069465	WO	A1	2013-05-16	Murata Manufacturing Co., Ltd.	☒
28	2015/009072	WO	A1	2015-01-22	AQ Corporation	☒
29	2016/056736	WO	A1	2016-04-14	AQ Corporation	☒

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30	2018/056765	WO	A1	2018-03-29	Amotech Co. Ltd.		☒
31	2018/117431	WO	A1	2018-06-28	Amotech Co. Ltd.		☒
32	10-2200083	KR	B1	2021-01-08	AMOTECH CO., LTD.		☒
33	10-1901715	KR	B1	2018-09-27	SAMSUNG ELECTRO-MECHANICS CO., LTD.		☒
34	10-2099310	KR	B1	2020-04-09	AMOTECH CO., LTD.		☒
35	10-2137633	KR	B1	2020-07-24	AMOTECH CO., LTD.		☒
36	10-2178575	KR	B1	2020-11-13	AMOTECH CO., LTD.		☒
37	10-2021-0078368	KR	A	2021-06-28	AMOTECH CO., LTD.		☒
38	10-2021-0100871	KR	A	2021-08-18	SAMSUNG ELECTRONICS CO., LTD.		☒
39	10-2239249	KR	B1	2021-04-12	AMOTECH CO., LTD.		☒
40	10-2021-0153484	KR	A	2021-12-17	AMOTECH CO., LTD.		☒

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	1	Office Action from U.S. Patent Application No. 15/614,484, dated September 22, 2017 - 44 pages.	
	2	Office Action from U.S. Patent Application No. 15/682,473, dated October 20, 2017 - 29 pages.	
	3	Notice of Allowance from U.S. Patent Application No. 15/614,484, dated February 23, 2018 - 13 pages.	

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Examiner Name	
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CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Mincheol Kim/	Date (YYYY-MM-DD)	2022-09-28
Name/Print	Mincheol Kim	Registration Number	51,306

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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COMBINED DECLARATION & ASSIGNMENT (37 CFR 1.63(e))

Application Data Sheet filed previously or concurrently

Docket No.: AQCRP.037PR2

Page 1 of 2

Title: SMARTPHONE ANTENNA IN FLEXIBLE PCB

Declaration

As the below-named inventor, I hereby declare that:

1. This Declaration is directed to:

The attached application, where "attached" means filed concurrently with, or

U.S. Patent Application No. 62/941636 filed on November 27, 2019.

2. The above-identified application was made or authorized to be made by me.
3. I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.
4. I hereby acknowledge that any willful false statement made in this Declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

Assignment from Inventor

WHEREAS, the below-named inventor (hereinafter "ASSIGNOR") invented certain new and useful improvements, technology, inventions, developments, ideas or discoveries disclosed in the above-identified application (hereinafter the "Application").

AND WHEREAS, **AQ Corporation**, with its principal place of business at **#205, Saneup-ro 155 Beon-gil, Kweonseon-gu, Suwon-si, Gyeonggi-do 16648 Republic of Korea** (hereinafter the "ASSIGNEE"), desires to acquire the entire right, title, and interest in and to the Application.

NOW, THEREFORE, for good and valuable consideration of which receipt is hereby acknowledged, ASSIGNOR hereby acknowledges that ASSIGNOR has sold, assigned, transferred and set over, and by these presents does hereby sell, assign, transfer and set over, unto said ASSIGNEE, its successors, legal representatives and assigns, the entire right, title, and interest in the Application and related application(s) filed or issued upon the Application (collectively "Patent Properties"), where "Patent Properties" include, but are not limited to:

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- all provisional application(s) to which the Application claims priority;
- all nonprovisional applications claiming priority to aforementioned provisional(s) and/or the Application, including, all divisional applications, continuation applications, and continuations-in-part applications, and reissue applications; and
- all Letters Patent of the United States which may be granted on the Application and the aforementioned nonprovisional applications, and all reissues and extensions thereof.

ASSIGNOR hereby acknowledges the ASSIGNEE as the Applicant for all aforementioned Patent Properties, and authorizes and requests the Commissioner of Patents of the United States to issue all related Letters Patent to the ASSIGNEE, its successors, legal representatives and assigns, in accordance with the terms of this instrument.

ASSIGNOR does hereby sell, assign, transfer, and convey to ASSIGNEE, its successors, legal representatives, and assigns all claims for damages and all remedies arising out of any violation of the rights assigned hereby that may have accrued prior to the date of this assignment to ASSIGNEE, or may accrue hereafter, including, but not limited to, the right to sue for, collect, and retain damages for past infringements of all Patent Properties;

COMBINED DECLARATION & ASSIGNMENT (37 CFR 1.63(e))*Application Data Sheet filed previously or concurrently*

Docket No.: AQCRP.037PR2

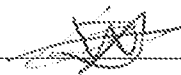
Page 2 of 2

Title: SMARTPHONE ANTENNA IN FLEXIBLE PCB

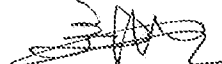
AND ASSIGNOR DOES HEREBY covenant and agree that ASSIGNOR will communicate to said ASSIGNEE, its successors, legal representatives and assigns, any facts known to ASSIGNOR respecting the Patent Properties, and testify in any legal proceeding, assist in the preparation of any applications relating to the Patent Properties, sign/execute all lawful papers, execute and make all rightful oaths and/or declarations in connection with the Patent Properties and generally do everything possible to aid the ASSIGNEE, its successors, legal representatives and assigns, to obtain and enforce proper patent protection for the Patent Properties.

Authorization to Add Application Information

In case this document is signed without the filing date and/or the application number in the Declaration section, I authorize the registrants of Knobbe, Martens, Olson & Bear, LLP, Customer No. 20,995 to add the filing date and application number in the blanks in the Declaration section before filing this document with the United States Patent and Trademark Office.

Legal Name of inventor 1: LEE, Sang HoonSignature: 

Date: 02/06/2020

Legal Name of inventor 2: CHOI, Kyoung JunSignature: 

Date: 02/06/2020

Legal Name of inventor 3: LEE, Sae RomSignature: 

Date: 02/06/2020

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Sang Hoon Lee
App. No.	:	Not Yet Assigned
Filed	:	Herewith
Examiner	:	Not Yet Assigned
Art Unit	:	Not Yet Assigned
Conf No.	:	Not Yet Assigned

RESCISSION OF ANY PRIOR DISCLAIMERS AND REQUEST TO REVISIT ART

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

The claims of the present application can be different and possibly broader in scope than the claims pursued in the parent application(s). To the extent any prior amendments or characterizations of the scope of any claim or referenced art could be construed as a disclaimer of any subject matter supported by the present disclosure, Applicant hereby rescinds and retracts such disclaimer. Accordingly, the references previously considered in the parent application(s) may need to be re-visited.

Respectfully submitted,

K&L GATES, LLP

Dated: September 28, 2022

By: /Mincheol Kim/
Mincheol Kim
Registration No. 51,306
Attorney of Record
Customer No. 45,200
(949) 623-3611

TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	Not yet assigned
Filing Date	Herewith
First Named Inventor	Sang Hoon LEE
Title	SMARTPHONE ANTENNA IN FLEXIBLE PCB
Art Unit	Not yet assigned
Examiner Name	Not yet assigned
Attorney Docket Number	1959706.00056/AQCRP.41C3

SIGNATURE of Applicant or Patent Practitioner

Signature	/Mincheol Kim/	Date (Optional)	September 28, 2022
Name	Mincheol Kim	Registration Number	51,306
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)			

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.



*Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☒ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above:

OR

45200

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☒ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name

Address

City

State

Zip

Country

Telephone

Email

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

AQ Corporation

- ☐ Inventor or Joint Inventor (title not required below)
- ☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)
- ☒ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)
- ☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature

Date (Optional)

Name

Sang Hoon Lee

Title

President

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☒ Total of 1 forms are submitted.

Electronic Patent Application Fee Transmittal

Application Number:				
Filing Date:				
Title of Invention:	SMARTPHONE ANTENNA IN FLEXIBLE PCB			
First Named Inventor/Applicant Name:	Sang Hoon LEE			
Filer:	Mincheol Kim/YOON JEE LEE			
Attorney Docket Number:	1959706.00056/AQCRP.41C3			
Filed as Small Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
UTILITY FILING FEE (ELECTRONIC FILING)	4011	1	80	80
UTILITY SEARCH FEE	2111	1	350	350
UTILITY EXAMINATION FEE	2311	1	400	400
Pages:				
Claims:				
CLAIMS IN EXCESS OF 20	2202	2	50	100
Miscellaneous-Filing:				
Petition:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				930

Electronic Acknowledgement Receipt

EFS ID:	46713807
Application Number:	17955126
International Application Number:	
Confirmation Number:	5216
Title of Invention:	SMARTPHONE ANTENNA IN FLEXIBLE PCB
First Named Inventor/Applicant Name:	Sang Hoon LEE
Customer Number:	45200
Filer:	Mincheol Kim/US Patent Mail
Filer Authorized By:	Mincheol Kim
Attorney Docket Number:	1959706.00056/AQCRP.41C3
Receipt Date:	28-SEP-2022
Filing Date:	
Time Stamp:	16:59:54
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	\$930
RAM confirmation Number	E20229RH00243857
Deposit Account	
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal of New Application	2022-09-28_0_Cover_Letter_A QCRP_41C3.pdf	96738	no	1
			2f5aa52045fea4b3c00bd91ced4e97ca217bec27		
Warnings:					
Information:					
2	Application Data Sheet	2022-09-28_1_ADS_AQCRP_41C3.pdf	1256661	no	9
			cae673e3cf38bd66f8375855e0e2d39cb2895ffe		
Warnings:					
Information:					
3		2022-09-28_2_Specification_A QCRP_41C3.PDF	550951	yes	68
			9f29fd69114fbd38c62f27b23f0e0bafbc44341c		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Specification		1	63	
	Claims		64	67	
	Abstract		68	68	
Warnings:					
Information:					
4	Drawings-other than black and white line drawings	2022-09-28_3_Drawings_AQCRP_41C3.PDF	1565292	no	52
			c22afe3f8b0970ccb5c9849aadcf3fcc58ce63f2		
Warnings:					
Information:					
5	Transmittal Letter	2022-09-28_4_1_IDS_Transmittal_AQCRP_41C3.pdf	74755	no	1
			de3376656deede4bde48d709576186771cafb12f		
Samsung					

Warnings:					
Information:					
6	Information Disclosure Statement (IDS) Form (SB08)	2022-09-28_4_2_IDS_AQCRP_41C3.pdf	1036833	no	11
			80cbfce64c4b34dbd9692e247597cb5bf4450a6b		
Warnings:					
Information:					
7	Oath or Declaration filed	2022-09-28_5_Copy_of_Declaration_from_Parent_AQCRP_41C3.pdf	1957434	no	2
			832e6b663c7898d6921b61798e2b73529b9e2006		
Warnings:					
Information:					
8	Miscellaneous Incoming Letter	2022-09-28_6_Rescission_of_Disclaimers_and_Request_to_Revisit_Art_AQCRP_41C3.pdf	75502	no	1
			9955f1efce2d5d7f7df78348a20faf1c6bad0783		
Warnings:					
Information:					
9	Power of Attorney	2022-09-28_7_Power_of_Attorney_AQCRP_41C3.pdf	1589972	no	2
			07d8dc4b856f472e2dfecce33370739d6c108bf		
Warnings:					
Information:					
10	Fee Worksheet (SB06)	fee-info.pdf	46533	no	2
			4876ebfd30d34f4a578762a1cc2c559d3c71737c		
Warnings:					
Information:					
Total Files Size (in bytes):			8250671		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

SCORE Placeholder Sheet for IFW Content

Application Number: 17955126

Document Date: 09/28/2022

The presence of this form in the IFW record indicates that the following document type was received in electronic format on the date identified above. This content is stored in the SCORE database.

Since this was an electronic submission, there is no physical artifact folder, no artifact folder is recorded in PALM, and no paper documents or physical media exist. The TIFF images in the IFW record were created from the original documents that are stored in SCORE.

- Drawing

At the time of document entry (noted above):

- USPTO employees may access SCORE content via DAV or via the SCORE web page.
- External customers may access SCORE content via PAIR using the Supplemental Content tab.



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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
17/955,126	09/28/2022	2837	930	1959706.00056/AQCRP.41C3	22	1

CONFIRMATION NO. 5216

FILING RECEIPT



0000000049608343

45200
K&L Gates LLP-Orange County
1 Park Plaza
Twelfth Floor
Irvine, CA 92614

Date Mailed: 10/12/2022

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Sang Hoon LEE, Suwon-si, KOREA, REPUBLIC OF;
Kyoung Jun CHOI, Seoul, KOREA, REPUBLIC OF;
Sae Rom LEE, Incheon, KOREA, REPUBLIC OF;

Applicant(s)

AQ CORPORATION, Seongnam-si, KOREA, REPUBLIC OF;

Power of Attorney: The patent practitioners associated with Customer Number 45200

Domestic Priority data as claimed by applicant

This application is a CON of 17/864,078 07/13/2022
which is a CON of 17/546,893 12/09/2021 PAT 11,437,712
which is a CON of 17/105,012 11/25/2020 PAT 11,303,011
which claims benefit of 62/941,636 11/27/2019

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see <http://www.uspto.gov> for more information.) - None.

Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

Projected Publication Date: 01/19/2023

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

SMARTPHONE ANTENNA IN FLEXIBLE PCB

Preliminary Class

336

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at <http://www.uspto.gov/web/offices/pac/doc/general/index.html>.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, <http://www.stopfakes.gov>. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER
Title 35, United States Code, Section 184
Title 37, Code of Federal Regulations, 5.11 & 5.15

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This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign Assets Control, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

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The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop technology, manufacture products, deliver services, and grow your business, visit <http://www.SelectUSA.gov> or call +1-202-482-6800.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number
17/955,126

APPLICATION AS FILED - PART I

(Column 1)		(Column 2)	SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE(\$)	FEE(\$)		RATE(\$)	FEE(\$)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	80		N/A	
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A	350		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	400		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	22 minus 20 =	*	x 50 =	100	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	1 minus 3 =	*	x =	0			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			0			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	830		TOTAL	

APPLICATION AS AMENDED - PART II

	(Column 1)	(Column 2)	(Column 3)	SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
		CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)	RATE(\$)	ADDITIONAL FEE(\$)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus **	=	x =		x =	
	Independent (37 CFR 1.16(h))	*	Minus ***	=	x =		x =	
	Application Size Fee (37 CFR 1.16(s))							
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
				TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus **	=	x =		x =	
	Independent (37 CFR 1.16(h))	*	Minus ***	=	x =		x =	
	Application Size Fee (37 CFR 1.16(s))							
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
				TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.



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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/955,126	09/28/2022	Sang Hoon LEE	1959706.00056/AQCRP.41C3

CONFIRMATION NO. 5216

NEW OR REVISED PPD NOTICE



OC000000136590904

45200
K&L Gates LLP-Orange County
1 Park Plaza
Twelfth Floor
Irvine, CA 92614

NOTICE OF NEW OR REVISED PROJECTED PUBLICATION DATE

The above-identified application has a new or revised projected publication date. The current projected publication date for this application is 01/19/2023. If this is a new projected publication date (there was no previous projected publication date), the application has been cleared by Licensing & Review or a secrecy order has been rescinded and the application is now in the publication queue.

If this is a revised projected publication date (one that is different from a previously communicated projected publication date), the publication date has been revised due to processing delays in the USPTO or the abandonment and subsequent revival of an application. The application is anticipated to be published on a date that is more than six weeks different from the originally-projected publication date.

More detailed publication information is available through the private side of Patent Application Information Retrieval (PAIR) System. The direct link to access PAIR is currently <http://pair.uspto.gov>. Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Questions relating to this Notice should be directed to the Office of Data Management, Application Assistance Unit at (571) 272-4000, or (571) 272-4200, or 1-888-786-0101.



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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
17/955,126	09/28/2022	OPAP	930	1959706.00056/AQCRP.41C3	22	1

45200
K&L Gates LLP-Orange County
1 Park Plaza
Twelfth Floor
Irvine, CA 92614

CONFIRMATION NO. 5216

CORRECTED FILING RECEIPT



0000000049864848

Date Mailed: 10/19/2022

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Sang Hoon LEE, Suwon-si, KOREA, REPUBLIC OF;
Kyoung Jun CHOI, Seoul, KOREA, REPUBLIC OF;
Sae Rom LEE, Incheon, KOREA, REPUBLIC OF;

Applicant(s)

AQ CORPORATION, Seongnam-si, KOREA, REPUBLIC OF;

Power of Attorney: The patent practitioners associated with Customer Number 45200

Domestic Priority data as claimed by applicant

This application is a CON of 17/864,078 07/13/2022
which is a CON of 17/546,893 12/09/2021 PAT 11,437,712
which is a CON of 17/105,012 11/25/2020 PAT 11,303,011
which claims benefit of 62/941,636 11/27/2019

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see <http://www.uspto.gov> for more information.) - None.

Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 10/11/2022

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 17/955,126**

Projected Publication Date: 01/19/2023

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

SMARTPHONE ANTENNA IN FLEXIBLE PCB

Preliminary Class

336

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at <http://www.uspto.gov/web/offices/pac/doc/general/index.html>.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, <http://www.stopfakes.gov>. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific

countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER
Title 35, United States Code, Section 184
Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign Assets Control, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop

technology, manufacture products, deliver services, and grow your business, visit <http://www.SelectUSA.gov> or call +1-202-482-6800.



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/955,126	09/28/2022	Sang Hoon LEE	1959706.00056/AQCRP.41C3

CONFIRMATION NO. 5216

45200
K&L Gates LLP-Orange County
1 Park Plaza
Twelfth Floor
Irvine, CA 92614

PUBLICATION NOTICE



OC000000137226123

Title:SMARTPHONE ANTENNA IN FLEXIBLE PCB

Publication No.US-2023-0013445-A1

Publication Date:01/19/2023

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently <http://www.uspto.gov/patft/>.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently <https://portal.uspto.gov/pair/PublicPair>. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

45200 7590 01/30/2023
K&L Gates LLP-Orange County
1 Park Plaza
Twelfth Floor
Irvine, CA 92614

EXAMINER	
LINDGREN BALTZEL, ANDREA J	
ART UNIT	PAPER NUMBER
2845	

DATE MAILED: 01/30/2023

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/955,126	09/28/2022	Sang Hoon LEE	1959706.00056/ AQCRP.41C3	5216

TITLE OF INVENTION: SMARTPHONE ANTENNA IN FLEXIBLE PCB

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	\$480	\$0.00	\$0.00	\$480	05/01/2023

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 40% the amount of undiscounted fees, and micro entity fees are 20% the amount of undiscounted fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

45200 7590 01/30/2023
K&L Gates LLP-Orange County
1 Park Plaza
Twelfth Floor
Irvine, CA 92614

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/955,126	09/28/2022	Sang Hoon LEE	1959706.00056/ AQCRP.41C3	5216

TITLE OF INVENTION: SMARTPHONE ANTENNA IN FLEXIBLE PCB

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	\$480	\$0.00	\$0.00	\$480	05/01/2023

EXAMINER	ART UNIT	CLASS-SUBCLASS
LINDGREN BALTZEL, ANDREA J	2845	336-192000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☐ Issue Fee ☐ Publication Fee (if required) ☐ Advance Order - # of Copies _____

4b. Method of Payment: (Please first reapply any previously paid fee shown above)

☐ Electronic Payment via EFS-Web ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. Change in Entity Status (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

☐ Applicant asserting small entity status. See 37 CFR 1.27

☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____

Date _____

Typed or printed name _____

Registration No. _____



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UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/955,126	09/28/2022	Sang Hoon LEE	1959706.00056/ AQCRP.41C3	5216
45200	7590	01/30/2023	EXAMINER	
K&L Gates LLP-Orange County 1 Park Plaza Twelfth Floor Irvine, CA 92614			LINDGREN BALTZEL, ANDREA J	
			ART UNIT	PAPER NUMBER
			2845	
DATE MAILED: 01/30/2023				

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 17/955,126	Applicant(s) LEE et al.	
	Examiner ANDREA J LINDGREN BALTZELL	Art Unit 2845	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to correspondence received 09/28/2022.
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☒ The allowed claim(s) is/are 1-22. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a) ☐ All b) ☐ Some* c) ☐ None of the:

1. ☐ Certified copies of the priority documents have been received.

2. ☐ Certified copies of the priority documents have been received in Application No. _____.

3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892) 2. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date <u>09/28/2022</u> . 3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____. 4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.	5. ☐ Examiner's Amendment/Comment 6. ☒ Examiner's Statement of Reasons for Allowance 7. ☐ Other _____.
---	--

/ANDREA LINDGREN BALTZELL/
Primary Examiner, Art Unit 2845

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

DETAILED ACTION

Priority

Foreign priority is not claimed for this application.

Information Disclosure Statement

The information disclosure statement (IDS) submitted 09/28/2022 is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Allowable Subject Matter

Claims 1-22 are allowed.

Upon conclusion of a comprehensive search of the pertinent prior art, the Office indicates that the claims are allowable.

The prior art, when taken alone, or, in combination, cannot be construed as reasonably teaching or suggesting all of the elements of the claimed invention as arranged, disposed, or provided in the manner as claimed by the Applicant. Added primarily for emphasis, the claim recitation “the outer antenna pattern comprising a plurality of concentric circular lines and defining a radially-extending outer gap into which the plurality of concentric circular lines of the outer antenna pattern does not extend, wherein at least part of the concentric circular lines of the outer antenna pattern overlaps the outer coil formed on the first major surface and is connected to the outer coil through vias, wherein at least part of the concentric circular lines of the outer antenna pattern generally surround at least part of the concentric circular lines of the inner antenna pattern, wherein

the radially-extending outer gap and the radially-extending inner gap are connected and aligned in a direction” is not found in the prior art of record.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Andrea Lindgren Baltzell whose telephone number is (571)272-5918. The examiner can normally be reached on Monday through Friday from 9am to 6pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Dameon Levi may be reached at (571)272-2105. The fax phone number for the organization where this application or proceeding is assigned is (571)273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at (866)217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call (800)786-9199 (IN USA OR CANADA) or (571)272-1000.

/Andrea Lindgren Baltzell/
Primary Examiner, Art Unit 2845

<i>Notice of References Cited</i>	Application/Control No. 17/955,126		Applicant(s)/Patent Under Reexamination LEE et al.	
	Examiner ANDREA J LINDGREN BALTZELL		Art Unit 2845	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20140339915-A1	11-2014	Kanno; Hiroshi	H02J50/20	307/104
*	B	US-20100309081-A1	12-2010	KOBAYASHI; Eiichi	H01Q7/06	343/788
	C					
	D					
	E					
	F					
	G					
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	I					
	J					
	K					
	L					
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FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Issue Classification 	Application/Control No. 17/955,126	Applicant(s)/Patent Under Reexamination LEE et al.
	Examiner ANDREA J LINDGREN BALTZELL	Art Unit 2845

CPC						
Symbol					Type	Version
H01Q	/	1	/	243	F	2013-01-01
H01Q	/	7	/	00	I	2013-01-01
H01Q	/	1	/	38	I	2013-01-01

CPC Combination Sets				
Symbol		Type	Set	Ranking
	/		/	

NONE (Assistant Examiner) (Date)		Total Claims Allowed: 22	
/ANDREA LINDGREN BALTZELL/ Primary Examiner, Art Unit 2845 (Primary Examiner) (Date)		14 January 2023 (Date)	O.G. Print Claim(s) 1
			O.G. Print Figure Fig. 3

<i>Issue Classification</i> 	Application/Control No. 17/955,126	Applicant(s)/Patent Under Reexamination LEE et al.
	Examiner ANDREA J LINDGREN BALTZELL	Art Unit 2845

INTERNATIONAL CLASSIFICATION			
CLAIMED			
H01Q	/	1	/ 38
NON-CLAIMED			
/		/	

US ORIGINAL CLASSIFICATION	
CLASS	SUBCLASS

CROSS REFERENCES(S)						
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	22	
/ANDREA LINDGREN BALTZELL/ Primary Examiner, Art Unit 2845	14 January 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	Fig. 3

Issue Classification 	Application/Control No. 17/955,126	Applicant(s)/Patent Under Reexamination LEE et al.
	Examiner ANDREA J LINDGREN BALTZELL	Art Unit 2845

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47															
CLAIMS															
Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	10	10	19	19										
2	2	11	11	20	20										
3	3	12	12	21	21										
4	4	13	13	22	22										
5	5	14	14												
6	6	15	15												
7	7	16	16												
8	8	17	17												
9	9	18	18												

NONE (Assistant Examiner) _____ (Date) _____		Total Claims Allowed: 22	
/ANDREA LINDGREN BALTZELL/ Primary Examiner, Art Unit 2845 (Primary Examiner) _____ (Date) 14 January 2023		O.G. Print Claim(s) 1	O.G. Print Figure Fig. 3

<i>Search Notes</i> 	Application/Control No. 17/955,126	Applicant(s)/Patent Under Reexamination LEE et al.
	Examiner ANDREA J LINDGREN BALTZELL	Art Unit 2845

CPC - Searched*		
Symbol	Date	Examiner
H01Q 1/24; 138; 7/00	01/14/2023	ALB

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
336	192	01/14/2023	ALB

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
PE2E Search	01/14/2023	ALB
Inventor Name Search	01/14/2023	ALB
Non Patent Literature Search	01/14/2023	ALB

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
H01Q 1/24; 138; 7/00		01/14/2023	ALB

/ANDREA LINDGREN BALTZELL/ Primary Examiner, Art Unit 2845	
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Bibliographic Data

Application No: 17/955,126

Foreign Priority claimed: ☐ Yes ☒ No

35 USC 119 (a-d) conditions met: ☐ Yes ☐ No ☐ Met After Allowance

Verified and Acknowledged: /ANDREA LINDGREN
BALTZELL/

Examiner's Signature

Initials

Title: SMARTPHONE ANTENNA IN FLEXIBLE PCB

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
09/28/2022	336	2845	1959706.00056/AQCRP.41C 3
RULE			

APPLICANTS

AQ CORPORATION,

INVENTORS

Sang Hoon LEE, Suwon-si, KOREA, REPUBLIC OF

Kyoung Jun CHOI, Seoul, KOREA, REPUBLIC OF

Sae Rom LEE, Incheon, KOREA, REPUBLIC OF

CONTINUING DATA

This application is a CON of 17864078 07/13/2022 PAT 11495875

17864078 is a CON of 17546893 12/09/2021 PAT 11437712

17546893 is a CON of 17105012 11/25/2020 PAT 11303011

17105012 has PRO of 62941636 11/27/2019

FOREIGN APPLICATIONS

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10/11/2022

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Irvine, CA 92614

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PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
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L2	7	"17864078"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/09/10 11:09 PM
L3	0	34/867.ccls.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/09/10 11:09 PM
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		"8436780" OR "8604992" OR "8638268" OR "8680960" OR "8698591" OR "8710948" OR "8855786" OR "9001001" OR "9300046" OR "9543655" OR "9627762").pn.					
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L20	407	L19 AND pattern	(US-PGPUB; USPAT)	OR	ON	ON	2022/09/10 11:16 PM
L21	92	L19 AND pattern AND gap	(US-PGPUB; USPAT)	OR	ON	ON	2022/09/10 11:16 PM
L23	1	"17955126"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/01/14 07:52 PM
L24	9	"17864078"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/01/14 07:52 PM
L25	0	34/867.ccls.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU,	OR	ON	ON	2023/01/14 07:52 PM

L26	1546	343/867.ccls.	SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB) (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/01/14 07:52 PM
L27	1241	L4 AND ((H01Q7/00 OR H01Q1/38 OR H01Q1/2216 OR H01Q1/2225 OR H01Q1/243 OR H01Q21/28 OR H01Q21/24 OR H01Q21/29 OR H01Q7/06 OR H01Q7/08 OR H01Q7/04 OR H01Q1/2208 OR H01Q7/005 OR H01Q1/22 OR H01Q1/36 OR H01Q21/30 OR H01Q5/371 OR H01Q9/42 OR H01Q5/40 OR H01Q21/08 OR H01Q21/205 OR H01Q9/26 OR H01Q1/273 OR H01Q9/16 OR H01Q9/28 OR H01Q11/12 OR H01Q1/24 OR H01Q1/04 OR H01Q1/3241 OR H01Q21/00 OR H01Q21/06 OR H01Q1/521 OR H01Q9/27 OR H01Q3/24 OR H01Q1/242 OR H01Q9/0407 OR H01Q21/061 OR H01Q3/26 OR H01Q9/265 OR H01Q23/00 OR H01Q25/00 OR H01Q1/40 OR H01Q1/50 OR H01Q9/285 OR H01Q1/48 OR H01Q11/14 OR	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/01/14 07:52 PM

		H01Q21/0006 OR H01Q5/357 OR H01Q7/02 OR H01Q1/44 OR H01Q9/0421 OR H01Q9/30 OR H01Q1/2283 OR H01Q5/321 OR H01Q5/378 OR H01Q13/10 OR H01Q1/1271 OR H01Q1/2241 OR H01Q1/362 OR H01Q1/3233 OR H01Q1/3275 OR H01Q1/3291 OR H01Q19/10 OR H01Q21/20 OR H01Q21/26 OR H01Q5/385 OR H01Q9/40 OR H01Q1/241 OR H01Q1/525 OR H01Q5/25 OR H01Q5/35 OR H01Q5/364 OR H01Q1/08 OR H01Q1/20 OR H01Q1/3225 OR H01Q1/42 OR H01Q15/18 OR H01Q21/0025 OR H01Q21/065 OR H01Q1/32 OR H01Q17/001 OR H01Q9/065 OR H01Q1/2266 OR H01Q1/2291 OR H01Q1/245 OR H01Q1/248 OR H01Q1/52 OR H01Q1/526 OR H01Q11/08 OR H01Q11/10 OR H01Q21/0087 OR H01Q21/12 OR H01Q21/293 OR H01Q5/328 OR H01Q9/145 OR H01Q1/1207 OR H01Q1/246 OR H01Q13/16 OR H01Q19/005 OR H01Q21/245 OR H01Q3/2605 OR H01Q5/28 OR H01Q1/085 OR H01Q1/1221 OR					
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		H01Q1/1235 OR H01Q1/14 OR H01Q1/225 OR H01Q1/244 OR H01Q1/26 OR H01Q1/276 OR H01Q1/28 OR H01Q1/3283 OR H01Q1/364 OR H01Q1/523 OR H01Q11/04 OR H01Q13/106 OR H01Q15/14 OR H01Q17/00 OR H01Q19/106 OR H01Q19/13 OR H01Q19/17 OR H01Q19/28 OR H01Q19/30 OR H01Q21/064 OR H01Q5/307 OR H01Q5/335 OR H01Q5/50 OR H01Q9/0428 OR H01Q9/0442 OR H01Q9/44 OR H01Q9/46 OR H01Q1/06 OR H01Q1/12 OR H01Q1/325 OR H01Q11/18 OR H01Q13/00 OR H01Q15/00 OR H01Q19/12 OR H01Q19/32 OR H01Q25/001 OR H01Q5/49 OR H01Q9/045 OR H01Q9/14 OR H01Q1/084 OR H01Q1/1228 OR H01Q1/1242 OR H01Q1/2233 OR H01Q1/2258 OR H01Q1/286 OR H01Q1/287 OR H01Q1/3266 OR H01Q1/34 OR H01Q1/366 OR H01Q1/405 OR H01Q11/02 OR H01Q11/06 OR H01Q13/085 OR H01Q13/203 OR H01Q13/206 OR H01Q15/0086 OR H01Q19/00 OR H01Q19/04 OR					
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		H01Q19/104 OR H01Q19/132 OR H01Q19/134 OR H01Q19/15 OR H01Q21/0075 OR H01Q21/062 OR H01Q21/067 OR H01Q21/10 OR H01Q21/14 OR H01Q21/16 OR H01Q25/005 OR H01Q25/02 OR H01Q3/02 OR H01Q3/14 OR H01Q3/2611 OR H01Q3/2617 OR H01Q3/34 OR H01Q3/36 OR H01Q3/40 OR H01Q3/46 OR H01Q5/00 OR H01Q5/10 OR H01Q5/15 OR H01Q5/48 OR H01Q9/04 OR H01Q9/0457 OR H01Q9/0464 OR H01Q9/0485 OR H01Q9/20 OR H01Q9/24 OR H01Q9/32 OR H01Q9/36 OR H01Q1/125 OR H01Q1/2275 OR H01Q13/18 OR H01Q15/0013 OR H01Q15/0053 OR H01Q15/006 OR H01Q21/22 OR H01Q3/12 OR H01Q3/18 OR H01Q5/314 OR H01Q5/42).cpc.)					
L28	1546	L4 OR L5	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/01/14 07:52 PM
L29	38	L6 AND gap AND antenna AND coil AND pattern	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO;	OR	ON	ON	2023/01/14 07:52 PM

L30	41	("20070069961" OR "20090189729" OR "20100309081" OR "20120081258" OR "20130134225" OR "20140049436" OR "20140071011" OR "20140139380" OR "20140184462" OR "20140339915" OR "20150077296" OR "20150145742" OR "20160132865" OR "20160149305" OR "20160180120" OR "20160254589" OR "20160261026" OR "20160336645" OR "20170005399" OR "20170054213" OR "20170133744" OR "20180301790" OR "20220085489" OR "3017633" OR "5808587" OR "5929825" OR "7000837" OR "7712672" OR "8294629" OR "8422190" OR "8436780" OR "8604992" OR "8638268" OR "8680960" OR "8698591" OR "8710948" OR "8855786" OR "9001001" OR "9300046" OR "9543655" OR "9627762").pn.	JPO; DERWENT; IBM_TDB) (US-PGPUB; USPAT)	OR	ON	ON	2023/01/14 07:52 PM
L31	1170	LEE-Sang-Hoon.in. OR CHOI-Kyoung-Jun.in. OR NameLEE-Sae- Rom.in.	(US-PGPUB; USPAT)	OR	ON	ON	2023/01/14 07:52 PM
L32	419	L9 AND pattern	(US-PGPUB; USPAT)	OR	ON	ON	2023/01/14 07:52 PM
L33	97	L9 AND pattern AND gap	(US-PGPUB; USPAT)	OR	ON	ON	2023/01/14 07:52 PM
L34	9	"17864078"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU,	OR	ON	ON	2023/01/14 07:52 PM

L35	1	"17955126"	SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB) (US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/01/14 07:52 PM
L36	0	34/867.ccls.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/01/14 07:52 PM
L37	1546	343/867.ccls.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/01/14 07:52 PM
L38	1241	L14 AND ((H01Q7/00 OR H01Q1/38 OR H01Q1/2216 OR H01Q1/2225 OR H01Q1/243 OR H01Q21/28 OR H01Q21/24 OR H01Q21/29 OR H01Q7/06 OR H01Q7/08 OR H01Q7/04 OR H01Q1/2208 OR H01Q7/005 OR H01Q1/22 OR H01Q1/36 OR H01Q21/30 OR H01Q5/371 OR H01Q9/42 OR H01Q5/40 OR H01Q21/08 OR H01Q21/205 OR H01Q9/26 OR H01Q1/273 OR H01Q9/16 OR H01Q9/28 OR H01Q11/12 OR H01Q1/24 OR H01Q1/04 OR H01Q1/3241 OR H01Q21/00 OR	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/01/14 07:52 PM

		H01Q21/06 OR H01Q1/521 OR H01Q9/27 OR H01Q3/24 OR H01Q1/242 OR H01Q9/0407 OR H01Q21/061 OR H01Q3/26 OR H01Q9/265 OR H01Q23/00 OR H01Q25/00 OR H01Q1/40 OR H01Q1/50 OR H01Q9/285 OR H01Q1/48 OR H01Q11/14 OR H01Q21/0006 OR H01Q5/357 OR H01Q7/02 OR H01Q1/44 OR H01Q9/0421 OR H01Q9/30 OR H01Q1/2283 OR H01Q5/321 OR H01Q5/378 OR H01Q13/10 OR H01Q1/1271 OR H01Q1/2241 OR H01Q1/362 OR H01Q1/3233 OR H01Q1/3275 OR H01Q1/3291 OR H01Q19/10 OR H01Q21/20 OR H01Q21/26 OR H01Q5/385 OR H01Q9/40 OR H01Q1/241 OR H01Q1/525 OR H01Q5/25 OR H01Q5/35 OR H01Q5/364 OR H01Q1/08 OR H01Q1/20 OR H01Q1/3225 OR H01Q1/42 OR H01Q15/18 OR H01Q21/0025 OR H01Q21/065 OR H01Q1/32 OR H01Q17/001 OR H01Q9/065 OR H01Q1/2266 OR H01Q1/2291 OR H01Q1/245 OR H01Q1/248 OR H01Q1/52 OR H01Q1/526 OR					
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		H01Q11/08 OR H01Q11/10 OR H01Q21/0087 OR H01Q21/12 OR H01Q21/293 OR H01Q5/328 OR H01Q9/145 OR H01Q1/1207 OR H01Q1/246 OR H01Q13/16 OR H01Q19/005 OR H01Q21/245 OR H01Q3/2605 OR H01Q5/28 OR H01Q1/085 OR H01Q1/1221 OR H01Q1/1235 OR H01Q1/14 OR H01Q1/225 OR H01Q1/244 OR H01Q1/26 OR H01Q1/276 OR H01Q1/28 OR H01Q1/3283 OR H01Q1/364 OR H01Q1/523 OR H01Q11/04 OR H01Q13/106 OR H01Q15/14 OR H01Q17/00 OR H01Q19/106 OR H01Q19/13 OR H01Q19/17 OR H01Q19/28 OR H01Q19/30 OR H01Q21/064 OR H01Q5/307 OR H01Q5/335 OR H01Q5/50 OR H01Q9/0428 OR H01Q9/0442 OR H01Q9/44 OR H01Q9/46 OR H01Q1/06 OR H01Q1/12 OR H01Q1/325 OR H01Q11/18 OR H01Q13/00 OR H01Q15/00 OR H01Q19/12 OR H01Q19/32 OR H01Q25/001 OR H01Q5/49 OR H01Q9/045 OR H01Q9/14 OR H01Q1/084 OR H01Q1/1228 OR H01Q1/1242 OR					
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		H01Q1/2233 OR H01Q1/2258 OR H01Q1/286 OR H01Q1/287 OR H01Q1/3266 OR H01Q1/34 OR H01Q1/366 OR H01Q1/405 OR H01Q11/02 OR H01Q11/06 OR H01Q13/085 OR H01Q13/203 OR H01Q13/206 OR H01Q15/0086 OR H01Q19/00 OR H01Q19/04 OR H01Q19/104 OR H01Q19/132 OR H01Q19/134 OR H01Q19/15 OR H01Q21/0075 OR H01Q21/062 OR H01Q21/067 OR H01Q21/10 OR H01Q21/14 OR H01Q21/16 OR H01Q25/005 OR H01Q25/02 OR H01Q3/02 OR H01Q3/14 OR H01Q3/2611 OR H01Q3/2617 OR H01Q3/34 OR H01Q3/36 OR H01Q3/40 OR H01Q3/46 OR H01Q5/00 OR H01Q5/10 OR H01Q5/15 OR H01Q5/48 OR H01Q9/04 OR H01Q9/0457 OR H01Q9/0464 OR H01Q9/0485 OR H01Q9/20 OR H01Q9/24 OR H01Q9/32 OR H01Q9/36 OR H01Q1/125 OR H01Q1/2275 OR H01Q13/18 OR H01Q15/0013 OR H01Q15/0053 OR H01Q15/006 OR H01Q21/22 OR H01Q3/12 OR H01Q3/18 OR H01Q5/314 OR					
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L39	1546	H01Q5/42).cpc.) L14 OR L15	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/01/14 07:52 PM
L40	38	L16 AND gap AND antenna AND coil AND pattern	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, CA, CH, CN, DD, DE, EA, EP, ES, FR, GB, JP, KR, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/01/14 07:52 PM
L41	41	("20070069961" OR "20090189729" OR "20100309081" OR "20120081258" OR "20130134225" OR "20140049436" OR "20140071011" OR "20140139380" OR "20140184462" OR "20140339915" OR "20150077296" OR "20150145742" OR "20160132865" OR "20160149305" OR "20160180120" OR "20160254589" OR "20160261026" OR "20160336645" OR "20170005399" OR "20170054213" OR "20170133744" OR "20180301790" OR "20220085489" OR "3017633" OR "5808587" OR "5929825" OR "7000837" OR "7712672" OR "8294629" OR "8422190" OR "8436780" OR "8604992" OR "8638268" OR "8680960" OR "8698591" OR "8710948" OR "8855786" OR "9001001" OR "9300046" OR "9543655" OR	(US-PGPUB; USPAT)	OR	ON	ON	2023/01/14 07:52 PM

L42	1170	"9627762").pn. LEE-Sang-Hoon.in. OR CHOI-Kyoung-Jun.in. OR NameLEE-Sae- Rom.in.	(US-PGPUB; USPAT)	OR	ON	ON	2023/01/14 07:52 PM
L43	419	L19 AND pattern	(US-PGPUB; USPAT)	OR	ON	ON	2023/01/14 07:52 PM
L44	97	L19 AND pattern AND gap	(US-PGPUB; USPAT)	OR	ON	ON	2023/01/14 07:52 PM

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N1	35	L5 AND gap AND antenna AND coil AND pattern	(US-PGPUB; USPAT)	OR	ON	ON	2022/09/10 11:12 PM
N2	32	N1 AND ((H01Q7/00 OR H01Q1/2225 OR H01Q1/243 OR H01Q21/28 OR H01Q1/2216 OR H01Q21/205 OR H01Q7/06 OR H01Q7/08 OR H01Q1/38 OR H01Q21/29 OR H01Q1/2283 OR H01Q1/26 OR H01Q1/36 OR H01Q11/14 OR H01Q11/18 OR H01Q21/0025 OR H01Q21/20 OR H01Q7/005 OR H01Q7/04 OR H01Q9/145 OR H01Q9/16 OR H01Q1/04 OR H01Q1/22 OR H01Q1/2208 OR H01Q1/2291 OR H01Q1/24 OR H01Q1/241 OR H01Q1/245 OR H01Q1/273 OR H01Q1/276 OR H01Q1/3283 OR H01Q1/364 OR H01Q1/366 OR H01Q1/42 OR H01Q1/50 OR H01Q1/521 OR H01Q1/523 OR H01Q1/525 OR H01Q1/526 OR	(US-PGPUB; USPAT)	OR	ON	ON	2022/09/10 11:12 PM

		H01Q11/12 OR H01Q13/10 OR H01Q21/00 OR H01Q21/061 OR H01Q21/08 OR H01Q21/24 OR H01Q21/30 OR H01Q3/2617 OR H01Q3/46 OR H01Q5/00 OR H01Q5/15 OR H01Q5/307 OR H01Q5/371 OR H01Q5/40 OR H01Q9/0485 OR H01Q9/26 OR H01Q9/285 OR H01Q9/30 OR H01Q9/42).cpc.)					
N3	35	N1 OR N2	(US-PGPUB; USPAT)	OR	ON	ON	2022/09/10 11:12 PM
N4	35	L5 AND gap AND antenna AND coil AND pattern	(US-PGPUB; USPAT)	OR	ON	ON	2022/09/10 11:12 PM
N5	32	N4 AND ((H01Q7/00 OR H01Q1/2225 OR H01Q1/243 OR H01Q21/28 OR H01Q1/2216 OR H01Q21/205 OR H01Q7/06 OR H01Q7/08 OR H01Q1/38 OR H01Q21/29 OR H01Q1/2283 OR H01Q1/26 OR H01Q1/36 OR H01Q11/14 OR H01Q11/18 OR H01Q21/0025 OR H01Q21/20 OR H01Q7/005 OR H01Q7/04 OR H01Q9/145 OR H01Q9/16 OR H01Q1/04 OR H01Q1/22 OR H01Q1/2208 OR H01Q1/2291 OR H01Q1/24 OR H01Q1/241 OR H01Q1/245 OR H01Q1/273 OR H01Q1/276 OR H01Q1/3283 OR H01Q1/364 OR H01Q1/366 OR	(US-PGPUB; USPAT)	OR	ON	ON	2022/09/10 11:12 PM

		H01Q1/42 OR H01Q1/50 OR H01Q1/521 OR H01Q1/523 OR H01Q1/525 OR H01Q1/526 OR H01Q11/12 OR H01Q13/10 OR H01Q21/00 OR H01Q21/061 OR H01Q21/08 OR H01Q21/24 OR H01Q21/30 OR H01Q3/2617 OR H01Q3/46 OR H01Q5/00 OR H01Q5/15 OR H01Q5/307 OR H01Q5/371 OR H01Q5/40 OR H01Q9/0485 OR H01Q9/26 OR H01Q9/285 OR H01Q9/30 OR H01Q9/42).cpc.)					
N6	35	N4 OR N5	(US-PGPUB; USPAT)	OR	ON	ON	2022/09/10 11:12 PM

Doc code: IDS

PTO/SB/08a (02-18)

Doc description: Information Disclosure Statement (IDS) Filed

Approved for use through 11/30/2020. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		
	Filing Date		
	First Named Inventor	Sang Hoon LEE	
	Art Unit		
	Examiner Name		
	Attorney Docket Number	1959706.00056/AQCRP.41C3	

U.S.PATENTS						Remove
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	3017633	A	1962-01-16	Marston et al.	
	2	5808587	A	1998-09-15	Shima	
	3	5929825	A	1999-07-27	Niu et al.	
	4	7000837	B2	2006-02-21	Akiho et al.	
	5	7712672	B2	2010-05-11	Takahashi et al.	
	6	8294629	B2	2012-10-23	Yosui et al.	
	7	8422190	B2	2013-04-16	Ito et al.	
	8	8436780	B2	2013-05-07	Schantz et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)

Application Number		
Filing Date		
First Named Inventor	Sang Hoon LEE	
Art Unit		
Examiner Name		
Attorney Docket Number	1959706.00056/AQCRP.41C3	

9	8604992	B2	2013-12-10	Kobayashi et al.	
10	8638268	B2	2014-01-28	Yosui et al.	
11	8680960	B2	2014-03-25	Singh et al.	
12	8698591	B2	2014-04-15	Singh et al.	
13	8710948	B2	2014-04-29	Singh et al.	
14	8855786	B2	2014-10-07	Derbas et al.	
15	9001001	B2	2015-04-07	Nakano et al.	
16	9300046	B2	2016-03-29	Singh et al.	
17	9543655	B2	2017-01-10	Lee et al.	
18	9627762	B2	2017-04-18	Ito	

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**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number		
Filing Date		
First Named Inventor	Sang Hoon LEE	
Art Unit		
Examiner Name		
Attorney Docket Number	1959706.00056/AQCRP.41C3	

Examiner Initial*	Cite No	Publication Number	Kind Code ¹	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	20070069961	A1	2007-03-29	Akiho et al.	
	2	20090189729	A1	2009-07-30	Kubo et al.	
	3	20100309081	A1	2010-12-09	Kobayashi et al.	
	4	20120081258	A1	2012-04-05	Yosui et al.	
	5	20130134225	A1	2013-05-30	Teshima	
	6	20140049436	A1	2014-02-20	Kubo et al.	
	7	20140071011	A1	2014-03-13	Yosui et al.	
	8	20140139380	A1	2014-05-22	Ouyang et al.	
	9	20140184462	A1	2014-07-03	Yosui	
	10	20140339915	A1	2014-11-20	Kanno et al.	

**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number		
Filing Date		
First Named Inventor	Sang Hoon LEE	
Art Unit		
Examiner Name		
Attorney Docket Number	1959706.00056/AQCRP.41C3	

11	20150077296	A1	2015-03-19	An et al.	
12	20150145742	A1	2015-05-28	Cao	
13	20160132865	A1	2016-05-12	Park et al.	
14	20160149305	A1	2016-05-26	Jeon et al.	
15	20160180120	A1	2016-06-23	Wallner	
16	20160254589	A1	2016-09-01	Ju et al.	
17	20160261026	A1	2016-09-08	Han et al.	
18	20160336645	A1	2016-11-17	Orihara et al.	
19	20170005399	A1	2017-01-05	Ito et al.	
20	20170054213	A1	2017-02-23	Singh et al.	
21	20170133744	A1	2017-05-11	An et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)

Application Number		
Filing Date		
First Named Inventor	Sang Hoon LEE	
Art Unit		
Examiner Name		
Attorney Docket Number	1959706.00056/AQCRP.41C3	

22	20180301790	A1	2018-10-18	Kim et al.
23	20220085489	A1	2022-05-17	Nam et al.

If you wish to add additional U.S. Published Application citation information please click the Add button.

FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number ³	Country Code ²	Kind Code ⁴	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear	T ⁵
	1	2003-022912	JP	A	2003-01-24	Mitsubishi Materials Corp.		×
	2	2006-195802	JP	A	2006-07-27	Fuji Electric Holdings		☒
	3	2006-270681	JP	A	2006-10-05	Sony Corporation		☒
	4	2010-278518	JP	A	2010-12-09	Sony Corporation		☒
	5	2012-209619	JP	A	2012-10-25	Toyota Central Research & Development et al.		☒
	6	2013-013144	JP	A	2013-01-17	Panasonic Corp.		☒
	7	2013-038821	JP	A	2013-02-21	Murata Manufacturing Co., Ltd.		☒

**INFORMATION DISCLOSURE
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Application Number		
Filing Date		
First Named Inventor	Sang Hoon LEE	
Art Unit		
Examiner Name		
Attorney Docket Number	1959706.00056/AQCRP.41C3	

8	2013-055637	JP	A	2013-03-21	Murata Manufacturing Co., Ltd.	☒
9	2013-121247	JP	A	2013-06-17	Panasonic Corp.	☒
10	2014-64284	JP	A	2014-04-10	Panasonic Corp.	☒
11	5360202	JP	B2	2013-12-04	Murata Manufacturing Co., Ltd.	☒
12	10-1185503	KR	B1	2012-09-24	AQ Co. Ltd.	☒
13	10-1210941	KR	B1	2012-12-11	AQ Co. Ltd.	☒
14	10-1282268	KR	B1	2013-07-10	AQ Co. Ltd.	☒
15	10-1339020	KR	B1	2013-12-09	AQ Co. Ltd.	☒
16	10-2003-0076039	KR	A	2003-09-26	Sangshin Elecom Co., Ltd. et al.	☒
17	10-2006-0008332	KR	A	2006-01-26	Sony Corporation	☒
18	10-2007-0006702	KR	A	2007-01-11	Omron Teteisi Electronics Co.	☒

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(Not for submission under 37 CFR 1.99)

Application Number		
Filing Date		
First Named Inventor	Sang Hoon LEE	
Art Unit		
Examiner Name		
Attorney Docket Number	1959706.00056/AQCRP.41C3	

19	10-2008-0008687	KR	A	2008-01-24	LG Electronics Inc.	☒
20	10-2010-0005071	KR	A	2010-01-13	Nokia Corporation	☒
21	10-2012-0099131	KR	A	2012-09-06	Murata Manufacturing Co., Ltd.	☒
22	10-2015-0051739	KR	A	2015-05-13	AQ Co. Ltd.	☒
23	10-2018-0033104	KR	A	2018-04-02	Amotech Co. Ltd.	☒
24	10-2018-0047823	KR	A	2018-05-10	Amotech Co. Ltd.	☒
25	2011/062238	WO	A1	2011-05-26	Murata Manufacturing Co., Ltd.	☒
26	2013/019455	WO	A1	2013-02-07	Brady Worldwide Inc.	☒
27	2013/069465	WO	A1	2013-05-16	Murata Manufacturing Co., Ltd.	☒
28	2015/009072	WO	A1	2015-01-22	AQ Corporation	☒
29	2016/056736	WO	A1	2016-04-14	AQ Corporation	☒

**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number		
Filing Date		
First Named Inventor	Sang Hoon LEE	
Art Unit		
Examiner Name		
Attorney Docket Number	1959706.00056/AQCRP.41C3	

30	2018/056765	WO	A1	2018-03-29	Amotech Co. Ltd.		☒
31	2018/117431	WO	A1	2018-06-28	Amotech Co. Ltd.		☒
32	10-2200083	KR	B1	2021-01-08	AMOTECH CO., LTD.		☒
33	10-1901715	KR	B1	2018-09-27	SAMSUNG ELECTRO-MECHANICS CO., LTD.		☒
34	10-2099310	KR	B1	2020-04-09	AMOTECH CO., LTD.		☒
35	10-2137633	KR	B1	2020-07-24	AMOTECH CO., LTD.		☒
36	10-2178575	KR	B1	2020-11-13	AMOTECH CO., LTD.		☒
37	10-2021-0078368	KR	A	2021-06-28	AMOTECH CO., LTD.		☒
38	10-2021-0100871	KR	A	2021-08-18	SAMSUNG ELECTRONICS CO., LTD.		☒
39	10-2239249	KR	B1	2021-04-12	AMOTECH CO., LTD.		☒
40	10-2021-0153484	KR	A	2021-12-17	AMOTECH CO., LTD.		☒

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)

Application Number		
Filing Date		
First Named Inventor	Sang Hoon LEE	
Art Unit		
Examiner Name		
Attorney Docket Number	1959706.00056/AQCRP.41C3	

If you wish to add additional Foreign Patent Document citation information please click the Add button

NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵
	1	Office Action from U.S. Patent Application No. 15/614,484, dated September 22, 2017 - 44 pages.	
	2	Office Action from U.S. Patent Application No. 15/682,473, dated October 20, 2017 - 29 pages.	
	3	Notice of Allowance from U.S. Patent Application No. 15/614,484, dated February 23, 2018 - 13 pages.	

If you wish to add additional non-patent literature document citation information please click the Add button

EXAMINER SIGNATURE

Examiner Signature	/ANDREA LINDGREN BALTZELL/	Date Considered	01/14/2023
--------------------	----------------------------	-----------------	------------

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number		
Filing Date		
First Named Inventor	Sang Hoon LEE	
Art Unit		
Examiner Name		
Attorney Docket Number	1959706.00056/AQCRP.41C3	

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Mincheol Kim/	Date (YYYY-MM-DD)	2022-09-28
Name/Print	Mincheol Kim	Registration Number	51,306

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/955,126	09/28/2022	Sang Hoon LEE	1959706.00056/ AQCRP.41C3	5216
45200	7590	02/03/2023	EXAMINER	
K&L Gates LLP-Orange County 1 Park Plaza Twelfth Floor Irvine, CA 92614			LINDGREN BALTZEL, ANDREA J	
			ART UNIT	PAPER NUMBER
			2845	
			NOTIFICATION DATE	DELIVERY MODE
			02/03/2023	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Commissioner for Patents
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P.O. Box 1450
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Application No. : 17955126
Applicant : Lee
Filing Date : 09/28/2022
Date Mailed : 02/03/2023

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Notice of Allowance Mailed

This application has been accorded an Allowance Date and is being prepared for issuance. The application, however, is incomplete for the reasons below.

Applicant is given two (2) months from the mail date of this Notice within which to respond. This time period for reply is extendable under 37 CFR 1.136(a) for only TWO additional MONTHS.

The informalities requiring correction are indicated in the attachment(s). If the informality pertains to the abstract, specification (including claims) or drawings, the informality must be corrected with an amendment in compliance with 37 CFR 1.121 (or, if the application is a reissue application, 37 CFR 1.173). Such an amendment may be filed after payment of the issue fee if limited to correction of informalities noted herein. See Waiver of 37 CFR 1.312 for Documents Required by the Office of Patent Publication, 1280 Off. Gaz. Patent Office 918 (March 23, 2004). In addition, if the informality is not corrected until after payment of the issue fee, for purposes of 35 U.S.C. 154(b)(1)(iv), “all outstanding requirements” will be considered to have been satisfied when the informality has been corrected. A failure to respond within the above-identified time period will result in the application being ABANDONED.

See attachment(s).

*A copy of this notice **MUST** be returned with the reply. Please address response to
“Mail Stop Issue Fee, Commissioner for Patents,
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/Tim Ritter/
Publication Branch
Office of Data Management
(571) 272-4200

IDENTIFICATION OF DRAWING DEFICIENCIES

- ☐ There is a hole or the image thereof within the illustration. FIG(s)
- ☐ The illustration is penetrated or traversed by a solid or broken line that is not intended to be part of the drawing, such as a dark line caused by a flaw in the copying process. FIG(s)
- ☐ An ink stamp or the image thereof obscures part of the illustration. FIG(s)
- ☐ The drawing is marred by black smudges, obliterations, or fax/copier marks (for example, speckles or dots in a substantial portion of the drawing). FIG(s)
- ☐ Figure numbers are duplicated or missing. FIG(s)
- ☐ Drawing sheet or figure is missing. FIG(s)
- ☐ Numbers, letters, or reference characters in the drawing have been crossed out or are illegibly handwritten. FIG(s)
- ☐ The character of the lines, numbers, and letters is poor. FIG(s)
- ☐ The drawing's background shows that the original drawing was made on graph paper or other paper with a pattern or decoration. FIG(s)
- ☐ The FIG. number label is placed in a location that causes the drawing to be read upside down. FIG(s)
- ☐ Data, a reference number, or part of the drawing is truncated or missing, or a lead line has no reference number. FIG(s)
- ☐ The drawing and/or the FIG. label contain(s) foreign language. FIG(s)
- ☒ This utility application contains a photograph of a view that is capable of being illustrated as a line drawing. FIG(s) 45
- ☐ A petition under 37 CFR 1.84(a)(2) to accept color drawings has been granted, but the brief description of the drawings in the specification does not contain (or has not been amended to contain) the paragraph required by 37 CFR 1.84(a)(2)(iii).
- ☐ This reissue application contains added and/or amended drawings that are not labeled as "New" or "Amended" or "Canceled" as required by 37 CFR 1.173(b)(3). FIG(s)
- ☐ This Design reissue application contains a drawing that is labeled as "Canceled" but is not surrounded by brackets, or a drawing that is surrounded by brackets but is not labeled as "Canceled." See 37 CFR 1.173(b)(3). FIG(s)
- ☐ OTHER:
- ☐ COMMENTS:

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Sang Hoon LEE
App. No.	:	17/955,126
Filed	:	September 28, 2022
Examiner	:	LINDGREN BALTZELL, ANDREA J
Art Unit	:	2845
Conf No.	:	5216

RESPONSE TO NOTICE TO FILE CORRECTED APPLICATION PAPERS**Mail Stop Issue Fee**

Commissioner for Patents

P.O. Box 1450

Alexandria, VA 22313-1450

Dear Sir:

In response to the Notice to File Corrected Application Papers dated on February 3, 2023,
Applicant submits the following:

1. Notice to File Corrected Application Papers
2. Replacement Sheet of FIG. 45

No fee is believed to be due. However, if any fee is necessary, please charge to Deposit
Account No. 02-1818.

Respectfully submitted,

K&L GATES, LLP

Dated: February 22, 2023

By: /Mincheol Kim/
Mincheol Kim
Registration No. 51,306
Attorney of Record
Customer No. 45,200
(949) 623-3611



UNITED STATES PATENT AND TRADEMARK OFFICE

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45200	7590	02/03/2023	EXAMINER	
K&L Gates LLP-Orange County			LINDGREN BALTZEL, ANDREA J	
1 Park Plaza			ART UNIT	PAPER NUMBER
Twelfth Floor			2845	
Irvine, CA 92614			NOTIFICATION DATE	DELIVERY MODE
			02/03/2023	ELECTRONIC

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uspatentmail@klgates.com



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See attachment(s).

*A copy of this notice **MUST** be returned with the reply. Please address response to
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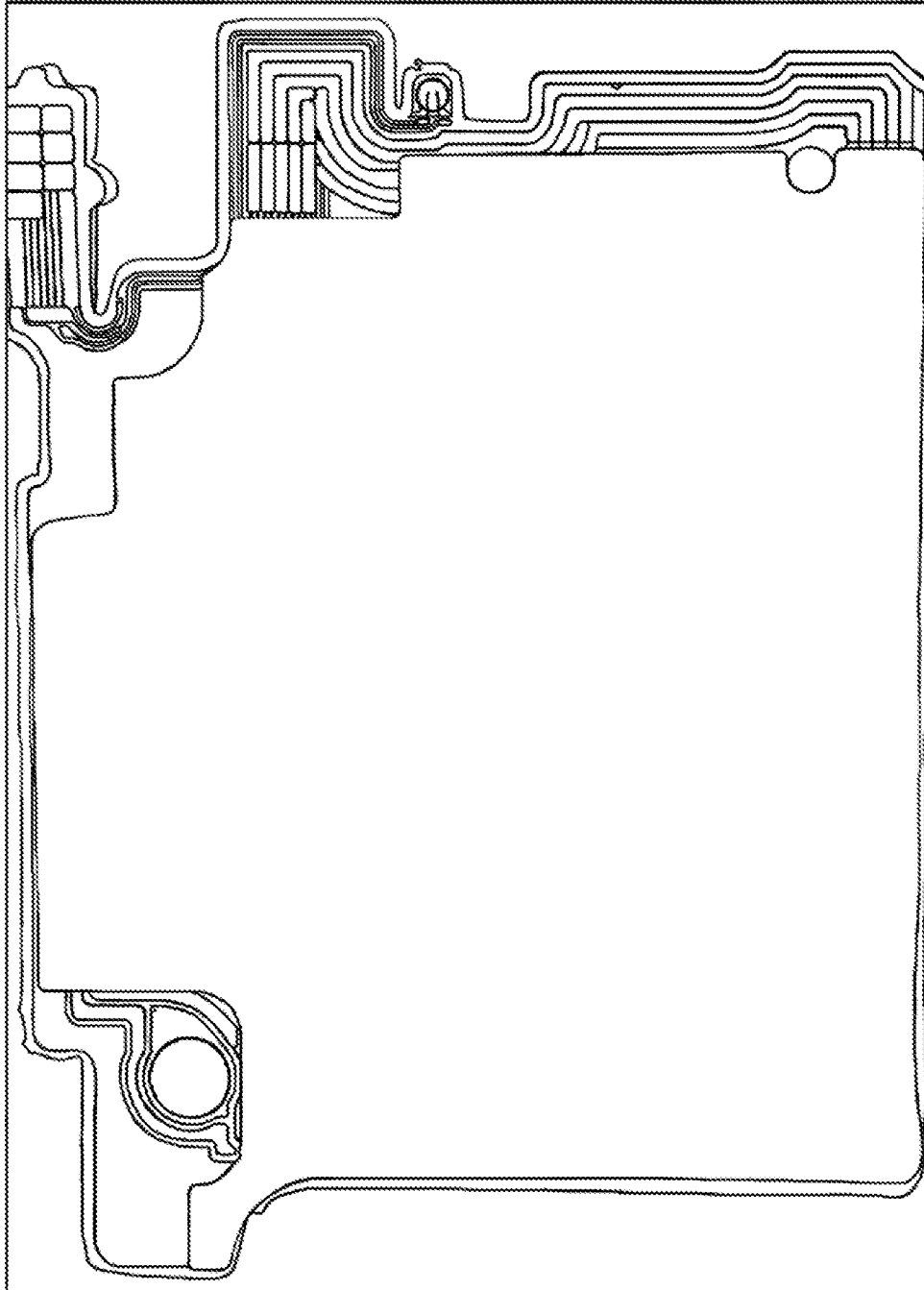
/Tim Ritter/
Publication Branch
Office of Data Management
(571) 272-4200

IDENTIFICATION OF DRAWING DEFICIENCIES

- ☐ There is a hole or the image thereof within the illustration. FIG(s)
- ☐ The illustration is penetrated or traversed by a solid or broken line that is not intended to be part of the drawing, such as a dark line caused by a flaw in the copying process. FIG(s)
- ☐ An ink stamp or the image thereof obscures part of the illustration. FIG(s)
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- ☐ Drawing sheet or figure is missing. FIG(s)
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- ☐ A petition under 37 CFR 1.84(a)(2) to accept color drawings has been granted, but the brief description of the drawings in the specification does not contain (or has not been amended to contain) the paragraph required by 37 CFR 1.84(a)(2)(iii).
- ☐ This reissue application contains added and/or amended drawings that are not labeled as "New" or "Amended" or "Canceled" as required by 37 CFR 1.173(b)(3). FIG(s)
- ☐ This Design reissue application contains a drawing that is labeled as "Canceled" but is not surrounded by brackets, or a drawing that is surrounded by brackets but is not labeled as "Canceled." See 37 CFR 1.173(b)(3). FIG(s)
- ☐ OTHER:
- ☐ COMMENTS:

Replacement Sheet

FIGURE 45



Electronic Acknowledgement Receipt

EFS ID:	47575261
Application Number:	17955126
International Application Number:	
Confirmation Number:	5216
Title of Invention:	SMARTPHONE ANTENNA IN FLEXIBLE PCB
First Named Inventor/Applicant Name:	Sang Hoon LEE
Customer Number:	45200
Filer:	Mincheol Kim/US Patent Mail
Filer Authorized By:	Mincheol Kim
Attorney Docket Number:	1959706.00056/AQCRP.41C3
Receipt Date:	22-FEB-2023
Filing Date:	28-SEP-2022
Time Stamp:	17:46:16
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
------------------------	----

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Amendment after Notice of Allowance (Rule 312)	0_Response_to_Notice_to_File_Corrected_Application_Papers_AQCRP-41C3.pdf	91054 8f2cdecf3f3febbd3962a1544f72bcbf7aeeb924	no	1

Warnings:

Information:					
2	Miscellaneous Incoming Letter	1_2023-02-03_Notice_to_file_Corrected_Application_Papers_AQCRP-41C3.pdf	115592	no	3
			7f504626cd563c154c0b2485176629cbb9a654c		
Warnings:					
Information:					
3	Drawings-only black and white line drawings	2_Replacement_Sheet_Fig45_AQCRP-41C3.pdf	210476	no	1
			5466d53241cf19277bfa500e61c7e424adf3cd78		
Warnings:					
Information:					
Total Files Size (in bytes):			417122		
<p>This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.</p> <p><u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.</p> <p><u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.</p> <p><u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.</p>					

Substitute for form 1449/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT <i>(use as many sheets as necessary)</i>				Complete if Known	
				Application Number	17/955,126
				Filing Date	September 28, 2022
				First Named Inventor	LEE, Sang Hoon
				Art Unit	2843
				Examiner Name	BALTZELL, Andrea J Lindgren
Sheet	1	of	2	Attorney Docket Number	1959706.00056/AQCRP.41C3

U.S. PATENT DOCUMENTS						
Examiner Initials*	Cite No. ¹	Document Number		Publication Date YYYY-MM-DD	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number - Kind Code ² (if known)				
	1	9607757	B2	2017-03-28	Hirobe et al.	
	2	10389183	B2	2019-08-20	Han et al.	
	3	10475571	B2	2019-11-12	Jang	
	4	20190393604	A1	2019-12-26	Ichikawa	
	5	10607770	B2	2020-03-31	Noh et al.	
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Examiner Initials*	Cite No. ¹	Foreign Patent Document		Publication Date YYYY-MM-DD	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T ⁶
		Country Code ³ -Number ⁴ -Kind Code ⁵ (<i>if known</i>)					
	1	WO 2019/151693	A1	2019-08-08	Lg Innotek Co., Ltd.		V
	2	WO 2017/200236	A1	2017-11-23	Emw Co., Ltd.		V
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	4	KR 10-1532052	B1	2015-06-29	Elentec		V
	5	KR 10-1574322	B1	2015-12-04	Imtech Inc		V
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	7	KR 10-1991011	B1	2019-06-19	Hansol Technics Inc.		V

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Substitute for form 1449/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT <i>(use as many sheets as necessary)</i>				Complete if Known	
				Application Number	17/955,126
				Filing Date	September 28, 2022
				First Named Inventor	LEE, Sang Hoon
				Art Unit	2843
				Examiner Name	BALTZELL, Andrea J Lindgren
Sheet	2	of	2	Attorney Docket Number	1959706.00056/AQCRP.41C3

U.S. PATENT DOCUMENTS						
Examiner Initials*	Cite No. ¹	Document Number		Publication Date YYYY-MM-DD	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number - Kind Code ² <i>(if known)</i>				
	11	11539401	B2	2022-12-27	Baek et al.	
	12	20180248255	A1	2018-08-30	NOH et al.	
	13	20170345535	A1	2017-11-30	KIM et al.	
	14	10868356	B1	2020-12-15	Da Costa Bras Lima et al.	
	15	20190027826	A1	2019-01-24	WON et al.	

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Examiner Initials*	Cite No. ¹	Foreign Patent Document		Publication Date YYYY-MM-DD	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T ⁶
		Country Code ³ -Number ⁴ -Kind Code ⁵ (<i>if known</i>)					
	8	KR 10-2018-0046243	A	2018-05-08	Doosung Industrial		V
	9	KR 10-1697303	B1	2017-01-17	Amosense Co., Ltd.		V
	10	KR 10-1719915	B1	2014-03-24	Samsung Electro-Mechanics Co., Ltd.		V
	11	KR 10-1640023	B1	2016-07-18	Imtech Inc		V
	12	CN 203103042	U	2013-07-31	Tai Tech Advanced Electronics Co Ltd		V
	13	KR 10-1811611	B1	2021-12-26	Lg Electronics Inc.		V
	14	CN 209015853	U	2019-06-21	Shenzhen Chuangxingqi Communication Co Ltd		V
	15	EP 3657519	A1	2020-05-27	NuCurrent, Inc.		

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Sheet	1	of	1	Attorney Docket Number	1959706.00056/AQCRP.41C3

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No. ¹	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published	T ²
	1	Hong, S., Lee, S., Jeong, S., Kim, D. H., Song, J., Kim, H., & Kim, J. (2017, May). Dual-Directional Near Field Communication Tag Antenna with Effective Magnetic Field Isolation from Wireless Power Transfer System. In 2017 IEEE Wireless Power Transfer Conference (WPTC) (pp. 1-3).	
	2	Hong, S., Jeong, S., Lee, S., Sim, B., Kim, H., & Kim, J. (2019, July). A Dual Resonance Near Field Communication Coil for EMF Reduction in Near Field Communication and Wireless Power Transfer Dual Coil System. In 2019 IEEE International Symposium on Electromagnetic Compatibility, Signal & Power Integrity (EMC+ SIPI) (pp. 644-647).	
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	Sang Hoon Lee
App. No.	:	17/955,126
Filed	:	September 28, 2022
Examiner	:	BALTZELL, Andrea J Lindgren
Art Unit	:	2843
Conf No.	:	5216

STATEMENT UNDER 37 CFR § 1.97(e)(2)

That no item of information contained in the information disclosure statement (accompanied PTO/SB/08a Form and PTO/SB/08b Form) was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in § 1.56(c) more than three months prior to the filing of the information disclosure statement.

Respectfully submitted,

K&L GATES, LLP

Dated: April 27, 2023

By: /Mincheol Kim/
Mincheol Kim
Registration No. 51,306
Attorney of Record
Customer No. 45,200
(949) 623-3611

Wireless charging receiver for improving antenna performance

List of publications

Publication date

PCT Application number 2019WO-KR00861 Date 2019-01-22 Register

WO2019/151693 A1 Published application with search report2019-08-08

English Title

Wireless charging receiver for improving antenna performance

French Title

Récepteur de charge sans fil permettant d'améliorer les performances d'une antenne

Other Title 안테나 성능을 개선시키는 무선 충전 수신기

Abstract - French

La présente invention porte sur un récepteur d'énergie sans fil comprenant : un substrat ; une bobine disposée dans le substrat de sorte à recevoir un signal d'énergie sans fil ; une première antenne de communication sans fil disposée à l'intérieur et à l'extérieur de la bobine ; et une seconde antenne de communication sans fil disposée à l'intérieur et à l'extérieur de la bobine, la première antenne de communication sans fil et la seconde antenne de communication sans fil prenant en charge différents procédés de communication.

English Abstract (Native or MT)

The present invention provides a wireless power receiver comprising: a substrate; a coil disposed in the substrate so as to receive a wireless power signal; a first wireless communication antenna disposed inside and outside the coil; and a second wireless communication antenna disposed inside and outside the coil, wherein the first wireless communication antenna and the second wireless communication antenna support different communication methods.

Other Abstracts

본 발명은 기판, 기판에 배치되어 무선 전력 신호를 수신하는 코일, 코일의 내측 및 외측에 배치되는 제1 무선 통신용 안테나, 및 코일의 내측 및 외측에 배치되는 제2 무선 통신용 안테나를 포함하고, 제1 무선 통신용 안테나와 제2 무선 통신용 안테나는 서로 다른 통신 방식을 지원하는 무선 전력 수신기를 제공한다.

Application Language KOREAN (KOR)

Inventor(s) LIM, SUNG-HYUN [KR]

Inventor(s) 임성현 [KR]

Applicant/Assignee

LG INNOTEK [KR]

| \$ 9 448 M

Assignee 엘지이노텍(주) [KR]

Applicant/Assignee Address LG INNOTEK CO., LTD. , KR

Patent Assignee History LG INNOTEK CO., LTD. [KR]

Representative LEE, SEUNG CHAN [KR]

Representative Address LEE, SEUNG CHAN , KR

Representative 이승찬 [KR]

Application Numbers & Dates WOKR2019/000861 2019-01-22 [2019WO-KR00861]

Priority Numbers & Dates KR20180013389 2018-02-02 [2018KR-0013389]

Technology domain Electrical machinery, apparatus, energy

Telecommunications

US codes history

IPC codes

H02J-050/10* H01F-038/14 H02J-005/00 H04B-005/00

IPC codes history

H01F-038/14 H02J-005/00 H02J-050/10* H04B-005/00

CPC codes

H01F-038/14 H02J-005/00 H04B-005/00 H04B-005/00/37 H04B-005/00/75 H02J-050/10*

CPC codes history

H01F-038/14 H02J-005/00 H04B-005/00 H04B-005/00/37 H04B-005/00/75 H02J-050/10*

Notes Extended kind: x

Cited Patents International Search Report [Examiner]

-KR20170018646 (A) (Cat. Y) [KR20170018646] SAMSUNG ELECTRONICS CO LTD; -KR101574322 (B1) (Cat. Y) [KR101574322] IMTECH INC; -JP2013146050 (A) (Cat. A) [JP2013146050] DEXERIALS CORP; -KR20170135759 (A) (Cat. A) [KR20170135759] SKC CO LTD; -KR20170017416 (A) (Cat. A) [KR20170017416] AMOSENSE CO LTD;

Description

TECHNICAL FIELD

[0001] The present invention relates to a wireless charging receiver, and more particularly, to provide a structure capable of improving antenna performance used for wireless mobile communication and near field communication in a miniaturized wireless charging receiver.

BACKGROUND ART

[0002] Wireless power transmission or wireless energy transfer is a technique for wirelessly transferring electrical energy from a transmitter to a receiver using the principle of induction of a magnetic field, an electric motor or transformer using electromagnetic induction principles has already begun in 1800, and thereafter, a method for transmitting electric energy by radiating electromagnetic waves such as radio waves, laser waves, radio waves, and microwave waves has also been attempted. Electric toothbrushes or some wireless razors that we often use are charged to electromagnetic induction principles.

[0003] To date, the energy transfer method using wireless may be largely divided into magnetic induction method, magnetic resonance method and RF transfer method using short-wavelength radio frequency.

[0004] The magnetic induction scheme uses a phenomenon of causing two coils to be adjacent to each other and then flowing a current to one coil, magnetic flux generated at this time causes

electromotive force to be generated in another coil, and it is rapidly being commercialized around a miniature device such as a mobile phone. The magnetic induction scheme is capable of transmitting power up to hundreds of kilowatts (kW) and has high efficiency, but the maximum transmission distance is 1 centimeter (cm) or less, and thus there is a disadvantage that the magnetic induction scheme generally needs to be adjacent to a charger or floor.

[0005] The magnetic resonance method uses an electric field or a magnetic field instead of using electromagnetic waves, current, and so on. Since the magnetic resonance method is hardly affected by electromagnetic wave problems, the magnetic resonance method has advantages of being safe for other electronic devices or human bodies. Meanwhile, there is a disadvantage that it can be utilized only in limited distances and spaces, and energy transfer efficiency is somewhat low.

[0006] Short-wavelength wireless power transfer schemes – briefly, RF transfer schemes – utilize that energy can be directly transmitted and received in radio wave form. The present technology relates to an RF wireless power transmission method using a rectenna, in which rectenna means an element for directly converting RF power into DC power as a combiner of an antenna and a rectifier. That is, the RF method is a technology for converting AC radio waves into DC to use, and research for compatibilization is actively conducted with improved efficiency.

[0007] The wireless power transfer technology may be utilized variously throughout the vehicle, it, railway, household appliance industry, etc., as well as mobile.

[0008] Such as a portable terminal, electronic devices that not only include a wireless charging reception function, but also perform wireless mobile communication, near field communication, etc., may include a plurality of different coils or antennas for performing each function. A plurality of different coils or antennas are included with increased functions required for the portable terminal, but the size of the portable terminal cannot become large enough for the plurality of different coils or antennas. Accordingly, performance of a coil or antenna can be degraded by arranging a plurality of different coils or antennas in a limited space.

DISCLOSURE

TECHNICAL PROBLEM

[0009] The present invention is designed to solve the problems of the prior art described above. the present invention can provide an apparatus and method for improving performance of a plurality of

different coils or antennas for performing a wireless charging reception function, a wireless mobile communication, and a near field communication.

[0010] In addition, the present invention provides an apparatus and method for improving performance of wireless mobile communication and near field communication by arranging at least one antenna for performing wireless mobile communication and near field communication inside a coil for wireless charging.

[0011] In addition, the present invention may provide an apparatus and a method for increasing inductance by arranging an antenna for wireless communication inside a coil for wireless charging to increase recognition rate as a wireless charging receiver.

[0012] In addition, the present invention can provide an apparatus and method for improving performance of a coil or an antenna by arranging a coil for wireless charging and an antenna for wireless mobile communication to overlap with each other on both surfaces of a substrate, thereby reducing resistance generated when forming a magnetic field.

[0013] The technical objectives intended to be achieved in the present disclosure are not limited to those mentioned above, and other technical objectives that are not mentioned above can be clearly understood to those skilled in the art based on the description provided below.

TECHNICAL SOLUTION

[0014] The present invention may provide a wireless charging receiver with improved antenna performance for wireless communication.

[0015] A wireless power receiver includes: a substrate; a coil disposed on the substrate to receive a wireless power signal; a first wireless communication antenna disposed inside and outside the coil; And a second wireless communication antenna disposed inside and outside the coil, wherein the first wireless communication antenna and the second wireless communication antenna support different communication methods.

[0016] The first wireless communication antenna includes a first pattern disposed inside the coil, and a second pattern disposed outside the coil, wherein the first pattern and the second pattern are disposed on one side of the substrate.

[0017] In addition, the first wireless communication antenna may include an antenna for near field communication (NFC).

[0018] In addition, the second wireless communication antenna may include a third pattern disposed inside the coil, and a fourth pattern disposed outside the coil. the third pattern may be disposed on the other side surface opposite to the one side surface on which the first pattern is disposed, and the fourth pattern may be disposed on the one side surface and the other side surface.

[0019] In addition, the second antenna for wireless communication may include an antenna for magnetic security transmission (MST).

[0020] Further, the number of antenna windings in the third pattern may be greater than in the first pattern.

[0021] Further, the third pattern may be disposed closer to the center than the first pattern.

[0022] Further, an inner diameter of the first pattern and an outer diameter of the third pattern may be spaced apart from each other by 2.3 mm or more with reference to a horizontal plane.

[0023] In addition, the wireless power receiver may further include: an antenna actuator disposed inside the first wireless communication antenna and the second wireless communication antenna; and a shielding material disposed corresponding to the substrate, wherein the shielding material may include a shielding reinforcement pattern having an area larger than an outer diameter of the third pattern.

[0024] In addition, the coil may include a fifth pattern and a sixth pattern disposed on both sides of the substrate, and an inner diameter and an outer diameter of the fifth pattern and the sixth pattern may be aligned with each other.

[0025] The aspects of the present disclosure are merely some of the preferred embodiments of the present disclosure, and various embodiments in which technical features of the present disclosure are reflected may be derived and understood based on the detailed description of the present disclosure to be explained below by reference to those skilled in the art.

ADVANTAGEOUS EFFECTS

[0026] The effects of the method and device according to the invention are described below.

[0027] The present invention can provide a wireless charging receiver in which an antenna for wireless communication is disposed, so that the antenna can improve transmission and reception performance of a wireless signal.

[0028] The effects obtainable in the present invention are not limited to those mentioned above, and other effects which are not mentioned above will be clearly understood to those skilled in the art from the description below.

DESCRIPTION OF DRAWINGS

[0029] The accompanying drawings, which follow, are intended to aid in understanding of the present invention and together with the description, provide embodiments for the present invention. However, the technical features of the present disclosure are not limited to specific drawings, and the features disclosed in the respective drawings may be combined with each other to constitute a new embodiment.

[0030] FIG. 1 is a block diagram provided to explain a wireless charging system according to one embodiment of the present disclosure.

[0031] FIG. 2 is a block diagram provided to explain a wireless charging system according to another embodiment of the present disclosure.

[0032] FIG. 3 is a diagram provided to explain a sensing signal transmission procedure in a wireless charging system according to an embodiment of the present invention.

[0033] FIG. 4 describes a first example of a wireless charging receiver.

[0034] FIG. 5 describes a cross-section of the wireless charging receiver described in FIG. 4.

[0035] FIG. 6 illustrates both sides of a board of the wireless charging receiver described in FIG. 4.

[0036] FIG. 7 illustrates an example of a hole disposed in a substrate.

[0037] FIG. 8 describes a second example of a wireless charging receiver.

[0038] FIG. 9 describes a cross-section of the wireless charging receiver described in FIG. 8.

[0039] Figs. 10 and 11 describe the effects of a conventional wireless charging receiver and a wireless charging receiver in accordance with an embodiment of the present invention.

BEST MODE

[0040] A wireless power receiver includes a substrate, a coil disposed on the substrate to receive a wireless power signal, a first wireless communication antenna disposed inside and outside the coil, and a second wireless communication antenna disposed inside and outside the coil. the first wireless communication antenna and the second wireless communication antenna may support different communication schemes.

MODE FOR INVENTION

[0041] Hereinafter, an apparatus to which embodiments of the present invention are applied and various methods will be described in more detail with reference to the drawings. The suffixes "module" and "part" for components used in the following description are given or combined with only ease of construction of the specification, and do not have a distinctive meaning or role of each other by themselves.

[0042] In the description of the embodiments, where described as being "above (above) or below (below) each component, the above (above) or below (below) includes both two components being in direct contact with each other or at least one other component being disposed between the two components. Further, when expressed as "up (up) or down (down)", it may include not only the upward direction but also the downward direction with reference to one component.

[illegible]

[0044] The transmitter according to the present invention may be configured in a pad shape, a pedestal shape, an access point (ap) shape, a small base station shape, a stent shape, a ceiling buried shape, a floor buried shape, a wall rest shape, and the like, and one transmitter may transmit wireless power to a plurality of wireless power receiving devices. To this end, the transmitter may include at least one wireless power transmission means. Here, various electroless-power transmission standards may be used for the wireless power transmission means based on an electromagnetic induction scheme in which a magnetic field is generated in the power transmitting end coil and charged by using an electromagnetic induction principle in which electricity is induced in the receiving end coil by the influence of the magnetic field. For example, the wireless power transmitting means may include wireless charging technology of electromagnetic induction schemes defined in wireless charging technology standard instruments such as Wireless Power Consortium (wpc), AirFuel Alliance (AFA), etc.

[0045] In addition, the receiver according to an embodiment of the present invention may be provided with at least one wireless power receiving means, and may receive wireless power simultaneously from two or more transmitters. Here, the wireless power receiving means may include, but is not limited to, a wireless charging technology of an electromagnetic induction scheme defined in Wireless Power Consortium (wpc), AirFuel Alliance (AFA), and the like, which is a wireless charging technology standard apparatus.

[0046] The wireless power receiver according to the present invention can be mounted on one side of a transport device, but is not limited thereto, as long as it is a device in which a wireless power receiving means according to the present invention can be charged with a battery.

[0047] FIG. 1 is a block diagram provided to explain a wireless charging system according to one embodiment of the present disclosure.

[0048] Referring to FIG. 1, a wireless charging system may be configured with a wireless power transmitting end 10 that transmits power largely wirelessly, a wireless power receiving end 20 that receives the transmitted power, and an electronic device 30 that is supplied with received power.

[0049] For example, the wireless power transmitting terminal 10 and the wireless power receiving terminal 20 may perform in-band communication in which information is exchanged using a frequency band identical to an operating frequency used for wireless power transmission. In another example, wireless power transmitting end 10 and wireless power receiving end 20 may perform Out-of-band communications that exchange information using separate frequency bands that are different from operating frequencies used for wireless power transfer.

[0050] For example, information exchanged between wireless power transmitting terminal 10 and wireless power receiving terminal 20 may include control information as well as state information of each other. Here, the state information and the control information exchanged between the transceivers will become more apparent through the description of the embodiments to be described below.

[0051] The in-band communication and out-of-band communication may provide bidirectional communication, but are not limited to, unidirectional communication or half-duplex communication.

[0052] For example, unidirectional communication may involve the wireless power receiving end 20 transmitting information only to the wireless power transmitting end 10, but not limited thereto. accordingly, the wireless power transmitting end 10 transmitting information to the wireless power receiving end 20.

[0053] The half-duplex communication method is characterized in that bidirectional communication between the wireless power receiving end (20) and the wireless power transmitting end (10) is possible, but information transmission can be performed only by either device at any point in time.

[0054] The wireless power receiving terminal 20 according to an embodiment of the present invention may acquire various state information of the electronic device 30. For example, the state information of the electronic device 30 may include, but is not limited to, current power usage information, information for identifying an application being executed, CPU usage information, battery state of charge information, battery output voltage/current information, and so on, as long as it is obtainable from the electronic device 30 and available for wireless power control.

[0055] In particular, the wireless power transmitting end 10 according to one embodiment of the present invention may transmit a predetermined packet indicating whether to support fast charging or not to support the wireless power receiving end 20. The wireless power receiving stage (20) may inform the electronic device (30) of the connected wireless power transmitting stage (10) when it is confirmed that it supports the fast charging mode. The electronic device 30 may indicate that high-speed charging is possible through certain display means, which may be, for example, a liquid crystal display.

[0056] Further, the user of the electronic device (30) may select a predetermined fast charging request button displayed on the liquid crystal display means to control the wireless power transmitting terminal (10) to operate in the fast charging mode. In this case, the electronic device 30 may transmit a predetermined fast charging request signal to the wireless power receiver 20 when the fast charging request button is selected by the user. The wireless power receiving end generates a charging mode packet corresponding to the received fast charging request signal and transmits the generated charging mode packet to the wireless power transmitting end, thereby switching the normal low power charging mode to the fast charging mode.

[0057] FIG. 2 is a block diagram provided to explain a wireless charging system according to another embodiment of the present disclosure.

[0058] For example, as shown at 200 a, the wireless power receiving terminal 20 may be configured with a plurality of wireless power receiving devices, and a plurality of wireless power receiving devices may be connected to one wireless power transmitting terminal 10 to perform wireless charging. In this case, the wireless power transmitting terminal 10 may distribute and transmit power to a plurality of wireless power receiving devices in a time-division manner, but not limited thereto. In another example, the wireless power transmitting terminal 10 may distribute and transmit power to a plurality of wireless power receiving devices using different frequency bands allocated for each wireless power receiving device.

[0059] Here, the number of wireless power receiving devices connectable to one wireless power transmitting device 10 may be adaptively determined based on at least one of a required power amount for each wireless power receiving device, a battery charge state, a power consumption amount of an electronic device, and an available power amount of the wireless power transmitting device.

[0060] As another example, as shown at 200 b, wireless power transmitting stage 10 may be configured with a plurality of wireless power transmitting devices. In this case, the wireless power receiving terminal 20 may be connected to a plurality of wireless power transmitting devices simultaneously, and may receive power from the connected wireless power transmitting devices simultaneously to perform charging. Here, the number of wireless power transmitting devices connected to the wireless power receiving terminal 20 may be adaptively determined based on a

required power amount of the wireless power receiving terminal 20, a battery charging state, a power consumption amount of the electronic device, an available power amount of the wireless power transmitting device, and so on.

[0061] FIG. 3 is a diagram provided to explain a sensing signal transmission procedure in a wireless charging system according to an embodiment of the present invention.

[0062] In one example, the wireless power transmitter may be equipped with three transmit coils 111, 112, 113. Each transmitter coil may be disposed such that some areas overlap each other with other transmitter coils, but this is merely one embodiment, and may be disposed non-overlapping with each other or may be mounted with one transmitter coil.

[0063] The wireless power transmitter transmits sequentially in a predefined order a predetermined sense signal (117, 127), e.g., digital ping, for sensing the presence of the wireless power receiver via each transmit coil.

[0064] As illustrated in FIG. 3 above, the wireless power transmitter sequentially transmits the sensing signal 117 when the primary sensing signal transmission procedure illustrated in FIG. number 110 is initiated, and may be a signal including a predetermined response signal from the wireless power receiver 115 – for example, received signal strength information corresponding to the sensing signal; For convenience of the description below, a Signal Strength Indicator 116 or a Signal Strength Packet may identify the received transmit coil 111, 112. Subsequently, the wireless power transmitter transmits the sense signal 127 sequentially once the secondary sense signal transmission procedure shown in FIG. number 120 is initiated, and the signal strength indicator 126 transmits the received transmit coil 111, 112) May identify a good transmit coil, i.e., the alignment state between the transmit coil and the receive coil, and control power to be transmitted through the identified transmit coil, i.e., wireless charging is made.

[0065] As seen in Figure 3 above, the reason the wireless power transmitter performs two sense signal transmission procedures is to more accurately identify to which transmit coil the receive coil of the wireless power receiver is well aligned.

[0066] If the signal strength indicators 116, 126 are received in the first transmit coil 111, the second transmit coil 112, as shown in Fig. 3 above; The wireless power transmitter selects a most aligned transmission coil based on a signal strength indicator (126) received in each of the first transmission coil (111) and the second transmission coil (112), and performs wireless charging using the selected transmission coil.

[0067] FIG. 4 describes a first example of a wireless charging receiver.

[0068] As shown, the wireless charging receiver includes a substrate 10 on which an antenna or coil may be disposed.

[0069] Substrate 10 may include a first antenna for performing data communication through a first wireless method, a second antenna for performing data communication through a second wireless method, and a third antenna for performing wireless charging through a third wireless method. The first antenna, the second antenna, and the third antenna may each include at least one coil portion on which a conductive wire is wound in a loop shape, and a connecting portion connecting the coil portion to a terminal disposed on the substrate 10. According to an embodiment, the coil portion included in each of the first to third antennas may have different shapes (cross section, thickness, constituent material, and the like) and the number of windings corresponding to the first to third wireless methods.

[0070] The wireless charging receiver may include a wireless charging coil portion (16 a) of a third antenna disposed on the substrate (10) and receiving a wireless power signal, a first wireless communication coil portion (14 a, 14C) disposed inside and outside the wireless charging coil portion (16 a), and a second wireless communication coil portion (12 a, 12 C) disposed inside and outside the wireless charging coil portion (16 a). Here, the first wireless communication coil portions (14 a, 14 C) and the second wireless communication coil portions (12 a, 12 C) may support different communication schemes.

[0071] For example, the first wireless communication coil portions 14A, 14C may include antennas for Near Field Communication (NFC), and the second wireless communication coil portions 12A, 12C may include antennas for Magnetic Secure Transmission (MST). Here, near field communication (NFC) is a technique for wireless communication available at a close distance (within about 10 cm) with a band of a predetermined frequency (e.g., 13.56 MHz). In near field communication (NFC), one terminal performs a function as a reader, the other terminal performs a function as a tag, and both terminals can perform 1:1 communication. Meanwhile, magnetic security transmission (MST) is a technology of embedding the principle of a magnetic field generated when scraping a terminal with a credit card or a check card that embeds a magnetic line using a magnetic field used by users, and payment can be achieved only by contacting a magnetic reader of a payment terminal. The first wireless communication coil portions 14 a, 14 C and the second wireless communication coil portions 12 a, 12 C can support financial payment functions using the wireless charging receiver.

[0072] The first wireless communication coil portions (14 a, 14 C) and the second wireless communication coil portions (12 a, 12 C) may be disposed both inside and outside of the wireless

charging coil portion (16 a). First wireless communication coil portions (14 a, 14 C) and second wireless communication coil portions (12 a, 12 C) are disposed inside and outside the wireless charging coil portion (16 a), thereby enhancing a wireless communication function.

[0073] FIG. 5 describes a cross-section of the wireless charging receiver described in FIG. 4. Specifically, a cross section A-A' of FIG. 1 will be described below.

[0074] As shown, coils or antennas may be disposed on both sides of the substrate 10. A wireless charging coil portion (16 a, 16B), a first wireless communication coil portion (14 a, 14C), and a second wireless communication coil portion (12 a, 12B, 12 C) disposed on one side and the other side of the substrate (10) include a plurality of patterns. Each of the wireless charging coil portion (16 a, 16B) of the third antenna, the first wireless communication coil portion (14 a, 14C) of the first antenna, and the second wireless communication coil portion (12 a, 12B, 12C) of the second antenna can operate separately. A plurality of patterns are disposed for each antenna in the plane of the wireless charging receiver and the plurality of patterns of each antenna operate together, thereby improving wireless charging and wireless communication functions. Although not illustrated, when the switch device is included between the plurality of patterns of each antenna, the plurality of patterns of each antenna may be selectively expanded and operated.

[0075] Specifically, looking at one side surface of the substrate 10, the first pattern 14C of the first wireless communication antenna may be disposed inside, and the second pattern 14A of the first wireless communication antenna and the fourth pattern 12A of the second wireless communication antenna may be disposed outside, with reference to the fifth pattern 16A of the coil for performing wireless charging.

[0076] Looking at the other side surface of the substrate 10, the third pattern 12C of the second antenna for wireless communication may be disposed inside, and the fourth pattern 12B of the second antenna for wireless communication may be disposed outside, with reference to the coil 16B for wireless charging.

[0077] An inner diameter and an outer diameter of the fifth pattern and the sixth pattern of the wireless charging coil are aligned with each other in a vertical direction. When coils arranged in spaces on one side and the other side of the substrate 10 are arranged to be aligned with each other within a range that does not overlap with antennas performing other functions, inductance can be maintained during wireless charging, thereby enhancing the wireless charging function.

[0078] Further, the fourth patterns 12A, 12B of the second antenna for wireless communication may also be aligned and disposed outside of the fifth pattern 16A and sixth pattern 16B of the coil. The

arrangement of the fourth patterns 12 a, 12 b of the second antenna for wireless communication may reduce resistance and form a stronger magnetic field, thereby enhancing a magnetic security transmission (MST) function through the second antenna for wireless communication.

[0079] FIG. 6 describes both sides of the substrate 10 of the wireless charging receiver described in FIG. 4. Specifically, (a) describes one side surface of the substrate 10 (outer side surface with reference to the internal circuit of the wireless charging receiver), and (b) describes the other side surface of the substrate 10 (inner side surface with reference to the internal circuit of the wireless charging receiver).

[0080] Referring first to FIG. 6 (a), the first pattern 14C of the first antenna for wireless communication may be disposed on one side surface of the substrate 10 on the inner side, and the second pattern 14A of the first antenna for wireless communication and the fourth pattern 12A of the second antenna for wireless communication may be disposed on the outer side surface of the substrate 10.

[0081] Referring to FIG. 6B, the third pattern 12C of the second antenna for wireless communication may be disposed inside, and the fourth pattern 12B of the second antenna for wireless communication may be disposed outside, with reference to the coil 16B for wireless charging.

[0082] Referring to figs. 5 and 6 (a) and (b), the first pattern 14C of the first antenna for wireless communication is disposed on one side of the substrate 10, while the third pattern 12C of the second antenna for wireless communication is disposed on the other side of the substrate 10. In the case of a first wireless communication antenna performing near-field communication (NFC), it is necessary to prevent an electric short from being separated from a shielding agent composed of iron oxide because it is possible to transmit or receive a high-frequency signal. On the other hand, because the second antenna for wireless communication performs magnetic security transmission (MST) has a low operating frequency, unlike the first antenna for wireless communication, it is possible to be more free to arrange.

[0083] Meanwhile, the first pattern 14C and the second pattern 14A of the first antenna for wireless communication disposed on one side surface of the substrate 10 have a loop shape, thereby reducing resistance when magnetic field is formed.

[0084] When comparing a first pattern 14 C of a first wireless communication antenna disposed inside the wireless charging coil portions 16 a, 16 b with a third pattern 12 C of a second wireless communication antenna, the number of antenna windings in the third pattern 12 C can be greater than the first pattern 14 C. This is because the magnetic security transmission (MST) performed in the second antenna for wireless communication operates in a lower frequency band than the near field communication (NFC) performed in the first antenna for wireless communication.

[0085] In addition, the strength of the magnetic field may be determined in proportion to the number of antenna windings, and the number of antenna windings may be increased in order to improve the recognition rate for magnetic security transmission (MST) because the leading module used in magnetic security transmission (MST) may be smaller than the leading module used in near field communication (NFC). In addition, a third pattern (12 C) of a second wireless communication antenna can be arranged closer to the center than a first pattern (14 C) of a first wireless communication antenna in order to increase a recognition rate with a leading module used in a smaller magnetic security transmission (MST).

[0086] Meanwhile, the number of turns of coils or antennas of wireless charging coil portions (16 a, 16B), first wireless communication coil portions (14 a, 14C), and second wireless communication coil portions (12 a, 12B, 12 C) disposed on one side and the other side of the substrate (10) may be determined corresponding to the operating frequency, and may be determined according to the inductance value range for maintaining the strength or performance of the magnetic field during operation. For example, the number of windings may be reduced in the order of two wireless communication coil portions 12 a, 12B, 12C, wireless charging coil portions 16 a, 16B, and first wireless communication coil portions 14 a, 14 C.

[0087] Further, wireless charging coil portions (16 a, 16B), first wireless communication coil portions (14 a, 14C), and second wireless communication coil portions (12 a, 12B, 12 C) may be constant, but the thickness of the conductor wires may be adjusted to be thin to prevent degradation in adjacent portions in areas overlapped with each other for electrical connection between patterns or connection with terminals.

[0088] In addition, in the case of second wireless communication coil portions (12 a, 12B, 12 C) disposed on one side and the other side of the substrate (10) and connected to each other, inductance can be increased using a cross section of the pattern and recognition range can be further increased.

[0089] Meanwhile, with reference to figs. 6 (a) and (b), physical connection of patterns, coils, or connectors included in the first to third antennas disposed on one side surface and the other side surfaces through a plurality of holes in the substrate 10 will be explained in more detail.

[0090] First, a first pattern (14 C) of the first antenna is disposed at a center of one side surface of the substrate (10), and a second pattern (14 a) is disposed at an edge (outer periphery) of the one side surface. One end (14 I) of the first pattern (14 C) is disposed on a hole disposed in the substrate (10) and connected to one end (14 J) of a leg portion (14 y) of a first antenna disposed on the other side of the substrate (10). The leg portion 14Y may be connected to one end 14K of the second pattern 14A

disposed on one side of the substrate 10 by passing through a cut portion of the sixth pattern 16B, which is a wireless charging coil disposed on the other side, and passing through a hole disposed on the substrate 10 again. The other end of the second pattern is electrically connected to a terminal portion disposed on one side surface of the substrate.

[0091] One end (16 p) of a fifth pattern (16 a) of a wireless charging coil included in the third antenna must be electrically connected to a connecting portion (16 R) connected to a terminal portion (42 a) disposed on one side of the substrate (10), but the second pattern (14 a) of the first antenna is disposed on one side of the substrate (10). Accordingly, one end 16P of the fifth pattern 16A disposed on one side surface of the substrate 10 may be connected to the connector 16Q disposed on the other side surface of the substrate 10 through the hole disposed on the substrate 10, and may be connected to the connector 16R disposed on the one side surface of the substrate 10 through the hole of the substrate 10 at a position where the second pattern 14A is electrically insulated. In addition, when one end of the sixth pattern 16B disposed on the other side surface of the substrate 10 is connected to the terminal portion 42B disposed on the other side surface of the substrate, it is difficult to directly connect by the fourth pattern 12B and the connection pattern (e.g., a pattern from 12J position to 12K position) of the second antenna. To overcome this, one end of the sixth pattern 16B disposed on the other side surface of the substrate 10 is connected to the connecting portion 16S of the one side surface of the substrate 10 through the hole disposed in the substrate 10, and the connecting portion 16S is connected to the connecting portion 16T disposed on the other side surface of the substrate through the hole of the substrate 10 to avoid crossing with the second pattern 14A. As described above, even if a plurality of antennas are disposed using a hole disposed in the substrate 10, the crossing of each other can be suppressed as much as possible. In particular, the coil portions (16 a, 16 b) and the connecting portions (16 p, 16Q, 16R, 16S, 16 t) of the third antenna for wireless charging can flow with voltages and currents larger than components of the first to second antennas, so that the coil portions (16 a, 16 b) of the third antenna for wireless charging can flow with a plurality of holes arranged in the substrate (10), 16B) and the connecting portions 16 p, 16Q, 16R, 16S, 16 t and the components of the first to second antennas intersect at one side surface of the substrate 10 (e.g., the side facing the outer wall when mounted on a portable device).

[0092] Further, although the fourth pattern 12A of the second antenna does not complete a loop shape on one side surface of the substrate 10, one end 12I of the fourth pattern 12A may be connected to the connect pattern 12J disposed on the other side surface of the substrate 10 through the hole of the substrate 10. Further, the connect pattern 12K may be connected with the other end 12J of the fourth pattern 12A through the hole of the substrate 10. The fourth pattern 12A may be implemented in a loop shape through a plurality of holes disposed in the substrate 10. On the other hand, a fourth pattern (12 b) of a second antenna disposed on the other side of the substrate (10) is implemented in a loop shape. Further, a reinforcing pattern 12 D of the second antenna is disposed on one side surface of the substrate 10. The reinforcement pattern 12D of the second antenna disposed on one side surface of the substrate 10 may be disposed to overlap with the fourth pattern 12B disposed on the other side surface of the substrate 10 to reduce noise when magnetic field is formed.

[0093] As described above, a plurality of patterns constituting the first antenna disposed on one side and the other side of the substrate 10 are connected to each other through a plurality of holes disposed in the substrate 10, a plurality of patterns constituting the second antenna are also connected to each other through a plurality of holes disposed in the substrate 10, and a plurality of patterns constituting the third antenna are also connected to each other through a plurality of holes disposed in the substrate 10. As a result, the terminal portions 42A, 42B disposed on one side surface and the other side surface of the substrate 10 may have no problem of supplying power to all patterns constituting the first to third antennas even when a total of six terminals are three each.

[0094] Further, depending on an embodiment, both ends of the first to third antennas may be connected one by one to the terminal portions 42A, 42B disposed on one side surface and the other side surface of the substrate 10. For example, when one side of the first antenna is connected to the terminal portion 42A disposed on one side surface of the substrate 10, the other side of the first antenna may be connected to the terminal portion 42B disposed on the other side surface of the substrate 10.

[0095] FIG. 7 will explain an example of a hole disposed in the substrate 10. Specifically, the connection of the antenna through the hole in a partial region 30 of the substrate 10 of FIG. 6 (a) will be explained below.

[0096] As illustrated, a plurality of holes H1, H2 may be arranged in the substrate 10. As described above with reference to figs. 6 (a) and (b), a plurality of holes are disposed in the substrate 10 to reduce crossing of the coil portion and the connection portion of each of the first to third antennas to minimize interference with each other and prevent degradation.

[0097] For example, referring to figs. 7 and 6 (a), (b), the first hole H1 connects one end 12S of the third pattern 12C of the second antenna disposed on the other side surface of the substrate 10 with the connecting portion 12P disposed on the center of the one side surface of the substrate 10.

[0098] Further, referring to figs. 7 and 6 (a), (b), the second hole H2 may connect one end 14I of the first pattern 14C of the first antenna disposed on one side surface of the substrate 10 to one end 14J of the leg portion 14Y of the first antenna disposed on the other side surface of the substrate 10.

[0099] For ease of understanding, the first and second holes H1, H2 illustrated in FIG. 7 may be further provided with a plurality of holes to connect the coil unit of each of the first to third antennas to the connection unit. For example, referring to figs. 6A, b, in the case of a connection portion connecting a coil portion of a third antenna to a terminal, the connection portion may include a plurality of patterns (e.g., 16P, 16Q, 16R, 16S, 16T) disposed on one side surface and the other side surface of the substrate

10, and the plurality of patterns may be connected to each other through a plurality of holes disposed in the substrate 10.

[0100] The coil portion and the connection portion of each of the first to third antennas are connected to each other through a plurality of holes arranged in the substrate 10, thereby allowing the coil portion and the connection portion of each of the first to third antennas to be fixed more securely to the substrate 10. When a plurality of antennas arranged on one side surface and the other side surface of the substrate 10 are fixed by adhesive insulation or heat with strong adhesive, the substrate 10 may be physically separated from the plurality of antennas arranged on one side surface and the other side surface of the substrate 10 by heat generated during a long use period. If the substrate 10 is physically separated from the substrate 10, problems may occur in the operation of the plurality of antennas. However, according to an embodiment of the present disclosure, a plurality of holes may be disposed in the substrate 10 to connect the coil portion and the connection portion of each of the first to third antennas to connect the coil portion and the connection portion of each of the first to third antennas, thereby connecting the coil portion and the connection portion of each of the first to third antennas to the substrate 10 more securely.

[0101] FIG. 8 describes a second example of a wireless charging receiver. Specifically, figs. 8 (a) and (b) describe areas where additional components may be disposed on a plane.

[0102] As shown, the wireless charging receiver may further include an antenna actuator 22 disposed inside of the first pattern 14C of the first wireless communications antenna and the third pattern 12C of the second wireless communications antenna.

[0103] In addition, the wireless charging receiver may further include a shielding reinforcement pattern (20) corresponding to the third pattern (12 C) of the second antenna for wireless communication and having an area larger than an outer diameter of the third pattern (12 C).

[0104] FIG. 9 describes a cross-section of the wireless charging receiver described in FIG. 8. Specifically, the cross-section of B-B' of FIG. 8 will be explained below.

[0105] As shown, the wireless charging receiver may include a substrate 10 and a shield 24 corresponding to the substrate 10.

[0106] With reference to the central axis Y-Y', the fifth pattern 16A of the coil and the first pattern 14C of the first wireless communication antenna may be disposed on one side surface of the substrate

10, and the sixth pattern 16B of the coil and the third pattern 12C of the second wireless communication antenna may be disposed on the other side surface of the substrate 10.

[0107] An antenna actuator 22 disposed on one side of the substrate 10 may be disposed inside the first pattern 14 C of the first antenna for wireless communication and the third pattern 12 C of the second antenna for wireless communication. Here, the thickness T3 of the antenna actuator 22 may be about 100 to 150 μm .

[0108] Further, corresponding to the third pattern 12C of the second antenna for wireless communication, the shielding reinforcement pattern 20 composed of ferrite having an area larger than an outer diameter of the third pattern 12C may be disposed on the shielding material 24. The thickness T2 of the shield reinforcement pattern 20 may be about 10 μm or less. Further, the shielding material 24 may be composed of nanocrystals and have a thickness T1 of about 150 μm or less.

[0109] On the other hand, the first pattern 14 C of the first antenna for wireless communication and the third pattern 12 C of the second antenna for wireless communication may be spaced apart from each other by a distance D3 in a range of 2 to 3.6 mm or more. In particular, the inner diameter of the first pattern (14 C) of the first wireless communication antenna and the outer diameter of the third pattern (12 C) of the second wireless communication antenna are maintained at a distance of at least 2.3 mm, thereby preventing deterioration due to functions performed by the first wireless communication antenna and the second wireless communication antenna, respectively.

[0110] Further, the shielding reinforcement pattern 20 may have an area greater than the outer diameter of the third pattern 12C of the second antenna for wireless communication by at least 0.5 mm (D5 is minimum 0.5 mm). Further, the shielding reinforcement pattern 20 may have a separation distance D4 of 1.6 mm or more from the first pattern 14C of the first wireless communication antenna.

[0111] Further, the antenna actuator 22 may have a separation D2 of 1.3 mm from the third pattern 12C of the second wireless communication antenna and may have a separation D1 of 6.3 mm from the first pattern 14C of the first wireless communication antenna.

[0112] Figs. 10 and 11 describe the effects of a conventional wireless charging receiver and a wireless charging receiver in accordance with an embodiment of the present invention. In particular, figs. 10 and 11 compare the rate of recognition via a second wireless communication antenna in a wireless charging receiver. Here, x and y represent positions (horizontal, vertical) on a plane, and Z represents a vertical distance (NFC or MST terminal and wireless charging receiver) to a corresponding leading module.

[0113] FIG. 10 illustrates the recognized number according to the change in vertical distance (0 mm to 3 cm) from the leading module in a recognition rate test using a wireless charging receiver having a conventional general structure. It can be seen that the recognition rate is greatly diminished at a perpendicular distance to the leading module (3 cm). The recognition success rate in the recognition rate test with a change in perpendicular distance (0 mm to 4 cm) to the leading module was aggregated to about 67.38%.

[0114] On the other hand, FIG. 11 illustrates a recognized number according to a change in vertical distance (0 mm to 3 cm) with a leading module in a recognition rate test using a wireless charging receiver in accordance with an embodiment of the present invention. Compared to the case of FIG. 9, it can be seen that the recognition rate is improved in all ranges of perpendicular distance to the leading module. The recognition success rate in the recognition rate test with a change in perpendicular distance (0 mm to 4 cm) to the leading module was aggregated to about 86.74%.

[0115] It is apparent to those skilled in the art that the present invention may be embodied in other specific forms to the extent that it does not depart from the spirit and essential characteristics of the invention.

[0116] Accordingly, the above detailed description is not to be construed as limiting in all respects and is to be considered illustrative. The scope of the invention should be determined by reasonable interpretation of the appended claims, and all modifications within the equivalent scope of the invention are encompassed by the scope of the invention.

INDUSTRIAL APPLICABILITY

[0117] The present invention can be applied to a wireless power receiving apparatus equipped with a plurality of different coils or antennas for performing wireless power receiving functions, wireless mobile communication and near field communication.

(12) 특허협력조약에 의하여 공개된 국제출원

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- (71) 출원인: 엘지이노텍(주) (**LG INNOTEK CO., LTD.**)
[KR/KR]; 04637 서울시 중구 후암로 98, Seoul (KR).
- (72) 발명자: 임성현 (**LEEM, Sung Hyun**); 04637 서울시 중구 후암로 98, Seoul (KR).
- (74) 대리인: 이승찬 (**LEE, Seung Chan**); 06604 서울시 서초구 서초중앙로 24길 19 나라빌딩 3층 KPH어소시에이츠, Seoul (KR).
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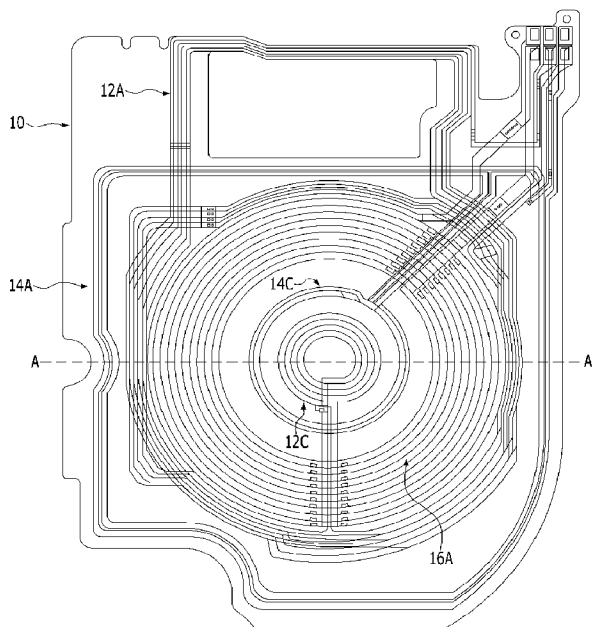
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공개:

국제조사보고서와 함께 (조약 제21조(3))

(54) Title: WIRELESS CHARGING RECEIVER FOR IMPROVING ANTENNA PERFORMANCE

(54) 발명의 명칭: 안테나 성능을 개선시키는 무선 충전 수신기



(57) Abstract: The present invention provides a wireless power receiver comprising: a substrate; a coil disposed in the substrate so as to receive a wireless power signal; a first wireless communication antenna disposed inside and outside the coil; and a second wireless communication antenna disposed inside and outside the coil, wherein the first wireless communication antenna and the second wireless communication antenna support different communication methods.

(57) 요약서: 본 발명은 기판, 기판에 배치되어 무선 전력 신호를 수신하는 코일, 코일의 내측 및 외측에 배치되는 제1 무선 통신용 안테나, 및 코일의 내측 및 외측에 배치되는 제2 무선 통신용 안테나를 포함하고, 제1 무선 통신용 안테나와 제2 무선 통신용 안테나는 서로 다른 통신 방식을 지원하는 무선 전력 수신기를 제공한다.

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명세서

발명의 명칭: 안테나 성능을 개선시키는 무선 충전 수신기

기술분야

- [1] 본 발명은 무선 충전 수신기에 관한 것으로서, 상세하게는 소형화된 무선 충전 수신기에서 무선 이동 통신 및 근거리 무선 통신에 사용되는 안테나 성능을 개선시킬 수 있는 구조를 제공하는 것이다.

배경기술

- [2] 무선 전력 전송 기술(wireless power transmission 또는 wireless energy transfer)은 자기장의 유도 원리를 이용하여 무선으로 송신기에서 수신기로 전기 에너지를 전송하는 기술로서, 이미 1800년대에 전자기유도 원리를 이용한 전기 모터나 변압기가 사용되기 시작했고, 그 후로는 라디오파나 레이저, 고주파, 마이크로웨이브와 같은 전자파를 방사해서 전기에너지를 전송하는 방법도 시도되었다. 우리가 흔히 사용하는 전동칫솔이나 일부 무선면도기도 실상은 전자기유도 원리로 충전된다.
- [3] 현재까지 무선을 이용한 에너지 전달 방식은 크게 자기 유도 방식, 자기 공진(Electromagnetic Resonance) 방식 및 단파장 무선 주파수를 이용한 RF 전송 방식 등으로 구분될 수 있다.
- [4] 자기 유도 방식은 두 개의 코일을 서로 인접시킨 후 한 개의 코일에 전류를 흘려보내면 이 때 발생한 자속(Magnetic Flux)이 다른 코일에 기전력을 일으키는 현상을 이용한 기술로서, 휴대폰과 같은 소형기기를 중심으로 빠르게 상용화가 진행되고 있다. 자기 유도 방식은 최대 수백 키로와트(kW)의 전력을 전송할 수 있고 효율도 높지만 최대 전송 거리가 1센티미터(cm) 이하이므로 일반적으로 충전기나 바닥에 인접시켜야 하는 단점이 있다.
- [5] 자기 공진 방식은 전자기파나 전류 등을 활용하는 대신 전기장이나 자기장을 이용하는 특징이 있다. 자기 공진 방식은 전자파 문제의 영향을 거의 받지 않으므로 다른 전자 기기나 인체에 안전하다는 장점이 있다. 반면, 한정된 거리와 공간에서만 활용할 수 있으며 에너지 전달 효율이 다소 낮다는 단점이 있다.
- [6] 단파장 무선 전력 전송 방식-간단히, RF 전송 방식-은 에너지가 라디오파(RadioWave)형태로 직접 송수신될 수 있다는 점을 활용한 것이다. 이 기술은 렉테나(rectenna)를 이용하는 RF 방식의 무선 전력 전송 방식으로, 렉테나는 안테나(antenna)와 정류기(rectifier)의 합성어로서 RF 전력을 직접 직류 전력으로 변환하는 소자를 의미한다. 즉, RF 방식은 AC 라디오파를 DC로 변환하여 사용하는 기술로서, 최근 효율이 향상되면서 상용화에 대한 연구가 활발히 진행되고 있다.
- [7] 무선 전력 전송 기술은 모바일 뿐만 아니라 차량, IT, 철도, 가전 산업 등 산업

전반에 다양하게 활용될 수 있다.

- [8] 휴대용 단말기와 같이, 무선 충전 수신 기능을 포함하고 있을 뿐만 아니라 무선 이동 통신, 근거리 무선 통신 등을 수행하는 전자기기들은 각 기능의 수행을 위한 복수의 서로 다른 코일 또는 안테나를 포함할 수 있다. 휴대용 단말기에 요구되는 기능이 늘어나면서 복수의 서로 다른 코일 또는 안테나가 포함되지만, 휴대용 단말기의 크기는 복수의 서로 다른 코일 또는 안테나를 위해 충분히 커질 수 없다. 따라서, 제한된 공간에 복수의 서로 다른 코일 또는 안테나를 배치함으로써 코일 또는 안테나의 성능이 열화될 수 있다.

발명의 상세한 설명

기술적 과제

- [9] 본 발명은 상술한 종래 기술의 문제점을 해결하기 위해 고안된 것으로, 본 발명은 무선 충전 수신 기능, 무선 이동 통신 및 근거리 무선 통신을 수행하기 위한 복수의 서로 다른 코일 또는 안테나를 성능을 개선할 수 있는 장치와 방법을 제공할 수 있다.
- [10] 또한, 본 발명은 무선 충전을 위한 코일의 내측에 무선 이동 통신 및 근거리 무선 통신을 수행하는 적어도 하나의 안테나를 배치시켜 무선 이동 통신 및 근거리 무선 통신의 성능을 개선할 수 있는 장치와 방법을 제공할 수 있다.
- [11] 또한, 본 발명은 무선 충전을 위한 코일의 내측에 무선 통신을 위한 안테나를 배치시켜 인덕턴스를 증가시킴으로써 무선 충전 수신기로서의 인식률을 높일 수 있는 장치와 방법을 제공할 수 있다.
- [12] 또한, 본 발명은 무선 충전을 위한 코일과 무선 이동 통신을 위한 안테나를 기판의 양면에 중첩하여 배치시켜 자기장 형성 시 발생하는 저항을 줄일 수 있어 코일 또는 안테나의 성능을 개선할 수 있는 장치와 방법을 제공할 수 있다.
- [13] 본 발명에서 이루고자 하는 기술적 과제들은 이상에서 언급한 기술적 과제들로 제한되지 않으며, 언급하지 않은 또 다른 기술적 과제들은 아래의 기재로부터 본 발명이 속하는 기술 분야에서 통상의 지식을 가진 자에게 명확하게 이해될 수 있을 것이다.

과제 해결 수단

- [14] 본 발명은 무선 통신을 위한 안테나 성능이 개선된 무선 충전 수신기를 제공할 수 있다.
- [15] 본 발명의 일 실시 예에 따른 무선 전력 수신기는 기판; 상기 기판에 배치되어 무선 전력 신호를 수신하는 코일; 상기 코일의 내측 및 외측에 배치되는 제1 무선 통신용 안테나; 및 상기 코일의 내측 및 외측에 배치되는 제2 무선 통신용 안테나를 포함하고, 상기 제1 무선 통신용 안테나와 상기 제2 무선 통신용 안테나는 서로 다른 통신 방식을 지원할 수 있다.
- [16] 또한, 상기 제1 무선 통신용 안테나는 상기 코일의 내측에 배치되는 제1 패턴; 및 상기 코일의 외측에 배치되는 제2 패턴을 포함하고, 상기 제1 패턴 및 상기

제2 패턴은 상기 기판의 일측면에 배치될 수 있다.

[17] 또한, 상기 제1 무선 통신용 안테나는 근거리 통신(Near Field Communication, NFC)을 위한 안테나를 포함할 수 있다.

[18] 또한, 상기 제2 무선 통신용 안테나는 상기 코일의 내측에 배치되는 제3 패턴; 및 상기 코일의 외측에 배치되는 제4 패턴을 포함하고, 상기 제3 패턴은 상기 제1 패턴이 배치된 상기 일측면에 반대면인 타측면에 배치되며, 상기 제4 패턴은 상기 일측면 및 상기 타측면에 배치될 수 있다.

[19] 또한, 상기 제2 무선 통신용 안테나는 마그네틱 보안 전송(Magnetic Secure Transmission, MST)을 위한 안테나를 포함할 수 있다.

[20] 또한, 상기 제1 패턴보다 상기 제3 패턴에서 안테나 권선 수가 더 클 수 있다.

[21] 또한, 상기 제1 패턴보다 상기 제3 패턴이 중심에 가깝도록 배치될 수 있다.

[22] 또한, 상기 제1 패턴의 내측경과 상기 제3 패턴의 외측경은 수평면을 기준으로 2.3 mm 이상 이격될 수 있다.

[23] 또한, 무선 전력 수신기는 상기 제1 무선 통신용 안테나 및 상기 제2 무선 통신용 안테나의 내측에 배치되는 안테나 엑추에이터; 및 상기 기판에 대응하여 배치되는 차폐재를 더 포함하고, 상기 차폐재에는 상기 제3 패턴의 외측경보다 넓은 면적을 가지는 차폐보강패턴이 포함될 수 있다.

[24] 또한, 상기 코일은 상기 기판의 양측면에 배치되는 제5 패턴 및 제6 패턴을 포함하고, 상기 제5 패턴과 상기 제6 패턴의 내측경과 외측경이 정렬될 수 있다.

[25] 상기 본 발명의 양태들은 본 발명의 바람직한 실시예들 중 일부에 불과하며, 본원 발명의 기술적 특징들이 반영된 다양한 실시예들이 당해 기술분야의 통상적인 지식을 가진 자에 의해 이하 상술할 본 발명의 상세한 설명을 기반으로 도출되고 이해될 수 있다.

발명의 효과

[26] 본 발명에 따른 방법 및 장치에 대한 효과에 대해 설명하면 다음과 같다.

[27] 본 발명은 무선 통신을 위한 안테나가 배치되는 면적을 확장할 수 있어, 안테나가 무선 신호의 송수신 성능을 개선할 수 있는 무선 충전 수신기를 제공할 수 있다.

[28] 본 발명에서 얻을 수 있는 효과는 이상에서 언급한 효과들로 제한되지 않으며, 언급하지 않은 또 다른 효과들은 아래의 기재로부터 본 발명이 속하는 기술분야에서 통상의 지식을 가진 자에게 명확하게 이해될 수 있을 것이다.

도면의 간단한 설명

[29] 이하에 첨부되는 도면들은 본 발명에 관한 이해를 돕기 위한 것으로, 상세한 설명과 함께 본 발명에 대한 실시예들을 제공한다. 다만, 본 발명의 기술적 특징이 특정 도면에 한정되는 것은 아니며, 각 도면에서 개시하는 특징들은 서로 조합되어 새로운 실시예로 구성될 수 있다.

[30] 도 1은 본 발명에 일 실시예에 따른 무선 충전 시스템을 설명하기 위한

블록도이다.

- [31] 도 2는 본 발명에 따른 실시예에 따른 무선 충전 시스템을 설명하기 위한 블록도이다.
- [32] 도 3은 본 발명의 일 실시예에 따른 무선 충전 시스템에서의 감지 신호 전송 절차를 설명하기 위한 도면이다.
- [33] 도 4는 무선 충전 수신기의 제1예를 설명한다.
- [34] 도 5는 도 4에서 설명한 무선 충전 수신기의 단면을 설명한다.
- [35] 도 6은 도 4에서 설명한 무선 충전 수신기의 기관의 양면을 설명한다.
- [36] 도 7은 기관에 배치되는 홀의 예를 설명한다.
- [37] 도 8은 무선 충전 수신기의 제2예를 설명한다.
- [38] 도 9는 도 8에서 설명한 무선 충전 수신기의 단면을 설명한다.
- [39] 도 10 및 도 11은 종래의 무선 충전 수신기와 본 발명의 일 실시예에 따른 무선 충전 수신기의 효과를 설명한다.

발명의 실시를 위한 최선의 형태

- [40] 실시 예에 따른 무선 전력 수신기는 기관; 상기 기관에 배치되어 무선 전력 신호를 수신하는 코일; 상기 코일의 내측 및 외측에 배치되는 제1 무선 통신용 안테나; 및 상기 코일의 내측 및 외측에 배치되는 제2 무선 통신용 안테나를 포함하고, 상기 제1 무선 통신용 안테나와 상기 제2 무선 통신용 안테나는 서로 다른 통신 방식을 지원할 수 있다.

발명의 실시를 위한 형태

- [41] 이하, 본 발명의 실시예들이 적용되는 장치 및 다양한 방법들에 대하여 도면을 참조하여 보다 상세하게 설명한다. 이하의 설명에서 사용되는 구성요소에 대한 접미사 "모듈" 및 "부"는 명세서 작성의 용이함만이 고려되어 부여되거나 혼용되는 것으로서, 그 자체로 서로 구별되는 의미 또는 역할을 갖는 것은 아니다.
- [42] 실시예의 설명에 있어서, 각 구성 요소의 "상(위) 또는 하(아래)"에 형성되는 것으로 기재되는 경우에 있어, 상(위) 또는 하(아래)는 두 개의 구성 요소들이 서로 직접 접촉되거나 하나 이상의 또 다른 구성 요소가 두 개의 구성 요소들 사이에 배치되어 형성되는 것을 모두 포함한다. 또한 "상(위) 또는 하(아래)"로 표현되는 경우 하나의 구성 요소를 기준으로 위쪽 방향뿐만 아니라 아래쪽 방향의 의미도 포함할 수 있다.
- [43] 실시예의 설명에 있어서, 무선 전력 시스템상에서 무선 전력을 송신하는 장치는 설명의 편의를 위해 무선 파워 송신기, 무선 파워 송신 장치, 무선 전력 송신 장치, 무선 전력 송신기, 송신단, 송신기, 송신 장치, 송신측, 무선 파워 전송 장치, 무선 파워 전송기 등을 혼용하여 사용하기로 한다. 또한, 무선 전력 송신 장치로부터 무선 전력을 수신하는 장치에 대한 표현으로 설명의 편의를 위해 무선 전력 수신 장치, 무선 전력 수신기, 무선 파워 수신 장치, 무선 파워 수신기,

- 수신 단말기, 수신측, 수신 장치, 수신기 등이 혼용되어 사용될 수 있다.
- [44] 본 발명에 따른 송신기는 패드 형태, 거치대 형태, AP(Access Point) 형태, 소형 기지국 형태, 스탠드 형태, 천장 매립 형태, 바닥 매립 형태, 벽걸이 형태 등으로 구성될 수 있으며, 하나의 송신기는 복수의 무선 전력 수신 장치에 무선 전력을 전송할 수도 있다. 이를 위해, 송신기는 적어도 하나의 무선 파워 전송 수단을 구비할 수도 있다. 여기서, 무선 파워 전송 수단에는 전력 송신단 코일에서 자기장을 발생시켜 그 자기장의 영향으로 수신단 코일에서 전기가 유도되는 전자기 유도 원리를 이용하여 충전하는 전자기 유도 방식에 기반한 다양한 무선 전력 전송 표준이 사용될 수 있다. 일 예로, 무선 파워 전송 수단은 WPC(Wireless Power Consortium), AFA(AirFuel Alliance) 등의 무선 충전 기술 표준 기구에서 정의된 전자기 유도 방식의 무선 충전 기술을 포함할 수 있다.
- [45] 또한, 본 발명의 일 실시예에 따른 수신기는 적어도 하나의 무선 전력 수신 수단이 구비될 수 있으며, 2개 이상의 송신기로부터 동시에 무선 전력을 수신할 수도 있다. 여기서, 무선 전력 수신 수단은 무선 충전 기술 표준 기구인 WPC(Wireless Power Consortium), AFA(AirFuel Alliance) 등에서 정의된 전자기 유도 방식의 무선 충전 기술을 포함할 수 있으나 이에 한정되지는 않는다.
- [46] 본 발명에 따른 무선 전력 수신기는 운송 장치의 일측에 장착될 수 있으나, 이에 국한되지는 아니하며 본 발명에 따른 무선 전력 수신 수단이 장착되어 배터리 충전이 가능한 기기라면 족하다.
- [47] 도 1은 본 발명에 일 실시예에 따른 무선 충전 시스템을 설명하기 위한 블록도이다.
- [48] 도 1을 참조하면, 무선 충전 시스템은 크게 무선으로 전력을 송신하는 무선 전력 송신단(10), 상기 송신된 전력을 수신하는 무선 전력 수신단(20) 및 수신된 전력을 공급 받는 전자기기(30)로 구성될 수 있다.
- [49] 일 예로, 무선 전력 송신단(10)과 무선 전력 수신단(20)은 무선 전력 전송에 사용되는 동작 주파수와 동일한 주파수 대역을 이용하여 정보를 교환하는 인밴드(In-band) 통신을 수행할 수 있다. 다른 일 예로, 무선 전력 송신단(10)과 무선 전력 수신단(20)은 무선 전력 전송에 사용되는 동작 주파수와 상이한 별도의 주파수 대역을 이용하여 정보를 교환하는 대역외(Out-of-band) 통신을 수행할 수도 있다.
- [50] 일 예로, 무선 전력 송신단(10)과 무선 전력 수신단(20) 사이에 교환되는 정보는 서로의 상태 정보뿐만 아니라 제어 정보도 포함될 수 있다. 여기서, 송수신단 사이에 교환되는 상태 정보 및 제어 정보는 후술할 실시예들의 설명을 통해 보다 명확해질 것이다.
- [51] 상기 인밴드 통신 및 대역외 통신은 양방향 통신을 제공할 수 있으나, 이에 한정되지는 않으며, 다른 실시예에 있어서는 단방향 통신 또는 반이중 방식의 통신을 제공할 수도 있다.
- [52] 일 예로, 단방향 통신은 무선 전력 수신단(20)이 무선 전력 송신단(10)으로만

정보를 전송하는 것일 수 있으나, 이에 한정되지는 않으며, 무선 전력 송신단(10)이 무선 전력 수신단(20)으로 정보를 전송하는 것일 수도 있다.

- [53] 반이중 통신 방식은 무선 전력 수신단(20)과 무선 전력 송신단(10) 사이의 양방향 통신은 가능하나, 어느 한 시점에 어느 하나의 장치에 의해서만 정보 전송이 가능한 특징이 있다.
- [54] 본 발명의 일 실시예에 따른 무선 전력 수신단(20)은 전자 기기(30)의 각종 상태 정보를 획득할 수도 있다. 일 예로, 전자 기기(30)의 상태 정보는 현재 전력 사용량 정보, 실행중인 응용을 식별하기 위한 정보, CPU 사용량 정보, 배터리 충전 상태 정보, 배터리 출력 전압/전류 정보 등을 포함할 수 있으나, 이에 한정되지는 않으며, 전자 기기(30)로부터 획득 가능하고, 무선 전력 제어에 활용 가능한 정보이면 족하다.
- [55] 특히, 본 발명의 일 실시예에 따른 무선 전력 송신단(10)은 고속 충전 지원 여부를 지시하는 소정 패킷을 무선 전력 수신단(20)에 전송할 수 있다. 무선 전력 수신단(20)은 접속된 무선 전력 송신단(10)이 고속 충전 모드를 지원하는 것으로 확인된 경우, 이를 전자 기기(30)에 알릴 수 있다. 전자 기기(30)는 구비된 소정 표시 수단-예를 들면, 액정 디스플레이일 수 있음-을 통해 고속 충전이 가능함을 표시할 수 있다.
- [56] 또한, 전자 기기(30) 사용자는 액정 표시 수단에 표시된 소정 고속 충전 요청 버튼을 선택하여 무선 전력 송신단(10)이 고속 충전 모드로 동작하도록 제어할 수도 있다. 이 경우, 전자 기기(30)는 사용자에게 의해 고속 충전 요청 버튼이 선택되면, 소정 고속 충전 요청 신호를 무선 전력 수신단(20)에 전송할 수 있다. 무선 전력 수신단(20)은 수신된 고속 충전 요청 신호에 상응하는 충전 모드 패킷을 생성하여 무선 전력 송신단(10)에 전송함으로써, 일반 저전력 충전 모드를 고속 충전 모드로 전환시킬 수 있다.
- [57] 도 2는 본 발명에 따른 실시예에 따른 무선 충전 시스템을 설명하기 위한 블록도이다.
- [58] 일 예로, 도면 부호 200a에 도시된 바와 같이, 무선 전력 수신단(20)은 복수의 무선 전력 수신 장치로 구성될 수 있으며, 하나의 무선 전력 송신단(10)에 복수의 무선 전력 수신 장치가 연결되어 무선 충전을 수행할 수도 있다. 이때, 무선 전력 송신단(10)은 시분할 방식으로 복수의 무선 전력 수신 장치에 전력을 분배하여 송신할 수 있으나, 이에 한정되지는 않으며. 다른 일 예로, 무선 전력 송신단(10)은 무선 전력 수신 장치 별 할당된 상이한 주파수 대역을 이용하여 복수의 무선 전력 수신 장치에 전력을 분배하여 송신할 수 있다.
- [59] 이때, 하나의 무선 전력 송신 장치(10)에 연결 가능한 무선 전력 수신 장치의 개수는 무선 전력 수신 장치 별 요구 전력량, 배터리 충전 상태, 전자 기기의 전력 소비량 및 무선 전력 송신 장치의 가용 전력량 중 적어도 하나에 기반하여 적응적으로 결정될 수 있다.
- [60] 다른 일 예로, 도면 부호 200b에 도시된 바와 같이, 무선 전력 송신단(10)은

복수의 무선 전력 송신 장치로 구성될 수도 있다. 이 경우, 무선 전력 수신단(20)은 복수의 무선 전력 송신 장치와 동시에 연결될 수 있으며, 연결된 무선 전력 송신 장치들로부터 동시에 전력을 수신하여 충전을 수행할 수도 있다. 이때, 무선 전력 수신단(20)과 연결된 무선 전력 송신 장치의 개수는 무선 전력 수신단(20)의 요구 전력량, 배터리 충전 상태, 전자 기기의 전력 소비량, 무선 전력 송신 장치의 가용 전력량 등에 기반하여 적응적으로 결정될 수 있다.

[61] 도 3은 본 발명의 일 실시예에 따른 무선 충전 시스템에서의 감지 신호 전송 절차를 설명하기 위한 도면이다.

[62] 일 예로, 무선 전력 송신기는 3개의 송신 코일(111, 112, 113)이 장착될 수 있다. 각각의 송신 코일은 일부 영역이 다른 송신 코일과 서로 중첩되도록 배치될 수 있으나, 이는 하나의 실시예에 불과하며, 서로 중첩되지 않게 배치되거나 하나의 송신 코일이 장착될 수도 있다.

[63] 무선 전력 송신기는 각각의 송신 코일을 통해 무선 전력 수신기의 존재를 감지하기 위한 소정 감지 신호(117, 127)-예를 들면, 디지털 펄스-를 미리 정의된 순서로 순차적으로 송신한다.

[64] 상기 도 3에 도시된 바와 같이, 무선 전력 송신기는 도면 번호 110에 도시된 1차 감지 신호 송신 절차가 개시되면 감지 신호(117)를 순차적으로 송신하고, 무선 전력 수신기(115)로부터 소정 응답 신호-예를 들면, 감지 신호에 대응되는 수신 신호 세기 정보가 포함된 신호일 수 있으며, 이하 설명의 편의를 위해, 신호 세기 지시자(Signal Strength Indicator, 116) 또는 신호 세기 패킷(Signal Strength Packet)이라 명함-가 수신된 송신 코일(111, 112)을 식별할 수 있다. 연이어, 무선 전력 송신기는 도면 번호 120에 도시된 2차 감지 신호 송신 절차가 개시되면 감지 신호(127)를 순차적으로 송신하고, 신호 세기 지시자(126)가 수신된 송신 코일(111, 112) 중 전력 전송 효율(또는 충전 효율)-즉, 송신 코일과 수신 코일 사이의 정렬 상태-이 좋은 송신 코일을 식별하고, 식별된 송신 코일을 통해 전력이 송신되도록-즉, 무선 충전이 이루어지도록- 제어할 수 있다.

[65] 상기의 도 3에서 보여지는 바와 같이, 무선 전력 송신기가 2회의 감지 신호 송신 절차를 수행하는 이유는 어느 송신 코일에 무선 전력 수신기의 수신 코일이 잘 정렬되어 있는지를 보다 정확하게 식별하기 위함이다.

[66] 만약, 상기한 도 3의 도면 번호 110 및 120에 도시된 바와 같이, 제1 송신 코일(111), 제2 송신 코일(112)에 신호 세기 지시자(116, 126)가 수신된 경우, 무선 전력 송신기는 제1 송신 코일(111)과 제2 송신 코일(112) 각각에 수신된 신호 세기 지시자(126)에 기반하여 가장 정렬이 잘된 송신 코일을 선택하고, 선택된 송신 코일을 이용하여 무선 충전을 수행한다.

[67] 도 4는 무선 충전 수신기의 제1예를 설명한다.

[68] 도시된 바와 같이, 무선 충전 수신기는 안테나 또는 코일이 배치될 수 있는 기판(10)을 포함한다.

[69] 기판(10)에는 제1 무선 방식을 통한 데이터 통신을 수행하기 위한 제1 안테나,

제2 무선 방식을 통한 데이터 통신을 수행하기 위한 제2 안테나 및 제3 무선 방식을 통해 무선 충전을 수행하기 위한 제3 안테나를 포함할 수 있다. 여기서, 제1 안테나, 제2 안테나 및 제3 안테나는 각각 도전선이 루프 형태로 감겨 배치되는 적어도 하나의 코일부 및 코일부와 기판(10)에 배치된 단자를 연결하는 연결부를 포함할 수 있다. 실시예에 따라, 제1 내지 제3 안테나 각각에 포함된 코일부는 제1 내지 제3 무선 방식에 대응하는 서로 다른 도전선의 형상(단면, 굵기, 구성물질 등) 및 권선 수를 가질 수 있다.

- [70] 무선 충전 수신기는 기판(10)에 배치되어 무선 전력 신호를 수신하는 제3 안테나의 무선 충전 코일부(16A), 무선 충전 코일부(16A)의 내측 및 외측에 배치되는 제1 무선 통신용 코일부(14A, 14C), 및 무선 충전 코일부(16A)의 내측 및 외측에 배치되는 제2 무선 통신용 코일부(12A, 12C)를 포함할 수 있다. 여기서, 제1 무선 통신용 코일부(14A, 14C)와 제2 무선 통신용 코일부(12A, 12C)는 서로 다른 통신 방식을 지원할 수 있다.
- [71] 예를 들어, 제1 무선 통신용 코일부(14A, 14C)는 근거리 통신(Near Field Communication, NFC)을 위한 안테나를 포함할 수 있고, 제2 무선 통신용 코일부(12A, 12C)는 마그네틱 보안 전송(Magnetic Secure Transmission, MST)을 위한 안테나를 포함할 수 있다. 여기서, 근거리 통신(NFC)은 기 설정된 주파수(예, 13.56MHz)의 대역을 가진 근접한 거리(약 10cm 이내)에서 사용 가능한 무선 통신을 위한 기술이다. 근거리 통신(NFC)에서는 일측 단말기는 리더(reader)로서의 기능을 수행하고, 타측 단말기는 태그(tag)로서의 기능을 수행하며 두 단말기가 1:1 통신을 수행할 수 있다. 한편, 마그네틱 보안 전송(MST)은 사용자들이 이용하는 자기장을 이용한 마그네틱 선을 내장하는 신용카드 혹은 체크카드를 단말기에 긁을 때 생기는 자기장의 원리를 휴대용 기기에 내장하는 기술로, 결제 단말기의 마그네틱 리더에 접촉하는 것만으로 결제가 이루어질 수 있다. 제1 무선 통신용 코일부(14A, 14C)와 제2 무선 통신용 코일부(12A, 12C)를 통해 무선 충전 수신기를 사용한 금융 결제(payment) 기능을 지원할 수 있다.
- [72] 제1 무선 통신용 코일부(14A, 14C)와 제2 무선 통신용 코일부(12A, 12C)는 무선 충전 코일부(16A)의 내측과 외측에 모두 배치될 수 있다. 무선 충전 코일부(16A)의 내측과 외측에 제1 무선 통신용 코일부(14A, 14C)와 제2 무선 통신용 코일부(12A, 12C)를 배치시켜 무선 통신 기능을 강화할 수 있다.
- [73] 도 5는 도 4에서 설명한 무선 충전 수신기의 단면을 설명한다. 구체적으로, 도 1의 A-A'의 단면을 설명한다.
- [74] 도시된 바와 같이, 기판(10)의 양측면에는 코일 또는 안테나가 배치될 수 있다. 기판(10)의 일측면과 타측면에 배치된 무선 충전 코일부(16A, 16B), 제1 무선 통신용 코일부(14A, 14C) 및 제2 무선 통신용 코일부(12A, 12B, 12C)는 복수의 패턴을 포함하고 있다. 제3 안테나의 무선 충전 코일부(16A, 16B), 제1 안테나의 제1 무선 통신용 코일부(14A, 14C) 및 제2 안테나의 제2 무선 통신용 코일부(12A,

12B, 12C) 각각은 개별적으로 동작할 수 있다. 무선 충전 수신기의 평면에 각 안테나마다 복수의 패턴이 배치되고 각 안테나의 복수의 패턴이 함께 동작함으로써 무선 충전 및 무선 통신 기능이 향상될 수 있다. 도시되지 않았으나, 각 안테나의 복수의 패턴 사이에 스위치 소자가 포함되는 경우, 각 안테나의 복수의 패턴을 선택적으로 확장시켜 동작시킬 수도 있다.

[75] 구체적으로, 기판(10)의 일측면을 살펴보면, 무선 충전을 수행하기 위한 코일의 제5 패턴(16A)을 기준으로 내측에 제1 무선 통신용 안테나의 제1 패턴(14C)이 배치되어 있고, 외측에는 제1 무선 통신용 안테나의 제2 패턴(14A) 및 제2 무선 통신용 안테나의 제4 패턴(12A)이 배치될 수 있다.

[76] 기판(10)의 타측면을 살펴보면, 무선 충전을 수행하기 위한 코일(16B)을 기준으로 내측에는 제2 무선 통신용 안테나의 제3 패턴(12C)이 배치되어 있고, 외측에는 제2 무선 통신용 안테나의 제4 패턴(12B)이 배치될 수 있다.

[77] 무선 충전 코일의 제5 패턴(16A) 및 제6 패턴(16B)의 내측경과 외측경은 수직 방향으로 서로 정렬되어 있다. 기판(10)의 일측면과 타측면에 있는 공간에 배치되는 코일이 다른 기능을 수행하는 안테나와 중첩되지 않는 범위 내에서 서로 정렬되어 배치되는 경우, 무선 충전 중 인덕턴스를 유지시켜 무선 충전 기능을 강화할 수 있다.

[78] 또한, 제2 무선 통신용 안테나의 제4 패턴(12A, 12B)도 코일의 제5 패턴(16A) 및 제6 패턴(16B)의 외측에 정렬되어 배치될 수 있다. 이러한 제2 무선 통신용 안테나의 제4 패턴(12A, 12B)의 배치는 저항을 줄이고 자기장을 보다 세게 형성할 수 있어, 제2 무선 통신용 안테나를 통한 마그네틱 보안 전송(MST) 기능을 강화할 수 있다.

[79] 도 6은 도 4에서 설명한 무선 충전 수신기의 기판(10)의 양면을 설명한다. 구체적으로, (a)는 기판(10)의 일측면(무선 충전 수신기의 내부 회로를 기준으로 외측면)을 설명하고, (b)는 기판(10)의 타측면(무선 충전 수신기의 내부 회로를 기준으로 내측면)을 설명한다.

[80] 먼저 도 6의 (a)를 참조하면, 기판(10)의 일측면에 무선 충전을 수행하기 위한 코일의 제5 패턴(16A)을 기준으로 내측에 제1 무선 통신용 안테나의 제1 패턴(14C)이 배치되어 있고, 외측에는 제1 무선 통신용 안테나의 제2 패턴(14A) 및 제2 무선 통신용 안테나의 제4 패턴(12A)이 배치될 수 있다.

[81] 도 6의 (b)를 참조하면, 무선 충전을 수행하기 위한 코일(16B)을 기준으로 내측에는 제2 무선 통신용 안테나의 제3 패턴(12C)이 배치되어 있고, 외측에는 제2 무선 통신용 안테나의 제4 패턴(12B)이 배치될 수 있다.

[82] 도 5 및 도 6의 (a) 및 (b)를 참조하면, 제1 무선 통신용 안테나의 제1 패턴(14C)은 기판(10)의 일측면에 배치되지만, 제2 무선 통신용 안테나의 제3 패턴(12C)은 기판(10)의 타측면에 배치되어 있다. 근거리 통신(NFC)을 수행하는 제1 무선 통신용 안테나의 경우 고주파수의 신호를 송신 또는 수신할 수 있기 때문에 산화철로 구성되는 차폐재와 이격하여 전기적 쇼트를 방지할 필요가

있다. 반면, 마그네틱 보안 전송(MST)을 수행하는 제2 무선 통신용 안테나의 경우 동작 주파수가 낮기 때문에 제1 무선 통신용 안테나와 달리 배치에 보다 자유로울 수 있다.

[83] 한편, 기관(10)의 일측면에 배치된 제1 무선 통신용 안테나의 제1 패턴(14C) 및 제2 패턴(14A)은 루프(loop)형태를 가지고 있어, 자기장 형성 시 저항을 감소시킬 수 있다.

[84] 또한, 무선 충전용 코일부(16A, 16B)의 내측에 배치되는 제1 무선 통신용 안테나의 제1 패턴(14C)과 제2 무선 통신용 안테나의 제3 패턴(12C)을 비교하면, 제1 패턴(14C)보다 제3 패턴(12C)에서 안테나 권선 수가 더 클 수 있다. 이는 제2 무선 통신용 안테나에서 수행되는 마그네틱 보안 전송(MST)이 제1 무선 통신용 안테나에서 수행되는 근거리 통신(NFC)에 비하여 낮은 주파수 대역에서 동작하기 때문이다.

[85] 또한, 안테나 권선 수에 비례하여 자기장의 세기가 결정될 수 있고, 마그네틱 보안 전송(MST)에서 사용되는 리딩 모듈이 근거리 통신(NFC)에서 사용되는 리딩 모듈에 비하여 더 작을 수 있기 때문에 마그네틱 보안 전송(MST)을 위한 인식률을 개선하기 위해 안테나 권선 수를 증가시킬 수 있다. 또한, 보다 더 작은 마그네틱 보안 전송(MST)에서 사용되는 리딩 모듈과의 인식률을 높이기 위해 제1 무선 통신용 안테나의 제1 패턴(14C) 보다 제2 무선 통신용 안테나의 제3 패턴(12C)이 더 중심에 가깝도록 배치될 수 있다.

[86] 한편, 기관(10)의 일측면과 타측면에 배치된 무선 충전 코일부(16A, 16B), 제1 무선 통신용 코일부(14A, 14C) 및 제2 무선 통신용 코일부(12A, 12B, 12C)의 코일 혹은 안테나의 권선 수는 동작 주파수에 대응하여 결정될 수 있으며, 동작 중 자기장의 세기 또는 성능을 유지하기 위한 인덕턴스 값의 범위에 따라 결정될 수도 있다. 예를 들어, 2 무선 통신용 코일부(12A, 12B, 12C), 무선 충전 코일부(16A, 16B), 제1 무선 통신용 코일부(14A, 14C)의 순서로 권선 수가 작아질 수 있다.

[87] 또한, 기관(10)의 일측면과 타측면에 배치된 무선 충전 코일부(16A, 16B), 제1 무선 통신용 코일부(14A, 14C) 및 제2 무선 통신용 코일부(12A, 12B, 12C)의 도선의 두께는 일정할 수 있으나, 패턴간의 전기적 연결 혹은 단자와의 연결을 위해 서로 중첩되는 영역에서는 인접한 부분에서의 열화를 방지하기 위해 도선의 두께를 얇게 조절할 수 있다.

[88] 또한, 기관(10)의 일측면과 타측면에 배치되어 연결되는 제2 무선 통신용 코일부(12A, 12B, 12C)의 경우, 패턴의 단면을 사용하여 인덕턴스를 증가시킬 수 있고, 인식 범위를 보다 증가시킬 수 있다.

[89] 한편, 도 6의 (a) 및 (b)를 참조하여, 기관(10) 내 복수의 홀을 통해 일측면과 타측면에 배치되는 제1 내지 제3 안테나에 포함된 패턴, 코일부 또는 연결부의 물리적 연결을 보다 자세히 설명한다.

[90] 먼저, 제1 안테나의 제1 패턴(14C)은 기관(10)의 일측면의 중심부에 배치되어

있고, 제2 패턴(14A)은 일측면의 가장자리(외곽)에 배치되어 있다. 제1 패턴(14C)의 일단(14I)은 기판(10)에 배치된 홀 상에 배치되어 기판(10)의 타측면에 배치되는 제1 안테나의 다리부(14Y)의 일단(14J)과 연결된다. 다리부(14Y)는 타측면에 배치된 무선 충전 코일인 제6 패턴(16B)의 절단 부분을 지나가 다시 기판(10)에 배치된 홀을 통과하여 기판(10)의 일측면에 배치된 제2 패턴(14A)의 일단(14K)과 연결될 수 있다. 제2 패턴(14A)의 타단은 기판(10)의 일측면에 배치된 단자부(42A)와 전기적으로 연결된다.

- [91] 제3 안테나에 포함되는 무선 충전 코일의 제5 패턴(16A)의 일단(16P)은 기판(10)의 일측면에 배치된 단자부(42A)와의 연결되는 연결부(16R)와 전기적으로 연결되어야 하지만, 제1 안테나의 제2 패턴(14A)이 기판(10)의 일측면에 배치되어 있다. 따라서, 기판(10)의 일측면에 배치된 제5 패턴(16A)의 일단(16P)은 기판(10)에 배치된 홀을 통해 기판(10)의 타측면에 배치된 연결부(16Q)와 연결되고, 제2 패턴(14A)과 전기적인 절연이 가능한 위치에서 기판(10)의 홀을 통해 기판(10)의 일측면에 배치된 연결부(16R)와 연결될 수 있다. 또한, 기판(10)의 타측면에 배치된 제6 패턴(16B)의 일단이 기판의 타측면에 배치된 단자부(42B)와 연결되는 데에는 제2안테나의 제4 패턴(12B) 및 연결패턴(예, 12J 위치에서 12K 위치까지의 패턴)에 의해 직접 연결되기 어렵다. 이를 극복하기 위해, 기판(10)의 타측면에 배치되는 제6 패턴(16B)의 일단은 기판(10)에 배치된 홀을 통해 기판(10)의 일측면의 연결부(16S)와 연결되고, 연결부(16S)는 제2 패턴(14A)과의 교차를 회피하기 위해 기판(10)의 홀을 통해 기판의 타측면에 배치되는 연결부(16T)와 연결된다. 전술한 바와 같이, 기판(10)에 배치되는 홀을 이용하여 복수의 안테나가 배치되더라도 서로가 교차되는 것을 최대한 억제할 수 있다. 특히, 무선 충전을 위한 제3 안테나의 코일부(16A, 16B)와 연결부(16P, 16Q, 16R, 16S, 16T)에는 제1~제2 안테나의 구성 요소보다 더 큰 전압과 전류가 흐를 수 있어, 기판(10) 내 배치된 복수의 홀을 이용하여 무선 충전을 위한 제3 안테나의 코일부(16A, 16B) 및 연결부(16P, 16Q, 16R, 16S, 16T)와 제1~제2 안테나의 구성 요소가 기판(10)의 일측면(예, 휴대용 기기에 탑재되었을 때 외벽으로 향하는 면)에서 교차되는 영역을 최대한 줄이는 것이 바람직하다.

- [92] 또한, 제2안테나의 제4 패턴(12A)은 기판(10)의 일측면에서는 루프(loop)형태를 완성하지 못하지만, 제4 패턴(12A)의 일단(12I)은 기판(10)의 홀을 통해 기판(10)의 타측면에 배치되는 연결패턴(12J)과 연결될 수 있다. 또한, 연결패턴(12K)은 기판(10)의 홀을 통해 제4 패턴(12A)의 타단(12J)과 연결될 수 있다. 제4 패턴(12A)은 기판(10)에 배치되는 복수의 홀을 통해 루프 형태로 구현될 수 있다. 한편, 기판(10)의 타측면에 배치된 제2안테나의 제4 패턴(12B)은 루프형태로 구현되어 있다. 또한, 기판(10)의 일측면에는 제2안테나의 보강 패턴(12D)이 배치되어 있다. 기판(10)의 일측면에 배치되는 제2안테나의 보강 패턴(12D)은 기판(10)의 타측면에 배치되는 제4 패턴(12B)과 중첩되도록

배치되어 자기장 형성 시 노이즈를 감소시킬 수 있다.

- [93] 전술한 바와 같이, 기판(10)의 일측면과 타측면에 배치되는 제1 안테나를 구성하는 복수의 패턴들은 기판(10)에 배치되는 복수의 홀을 통해 서로 연결되고, 제2 안테나를 구성하는 복수의 패턴들도 기판(10)에 배치되는 복수의 홀을 통해 서로 연결되며, 제3 안테나를 구성하는 복수의 패턴들도 기판(10)에 배치되는 복수의 홀을 통해 서로 연결된다. 이로 인해, 기판(10)의 일측면과 타측면에 배치되는 단자부(42A, 42B)에는 각 3개씩 총 6개의 단자만 있어도 제1 내지 제3 안테나를 구성하는 모든 패턴에 전원을 공급하는 데 문제가 없을 수 있다.
- [94] 또한 실시예에 따라, 제1 내지 제3 안테나의 양단은 기판(10)의 일측면과 타측면에 배치되는 단자부(42A, 42B)에 하나씩 연결될 수 있다. 예를 들어 제1 안테나의 일측이 기판(10)의 일측면에 배치된 단자부(42A)에 연결되면 제1 안테나의 타측은 기판(10)의 타측면에 배치된 단자부(42B)에 연결될 수 있다.
- [95] 도 7은 기판(10)에 배치되는 홀의 예를 설명한다. 구체적으로, 도 6의 (a)의 기판(10)의 일부 영역(30)에서 홀을 통한 안테나의 연결을 설명한다.
- [96] 도시된 바와 같이, 기판(10)에는 복수의 홀(H1, H2)이 배치될 수 있다. 도 6의 (a) 및 (b)에서 설명한 바와 같이, 제1 내지 제3 안테나 각각의 코일부와 연결부가 서로의 간섭을 최소화하고, 열화를 방지하기 위해 교차되는 것을 줄이기 위해 기판(10)에는 복수의 홀이 배치된다.
- [97] 예를 들어, 도 7 및 도 6(a), (b)를 참조하면, 제1 홀(H1)은 기판(10)의 타측면에 배치되는 제2 안테나의 제3 패턴(12C)의 일단(12S)과 기판(10)의 일측면의 중심에 배치되는 연결부(12P)를 연결시킨다.
- [98] 또한, 도 7 및 도 6(a), (b)를 참조하면, 제2 홀(H2)은 기판(10)의 일측면에 배치되는 제1 안테나의 제1 패턴(14C)의 일단(14I)과 기판(10)의 타측면에 배치되는 제1 안테나의 다리부(14Y)의 일단(14J)을 연결시킬 수 있다.
- [99] 도 7에 도시된 제1, 제2 홀(H1, H2)은 이해를 돕기 위해 설명한 예로서, 기판(10)에는 제1 내지 제3 안테나 각각의 코일부와 연결부를 연결시키기 위한 복수의 홀이 더 배치될 수 있다. 예를 들어, 도 6(a), (b)를 참조하면, 제3 안테나의 코일부와 단자를 연결하는 연결부의 경우 다른 안테나와의 교차를 피하기 위해 연결부가 기판(10)의 일측면과 타측면에 배치되는 복수의 패턴(예, 16P, 16Q, 16R, 16S, 16T)으로 구성되고, 복수의 패턴은 기판(10)에 배치되는 복수의 홀을 통해 서로 연결될 수 있다.
- [100] 기판(10)에 배치된 복수의 홀을 통해 제1 내지 제3 안테나 각각의 코일부와 연결부를 연결함에 따라 제1 내지 제3 안테나 각각의 코일부와 연결부가 기판(10)에 더욱 단단하게 고정되는 효과가 있다. 기판(10)의 일측면과 타측면에 배치되는 복수의 안테나를 접착성 절연물 혹은 열에 강한 접착제로 고정하는 경우, 긴 사용기간 동안 발생하는 열 등에 의해 복수의 안테나와 기판(10)의 일측면과 타측면에 배치되는 복수의 안테나가 기판(10)이 물리적으로 분리될

수도 있다. 만약, 복수의 안테나가 기관(10)가 물리적으로 분리되는 경우, 복수의 안테나 동작에 문제가 발생할 수 있다. 하지만, 본 발명의 일 실시예에서는 제1 내지 제3 안테나 각각의 코일부와 연결부의 연결을 위해 기관(10)에 복수의 홀을 배치시키고 이를 통하여 제1 내지 제3 안테나 각각의 코일부와 연결부를 연결함으로써 제1 내지 제3 안테나 각각의 코일부와 연결부가 기관(10)에 더욱 단단히 고정될 수 있다.

- [101] 도 8은 무선 충전 수신기의 제2예를 설명한다. 구체적으로, 도 8의 (a) 및 (b)는 평면 상에서 추가 구성 요소들이 배치될 수 있는 영역을 설명한다.
- [102] 도시된 바와 같이, 무선 충전 수신기는 제1 무선 통신용 안테나의 제1 패턴(14C) 및 제2 무선 통신용 안테나의 제3 패턴(12C)의 내측에 배치되는 안테나 액추에이터(22)를 더 포함할 수 있다.
- [103] 또한, 무선 충전 수신기는 제2 무선 통신용 안테나의 제3 패턴(12C)에 대응하여 제3 패턴(12C)의 외측경보다 넓은 면적을 가지는 차폐보강패턴(20)을 더 포함할 수 있다.
- [104] 도 9는 도 8에서 설명한 무선 충전 수신기의 단면을 설명한다. 구체적으로, 도 8의 B-B'의 단면을 설명한다.
- [105] 도시된 바와 같이, 무선 충전 수신기는 기관(10)과 기관(10)에 대응하는 차폐재(24)를 포함할 수 있다.
- [106] 중심축(Y-Y')을 기준으로, 코일의 제5 패턴(16A)의 내측으로, 기관(10)의 일측면에는 코일의 제5 패턴(16A)과 제1 무선 통신용 안테나의 제1 패턴(14C)이 배치될 수 있고, 기관(10)의 타측면에는 코일의 제6 패턴(16B)과 제2 무선 통신용 안테나의 제3 패턴(12C)이 배치될 수 있다.
- [107] 기관(10)의 일측면에 배치되는 안테나 액추에이터(22)는 제1 무선 통신용 안테나의 제1 패턴(14C) 및 제2 무선 통신용 안테나의 제3 패턴(12C)의 내측에 배치될 수 있다. 여기서 안테나 액추에이터(22)의 두께(T3)는 약 100~150 μ m일 수 있다.
- [108] 또한, 제2 무선 통신용 안테나의 제3 패턴(12C)에 대응하여 제3 패턴(12C)의 외측경보다 넓은 면적을 가지는 페라이트로 구성된 차폐보강패턴(20)은 차폐재(24) 상에 배치될 수 있다. 여기서 차폐보강패턴(20)의 두께(T2)는 약 10 μ m 이하일 수 있다. 또한 차폐재(24)는 나노 크리스탈로 구성되어 두께(T1)가 약 150 μ m 이하일 수 있다.
- [109] 한편, 제1 무선 통신용 안테나의 제1 패턴(14C)과 제2 무선 통신용 안테나의 제3 패턴(12C)은 2~3.6mm의 범위 이상의 거리(D3)로 이격될 수 있다. 특히, 제1 무선 통신용 안테나의 제1 패턴(14C)의 내측경과 제2 무선 통신용 안테나의 제3 패턴(12C)의 외측경이 적어도 2.3mm의 간격을 유지하여 제1 무선 통신용 안테나와 제2 무선 통신용 안테나가 각각 수행하는 기능에 의해 열화되는 것을 방지할 수 있다.
- [110] 또한, 차폐보강패턴(20)은 제2 무선 통신용 안테나의 제3 패턴(12C)의

외측경보다 적어도 0.5 mm이상 큰 면적을 가질 수 있다(D5는 최소 0.5mm). 또한, 차폐보강 패턴(20)은 제1 무선 통신용 안테나의 제1 패턴(14C)로부터 1.6mm 이상의 이격 거리(D4)를 가질 수 있다.

[111] 또한, 안테나 액추에이터(22)는 제2 무선 통신용 안테나의 제3 패턴(12C)로부터 1.3mm의 이격 거리(D2)를 가질 수 있고, 제1 무선 통신용 안테나의 제1 패턴(14C)로부터 6.3mm의 이격거리(D1)를 가질 수 있다.

[112] 도 10 및 도 11은 종래의 무선 충전 수신기와 본 발명의 일 실시예에 따른 무선 충전 수신기의 효과를 설명한다. 특히, 도 10 및 도 11은 무선 충전 수신기에서 제2 무선 통신용 안테나를 통한 인식률을 비교하고 있다. 여기서, X 및 Y는 평면상의 위치(가로, 세로)를 의미하고, Z는 대응하는 리딩 모듈과의 수직한 거리(NFC 혹은 MST 단말기와 무선 충전 수신기의 거리)는 의미할 수 있다.

[113] 도 10은 종래의 일반적인 구조를 가지는 무선 충전 수신기를 사용한 인식률 시험에서 리딩 모듈과의 수직한 거리(0mm에서 3cm)의 변화에 따른 인식된 수를 표시하고 있다. 리딩 모듈과의 수직한 거리(Z=3cm)에서 인식률이 크게 저하된 것을 확인할 수 있다. 인식률 시험에서 리딩 모듈과의 수직한 거리(0mm에서 4cm)의 변화에 따른 인식 성공율은 약 67.38%로 집계되었다.

[114] 반면, 도 11은 본 발명의 일 실시예에 따른 무선 충전 수신기를 사용한 인식률 시험에서 리딩 모듈과의 수직한 거리(0mm에서 3cm)의 변화에 따른 인식된 수를 표시하고 있다. 도 9의 경우와 비교하면, 리딩 모듈과의 수직한 거리의 모든 범위에서 인식률이 개선됨을 확인할 수 있다. 인식률 시험에서 리딩 모듈과의 수직한 거리(0mm에서 4cm)의 변화에 따른 인식 성공율은 약 86.74%로 집계되었다.

[115] 본 발명은 본 발명의 정신 및 필수적 특징을 벗어나지 않는 범위에서 다른 특정한 형태로 구체화될 수 있음은 당업자에게 자명하다.

[116] 따라서, 상기의 상세한 설명은 모든 면에서 제한적으로 해석되어서는 아니되고 예시적인 것으로 고려되어야 한다. 본 발명의 범위는 첨부된 청구항의 합리적 해석에 의해 결정되어야 하고, 본 발명의 등가적 범위 내에서의 모든 변경은 본 발명의 범위에 포함된다.

산업상 이용가능성

[117] 본 발명은 무선 전력 수신 기능, 무선 이동 통신 및 근거리 무선 통신을 수행하기 위한 복수의 서로 다른 코일 또는 안테나가 탑재된 무선 전력 수신 장치에 적용될 수 있다.

청구범위

- [청구항 1] 기판;
 상기 기판에 배치되는 무선 충전 코일부를 포함하는 무선 충전용 안테나;
 상기 무선 충전용 안테나의 내측 및 외측에 배치되는 제1 무선 통신
 코일부를 포함하는 제1 무선 통신용 안테나; 및
 상기 무선 충전용 안테나의 내측 및 외측에 배치되는 제2 무선 통신
 코일부를 포함하는 제2 무선 통신용 안테나
 를 포함하고,
 상기 제1 무선 통신용 안테나와 상기 제2 무선 통신용 안테나는 서로 다른
 통신 방식을 지원하는 무선 전력 수신기.
- [청구항 2] 제1항에 있어서,
 상기 제1 무선 통신 코일부는
 상기 무선 충전 코일부의 내측에 배치되는 제1 패턴; 및
 상기 무선 충전 코일부의 외측에 배치되는 제2 패턴을 포함하고,
 상기 제1 패턴 및 상기 제2 패턴은 상기 기판의 일측면에 배치되는 무선
 전력 수신기.
- [청구항 3] 제2항에 있어서,
 상기 제1 무선 통신용 안테나는 근거리 통신(Near Field Communication,
 NFC)을 위한 안테나를 포함하는 무선 전력 수신기.
- [청구항 4] 제2항에 있어서,
 상기 제2 무선 통신 코일부는
 상기 무선 충전 코일부의 내측에 배치되는 제3 패턴; 및
 상기 무선 충전 코일부의 외측에 배치되는 제4 패턴을 포함하고,
 상기 제3 패턴은 상기 제1 패턴이 배치된 상기 일측면에 반대면인
 타측면에 배치되며,
 상기 제4 패턴은 상기 일측면 및 상기 타측면에 배치되는 무선 전력
 수신기.
- [청구항 5] 제4항에 있어서,
 상기 제2 무선 통신용 안테나는 마그네틱 보안 전송(Magnetic Secure
 Transmission, MST)을 위한 안테나를 포함하는 무선 전력 수신기.
- [청구항 6] 제4항에 있어서,
 상기 제1 패턴보다 상기 제3 패턴에서 안테나 권선 수가 더 큰 무선 전력
 수신기.
- [청구항 7] 제4항에 있어서,
 상기 제1 패턴보다 상기 제3 패턴이 중심에 가깝도록 배치되는 무선 전력
 수신기.
- [청구항 8] 제7항에 있어서,

상기 제1 패턴의 내측경과 상기 제3 패턴의 외측경은 수평면을 기준으로 2.3 mm 이상 이격되는 무선 전력 수신기.

[청구항 9]

제4항에 있어서,

상기 제3 패턴의 내측에 배치되는 안테나 액추에이터; 및

상기 기판에 대응하여 배치되는 차폐재를 더 포함하고,

상기 차폐재 상에 배치되고 상기 제3 패턴의 외측경보다 크고 상기 제1 패턴의 외측경의 작은 외측경을 가지는 차폐보강패턴이 포함되는 무선 전력 수신기.

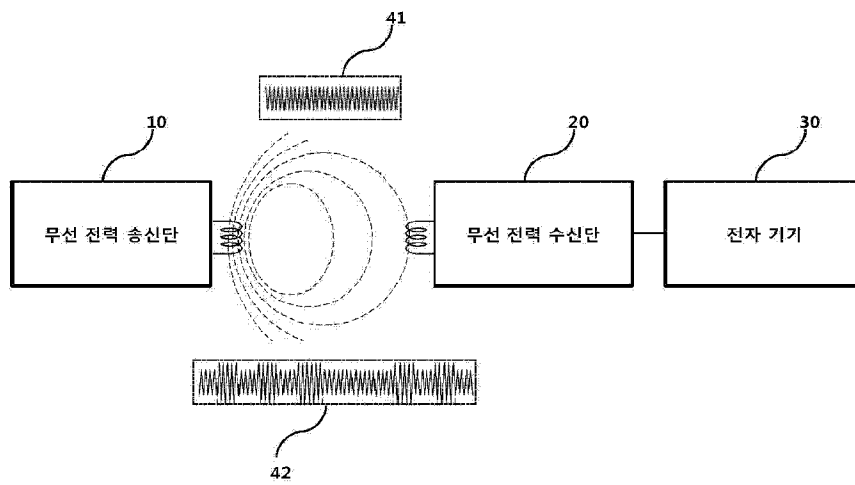
[청구항 10]

제1항에 있어서,

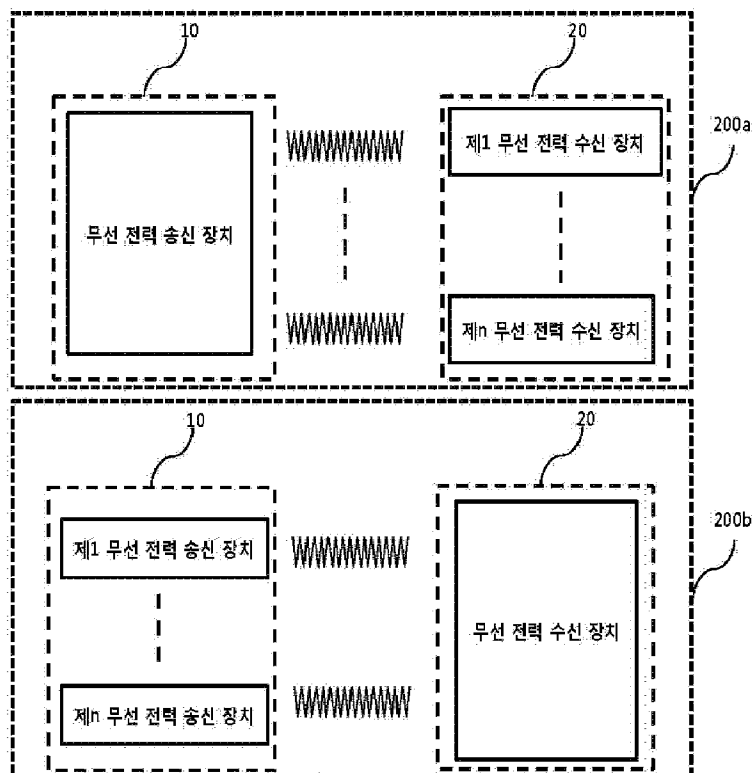
상기 무선 충전 코일부는 상기 기판의 양측면에 배치되는 제5 패턴 및 제6 패턴을 포함하고,

상기 제5 패턴과 상기 제6 패턴의 내측경과 외측경이 정렬되는 무선 전력 수신기.

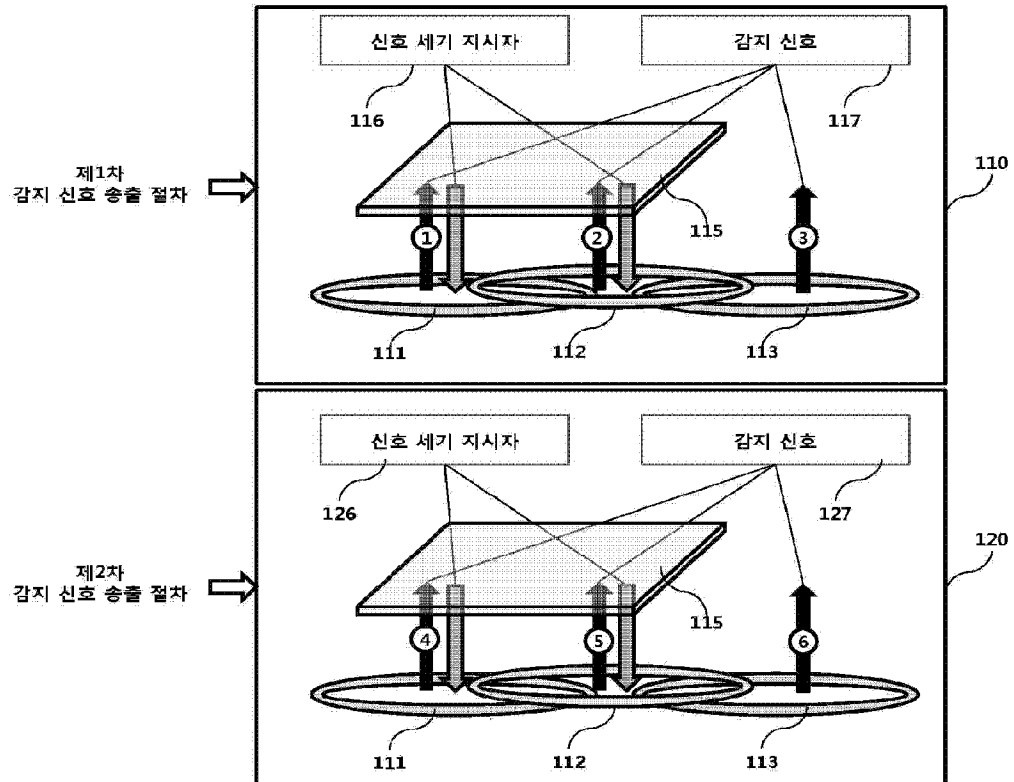
[도1]



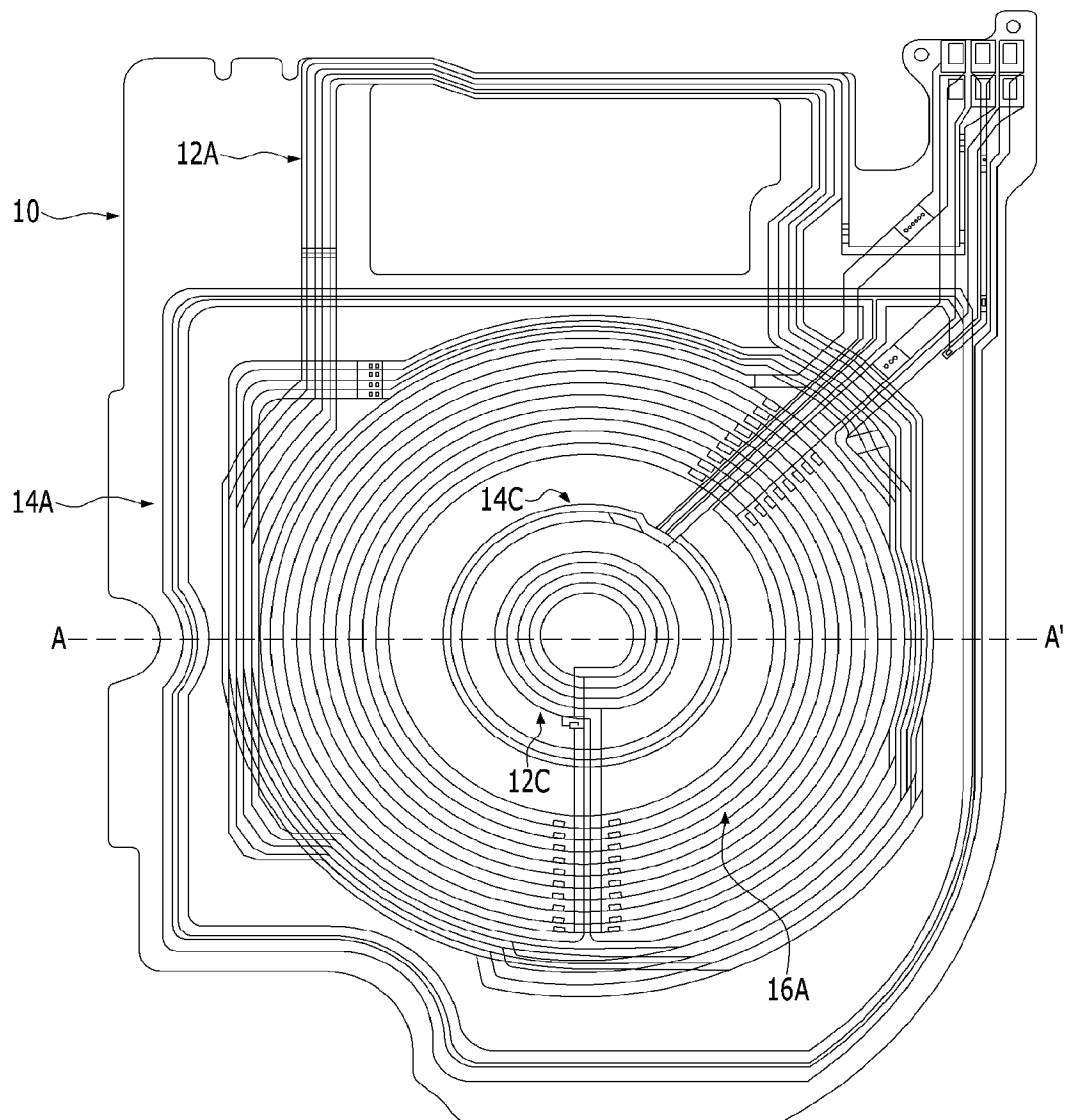
[도2]



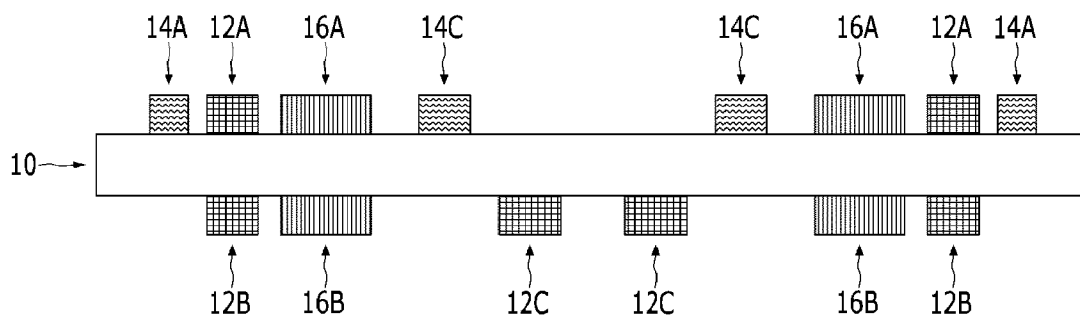
[도3]



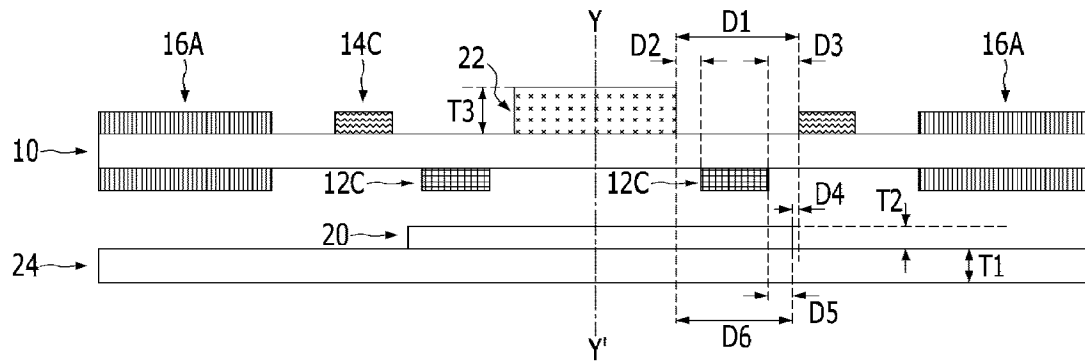
[도4]



[도5]



[도9]



[도10]

Z = 0mm												
Y \ X	-5	-4	-3	-2	-1	0	1	2	3	4	5	
5						3	3	3				
4					3	3	3	3				
3				3	3	3	3	3				
2			3	3	3	3	3	3	3			
1			3	3	3	3	3	3	3			
0				3	3	3	3	3				
-1			3	3	3	3	3	3				
-2			3	3	3	3	3	3				
-3				3	3	3	3	3				
-4					3	3	3	3				
-5						3	3	3				
count												58

Z = 1cm												
Y \ X	-5	-4	-3	-2	-1	0	1	2	3	4	5	
5						3	3	3				
4					3	3	3	3				
3					3	3	3	3	3			
2				3	3	3	3	3	3			
1				3	3	3	3	3	3			
0					3	3	3	3	3			
-1				3	3	3	3	3	3			
-2				3	3	3	3	3	3			
-3					3	3	3	3	3			
-4					3	3	3	3	3			
-5						3	3	3				
count												58

Z = 2cm												
Y \ X	-5	-4	-3	-2	-1	0	1	2	3	4	5	
5						3	3	3				
4					3	3	3	3				
3					3	3	3	3	3			
2				3	3	3	3	3	3			
1				3	3	3	3	3	3			
0												
-1				3	3	3	3	3	3			
-2				3	3	3	3	3	3			
-3				3	3	3	3	3	3			
-4					3	3	3					
-5						3	3	3				
count												52

Z = 3cm												
Y \ X	-5	-4	-3	-2	-1	0	1	2	3	4	5	
5							3					
4							3					
3						3	3	3				
2						3	3	3				
1							3	3				
0												
-1							3					
-2							3					
-3							3	3	3			
-4								3	3			
-5								3				
count												20

[도 11]

Z = 0mm

Y \ X	-5	-4	-3	-2	-1	0	1	2	3	4	5
5						3					
4				3	3	3	3	3			
3			3	3	3	3	3	3	3		
2			3	3	3	3	3	3	3		
1			3	3	3	3	3	3	3		
0				3	3	3	3	3			
-1			3	3	3	3	3	3	3		
-2			3	3	3	3	3	3	3		
-3			3	3	3	3	3	3	3		
-4					3	3	3	3			
-5											
count	57										

Z = 1cm

Y \ X	-5	-4	-3	-2	-1	0	1	2	3	4	5
5					3	3	3				
4				3	3	3	3	3			
3				3	3	3	3	3	3		
2				3	3	3	3	3	3	3	
1				3	3	3	3	3	3	3	
0				3	3	3	3	3	3	3	
-1				3	3	3	3	3	3	3	
-2				3	3	3	3	3	3	3	
-3					3	3	3	3	3		
-4					3	3	3	3	3		
-5						3	3	3			
count	62										

Z = 2cm

Y \ X	-5	-4	-3	-2	-1	0	1	2	3	4	5
5						3	3	3			
4				3	3	3	3	3			
3				3	3	3	3	3	3		
2			3	3	3	3	3	3	3		
1			3	3	3	3	3	3	3		
0			3						3		
-1			3	3	3	3	3	3	3		
-2			3	3	3	3	3	3	3		
-3			3	3	3	3	3	3			
-4			3	3	3	3	3				
-5					3	3	3				
count	55										

Z = 3cm

Y \ X	-5	-4	-3	-2	-1	0	1	2	3	4	5
5					3	3	3				
4				3	3	3	3	3			
3				3	3	3	3	3	3		
2				3	3	3	3	3			
1				3	3	3	3				
0											
-1				3	3	3	3				
-2				3	3	3	3	3			
-3				3	3	3	3	3			
-4				3	3	3	3	3			
-5					3	3	3				
count	44										

INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2019/000861

A. CLASSIFICATION OF SUBJECT MATTER

H02J 50/10(2016.01)i, H01F 38/14(2006.01)i, H04B 5/00(2006.01)i, H02J 5/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H02J 50/10; H01F 1/147; H01Q 1/22; H01Q 1/24; H01Q 1/38; H01Q 7/06; H02J 7/02; H04B 1/40; H01F 38/14; H04B 5/00; H02J 5/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models: IPC as above
Japanese utility models and applications for utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS (KIPO internal) & Keywords: wireless power, antenna, coil, charging, communication, inner side, outer side, NFC, MST

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-2017-0018646 A (SAMSUNG ELECTRONICS CO., LTD.) 20 February 2017 See paragraphs [55]-[71], figures 3-4.	1-10
Y	KR 10-1574322 B1 (IMTECH INC.) 04 December 2015 See paragraphs [75]-[88], figures 5a-5b.	1-10
A	JP 2013-146050 A (DEXERIALS CORP.) 25 July 2013 See the entire document.	1-10
A	KR 10-2017-0135759 A (SKC CO., LTD.) 08 December 2017 See the entire document.	1-10
A	KR 10-2017-0017416 A (AMOSENSE CO., LTD.) 15 February 2017 See the entire document.	1-10



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

“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

“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

“O” document referring to an oral disclosure, use, exhibition or other means

“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

14 MAY 2019 (14.05.2019)

Date of mailing of the international search report

14 MAY 2019 (14.05.2019)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
Government Complex Daejeon Building 4, 189, Cheongsu-ro, Seo-gu,
Daejeon, 35208, Republic of Korea

Facsimile No. +82-42-481-8578

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/KR2019/000861

Patent document cited in search report	Publication date	Patent family member	Publication date
KR 10-2017-0018646 A	20/02/2017	CN 107925163 A EP 3335269 A1 US 2017-0047636 A1 WO 2017-026659 A1	17/04/2018 20/06/2018 16/02/2017 16/02/2017
KR 10-1574322 B1	04/12/2015	None	
JP 2013-146050 A	25/07/2013	TW 201324950 A WO 2013-088912 A1	16/06/2013 20/06/2013
KR 10-2017-0135759 A	08/12/2017	CN 107415353 A CN 107452461 A CN 107453048 A JP 2018-023091 A JP 2018-029169 A JP 2018-039251 A KR 10-1831847 B1 KR 10-1831860 B1 KR 10-1831862 B1 KR 10-1831865 B1 KR 10-1831869 B1 KR 10-1831870 B1 KR 10-1831875 B1 KR 10-2017-0135632 A KR 10-2017-0135633 A KR 10-2017-0135635 A KR 10-2017-0135636 A KR 10-2017-0135637 A KR 10-2017-0135638 A KR 10-2017-0135639 A TW 201801393 A TW 201802837 A TW 201803203 A TW 1646725 B TW 1646728 B US 2017-0341341 A1 US 2017-0345535 A1 US 2017-0346165 A1	01/12/2017 08/12/2017 08/12/2017 08/02/2018 22/02/2018 15/03/2018 23/02/2018 26/02/2018 26/02/2018 26/02/2018 26/02/2018 26/02/2018 26/02/2018 26/02/2018 08/12/2017 08/12/2017 08/12/2017 08/12/2017 08/12/2017 08/12/2017 08/12/2017 01/01/2018 16/01/2018 16/01/2018 01/01/2019 01/01/2019 30/11/2017 30/11/2017 30/11/2017
KR 10-2017-0017416 A	15/02/2017	None	

A. 발명이 속하는 기술분류(국제특허분류(IPC))

H02J 50/10(2016.01)i, H01F 38/14(2006.01)i, H04B 5/00(2006.01)i, H02J 5/00(2006.01)i

B. 조사된 분야

조사된 최소문헌(국제특허분류를 기재)

H02J 50/10; H01F 1/147; H01Q 1/22; H01Q 1/24; H01Q 1/38; H01Q 7/06; H02J 7/02; H04B 1/40; H01F 38/14; H04B 5/00; H02J 5/00

조사된 기술분야에 속하는 최소문헌 이외의 문헌

한국등록실용신안공보 및 한국공개실용신안공보: 조사된 최소문헌란에 기재된 IPC
일본등록실용신안공보 및 일본공개실용신안공보: 조사된 최소문헌란에 기재된 IPC

국제조사에 이용된 전산 데이터베이스(데이터베이스의 명칭 및 검색어(해당하는 경우))

eKOMPASS(특허청 내부 검색시스템) & 키워드: 무선 전력, 안테나, 코일, 충전, 통신, 내측, 외측, NFC, MST

C. 관련 문헌

카테고리*	인용문헌명 및 관련 구절(해당하는 경우)의 기재	관련 청구항
Y	KR 10-2017-0018646 A (삼성전자주식회사) 2017.02.20 단락 55-71, 도면 3-4 참조.	1-10
Y	KR 10-1574322 B1 (주식회사 아이엠텍) 2015.12.04 단락 75-88, 도면 5a-5b 참조.	1-10
A	JP 2013-146050 A (DEXERIALS CORP.) 2013.07.25 전체 문헌 참조.	1-10
A	KR 10-2017-0135759 A (에스케이씨 주식회사) 2017.12.08 전체 문헌 참조.	1-10
A	KR 10-2017-0017416 A (주식회사 아모센스) 2017.02.15 전체 문헌 참조.	1-10

☐ 추가 문헌이 C(계속)에 기재되어 있습니다.

☒ 대응특허에 관한 별지를 참조하십시오.

* 인용된 문헌의 특별 카테고리:

“A” 특별히 관련이 없는 것으로 보이는 일반적인 기술수준을 정의한 문헌

“E” 국제출원일보다 빠른 출원일 또는 우선일을 가지나 국제출원일 이후에 공개된 선출원 또는 특허 문헌

“L” 우선권 주장에 의문을 제기하는 문헌 또는 다른 인용문헌의 공개일 또는 다른 특별한 이유(이유를 명시)를 밝히기 위하여 인용된 문헌

“O” 구두 개시, 사용, 전시 또는 기타 수단을 언급하고 있는 문헌

“P” 우선일 이후에 공개되었으나 국제출원일 이전에 공개된 문헌

“T” 국제출원일 또는 우선일 후에 공개된 문헌으로, 출원과 상충하지 않으며 발명의 기초가 되는 원리나 이론을 이해하기 위해 인용된 문헌

“X” 특별한 관련이 있는 문헌. 해당 문헌 하나만으로 청구된 발명의 신규성 또는 진보성이 없는 것으로 본다.

“Y” 특별한 관련이 있는 문헌. 해당 문헌이 하나 이상의 다른 문헌과 조합하는 경우로 그 조합이 당업자에게 자명한 경우 청구된 발명은 진보성이 없는 것으로 본다.

“&” 동일한 대응특허문헌에 속하는 문헌

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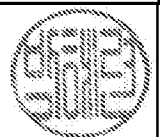
대한민국 특허청
(35208) 대전광역시 서구 청사로 189,
4동 (둔산동, 정부대전청사)

팩스 번호 +82-42-481-8578

심사관

박혜련

전화번호 +82-42-481-3463



국제조사보고서에서 인용된 특허문헌	공개일	대응특허문헌	공개일
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Antenna module, method for manufacturing same, and mobile terminal comprising same

List of publications

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English Title

Antenna module, method for manufacturing same, and mobile terminal comprising same

French Title

Module d'antenne, son procédé de fabrication, et terminal mobile le comprenant

Other Title 안테나 모듈과 그 제조 방법 및 이를 구비한 휴대용 단말기

Abstract - French

L'invention porte sur un module d'antenne, sur son procédé de fabrication et sur un terminal mobile le comprenant. Le module d'antenne selon un exemple de mode de réalisation comprend : une feuille magnétique; un premier motif formé sur une surface de la feuille magnétique; une première feuille de couverture formée pour recouvrir le premier motif sur ladite surface de la feuille magnétique; un second motif formé sur l'autre surface de la feuille magnétique; une seconde feuille de couverture formée pour recouvrir le second motif sur l'autre surface de la feuille magnétique; et au moins un trou d'interconnexion, formé à travers le premier motif, la feuille magnétique et le second motif, pour connecter électriquement le premier motif au second motif.

English Abstract (Native or MT)

Disclosed are an antenna module, a method for manufacturing the same, and a mobile terminal comprising the same. The antenna module according to an exemplary embodiment comprises: a magnetic sheet; a first pattern formed on one surface of the magnetic sheet; a first cover sheet formed

to cover the first pattern on the one surface of the magnetic sheet; a second pattern formed on the other surface of the magnetic sheet; a second cover sheet formed to cover the second pattern on the other surface of the magnetic sheet; and at least one via hole, formed through the first pattern, the magnetic sheet, and the second pattern, for electrically connecting the first pattern to the second pattern.

Other Abstracts

안테나 모듈과 그 제조 방법 및 이를 구비한 휴대용 단말기가 개시된다. 예시적인 실시예에 따른 안테나 모듈은, 자성 시트, 자성 시트의 일면에 형성되는 제1 패턴, 자성 시트의 일면 상에서 제1 패턴을 감싸며 형성되는 제1 커버 시트, 자성 시트의 타면에 형성되는 제2 패턴, 자성 시트의 타면 상에서 제2 패턴을 감싸며 형성되는 제2 커버 시트; 및 제1 패턴, 자성 시트, 및 제2 패턴을 관통하여 형성되고 제1 패턴과 제2 패턴을 전기적으로 연결시키는 적어도 하나의 비아 홀을 포함한다.

Application Language KOREAN (KOR)

Inventor(s) SEONG WON MO [KR]

OH JUNG HAN [KR]

JANG SUNG IL [KR]

Inventor(s) 성원모 [KR]

오정한 [KR]

장성일 [KR]

Applicant/Assignee

EMW [KR]

owned by KESPION

\$ 39 M

Assignee 주식회사 이엠따블유 [KR]

Applicant/Assignee Address EMW CO., LTD. 155, Namdongseo-ro Namdong-gu Incheon 21695 , 21695 , KR

Patent Assignee History EMW CO., LTD. [KR]

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JP2015149405 (A) (Cat. Y) [JP2015149405] DEXERIALS CORP; -KR20150131925 (A) (Cat. A)
[KR20150131925] ITM SEMICONDUCTOR CO LTD; -KR101381135 (B1) (Cat. A) [KR101381135] KIM SUN
KI, et al;

Description

TECHNICAL FIELD

[0001] Embodiments of the present invention relate to antenna technology.

BACKGROUND ART

[0002] Generally, NFC (Near Field Communication) technology is a contactless near field communication technology capable of transmitting data at low power in the near field using frequencies such as 13.56 MHz, 125 MHz, 135 MHz, 900 MHz band, etc., and is defined as standard in ISO 18092. NFC technology is being used for traffic card payment systems, food fee calculation systems, and the like.

[0003] In addition, recently, the use of intelligent mobile terminals such as smart phones and tablet PCs has become common, and various applications dedicated to mobile devices are provided in order to provide users with more diverse and new services, and among these applications, there are a kind requiring interworking with NFC technology. For example, a service of an electronic payment system may be provided through the interworking of NFC with an application of a smart phone.

[0004] In addition, the wireless charging technology in the past is that charging is performed by placing the portable terminal on the charger or placing the portable terminal in the vicinity of the charger without directly connecting the connector of the charger and the connector of the portable terminal. This generates and charges an induced current between two adjacent coil patterns by an electromagnetic induction method.

[0005] Here, the NFC antenna module and the wireless charging antenna module are formed by interleaving of FPCB 10 and ferrite sheet 20, as shown in FIG. 1. Then, a pattern (11) is formed in the FPCB (10). in the case of an NFC antenna module, the pattern (11) is used as a radiator for near field communication, and in the case of a wireless charging antenna module, the pattern (11) is used as a coil for generating an induced current.

[0006] Since the conventional NFC antenna module and the wireless charging antenna module described above have the pattern 11 formed on the FPCB 10, the thickness of the module itself tends to be thicker than the thickness of the FPCB 10. Accordingly, the thickness of the portable terminal on which the NFC antenna module and the wireless charging antenna module are mounted is increased.

DISCLOSURE

TECHNICAL PROBLEM

[0007] Embodiments of the present invention provide an antenna module capable of reducing an overall thickness and components and simplifying a manufacturing process, a manufacturing method thereof, and a portable terminal having the same.

[0008] Embodiments of the present invention provide an antenna module capable of increasing space utilization by forming a plurality of antenna patterns on a magnetic sheet, a method of manufacturing the antenna module, and a portable terminal having the antenna module.

TECHNICAL SOLUTION

[0009] An antenna module includes: a magnetic sheet; a first pattern formed on one surface of the magnetic sheet; a first cover sheet formed on one surface of the magnetic sheet to surround the first pattern; a second pattern formed on the other surface of the magnetic sheet; A second cover sheet formed on the other surface of the magnetic sheet to surround the second pattern; and at least one via hole penetrating the first pattern, the magnetic sheet, and the second pattern to electrically connect the first pattern to the second pattern.

[0010] Wherein each of the first pattern and the second pattern has one end extending outward of the magnetic sheet beyond an edge of the magnetic sheet, and a connection terminal is formed at a portion extending outward.

[0011] The first pattern and the second pattern may be formed to have at least one of different thickness and width.

[0012] Each of the first pattern and the second pattern includes at least two patterns among a near field communication (NFC) pattern, a magnetic secure transmission (MST) pattern, and a wireless power charge (wpc) pattern, and the at least two patterns are spaced apart from each other.

[0013] The first pattern and the second pattern each include the NFC pattern, the MST pattern, and the wpc pattern, and the NFC pattern, the MST pattern, and the wpc pattern are sequentially formed inward from an outer edge of the magnetic sheet.

[0014] The NFC pattern may include a first NFC pattern formed along at least one section of an edge of the magnetic sheet and a second NFC pattern formed inside the wpc pattern to be spaced apart from the wpc pattern.

[0015] Wherein the MST pattern is formed in a loop shape spaced apart from an edge of the magnetic sheet by a predetermined distance, at least one of an inner length in a transverse direction of

the MST pattern and an inner length in a longitudinal direction of the MST pattern is formed to be less than or equal to a diameter of the wpc pattern, A bent portion having one portion bent outward so as not to overlap the wpc pattern may be formed in a direction perpendicular to a direction formed to have a diameter equal to or less than a diameter of the wpc pattern among a horizontal direction and a vertical direction of the MST pattern.

[0016] The magnetic sheet may further include an extended portion extending from one side of the magnetic sheet, and the MST pattern may include a first MST pattern formed in the magnetic sheet and a second MST pattern formed in the extended portion.

[0017] The magnetic sheet may further include a connection portion formed on one side of the extension portion. the connection portion may include a first connection terminal electrically connected to the NFC pattern, a second connection terminal electrically connected to the MST pattern, and a third connection terminal electrically connected to the wpc pattern.

[0018] The antenna module may further include a thermistor formed on the magnetic sheet and configured to measure a temperature of at least one of the NFC pattern, the MST pattern, and the wpc pattern.

[0019] A method of manufacturing an antenna module includes: forming a first metal thin film and a second metal thin film on one surface and the other surface of a magnetic sheet, respectively; forming a via hole electrically connecting the first metal thin film and the second metal thin film; Removing portions of the first metal thin film and the second metal thin film to form a first pattern and a second pattern on one surface and the other surface of the magnetic sheet, respectively, forming a first cover sheet on the one surface of the magnetic sheet to surround the first pattern, and forming a second cover sheet on the other surface of the magnetic sheet to surround the second pattern.

[0020] Wherein the forming of the first metal thin film and the second metal thin film comprises: bonding the first metal thin film to one surface of the magnetic sheet through a first bonding sheet;

[0021] And bonding the second metal thin film to the other surface of the magnetic sheet through a second bonding sheet.

[0022] The forming of the first pattern and the second pattern may form at least one of a width and a thickness of the first pattern and the second pattern different from each other.

[0023] Forming a first plating layer on the first pattern after forming the first pattern and the second pattern; and forming a second plating layer on the second pattern, wherein the first plating layer and the second plating layer have different thicknesses.

ADVANTAGEOUS EFFECTS

[0024] According to an embodiment of the present invention, the antenna pattern is directly formed on the magnetic sheet, rather than the antenna pattern being formed on a flexible printed circuit board (FPCB) and then combined with the magnetic sheet, so that the thickness of the antenna module can be reduced, the components used in the antenna module can be reduced, and the overall manufacturing process of the antenna module can be simplified. That is, since the magnetic sheet also serves as a support member of the antenna pattern, a separate support member (e.g., FPCB, etc.) is not required, thereby reducing the thickness of the antenna module and reducing the number of components. In addition, since the process of combining the FPCB and the magnetic sheet can be omitted, the overall manufacturing process of the antenna module can be simplified. In addition, the NFC pattern, the MST pattern, and the wpc pattern are formed in the magnetic sheet, thereby effectively implementing individual performance of each antenna while improving space utilization.

DESCRIPTION OF DRAWINGS

[0025] Fig. 1 shows a state in which a conventional FPCB and a ferrite sheet are brought together.

[0026] FIG. 2 shows an exploded perspective view of an antenna module according to an illustrative embodiment.

[0027] FIG. 3 is a flowchart illustrating a method of manufacturing an antenna module according to an exemplary embodiment.

[0028] FIG. 4 illustrates an example in which a first pattern and a second pattern have different widths in an antenna module according to an exemplary embodiment.

[0029] FIG. 5 illustrates a first pattern in an antenna module according to an exemplary embodiment.

[0030] FIG. 6 illustrates a second pattern in an antenna module according to an exemplary embodiment.

[0031] FIG. 7 shows a first NFC pattern formed on an upper surface of a magnetic sheet in an antenna module according to an exemplary embodiment;

[0032] FIG. 8 shows a second NFC pattern formed on a lower surface of a magnetic sheet in an antenna module according to an exemplary embodiment.

[0033] FIG. 9 is a view illustrating a first MST pattern formed on an upper surface of a magnetic sheet in an antenna module according to an exemplary embodiment;

[0034] FIG. 10 is a view illustrating a second MST pattern formed on a lower surface of a magnetic sheet in an antenna module according to an exemplary embodiment;

[0035] FIG. 11 is a view illustrating a state in which an MST pattern and a wpc pattern are formed on an upper surface of a magnetic sheet according to an exemplary embodiment;

[0036] FIG. 12 is a view illustrating a first wpc pattern formed on an upper surface of a magnetic sheet in an antenna module according to an exemplary embodiment;

[0037] FIG. 13 is a view illustrating a second wpc pattern formed on a lower surface of a magnetic sheet in an antenna module according to an exemplary embodiment; FIG. 14 is a view illustrating a connection in an antenna module according to an exemplary embodiment;

MODE FOR INVENTION

[0039] Hereinafter, specific embodiments of the present disclosure will be described with reference to the drawings. The following detailed description is provided to aid in a comprehensive understanding of the methods, devices and/or systems described herein. However, this is merely an example and the present disclosure is not limited thereto.

[0040] In describing the embodiments of the present invention, when it is determined that a detailed description of the well-known technology related to the present invention may unnecessarily obscure the subject matter of the present invention, the detailed description will be omitted. And, the terms described below are terms defined in view of the functionality herein that may vary depending on the user, intent or practice of the operator, etc. The definitions, therefore, should be made based on content throughout the specification. The terminology used in the detailed description is for the purpose of describing the embodiments of the invention only and is in no way limiting. Unless expressly used otherwise, singular forms "a," an, "and" the "include plural forms of meaning. In this description, expressions such as "comprising" or "provided with" are intended to refer to any characteristics, numbers, steps, operations, elements, some or combination thereof, and should not be construed to exclude the presence or possibility of one or more other characteristics, numbers, steps, operations, elements, some or combination thereof besides described.

[0041] Meanwhile, directional terminology such as top, bottom, one side, the other side, etc., is used with reference to the orientation of the disclosed figures. Directional terminology is used for purposes of illustration and not limitation, as components of embodiments of the present invention may be positioned in various orientations. Further, although the terms first, second, etc. may be used to describe various components, the components should not be limited by the terms. The terms may be used for the purpose of distinguishing one component from another. For example, a first component may be referred to as a second component, and similarly a second component may be referred to as a first component, without departing from the scope of the invention.

[0042] FIG. 2 is a diagram illustrating an exploded perspective view of an antenna module according to an exemplary embodiment.

[0043] Referring to FIG. 2, the antenna module 100 may include a magnetic sheet 102, a first bonding sheet 104, a second bonding sheet 106, a first pattern 108, a second pattern 110, a first cover sheet 112, a second cover sheet 114, and a heat spreading sheet 116.

[0044] The magnetic sheet 102 may be formed of a material having a characteristic of magnetizing when a current flows through the first pattern 108 and the second pattern 110. For example, the magnetic sheet 102 may comprise at least one of Ferrite, Nano Crystal, Amorphous, Permophous, Polymer Metal.

[0045] The lower surface of the first bonding sheet 104 may be adhered to the upper surface of the magnetic sheet 102. The first bonding sheet 104 plays a role of adhering the first pattern 108 to the upper surface of the magnetic sheet 102.

[0046] The upper surface of the second bonding sheet 106 may be adhered to the lower surface of the magnetic sheet 102. The second bonding sheet 106 plays a role of adhering the second pattern 110 to the lower surface of the magnetic sheet 102.

[0047] The first pattern 108 may be adhered to the upper surface of the first bonding sheet 104. The first pattern 108 is directly adhered to the upper surface of the magnetic sheet 102 by the first bonding sheet 104.

[0048] The first pattern 108 may be an antenna pattern, and may include a plurality of patterns of different frequency bands from each other. In an exemplary embodiment, the first pattern 108 may include a Near Field Communication (NFC) pattern, a Magnetic Secure Transmission (MST) pattern, and a Wireless

[0049] Power Charge pattern.

[0050] The second pattern 110 may be adhered to the lower surface of the second bonding sheet 106. The second pattern 110 is directly adhered to the lower surface of the magnetic sheet 102 by the second bonding sheet 106.

[0051] The second pattern 110 may be an antenna pattern, and may include a plurality of patterns of different frequency bands from each other. In an exemplary embodiment, the second pattern 110 may include a Near Field Communication (NFC) pattern, a Magnetic Secure Transmission (MST) pattern, and a Wireless

[0052] Power Charge pattern.

[0053] That is, the antenna module 100 may include an NFC pattern, an MST pattern, and a wpc pattern, and the NFC pattern, the MST pattern, and the wpc pattern may be formed on the upper surface and the lower surface of the magnetic sheet 102 by the bonding sheets 104, 106, respectively. Plating layers (not illustrated) may be formed on the first pattern 108 and the second pattern 110, respectively. Further, the first pattern 108 and the second pattern 110 may be electrically connected through a via hole (not illustrated) formed while penetrating through the magnetic sheet 102.

[0054] The first cover sheet 112 may be formed on an upper portion of the first pattern 108. The first cover sheet 112 serves to protect the first pattern 108 from external environment. The first cover sheet 112 may be adhered to the upper surface of the first bonding sheet 104 and cover the first pattern 108.

[0055] The second cover sheet 114 may be formed under the second pattern 110. The second cover sheet 114 serves to protect the second pattern 110 from external environment. The second cover sheet 114 may be adhered to the lower surface of the second bonding sheet 106, and may cover the second pattern 110.

[0056] The heat spreading sheet 116 may be formed on top of the first cover sheet 112.

[0057] Heat spreading sheet 116 may be adhered to first cover sheet 112 via double-sided adhesive tape 117 at the top of first cover sheet 112. The heat spreading sheet 116 may play a role of radiating heat generated in the antenna module 100 to the outside. The heat spreading sheet 116 may be formed of a material having excellent thermal conductivity (e.g., graphite, etc.).

[0058] Although it is described herein that the heat spreading sheet 116 is formed on an upper portion of the first cover sheet 112, exemplary embodiments are not limited hereto and without the first cover sheet 112, the heat spreading sheet 116 may be formed to cover the first pattern 108. Further, the heat spreading sheet 116 may be formed on a lower portion of the second cover sheet 114, or may be formed to cover the second pattern 110 without the second cover sheet 114.

[0059] Further, the antenna module 100 may additionally include a carrier 118 formed on a lower portion of the second cover sheet 114. The carrier 118 may be used to handle the antenna module 100. A contact reinforcement 119 may be formed on the carrier 118 to reinforce contacts of the antenna pattern.

[0060] According to an embodiment of the present invention, the antenna pattern is directly formed on the magnetic sheet, rather than the antenna pattern being formed on a flexible printed circuit board (FPCB) and then combined with the magnetic sheet, so that the thickness of the antenna module can be reduced, the components used in the antenna module can be reduced, and the overall manufacturing process of the antenna module can be simplified. That is, since the magnetic sheet also serves as a support member of the antenna pattern, a separate support member (e.g., FPCB, etc.) is not required, thereby reducing the thickness of the antenna module and reducing the number of components. In addition, since the process of combining the FPCB and the magnetic sheet can be omitted, the overall manufacturing process of the antenna module can be simplified.

[0061] FIG. 3 is a flowchart illustrating a method of manufacturing an antenna module according to an exemplary embodiment.

[0062] First, the first metal thin film 108 a and the second metal thin film 110 a are formed on the upper surface and the lower surface of the magnetic sheet 102, respectively (FIG. 3 (a)). Specifically, the first metal thin film 108 a may be adhered to the upper surface of the magnetic sheet 102 via the first bonding sheet 104, and the second metal thin film 110 a may be adhered to the lower surface of the magnetic sheet 102 via the second bonding sheet 106. At this time, one end of the first metal thin film 108 a and the second metal thin film 110 a may be bonded so as to extend outward beyond the edge of the magnetic sheet 102. Connection terminals may be formed on portions of the first metal thin film 108 a and the second metal thin film 110 a extending outward of the magnetic sheet 102, respectively.

[0063] Next, a via hole 121 electrically connecting the first metal thin film 108 a and the second metal thin film 110 a is formed (FIG. 3 (b)). Specifically, a through hole penetrating through the first metal thin film 108 a, the magnetic sheet 102, and the second metal thin film 110 a may be formed at a portion where the first metal thin film 108 a and the second metal thin film 110 a are electrically connected to each other, and thereafter, the through hole may be filled with a conductive material to form the via hole 121. In this case, the first metal thin film 108 a and the second metal thin film 110 a may be electrically connected to each other by plating an inner wall of the through hole.

[0064] Next, a portion of the first metal thin film 108 a and the second metal thin film 110 a are etched to form a first pattern 108 and a second pattern 110 on the upper surface and the lower surface of the magnetic sheet 102, respectively (FIG. 3 (c)). For convenience of explanation, the first pattern 108 and the second pattern 110 are not illustrated in a pattern form, but are also illustrated in a thin film form. The first pattern 108 and the second pattern 110 may be formed through photolithography process. The first pattern 108 and the second pattern 110 may be formed to include an NFC pattern, an MST pattern, and a wpc pattern, respectively. The width and the thickness of the first pattern 108 and the second pattern 110 may be the same as each other. However, exemplary embodiments are not limited thereto, and at least one of a width and a thickness of the first pattern 108 and the second pattern 110 may be formed differently. In this case, the magnetic sheet 102 also serves as a support member (e.g., a substrate) that supports the first pattern 108 and the second pattern 110.

[0065] In this case, since the first pattern 108 and the second pattern 110 are respectively formed on the upper surface and the lower surface of the magnetic sheet 102 and are electrically connected by the via hole 121, the connection terminals formed on the portions extended outward of the magnetic sheet 102 of the first pattern 108 and the second pattern 110 are not in contact with each other, thus preventing electrical short.

[0066] Next, the first plating layer 123 is formed on the upper surface of the first pattern 108, and the second plating layer 125 is formed on the lower surface of the second pattern 110 (FIG. 3 (d)). The first plating layer 123 and the second plating layer 125 may be formed to have the same thickness, or may be formed to have different thicknesses as necessary. For example, with the same thickness of the first pattern 108 and the second pattern 110, the first plating layer 123 may be formed thicker than the second plating layer 125. In this case, the total thickness of the first pattern portion (that is, the first pattern 108 and the first plating layer 123) increases, resulting in increased radiation efficiency or wireless charging efficiency. As such, first plating layer 123 and

[0067] By adjusting the thickness of the second plating layer 125, thicknesses of the first pattern portion and the second pattern portion (i.e., the second pattern 110 and the second plating layer 125) may be adjusted as necessary.

[0068] Next, a first cover sheet 112 is formed on an upper portion of the first pattern 108 to cover the first pattern 108, and a second cover sheet 114 is formed on a lower portion of the second pattern 110 to cover the second pattern 110 (e) of FIG. 3. Specifically, the first cover sheet 112 may be positioned on the upper portion of the first pattern 108, the second cover sheet 114 may be positioned on the lower portion of the second pattern 110, and the first cover sheet 112 may be formed on the upper portion of the first pattern 108 and the second cover sheet 114 may be formed on the lower portion of the second pattern 110.

[0069] Next, a heat spreading sheet 116 is formed on top of the first cover sheet 112 (f) of FIG. 3. The heat spreading sheet 116 may be adhered to the top of the first cover sheet 112 using double-sided tape or the like.

[0070] FIG. 4 is a view illustrating an example in which a first pattern and a second pattern have different widths in an antenna module according to an exemplary embodiment. FIG. 4 omits the bonding sheets 104 and 106 for convenience of explanation.

[0071] Referring to FIG. 4, the width w_2 of the second pattern 110 formed on the lower surface of the magnetic sheet 102 may be wider than the width w_1 of the first pattern 108 formed on the upper surface of the magnetic sheet 102. Here, when the width of the pattern is formed to be wider, the cross-sectional area of the circuit may be wider to reduce resistance, thereby improving the efficiency of the circuit as a whole. The first plating layer 123 and the second plating layer 125 may be formed to have the same width as that of the first pattern 108 and the second pattern 110, respectively.

[0072] As illustrated herein, the width w_2 of the second pattern 110 is formed to be wider than the width w_1 of the first pattern 108, but exemplary embodiments are not limited thereto, but the width w_1

of the first pattern 108 may be formed to be wider than the width w_2 of the second pattern 110. Further, although it is illustrated herein that the thickness of the first pattern 108 and the thickness of the second pattern 110 are the same, exemplary embodiments are not limited hereto, and the thickness of the first pattern 108 and the thickness of the second pattern 110 may be formed differently from each other.

[0073] Meanwhile, each of the first pattern 108 and the second pattern 110 may be formed to include at least one of NFC pattern, MST pattern, and wpc pattern. Hereinbelow, the first pattern 108 and the second pattern 110 of the antenna module 100 will be described in detail.

[0074] FIG. 5 is a view illustrating a first pattern 108 in an antenna module according to an exemplary embodiment, and FIG. 6 is a view illustrating a second pattern 110 in an antenna module according to an exemplary embodiment. That is, FIG. 5 is a view illustrating a first pattern 108 formed on an upper surface of the magnetic sheet 102, and FIG. 6 is a view illustrating a second pattern 110 formed on a lower surface of the magnetic sheet 102.

[0075] Referring to figs. 5 and 6, the first pattern 108 and the second pattern 110 may include an NFC pattern 130, an MST pattern 140, and a wpc pattern 150, respectively. The NFC pattern 130, the MST pattern 140, and the wpc pattern 150 may be spaced apart from each other in order from the outer periphery of the magnetic sheet 102 inward. That is, the wpc pattern 150 may be formed on a center of the magnetic sheet 102, the MST pattern 140 may be formed on an outer side of the wpc pattern 150, and the NFC pattern 130 may be formed on an outer side of the MST pattern 140.

[0076] Meanwhile, the magnetic sheet 102 may have an approximately rectangular shape. However, the present disclosure is not limited thereto, and various forms may be changed according to the internal structure of the portable terminal on which the antenna module 100 is mounted. Further, the magnetic sheet 102 may have an extended portion 161 formed on one side (upper side in figs. 5 and 6) of the magnetic sheet 102. The extended portions 161 may be extended from one side (left) and the other side (right) of the upper side of the magnetic sheet 102, respectively, and the extended portions may be connected to each other. A hole may be formed inside the extension portion 161 according to an internal structure of the portable terminal. In this case, the extension 161 may be formed in a semicircular arc (or half loop) shape on the upper side of the magnetic sheet 102. A connection portion 162 in which connection terminals of NFC pattern 130, MST pattern 140, and wpc pattern 150 are formed may be formed on one side of extension portion 161.

[0077] Further, the magnetic sheet 102 may be formed with a thermistor 165 capable of measuring a temperature of at least one of the NFC pattern 130, the MST pattern 140, and the wpc pattern 150. When the temperature measured by the thermistor 165 exceeds the predetermined temperature, the current supply to the corresponding pattern may be cut off. As illustrated, the thermistor 165 may be

formed on an upper side of the magnetic sheet 102, but exemplary embodiments are not limited thereto, and the formation position of the thermistor 165 may be variously changed according to need.

[0078] FIG. 7 is a view illustrating a first NFC pattern 130 a formed on an upper surface of a magnetic sheet 102 in an antenna module according to an exemplary embodiment, and FIG. 8 is a view illustrating a second NFC pattern 130 b formed on a lower surface of the magnetic sheet 102 in an antenna module according to an exemplary embodiment.

[0079] Referring to figs. 7 and 8, the first NFC pattern 130 a may include a 1-1 NFC pattern 130 a-1 formed along one side border (e.g., a left border) of the magnetic sheet 102 and a lower border of the magnetic sheet 102, A 1-2 NFC pattern 130 a-2 spaced apart from the 1-1 NFC pattern 130 a-1 and formed in a circular shape at a center of the magnetic sheet 102, and a 1-3 NFC pattern 130 a-3 formed in a diagonal direction from an upper end of one side of the magnetic sheet 102 and connected to the 1-2 NFC pattern 130 a-2.

[0080] The second NFC pattern 130 b may include a second-first NFC pattern 130 b-1 formed along each edge of the magnetic sheet 102 and a second-second NFC pattern 130 b-2 spaced apart from the second-first NFC pattern 130 b-1 and formed in a circular shape at a center of the magnetic sheet 102. The second-second NFC pattern 130 b-2 may be formed corresponding to the first-second NFC pattern 130 a-2. Here, the 1-1 NFC pattern 130 a-1 and the 2-1 NFC pattern 130 b-1 formed on the lower edge of the magnetic sheet 102 may be formed by partially bending according to the shape of the magnetic sheet 102.

[0081] The first NFC pattern 130 a and the second NFC pattern 130 b may be electrically connected through a via hole.

[0082] In an embodiment of the present disclosure, NFC pattern 130 is additionally formed in a central portion of the magnetic sheet 102 as well as in an edge of the magnetic sheet 102, thereby further improving NFC performance. That is, since the first-second NFC pattern 130 a-2 and the second-second NFC pattern 130 b-2 are formed to be spaced apart from the wpc pattern 150 inside the wpc pattern 150 to be described below, the NFC pattern 130 is extended to further improve NFC performance.

[0083] Meanwhile, although figs. 7 and 8 illustrate that the NFC pattern 130 is a one-turn conductive line, this is merely an example for convenience of understanding, and it is of course possible to form a plurality of conductive lines. Further, since the expressions "first" and "second" and the like are intended to distinguish one component from another, a first component may be named a second component, and a second component may be named a first component, as well.

[0084] FIG. 9 is a view illustrating a first MST pattern 140 a formed on an upper surface of a magnetic sheet 102 in an antenna module according to an exemplary embodiment, and FIG. 10 is a view illustrating a second MST pattern 140 b formed on a lower surface of the magnetic sheet 102 in an antenna module according to an exemplary embodiment.

[0085] Referring to figs. 9 and 10, the first MST pattern 140 a may include a 1-1 MST pattern 140 a-1 formed to be spaced apart from the edge of the magnetic sheet 102 by a predetermined distance and formed in a loop shape, and a 1-2 MST pattern 140 a-2 formed in a loop shape on the upper surface and the extension portion 161 of the magnetic sheet 102. The first-first MST pattern 140 a-1 may be spaced apart from each other inside of the first-first NFC pattern 130 a-1. The first-second MST patterns 140 a-2 may be formed by extending from the first-first MST patterns 140 a-1, but exemplary embodiments are not limited hereto, but may be spaced apart from the first-first MST patterns 140 a-1 and coupled to the first-first MST patterns 140 a-1.

[0086] The second MST pattern 140 b may include a second-first MST pattern 140 b-1 formed to be spaced apart from the edge of the magnetic sheet 102 by a predetermined distance and formed in a loop shape, and a second-second MST pattern 140 b-2 formed in a loop shape on the upper surface and the extended portion 161 of the magnetic sheet 102. The second-first MST pattern 140 b-1 may be spaced apart from each other inside of the second-first NFC pattern 130 b-1. The second-second MST pattern 140 b-2 may be formed by extending from the second-first MST pattern 140 b-1, but exemplary embodiments are not limited thereto, but may be spaced apart from the second-first MST pattern 140 b-1 and coupled to the second-first MST pattern 140 b-1. In an example, the first MST pattern 140 a and the second MST pattern 140 b may be electrically connected through a via hole.

[0087] Inner lengths of the first-first MST pattern 140 a-1 and the second-first MST pattern 140 b-1 formed in a loop shape in the transverse direction may be formed to be equal to or less than a diameter of the wpc pattern 150 to be described below. Further, inner lengths of the first-first MST pattern 140 a-1 and the second-first MST pattern 140 b-1 in the lengthwise direction may be formed to be equal to or greater than a diameter of the wpc pattern 150 to be described below.

[0088] This will be explained in detail with reference to FIG. 11. FIG. 11 is a view illustrating a state in which the MST pattern 140 (more specifically, the first MST pattern 140 a) and the wpc pattern 150 are formed on an upper surface of the magnetic sheet 102 according to an exemplary embodiment. Here, although only the upper surface of the magnetic sheet 102 is illustrated for convenience of explanation, patterns formed on the lower surface of the magnetic sheet 102 may be understood as the same.

[0089] Referring to FIG. 11, as an inner length in the transverse direction of the first-first MST pattern 140 a-1 is formed to be equal to or less than a diameter of the wpc pattern 150, the first-first MST pattern 140 a-1 may include a bent portion 141 bent outward in the longitudinal direction of the first-first MST pattern 140 a-1. As described above, by forming the bent portion 141 on the first-first MST pattern 140 a-1, an effect of extending a pattern length by a length corresponding to bending can be obtained while preventing the first-first MST pattern 140 a-1 from overlapping the wpc pattern 150. Further, space utilization can be enhanced by arranging several antenna patterns on the magnetic sheet 102 having a predetermined size.

[0090] Although it is illustrated herein that the inner length of the first-first MST pattern 140 a-1 in the vertical direction is equal to or greater than the diameter of the wpc pattern 150, exemplary embodiments may not be limited hereto, the inner length of the first-first MST pattern 140 a-1 in the vertical direction may also be equal to or less than the diameter of the wpc pattern 150. In this case, the bent portion 141 may be formed in the transverse direction of the first-first MST pattern 140 a-1 so as not to overlap the wpc pattern 150. Further, the bent portions 141 may be formed in each of the transverse direction and the vertical direction of the first-first MST pattern 140 a-1 to prevent overlap with the wpc pattern 150 within a predetermined size of the magnetic sheet 102, while ensuring an electrical length value necessary for a corresponding frequency band.

[0091] Meanwhile, the MST pattern 140 is for payment for replacing a credit card, and when payment is performed through a portable terminal mounted with the antenna module 100, a direction in which the portable terminal approaches a point of Sales (pos) terminal may be different for each user. For example, some users may use the portable terminal in a horizontal direction to access the pos terminal, and other users may use the pos terminal to access the pos terminal with the upper end or the lower end of the portable terminal tilted. As described above, since the direction in which the portable terminal approaches the pos terminal may vary for each deletion, when payment must be made to approach the pos terminal from a specific direction, a user feels discomfort, and thus needs to be made regardless of the access direction of the portable terminal.

[0092] Accordingly, in an embodiment of the present disclosure, the MST pattern 140 may also be formed on the extended portion 161 (i.e., the MST pattern 140 includes the first-second MST pattern 140 a-2 and the second-second MST pattern 140 b-2), and thus payment may be performed using the MST pattern 140 regardless of the approaching direction of the portable terminal.

[0093] That is, as the MST pattern 140 is also formed in the extended portion 161 formed by extending from one side of the magnetic sheet 102 (in other words, the MST pattern 140 is formed to correspond to the entire area of the portable terminal rather than a partial area of the portable terminal), Even if the user tilts an upper end or a lower end of the portable terminal to approach the pos terminal, payment using the MST pattern 140 may be made in each direction.

[0094] FIG. 12 is a view illustrating a first wpc pattern 150 a formed on an upper surface of a magnetic sheet 102 in an antenna module according to an exemplary embodiment, and FIG. 13 is a view illustrating a second wpc pattern 150 b formed on a lower surface of the magnetic sheet 102 in an antenna module according to an exemplary embodiment.

[0095] Referring to figs. 12 and 13, the first wpc pattern 150 a and the second wpc pattern 150 b may each be formed in a circular shape at a center portion of the magnetic sheet 102.

[0096] The first wpc pattern 150 a and the second wpc pattern 150 b may be provided to have a maximum number of turns within the magnetic sheet 102 having a predetermined size, as the number of turns increases, wireless charging efficiency increases. The first wpc pattern 150 a and the second wpc pattern 150 b may be electrically connected through a via hole.

[0097] FIG. 14 is a diagram illustrating a connection in an antenna module according to an illustrative embodiment.

[0098] Referring to FIG. 14, a connection portion 162 may be formed on one side of the extension portion 161. The connection portion 162 may be formed with a first connection terminal 171, a second connection terminal 173, a third connection terminal 175, and a fourth connection terminal 177.

[0099] The first connection terminal 171 may be electrically connected with the NFC pattern 130.

[0100] The second connection terminal 173 may be electrically connected with the MST pattern 140. The third connection terminal 175 may be electrically connected with the wpc pattern 150. The fourth connection terminal 177 may be electrically connected with the thermistor 165.

[0101] Although exemplary embodiments of the present disclosure have been described in detail above, it will be understood by those skilled in the art that various modifications are made to the extent not departing from the scope of the present disclosure. Therefore, the scope of the present invention should not be limited to the embodiments described above, but should not be limited by the claims described below, but also by those equivalent thereto.

(12) 특허협력조약에 의하여 공개된 국제출원

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- (71) 출원인: 주식회사 이엠파블류 (EMW CO., LTD.) [KR/KR]; 21695 인천시 남동구 남동서로 155, Incheon (KR).
- (72) 발명자: 성원모 (SEONG, Won Mo); 14101 경기도 안양시 동안구 부림로 34, 204동 601호(평촌동,꿈마울우성아파트), Gyeonggi-do (KR). 오정한 (OH, Jung Han); 16546 경기도 수원시 영통구 동수원로 316, 1동 104호(매탄3동, 임광아파트), Gyeonggi-do (KR). 장성일 (JANG, Sung Il); 21085 인천시 계양구 주부도로 442, 101동 403호 (작전동, 상록파라브아파트), Incheon (KR).
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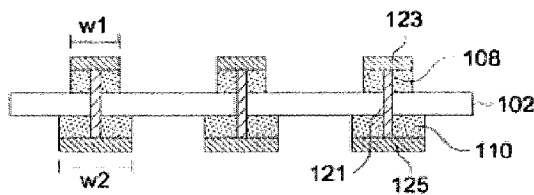
공개:

— 국제조사보고서와 함께 (조약 제21조(3))

(54) Title: ANTENNA MODULE, METHOD FOR MANUFACTURING SAME, AND MOBILE TERMINAL COMPRISING SAME

(54) 발명의 명칭: 안테나 모듈과 그 제조 방법 및 이를 구비한 휴대용 단말기

[도4]



(57) Abstract: Disclosed are an antenna module, a method for manufacturing the same, and a mobile terminal comprising the same. The antenna module according to an exemplary embodiment comprises: a magnetic sheet; a first pattern formed on one surface of the magnetic sheet; a first cover sheet formed to cover the first pattern on the one surface of the magnetic sheet; a second pattern formed on the other surface of the magnetic sheet; a second cover sheet formed to cover the second pattern on the other surface of the magnetic sheet; and at least one via hole, formed through the first pattern, the magnetic sheet, and the second pattern, for electrically connecting the first pattern to the second pattern.

(57) 요약서: 안테나 모듈과 그 제조 방법 및 이를 구비한 휴대용 단말기가 개시된다. 예시적인 실시예에 따른 안테나 모듈은, 자성 시트, 자성 시트의 일면에 형성되는 제1 패턴, 자성 시트의 일면 상에서 제1 패턴을 감싸며 형성되는 제1 커버 시트, 자성 시트의 타면에 형성되는 제2 패턴, 자성 시트의 타면 상에서 제2 패턴을 감싸며 형성되는 제2 커버 시트; 및 제1 패턴, 자성 시트, 및 제2 패턴을 관통하여 형성되고 제1 패턴과 제2 패턴을 전기적으로 연결시키는 적어도 하나의 비아 홀을 포함한다.



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명세서

발명의 명칭: 안테나 모듈과 그 제조 방법 및 이를 구비한 휴대용 단말기

기술분야

- [1] 본 발명의 실시예는 안테나 기술과 관련된다.

배경기술

- [2] 일반적으로, NFC(Near Field Communication: 근거리 무선 통신) 기술은 13.56Mhz, 125Mhz, 135Mhz, 900Mhz 대역 등의 주파수를 사용하여 근거리에서 낮은 전력으로 데이터를 전송할 수 있는 비접촉식 근거리 무선통신 기술로서, ISO 18092에 표준으로 규정되어 있다. NFC 기술은 교통 카드 결제 시스템이나 음식 요금 정산 시스템 등에 사용되고 있다.
- [3] 또한, 최근에는 스마트 폰 등 지능형 모바일 단말기 및 태블릿 PC의 사용이 보편화되면서, 사용자에게 보다 다양하고 새로운 서비스를 제공하기 위해 모바일 기기 전용의 다양한 어플리케이션이 제공되고 있으며, 이러한 어플리케이션 중에는 NFC 기술과 연동을 요하는 종류도 있다. 예를 들어, 스마트 폰의 어플리케이션과 NFC의 연동을 통해 전자 결제 시스템의 서비스를 제공할 수 있다.
- [4] 또한, 근래에 들어서 각광받고 있는 무선 충전 기술은 충전기의 커넥터와 휴대용 단말기의 커넥터를 직접 연결하지 않고, 휴대용 단말기를 충전기에 올려놓거나 충전기의 부근에 배치하는 것으로 충전이 이루어지는 것이다. 이는 전자기 유도방식에 의한 것으로 인접하게 배치된 두 개의 코일 패턴 간에 유도 전류를 발생시켜 충전하게 된다.
- [5] 여기서, NFC 안테나 모듈 및 무선 충전 안테나 모듈은, 도 1에 도시된 바와 같이, FPCB(10) 및 페라이트 시트(20)의 합지에 의해 형성된다. 이때, FPCB(10)에는 패턴(11)이 형성되는데, NFC 안테나 모듈의 경우 상기 패턴(11)이 근거리 통신을 위한 방사체로 사용되고, 무선 충전 안테나 모듈의 경우 상기 패턴(11)이 유도 전류를 발생시키는 코일로 사용된다.
- [6] 상기와 같은 종래의 NFC 안테나 모듈 및 무선 충전 안테나 모듈은 FPCB(10)에 패턴(11)이 형성되어 있기 때문에, FPCB(10)의 두께만큼 모듈 자체의 두께가 두꺼워지는 경향이 있다. 이에 따라, NFC 안테나 모듈 및 무선 충전 안테나모듈이 탑재되는 휴대용 단말기의 두께 또한 증가하는 문제점이 있다.

발명의 상세한 설명

기술적 과제

- [7] 본 발명의 실시예는 전체 두께 및 부품을 줄이고 제조 공정을 간소화 할 수 있는 안테나 모듈과 그 제조 방법 및 이를 구비한 휴대용 단말기를 제공하기 위한 것이다.

- [8] 본 발명의 실시예는 자성 시트에 복수 개의 안테나 패턴을 형성하여 공간 활용성을 높일 수 있는 안테나 모듈과 그 제조 방법 및 이를 구비한 휴대용 단말기를 제공하기 위한 것이다.

과제 해결 수단

- [9] 예시적인 실시예에 따른 안테나 모듈은, 자성 시트; 상기 자성 시트의 일면에 형성되는 제1 패턴; 상기 자성 시트의 일면 상에서 상기 제1 패턴을 감싸며 형성되는 제1 커버 시트; 상기 자성 시트의 타면에 형성되는 제2 패턴; 상기 자성 시트의 타면 상에서 상기 제2 패턴을 감싸며 형성되는 제2 커버 시트; 및 상기 제1 패턴, 상기 자성 시트, 및 상기 제2 패턴을 관통하여 형성되고 상기 제1 패턴과 상기 제2 패턴을 전기적으로 연결시키는 적어도 하나의 비아 홀을 포함한다.
- [10] 상기 제1 패턴 및 상기 제2 패턴은 각각, 일측 단부가 상기 자성 시트의 가장 자리를 벗어나 상기 자성 시트의 외측으로 연장되며, 상기 외측으로 연장된 부분에 접속 단자가 형성될 수 있다.
- [11] 상기 제1 패턴 및 상기 제2 패턴은, 두께 및 폭 중 적어도 하나가 다르게 형성될 수 있다.
- [12] 상기 제1 패턴 및 상기 제2 패턴은 각각, NFC(Near Field Communication) 패턴, MST(Magnetic Secure Transmission) 패턴, 및 WPC(Wireless Power Charge) 패턴 중 적어도 2개의 패턴을 포함하고, 상기 적어도 2개의 패턴은 각각 상호 이격되어 형성될 수 있다.
- [13] 상기 제1 패턴 및 상기 제2 패턴은 각각, 상기 NFC 패턴, 상기 MST 패턴, 및 상기 WPC 패턴을 포함하고, 상기 NFC 패턴, 상기 MST 패턴, 및 상기 WPC 패턴은, 상기 자성 시트의 외곽으로부터 안쪽으로 순서대로 형성될 수 있다.
- [14] 상기 NFC 패턴은, 상기 자성 시트의 테두리의 적어도 일 구간을 따라 형성되는 제1 NFC 패턴 및 상기 WPC 패턴의 내측에서 상기 WPC 패턴과 이격되어 형성되는 제2 NFC 패턴을 포함할 수 있다.
- [15] 상기 MST 패턴은, 상기 자성 시트의 테두리에서 소정 거리 이격되어 루프 형태로 형성되고, 상기 MST 패턴의 가로 방향의 내측 길이 및 상기 MST 패턴의 세로 방향의 내측 길이 중 적어도 하나는 상기 WPC 패턴의 지름 이하로 형성되며, 상기 MST 패턴의 가로 방향 및 세로 방향 중 상기 WPC 패턴의 지름 이하로 형성되는 방향과 수직하는 방향에는 상기 WPC 패턴과 겹치지 않도록 일부분이 외측으로 굴곡된 굴곡부가 형성될 수 있다.
- [16] 상기 자성 시트는, 상기 자성 시트의 일측에서 연장되어 형성되는 연장부를 더 포함하며, 상기 MST 패턴은, 상기 자성 시트에 형성되는 제1 MST 패턴 및 상기 연장부에 형성되는 제2 MST 패턴을 포함할 수 있다.
- [17] 상기 자성 시트는, 상기 연장부의 일측에 형성되는 접속부를 더 포함하고, 상기 접속부는, 상기 NFC 패턴과 전기적으로 연결되는 제1 접속 단자; 상기 MST

패턴과 전기적으로 연결되는 제2 접속 단자; 및 상기 WPC 패턴과 전기적으로 연결되는 제3 접속 단자를 포함할 수 있다.

- [18] 상기 안테나 모듈은, 상기 자성 시트에 형성되고 상기 NFC 패턴, 상기 MST 패턴, 및 상기 WPC 패턴 중 적어도 하나의 온도를 측정하는 써미스터를 더 포함할 수 있다.
- [19] 예시적인 실시예에 따른 안테나 모듈의 제조 방법은, 자성 시트의 일면 및 타면에 각각 제1 금속 박막 및 제2 금속 박막을 형성하는 단계; 상기 제1 금속 박막 및 상기 제2 금속 박막을 전기적으로 연결하는 비아 홀을 형성하는 단계; 상기 제1 금속 박막 및 상기 제2 금속 박막의 일부를 제거하여 상기 자성 시트의 일면 및 타면에 각각 제1 패턴 및 제2 패턴을 형성하는 단계; 상기 자성 시트의 일면 상에서 상기 제1 패턴을 감싸며 제1 커버 시트를 형성하는 단계; 및 상기 자성 시트의 타면 상에서 상기 제2 패턴을 감싸며 제2 커버 시트를 형성하는 단계를 포함한다.
- [20] 상기 제1 금속 박막 및 제2 금속 박막을 형성하는 단계는, 상기 자성 시트의 일면에 제1 본딩 시트를 통해 상기 제1 금속 박막을 접착시키는 단계;
- [21] 및 상기 자성 시트의 타면에 제2 본딩 시트를 통해 상기 제2 금속 박막을 접착시키는 단계를 포함할 수 있다.
- [22] 상기 제1 패턴 및 제2 패턴을 형성하는 단계는, 상기 제1 패턴 및 상기 제2 패턴의 폭 및 두께 중 적어도 하나를 서로 다르게 형성할 수 있다.
- [23] 상기 제1 패턴 및 제2 패턴을 형성하는 단계 이후에, 상기 제1 패턴에 제1 도금층을 형성하는 단계; 및 상기 제2 패턴에 제2 도금층을 형성하는 단계를 더 포함하고, 상기 제1 도금층 및 상기 제2 도금층은, 두께가 서로 다르게 형성될 수 있다.

발명의 효과

- [24] 본 발명의 실시예에 의하면, 안테나 패턴을 FPCB(Flexible Printed Circuit Board)에 형성한 후 자성 시트와 합지하는 것이 아니라, 안테나 패턴을 자성 시트에 바로 형성하기 때문에, 안테나 모듈의 두께를 줄일 수 있으며, 안테나 모듈에 사용되는 부품을 줄일 수 있고, 안테나 모듈의 전체 제조 공정을 간소화할 수 있게 된다. 즉, 자성 시트가 안테나 패턴의 지지 부재 역할도 하게 되므로, 별도의 지지 부재(예를 들어, FPCB 등)가 필요 없게 되며, 그로 인해 안테나 모듈의 두께를 줄이고 부품 수를 줄일 수 있게 된다. 또한, FPCB와 자성 시트를 합지하는 공정을 생략할 수 있으므로 안테나 모듈의 전체 제조 공정도 간소화할 수 있게 된다. 또한, 자성 시트에 NFC 패턴, MST 패턴, 및 WPC 패턴을 모두 형성함으로써, 공간 활용성을 높이면서 각 안테나의 개별 성능을 효과적으로 구현할 수 있다.

도면의 간단한 설명

- [25] 도 1은 종래의 FPCB와 페라이트 시트가 합지되는 상태를 나타낸 도면

- [26] 도 2는 예시적인 실시예에 따른 안테나 모듈의 분해 사시도를 나타낸 도면
- [27] 도 3은 예시적인 실시예에 따른 안테나 모듈의 제조 방법을 나타낸 순서도
- [28] 도 4는 예시적인 실시예에 따른 안테나 모듈에서 제1 패턴 및 제2 패턴이 서로 다른 쪽을 갖는 경우를 나타낸 도면
- [29] 도 5는 예시적인 실시예에 따른 안테나 모듈에서 제1 패턴을 나타낸 도면
- [30] 도 6은 예시적인 실시예에 따른 안테나 모듈에서 제2 패턴을 나타낸 도면
- [31] 도 7은 예시적인 실시예에 따른 안테나 모듈에서 자성 시트의 상면에 형성되는 제1 NFC 패턴을 나타낸 도면
- [32] 도 8은 예시적인 실시예에 따른 안테나 모듈에서 자성 시트의 하면에 형성되는 제2 NFC 패턴을 나타낸 도면
- [33] 도 9는 예시적인 실시예에 따른 안테나 모듈에서 자성 시트의 상면에 형성되는 제1 MST 패턴을 나타낸 도면
- [34] 도 10은 예시적인 실시예에 따른 안테나 모듈에서 자성 시트의 하면에 형성되는 제2 MST 패턴을 나타낸 도면
- [35] 도 11은 예시적인 실시예에 따른 자성 시트의 상면에 MST 패턴 및 WPC 패턴이 형성된 상태를 나타낸 도면
- [36] 도 12는 예시적인 실시예에 따른 안테나 모듈에서 자성 시트의 상면에 형성되는 제1 WPC 패턴을 나타낸 도면
- [37] 도 13은 예시적인 실시예에 따른 안테나 모듈에서 자성 시트의 하면에 형성되는 제2 WPC 패턴을 나타낸 도면도 14는 예시적인 실시예에 따른 안테나 모듈에서 접속부를 나타낸 도면

[38]

발명의 실시를 위한 형태

- [39] 이하, 도면을 참조하여 본 발명의 구체적인 실시형태를 설명하기로 한다. 이하의 상세한 설명은 본 명세서에서 기술된 방법, 장치 및/또는 시스템에 대한 포괄적인 이해를 돕기 위해 제공된다. 그러나 이는 예시에 불과하며 본 발명은 이에 제한되지 않는다.
- [40] 본 발명의 실시예들을 설명함에 있어서, 본 발명과 관련된 공지기술에 대한 구체적인 설명이 본 발명의 요지를 불필요하게 흐릴 수 있다고 판단되는 경우에는 그 상세한 설명을 생략하기로 한다. 그리고, 후술되는 용어들은 본 발명에서의 기능을 고려하여 정의된 용어들로서 이는 사용자, 운용자의 의도 또는 관례등에 따라 달라질 수 있다. 그러므로 그 정의는 본 명세서 전반에 걸친 내용을 토대로 내려져야 할 것이다. 상세한 설명에서 사용되는 용어는 단지 본 발명의 실시예들을 기술하기 위한 것이며, 결코 제한적이지 않는 한, 단수 형태의 표현은 복수 형태의 의미를 포함한다. 본 설명에서, "포함" 또는 "구비"와 같은 표현은 어떤 특성들, 숫자들, 단계들, 동작들, 요소들, 이들의 일부 또는 조합을 가리키기 위한 것이며, 기술된

것 이외에 하나 또는 그 이상의 다른 특성, 숫자, 단계, 동작, 요소, 이들의 일부 또는 조합의 존재 또는가능성을 배제하도록 해석되어서는 안 된다.

- [41] 한편, 상측, 하측, 일측, 타측 등과 같은 방향성 용어는 개시된 도면들의 배향과 관련하여 사용된다. 본 발명의 실시예의 구성 요소는 다양한 배향으로 위치 설정될 수 있으므로, 방향성 용어는 예시를 목적으로 사용되는 것이지 이를 제한하는 것은 아니다. 또한, 제1, 제2 등의 용어는 다양한 구성 요소들을 설명하는데 사용될 수 있지만, 상기 구성 요소들은 상기 용어들에 의해 한정되어서는안 된다. 상기 용어들은 하나의 구성 요소를 다른 구성 요소로부터 구별하는 목적으로 사용될 수 있다. 예를 들어, 본 발명의 권리 범위를 벗어나지 않으면서 제1 구성 요소는 제2 구성 요소로 명명될 수 있고, 유사하게 제2 구성 요소도 제1 구성 요소로 명명될 수 있다.
- [42] 도 2는 예시적인 실시예에 따른 안테나 모듈의 분해 사시도를 나타낸 도면이다.
- [43] 도 2를 참조하면, 안테나 모듈(100)은 자성 시트(102), 제1 본딩 시트(104), 제2 본딩 시트(106), 제1 패턴(108), 제2 패턴(110), 제1 커버 시트(112), 제2 커버 시트(114), 및 열 확산 시트(116)를 포함할 수 있다.
- [44] 자성 시트(102)는 제1 패턴(108) 및 제2 패턴(110)에 전류가 흐르는 경우 자화되는 특성을 가지는 물질로 이루어질 수 있다. 예를 들어, 자성 시트(102)는 페라이트(Ferrite), 나노 크리스탈(Nano Crystal), 아모폴스(Amorphous), 퍼몰로이, 폴리머 메탈 중 적어도 하나를 포함하여 이루어질 수 있다.
- [45] 제1 본딩 시트(104)의 하면은 자성 시트(102)의 상면에 접촉될 수 있다. 제1 본딩 시트(104)는 제1 패턴(108)을 자성 시트(102)의 상면에 접촉시키는 역할을 한다.
- [46] 제2 본딩 시트(106)의 상면은 자성 시트(102)의 하면에 접촉될 수 있다. 제2 본딩 시트(106)는 제2 패턴(110)을 자성 시트(102)의 하면에 접촉시키는 역할을 한다.
- [47] 제1 패턴(108)은 제1 본딩 시트(104)의 상면에 접촉될 수 있다. 제1 패턴(108)은 제1 본딩 시트(104)에 의해 자성 시트(102)의 상면에 바로 접촉된다.
- [48] 제1 패턴(108)은 안테나 패턴으로서, 서로 다른 주파수 대역의 복수 개의 패턴을 포함할 수 있다. 예시적인 실시예에서, 제1 패턴(108)은 NFC(Near Field Communication) 패턴, MST(Magnetic Secure Transmission) 패턴, 및 WPC(Wireless Power Charge) 패턴을 포함할 수 있다.
- [49] 제2 패턴(110)은 제2 본딩 시트(106)의 하면에 접촉될 수 있다. 제2 패턴(110)은 제2 본딩 시트(106)에 의해 자성 시트(102)의 하면에 바로 접촉된다.
- [51] 제2 패턴(110)은 안테나 패턴으로서, 서로 다른 주파수 대역의 복수 개의 패턴을 포함할 수 있다. 예시적인 실시예에서, 제2 패턴(110)은 NFC(Near Field Communication) 패턴, MST(Magnetic Secure Transmission) 패턴, 및 WPC(Wireless Power Charge) 패턴을 포함할 수 있다.
- [52] 즉, 안테나 모듈(100)은 NFC 패턴, MST 패턴, 및 WPC 패턴을 포함하며, NFC

패턴, MST 패턴, 및 WPC 패턴은 본딩 시트(104, 106)에 의해 자성 시트(102)의 상면 및 하면에 각각 형성될 수 있다. 제1 패턴(108) 및 제2 패턴(110)에는 각각 도금층(미도시)이 형성될 수 있다. 또한, 제1 패턴(108) 및 제2 패턴(110)은 자성 시트(102)를 관통하며 형성되는 비아홀(미도시)을 통해 전기적으로 연결될 수 있다.

- [54] 제1 커버 시트(112)는 제1 패턴(108)의 상부에 형성될 수 있다. 제1 커버 시트(112)는 제1 패턴(108)을 외부 환경으로부터 보호하는 역할을 한다. 제1 커버 시트(112)는 제1 본딩 시트(104)의 상면에 접촉되면서 제1 패턴(108)을 커버 할 수 있다.
- [55] 제2 커버 시트(114)는 제2 패턴(110)의 하부에 형성될 수 있다. 제2 커버 시트(114)는 제2 패턴(110)을 외부 환경으로부터 보호하는 역할을 한다. 제2 커버 시트(114)는 제2 본딩 시트(106)의 하면에 접촉되면서 제2 패턴(110)을 커버 할 수 있다.
- [56] 열 확산 시트(116)는 제1 커버 시트(112)의 상부에 형성될 수 있다.
- [57] 열 확산 시트(116)는 제1 커버 시트(112)의 상부에서 양면 접착 테이프(117)를 통해 제1 커버 시트(112)에 접촉될 수 있다. 열 확산 시트(116)는 안테나 모듈(100)에서 발생하는 열을 외부로 방출하는 역할을 할 수 있다. 열 확산 시트(116)는 열전도성이 우수한 재질(예를 들어, 그래파이트(Graphite) 등)로 이루어질 수 있다.
- [58] 여기서는, 열 확산 시트(116)가 제1 커버 시트(112)의 상부에 형성되는 것으로 설명하였으나, 이에 한정되는 것은 아니며 제1 커버 시트(112) 없이 열 확산 시트(116)가 제1 패턴(108)을 커버하며 형성될 수도 있다. 또한, 열 확산 시트(116)는 제2 커버 시트(114)의 하부에 형성되거나 제2 커버 시트(114) 없이 제2 패턴(110)을 커버하며 형성될 수도 있다.
- [59] 또한, 안테나 모듈(100)은 제2 커버 시트(114)의 하부에 형성되는 캐리어(118)를 더 포함할 수 있다. 캐리어(118)는 안테나 모듈(100)을 핸들링 하는데 사용될 수 있다. 캐리어(118)에는 안테나 패턴의 접점을 보강하기 위한 접점 보강부(119)가 형성될 수 있다.
- [60] 본 발명의 실시예에 의하면, 안테나 패턴을 FPCB(Flexible Printed Circuit Board)에 형성한 후 자성 시트와 합지하는 것이 아니라, 안테나 패턴을 자성 시트에 바로 형성하기 때문에, 안테나 모듈의 두께를 줄일 수 있으며, 안테나 모듈에 사용되는 부품을 줄일 수 있고, 안테나 모듈의 전체 제조 공정을 간소화 할 수 있게 된다. 즉, 자성 시트가 안테나 패턴의 지지 부재 역할도 하게 되므로, 별도의 지지 부재(예를 들어, FPCB 등)가 필요 없게 되며, 그로 인해 안테나 모듈의 두께를 줄이고 부품 수를 줄일 수 있게 된다. 또한, FPCB와 자성 시트를 합지하는 공정을 생략할 수 있으므로 안테나 모듈의 전체 제조 공정도 간소화 할 수 있게 된다.
- [61] 도 3은 예시적인 실시예에 따른 안테나 모듈의 제조 방법을 나타낸 순서도이다.

- [62] 먼저, 자성 시트(102)의 상면 및 하면에 각각 제1 금속 박막(108a) 및 제2 금속 박막(110a)을 형성한다(도 3의 (a)). 구체적으로, 자성 시트(102)의 상면에 제1 본딩 시트(104)를 통해 제1 금속 박막(108a)을 접착시키고, 자성 시트(102)의 하면에 제2 본딩 시트(106)를 통해 제2 금속 박막(110a)을 접착시킬 수 있다. 이때, 제1 금속 박막(108a) 및 제2 금속 박막(110a)의 일측 단부가 자성 시트(102)의 가장 자리를 벗어나 외측으로 연장되도록 접착시킬 수 있다. 제1 금속 박막(108a) 및 제2 금속 박막(110a)에서 자성 시트(102)의 외측으로 연장된 부분에는 접속 단자가 각각 형성될 수 있다.
- [63] 다음으로, 제1 금속 박막(108a) 및 제2 금속 박막(110a)을 전기적으로 연결하는 비아 홀(121)을 형성한다(도 3의 (b)). 구체적으로, 제1 금속 박막(108a) 및 제2 금속 박막(110a)을 전기적으로 연결할 부위에 제1 금속 박막(108a), 자성 시트(102), 및 제2 금속 박막(110a)을 관통하는 관통홀을 형성한 후, 관통홀 내부를 전도성 물질로 충전하여 비아 홀(121)을 형성할 수 있다. 이때, 관통홀의 내벽을 도금하여 제1 금속 박막(108a)과 제2 금속 박막(110a)을 전기적으로 연결할 수도 있다.
- [64] 다음으로, 제1 금속 박막(108a) 및 제2 금속 박막(110a)의 일부를 에칭하여 자성 시트(102)의 상면 및 하면에 각각 제1 패턴(108) 및 제2 패턴(110)을 형성한다(도 3의 (c)). 여기서는 편의상 제1 패턴(108) 및 제2 패턴(110)을 패턴 형태로 도시하지 않고 박막 형태로 도시하였다. 제1 패턴(108) 및 제2 패턴(110)은 포토리소그래피 공정을 통해 형성할 수 있다. 제1 패턴(108) 및 제2 패턴(110)은 각각 NFC 패턴, MST 패턴, 및 WPC 패턴을 포함하도록 형성될 수 있다. 제1 패턴(108) 및 제2 패턴(110)의 폭 및 두께는 각각 동일하게 형성될 수 있다. 그러나, 이에 한정되는 것은 아니며 제1 패턴(108) 및 제2 패턴(110)의 폭 및 두께 중 적어도 하나가 다르게 형성될 수도 있다. 이 경우, 자성 시트(102)가 제1 패턴(108) 및 제2 패턴(110)을 지지하는 지지 부재(예를 들어, 기판)의 역할도 하게 된다.
- [65] 여기서, 제1 패턴(108) 및 제2 패턴(110)은 자성 시트(102)의 상면 및 하면에 각각 형성되고 비아 홀(121)에 의해 전기적으로 연결됨에 따라, 제1 패턴(108) 및 제2 패턴(110)의 자성 시트(102)의 외측으로 연장된 부분에 형성되는 각 접속 단자가 서로 접촉되지 않으므로, 전기적 쇼트를 방지할 수 있게 된다.
- [66] 다음으로, 제1 패턴(108)의 상면에 제1 도금층(123)을 형성하고, 제2 패턴(110)의 하면에 제2 도금층(125)을 형성한다(도 3의 (d)). 제1 도금층(123) 및 제2 도금층(125)은 동일한 두께로 형성될 수도 있고 필요에 따라 다른 두께로 형성될 수도 있다. 예를 들어, 제1 패턴(108) 및 제2 패턴(110)의 두께가 동일한 상태에서, 제1 도금층(123)을 제2 도금층(125)보다 두껍게 형성할 수 있다. 이 경우, 제1 패턴부(즉, 제1 패턴(108) 및 제1 도금층(123))의 전체 두께가 두꺼워져 방사 효율 또는 무선 충전 효율이 증가하게 된다. 이와 같이, 제1 도금층(123) 및
- [67] 제2 도금층(125)의 두께를 조절함에 따라 제1 패턴부 및 제2 패턴부(즉, 제2

패턴(110) 및 제2 도금층(125))의 두께를 필요에 따라 조절할 수 있게 된다.

- [68] 다음으로, 제1 패턴(108)의 상부에 제1 패턴(108)을 커버하며 제1 커버 시트(112)를 형성하고, 제2 패턴(110)의 하부에 제2 패턴(110)을 커버하며 제2 커버 시트(114)를 형성한다(도 3의 (e)). 구체적으로, 제1 패턴(108)의 상부에 제1 커버 시트(112)를 위치시키고, 제2 패턴(110)의 하부에 제2 커버 시트(114)를 위치시킨 후, 핫 프레스 공정을 수행하여 제1 패턴(108)의 상부에 제1 커버 시트(112)를 형성하고, 제2 패턴(110)의 하부에 제2 커버 시트(114)를 형성할 수 있다.
- [69] 다음으로, 제1 커버 시트(112) 상부에 열 확산 시트(116)를 형성한다(도 3의 (f)). 열 확산 시트(116)는 양면 테이프 등을 이용하여 제1 커버 시트(112)의 상부에 접착시킬 수 있다.
- [70] 도 4는 예시적인 실시예에 따른 안테나 모듈에서 제1 패턴 및 제2 패턴이 서로 다른 폭을 갖는 경우를 나타낸 도면이다. 도 4에서는 설명의 편의상 본딩 시트(104, 106)는 생략하였다.
- [71] 도 4를 참조하면, 자성 시트(102)의 상면에 형성되는 제1 패턴(108)의 폭(w1)에 비해 자성 시트(102)의 하면에 형성되는 제2 패턴(110)의 폭(w2)이 넓게 형성될 수 있다. 여기서, 패턴의 폭이 넓게 형성되면 회로의 단면적이 넓어져 저항을 줄일 수 있으므로, 회로 전체의 효율을 개선할 수 있게 된다. 제1 도금층(123) 및 제2 도금층(125)은 각각 제1 패턴(108) 및 제2 패턴(110)의 폭과 동일한 폭으로 형성될 수 있다.
- [72] 여기서, 제2 패턴(110)의 폭(w2)을 제1 패턴(108)의 폭(w1)보다 넓게 형성한 것을 도시하였으나, 이에 한정되는 것은 아니며 제1 패턴(108)의 폭(w1)을 제2 패턴(110)의 폭(w2) 보다 넓게 형성할 수도 있다. 또한, 여기서, 제1 패턴(108)의 두께와 제2 패턴(110)의 두께가 동일한 것으로 도시하였으나, 이에 한정되는 것은 아니며 제1 패턴(108)의 두께와 제2 패턴(110)의 두께를 서로 다르게 형성할 수도 있다.
- [73] 한편, 제1 패턴(108) 및 제2 패턴(110)은 각각 NFC 패턴, MST 패턴, 및 WPC 패턴 중 적어도 하나를 포함하도록 형성될 수 있다. 이하에서는 안테나 모듈(100)의 제1 패턴(108) 및 제2 패턴(110)에 대해 상세히 설명하기로 한다.
- [74] 도 5는 예시적인 실시예에 따른 안테나 모듈에서 제1 패턴(108)을 나타낸 도면이고, 도 6은 예시적인 실시예에 따른 안테나 모듈에서 제2 패턴(110)을 나타낸 도면이다. 즉, 도 5는 자성 시트(102)의 상면에 형성되는 제1 패턴(108)을 나타낸 도면이고, 도 6은 자성 시트(102)의 하면에 형성되는 제2 패턴(110)을 나타낸 도면이다.
- [75] 도 5 및 도 6을 참조하면, 제1 패턴(108) 및 제2 패턴(110)은 NFC 패턴(130), MST 패턴(140), 및 WPC 패턴(150)을 각각 포함할 수 있다. NFC 패턴(130), MST 패턴(140), 및 WPC 패턴(150)은 자성 시트(102)의 외곽으로부터 안쪽으로 순서대로 상호 이격되어 형성될 수 있다. 즉, WPC 패턴(150)이 자성 시트(102)의

중심부에 형성되고, WPC 패턴(150)의 외측에 MST 패턴(140)이 형성되며, MST 패턴(140)의 외측에 NFC 패턴(130)이 형성될 수 있다.

- [76] 한편, 자성 시트(102)는 대략적으로 직사각형 형태로 이루어질 수 있다. 그러나, 이에 한정되는 것은 아니며 안테나 모듈(100)이 실장되는 휴대용 단말기의 내부 구조에 따라 다양한 형태로 변경될 수 있다. 또한, 자성 시트(102)는 자성 시트(102)의 일측(도 5 및 도 6에서는 상측)에 연장부(161)가 형성될 수 있다. 연장부(161)는 자성 시트(102)의 상측의 일측(좌측) 및 타측(우측)에서 각각 연장되고 각 연장된 부분이 상호 연결되어 이루어질 수 있다. 연장부(161)의 내측에는 휴대용 단말기의 내부 구조에 따라 홀이 형성될 수 있다. 이 경우, 연장부(161)는 자성 시트(102)의 상측에서 반원호(또는 하프 루프) 형상으로 형성될 수 있다. 연장부(161)의 일측에는 NFC 패턴(130), MST 패턴(140), 및 WPC 패턴(150)의 접속 단자가 형성되는 접속부(162)가 형성될 수 있다.
- [77] 또한, 자성 시트(102)에는 NFC 패턴(130), MST 패턴(140), 및 WPC 패턴(150) 중 적어도 하나의 온도를 측정할 수 있는 써미스터(Thermistor)(165)가 형성될 수 있다. 써미스터(165)가 측정한 온도가 기 설정된 온도를 초과하는 경우, 해당 패턴으로의 전류 공급을 차단할 수 있다. 써미스터(165)는 자성 시트(102)의 상측에 형성되는 것으로 도시하였으나, 이에 한정되는 것은 아니며 써미스터(165)의 형성 위치는 필요에 따라 다양하게 변경할 수 있다.
- [78] 도 7은 예시적인 실시예에 따른 안테나 모듈에서 자성 시트(102)의 상면에 형성되는 제1 NFC 패턴(130a)을 나타낸 도면이고, 도 8은 예시적인 실시예에 따른 안테나 모듈에서 자성 시트(102)의 하면에 형성되는 제2 NFC 패턴(130b)을 나타낸 도면이다.
- [79] 도 7 및 도 8을 참조하면, 제1 NFC 패턴(130a)은 자성 시트(102)의 일측 테두리(예를 들어, 좌측 테두리) 및 자성 시트(102)의 하측 테두리를 따라 형성되는 제1-1 NFC 패턴(130a-1), 제1-1 NFC 패턴(130a-1)과 이격되고 자성 시트(102)의 중앙부에 원 형상으로 형성되는 제1-2 NFC 패턴(130a-2), 및 자성 시트(102)의 일측 상단에서 타측 하단의 대각선 방향으로 형성되어 제1-2 NFC 패턴(130a-2)과 연결되는 제1-3 NFC 패턴(130a-3)을 포함할 수 있다.
- [80] 제2 NFC 패턴(130b)은 자성 시트(102)의 각 테두리를 따라 형성되는 제2-1 NFC 패턴(130b-1) 및 제2-1 NFC 패턴(130b-1)과 이격되고 자성 시트(102)의 중앙부에 원 형상으로 형성되는 제2-2 NFC 패턴(130b-2)을 포함할 수 있다. 제2-2 NFC 패턴(130b-2)은 제1-2 NFC 패턴(130a-2)과 대응하여 형성될 수 있다. 여기서, 자성 시트(102)의 하측 테두리에 형성되는 제1-1 NFC 패턴(130a-1) 및 제2-1 NFC 패턴(130b-1)은 자성 시트(102)의 형상에 따라 일부가 절곡되어 형성될 수 있다.
- [81] 제1 NFC 패턴(130a) 및 제2 NFC 패턴(130b)은 비아홀을 통해 전기적으로 연결될 수 있다.
- [82] 본 발명의 실시예에서는, NFC 패턴(130)을 자성 시트(102)의 테두리뿐만

아니라 자성 시트(102)의 중앙부에도 추가로 형성함으로써, NFC 성능을 보다 향상시킬 수 있게 된다. 즉, 제1-2 NFC 패턴(130a-2) 및 제2-2 NFC 패턴(130b-2)이 후술할 WPC 패턴(150)의 내측에서 WPC 패턴(150)과 이격되어 형성됨으로써, NFC 패턴(130)이 연장되어 NFC 성능을 보다 향상시킬 수 있게 된다.

- [83] 한편, 도 7 및 도 8에서는 NFC 패턴(130)이 한 턴(Turn)의 도전성 라인인 것으로 도시되어 있으나, 이는 이해의 편의를 돕기 위한 예시적인 것일 뿐, 복수의 도전성 라인으로 형성할 수 있음은 물론이다. 또한, 본 명세서에서 “제1” 및 “제2” 등의 표현은 일 구성을 다른 구성과 구별하기 위한 것이므로, 제1 구성 요소는 제2 구성 요소로 명명될 수 있고, 제2 구성 요소도 제1 구성 요소로 명명될 수 있다.
- [84] 도 9는 예시적인 실시예에 따른 안테나 모듈에서 자성 시트(102)의 상면에 형성되는 제1 MST 패턴(140a)을 나타낸 도면이고, 도 10은 예시적인 실시예에 따른 안테나 모듈에서 자성 시트(102)의 하면에 형성되는 제2 MST 패턴(140b)을 나타낸 도면이다.
- [85] 도 9 및 도 10을 참조하면, 제1 MST 패턴(140a)은 자성 시트(102)의 테두리에서 소정 거리 이격되어 형성되고 루프 형태로 형성되는 제1-1 MST 패턴(140a-1) 및 자성 시트(102)의 상측 및 연장부(161)에 루프 형태로 형성되는 제1-2 MST 패턴(140a-2)을 포함할 수 있다. 제1-1 MST 패턴(140a-1)은 제1-1 NFC 패턴(130a-1)의 내측에 상호 이격되어 형성될 수 있다. 제1-2 MST 패턴(140a-2)은 제1-1 MST 패턴(140a-1)으로부터 연장되어 형성될 수 있으나, 이에 한정되는 것은 아니며 제1-1 MST 패턴(140a-1)과 이격되고 제1-1 MST 패턴(140a-1)과 커플링되도록 마련될 수도 있다.
- [86] 제2 MST 패턴(140b)은 자성 시트(102)의 테두리에서 소정 거리 이격되어 형성되고 루프 형태로 형성되는 제2-1 MST 패턴(140b-1) 및 자성 시트(102)의 상측 및 연장부(161)에 루프 형태로 형성되는 제2-2 MST 패턴(140b-2)을 포함할 수 있다. 제2-1 MST 패턴(140b-1)은 제2-1 NFC 패턴(130b-1)의 내측에 상호 이격되어 형성될 수 있다. 제2-2 MST 패턴(140b-2)은 제2-1 MST 패턴(140b-1)으로부터 연장되어 형성될 수 있으나, 이에 한정되는 것은 아니며 제2-1 MST 패턴(140b-1)과 이격되고 제2-1 MST 패턴(140b-1)과 커플링되도록 마련될 수도 있다. 여기서, 제1 MST 패턴(140a) 및 제2 MST 패턴(140b)은 비아홀을 통해 전기적으로 연결될 수 있다.
- [87] 루프 형태로 형성되는 제1-1 MST 패턴(140a-1) 및 제2-1 MST 패턴(140b-1)의 가로 방향의 내측 길이는 후술할 WPC 패턴(150)의 지름 이하가 되도록 형성될 수 있다. 또한, 제1-1 MST 패턴(140a-1) 및 제2-1 MST 패턴(140b-1)의 세로 방향의 내측 길이는 후술할 WPC 패턴(150)의 지름 이상이 되도록 형성될 수 있다.
- [88] 이에 대해 도 11을 참조하여 자세히 설명하기로 한다. 도 11은 예시적인 실시예에 따른 자성 시트(102)의 상면에 MST 패턴(140)(보다 자세하게는 제1 MST 패턴(140a)) 및 WPC 패턴(150)이 형성된 상태를 나타낸 도면이다.

여기서는, 설명의 편의상 자성 시트(102)의 상면만을 도시하나, 자성 시트(102)의 하면에 형성되는 패턴들도 동일하게 이해될 수 있다.

[89] 도 11을 참조하면, 제1-1 MST 패턴(140a-1)의 가로 방향의 내측 길이가 WPC 패턴(150)의 지름 이하가 되도록 형성됨에 따라, 제1-1 MST 패턴(140a-1)은 제1-1 MST 패턴(140a-1)의 세로 방향에 외측으로 굴곡되는 굴곡부(141)를 포함할 수 있다. 이와 같이, 제1-1 MST 패턴(140a-1)에 굴곡부(141)를 형성함으로써, 제1-1 MST 패턴(140a-1)이 WPC 패턴(150)과 겹치는 것을 방지하면서 굴곡에 따른 길이만큼 패턴 길이가 연장되는 효과를 얻을 수 있게 된다. 또한, 정해진 크기의 자성 시트(102)에서 여러 개의 안테나 패턴을 배치하여 공간 활용성을 높일 수 있게 된다.

[90] 여기서는 제1-1 MST 패턴(140a-1)의 세로 방향의 내측 길이가 WPC 패턴(150)의 지름 이상인 것으로 도시하였으나, 이에 한정되는 것은 아니며 제1-1 MST 패턴(140a-1)의 세로 방향의 내측 길이도 WPC 패턴(150)의 지름 이하가 되도록 형성될 수 있다. 이 경우, WPC 패턴(150)과 겹치지 않도록 제1-1 MST 패턴(140a-1)의 가로 방향에 굴곡부(141)를 형성할 수 있다. 또한, 제1-1 MST 패턴(140a-1)의 가로 방향 및 세로 방향 각각에 굴곡부(141)를 형성하여 자성 시트(102)의 정해진 크기 안에서 WPC 패턴(150)과 겹치는 것을 방지하면서 해당 주파수 대역에 필요한 전기적 길이 값을 확보할 수 있다.

[91] 한편, MST 패턴(140)은 신용 카드 대체 결제를 위한 것으로, 안테나모듈(100)이 실장된 휴대용 단말기를 통해 결제를 하는 경우, POS(Point of Sales) 단말기에 휴대용 단말기를 접근시키는 방향이 사용자마다 상이할 수 있다. 예를 들어, 어떤 사용자는 휴대용 단말기를 수평 방향으로 하여 POS 단말기에 접근시키고, 다른 사용자는 휴대용 단말기의 상단 또는 하단을 기울인 채로 POS 단말기에 접근시킬 수 있다. 이와 같이, 휴대용 단말기를 POS 단말기에 접근시키는 방향은 각 결제시마다 달라질 수 있기 때문에, 휴대용 단말기를 특정 방향에서 POS 단말기로 접근시켜야 결제가 수행되도록 하면, 사용자는 불편함을 느끼게 되는 바, 휴대용 단말기의 접근 방향에 관계 없이 결제가 이루어지도록 하기 위한 방안이 필요하다.

[92] 이에 본 발명의 실시예에서는, MST 패턴(140)을 연장부(161)에도 형성(즉, MST 패턴(140)이 제1-2 MST 패턴(140a-2) 및 제2-2 MST 패턴(140b-2)을 포함)시킴에 따라 휴대용 단말기의 접근 방향에 관계 없이 MST 패턴(140)을 이용한 결제가 이루어지도록 할 수 있다.

[93] 즉, MST 패턴(140)이 자성 시트(102)의 일측에서 연장되어 형성되는 연장부(161)에도 형성(다시 말하면, MST 패턴(140)이 휴대용 단말기의 일부 영역이 아닌 휴대용 단말기의 전 영역에 대응하여 형성)됨에 따라, 사용자가 휴대용 단말기의 상단 또는 하단을 기울여 POS 단말기에 접근시킨다 하더라도 각 방향에서 MST 패턴(140)을 이용한 결제가 이루어질 수 있게 된다.

[94] 도 12는 예시적인 실시예에 따른 안테나 모듈에서 자성 시트(102)의 상면에

형성되는 제1 WPC 패턴(150a)을 나타낸 도면이고, 도 13은 예시적인 실시예에 따른 안테나 모듈에서 자성 시트(102)의 하면에 형성되는 제2 WPC 패턴(150b)을 나타낸 도면이다.

- [95] 도 12 및 도 13을 참조하면, 제1 WPC 패턴(150a) 및 제2 WPC 패턴 (150b)은 자성 시트(102)의 중심부에서 각각 원형의 형상으로 이루어질 수 있다.
- [96] 제1 WPC 패턴(150a) 및 제2 WPC 패턴(150b)은 턴 수가 많아질수록 무선 충전 효율이 높아지는 바, 정해진 크기의 자성 시트(102) 내에서 최대한의 턴 수를 갖도록 마련될 수 있다. 제1 WPC 패턴(150a) 및 제2 WPC 패턴(150b)은 비아홀을 통해 전기적으로 연결될 수 있다.
- [97] 도 14는 예시적인 실시예에 따른 안테나 모듈에서 접속부를 나타낸 도면이다.
- [98] 도 14를 참조하면, 연장부(161)의 일측에는 접속부(162)가 형성될 수 있다. 접속부(162)에는 제1 접속 단자(171), 제2 접속 단자(173), 제3 접속 단자(175), 및 제4 접속 단자(177)가 형성될 수 있다.
- [99] 제1 접속 단자(171)는 NFC 패턴(130)과 전기적으로 연결될 수 있다.
- [100] 제2 접속 단자(173)는 MST 패턴(140)과 전기적으로 연결될 수 있다. 제3 접속 단자(175)는 WPC 패턴(150)과 전기적으로 연결될 수 있다. 제4 접속 단자(177)는 써미스터(165)와 전기적으로 연결될 수 있다.
- [101] 이상에서 본 발명의 대표적인 실시예들을 상세하게 설명하였으나, 본 발명이 속하는 기술분야에서 통상의 지식을 가진 자는 상술한 실시예에 대하여 본 발명의 범주에서 벗어나지 않는 한도 내에서 다양한 변형이 가능함을 이해할 것이다. 그러므로 본 발명의 권리범위는 설명된 실시예에 국한되어 정해져서는 안 되며, 후술하는 특허청구범위뿐만 아니라 이 특허청구범위와 균등한 것들에 의해 정해져야 한다.

청구범위

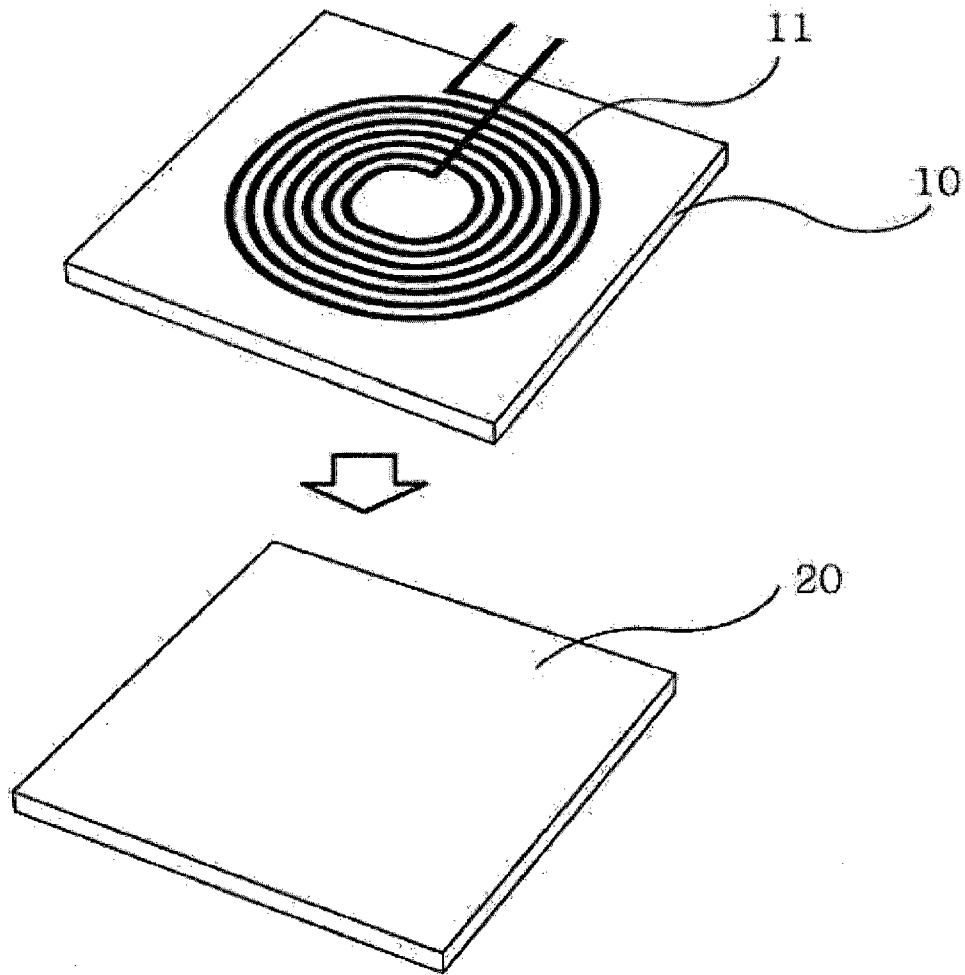
- [청구항 1] 자성 시트;
 상기 자성 시트의 일면에 형성되는 제1 패턴;
 상기 자성 시트의 일면 상에서 상기 제1 패턴을 감싸며 형성되는 제1 커버 시트;
 상기 자성 시트의 타면에 형성되는 제2 패턴;
 상기 자성 시트의 타면 상에서 상기 제2 패턴을 감싸며 형성되는 제2 커버 시트; 및
 상기 제1 패턴, 상기 자성 시트, 및 상기 제2 패턴을 관통하여 형성되고
 상기 제1 패턴과 상기 제2 패턴을 전기적으로 연결시키는 적어도 하나의
 비아 홀을 포함하는, 안테나 모듈.
- [청구항 2] 청구항 1에 있어서,
 상기 제1 패턴 및 상기 제2 패턴은 각각,
 일측 단부가 상기 자성 시트의 가장 자리를 벗어나 상기 자성 시트의
 외측으로 연장되며, 상기 외측으로 연장된 부분에 접속 단자가 형성되는,
 안테나 모듈.
- [청구항 3] 청구항 1에 있어서,
 상기 제1 패턴 및 상기 제2 패턴은,
 두께 및 폭 중 적어도 하나가 다르게 형성되는, 안테나 모듈.
- [청구항 4] 청구항 1에 있어서,
 상기 제1 패턴 및 상기 제2 패턴은 각각,
 NFC(Near Field Communication) 패턴, MST(Magnetic Secure
 Transmission)패턴, 및 WPC(Wireless Power Charge) 패턴 중 적어도 2개의
 패턴을 포함하고, 상기 적어도 2개의 패턴은 각각 상호 이격되어
 형성되는, 안테나 모듈.
- [청구항 5] 청구항 4에 있어서,
 상기 제1 패턴 및 상기 제2 패턴은 각각,
 상기 NFC 패턴, 상기 MST 패턴, 및 상기 WPC 패턴을 포함하고,
 상기 NFC 패턴, 상기 MST 패턴, 및 상기 WPC 패턴은, 상기 자성 시트의
 외곽으로부터 안쪽으로 순서대로 형성되는, 안테나 모듈.
- [청구항 6] 청구항 5에 있어서,
 상기 NFC 패턴은,
 상기 자성 시트의 테두리의 적어도 일 구간을 따라 형성되는 제1 NFC
 패턴 및 상기 WPC 패턴의 내측에서 상기 WPC 패턴과 이격되어 형성되는
 제2 NFC 패턴을 포함하는, 안테나 모듈.
- [청구항 7] 청구항 5에 있어서,
 상기 MST 패턴은,

- 상기 자성 시트의 테두리에서 소정 거리 이격되어 루프 형태로 형성되고, 상기 MST 패턴의 가로 방향의 내측 길이 및 상기 MST 패턴의 세로 방향의 내측 길이 중 적어도 하나는 상기 WPC 패턴의 지름 이하로 형성되며,
- 상기 MST 패턴의 가로 방향 및 세로 방향 중 상기 WPC 패턴의 지름 이하로 형성되는 방향과 수직하는 방향에는 상기 WPC 패턴과 겹치지 않도록 일 부분이 외측으로 굴곡된 굴곡부가 형성되는, 안테나 모듈.
- [청구항 8] 청구항 5에 있어서,
상기 자성 시트는, 상기 자성 시트의 일측에서 연장되어 형성되는 연장부를 더 포함하며,
상기 MST 패턴은, 상기 자성 시트에 형성되는 제1 MST 패턴 및 상기 연장부에 형성되는 제2 MST 패턴을 포함하는, 안테나 모듈.
- [청구항 9] 청구항 8에 있어서,
상기 자성 시트는, 상기 연장부의 일측에 형성되는 접속부를 더 포함하고, 상기 접속부는,
상기 NFC 패턴과 전기적으로 연결되는 제1 접속 단자;
상기 MST 패턴과 전기적으로 연결되는 제2 접속 단자; 및
상기 WPC 패턴과 전기적으로 연결되는 제3 접속 단자를 포함하는, 안테나 모듈.
- [청구항 10] 청구항 5에 있어서,
상기 안테나 모듈은,
상기 자성 시트에 형성되고 상기 NFC 패턴, 상기 MST 패턴, 및 상기 WPC 패턴 중 적어도 하나의 온도를 측정하는 써미스터를 더 포함하는, 안테나 모듈.
- [청구항 11] 자성 시트의 일면 및 타면에 각각 제1 금속 박막 및 제2 금속 박막을 형성하는 단계;
상기 제1 금속 박막 및 상기 제2 금속 박막을 전기적으로 연결하는비아홀을 형성하는 단계;
상기 제1 금속 박막 및 상기 제2 금속 박막의 일부를 제거하여 상기 자성 시트의 일면 및 타면에 각각 제1 패턴 및 제2 패턴을 형성하는 단계;
상기 자성 시트의 일면 상에서 상기 제1 패턴을 감싸며 제1 커버 시트를 형성하는 단계; 및
상기 자성 시트의 타면 상에서 상기 제2 패턴을 감싸며 제2 커버 시트를 형성하는 단계를 포함하는, 안테나 모듈의 제조 방법.
- [청구항 12] 청구항 11에 있어서,
상기 제1 금속 박막 및 제2 금속 박막을 형성하는 단계는,

상기 자성 시트의 일면에 제1 본딩 시트를 통해 상기 제1 금속 박막을 접착시키는 단계; 및
 상기 자성 시트의 타면에 제2 본딩 시트를 통해 상기 제2 금속 박막을 접착시키는 단계를 포함하는, 안테나 모듈의 제조 방법.

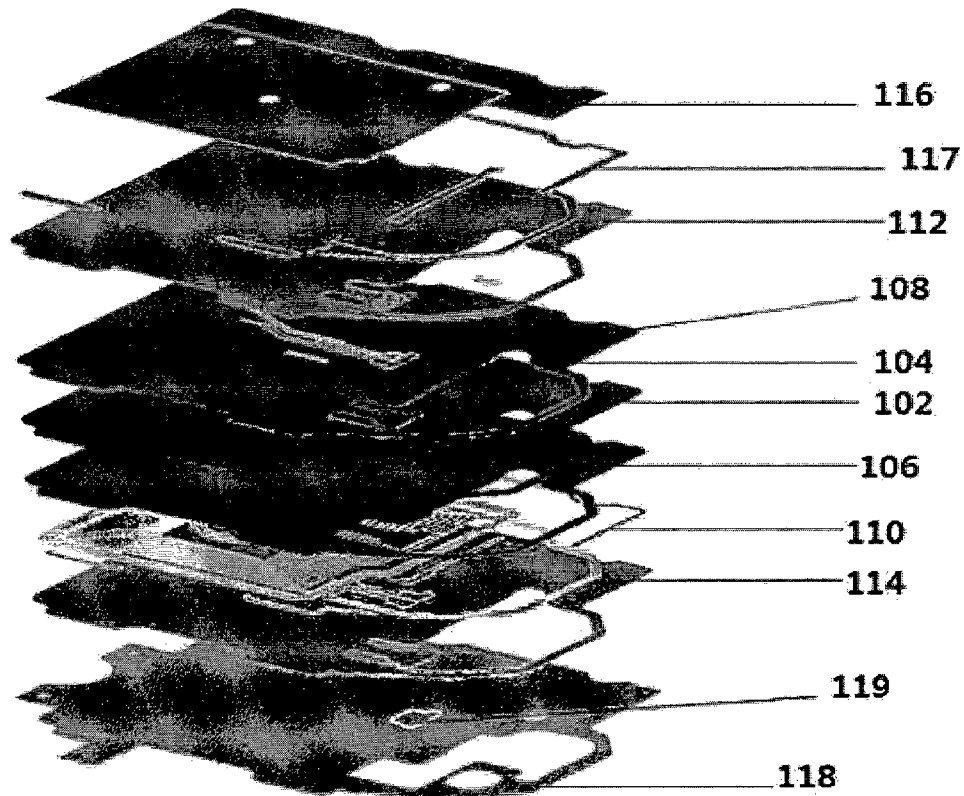
- [청구항 13] 청구항 11에 있어서,
 상기 제1 패턴 및 제2 패턴을 형성하는 단계는,
 상기 제1 패턴 및 상기 제2 패턴의 폭 및 두께 중 적어도 하나를 서로 다르게 형성하는, 안테나 모듈의 제조 방법.
- [청구항 14] 청구항 11에 있어서,
 상기 제1 패턴 및 제2 패턴을 형성하는 단계 이후에,
 상기 제1 패턴에 제1 도금층을 형성하는 단계; 및
 상기 제2 패턴에 제2 도금층을 형성하는 단계를 더 포함하고,
 상기 제1 도금층 및 상기 제2 도금층은, 두께가 서로 다르게 형성되는,
 안테나 모듈의 제조 방법.
- [청구항 15] 청구항 1 내지 청구항 10 중 어느 하나의 항에 기재된 안테나 모듈을
 구비한
 휴대용 단말기.

[도1]

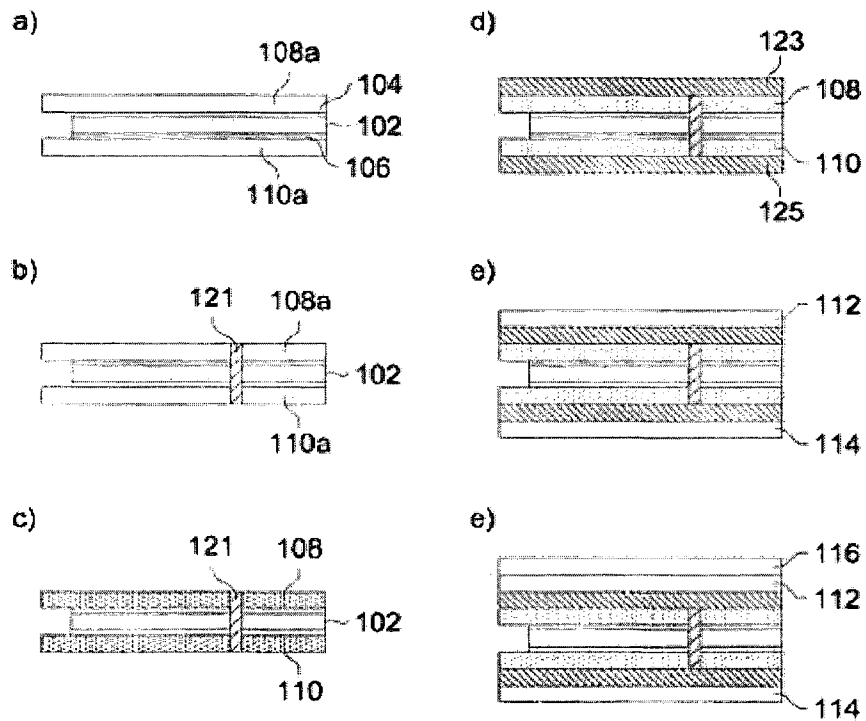


[도2]

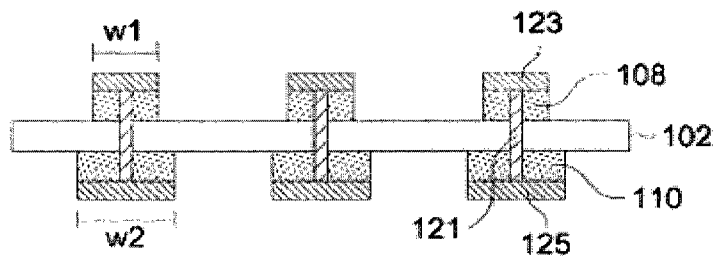
100



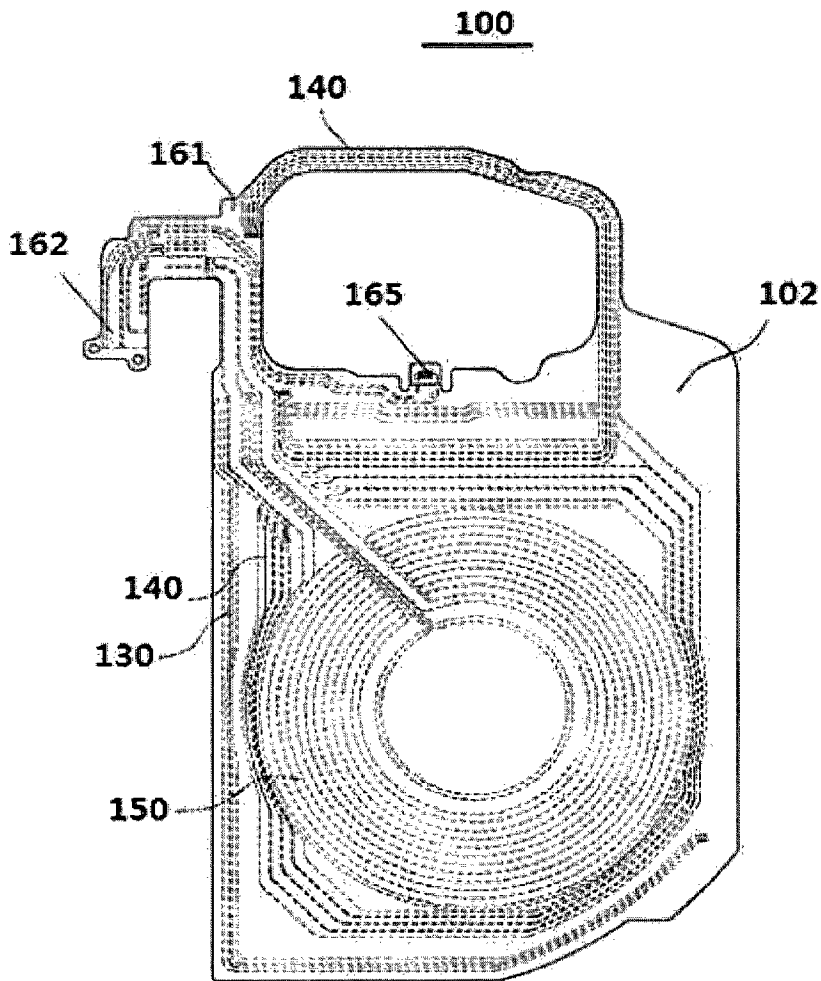
[도3]



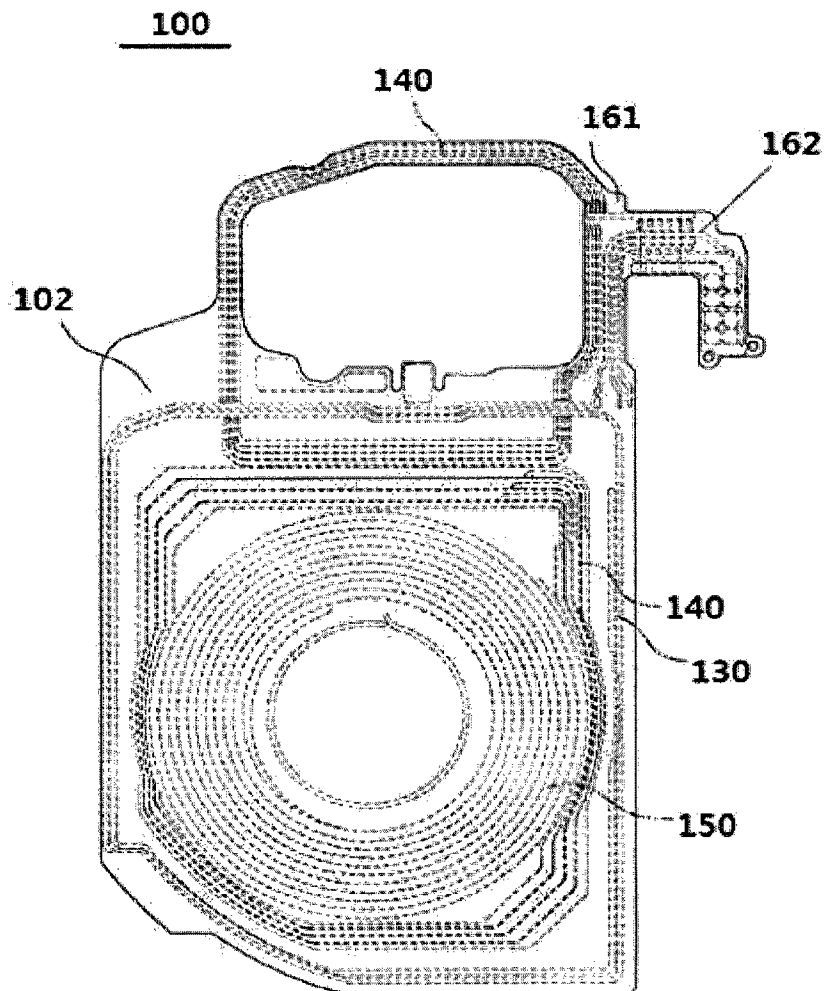
[도4]



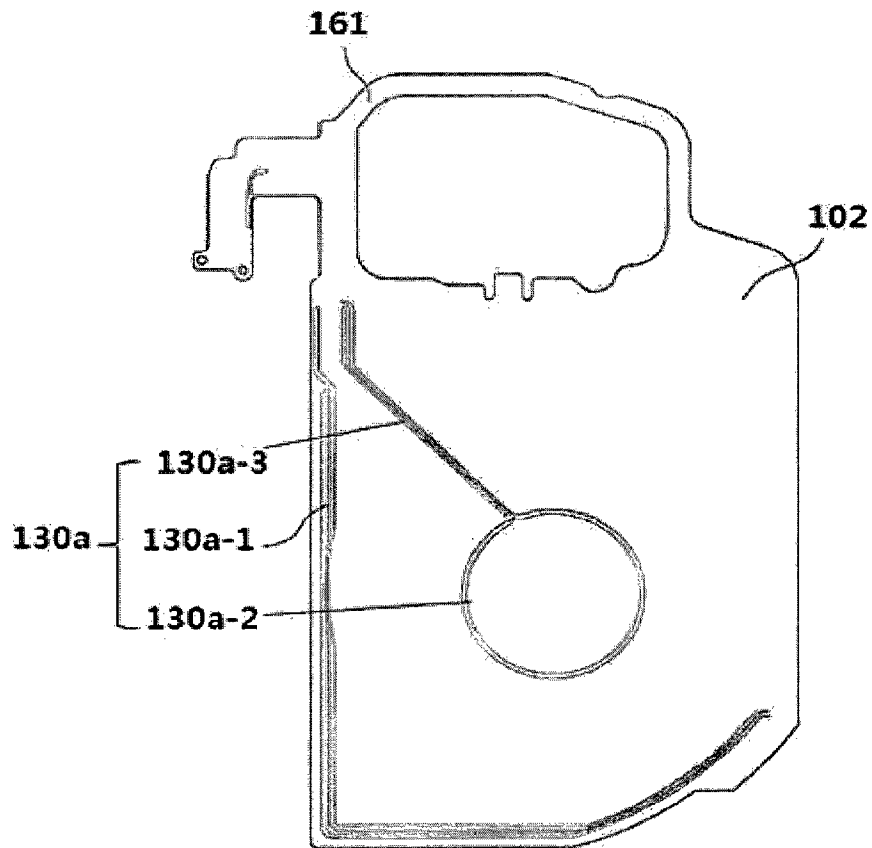
[도5]



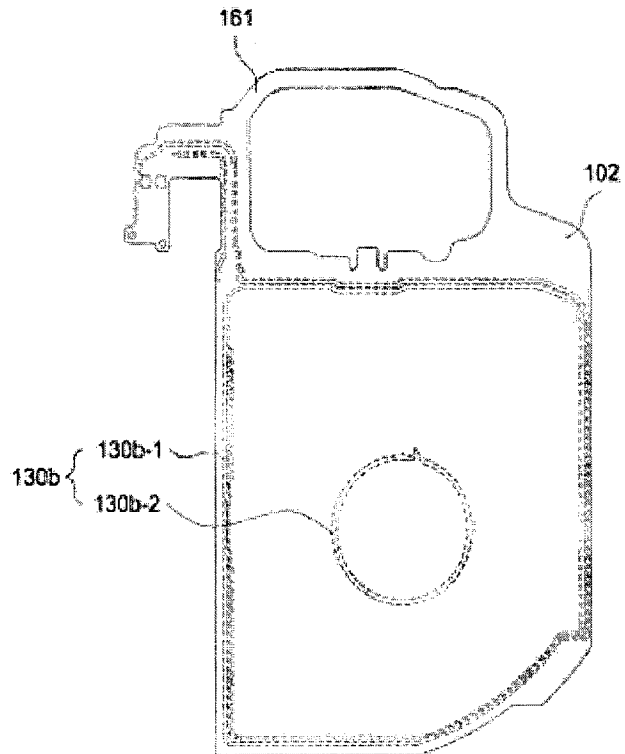
[도6]



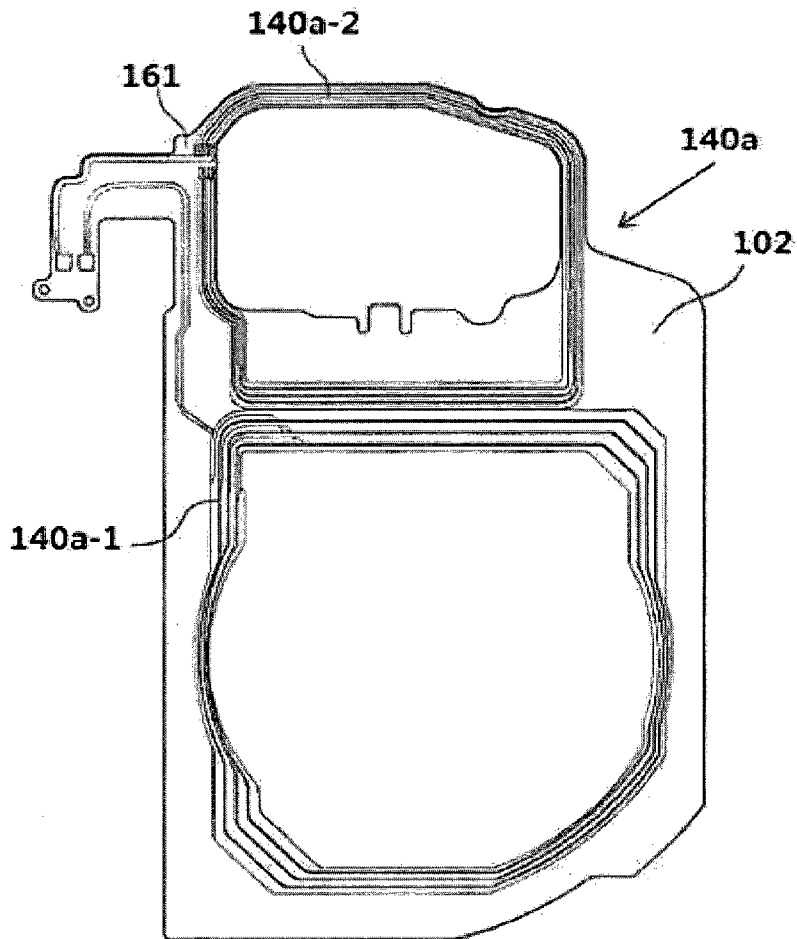
[도 7]



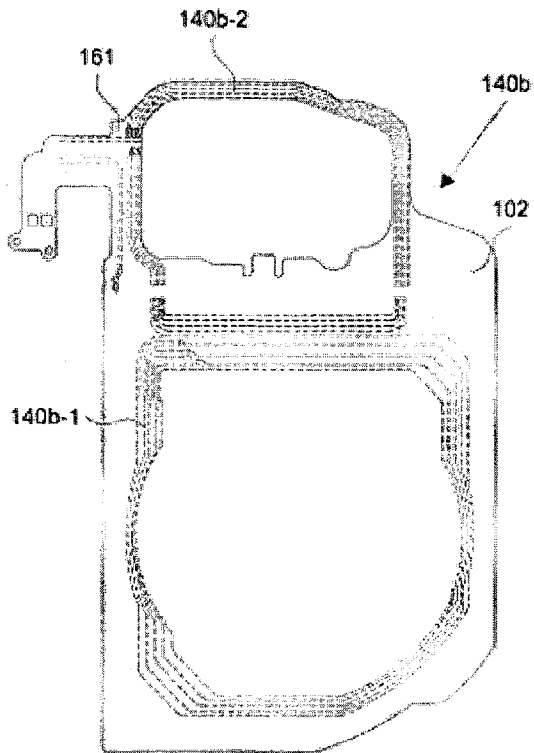
[도8]



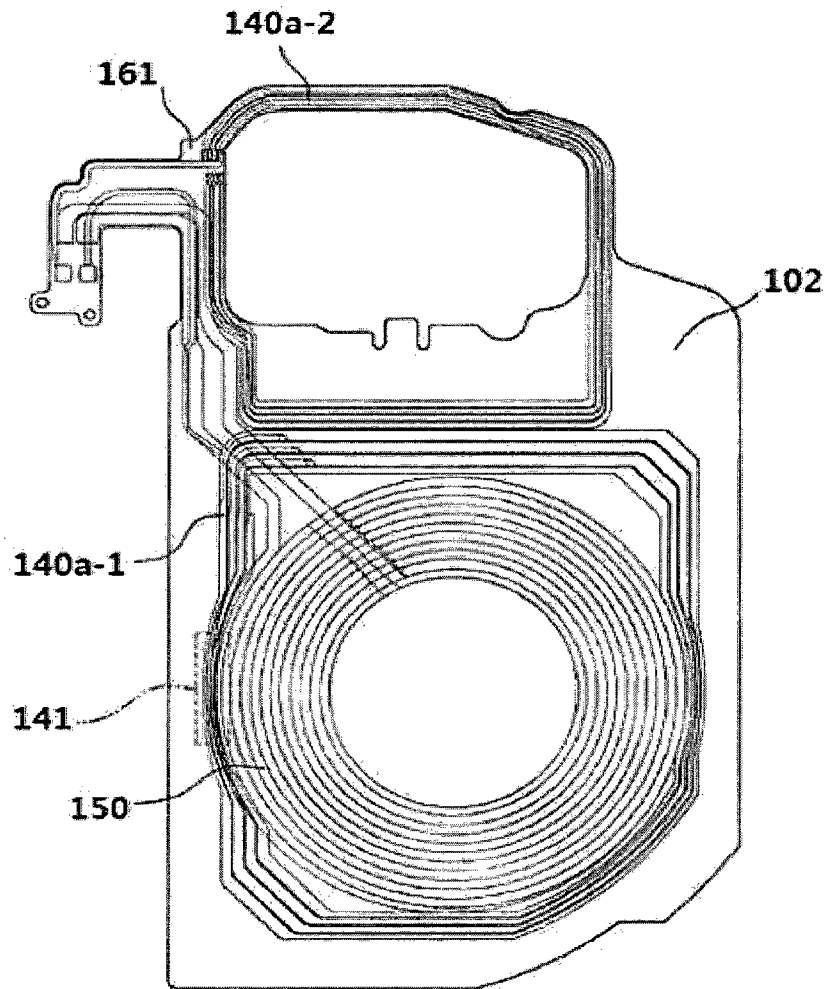
[도9]



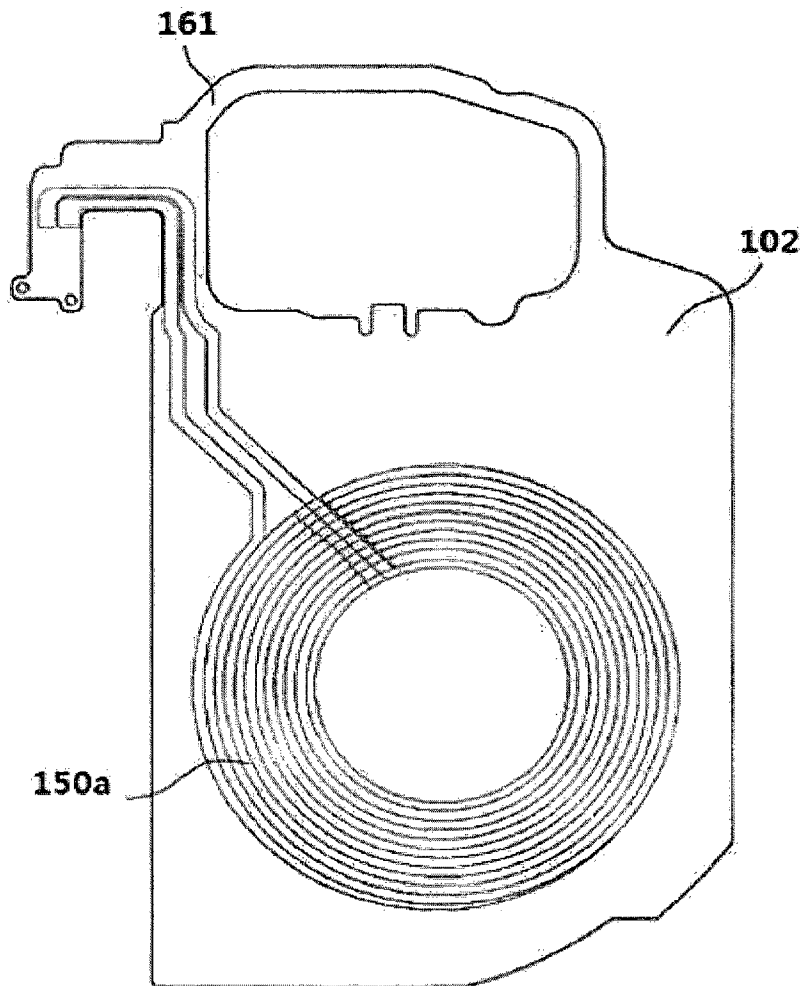
[도10]



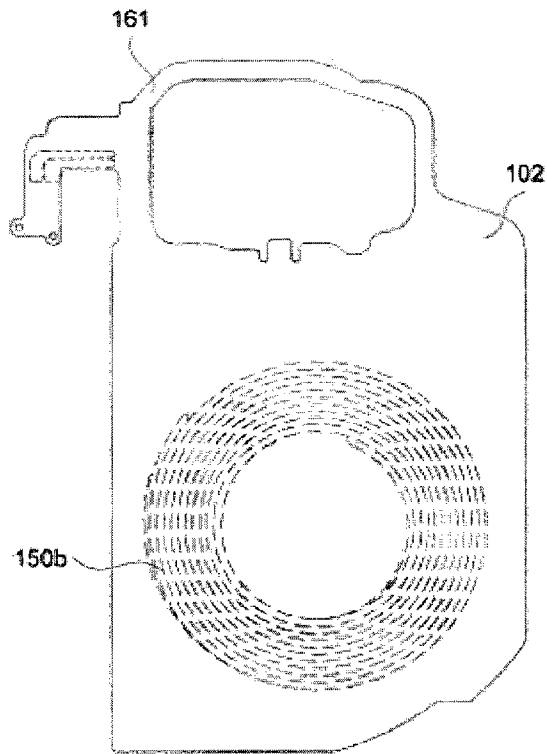
[도11]



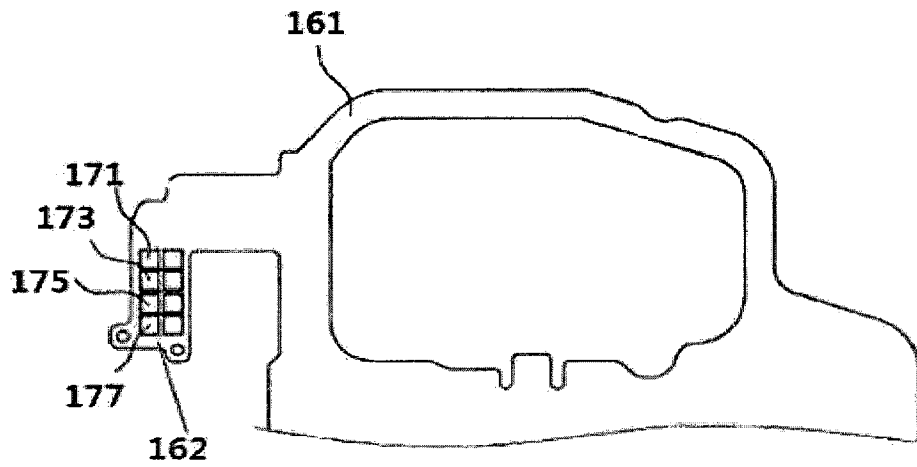
[도12]



[도13]



[도14]



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2017/004852**A. CLASSIFICATION OF SUBJECT MATTER****H01Q 7/06(2006.01)i, H01Q 1/22(2006.01)i, H02J 7/02(2006.01)i, H02J 50/12(2016.01)i, H01Q 1/38(2006.01)i, H04M 1/02(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01Q 7/06; H01M 10/42; H01Q 1/38; H01F 38/14; H01F 17/04; H01Q 7/02; H01Q 7/08; H01Q 1/22; H02J 7/02; H02J 50/12; H04M 1/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Utility models and applications for Utility models: IPC as above
Japanese Utility models and applications for Utility models: IPC as aboveElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS (KIPO internal) & Keywords: antenna, module, pattern, sheet, magnetic**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 10-1197684 B1 (AMOTECH CO., LTD.) 05 November 2012 See paragraphs [0084], [0105], [0117], claims 2, 13, 17 and figure 9.	1,3,11-14
Y		2,4-10,15
Y	KR 10-1554129 B1 (IMTECH INC.) 21 September 2015 See paragraphs [0057], [0073], claim 8 and figure 3a.	2,4-10,15
Y	JP 2015-149405 A (DEXERIALS CORP.) 20 August 2015 See paragraph [0038] and figure 3.	10
A	KR 10-2015-0131925 A (ITM SEMICONDUCTOR CO., LTD.) 25 November 2015 See paragraphs [0064]-[0065], claim 1 and figures 13-15.	1-15
A	KR 10-1381135 B1 (KIM, Sun-Ki et al.) 04 April 2014 See claims 1-3 and figure 3.	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

*** Special categories of cited documents:**

“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

“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

“O” document referring to an oral disclosure, use, exhibition or other means

“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

30 AUGUST 2017 (30.08.2017)

Date of mailing of the international search report

30 AUGUST 2017 (30.08.2017)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
Government Complex-Daejeon, 189 Seonsa-ro, Daejeon 302-701,
Republic of Korea

Facsimile No. +82-42-481-8578

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/KR2017/004852

Patent document cited in search report	Publication date	Patent family member	Publication date
KR 10-1197684 B1	05/11/2012	KR 10-2010-0111409 A	15/10/2010
KR 10-1554129 B1	21/09/2015	NONE	
JP 2015-149405 A	20/08/2015	CN 104836022 A	12/08/2015
		US 2015-0222018 A1	06/08/2015
KR 10-2015-0131925 A	25/11/2015	CN 105098132 A	25/11/2015
		CN 105720313 A	29/06/2016
		KR 10-1548730 B1	01/09/2015
		KR 10-1599522 B1	03/03/2016
		KR 10-1602832 B1	11/03/2016
		KR 10-1604384 B1	17/03/2016
		KR 10-1628921 B1	09/06/2016
		KR 10-1638372 B1	11/07/2016
		KR 10-1659561 B1	23/09/2016
		KR 10-2015-0131899 A	25/11/2015
		KR 10-2015-0131920 A	25/11/2015
		KR 10-2015-0131921 A	25/11/2015
		KR 10-2015-0131922 A	25/11/2015
		KR 10-2015-0131923 A	25/11/2015
		KR 10-2015-0131924 A	25/11/2015
		KR 10-2015-0131926 A	25/11/2015
		KR 10-2015-0131929 A	25/11/2015
		TW 201546998 A	16/12/2015
		TW 1566368 B	11/01/2017
		US 2015-0333547 A1	19/11/2015
		US 2016-0181705 A1	23/06/2016
		US 9680973 B2	13/06/2017
		WO 2015-174633 A1	19/11/2015
		WO 2015-174634 A1	19/11/2015
		WO 2015-174635 A1	19/11/2015
KR 10-1381135 B1	04/04/2014	NONE	

A. 발명이 속하는 기술분류(국제특허분류(IPC))

H01Q 7/06(2006.01)i, H01Q 1/22(2006.01)i, H02J 7/02(2006.01)i, H02J 50/12(2016.01)i, H01Q 1/38(2006.01)i, H04M 1/02(2006.01)i

B. 조사된 분야

조사된 최소문헌(국제특허분류를 기재)

H01Q 7/06; H01M 10/42; H01Q 1/38; H01F 38/14; H01F 17/04; H01Q 7/02; H01Q 7/08; H01Q 1/22; H02J 7/02; H02J 50/12; H04M 1/02

조사된 기술분야에 속하는 최소문헌 이외의 문헌

한국등록실용신안공보 및 한국공개실용신안공보: 조사된 최소문헌란에 기재된 IPC
일본등록실용신안공보 및 일본공개실용신안공보: 조사된 최소문헌란에 기재된 IPC

국제조사에 이용된 전산 데이터베이스(데이터베이스의 명칭 및 검색어(해당하는 경우))

eKOMPASS(특허청 내부 검색시스템) & 키워드: 안테나, 모듈, 패턴, 시트, 자성

C. 관련 문헌

카테고리*	인용문헌명 및 관련 구절(해당하는 경우)의 기재	관련 청구항
X	KR 10-1197684 B1 (주식회사 아모텍) 2012.11.05 단락 [0084],[0105],[0117], 청구항 2,13,17 및 도면 9 참조.	1,3,11-14
Y		2,4-10,15
Y	KR 10-1554129 B1 (주식회사 아이엠텍) 2015.09.21 단락 [0057],[0073], 청구항 8 및 도면 3a 참조.	2,4-10,15
Y	JP 2015-149405 A (DEXERIALS CORP.) 2015.08.20 단락 [0038] 및 도면 3 참조.	10
A	KR 10-2015-0131925 A (주식회사 아이티엠반도체) 2015.11.25 단락 [0064] [0065], 청구항 1 및 도면 13 15 참조.	1-15
A	KR 10-1381135 B1 (김선기 등) 2014.04.04 청구항 1 3 및 도면 3 참조.	1-15

☐ 추가 문헌이 C(계속)에 기재되어 있습니다.

☒ 대응특허에 관한 별지를 참조하십시오.

* 인용된 문헌의 특별 카테고리:

“A” 특별히 관련이 없는 것으로 보이는 일반적인 기술수준을 정의한 문헌

“E” 국제출원일보다 빠른 출원일 또는 우선일을 가지나 국제출원일 이후에 공개된 선출원 또는 특허 문헌

“L” 우선권 주장에 의문을 제기하는 문헌 또는 다른 인용문헌의 공개일 또는 다른 특별한 이유(이유를 명시)를 밝히기 위하여 인용된 문헌

“O” 구두 개시, 사용, 전시 또는 기타 수단을 언급하고 있는 문헌

“P” 우선일 이후에 공개되었으나 국제출원일 이전에 공개된 문헌

“T” 국제출원일 또는 우선일 후에 공개된 문헌으로, 출원과 상충하지 않으며 발명의 기초가 되는 원리나 이론을 이해하기 위해 인용된 문헌

“X” 특별한 관련이 있는 문헌. 해당 문헌 하나만으로 청구된 발명의 신규성 또는 진보성이 없는 것으로 본다.

“Y” 특별한 관련이 있는 문헌. 해당 문헌이 하나 이상의 다른 문헌과 조합하는 경우로 그 조합이 당업자에게 자명한 경우 청구된 발명은 진보성이 없는 것으로 본다.

“&” 동일한 대응특허문헌에 속하는 문헌

국제조사의 실제 완료일

2017년 08월 30일 (30.08.2017)

국제조사보고서 발송일

2017년 08월 30일 (30.08.2017)

ISA/KR의 명칭 및 우편주소



대한민국 특허청
(35208) 대전광역시 서구 청사로 189,
4동 (둔산동, 정부대전청사)

팩스 번호 +82-42-481-8578

심사관

장기정

전화번호 +82-42-481-8364



국제조사보고서에서 인용된 특허문헌	공개일	대응특허문헌	공개일
KR 10-1197684 B1	2012/11/05	KR 10-2010-0111409 A	2010/10/15
KR 10-1554129 B1	2015/09/21	없음	
JP 2015-149405 A	2015/08/20	CN 104836022 A US 2015-0222018 A1	2015/08/12 2015/08/06
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Flexible printed circuit board for wireless communications
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- Application number 2014KR-0189125 Date 2014-12-24 [Register](#)
 - KR10-1649259 B1 Patent specification 2016-08-19

English Title

Flexible printed circuit board for wireless communications

Other Title

무선통신용 플렉시블 회로기판

English Abstract (Native or MT)

The present invention relates to a flexible printed circuit board for wireless communication, which is capable of more considerably improving wireless communication efficiency of both of a main loop pattern (10) and a sub loop pattern (20) by further including a transverse portion (23) which is provided in a sub region (42), but does not contact and transverses the main loop pattern (10) provided in a main region (41) so as to supplement the wireless communication efficiency of the sub loop pattern (20) without unilaterally considering only the wireless communication efficiency of the main loop pattern (10) even when the main region (41) wound with the main loop pattern (10) is disposed at any position of a base film (40). The flexible printed circuit board for wireless communication comprises the base film (40), the main loop pattern (10) provided in the base film (40), and the sub loop pattern (20), wherein the main loop pattern (10) is provided in the main region (41) of the base film (40), and the sub loop pattern (20) is provided in the sub region (42) of the base film (40), does not contact the main loop pattern (10), and further includes the transverse portion (23).

Other Abstracts

본 발명은 메인 루프패턴(10)이 권회되는 메인영역(41)이 베이스필름(40)의 어느 곳에 위치되더라도 일방적으로 메인 루프패턴(10)의 무선통신 효율만을 고려하는 것인 아닌 서브 루프패턴(20)의 무선통신 효율 역시 보완 보충토록 하기 위하여 서브영역(42)에 마련되면서도 메인영역(41)에 마련된 메인 루프패턴(10)에 접속되지 않으면서 가로지르는 횡단부(23)를 더 가지도록 하여 메인 루프패턴(10) 및 서브 루프패턴(20) 모두의 무선통신 효율을 더욱 크게 향상시킬 수 있도록 한 무선통신용 플렉시블 회로기판에 관한 것이다.

**Application
Language**

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Inventor(s)

PARK, JUNG-IL
PARK, JONG-JIN

Inventor(s) 박정일
박종진

Applicant/Assignee IMTECH

Assignee 주식회사 아이엠텍
Reg. Nb: 120010259405

Patent Assignee History IMTECH INC.
IMTECH INC.

Representative WON, EUN SUP
Reg. Nb: 919980004162

Representative Address WON, EUN SUP , 919980004162

WON, EUN SUP , 919980004162

Representative 원은섭
Reg. Nb: 919980004162

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(A) [KR20100074595] SAMSUNG ELECTRONICS CO LTD; ;
KR101063154 (B1) [KR101063154];

Description

TECHNICAL FIELD

[0001] The present invention relates to a flexible circuit board for wireless communication, More specifically, in order to compensate for the wireless communication efficiency of the sub-loop pattern which does not consider only the wireless communication efficiency of the main loop pattern in one way, even if the main region where the main loop pattern is wound is located at any place of the base film, Wherein the flexible circuit board is provided and further has a transverse end portion which is not connected to the main loop pattern and crosses the same, so that wireless communication efficiency of both the main loop pattern and the sub loop pattern can be improved significantly.

BACKGROUND ART

[0002] In general, the mobile terminal may include, for example, a smart phone and various applications (application programs) while viewing a window for displaying a screen as an intelligent terminal to which computer assistance functions such as Internet communication and information retrieval are added to the mobile phone.

[0003] Publication No. 2013-0113222 (antenna and mobile terminal equipped with the same) can be introduced as prior art document 1.

[0004] FIG. 1A is a block diagram of a mobile terminal associated with prior art document 1.

[0005] The mobile terminal 100 may include a wireless communication unit 110, an Audio/Video (a/V) input unit 120, a user input unit 130, a sensing unit 140, an output unit 150, a memory 160, an interface unit 170, a control unit 180, a power supply unit 190, and the like, as illustrated in FIG. 1A.

[0006] The wireless communication unit 110 may include a broadcast reception module 111, a mobile communication module 112, a wireless Internet module 113, a near field communication module 114, a location information module 115, and so on, an audio/video (a/V) input unit 120 is for inputting an audio signal or a video signal, A camera 121, a microphone 122, and the like may be included, and the user input unit 130 may be configured by a button 136, a touch sensor (static pressure/static) 137 disposed on a front surface, a rear surface, or a side surface of the mobile terminal 100.

[0007] The sensing unit 140 generates a sensing signal for controlling an operation of the mobile terminal 100 by sensing a current state of the mobile terminal 100 such as an open/close state of the mobile terminal 100, a position of the mobile terminal 100, presence/absence of a user contact, an orientation of the mobile terminal, acceleration/deceleration of the mobile terminal, and so on, The output 150 may include a proximity sensor 141, and the output 150 may be for generating output related to visual, audio, tactile, or the like, including a display unit 151, an acoustic output module 152, an alarm unit 153, a haptic module 154, and the like.

[0008] The memory unit 160 may store a program for processing and controlling the control unit 180, or may perform a function for temporary storage of input/output data (e.g., phone book unit, message, audio, still image, moving image, etc.).

[0009] The interface unit 170 serves as a passage with all external devices connected to the mobile terminal 100. The interface unit 170 may receive data from the external device, receive power and transmit the received data to each component in the mobile terminal 100, or transmit the data in the mobile terminal 100 to the external device. For example, a wired/wireless headset port, an external charger port, a wired/wireless data port, a memory card port, a port connecting a device provided with an identification module, an audio input/output (I/o) port, a video input/output (I/o) port, an earphone port, and the like may be included in the interface unit 170.

[0010] A controller 180 typically controls the overall operation of the mobile terminal. Related controls and processes are performed, for example, for voice calls, data communications, video calls, and the like. The control unit 180 may include a multimedia module 181 for multi-media playback.

[0011] The power supply 190 receives external power and internal power under control of the control unit 180, and supplies power necessary for operation of the respective components.

[0012] The power supply 190 may include, for example, a battery, a connection port, a power supply controller, and a charge monitoring unit.

[0013] FIG. 1B is a rear perspective view of a mobile terminal according to prior art document 1.

[0014] Referring to FIG. 1B, the rear face of the terminal body, i.e., the rear case 102, may be further equipped with a camera 121 '. Adjacent to camera 121 ', flash 123 and mirror 124 may be further disposed. The flash 123 shines light toward the subject when photographing the subject with the camera 121 '.

[0015] FIG. 1C is a top view illustrating attachment of an antenna 200 according to the prior art document to a rear cover 103 of a mobile terminal 100.

[0016] Referring to figs. 1A-1C, shown are front case 101, rear case 102, rear cover (or battery cover) 103, camera 121 ', interface 170, microphone 122, sound output 152', battery 191, battery mount 104, USIM card mount 105, memory card mount 106.

[0017] A space may be provided on a surface of the rear case 102 to mount external components such as the battery mounting unit 104, the USIM card mounting unit 105, and the memory card mounting unit 106. The exterior parts mounted on the surface of the rear case (102) are generally intended to enable the functions of the mobile terminal (100) to be diversified and expand the functions of the mobile terminal (100) to meet diversified consumer needs.

[0018] The antenna 200 has increased need for wireless communication with external devices and servers while diversifying functions of the mobile terminal 100. For example, an antenna (200) for receiving broadcast information such as Electronic Program Guide (EPG) of Digital Multimedia Broadcasting (DMB) or Electronic Service Guide (ESG) of Digital Video Broadcast-Handheld (DVB-H), Wibro, HSDPA, GSM, CDMA, WCDMA, an antenna (200) for wireless Internet such as LTE, etc., an antenna (200) for wireless Internet such as Bluetooth, Radio Frequency Identification (RFID), an antenna 200 for infrared data association (IrDA), Ultra Wideband (uwb), ZigBee near field communication, and the like is needed.

[0019] Such an antenna (200) is preferably formed in a large area for reception of radio waves and is preferably located on the surface side of the mobile terminal (100) so as not to be affected by other electronic components. Accordingly, as illustrated in FIG. 1C, the antenna 200 is disposed on the rear cover 103, which generally does not mount an electronic component and can secure a large area.

[0020] The antenna 200 of prior art document 1 mainly constitutes a flexible substrate 210, two kinds of patterns, and a magnetic sheet 230 as shown in FIG. 1 (c).

[0021] The pattern is divided into two kinds of high-frequency patterns 220 and low-frequency patterns 225. That is, the high-frequency pattern 220 is suitable for wireless communication, and the low-frequency pattern 225 is mainly suitable for wireless charging of the battery.

[0022] Radiocharger techniques used in mobile terminals (100) utilize electromagnetic induction principles.

[0023] Electromagnetic induction causes a current to flow to form a magnetic field, and when the mobile terminal 100 is placed thereon, a current flows through a low-frequency pattern mounted on the mobile terminal 100, i.e., a wireless charging coil 225, to charge.

[0024] The frequency may vary depending on the amount of power transmitted, but generally, the power used in small household appliances such as mobile terminal 100 may use a relatively low frequency to hundreds of kHz or less.

[0025] The wireless communication requires an antenna to perform functions such as Near Field Communication (NFC), Radio Frequency Identification (RFID), etc., in addition to transmission of radio waves for telephone calls, as a function of the mobile terminal 100 diversified. In particular, the frequencies used according to the wireless communication technology are different, and a relatively high frequency is used as compared to the frequencies used for wireless charging to transmit a large amount of data.

[0026] An example of a communication scheme in which the wireless communication antenna 200 of prior art document 1 is used includes Near Field Communication (NFC). Near field wireless communication is a contactless wireless communication module that utilizes about a 13.56 MHz frequency band as a kind of electronic tag (RFID).

[0027] A technology for transmitting data between terminals (100) at a close distance of approximately 10 to 40 cm is disclosed, which is a next-generation short-range communication technology having relatively excellent security and low cost because of a short communication distance. Both data reading

and writing can be used, setting is not necessary for a device period like Bluetooth, and a near field communication function is added to the mobile terminal 100 in recent years.

[0028] FIG. 2 (a) is an exemplary diagram showing an on-plane arrangement of an NFC antenna and a wpt resonator in a resonance type wireless power receiving system to which prior art document 2 (Publication No. 2013-0123310; resonance stage arrangement in a resonance type wireless power receiving system) is applied, and FIG. 2 (b) shows an arrangement of an NFC antenna and a wpt resonator on a portable terminal.

[0029] Referring to Figs. 2A and 2B, looking first at mechanical mounting states of NFC antenna 10 and WPT resonator 20 in a wireless power receiving system to which Prior Art Document 2 is applied, for example, a portable terminal, planarly a looped antenna structure is installed so that NFC antenna 10 is located inside WPT resonator 20 having a looped antenna structure.

[0030] In addition, NFC antenna 10 can be installed on the rear surface of main body 1 of the portable terminal (at a battery portion that can be detachably installed), and wpt antenna 20 can be installed on the rear surface cover 2 of the portable terminal.

[0031] In this case, isolation distances (isolation d, isolation h) may occur between the NFC antenna 10 and the WPT resonator 20. This separation distance mechanically determines isolation characteristics of both frequencies (13.56 MHz, 6.78 MHz) of NFC antenna (10) and WPT resonator (20).

[0032] FIG. 2C is a circuit diagram of a resonant stage device in a resonant type wireless power receiving system according to one embodiment of prior art document 2, and numeral 20 is a high impedance circuit.

[0033] Referring to Fig. 2c, a resonant stage device according to the features of prior art document 2 may connect a shunt capacitor 40 to a WPT resonator 20 in order to prevent harmonics emitted from a PA (not shown) from radiating to the outside.

[0034] Referring to prior art documents 1 and 2, WPT, NFC or RFID for wireless communication is well introduced. However, references to wireless charging efficiency of WPT are not addressed.

[0035] Referring to prior art related to wireless charging efficiency of wpt, the following are described.

[0036] One electromagnetic induction method of a contactless charging system of a WPT approaches a secondary coil on the side of a device (battery) to be charged to a primary coil provided in a transmitter (charger) to which alternating current power is supplied, and charges the device (battery) with an induction electromotive force generated by causing electromagnetic induction between the primary coil and the secondary coil.

[0037] WPT suggests several ways to increase efficiency of contactless charging.

[0038] The first method is to accurately maintain the position of the quantum coil by magnetic force by mounting a permanent magnet at the center of the transmitter (primary coil) and the receiver (secondary coil).

[0039] The second method is such that when a receiving unit (secondary coil) is raised on a transmitting unit (primary coil), the position of the secondary coil is detected and the primary coil is moved to the

position of the secondary coil by a stepping motor to fix the position of the primary coil with respect to the secondary coil.

[0040] The third method is a method in which a plurality of primary coils are installed in a transmitter and, when a secondary coil is raised thereto, a current is applied to the primary coil closest to the secondary coil so that an overlapping area of the quantum coils is maintained wide, thereby increasing an inductive power between the primary coil and the secondary coil.

[0041] Here, the second method has a limitation that the weight of the primary coil is limited in order to reduce the load received by the motor, and the third method has a problem that the size of the transmitter increases excessively due to the array structure of the primary coils, while limiting the size of each of the primary coils.

[0042] Therefore, although the first method of increasing charging efficiency by using magnets is most widely used in practice, when applied to devices, there are problems such as causing malfunctions to other devices due to magnetic interference.

[0043] Consequently, the problem mentioned above is solved and at the same time, a technique for increasing charging efficiency is necessary.

[0044] Korean Patent No. 10-2010-0074595, Korean Patent No. 10-1063154 and the like are prior art for improving charging efficiency of such a contactless charging system.

CITATION LIST

PATENT LITERATURE

[0045] Korean Publication No. 2013-0113222-Antenna and Mobile Terminal Having the Same
Korean Publication No. 2013-0123310-Resonant Stage Device in Resonant Type Wireless Power
Receiving System
Korean Publication No. 10-2010-0074595-Wireless Charging System and Method
Korean Registration No. 1063154-Korean Registration No. 1063154-contactless charging device

SUMMARY OF INVENTION

TECH PROBLEM

[0046] An object of the present invention is to replenish the wireless communication efficiency of a sub-loop pattern which does not consider only the wireless communication efficiency of the main loop pattern in one way even if a main region in which the main loop pattern is wound is located anywhere in the base film, The present invention provides a flexible circuit board for wireless communication, which is provided and further has a transverse end portion which is not connected to the main loop pattern, so that the wireless communication efficiency of both the main loop pattern and the sub loop pattern can be improved significantly.

[0047] The object of the present invention is to be an object of the present invention is to be an area where a main loop pattern is wound is pre-arranged as an area that can be matched with a primary coil of a wireless charger, so that even if a sub-area where a sub-loop pattern is wound is relatively contracted, NFC applied to the sub-loop pattern by expanding a relatively contracted occupation area through a transverse section across the transverse section without restricting the loop pattern to only a

sub-region of the base film and not connecting to a main loop pattern provided in the main region, To provide a flexible circuit board for wireless communication which complements the reduction in wireless communication efficiency of RFID or MST.

[0048] An object of the present invention is to provide a flexible circuit board for wireless communication, in which a WPT main loop pattern for reception power RX is accurately matched to a lower primary coil for transmission power TX even when the smartphone is transversely placed on a wireless charger, thereby maximizing charging of the smartphone to a battery by non-contact magnetic induction coupling.

[0049] An object of the present invention is to provide a flexible circuit board for wireless communication which makes it possible to increase wireless communication efficiency by making the radius of a sub-loop pattern larger.

TECH SOLUTION

[0050] In order to achieve the above object, the present invention provides a process comprising:

[0051] A flexible circuit board for wireless communication, comprising: a flexible base film; and a main loop pattern and a sub loop pattern provided on the base film,

[0052] Wherein the main loop pattern is provided in a main region of the base film, and

[0053] Wherein the sub-loop pattern is provided in a sub-region of the base film, is provided in the main region, and has a transverse end that crosses without being connected to the main loop pattern.

ADVANTAGEOUS EFFECTS

[0054] The present invention replenishes the wireless communication efficiency of the sub-loop pattern, which does not consider only the wireless communication efficiency of the main loop pattern in one way even if a main region around which the main loop pattern is wound, is located at any place of the base film: In order to further improve the wireless communication efficiency of both the main loop pattern and the sub-loop pattern, while being provided in the sub-region to further have a transverse portion which is not connected to the main loop pattern.

[0055] According to the present invention, a main area in which a main loop pattern is wound is pre-arranged as an area capable of matching with a primary coil of a wireless charger, so that even if a sub-area in which a sub-loop pattern is wound is relatively contracted, the sub-loop pattern NFC applied to a sub-loop pattern by expanding a relatively contracted occupation area through a transverse section across the transverse section without being limited to only a sub-region of the base film and not being connected to a main loop pattern provided in the main region, It is possible to supplement the reduction of wireless communication efficiency of RFID or MST.

[0056] According to the present invention, the outermost diameter of the main loop pattern wound around the main region is expanded to approach the size of the width of the base film, thereby greatly improving wireless charging efficiency by maximizing non-contact magnetic induction coupling force with the primary coil of the wireless charger.

[0057] Even when a smartphone is transversely placed on a wireless charger, a main loop pattern for a reception power RX is accurately matched to a lower primary coil for a transmission power TX, thereby maximizing charging of the smartphone to a battery by non-contact magnetic induction coupling.

[0058] The present invention provides an upper main loop pattern wound on an upper portion of a main region as a main loop pattern, completing a closed loop of a char perfectly matched with a primary coil of a wireless charger to maximize non-contact magnetic induction coupling force, As a sub-loop pattern, an expanded closed loop wound around a lower portion of the sub-region and connected to a lower transverse portion is formed, thereby enabling complementary compensation of wireless communication efficiency.

[0059] The present invention can maximize wireless communication efficiency (wireless charging efficiency of WPT) by increasing the number of turns, instead of reducing the resistance by increasing the number of turns, since the main loop pattern is stacked up and down to an upper main loop pattern as well as a lower main loop pattern through a via hole.

[0060] The present invention can maximize wireless communication efficiency (near field data communication efficiency of NFC, RFID, or MST) by increasing the number of turns, instead of decreasing the resistance by increasing the number of turns, since the sub-loop pattern is stacked up and down in parallel not only to a lower sub-loop pattern but also to an upper sub-loop pattern through a via hole.

[0061] The present invention can increase wireless communication efficiency by increasing the radius of the sub-loop pattern.

[0062] According to the present invention, by applying a main magnetic sheet and a sub magnetic sheet having a substantially bisected form of a base film, a double action effect in which efficiency of WPT or NFC, RFID and MST is high and loss of the magnetic sheet is relatively reduced can be obtained.

[0063] A third loop pattern is formed so that the main loop pattern is utilized as a WPT, the sub loop pattern is utilized as NFC or RFID, and the third loop pattern is utilized as an MST.

DESCRIPTION OF DRAWINGS

[0064] Fig. 1A is a block schematic diagram of a mobile terminal in connection with prior art document 1. FIG. 1B is a rear perspective view of a mobile terminal according to prior art document 1. FIG. 1C is a plan view showing the antenna according to prior art document 1 attached to the rear cover of the mobile terminal. FIG. 2A is an exemplary diagram illustrating an on-plane arrangement of an NFC antenna and a WPT resonator in a resonant type wireless power receiving system to which prior art document 2 is applied. FIG. 2B is a structure diagram showing an arrangement structure of NFC antenna and WPT resonator of prior art document 2 on a portable terminal. FIG. 2C is a circuit diagram of a resonant stage device in a resonant type wireless power receiving system according to one embodiment of prior art document 2. Figure 3 (a) is a photograph and an image showing a general wireless communication flexible circuit board. FIG. 3B is a conceptual diagram illustrating a wireless charger. Figure 3 (c) is a conceptual diagram showing a smartphone equipped with a general wireless flexible circuit board. FIG. 3D is a conceptual diagram illustrating a view of a general smartphone being longitudinally subjected to a wireless charger. FIG. 3E is a conceptual diagram illustrating a view of a general smartphone transversely subjected to a wireless charger. FIG. 4A is a surface view showing a flexible circuit board for wireless communication according to an embodiment of the present invention.

FIG. 4B is a rear view illustrating a flexible circuit board for wireless communication according to an embodiment of the present invention. FIG. 5A is a photograph and an image showing a flexible circuit board for wireless communication according to an embodiment of the present invention. FIG. 5B is a conceptual diagram illustrating a wireless charger. FIG. 5C is a conceptual diagram showing a smartphone equipped with a flexible circuit board for wireless communication according to the present invention. FIG. 5 (d) is a conceptual diagram showing a view of vertically passing a smartphone to which a flexible circuit board for wireless communication according to the present invention is applied on a wireless charger. FIG. 5 (e) is a conceptual diagram showing a view of a smartphone to which a flexible circuit board for wireless communication according to the present invention is applied transversely to a wireless charger. FIG. 6 is a photograph showing a general wireless communication flexible circuit board and a magnetic sheet. FIG. 7 is a photograph showing a flexible circuit board for wireless communication and a magnetic sheet according to the present invention. FIG. 8A is a surface view showing a flexible circuit board for wireless communication according to another embodiment of the present invention. FIG. 8B is a rear view showing a flexible circuit board for wireless communication according to another embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0065] Hereinafter, a preferred embodiment of a flexible circuit board for wireless communication according to the present invention will be described with reference to the drawings, and there may be a plurality of embodiments, and objects, features and advantages of the present invention can be better understood through such embodiments.

[0066] FIG. 3A is a photograph and an image showing a general flexible circuit board for wireless communication, wherein when the photograph (a) of FIG. 3A, a main loop pattern 10 for WPT and a sub loop pattern 20 for NFC can be identified in a flexible base film 40; It can also be confirmed that when the main loop pattern 10 is wound around the center region 43 of the base film 40, the sub loop pattern 20 is wound around the outer region 44 of the base film 40 spaced apart from the main loop pattern 10.

[0067] In this case, it is generally possible that the main loop pattern 10 for WPT is centered at the center of the base film 40, that is, wound around the center region 43, and this is shown as an image as shown in FIG. 3A (b) (the image of the sub-loop pattern 20 for NFC is omitted for convenience of explanation).

[0068] FIG. 3B is a concept view illustrating a wireless charger m showing a primary coil M1 for non-contact magnetic induction coupling (in which the primary coil M1 is double-arranged to constitute a primary multiple coil) for transmission power TX, FIG. 3C is a conceptual diagram illustrating a smartphone h on which a general wireless communication flexible circuit board is mounted, and can be coupled to a primary coil M1 of the wireless charger m of FIG. 3B by non-contact magnetic induction to confirm a wireless communication flexible circuit board (which can be referred to as a secondary coil) for receiving power RX.

[0069] FIG. 3 (d) is a conceptual diagram illustrating a general smartphone h longitudinally placed on a radio charger m, and FIG. 3 (e) is a conceptual diagram illustrating a general smartphone h laterally placed on a radio charger M.

[0070] Longitudinally resting the smartphone h on the radiocharger m as shown in Fig. 3d, most users are in alignment with the outer shape of the radiocharger m and the outer shape of the smartphone h in mutual position; In this case, a main loop pattern 10 for WPT of a wireless communication flexible circuit board for receiving power RX is matched with an upper primary coil M1 for transmitting power TX to enable charging of a smartphone h into a battery by non-contact magnetic induction coupling.

[0071] However, when the smartphone h is placed laterally on the radio charger m as shown in Fig. 3E, most users are placed in alignment with the outer shape of the radio charger m and the outer shape of the smartphone h each other; In this case, the WPT main loop pattern 10 of the wireless communication flexible circuit board for the reception power RX must be matched to the lower primary coil M1 for the transmission power TX, and when the smart phone h is not normally charged by non-contact magnetic induction coupling, as shown in FIG. 3 (e), charging efficiency is greatly reduced.

[0072] In view of this phenomenon, a user must hold the smartphone h on the left side of the wireless charger m, and in a user entry where the position of the flexible circuit board for wireless communication is not accurately recognized, only the position of the external shape of the smartphone h and the external shape of the wireless charger m can be reflectively highly focused.

[0073] For reference, the camera module, the home key, etc., shown not, are disposed on the back cover of the smartphone h, and the flexible circuit board for wireless communication, etc., as well as the battery are not positioned at the center, but are mainly pushed downward.

[0074] FIG. 4A is a surface view showing a flexible circuit board for wireless communication according to an embodiment of the present invention, and FIG. 4B is a rear view showing a flexible circuit board for wireless communication according to an embodiment of the present invention.

[0075] A flexible circuit board for wireless communication according to an embodiment of the present invention includes a flexible base film 40 as shown in figs. 4 a and 4 b, and a main loop pattern 10 and a sub loop pattern 20 provided on the base film 40, wherein the main loop pattern 10 is utilized as a WPT (WPT), The main region 41 may be any region of the base film 40 that can be centered on the primary coil M1 of the radio charger m, the sub-loop pattern 20 is utilized as NFC, RFID, or MST, and the sub-region 42 may be any region of the base film 40 other than the main region 41.

[0076] In this case, the main loop pattern 10 may be provided in the main region 41 of the base film 40, Since the main region 41 is a region that can be matched with the primary coil M1 of the wireless charger m (a region that can maximize wireless charging efficiency), a camera module, a home key, and the like are disposed on the back cover of the smartphone h, In consideration of the fact that the flexible circuit board or the like is not positioned at the center and is mainly pushed downward, it can be exemplified to eccentrically occupy the upper portion of the base film 40 as shown in figs. 4A and 4B.

[0077] In this case, the winding range of the sub-loop pattern 20 can be relatively contracted, and in particular consideration of this problem, the sub-loop pattern 20 has a cross section 23 which is provided in the sub-region 42 of the base film 40 and crosses without being connected to the main loop pattern 10 provided in the main region 41.

[0078] That is, Since the main region 41 around which the main loop pattern 10 is wound is pre-disposed as a region that can be matched with the primary coil M1 of the radio charger m, even if the sub-region 42 around which the sub-loop pattern 20 is wound is relatively contracted, NFC applied to a sub-loop

pattern 20 by expanding a relatively contracted occupation area through a transverse cross section 23 without being limited to only a sub-region 42 of a base film 40 and not being connected to a main loop pattern 10 provided in a main region 41, To supplement the reduction of wireless communication efficiency of RFID or MST.

[0079] Preferably, the main loop pattern 10 can be closely matched with the primary coil M1 of the wireless charger m by forming a circle in the main region 41, and the sub-loop pattern 20 can be connected to the transverse portion 23 and form a closed loop, thereby making it possible to supplement the complementary wireless communication efficiency, In particular, the outermost diameter of the main loop pattern 10 wound around the main region 41 is expanded to approach the size of the width of the base film 40, so that wireless charging efficiency can be greatly improved by maximum non-contact magnetic induction coupling power with the primary coil M1 of the wireless charger M.

[0080] Although the main loop pattern 10 is described as a Charter, the main loop pattern 10 is of course possible as long as it can take an oval shape, a polygon shape, or the like.

[0081] FIG. 5A is a photograph and an image showing a flexible circuit board for wireless communication according to an embodiment of the present invention. when viewing the photograph (a) of FIG. 5A, a main loop pattern 10 for WPT and a sub loop pattern 20 for NFC, RFID, or MST can be identified in a flexible base film 40, For example, it can be confirmed that when the sub-loop pattern 20 is wound eccentrically to the base film 40 so as to be matched to the primary coil M1 of the radio charger m, the sub-loop pattern 20 is wound in a closed loop while being provided in the sub-region 42 of the base film 40 and further having a transverse portion 23 crossing without being connected to the main loop pattern 10 provided in the main region 41.

[0082] In this case, the main loop pattern 10 for the WPT is wound around the eccentric main region 41 of the base film 40 so as to be registered with the primary coil M1 of the radio charger m, and this can be illustrated as shown as (b) in FIG. 5A (an image of the sub-loop pattern 20 for NFC, RFID, or MST is omitted for convenience of explanation).

[0083] FIG. 5B is a conceptual diagram illustrating a wireless charger m showing a primary coil M1 (in which the primary coil M1 is double-arranged to constitute a primary multiple coil) for non-contact magnetic induction coupling for transmission power TX, FIG. 5C is a concept view illustrating a smartphone h on which a flexible circuit board for wireless communication according to the present invention is mounted, and capable of confirming a flexible circuit board (which may be referred to as a secondary coil) for receiving power RX by non-contact magnetic induction coupling with a primary coil M1 of the wireless charger m of FIG. 5B.

[0084] FIG. 5D is a conceptual diagram showing a view of vertically passing a smartphone h to which a flexible circuit board for wireless communication according to the present invention is applied, and FIG. 5E is a conceptual diagram showing a view of transversely passing a smartphone h to which a flexible circuit board for wireless communication according to the present invention is applied.

[0085] Longitudinally resting the smartphone h on the radiocharger m as shown in FIG. 5D, most users are in alignment with the outer shape of the radiocharger m and the outer shape of the smartphone h in mutual position; When this is done, the WPT main loop pattern 10 of the wireless communication

flexible circuit board of the present invention for receiving power RX is completely matched to the upper primary coil M1 for transmitting power TX, thereby realizing charging of a smartphone h into a battery by non-contact magnetic induction coupling [Maximum charging efficiency with full matching].

[0086] And when the smartphone h is placed laterally on the radio charger m as shown in Fig. 5E, most users are placed in alignment with each other in position between the outer shape of the radio charger m and the outer shape of the smartphone h; Even if this is the case, a main loop pattern 10 for WPT of a wireless communication flexible circuit board of the present invention for receiving power RX is correctly matched to a lower primary coil M1 for transmitting power TX, thereby realizing charging of a smartphone h into a battery by non-contact magnetic induction coupling [Maximum charging efficiency with correct matching].

[0087] As such, The flexible circuit board for wireless communication according to the present invention is characterized in that the wireless communication efficiency of the sub-loop pattern 20, which does not consider only the wireless communication efficiency of the main loop pattern 10 in one way even when a main region 41 around which the main loop pattern 10 is wound, is located at any position of a base film 40. In order to achieve this, it is possible to further improve wireless communication efficiency of both the main loop pattern 10 and the sub loop pattern 20 by further having a transverse end 23 which is not connected to the main loop pattern 10 provided in the main region 42 and is not connected to the main loop pattern 10 provided in the main region 41.

[0088] More specifically, the main loop pattern 10 includes an upper main loop pattern 11 wound on an upper portion of the main region 41, the transverse end 23 includes a lower transverse end 23 a provided on a lower portion of the main region 41 so as not to be connected to the upper main loop pattern 11, The sub-loop pattern 20 includes a lower sub-loop pattern 22 wound around a lower portion of the sub-region 42 and connected to a lower transverse portion 23 a.

[0089] An upper main loop pattern 11 wound on an upper portion of a main region 41 is provided as a main loop pattern 10 to complete a closed loop of a char perfectly matched with a primary coil M1 of a radio charger m to maximize a non-contact magnetic induction coupling force, As the sub-loop pattern 20, an expanded closed loop wound around a lower portion of the sub-region 42 and connected to a lower transverse portion 23 a can be formed, thereby making it possible to supplement complementary wireless communication efficiency.

[0090] Preferably, the main loop pattern 10 may further include a lower main loop pattern 12 wound on a lower portion of the main region 41 while being connected to the upper main loop pattern 11 through the via hole V so as not to be connected to the lower transverse end 23a, The sub-loop pattern 20 may further include an upper sub-loop pattern 21 wound on top of the sub-region 42 while being connected to the lower sub-loop pattern 22 through the via hole V so as not to be connected to the upper main loop pattern 11.

[0091] Since the main loop pattern 10 is stacked up and down to the lower main loop pattern 12 through the via hole V as well as the upper main loop pattern 11, inductance can be increased instead of reducing resistance by increasing the number of turns, that is, relatively increasing inductance versus resistance, thereby maximizing wireless communication efficiency (wireless charging efficiency of WPT), Since the sub-loop pattern 20 is stacked up and down to the lower sub-loop pattern 22 as well as the upper sub-loop pattern through the via hole V, it is possible to maximize wireless communication

efficiency (near field data communication efficiency of NFC, RFID, or MST), instead of reducing resistance by increasing the number of turns by increasing inductance, that is, relatively increasing inductance compared to resistance.

[0092] On the other hand, when the main loop pattern 10 crosses the central region 41 a of the unwound main region 41, the transverse portion 23 further includes a lower central transverse portion 23 b provided below the central region 41 a, so as to ultimately increase the radius of the sub-loop pattern 20 and increase the wireless communication efficiency.

[0093] Furthermore, the transverse end 23 may further include an upper central transverse end 23 c connected to the lower central transverse end 23 b through the via hole V. The sub-loop pattern 20 may further include an upper sub-loop pattern 21 wound on an upper portion of the sub-region 42 and connected to the lower sub-loop pattern 22 through the via hole V so as not to be connected to the upper main loop pattern 11, thereby further increasing the radius of the sub-loop pattern 20.

[0094] Meanwhile, the main loop pattern 10, which is not specifically described in the present disclosure, is connected to the external main start terminal S1 and the main end terminal E1, and the sub loop pattern 20 is also connected to the external sub start terminal S2 and the sub end terminal E2, and this technical explanation will not be described in detail.

[0095] FIG. 6 is a photograph showing a general wireless communication flexible circuit board and a magnetic sheet.

[0096] In a general wireless communication flexible circuit board, a magnetic sheet f is attached so as to serve as shielding a magnetic field, and conventionally, a main loop pattern 10 for WPT and a sub loop pattern 20 for NFC have been taken to attach a single magnetic sheet f despite different frequencies and uses.

[0097] For example, a magnetic sheet f constituting a magnetic body having a high magnetic permeability and a high saturation magnetic flux suitable for the main loop pattern 10 for WPT is matched to the area of the main loop pattern 10. When the area of the sub-loop pattern 20 is matched to the area of the sub-loop pattern 20 in order to use the magnetic sheet f constituting the magnetic body having low loss characteristics suitable for the sub-loop pattern 20 for NFC, the magnetic sheet f constituting the magnetic body for NFC cannot be used by striking the center, so that economic efficiency due to loss of the magnetic sheet f itself cannot be ensured.

[0098] FIG. 7 is a photograph showing a flexible circuit board and a magnetic sheet for wireless communication according to the present invention.

[0099] A magnetic sheet f is attached to a flexible circuit board for wireless communication according to the present invention so as to serve as shielding a magnetic field. the magnetic sheet f is attached to a lower portion of a base film 40 by actively utilizing different frequencies and uses of a main loop pattern 10 for WPT and a sub loop pattern 20 for NFC, RFID, or MST. The magnetic sheet f can be divided into a main magnetic sheet F1 attached to a lower portion of the main region 41 and a sub magnetic sheet F2 attached to a lower portion of the sub region 42, respectively.

[0100] For example, in order to use a main magnetic sheet F1 forming a magnetic body with high magnetic permeability and high saturation magnetic flux suitable for a main loop pattern 10 for WPT, an

area of the main loop pattern 10 is set to a wound main region 41, When a sub-loop pattern (20) is fitted to a wound sub-region (42) in order to use a sub-magnetic sheet (F2) constituting a magnetic material having low loss characteristics suitable for a sub-loop pattern (20) for RFID or MST and having a magnetic permeability of between tens and hundreds, The base film (40) can be simply made of a main magnetic sheet (F1) and a sub magnetic sheet (F2) in a substantially bisected form, so that the efficiency of the wpt or NFC, RFID, and MST can be increased and the loss of the magnetic sheet (f) can be obtained.

[0101] FIG. 8A is a surface view showing a flexible circuit board for wireless communication according to another embodiment of the present invention, and FIG. 8B is a rear view showing a flexible circuit board for wireless communication according to another embodiment of the present invention.

[0102] The flexible circuit board for wireless communication according to another embodiment of the present invention may further include a third loop pattern 30 which occupies a main region 41 and a sub-region 42 together as shown in figs. 8A and 8B, The third loop pattern (30) may be wound while selectively passing through an upper portion and a lower portion of the base film (40) through the via hole (V), wherein the third loop pattern (30) may further have a third transverse end (31) crossing without being connected to the main loop pattern (10) or the sub loop pattern (20), Furthermore, the main loop pattern 10 may be utilized as WPT, the sub-loop pattern 20 may be utilized as NFC or RFID, and the third loop pattern 30 may be utilized as MST. conversely, the main loop pattern 10 may be utilized as WPT, the sub-loop pattern 20 may be utilized as MST, and the third loop pattern 30 may be utilized as NFC or RFID.

[0103] Such a third loop pattern 30 is performed within the actions and effects of the main loop pattern 10 and the sub-loop pattern 20, which are key technologies of the present disclosure, and is not limited to greatly the structure and shape thereof, and specific explanation thereof will also be omitted.

[0104] Meanwhile, the third loop pattern 30, which is not specifically described in the present disclosure, may be connected to the external third start terminal S3 and the third end terminal E3, and since such technical description is also known, detailed description will be omitted.

[0105] On the other hand, Near Field Communication (NFC) or Radio Frequency Identification (RFID) is for transmitting data between terminals with Non-Contact Magnetic Inductive Coupling Power in a frequency band of 13.56 MHz at a distance close to approximately 10 to 40 cm, Magnetic Secure Transmission (MST) is a known technology for transmitting data between external terminals with non-contact magnetic induction coupling force in a frequency band of 13.56 MHz at a near field of 10 to 200 cm, and will not be described in detail below.

INDUSTRIAL APPLICABILITY

[0106] The present invention can be used in the industry of mobile terminals such as tablet PC or smart phone.

REFERENCE SIGNS LIST

[0107] 10: main loop pattern 11: upper main loop pattern 12: lower main loop pattern S1: main start terminal E1: Main end terminal 20: sub-loop pattern 21: upper sub-loop pattern 22: lower sub-loop pattern 23: Transverse end portion 23 a: lower transverse end portion 23 b: lower central transverse

end portion 23 c: upper central transverse end portion S2: sub start terminal E2: sub end terminal 30:
third loop pattern 31: Third transverse end portion S3: third start terminal E3: third end terminal 40:
base film 41: Main region 41 a: center region 42: sub-region 43: center region 44: Outer region V: via
hole m: wireless charger M1: primary coil f: magnetic sheet F1: main magnetic sheet F2: sub magnetic
sheet h: smartphone



(19) 대한민국특허청(KR)
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(73) 특허권자

주식회사 아이애크

경기도 파주시 월롱면 엘지로 274-43

(72) 발명자

박정일

경기도 성남시 분당구 궁내로40번길 36 (궁내동)

박종진

전라북도 전주시 완산구 신촌2길 20 4동 302호

(중화산동2가, 한신코아아파트)

(74) 대리인

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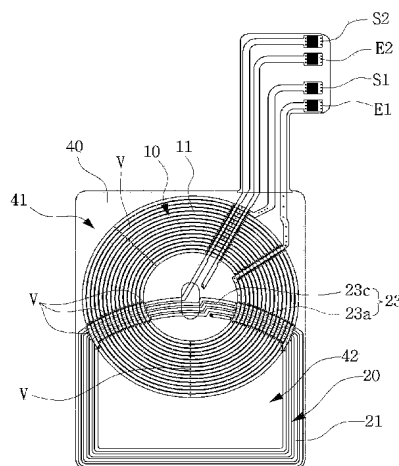
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(54) 발명의 명칭 무선통신용 플렉시블 회로기판

(57) 요약

본 발명은 메인 루프패턴(10)이 권회되는 메인영역(41)이 베이스필름(40)의 어느 곳에 위치되더라도 일방적으로 메인 루프패턴(10)의 무선통신 효율만을 고려하는 것이 아닌 서브 루프패턴(20)의 무선통신 효율 역시 보완 보충토록 하기 위하여 서브영역(42)에 마련되면서도 메인영역(41)에 마련된 메인 루프패턴(10)에 접속되지 않으면서 가로지르는 횡단부(23)를 더 가지도록 하여 메인 루프패턴(10) 및 서브 루프패턴(20) 모두의 무선통신 효율을 더욱 크게 향상시킬 수 있도록 한 무선통신용 플렉시블 회로기판에 관한 것이다.

도면도 - 도4a



명세서

청구범위

청구항 1

삭제

청구항 2

플렉시블한 베이스필름(40)과, 상기 베이스필름(40)에 마련된 메인 루프패턴(10) 및 서브 루프패턴(20)을 포함하는 무선통신용 플렉시블 회로기판에 있어서,

상기 메인 루프패턴(10)은 상기 베이스필름(40)의 메인영역(41)에 마련되고,

상기 서브 루프패턴(20)은 상기 베이스필름(40)의 서브영역(42)에 마련됨과 동시에 상기 메인영역(41)에 마련된 상기 메인 루프패턴(10)에 접속되지 않으면서 가로지르는 횡단부(23)를 더 가지고,

상기 메인 루프패턴(10)은 상기 메인영역(41)의 상부에 권회되는 상부 메인루프패턴(11)을 구비하고,

상기 횡단부(23)는 상기 상부 메인루프패턴(11)에 접속되지 않도록 상기 메인영역(41)의 하부에 마련된 하부 횡단부(23a)를 구비하고,

상기 서브 루프패턴(20)은 상기 서브영역(42)의 하부에 권회되면서 상기 하부 횡단부(23a)에 연결되는 하부 서브루프패턴(22)을 구비하는 것을 특징으로 하는 무선통신용 플렉시블 회로기판.

청구항 3

제 2 항에 있어서,

상기 메인 루프패턴(10)은 상기 하부 횡단부(23a)에 접속되지 않도록 비아홀(V)을 통해 상기 상부 메인루프패턴(11)에 연결되면서 상기 메인영역(41)의 하부에 권회되는 하부 메인루프패턴(12)을 더 구비하는 것을 특징으로 하는 무선통신용 플렉시블 회로기판.

청구항 4

제 2 항에 있어서,

상기 서브 루프패턴(20)은 상기 상부 메인루프패턴(11)에 접속되지 않도록 비아홀(V)을 통해 상기 하부 서브루프패턴(22)에 연결되면서 상기 서브영역(42)의 상부에 권회되는 상부 서브루프패턴(21)을 더 구비하는 것을 특징으로 하는 무선통신용 플렉시블 회로기판.

청구항 5

제 2 항에 있어서,

상기 횡단부(23)는 상기 메인 루프패턴(10)이 권회되지 않은 상기 메인영역(41)의 중심영역(41a)까지 가로지를 경우 상기 중심영역(41a)의 하부에 마련되는 하부 중심횡단부(23b)를 더 구비하는 것을 특징으로 하는 무선통신용 플렉시블 회로기판.

청구항 6

제 5 항에 있어서,

상기 횡단부(23)는 비아홀(V)을 통해 상기 하부 중심횡단부(23b)에 연결되는 상부 중심횡단부(23c)를 더 구비하고,

상기 서브 루프패턴(20)은 상기 상부 메인루프패턴(11)에 접속되지 않도록 비아홀(V)을 통해 상기 하부 서브루프패턴(22)에 연결되면서 상기 서브영역(42)의 상부에 권회되는 상부 서브루프패턴(21)을 더 구비하는 것을 특징으로 하는 무선통신용 플렉시블 회로기판.

청구항 7

제 2 항 내지 제 6 항 중 어느 한 항에 있어서,

상기 메인 루프패턴(10)은 WPT로 활용되고,

상기 메인영역(41)은 무선충전기(M)의 1차코일(M1)에 센터링될 수 있는 상기 베이스필름(40)의 어느 한 영역이고,

상기 서브 루프패턴(20)은 NFC, RFID 또는 MST로 활용되고,

상기 서브영역(42)은 상기 메인영역(41) 이외의 상기 베이스필름(40)의 어느 한 영역인 것을 특징으로 하는 무선통신용 플렉시블 회로기판.

청구항 8

제 7 항에 있어서,

상기 메인영역(41)에 권회된 상기 메인 루프패턴(10)의 최외곽 직경은 상기 베이스필름(40)의 폭의 크기에 근접되도록 확장 구현되는 것을 특징으로 하는 무선통신용 플렉시블 회로기판.

청구항 9

제 2 항 내지 제 6 항 중 어느 한 항에 있어서,

상기 베이스필름(40)의 하부에 자성시트(F)가 부착되고,

상기 자성시트(F)는 상기 메인영역(41)의 하부에 부착되는 메인 자성시트(F1)와, 상기 서브영역(42)의 하부에 부착되는 서브 자성시트(F2)로 각각 분할되는 것을 특징으로 하는 무선통신용 플렉시블 회로기판.

청구항 10

제 7 항에 있어서,

상기 베이스필름(40)의 하부에 자성시트(F)가 부착되고,

상기 자성시트(F)는 상기 메인영역(41)의 하부에 부착되는 메인 자성시트(F1)와, 상기 서브영역(42)의 하부에 부착되는 서브 자성시트(F2)로 각각 분할되는 것을 특징으로 하는 무선통신용 플렉시블 회로기판.

청구항 11

제 2 항 내지 제 6 항 중 어느 한 항에 있어서,

상기 메인영역(41) 및 서브영역(42)을 함께 점유한 제 3의 루프패턴(30)을 더 포함하는 것을 특징으로 하는 무선통신용 플렉시블 회로기판.

청구항 12

제 11 항에 있어서,

상기 제 3의 루프패턴(30)은 비아홀(V)을 통해 상기 베이스필름(40)의 상부 및 하부를 선택적으로 경유하면서 권회되는 것을 특징으로 하는 무선통신용 플렉시블 회로기판.

청구항 13

제 12 항에 있어서,

상기 제 3의 루프패턴(30)은 상기 메인 루프패턴(10) 또는 서브 루프패턴(20)에 접속되지 않으면서 가로지르는 제 3의 횡단부(31)를 더 가지는 것을 특징으로 하는 무선통신용 플렉시블 회로기판.

청구항 14

제 13 항에 있어서,

상기 메인 루프패턴(10)은 WPT로 활용되고,

상기 서브 루프패턴(20)은 NFC 또는 RFID로 활용되고,

상기 제 3의 루프패턴(30)은 MST로 활용되는 것을 특징으로 하는 무선통신용 플렉시블 회로기판.

청구항 15

제 13 항에 있어서,

상기 메인 루프패턴(10)은 WPT로 활용되고,

상기 서브 루프패턴(20)은 MST로 활용되고,

상기 제 3의 루프패턴(30)은 NFC 또는 RFID로 활용되는 것을 특징으로 하는 무선통신용 플렉시블 회로기판.

발명의 설명

기술 분야

[0001] 본 발명은 무선통신용 플렉시블 회로기판에 관한 것으로, 더욱 상세하게는 메인 루프패턴이 권회되는 메인영역이 베이스필름의 어느 곳에 위치되더라도 일방적으로 메인 루프패턴의 무선통신 효율만을 고려하는 것인 아닌 서브 루프패턴의 무선통신 효율 역시 보완 보충토록 하기 위하여 서브영역에 마련되면서도 메인 루프패턴에 접속되지 않으면서 가로지르는 횡단부를 더 가지도록 하여 메인 루프패턴 및 서브 루프패턴 모두의 무선통신 효율을 더욱 크게 향상시킬 수 있도록 하는 무선통신용 플렉시블 회로기판에 관한 것이다.

배경 기술

[0002] 일반적으로 휴대 단말기는 휴대전화에 인터넷 통신과 정보검색 등 컴퓨터 지원 기능을 추가한 지능형 단말기로서 화면을 디스플레이하는 윈도우를 보면서 인터넷 및 다양한 애플리케이션(응용프로그램)을 활용할 수 있도록 하는 스마트 폰 등을 한 예로 들 수 있다.

[0003] 선행기술문헌 1로서 공개특허 제2013-0113222호(안테나 및 이를 구비한 이동 단말기)를 소개할 수 있다.

[0004] 도 1a는 선행기술문헌 1과 관련된 이동 단말기의 블록 구성도(block diagram)이다.

[0005] 이동 단말기(100)는 도 1a에 도시된 바와 같이 무선 통신부(110), A/V(Audio/Video) 입력부(120), 사용자 입력부(130), 센싱부(140), 출력부(150), 메모리(160), 인터페이스부(170), 제어부(180) 및 전원 공급부(190) 등을 포함할 수 있다.

[0006] 무선 통신부(110)는 방송 수신 모듈(111), 이동통신 모듈(112), 무선 인터넷 모듈(113), 근거리 통신 모듈(114) 및 위치정보 모듈(115) 등을 포함할 수 있고, A/V(Audio/Video) 입력부(120)는 오디오 신호 또는 비디오 신호 입력을 위한 것으로, 카메라(121)와 마이크(122) 등이 포함될 수 있으며, 사용자 입력부(130)는 이동 단말기(100)의 전·후면 또는 측면에 위치하는 버튼(136), 터치 센서(정압/정전; 137)로 구성될 수 있다.

[0007] 센싱부(140)는 이동 단말기(100)의 개폐 상태, 이동 단말기(100)의 위치, 사용자 접촉 유무, 이동 단말기의 방위, 이동 단말기의 가속/감속 등과 같이 이동 단말기(100)의 현 상태를 감지하여 이동 단말기(100)의 동작을 제어하기 위한 센싱 신호를 발생시키고, 근접 센서(141)를 포함할 수 있으며, 출력부(150)는 시각, 청각 또는 촉각 등과 관련된 출력을 발생시키기 위한 것으로, 이에는 디스플레이부(151), 음향 출력 모듈(152), 알람부(153) 및 햅틱 모듈(154) 등이 포함될 수 있다.

[0008] 메모리부(160)는 제어부(180)의 처리 및 제어를 위한 프로그램이 저장될 수도 있고, 입/출력되는 데이터들(예를 들어, 전화번호부, 메시지, 오디오, 정지영상, 동영상 등)의 임시 저장을 위한 기능을 수행할 수도 있다.

[0009] 인터페이스부(170)는 이동 단말기(100)에 연결되는 모든 외부기기와의 통로 역할을 한다. 인터페이스부(170)는 외부 기기로부터 데이터를 전송받거나, 전원을 공급받아 이동 단말기(100) 내부의 각 구성 요소에 전달하거나,

이동 단말기(100) 내부의 데이터가 외부 기기로 전송되도록 한다. 예를 들어, 유/무선 헤드셋 포트, 외부 충전기 포트, 유/무선 데이터 포트, 메모리 카드(memory card) 포트, 식별 모듈이 구비된 장치를 연결하는 포트, 오디오 I/O(Input/Output) 포트, 비디오 I/O(Input/Output) 포트, 이어폰 포트 등이 인터페이스부(170)에 포함될 수 있다.

- [0010] 제어부(controller; 180)는 통상적으로 이동 단말기의 전반적인 동작을 제어한다. 예를 들어 음성 통화, 데이터 통신, 화상 통화 등을 위한 관련된 제어 및 처리를 수행한다. 제어부(180)는 멀티 미디어 재생을 위한 멀티미디어 모듈(181)을 구비할 수도 있다.
- [0011] 전원 공급부(190)는 제어부(180)의 제어에 의해 외부의 전원, 내부의 전원을 인가받아 각 구성요소들의 동작에 필요한 전원을 공급한다.
- [0012] 전원 공급부(190)는 예를 들어 배터리, 연결포트, 전원공급제어부 및 충전모니터링부를 포함할 수 있다.
- [0013] 도 1b는 선행기술문헌 1에 따른 이동 단말기의 후면 사시도이다.
- [0014] 도 1b를 참조하면, 단말기 바디의 후면 즉, 리어 케이스(102)에는 카메라(121')가 추가로 장착될 수 있다. 카메라(121')에 인접하게는 플래쉬(123)와 기울(124)이 추가로 배치될 수 있다. 플래쉬(123)는 카메라(121')로 피사체를 촬영하는 경우에 피사체를 향해 빛을 비추게 된다.
- [0015] 도 1c는 선행기술문헌에 따른 안테나(200)가 이동 단말기(100)의 후면커버(103)에 부착된 것을 도시한 평면도이다.
- [0016] 도 1a 내지 도 1c를 참조하면, 프론트 케이스(101), 리어 케이스(102), 후면커버(또는 배터리 커버; 103), 카메라(121'), 인터페이스부(170), 마이크(122), 음향출력부(152'), 배터리(191), 배터리 장착부(104), USIM카드 장착부(105), 메모리카드 장착부(106)가 도시되어 있다.
- [0017] 리어 케이스(102) 표면에는 배터리 장착부(104), USIM카드 장착부(105) 및 메모리카드 장착부(106)와 같은 외장 부품이 실장될 수 있는 공간을 구비할 수 있다. 일반적으로 리어 케이스(102)의 표면에 실장되는 외장부품은 이동 단말기(100)의 기능이 다양화되고 다양해진 소비자의 요구를 충족시키기 위해 이동 단말기(100)의 기능을 확장할 수 있도록 하기 위함이다.
- [0018] 안테나(200)는 이동 단말기(100)의 기능이 다양화되면서 외부 장치 및 서버와 무선 통신을 할 필요성이 높아졌다. 예를 들면, DMB(Digital Multimedia Broadcasting)의 EPG(Electronic Program Guide) 또는 DVB-H(Digital Video Broadcast-Handheld)의 ESG(Electronic Service Guide) 등의 방송정보를 수신하기 위한 안테나(200), Wibro, HSDPA, GSM, CDMA, WCDMA, LTE 등 무선인터넷을 위한 안테나(200), 근거리 통신(short range communication) 기술로 블루투스(Bluetooth), RFID(Radio Frequency Identification), 적외선 통신(IrDA, infrared Data Association), UWB(Ultra Wideband), ZigBee 근거리 무선통신을 위한 안테나(200) 등이 필요하다.
- [0019] 이러한 안테나(200)는 전파의 수신을 위해 넓은 면적에 형성하는 것이 바람직하고 다른 전자부품들의 영향을 받지 않기 위해 이동 단말기(100)의 표면 쪽에 위치함이 바람직하다. 따라서, 도 1c에 도시된 바와 같이 일반적으로 전자부품이 실장 되지 않아 넓은 면적을 확보할 수 있는 후면커버(103)에 상기 안테나(200)를 배치한다.
- [0020] 선행기술문헌 1의 안테나(200)는 도 1c에 도시된 바와 같이 연성기관(210), 2가지 종류의 패턴, 자성시트(230)를 주요구성으로 한다.
- [0021] 패턴은 크게 2가지 종류로 고주파용 패턴(220)과 저주파용 패턴(225)으로 구분된다. 즉, 서로 다른 주파수 대역을 이용하는 것을 특징으로 하며, 고주파용 패턴(220)은 무선통신에 적합하고, 저주파용 패턴(225)은 주로 배터리의 무선충전에 적합하다.
- [0022] 이동 단말기(100)에 이용되는 무선충전기술은 전자기 유도 원리를 이용한다.
- [0023] 전자기 유도는 전류를 흘려 자기장을 형성하고, 그 위에 이동 단말기(100)를 놓으면 이동 단말기(100)에 장착된 저주파용 패턴, 즉 무선 충전용 코일(225)에 전류가 흘러 충전이 된다.
- [0024] 전송하는 전력량에 따라 주파수가 달라질 수 있으나, 일반적으로 이동 단말기(100)와 같은 소형 가전제품에 이용되는 전력은 수백 mW 이하로 비교적 낮은 주파수를 이용한다.
- [0025] 무선통신은 이동 단말기(100)의 기능이 다양화되면서, 전화통화를 위한 전파의 전송 이외에 NFC(Near Field

Communication), RFID(Radio Frequency Identification) 등의 기능을 위해서도 안테나가 필요하다. 특히 무선 통신 기술에 따라 이용하는 주파수는 다르며, 많은 양의 데이터를 전송하기 위해 무선 충전에 이용되는 주파수에 비해 상대적으로 고주파를 이용한다.

- [0026] 선행기술문헌 1의 무선 통신용 안테나(200)가 이용되는 통신 방식의 예로 근거리 무선통신(NFC: Near Field Communication)을 들 수 있다. 근거리 무선통신은 전자태그(RFID)의 일종으로 약 13.56MHz주파수 대역을 이용하는 비접촉식 무선통신 모듈이다.
- [0027] 대략 10~40cm의 가까운 거리에서 단말기(100) 간의 데이터를 전송하는 기술로서, 통신거리가 짧기 때문에 상대적으로 보안이 우수하고 가격이 저렴해 주목받는 차세대 근거리 통신기술이다. 데이터 읽기와 쓰기를 모두 이용할 수 있으며, 블루투스처럼 기기간에 설정이 필요 없어 최근 이동 단말기(100)에 근거리 무선통신 기능을 부가하고 있다.
- [0028] 도 2a는 선행기술문헌 2(공개특허 제2013-0123310호; 공진 방식 무선 전력 수신 시스템에서 공진단 장치)가 적용되는 공진 방식 무선 전력 수신 시스템에서 NFC 안테나 및 WPT 공진기의 평면상 배치 구조를 나타낸 예시도이며, 도 2b는 NFC 안테나 및 WPT 공진기의 휴대용 단말기 상에서의 배치 구조를 나타낸다.
- [0029] 도 2a 및 도 2b를 참조하여, 먼저 선행기술문헌 2가 적용되는 무선 전력 수신 시스템, 예를 들어 휴대용 단말기에서 NFC 안테나(10) 및 WPT 공진기(20)의 기구적인 실장 상태를 살펴보면, 평면적으로 루프형 안테나 구조를 NFC 안테나(10)는 마찬가지로 루프형 안테나 구조를 가지는 WPT 공진기(20)의 내측에 위치하도록 설치된다.
- [0030] 또한, NFC 안테나(10)는 휴대용 단말기의 본체(1) 뒷면에서 (착탈 가능하게 설치될 수 있는 배터리 부위에) 설치될 수 있으며, WPT 안테나(20)는 휴대용 단말기의 뒷면 커버(2)에 설치될 수 있다.
- [0031] 이때, NFC 안테나(10)와 WPT 공진기(20) 사이에는 아이솔레이션 특성확보를 위해 적절히 설계된 이격 거리(Isolation d, Isolation h)가 발생한다. 이와 같은 이격 거리에 의해 NFC 안테나(10)와 WPT 공진기(20) 두 주파수(13.56MHz, 6.78MHz)의 아이솔레이션 특성이 기구적으로 결정된다.
- [0032] 도 2c는 선행기술문헌 2의 일 실시예에 따른 공진 방식 무선 전력 수신 시스템에서 공진단 장치의 회로도이고, 부호 20은 고임피던스 회로이다.
- [0033] 도 2c를 참조하여, 선행기술문헌 2의 특징에 따른 공진단 장치는 WPT 전력용 증폭기(Power Amplifier: PA)(미도시)에서 방출되는 체배 성분(harmonics)이 외부로 방사되지 않도록 하기 위하여 WPT 공진기(20)에 셉트 캐패시터(shunt capacitor; 40)를 연결할 수 있다.
- [0034] 선행기술문헌 1 및 2를 참조하면, 무선통신을 위한 WPT, NFC 또는 RFID를 잘 소개하고 있다. 그렇지만 WPT의 무선충전효율에 대한 언급은 다루지 않고 있다.
- [0035] WPT의 무선충전효율에 관한 종래 기술을 언급하면 다음과 같다.
- [0036] WPT의 무접점충전 시스템의 하나인 전자기 유도 방식은 교류전원이 공급되는 송신기(충전기)에 설치된 1차 코일에 충전하고자 하는 기기(배터리) 측의 2차 코일을 접근시켜, 1차 코일과 2차 코일 사이에 전자기 유도를 일으킴으로써 발생한 유도기전력으로 기기(배터리)를 충전한다.
- [0037] WPT에서는 무접점충전의 효율을 높이기 위한 몇 가지 방안을 제시하고 있다.
- [0038] 첫 번째 방법은 송신부(1차 코일)와 수신부(2차 코일)의 중앙에 영구자석을 장착하여 자력에 의해 양자 코일의 위치를 정확하게 유지하는 방법이다.
- [0039] 두 번째 방법은 송신부(1차 코일) 위에 수신부(2차 코일)를 올리면, 2차 코일의 위치를 검출하여 스텝핑 모터로 1차 코일을 2차 코일의 위치로 이동하여 2차 코일에 대한 1차 코일의 위치를 정위치시키는 방법이다.
- [0040] 세 번째 방법은 송신부에 1차 코일을 복수로 설치하고 여기에 2차 코일을 올리면 2차 코일과 가장 인접한 1차 코일에 전류를 인가하여 양자 코일의 겹친 면적을 넓게 유지함으로써 결과적으로 1차 코일과 2차 코일 사이의 유도기전력을 높이는 방법이다.
- [0041] 이때, 두 번째 방법은 모터가 받는 부하를 줄이기 위하여 1차 코일의 무게를 제한해야 하는 한계가 있고, 세 번

제 방법은 1차 코일의 어레이 구조로 인해 송신부의 크기가 과도하게 증가하는 한편, 각 1차 코일들의 크기를 제한해야 하는 문제점이 있다.

[0042] 따라서, 현실적으로 자석을 이용하여 충전효율을 높이는 첫 번째 방법이 가장 널리 사용되고 있으나, 기기에 적용할 경우 다른 장치들에 자기 간섭으로 인하여 오동작을 유발하는 등의 문제가 있다.

[0043] 결국, 위에서 언급한 문제점을 해결하는 것과 동시에 충전효율을 높이기 위한 기술이 필요한 실정인 것이다.

[0044] 이러한 무접점충전시스템의 충전효율을 개선하기 위한 종래 기술로서 한국공개특허 제10-2010-0074595호, 한국등록특허 제10-1063154호 등이 있다.

선행기술문헌

특허문헌

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- (특허문헌 0003) 대한민국 공개특허 제10-2010-0074595호 - 무선 충전 시스템 및 방법
- (특허문헌 0004) 대한민국 등록특허 제1063154호 - 무접점 충전 장치

발명의 내용

해결하려는 과제

[0046] 본 발명의 목적은 메인 루프패턴이 권회되는 메인영역이 베이스필름의 어느 곳에 위치되더라도 일방적으로 메인 루프패턴의 무선통신 효율만을 고려하는 것인 아닌 서브 루프패턴의 무선통신 효율 역시 보완 보충토록 하기 위하여 서브영역에 마련되면서도 메인 루프패턴에 접속되지 않으면서 가로지르는 횡단부를 더 가지도록 하여 메인 루프패턴 및 서브 루프패턴 모두의 무선통신 효율을 더욱 크게 향상시킬 수 있도록 하는 무선통신용 플렉시블 회로기판을 제공함에 있다.

[0047] 본 발명의 목적은 메인 루프패턴이 권회되는 메인영역이 무선충전기의 1차코일과 정합될 수 있는 영역으로 선 배치되므로 인하여 상대적으로 서브 루프패턴이 권회되는 서브영역이 위축되더라도 서브 루프패턴을 베이스필름의 서브영역에만 국한시키지 아니하고 메인영역에 마련된 메인 루프패턴에 접속되지 않으면서 가로지르는 횡단부를 통해 상대적으로 위축된 점유면적을 확장케 하여 서브 루프패턴에 적용되는 NFC, RFID 또는 MST의 무선통신 효율을 떨어짐을 보완 보충토록 하는 무선통신용 플렉시블 회로기판을 제공함에 있다.

[0048] 본 발명의 목적은 스마트폰을 무선충전기에 가로방향으로 거치할 경우이더라도 송신전력(TX)을 위한 아랫쪽 1차 코일에 수신전력(RX)을 위한 WPT용 메인 루프패턴이 정확하게 정합되어 비접촉 자기유도 결합에 의한 스마트폰의 배터리로의 충전을 극대화시킬 수 있는 무선통신용 플렉시블 회로기판을 제공함에 있다.

[0049] 본 발명의 목적은 서브 루프패턴의 반경을 더 크게 하여 무선통신 효율을 높일 수 있도록 하는 무선통신용 플렉시블 회로기판을 제공함에 있다.

과제의 해결 수단

[0050] 상기 목적을 달성하기 위한 본 발명은,

[0051] 플렉시블한 베이스필름과, 상기 베이스필름에 마련된 메인 루프패턴 및 서브 루프패턴을 포함하는 무선통신용 플렉시블 회로기판에 있어서,

[0052] 상기 메인 루프패턴은 상기 베이스필름의 메인영역에 마련되고,

[0053] 상기 서브 루프패턴은 상기 베이스필름의 서브영역에 마련되면서 상기 메인영역에 마련됨과 동시에 상기 메인

루프패턴에 접속되지 않으면서 가로지르는 횡단부를 가지는 것을 그 기술적 구성상의 기본 특징으로 한다.

발명의 효과

- [0054] 본 발명은 메인 루프패턴이 권회되는 메인영역이 베이스필름의 어느 곳에 위치되더라도 일방적으로 메인 루프패턴의 무선통신 효율만을 고려하는 것인 아닌 서브 루프패턴의 무선통신 효율 역시 보완 보충토록 하기 위하여 서브영역에 마련되면서도 메인 루프패턴에 접속되지 않으면서 가로지르는 횡단부를 더 가지도록 하여 메인 루프패턴 및 서브 루프패턴 모두의 무선통신 효율을 더욱 크게 향상시킬 수 있도록 하는 효과가 있다.
- [0055] 본 발명은 메인 루프패턴이 권회되는 메인영역이 무선충전기의 1차코일과 정합될 수 있는 영역으로 선 배치되므로 인하여 상대적으로 서브 루프패턴이 권회되는 서브영역이 위축되더라도 서브 루프패턴을 베이스필름의 서브영역에만 국한시키지 아니하고 메인영역에 마련된 메인 루프패턴에 접속되지 않으면서 가로지르는 횡단부를 통해 상대적으로 위축된 점유면적을 확장케 하여 서브 루프패턴에 적용되는 NFC, RFID 또는 MST의 무선통신 효율을 떨어짐을 보완 보충토록 하는 효과가 있다.
- [0056] 본 발명은 메인영역에 권회된 메인 루프패턴의 최외곽 직경이 베이스필름의 폭의 크기에 근접되도록 확장 구형되도록 하여 무선충전기의 1차코일과의 비접촉 자기유도 결합력의 극대화로 무선충전 효율을 크게 향상시킬 수 있도록 하는 효과가 있다.
- [0057] 본 발명은 스마트폰을 무선충전기에 가로방향으로 거치할 경우이더라도 송신전력(TX)을 위한 아랫쪽 1차코일에 수신전력(RX)을 위한 WPT용 메인 루프패턴이 정확하게 정합되어 비접촉 자기유도 결합에 의한 스마트폰의 배터리로의 충전을 극대화시킬 수 있는 효과가 있다.
- [0058] 본 발명은 메인 루프패턴으로서 메인영역의 상부에 권회되는 상부 메인루프패턴을 구비토록 하여 무선충전기의 1차코일과 완전 정합되는 정원의 패루프를 완성시켜 비접촉 자기유도 결합력을 극대화시킬 수 있도록 하고, 서브 루프패턴으로서 서브영역의 하부에 권회되면서 하부 횡단부에 연결되는 확장 패루프를 이룰 수 있도록 하여 무선통신 효율의 보완 보충을 가능토록 하는 효과가 있다.
- [0059] 본 발명은 메인 루프패턴이 상부 메인루프패턴뿐만 아니라 비아홀을 통해 하부 메인루프패턴까지 상하 병렬로 적층토록 하여 권회수의 증가로 저항을 줄이는 대신 인덕턴스를 증가시켜, 즉 저항 대비 인덕턴스를 상대적으로 증가시켜 무선통신 효율(WPT의 무선충전 효율)을 극대화시킬 수 있는 효과가 있다.
- [0060] 본 발명은 서브 루프패턴이 하부 서브루프패턴뿐만 아니라 비아홀을 통해 상부 서브루프패턴까지 상하 병렬로 적층토록 하여 권회수의 증가로 저항을 줄이는 대신 인덕턴스를 증가시켜, 즉 저항 대비 인덕턴스를 상대적으로 증가시켜 무선통신 효율(NFC, RFID 또는 MST의 근거리 데이터 통신 효율)의 극대화를 도모토록 하는 효과가 있다.
- [0061] 본 발명은 서브 루프패턴의 반경을 더 크게 하여 무선통신 효율을 높일 수 있도록 하는 효과가 있다.
- [0062] 본 발명은 베이스필름을 대략 이등분한 형태의 메인 자성시트와 서브 자성시트를 적용토록 하여 WPT 또는 NFC, RFID 및 MST의 효율은 높이고 자성시트의 손실은 상대적으로 줄일 수 있는 2중의 작용 효과를 얻을 수 있는 효과가 있다.
- [0063] 본 발명은 제 3의 루프패턴을 형성시켜 메인 루프패턴은 WPT로 활용되도록 하고, 서브 루프패턴은 NFC 또는 RFID로 활용되도록 하고, 제 3의 루프패턴은 MST로 활용되도록 할 수 있는 효과가 있다.

도면의 간단한 설명

- [0064] 도 1a는 선행기술문헌 1과 관련된 이동 단말기의 블록 구성도.
- 도 1b는 선행기술문헌1에 따른 이동 단말기의 후면 사시도.
- 도 1c는 선행기술문헌 1에 따른 안테나가 이동 단말기의 후면커버에 부착된 것을 도시한 평면도.
- 도 2a는 선행기술문헌 2가 적용되는 공진 방식 무선 전력 수신 시스템에서 NFC 안테나 및 WPT 공진기의 평면상 배치 구조를 나타낸 예시도.

- 도 2b는 선행기술문헌 2의 NFC 안테나 및 WPT 공진기의 휴대용 단말기 상에서의 배치 구조를 나타내는 구조도.
- 도 2c는 선행기술문헌 2의 일 실시예에 따른 공진 방식 무선 전력 수신 시스템에서 공진단 장치의 회로도.
- 도 3a는 일반적인 무선통신용 플렉시블 회로기판을 나타내는 사진 및 이미지.
- 도 3b는 무선충전기를 나타내는 개념도.
- 도 3c는 일반적인 무선통신용 플렉시블 회로기판이 장착된 스마트폰을 나타내는 개념도.
- 도 3d는 일반적인 스마트폰을 무선충전기에 세로방향으로 기치한 모습을 나타내는 개념도.
- 도 3e는 일반적인 스마트폰을 무선충전기에 가로방향으로 기치한 모습을 나타내는 개념도.
- 도 4a는 본 발명의 실시예에 따른 무선통신용 플렉시블 회로기판을 나타내는 표면도.
- 도 4b는 본 발명의 실시예에 따른 무선통신용 플렉시블 회로기판을 나타내는 이면도.
- 도 5a는 본 발명의 실시예에 따른 무선통신용 플렉시블 회로기판을 나타내는 사진 및 이미지.
- 도 5b는 무선충전기를 나타내는 개념도.
- 도 5c는 본 발명에 따른 무선통신용 플렉시블 회로기판이 장착된 스마트폰을 나타내는 개념도.
- 도 5d는 본 발명에 따른 무선통신용 플렉시블 회로기판이 적용된 스마트폰을 무선충전기에 세로방향으로 기치한 모습을 나타내는 개념도.
- 도 5e는 본 발명에 따른 무선통신용 플렉시블 회로기판이 적용된 스마트폰을 무선충전기에 가로방향으로 기치한 모습을 나타내는 개념도.
- 도 6은 일반적인 무선통신용 플렉시블 회로기판 및 자성시트를 나타내는 사진.
- 도 7은 본 발명에 따른 무선통신용 플렉시블 회로기판 및 자성시트를 나타내는 사진.
- 도 8a는 본 발명의 다른 실시예에 따른 무선통신용 플렉시블 회로기판을 나타내는 표면도.
- 도 8b는 본 발명의 다른 실시예에 따른 무선통신용 플렉시블 회로기판을 나타내는 이면도.

발명을 실시하기 위한 구체적인 내용

- [0065] 이하, 본 발명에 따른 무선통신용 플렉시블 회로기판의 바람직한 실시예를 도면을 참조하여 설명하기로 하고, 그 실시예로는 다수 개가 존재할 수 있으며, 이러한 실시예를 통하여 본 발명의 목적, 특징 및 이점들을 더욱 잘 이해할 수 있게 된다.
- [0066] 도 3a는 일반적인 무선통신용 플렉시블 회로기판을 나타내는 사진 및 이미지로서, 도 3a의 (A) 사진을 보면 플렉시블한 베이스필름(40)에 WPT용 메인 루프패턴(10)과 NFC용 시브 루프패턴(20)을 확인할 수 있고, 메인 루프패턴(10)이 베이스필름(40)의 중앙영역(43)에 권회될 경우 시브 루프패턴(20)은 메인 루프패턴(10)으로부터 이격되는 베이스필름(40)의 외곽영역(44)에 권회되는 구조로 이루어져 있음을 또한 확인할 수 있다.
- [0067] 이러한 경우 WPT용의 메인 루프패턴(10)은 베이스필름(40)의 정중앙에 센터링되는, 즉 중앙영역(43)에 권회되는 것이 일반적이고, 이를 이미지로 나타내면 도 3a의 (B)와 같이 도시할 수 있다(설명상의 편의를 위하여 NFC용 시브 루프패턴(20)의 이미지는 생략하였다).
- [0068] 도 3b는 무선충전기(M)를 나타내는 개념도로서 송신전력(TX)을 위한 비접촉 자기유도 결합용 1차코일(M1)[1차코일(M1)이 이중으로 배치되어 1차다중코일을 구성함]을 보여주고 있고, 도 3c는 일반적인 무선통신용 플렉시블 회로기판이 장착된 스마트폰(H)을 나타내는 개념도로서 도 3b의 무선충전기(M)의 1차코일(M1)과 비접촉 자기유도 결합되어 수신전력(RX)을 위한 무선통신용 플렉시블 회로기판[2차코일이라 할 수 있음]을 확인할 수 있다.
- [0069] 도 3d는 일반적인 스마트폰(H)을 무선충전기(M)에 세로방향으로 기치한 모습을 나타내는 개념도이고, 도 3e는 일반적인 스마트폰(H)을 무선충전기(M)에 가로방향으로 기치한 모습을 나타내는 개념도이다.
- [0070] 도 3d에 도시된 바와 같이 스마트폰(H)을 무선충전기(M)에 세로방향으로 기치할 경우 대부분의 사용자는 무선충전기(M)의 외형과 스마트폰(H)의 외형 상호간의 정위치에 맞추어 기치하게 되는데, 이러한 경우 송신전력(TX)을 위한 윗쪽 1차코일(M1)에 수신전력(RX)을 위한 무선통신용 플렉시블 회로기판의 WPT용 메인 루프패턴(10)이 정

합되어 비접촉 자기유도 결합에 의한 스마트폰(H)의 배터리로의 충전을 가능케 한다.

- [0071] 그런데, 도 3e에 도시된 바와 같이 스마트폰(H)을 무선충전기(M)에 가로방향으로 거치할 경우 대부분의 사용자는 무선충전기(M)의 외형과 스마트폰(H)의 외형 상호간의 정위치에 맞추어 거치하게 되는데, 이러한 경우 송신 전력(TX)을 위한 아랫쪽 1차코일(M1)에 수신전력(RX)을 위한 무선통신용 플렉시블 회로기관의 WPT용 메인 루프패턴(10)이 정합되어야 하는데, 도 3e에 도시된 바와 같이 상호간 비정합되어 비접촉 자기유도 결합에 의한 스마트폰(H)의 배터리로의 충전이 정상적으로 이루어지지 않는 경우가 발생하게 된다[충전효율이 크게 떨어진다].
- [0072] 이러한 현상을 고려하여 사용자가 스마트폰(H)을 무선충전기(M)의 왼쪽으로 치우치게 거치하여야만 하는데, 무선통신용 플렉시블 회로기관의 위치를 정확하게 파악치 못하는 사용자 입장에서는 스마트폰(H)의 외형과 무선충전기(M)의 외형 상호간의 정위치만을 반사적으로 고집할 수밖에 없게 된다.
- [0073] 참고로, 스마트폰(H)의 백커버에는 미 도시된 카메라모듈이나 홈키 등이 배치되고 있어 배터리와 더불어 무선통신용 플렉시블 회로기관 등은 정중앙에 위치되지 아니하고 주로 하향으로 밀려서 배치되고 있다.
- [0074] 도 4a는 본 발명의 실시예에 따른 무선통신용 플렉시블 회로기관을 나타내는 표면도이고, 도 4b는 본 발명의 실시예에 따른 무선통신용 플렉시블 회로기관을 나타내는 이면도이다.
- [0075] 본 발명의 실시예에 따른 무선통신용 플렉시블 회로기관은 도 4a 및 도 4b에 도시된 바와 같이 플렉시블한 베이스필름(40)과, 이 베이스필름(40)에 마련된 메인 루프패턴(10) 및 서브 루프패턴(20)을 포함하며, 이때 메인 루프패턴(10)은 WPT로 활용되고, 메인영역(41)은 무선충전기(M)의 1차코일(M1)에 센터링될 수 있는 베이스필름(40)의 어느 한 영역이 될 수 있고, 서브 루프패턴(20)은 NFC, RFID 또는 MST로 활용되고, 서브영역(42)은 메인영역(41) 이외의 베이스필름(40)의 어느 한 영역이 될 수 있다.
- [0076] 이때, 메인 루프패턴(10)은 베이스필름(40)의 메인영역(41)에 마련될 수 있는데, 메인영역(41)은 무선충전기(M)의 1차코일(M1)과 정합될 수 있는 영역[무선충전 효율을 극대화시킬 수 있는 영역]으로 스마트폰(H)의 백커버에 카메라모듈이나 홈키 등이 배치되므로 인하여 배터리와 더불어 무선통신용 플렉시블 회로기관 등이 정중앙에 위치되지 못하고 주로 하향으로 밀려서 배치되는 점을 고려하여 도 4a 및 도 4b에 도시된 바와 같이 베이스필름(40)의 상부에 편심되게 점유토록 하는 것을 예로 들 수 있다.
- [0077] 이러한 경우 서브 루프패턴(20)의 권회 범위가 상대적으로 위축될 수 있는데, 본 발명에서는 이러한 점을 특별히 고려하여, 서브 루프패턴(20)은 베이스필름(40)의 서브영역(42)에 마련됨과 동시에 메인영역(41)에 마련된 메인 루프패턴(10)에 접촉되지 않으면서 가로지르는 횡단부(23)를 더 가지는 것을 핵심 특징으로 한다.
- [0078] 즉, 메인 루프패턴(10)이 권회되는 메인영역(41)이 무선충전기(M)의 1차코일(M1)과 정합될 수 있는 영역으로 선 배치되므로 인하여 상대적으로 서브 루프패턴(20)이 권회되는 서브영역(42)이 위축되더라도 서브 루프패턴(20)을 베이스필름(40)의 서브영역(42)에만 국한시키지 아니하고 메인영역(41)에 마련된 메인 루프패턴(10)에 접촉되지 않으면서 가로지르는 횡단부(23)를 통해 상대적으로 위축된 점유면적을 확장케 하여 서브 루프패턴(20)에 적용되는 NFC, RFID 또는 MST의 무선통신 효율을 떨어짐을 보완 보충토록 하는 것이다.
- [0079] 바람직하게, 메인 루프패턴(10)은 메인영역(41)에 정원(正圓; Circle)을 이루도록 하여 무선충전기(M)의 1차코일(M1)과 긴밀하게 정합될 수 있도록 하고, 서브 루프패턴(20)은 횡단부(23)에 연결되면서 페루프를 이룰 수 있도록 하여 무선통신 효율의 보완 보충을 가능케 함은 물론이며, 특히 메인영역(41)에 권회된 메인 루프패턴(10)의 최외곽 직경이 베이스필름(40)의 폭의 크기에 근접되도록 확장 구현되도록 하여 무선충전기(M)의 1차코일(M1)과의 비접촉 자기유도 결합력(Non-Contact Magnetic Inductive Coupling Power)의 극대화로 무선충전 효율을 크게 향상시킬 수 있도록 한다.
- [0080] 본 발명에서 메인 루프패턴(10)을 정원으로 기술하고 있지만 타원, 다각형 기타 폐구형을 취할 수 있는 구조라면 모두 가능함은 물론이다.
- [0081] 도 5a는 본 발명의 실시예에 따른 무선통신용 플렉시블 회로기관을 나타내는 사진 및 이미지로서, 도 5a의 (A) 사진을 보면 플렉시블한 베이스필름(40)에 WPT용 메인 루프패턴(10)과 NFC, RFID 또는 MST용 서브 루프패턴(20)을 확인할 수 있고, 메인 루프패턴(10)이 베이스필름(40)의 메인영역(41), 예를 들면 무선충전기(M)의 1차코일(M1)에 정합되도록 베이스필름(40)에 편심되게 정원으로 권회될 경우 서브 루프패턴(20)은 베이스필름(40)의 서브영역(42)에 마련됨과 동시에 메인영역(41)에 마련된 메인 루프패턴(10)에 접촉되지 않으면서 가로지르는 횡

단부(23)를 더 가지면서 페루프를 권회됨을 확인할 수 있다.

- [0082] 이러한 경우 WPT용의 메인 루프패턴(10)은 무선충전기(M)의 1차코일(M1)에 정합되도록 베이스필름(40)의 편심된 메인영역(41)에 정원으로 권회되고, 이를 이미지로 나타내면 도 5a의 (B)와 같이 도시할 수 있다(설명상의 편의를 위하여 NFC, RFID 또는 MST용 서브 루프패턴(20)의 이미지는 생략하였다).
- [0083] 도 5b는 무선충전기(M)를 나타내는 개념도로서 송신전력(TX)을 위한 비접촉 자기유도 결합용 1차코일(M1)[1차코일(M1)이 이중으로 배치되어 1차다중코일을 구성함]을 보여주고 있고, 도 5c는 본 발명에 따른 무선통신용 플렉시블 회로기판이 장착된 스마트폰(H)을 나타내는 개념도로서 도 5b의 무선충전기(M)의 1차코일(M1)과 비접촉 자기유도 결합되어 수신전력(RX)을 위한 무선통신용 플렉시블 회로기판[2차코일이라 할 수 있음]을 확인할 수 있다.
- [0084] 도 5d는 본 발명에 따른 무선통신용 플렉시블 회로기판이 적용된 스마트폰(H)을 무선충전기(M)에 세로방향으로 거치한 모습을 나타내는 개념도이고, 도 5e는 본 발명에 따른 무선통신용 플렉시블 회로기판이 적용된 스마트폰(H)을 무선충전기(M)에 가로방향으로 거치한 모습을 나타내는 개념도이다.
- [0085] 도 5d에 도시된 바와 같이 스마트폰(H)을 무선충전기(M)에 세로방향으로 거치할 경우 대부분의 사용자는 무선충전기(M)의 외형과 스마트폰(H)의 외형 상호간의 정위치에 맞추어 거치하게 되는데, 이러한 경우 송신전력(TX)을 위한 윗쪽 1차코일(M1)에 수신전력(RX)을 위한 본 발명의 무선통신용 플렉시블 회로기판의 WPT용 메인 루프패턴(10)이 완전히 정합되어 비접촉 자기유도 결합에 의한 스마트폰(H)의 배터리의 충전을 실현케 한다[완전 정합으로 충전효율 극대화].
- [0086] 그리고, 도 5e에 도시된 바와 같이 스마트폰(H)을 무선충전기(M)에 가로방향으로 거치할 경우 대부분의 사용자는 무선충전기(M)의 외형과 스마트폰(H)의 외형 상호간의 정위치에 맞추어 거치하게 되는데, 이러한 경우이더라도 송신전력(TX)을 위한 아랫쪽 1차코일(M1)에 수신전력(RX)을 위한 본 발명의 무선통신용 플렉시블 회로기판의 WPT용 메인 루프패턴(10)이 정확하게 정합되어 비접촉 자기유도 결합에 의한 스마트폰(H)의 배터리의 충전을 실현할 수 있게 된다[정확한 정합으로 충전효율 극대화].
- [0087] 이와 같이, 본 발명에 따른 무선통신용 플렉시블 회로기판은 메인 루프패턴(10)이 권회되는 메인영역(41)이 베이스필름(40)의 어느 곳에 위치되더라도 일방적으로 메인 루프패턴(10)의 무선통신 효율만을 고려하는 것인 아닌 서브 루프패턴(20)의 무선통신 효율 역시 보완 보충토록 하기 위하여 서브영역(42)에 마련되면서도 메인영역(41)에 마련된 메인 루프패턴(10)에 접속되지 않으면서 가로지르는 횡단부(23)를 더 가지도록 하여 메인 루프패턴(10) 및 서브 루프패턴(20) 모두의 무선통신 효율을 더욱 크게 향상시킬 수 있도록 한 것이다.
- [0088] 더욱 구체적으로, 메인 루프패턴(10)은 메인영역(41)의 상부에 권회되는 상부 메인루프패턴(11)을 구비하고, 횡단부(23)는 상부 메인루프패턴(11)에 접속되지 않도록 메인영역(41)의 하부에 마련된 하부 횡단부(23a)를 구비하고, 서브 루프패턴(20)은 서브영역(42)의 하부에 권회되면서 하부 횡단부(23a)에 연결되는 하부 서브루프패턴(22)을 구비한다.
- [0089] 메인 루프패턴(10)으로서 메인영역(41)의 상부에 권회되는 상부 메인루프패턴(11)을 구비토록 하여 무선충전기(M)의 1차코일(M1)과 완전 정합되는 정원의 페루프를 완성시켜 비접촉 자기유도 결합력을 극대화시킬 수 있도록 하고, 서브 루프패턴(20)으로서 서브영역(42)의 하부에 권회되면서 하부 횡단부(23a)에 연결되는 확장 페루프를 이룰 수 있도록 하여 무선통신 효율의 보완 보충을 가능토록 하는 것이다.
- [0090] 바람직하게, 메인 루프패턴(10)은 하부 횡단부(23a)에 접속되지 않도록 비아홀(V)을 통해 상부 메인루프패턴(11)에 연결되면서 메인영역(41)의 하부에 권회되는 하부 메인루프패턴(12)을 더 구비할 수 있고, 서브 루프패턴(20)은 상부 메인루프패턴(11)에 접속되지 않도록 비아홀(V)을 통해 하부 서브루프패턴(22)에 연결되면서 서브영역(42)의 상부에 권회되는 상부 서브루프패턴(21)을 더 구비할 수 있다.
- [0091] 메인 루프패턴(10)이 상부 메인루프패턴(11)뿐만 아니라 비아홀(V)을 통해 하부 메인루프패턴(12)까지 상하 병렬로 적층토록 하여 권회수의 증가로 저항을 줄이는 대신 인덕턴스를 증가시켜, 즉 저항 대비 인덕턴스를 상대적으로 증가시켜 무선통신 효율(WPT의 무선충전 효율)을 극대화시킬 수 있도록 하고, 서브 루프패턴(20)이 하부 서브루프패턴(22)뿐만 아니라 비아홀(V)을 통해 상부 서브루프패턴까지 상하 병렬로 적층토록 하여 권회수의 증가로 저항을 줄이는 대신 인덕턴스를 증가시켜, 즉 저항 대비 인덕턴스를 상대적으로 증가시켜 무선통신 효율(NFC, RFID 또는 MST의 근거리 데이터 통신 효율)의 극대화를 도모토록 한다.
- [0092] 한편, 횡단부(23)는 메인 루프패턴(10)이 권회되지 않은 메인영역(41)의 중심영역(41a)까지 가로지르는 경우 중심

영역(41a)의 하부에 마련되는 하부 중심횡단부(23b)를 더 구비토록 하여 궁극적으로 서브 루프패턴(20)의 반경을 더 크게 하여 무선통신 효율을 높일 수 있도록 할 수 있다.

- [0093] 나아가, 횡단부(23)는 비아홀(V)을 통해 하부 중심횡단부(23b)에 연결되는 상부 중심횡단부(23c)를 더 구비할 수 있고, 서브 루프패턴(20)은 상부 메인루프패턴(11)에 접속되지 않도록 비아홀(V)을 통해 하부 서브루프패턴(22)에 연결되면서 서브영역(42)의 상부에 권회되는 상부 서브루프패턴(21)을 더 구비하여 궁극적으로 서브 루프패턴(20)의 반경을 더 키워 무선통신 효율을 더욱 높일 수 있도록 할 수 있다.
- [0094] 한편, 본 발명에서 특별히 설명치 않는 메인 루프패턴(10)은 외부의 메인 스타트단자(S1) 및 메인 엔드단자(E1)에 연결되고, 서브 루프패턴(20) 역시 외부의 서브 스타트단자(S2) 및 서브 엔드단자(E2)에 연결되며, 이러한 기술적 설명은 공지된 것이므로 상세한 설명은 생략하기로 한다.
- [0095] 도 6은 일반적인 무선통신용 플렉시블 회로기판 및 자성시트를 나타내는 사진이다.
- [0096] 일반적인 무선통신용 플렉시블 회로기판은 자계의 차폐역할을 할 수 있도록 자성시트(F)가 부착되는데, 종래에는 WPT용 메인 루프패턴(10)과 NFC용 서브 루프패턴(20) 상호간의 사용되는 주파수 및 용도가 다름에도 불구하고 단일의 자성시트(F)를 부착시키는 형태를 취해 왔다.
- [0097] 예를 들어, WPT용 메인 루프패턴(10)에 적합한 고투자율 및 포화자속이 높은 자성체를 이루는 자성시트(F)를 사용하기 위하여 메인 루프패턴(10)의 면적에 맞추고, NFC용 서브 루프패턴(20)에 적합한 저손실특성을 지니면서 수직에서 수백 사이의 투자율을 가지는 자성체를 이루는 자성시트(F)를 사용하기 위하여 서브 루프패턴(20)의 면적에 맞출 경우, NFC용 자성체를 이루는 자성시트(F)는 중앙을 타발시켜 사용할 수밖에 없어 자성시트(F) 자체의 손실로 인한 경제성을 보장받을 수 없는 한계를 떠 안게 된다.
- [0098] 도 7은 본 발명에 따른 무선통신용 플렉시블 회로기판 및 자성시트를 나타내는 사진이다.
- [0099] 본 발명에 따른 무선통신용 플렉시블 회로기판 역시 자계의 차폐역할을 할 수 있도록 자성시트(F)가 부착되는데, WPT용 메인 루프패턴(10)과 NFC, RFID 또는 MST용 서브 루프패턴(20) 상호간의 사용되는 주파수 및 용도가 다름을 적극적으로 활용하여 베이스필름(40)의 하부에 자성시트(F)가 부착되도록 하되, 이 자성시트(F)는 메인영역(41)의 하부에 부착되는 메인 자성시트(F1)와, 서브영역(42)의 하부에 부착되는 서브 자성시트(F2)로 각각 분할될 수 있도록 한다.
- [0100] 예를 들어, WPT용 메인 루프패턴(10)에 적합한 고투자율 및 포화자속이 높은 자성체를 이루는 메인 자성시트(F1)를 사용하기 위하여 메인 루프패턴(10)이 권회된 메인영역(41)에 면적에 맞추고, NFC, RFID 또는 MST용 서브 루프패턴(20)에 적합한 저손실특성을 지니면서 수직에서 수백 사이의 투자율을 가지는 자성체를 이루는 서브 자성시트(F2)를 사용하기 위하여 서브 루프패턴(20)이 권회된 서브영역(42)에 맞출 경우, 베이스필름(40)을 대략 이등분한 형태의 메인 자성시트(F1)와 서브 자성시트(F2)로 간단히 만들 수 있게 되어, WPT 또는 NFC, RFID 및 MST의 효율은 높이고 자성시트(F)의 손실을 줄이는 2중의 작용 효과를 얻을 수 있게 되는 것이다.
- [0101] 도 8a는 본 발명의 다른 실시예에 따른 무선통신용 플렉시블 회로기판을 나타내는 표면도이고, 도 8b는 본 발명의 다른 실시예에 따른 무선통신용 플렉시블 회로기판을 나타내는 이면도이다.
- [0102] 본 발명의 다른 실시예에 따른 무선통신용 플렉시블 회로기판은 도 8a 및 도 8b에 도시된 바와 같이 메인영역(41) 및 서브영역(42)을 함께 점유한 제 3의 루프패턴(30)을 더 포함할 수 있고, 제 3의 루프패턴(30)은 비아홀(V)을 통해 베이스필름(40)의 상부 및 하부를 선택적으로 경유하면서 권회될 수 있으며, 이때 제 3의 루프패턴(30)은 메인 루프패턴(10) 또는 서브 루프패턴(20)에 접속되지 않으면서 가로지르는 제 3의 횡단부(31)를 더 가질 수 있고, 나아가 메인 루프패턴(10)은 WPT로 활용되고, 서브 루프패턴(20)은 NFC 또는 RFID로 활용되고, 제 3의 루프패턴(30)은 MST로 활용될 수 있으며, 역으로 메인 루프패턴(10)은 WPT로 활용되고, 서브 루프패턴(20)은 MST로 활용되고, 제 3의 루프패턴(30)은 NFC 또는 RFID로 활용될 수 있음은 물론이다.
- [0103] 이러한 제 3의 루프패턴(30)은 본 발명의 핵심 기술인 메인 루프패턴(10) 및 서브 루프패턴(20)의 작용 및 효과 속에 이루어지는 것으로 그 구조 및 형상에는 크게 제한되지 않는 것으로 하며, 그에 대한 구체적인 설명 역시 생략하기로 한다.
- [0104] 한편, 본 발명에서 특별히 설명치 않는 제 3의 루프패턴(30)은 외부의 제 3의 스타트단자(S3) 및 제 3의 엔드단

자(E3)에 연결되고, 이러한 기술적 설명 역시 공지된 것이므로 상세한 설명은 생략하기로 한다.

[0105] 다른 한편으로, NFC(Near Field Communication) 또는 RFID(Radio Frequency Identification)는 대략 10~40cm의 가까운 거리에서 13.56MHz 주파수 대역의 비접촉 자기유도 결합력(Non-Contact Magnetic Inductive Coupling Power)으로 단말기 상호간 데이터를 전송키 위한 것이고, MST(Magnetic Secure Transmission)는 10~200cm의 근거리에서 13.56MHz 주파수 대역의 비접촉 자기유도 결합력으로 외부의 단말기 상호간 데이터를 전송키 위한 공지 기술로서 이에 대한 상세한 설명 역시 생략하기로 한다.

산업상 이용가능성

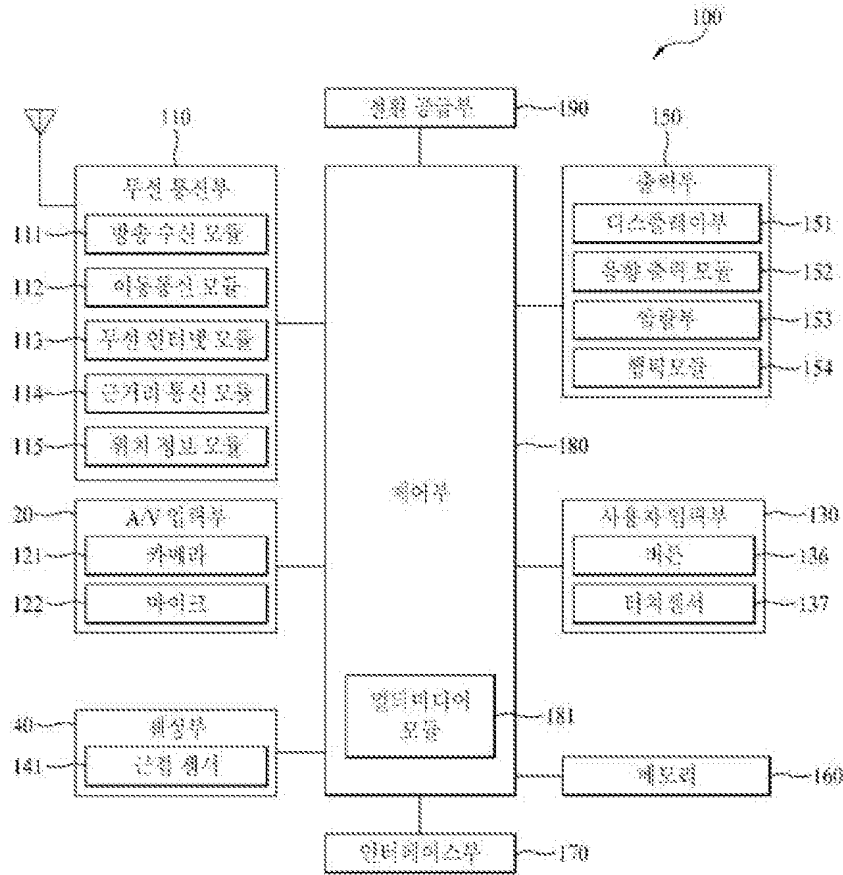
[0106] 본 발명은 테블릿 PC나 스마트 폰 등과 같은 휴대 단말기 산업분야에 이용될 수 있다.

부호의 설명

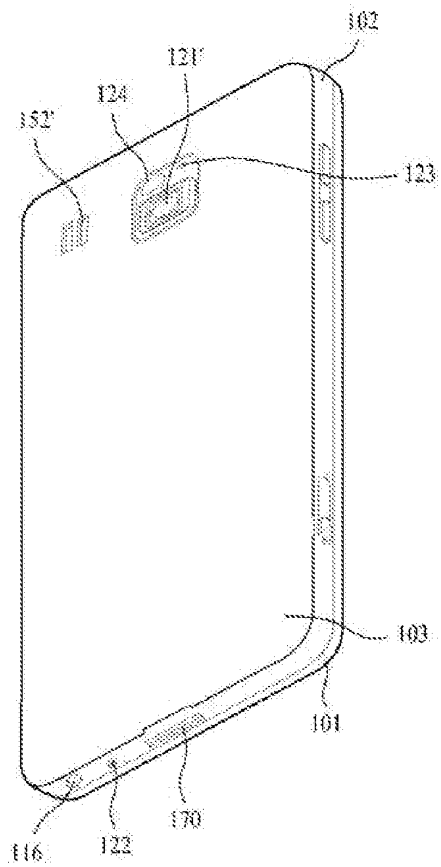
[0107]	10 : 메인 루프패턴	11 : 상부 메인루프패턴
	12 : 하부 메인루프패턴	S1 : 메인 스타트단자
	E1 : 메인 엔드단자	20 : 서브 루프패턴
	21 : 상부 서브루프패턴	22 : 하부 서브루프패턴
	23 : 횡단부	23a : 하부 횡단부
	23b : 하부 중심횡단부	23c : 상부 중심횡단부
	S2 : 서브 스타트단자	E2 : 서브 엔드단자
	30 : 제 3의 루프패턴	31 : 제 3의 횡단부
	S3 : 제 3의 스타트단자	E3 : 제 3의 엔드단자
	40 : 베이스필름	41 : 메인영역
	41a : 중심영역	42 : 서브영역
	43 : 중앙영역	44 : 외곽영역
	V : 비아홀	M : 무선충전기
	M1 : 1차코일	F : 자성시트
	F1 : 메인 자성시트	F2 : 서브 자성시트
	H : 스마트폰	

도면

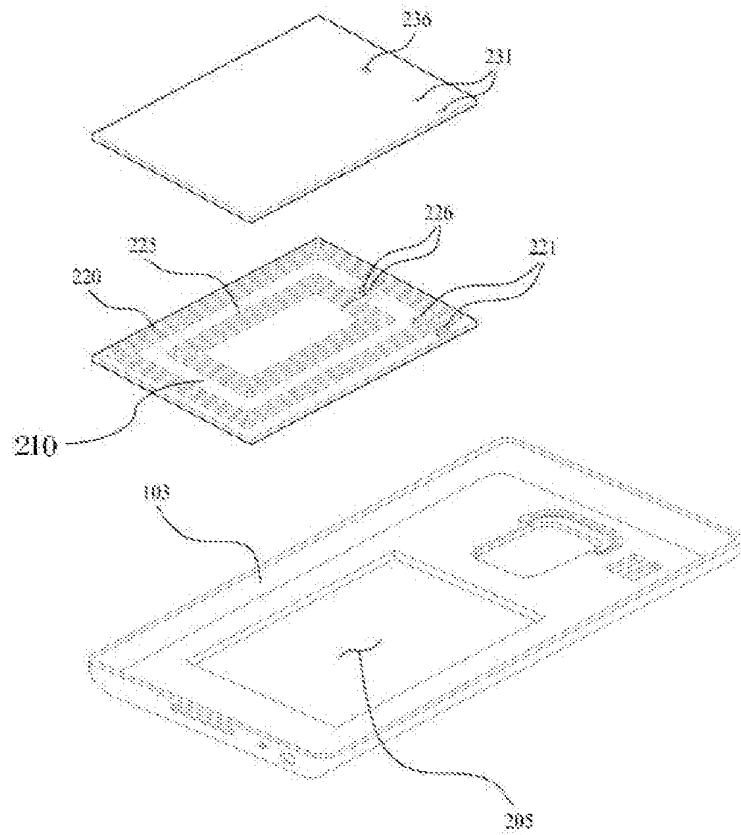
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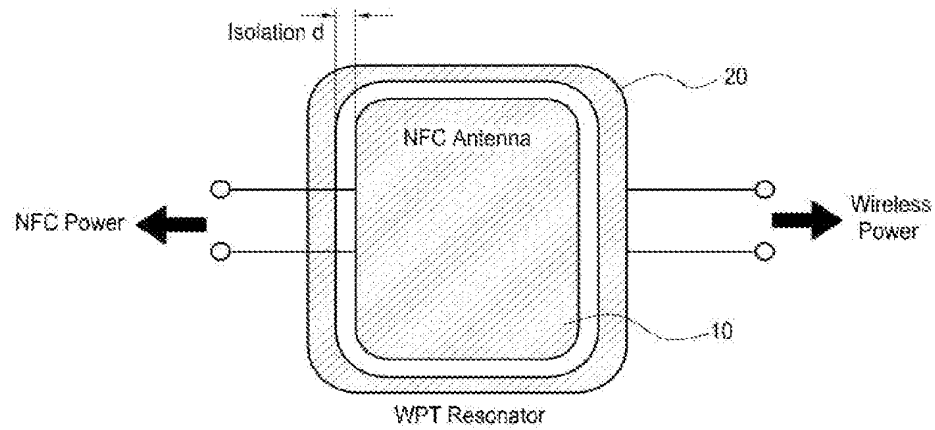
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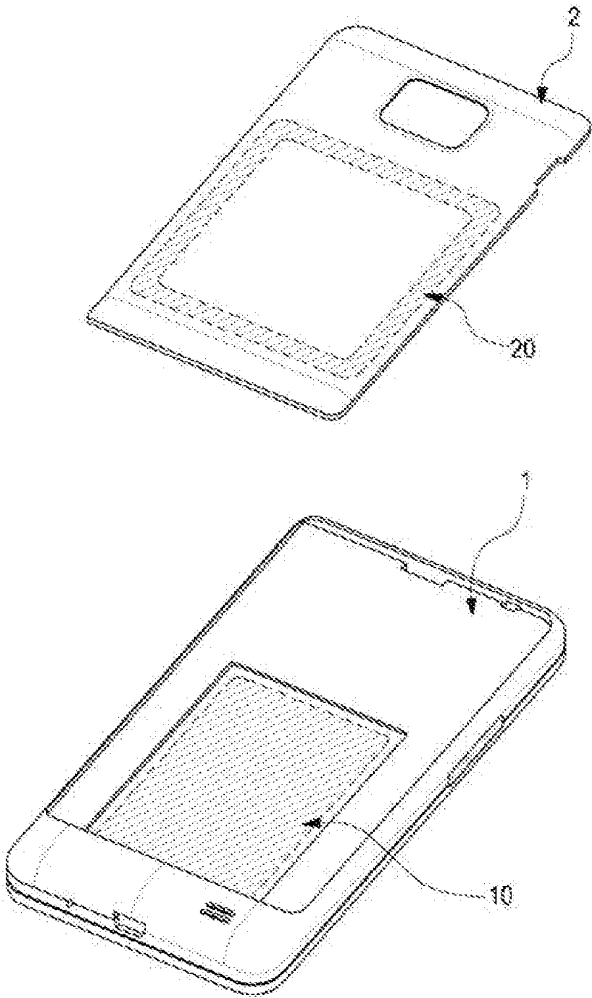
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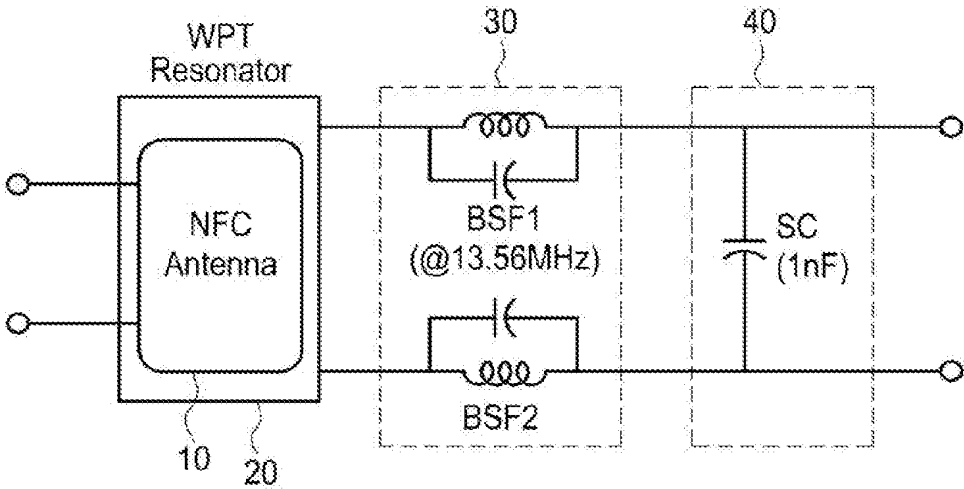
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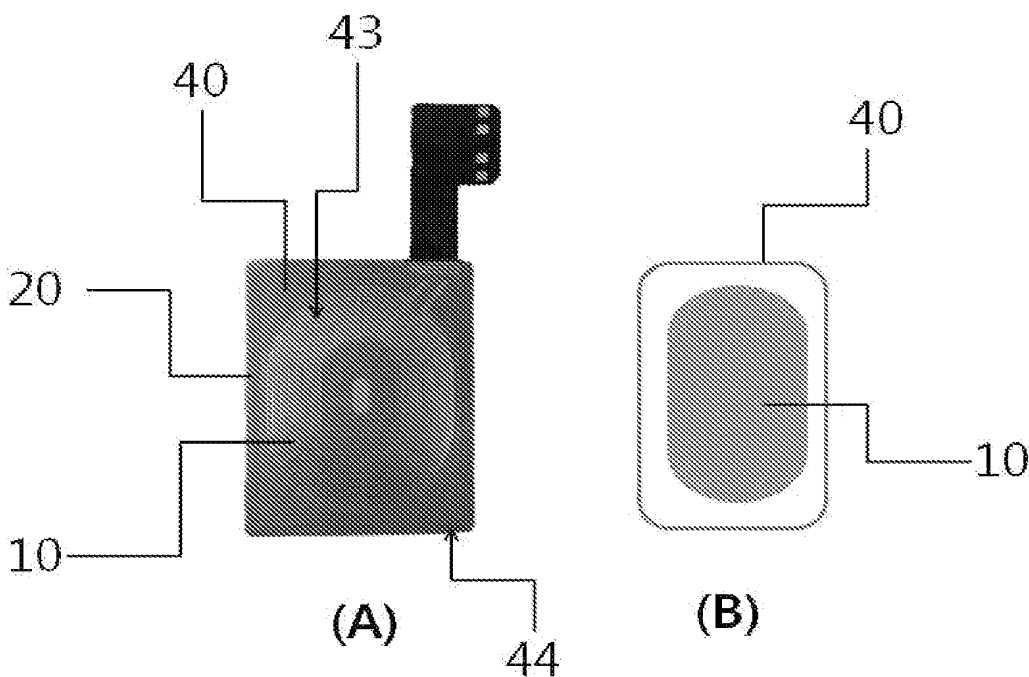
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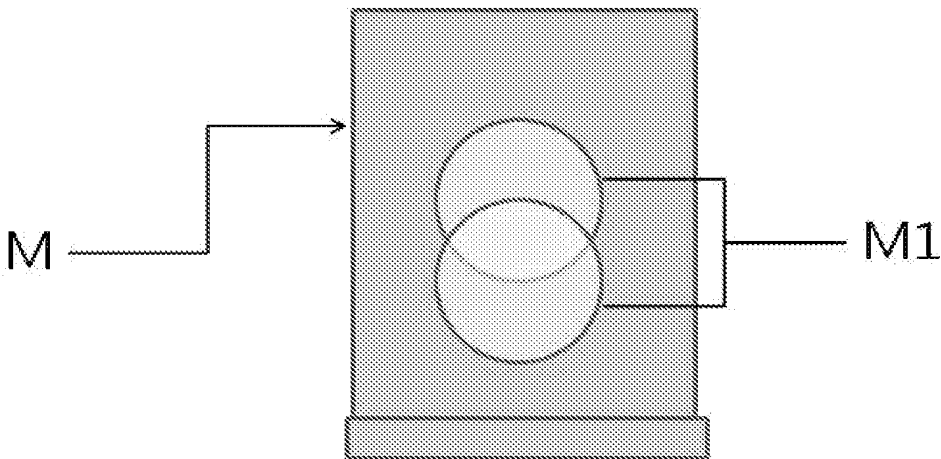
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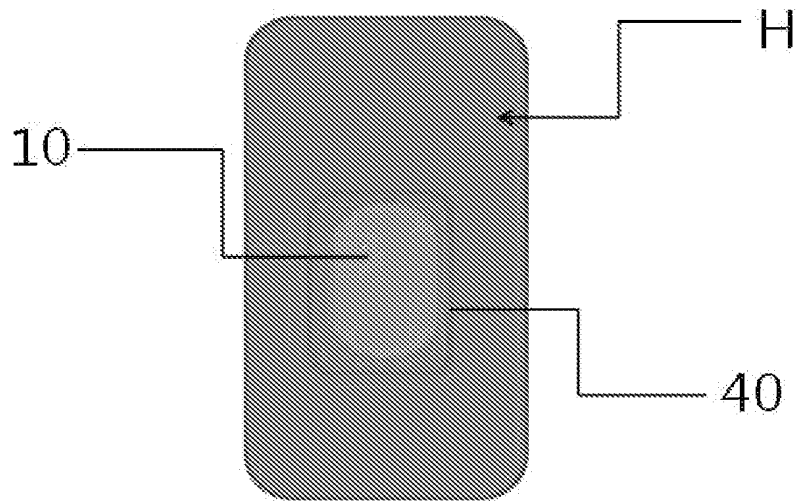
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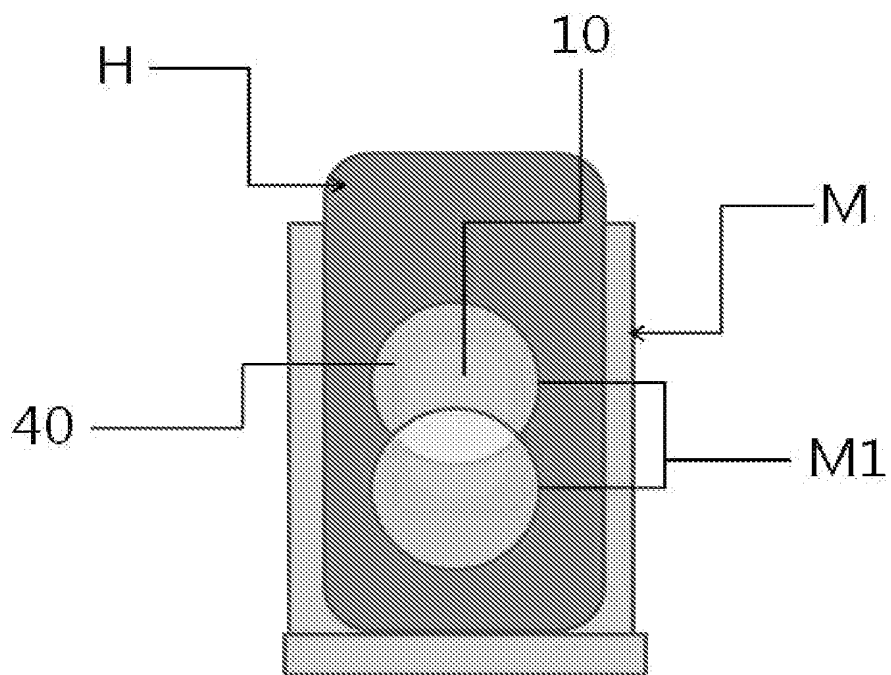
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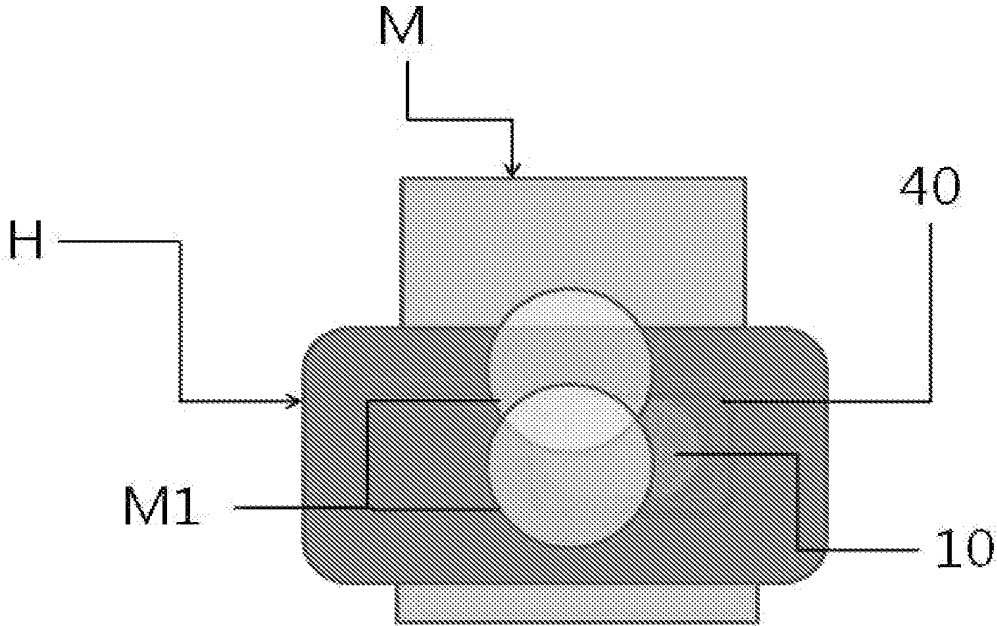
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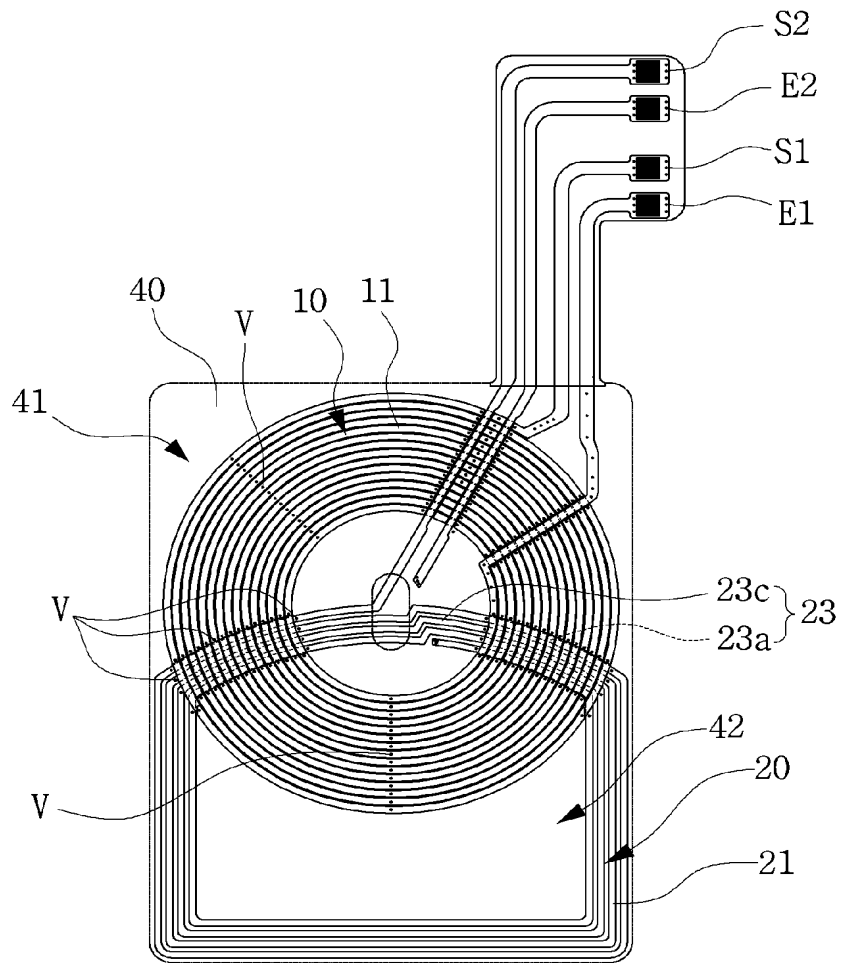


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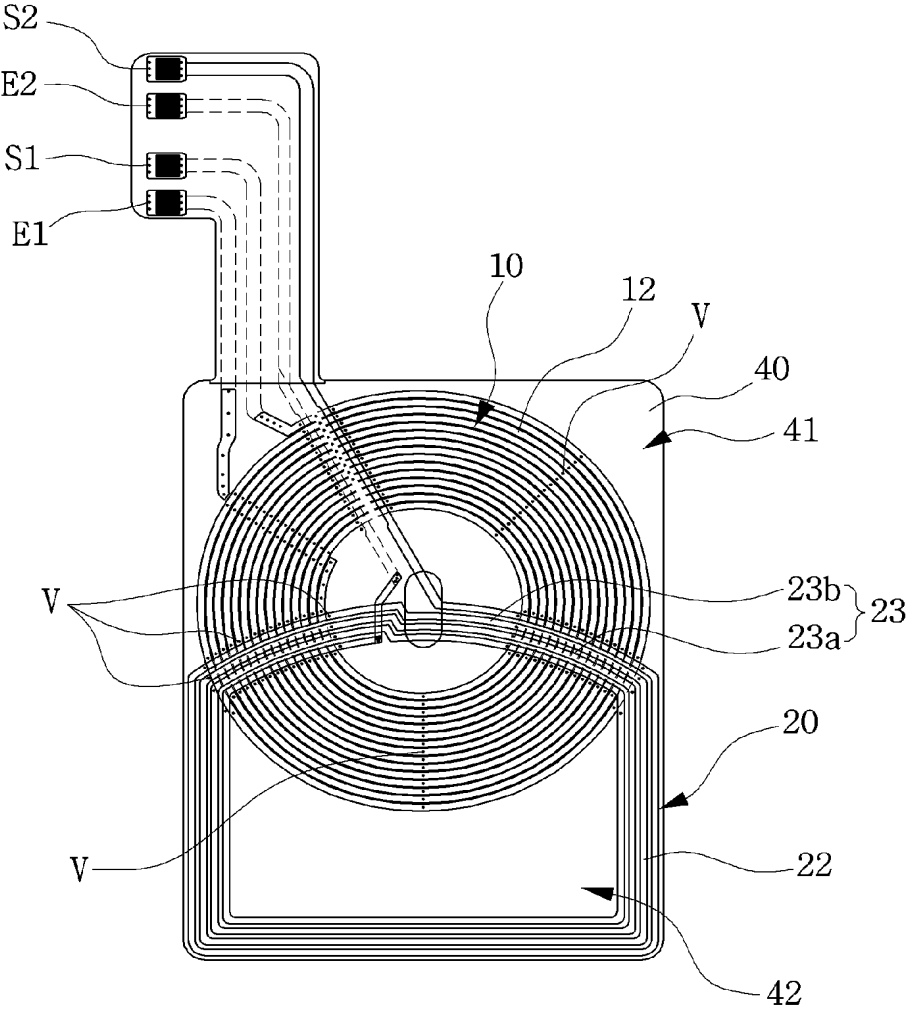


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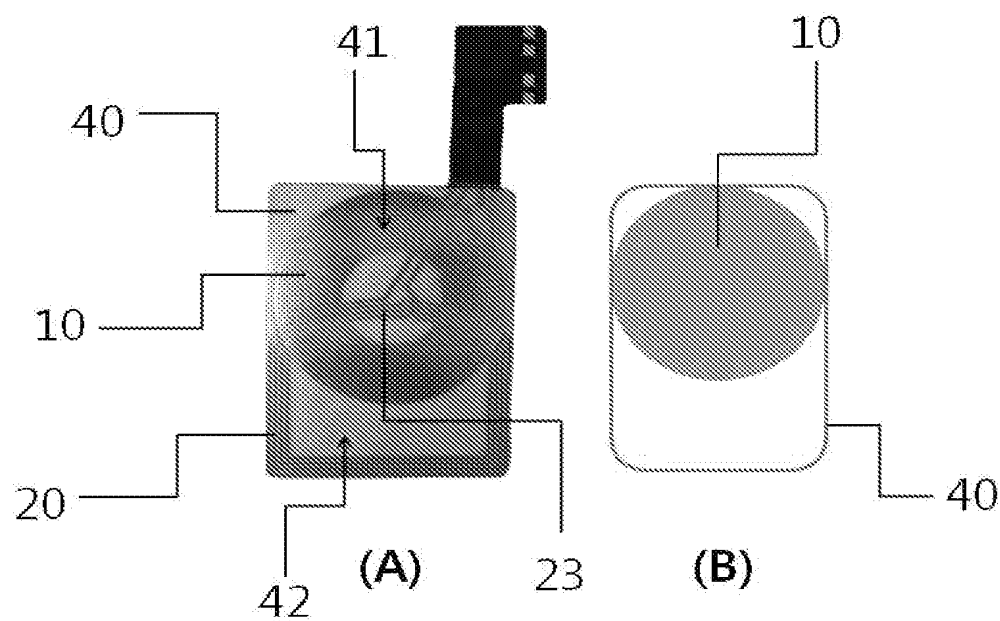




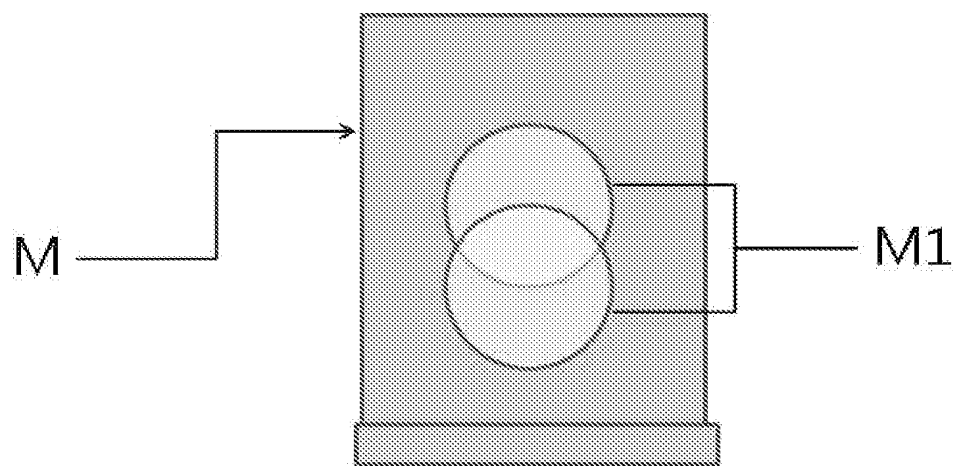
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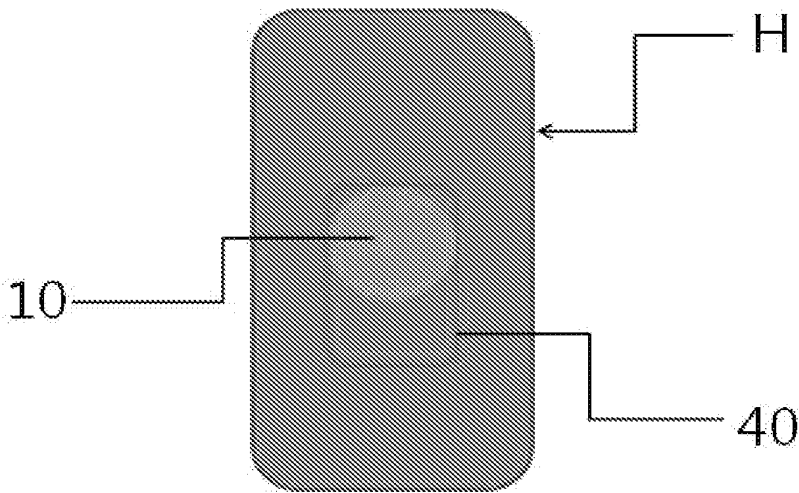
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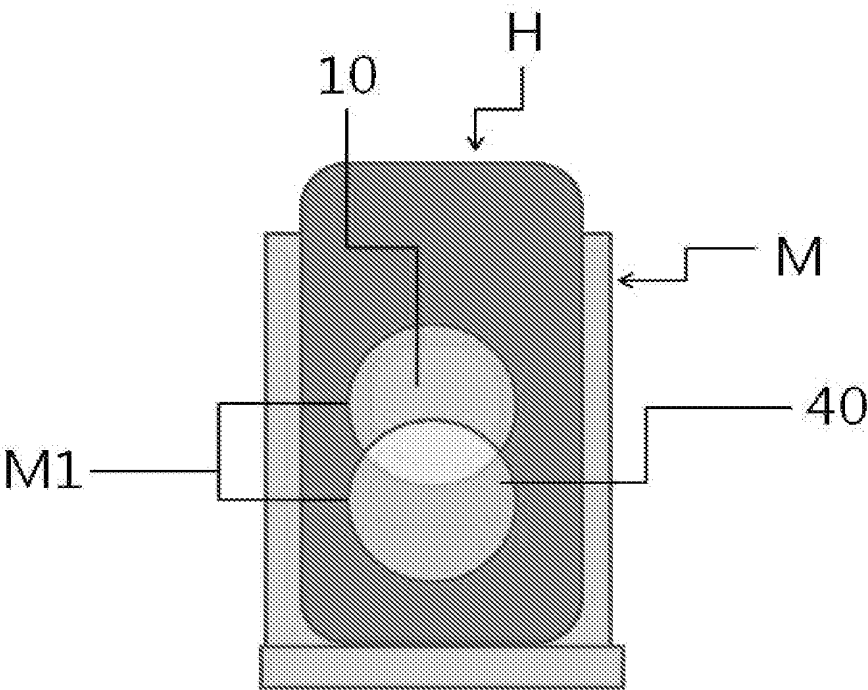
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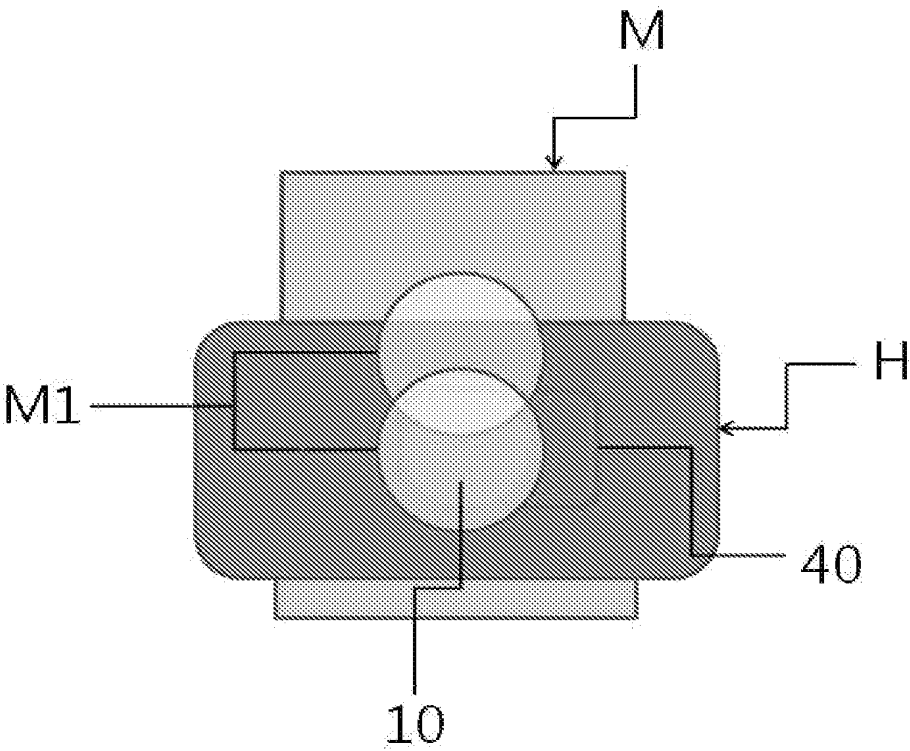
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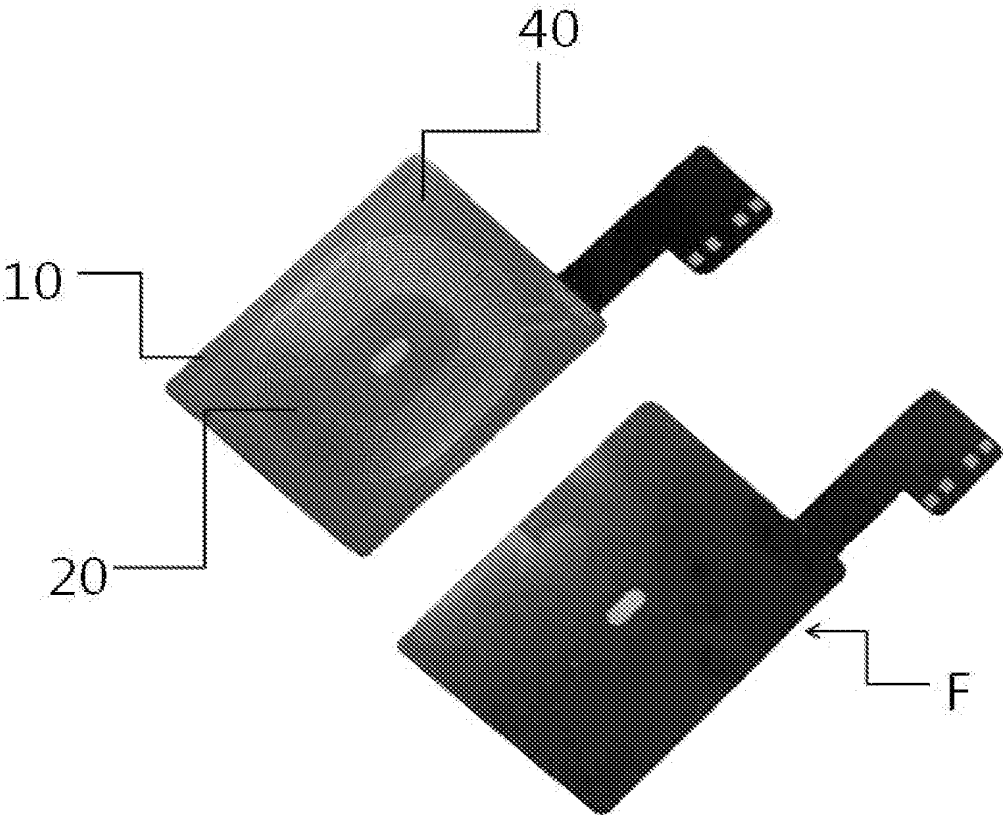
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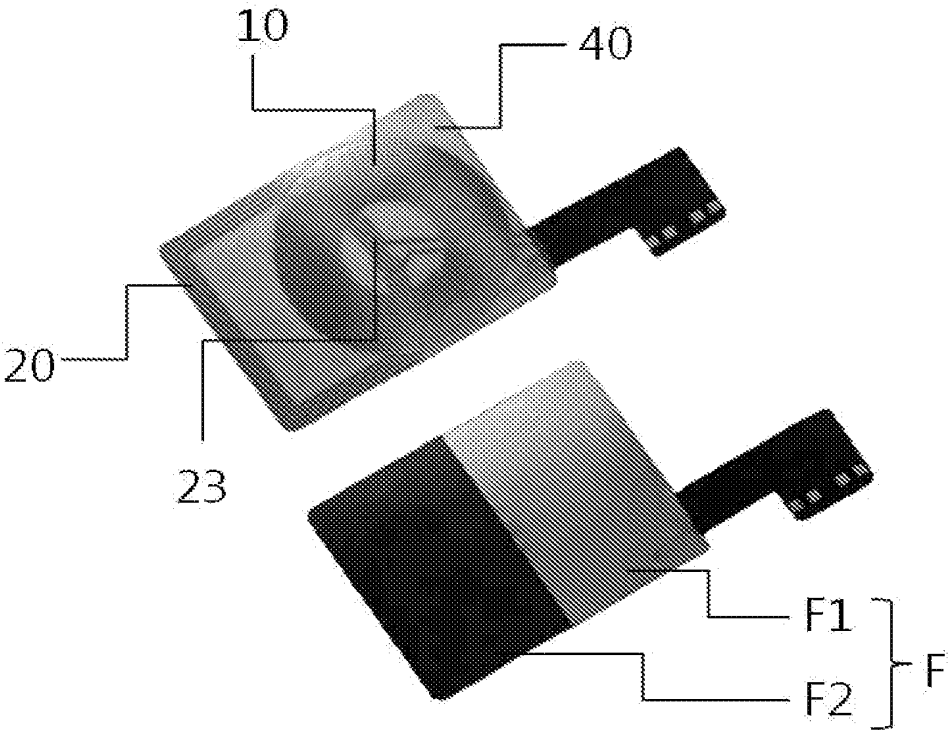
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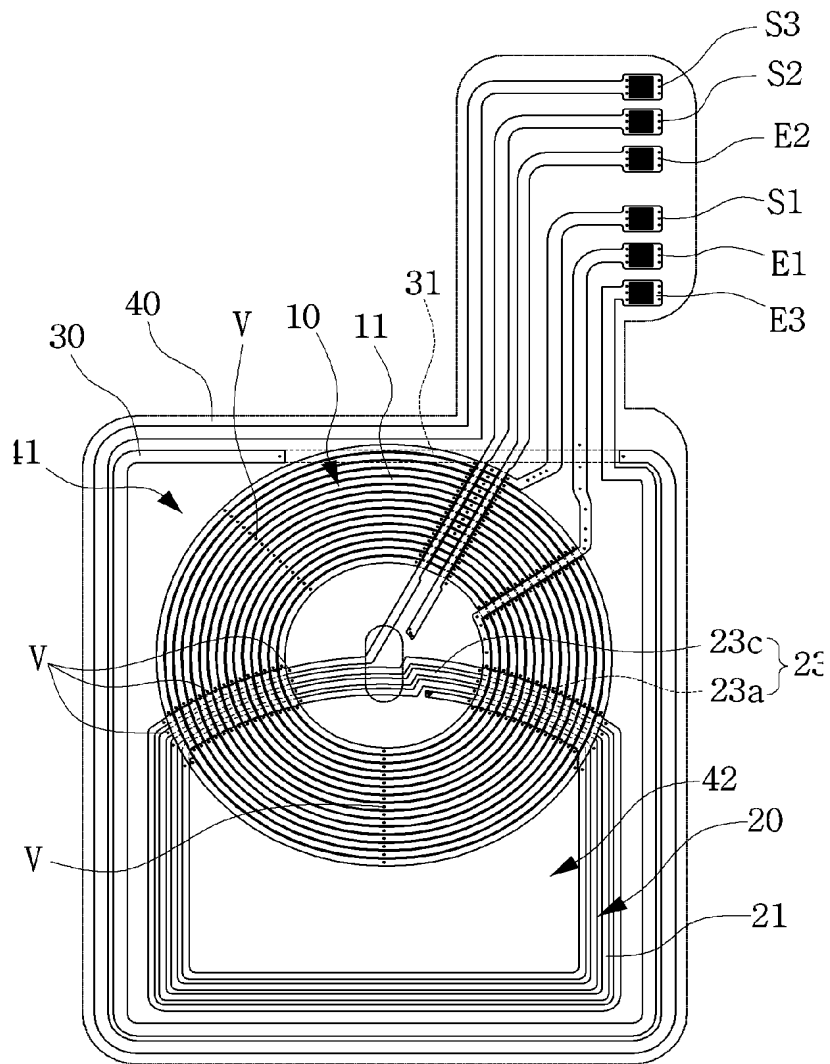
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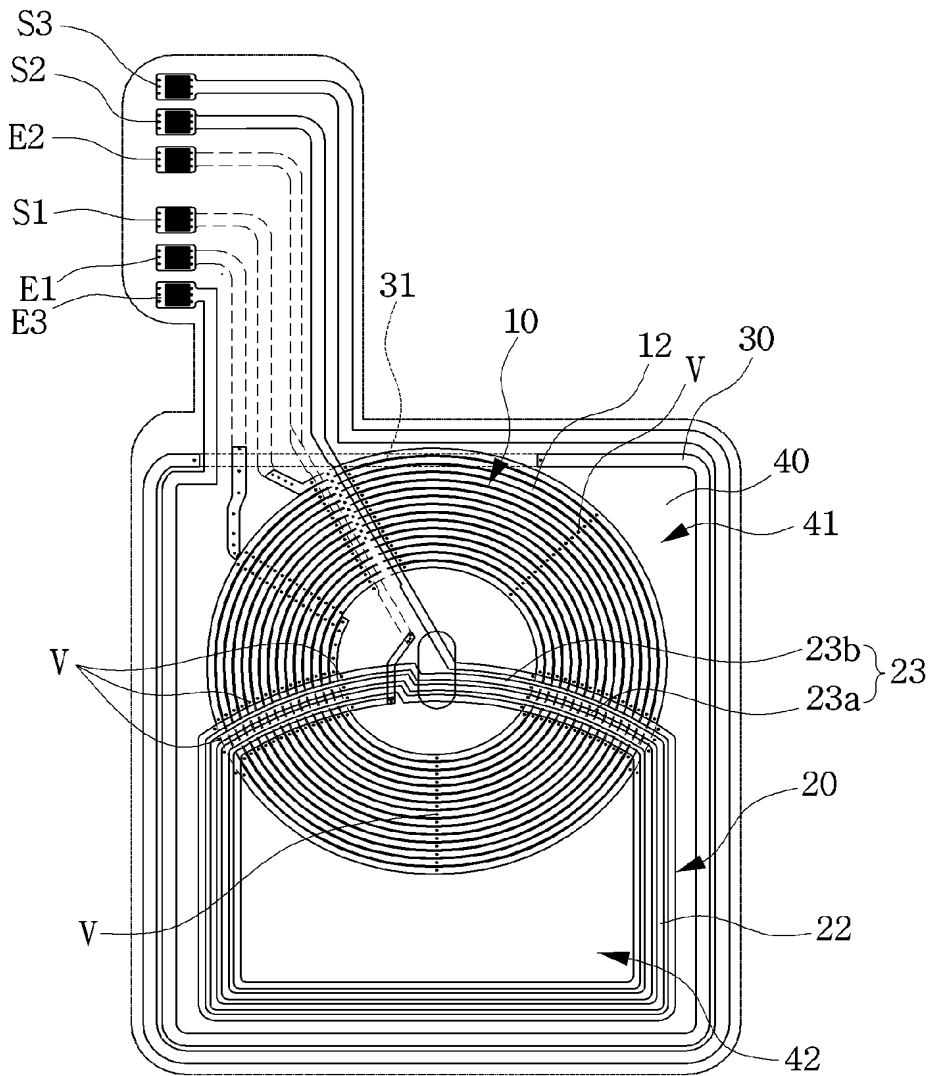
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598a



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Antenna patch comprising common terminals for wireless charging and nfc communication

List of publications

Publication date

Application number 2013KR-0102968 Date 2013-08-29 Register

KR10-1532052 B1 Patent specification 2015-06-29

English Title

Antenna patch comprising common terminals for wireless charging and nfc communication

Other Title 무선충전 및 엔에프씨 통신 겸용 단자부를 포함하는 안테나 패치

English Abstract (Native or MT)

An antenna patch according to the present invention is an antenna patch which comprises a terminal unit used both for wireless charging and near field communication, is installed on a battery pack to perform wireless charging and near field communication functions, and comprises: a board member; a wireless charging antenna unit formed on the board member; a near field communication (NFC) antenna unit formed on the board member; a pair of wireless charging terminal units connected to the wireless charging antenna unit; and a pair of NFC terminal units connected to the NFC antenna unit. One of the wireless charging terminal units is characterized in being used as one of the NFC terminal units. According to the invention, terminal units for wireless charging and terminal units for NFC share a common terminal unit such that the number of terminal units is decreased, and an area occupied by the the terminal units is reduced to decrease a size of the antenna patch. Also, antenna patterns for wireless charging and NFC can be formed at both sides of the board member, thereby improving charging efficiency or NFC communication efficiency.

Other Abstracts

본 발명에 따른 무선충전 및 엔에프씨 통신 겸용 단자부를 포함하는 안테나 패치는 배터리팩의 표면에 설치되어 무선충전 및 엔에프씨 통신을 수행하기 위한 안테나 패치로서, 기판부재와, 상기 기판부재에 형성되는 무선충전안테나부와, 상기 기판부재에 형성되는 엔에프씨통신안테나부와, 상기 무선충전안테나부에 연결되는 한쌍의 무선충전단자부와, 상기 엔에프씨통신안테나부에

연결되는 한쌍의 엔에프씨통신단자부를 포함하며, 상기 한쌍의 무선충전단자부 중의 어느 하나는 상기 한쌍의 엔에프씨통신단자부 중의 하나로 이용되는 것을 특징으로 한다. 본 발명에 의해, 무선충전을 위한 단자부와 엔에프씨 통신을 위한 단자부가 공통의 단자부를 이용하여 단자부의 갯수를 감소시킴으로써, 단자부가 차지하는 면적을 감소시켜 안테나 패치를 보다 소형으로 구성가능하다. 또한, 무선충전 또는 엔에프씨 통신을 위한 안테나 패턴을 기판부재의 양면에 형성함으로써, 무선충전 또는 엔에프씨 통신 효율을 상승시킬 수 있다.

Application Language KOREAN (KOR)

Inventor(s) JIN, DAE WON

Inventor(s) 진대원

Applicant/Assignee

ELENTEC

| \$ 783 M

Assignee 주식회사 이랜텍

Reg. Nb: 119980007885

Applicant/Assignee Address ELENTEC CO., LTD. , 119980007885

ELENTEC CO., LTD. , 119980007885

Patent Assignee History ELENTEC CO., LTD.

ELENTEC CO., LTD.

Representative CHEON TAE YOUNG

Reg. Nb: 920050013465

Representative Address CHEON TAE YOUNG , 920050013465

CHEON TAE YOUNG , 920050013465

Representative 천태용

Reg. Nb: 920050013465

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Telecommunications

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Notes Number of Claims: 3

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Cited Patents Examiner citations

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KR101179398 (B1) [KR101179398]; -JP2008172873 (A) [JP2008172873];

Search Report [Examiner]

-KR101179398 (B1) [KR101179398] SAMSUNG ELECTRO MECH; -JP2008172873 (A) [JP2008172873]
SONY ERICSSON MOBILE COMM JP,

Description

TECHNICAL FIELD

[0001] The present disclosure relates to an antenna patch installed in a battery pack, and more particularly, to an antenna patch including a terminal unit combined with wireless charging and NF communication configured to increase wireless charging efficiency by using a common terminal unit.

BACKGROUND ART

[0002] Recent developments in information communication technologies increase the use of portable terminals capable of Internet, video calls, and various document tasks, as well as voice calls, and various portable terminals having new performance are being developed and distributed according to the development of technologies.

[0003] An inner type battery pack used as a power supply of a portable communication terminal is configured to have a structure in which a battery cell and a Fishby board including a protection circuit module (PCM) are combined.

[0004] The battery pack has a structure in which a fishby substrate including a battery cell and a protection circuit module are coupled to each other and packaged in one unit form, and the battery pack is recently demanding miniaturization, thinning and lightening trends in size and lightening of a portable communication terminal using the battery pack.

[0005] Generally, the charging method of the battery pack, which is most used, is a method of charging the battery pack via a portable terminal in a charger so that the terminal of the battery pack contacts, or charging the battery pack by directly connecting a connector of the charger and a connector unit of the portable terminal.

[0006] Recently, a wireless charging scheme has been developed in which charging is performed by placing a portable terminal on a charger or placing it in the vicinity of a charger, without passing the portable terminal on the charger or directly connecting the connector of the charger and the connector of the portable terminal.

[0007] The wireless charging scheme is largely a magnetic resonance scheme and an electromagnetic induction scheme, and the magnetic resonance scheme is a scheme of transmitting power through a frequency between transmission and reception ends of power for wireless charging.

[0008] In comparison, the electromagnetic induction method generates and charges an induction current between two coils disposed adjacent to each other, and uses the principle that the induction current is generated according to the number of turns of the two coils and the distance between the coils.

[0009] Meanwhile, NFC (Near Field Communication) communication is a contactless communication technology that uses a frequency band of 13.56 MHz as one of communication technologies that transmit and receive various wireless data at a close distance within 10 cm.

[0010] Since the NF communication has a short communication distance, it is relatively excellent in security and low in price, recent attention is made to the next-generation near-field communication technology. since both data reading and writing functions can be used, a dongle (reader) required for RFID use is not required.

SUMMARY OF INVENTION

TECH PROBLEM

[0011] An object of the present invention is to provide an antenna patch including a terminal unit for combining wireless charging and FC communication by reducing the number of terminal units by using a terminal unit in which a terminal unit for wireless charging and a terminal unit for FC communication are shared, thereby reducing the area occupied by the terminal unit, thereby configuring the antenna patch more compact.

[0012] Another object of the present invention is to provide an antenna patch including a combined wireless-charging and NF communication terminal portion configured to increase wireless-charging or NF communication efficiency by forming an antenna pattern for wireless-charging or NF communication on both sides of a substrate member.

TECH SOLUTION

[0013] In order to achieve the object, the antenna patch including a terminal unit for both wireless charging and RF communication according to the present invention is an antenna patch installed on a surface of a battery pack for performing wireless charging and RF communication, the antenna patch including a substrate member, a wireless charging antenna unit formed on the substrate member, A pair

of wireless charging terminal portions connected to the wireless charging antenna portions, and a pair of NF communication terminal portions connected to the wireless charging antenna portions. any one of the pair of wireless charging terminal portions is used as one of the pair of NF communication terminal portions.

[0014] Preferably, the wireless charging antenna unit is formed on both surfaces of the substrate member and is configured to be conducted through a through hole.

[0015] In addition, the NF communication antenna unit may be formed on both surfaces of the substrate member and configured to conduct the conduction through a through hole.

ADVANTAGEOUS EFFECTS

[0016] According to the present invention, the number of terminal portions is reduced by using a common terminal portion of a terminal portion for wireless charging and a terminal portion for FC communication are reduced, and the area occupied by the terminal portion is reduced, thereby making it possible to configure the antenna patch more compact.

[0017] In addition, antenna patterns for wireless charging or FC communication are formed on both surfaces of the substrate member, thereby increasing wireless charging or FC communication efficiency.

DESCRIPTION OF DRAWINGS

[0018] Since the following drawings are provided to understand the technical concept of the present disclosure together with the detailed description of the present disclosure, the present disclosure should not be construed as limited to the concept illustrated in the following drawings. FIG. 1 is a front view of one side of an antenna patch including a terminal unit for combining wireless charging and RF communication according to the present disclosure, and FIG. 2 is a front view of the other side of the antenna patch.

DESCRIPTION OF EMBODIMENTS

[0019] Hereinafter, the configuration of the present disclosure will be described in detail with reference to the accompanying drawings.

[0020] Prior to the description, the terms used in the specification and the claims should not be construed as limited to dictionary meanings, but interpreted based on the meanings and concepts corresponding to technical concept of the present disclosure on the basis of the principle that the inventor can define terms appropriately for the best explanation.

[0021] Therefore, the embodiments described herein and the configurations illustrated in the drawings are merely preferred embodiments of the present disclosure, and are not all representative of the technical concept of the present disclosure, and therefore, it should be understood that various equivalents and modifications may exist that may replace them at the time of the present application.

[0022] FIG. 1 is a front view of one side of an antenna patch including a terminal unit for combining wireless charging and RF communication according to the present disclosure, and FIG. 2 is a front view of the other side of the antenna patch.

[0023] An antenna patch including a terminal unit for both wireless charging and NF communication is installed on a surface of a battery pack to perform wireless charging and NF communication. the antenna patch includes a substrate member, a wireless charging antenna unit formed on the substrate member, an NF communication antenna unit formed on the substrate member, A pair of wireless charging terminal portions (22, 50) connected to the wireless charging antenna portion (20), and a pair of NF-communication terminal portions (50, 32) connected to the NF-communication antenna portion (30), wherein one (50) of the pair of wireless charging terminal portions (22, 50) is used as one (50) of the pair of NF-communication terminal portions (50, 32).

[0024] The antenna patch according to the present invention is installed on the side of a battery pack used in a mobile communication device such as a smartphone, and is used for wireless charging of the battery pack and RF communication of the mobile communication device.

[0025] The battery pack may be provided in a form in which an electrode stacking unit composed of a negative electrode sheet and a positive electrode sheet is accommodated inside a metal casing.

[0026] The battery pack may be prepared in various types, for example, a nickel-cadmium battery, a nickel-hydrogen battery, or a lithium-ion battery.

[0027] Preferably, the battery pack is capable of charging a large capacity voltage with respect to a size of the battery pack as compared with other batteries, is capable of continuing power supply after

charging for a long period of time, and is composed of one battery, and can be prepared as a lithium ion battery which is easy to manage.

[0028] The substrate member (10) is flexibly constructed of a synthetic resin material such as epoxy, so that the wireless charging antenna portion (20) and the NF communication antenna portion (30) are formed in the form of wiring on the substrate member (10).

[0029] The wireless charging antenna portion (20) and the NF communication antenna portion (30) are formed on the substrate member (10) by etching or plating with copper or copper alloy wire.

[0030] The wireless charging antenna unit 20 may be arranged in a concentric circle on the substrate member 10, and the NF communication antenna unit 30 may be formed in the form of a wiring on an edge portion of the substrate member 10.

[0031] The 'concentric circular' as used herein does not refer to a perfect circular shape, but includes approximately circular or spiral shapes as shown in figs. 1 and 2, and the deformation may be performed in various shapes in order to efficiently arrange on the substrate 10.

[0032] A wireless charging circuit unit for converting electric power from the wireless charging antenna unit into electric power of a predetermined voltage, and the like are included in the battery pack.

[0033] Further, RF power or electromagnetic wave received through the RF communication antenna unit 30 is transmitted to the mobile communication device through an RF signal transmission terminal unit provided in the battery pack.

[0034] The wireless charging antenna unit 20 is configured to wirelessly charge the battery pack, and receives electromagnetic force from a wireless charger (wpc).

[0035] In addition, the NF communication antenna unit 30 is configured to serve as an antenna for performing NF communication, and receives data from an NF communication terminal.

[0036] Power from the wireless charging antenna unit received by RF radio waves or electromagnetic waves is filtered by the wireless charging circuit unit into electromagnetic waves of a specific frequency band which can be used in a mobile communication device.

[0037] Since the electromagnetic wave filtered as described above is in an alternating current state, the electromagnetic wave in the alternating current state is converted into direct current power through a rectifier installed in the battery pack.

[0038] Thereafter, the power converted into direct current power is converted into direct current power of a predetermined voltage through a voltage regulator.

[0039] The wireless charging antenna unit 20 may be configured to conduct the antenna units on both sides through the through holes in a state where the wireless charging antenna unit 20 is formed in a form of wires on both sides of the substrate member 10.

[0040] In the form shown in Fig. 1, the wireless charging antenna unit 20 is formed on one surface of the substrate member 10 in a concentric circle with one side disconnected from each other, and in the form shown in Fig. 2, the wireless charging antenna unit 26 is formed on the other surface of the substrate member 10 in a spiral shape.

[0041] In addition, the wireless charging antenna units 20, 26 on both sides are configured to be electrically conductive with each other through through-holes 24.

[0042] By making the antenna units 20, 26 conductive with each other as described above, the conductive area of the antenna unit increases, and consequently, wireless charging efficiency can be increased.

[0043] In addition, the F communication antenna portion 30 is also formed on both surfaces of the substrate member 10 so as to be electrically conductive with each other through the through holes, thereby increasing the communication efficiency.

[0044] Wireless charging terminal units 22, 50 are connected to ends of the wireless charging antenna unit 20.

[0045] Among the wireless charging terminal units 22, 50, one terminal unit 22 is connected to an outermost pattern from the pattern of the wireless charging antenna unit 20, and the other terminal unit 50 is connected to an innermost pattern, and is configured to transmit wireless charging power to the battery pack.

[0046] In addition, an outermost pattern of the NF communication antenna portion 30 disposed at an edge portion of the substrate member 10 is connected to the NF communication terminal portion 32, and an innermost pattern of the NF communication antenna portion 30 is connected to an intermediate connection portion 25 of a pattern to which the other terminal portion 50 of the wireless charging antenna portion 20 is connected.

[0047] Thus, the terminal portion 50 is configured to be commonly used as a wireless charging terminal portion and an NF communication terminal portion.

[0048] Here, in a state in which a pair of connection pad portions made of copper or a copper alloy are provided on both surfaces of the substrate member 10, the pair of connection pad portions are configured to be electrically conductive with each other through through-holes 54.

[0049] Thus, a stable electrical connection can be established between the terminal portion and the terminal portion of the battery pack.

[0050] Although the present disclosure has been described with reference to examples and drawings, the technical concept of the present disclosure is not limited thereto. accordingly, various modifications and variations may be made within the same scope as those skilled in the art as well as the technical concept of the present disclosure will be made.

REFERENCE SIGNS LIST

[0051] 10: board member 20: wireless charging antenna portion 30: NF antenna portion 40: terminal portion



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(73) 특허권자

주식회사 이랜텍

경기도 수원시 영통구 삼성로268번길 37 (원천동)

(72) 발명자

진대원

서울 강동구 고덕로38길 34-9, 101동 603호 (명일동, 우성아파트)

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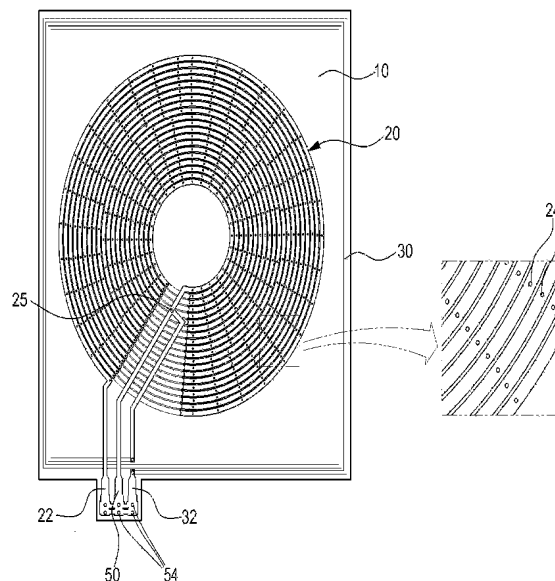
(54) 발명의 명칭 무선충전 및 엔에프씨 통신 겸용 단자부를 포함하는 안테나 패치

(57) 요약

본 발명에 따른 무선충전 및 엔에프씨 통신 겸용 단자부를 포함하는 안테나 패치는 배터리팩의 표면에 설치되어 무선충전 및 엔에프씨 통신을 수행하기 위한 안테나 패치로서, 기관부재와, 상기 기관부재에 형성되는 무선충전 안테나부와, 상기 기관부재에 형성되는 엔에프씨통신안테나부와, 상기 무선충전안테나부에 연결되는 한쌍의 무선

(뒷면에 계속)

배터리팩 - 도1



충전단자부와, 상기 엔에프씨통신안테나부에 연결되는 한쌍의 엔에프씨통신단자부를 포함하며, 상기 한쌍의 무선 충전단자부 중의 어느 하나는 상기 한쌍의 엔에프씨통신단자부 중의 하나로 이용되는 것을 특징으로 한다.

본 발명에 의해, 무선충전을 위한 단자부와 엔에프씨 통신을 위한 단자부가 공통의 단자부를 이용하여 단자부의 갯수를 감소시킴으로써, 단자부가 차지하는 면적을 감소시켜 안테나 패치를 보다 소형으로 구성가능하다.

또한, 무선충전 또는 엔에프씨 통신을 위한 안테나 패턴을 기판부재의 양면에 형성함으로써, 무선충전 또는 엔에프씨 통신 효율을 상승시킬 수 있다.

명세서

청구범위

청구항 1

배터리팩의 표면에 설치되어 무선충전 및 엔에프씨 통신을 수행하기 위한 안테나 패치로서,

기관부재와;

상기 기관부재에 형성되는 무선충전안테나부와;

상기 기관부재에 형성되는 엔에프씨통신안테나부와;

상기 무선충전안테나부에 연결되는 한쌍의 무선충전단자부와;

상기 엔에프씨통신안테나부에 연결되는 한쌍의 엔에프씨통신단자부를 포함하며,

상기 기관부재의 일면에 형성된 무선충전안테나부는 일측의 연결이 끊어진 동심원적 원형으로 형성되고, 타면에 형성된 무선충전안테나부는 나선형으로 형성되어,

상기 기관부재의 양면에 형성되는 무선충전안테나부는 쓰루홀을 통해 도통되도록 구성되며,

상기 엔에프씨통신안테나부는 상기 기관부재의 양면에서 상기 무선충전안테나부의 외부에 사각 나선형으로 형성되되,

상기 기관부재의 양면에 형성되는 엔에프씨통신안테나부들이 쓰루홀을 통해 도통되도록 구성되며,

상기 무선충전단자부 중에서 일 단자부는 무선충전안테나부의 패턴에서 최외부 패턴에 연결되고, 타 단자부는 최내부 패턴에 연결되며,

상기 엔에프씨통신안테나부 패턴에서 최외부 패턴이 엔에프씨통신단자부에 연결되고,

상기 무선충전안테나부의 상기 타 단자부가 상기 최내부 패턴에 연결되는 중간접속부에 엔에프씨통신안테나부의 최내부 패턴이 연결되어,

상기 타단자부를 무선충전단자부 및 엔에프씨통신단자부로서 공통으로 이용하도록 구성되며,

상기 무선충전단자부와 엔에프씨통신단자부에는 구리 또는 구리합금으로 구성되는 접속패드부가 기관부재의 양면에 한쌍 설치된 상태에서,

상기 한쌍의 접속패드부들이 쓰루홀을 통해 상호 도통되도록 구성되는 것을 특징으로 하는 무선충전 및 엔에프씨 통신 겸용 단자부를 포함하는 안테나 패치.

청구항 2

삭제

청구항 3

삭제

발명의 설명

기술분야

[0001]

본 발명은 배터리팩에 설치되는 안테나패치에 관한 것으로서, 보다 상세하게는 무선충전을 위한 단자부와 엔에프씨 통신을 위한 단자부가 공통의 단자부를 이용하도록 하고, 무선충전 효율을 상승시키도록 구성되는 무선충전 및 엔에프씨 통신 겸용 단자부를 포함하는 안테나 패치에 관한 발명이다.

배경기술

- [0002] 최근 정보통신기술의 발달로 인해 음성통화뿐만 아니라 인터넷, 화상통화 및 다양한 문서작업들이 가능한 휴대용 단말기의 사용이 증가하고 있으며, 기술의 발달에 따라 새로운 성능의 다양한 휴대용 단말기가 개발 보급되고 있다.
- [0003] 휴대용 통신단말기의 전원으로 사용되는 이너형 배터리 팩은 배터리 셀(cell)과 보호회로모듈(PCM:Protection Circuit Module)을 포함하는 피시비 기판이 결합되는 구조로 구성된다.
- [0004] 상기 배터리 팩은 배터리 셀과 보호회로모듈을 포함하는 피시비 기판이 상호 결합되어 하나의 유닛 형태로 포장된 구조이며, 이러한 배터리 팩은 최근 이를 사용하는 휴대용 통신단말기의 소형화 및 경량화 추세에 따라 소형화, 박형화, 경량화가 요구되고 있다.
- [0005] 일반적으로 가장 많이 이용되는 배터리팩의 충전 방식은, 충전기에 휴대용 단말기를 거치하여 배터리팩의 단자가 접촉되도록 하여 충전하거나, 충전기의 커넥터와 휴대용 단말기의 커넥터부를 직접 연결하여 충전하는 방식이 이용된다.
- [0006] 근래에는, 충전기에 휴대용 단말기를 거치하거나 충전기의 커넥터와 휴대용 단말기의 커넥터를 직접 연결하지 않고, 휴대용 단말기를 충전기에 올려놓거나 충전기의 부근에 배치시키는 것으로 충전이 이루어지는 무선충전방식이 개발되었다.
- [0007] 상기 무선충전방식은 크게 자기공명방식과 전자기유도방식이 있는데, 자기공명방식은 무선충전을 위한 전력의 송수신단 간에 주파수를 통해 전력을 보내는 방식이다.
- [0008] 이에 비해, 전자기유도방식은 인접하게 배치된 두개의 코일 간에 유도전류를 발생시켜 충전하는 방식으로, 두 코일의 권선 수와 코일간의 거리에 따라 유도전류가 발생하는 원리를 이용한다.
- [0009] 한편, 엔에프씨(NFC: Near Field Communication)통신은 10cm 이내의 가까운 거리에서 다양한 무선 데이터를 주고받는 통신 기술 중 하나로 13.56MHz의 주파수 대역을 사용하는 비접촉식 통신 기술이다.
- [0010] 상기 엔에프씨통신은 통신거리가 짧기 때문에 상대적으로 보안이 우수하고 가격이 저렴해 최근 주목받는 차세대 근거리 통신 기술로서, 데이터 읽기와 쓰기 기능을 모두 사용할 수 있기 때문에 기존에 RFID 사용을 위해 필요했던 동글(리더)이 필요하지 않다.

발명의 내용

해결하려는 과제

- [0011] 본 발명의 목적은, 무선충전을 위한 단자부와 엔에프씨 통신을 위한 단자부가 공통의 단자부를 이용하여 단자부의 갯수를 감소시킴으로써, 단자부가 차지하는 면적을 감소시켜 안테나 패치를 보다 소형으로 구성가능한 무선충전 및 엔에프씨 통신 겸용 단자부를 포함하는 안테나 패치를 제공하는 것이다.
- [0012] 본 발명의 또 다른 목적은, 무선충전 또는 엔에프씨 통신을 위한 안테나 패턴을 기판부재의 양면에 형성함으로써, 무선충전 또는 엔에프씨 통신 효율을 상승시키도록 구성되는 무선충전 및 엔에프씨 통신 겸용 단자부를 포함하는 안테나 패치를 제공하는 것이다.

과제의 해결 수단

- [0013] 상기 목적을 달성하기 위한 본 발명에 따른 무선충전 및 엔에프씨 통신 겸용 단자부를 포함하는 안테나 패치는 배터리팩의 표면에 설치되어 무선충전 및 엔에프씨 통신을 수행하기 위한 안테나 패치로서, 기판부재와, 상기 기판부재에 형성되는 무선충전안테나부와, 상기 기판부재에 형성되는 엔에프씨통신안테나부와, 상기 무선충전안테나부에 연결되는 한쌍의 무선충전단자부와, 상기 엔에프씨통신안테나부에 연결되는 한쌍의 엔에프씨통신단자부를 포함하며, 상기 한쌍의 무선충전단자부 중의 어느 하나는 상기 한쌍의 엔에프씨통신단자부 중의 하나로 이용되는 것을 특징으로 한다.
- [0014] 바람직하게는, 상기 무선충전안테나부는 상기 기판부재의 양면에 형성되어 쓰루홀을 통해 도통되도록 구성된다.
- [0015] 또한, 상기 엔에프씨통신안테나부는 상기 기판부재의 양면에 형성되어 쓰루홀을 통해 도통되도록 구성될 수 있다.

발명의 효과

[0016] 본 발명에 의해, 무선충전을 위한 단자부와 엔에프씨 통신을 위한 단자부가 공통의 단자부를 이용하여 단자부의 갯수를 감소시킴으로써, 단자부가 차지하는 면적을 감소시켜 안테나 패치를 보다 소형으로 구성가능하다.

[0017] 또한, 무선충전 또는 엔에프씨 통신을 위한 안테나 패턴을 기관부재의 양면에 형성함으로써, 무선충전 또는 엔에프씨 통신 효율을 상승시킬 수 있다.

도면의 간단한 설명

[0018] 첨부된 하기 도면들은, 발명의 상세한 설명과 함께 본 발명의 기술적 사상을 이해시키기 위한 것이므로, 본 발명은 하기 도면에 도시된 사항에 한정 해석되어서는 아니 된다.

도 1 은 본 발명에 따른 무선충전 및 엔에프씨 통신 겸용 단자부를 포함하는 안테나 패치의 일면의 정면도이며, 도 2 는 상기 안테나 패치의 타면의 정면도이다.

발명을 실시하기 위한 구체적인 내용

[0019] 이하, 첨부된 도면을 참조하여 본 발명의 구성을 상세히 설명하기로 한다.

[0020] 이에 앞서, 본 명세서 및 청구범위에 사용된 용어는 사전적인 의미로 한정 해석되어서는 아니되며, 발명자는 자신의 발명을 최선의 방법으로 설명하기 위해 용어의 개념을 적절히 정의할 수 있다는 원칙에 입각하여, 본 발명의 기술적 사상에 부합되는 의미와 개념으로 해석되어야 한다.

[0021] 따라서, 본 명세서에 기재된 실시예 및 도면에 도시된 구성은 본 발명의 바람직한 실시예에 불과할 뿐이고, 본 발명의 기술적 사상을 모두 표현하는 것은 아니므로, 본 출원 시점에 있어 이들을 대체할 수 있는 다양한 균등물과 변형예들이 존재할 수 있음을 이해하여야 한다.

[0022] 도 1 은 본 발명에 따른 무선충전 및 엔에프씨 통신 겸용 단자부를 포함하는 안테나 패치의 일면의 정면도이며, 도 2 는 상기 안테나 패치의 타면의 정면도이다.

[0023] 본 발명에 따른 무선충전 및 엔에프씨 통신 겸용 단자부를 포함하는 안테나 패치는 배터리팩의 표면에 설치되어 무선충전 및 엔에프씨 통신을 수행하기 위한 안테나 패치로서, 기관부재(10)와, 상기 기관부재(10)에 형성되는 무선충전안테나부(20)와, 상기 기관부재(10)에 형성되는 엔에프씨통신안테나부(30)와, 상기 무선충전안테나부(20)에 연결되는 한쌍의 무선충전단자부(22, 50)와, 상기 엔에프씨통신안테나부(30)에 연결되는 한쌍의 엔에프씨통신단자부(50, 32)를 포함하며, 상기 한쌍의 무선충전단자부(22, 50) 중의 어느 하나(50)는 상기 한쌍의 엔에프씨통신단자부(50, 32) 중의 하나(50)로 이용되는 것을 특징으로 한다.

[0024] 본 발명에 따른 안테나 패치는 스마트폰과 같은 이동통신 장치에 이용되는 배터리팩의 측면에 설치되어 상기 배터리팩의 무선충전 및 이동통신 장치의 엔에프씨 통신을 위해 이용된다.

[0025] 상기 배터리팩은 음극시트와 양극시트로 구성되는 전극적층유닛이 금속케이싱 내부에 수용된 형태로 마련될 수 있다.

[0026] 상기 배터리팩은 다양한 종류로 마련될 수 있으며, 예를 들면, 니켈-카드뮴 배터리, 니켈-수소 배터리 또는 리튬이온 배터리로 마련될 수 있다.

[0027] 바람직하게는, 상기 배터리팩은 다른 배터리와 비교시 크기에 대해 대용량 전압의 충전이 가능하고, 충전 후 전원공급이 장시간 동안 지속가능하며, 하나의 배터리로 구성되어 관리가 용이한 리튬이온 배터리로 마련될 수 있다.

[0028] 상기 기관부재(10)는 예폭시 등의 합성수지재로 플렉시블하게 구성되어, 상기 무선충전안테나부(20)와 엔에프씨통신안테나부(30)가 상기 기관부재(10) 상에 배선의 형태로 형성된다.

[0029] 상기 무선충전안테나부(20)와 엔에프씨통신안테나부(30)는 구리 또는 구리합금 선으로 에칭 또는 도금 등의 방식에 의해 상기 기관부재(10)에 형성된다.

[0030] 상기 무선충전안테나부(20)는 상기 기관부재(10) 상에 동심원적 원형으로 배치되며, 상기 엔에프씨통신안테나부(30)는 상기 기관부재(10)의 테두리 부분에 배선의 형태로 형성될 수 있다.

[0031] 여기서, 동심원적 원형이라 함은 완전한 원형을 의미하는 것이 아니라, 도 1 및 2 에서와 같이 대략적인 원형 또는 나선형을 포함하는 의미로서, 상기 기관(10) 상에 효율적으로 배치하기 위해 다양한 형상으로 변형 실시가

가능하다.

- [0032] 상기 무선충전안테나부(20)로부터의 전력을 미리 지정된 전압의 전력으로 변환하기 위한 무선충전회로부 등은 상기 배터리팩에 포함된다.
- [0033] 또한, 상기 엔에프씨통신안테나부(30)를 통해 수신된 알에프전력 또는 전자기파는 상기 배터리팩에 마련되는 엔에프씨 신호 전달단자부를 통해 이동통신장치로 전달된다.
- [0034] 상기 무선충전안테나부(20)는 상기 배터리팩을 무선으로 충전하기 위한 구성으로서, 무선충전기(WPC: Wireless Power Charger)로부터 전자기력을 전달받는다.
- [0035] 또한, 상기 엔에프씨통신안테나부(30)는 엔에프씨 통신을 수행하기 위한 안테나로서의 역할을 하기 위한 구성으로서, 엔에프씨 통신 단말기로부터 데이터를 전달받는다.
- [0036] RF 전파 또는 전자기파로 수신되는 상기 무선충전안테나부(20)로부터의 전력은 상기 무선충전회로부에 의해 이동통신장치에 이용될 수 있는 특정 주파수 대역의 전자기파로 필터링된다.
- [0037] 상기와 같이 필터링된 전자기파는 교류 상태이므로, 이러한 교류 상태의 전자기파는 배터리팩에 설치되는 정류부를 통해 직류 전력으로 변환시킨다.
- [0038] 이후, 상기와 같이 직류 전력으로 변환된 전력은 전압조정부를 통해 소정 전압의 직류 전원으로 변환된다.
- [0039] 상기 무선충전안테나부(20)는 상기 기관부재(10)의 양면에 배선의 형태로 형성된 상태에서 쓰루홀을 통해 양면의 안테나부들이 상호 도통되도록 구성될 수 있다.
- [0040] 도 1 에 도시된 형태에서는 상기 무선충전안테나부(20)가 일측의 연결이 끊어진 동심원적 원형으로 기관부재(10)의 일면에 형성되고, 도 2 에 도시된 형태에서는 상기 무선충전안테나부(26)가 나선형으로 기관부재(10)의 타면에 형성된다.
- [0041] 그리고, 상기 양면의 무선충전안테나부(20, 26)가 쓰루홀(Through-hole)(24)을 통해 상호 도통되도록 구성된다.
- [0042] 상기와 같이 양면의 안테나부(20, 26)들을 상호 도통되도록 함으로써, 안테나부의 도통 면적이 증대되는 효과를 발휘하여, 결과적으로 무선충전 효율을 상승시킬 수 있다.
- [0043] 또한, 엔에프씨통신안테나부(30) 역시 상기 기관부재(10)의 양면에 형성된 상태에서 쓰루홀을 통해 상호 도통되도록 형성함으로써, 통신 효율을 상승시킬 수 있다.
- [0044] 상기 무선충전안테나부(20)의 단부에는 무선충전 단자부(22, 50)가 연결된다.
- [0045] 상기 무선충전 단자부(22, 50) 중에서 일 단자부(22)는 무선충전안테나부(20)의 패턴에서 최외부 패턴에 연결되고, 타 단자부(50)는 최내부 패턴에 연결되어, 무선충전전력을 배터리팩으로 전달하도록 구성된다.
- [0046] 또한, 상기 기관부재(10)의 가장자리부에 배치되는 엔에프씨통신안테나부(30) 패턴에서 최외부 패턴이 엔에프씨 통신 단자부(32)에 연결되고, 상기 무선충전안테나부(20)의 타 단자부(50)가 연결되는 패턴의 중간 접속부(25)에 엔에프씨통신안테나부(30)에서 최내부 패턴이 연결된다.
- [0047] 그리하여, 상기 단자부(50)를 무선충전단자부 및 엔에프씨통신단자부로서 공통으로 이용할 수 있도록 구성된다.
- [0048] 여기서, 상기 단자부에는 구리 또는 구리합금으로 구성되는 접속패드부가 기관부재(10)의 양면에 한쌍 설치된 상태에서, 상기 한쌍의 접속패드부들이 쓰루홀(54)을 통해 상호 도통되도록 구성된다.
- [0049] 그리하여, 상기 단자부와 배터리팩의 단자부 사이에 안정적인 전기적 접속을 이룰 수 있도록 구성된다.
- [0050] 이상, 본 발명은 비록 한정된 실시예와 도면에 의해 설명되었으나, 본 발명의 기술적 사상은 이러한 것에 한정되지 않으며, 본 발명이 속하는 기술분야에서 통상의 지식을 가진 자에 의해, 본 발명의 기술적 사상과 하기 될 특허청구범위의 균등범위 내에서 다양한 수정 및 변형 실시가 가능할 것이다.

부호의 설명

- [0051] 10: 기관부재

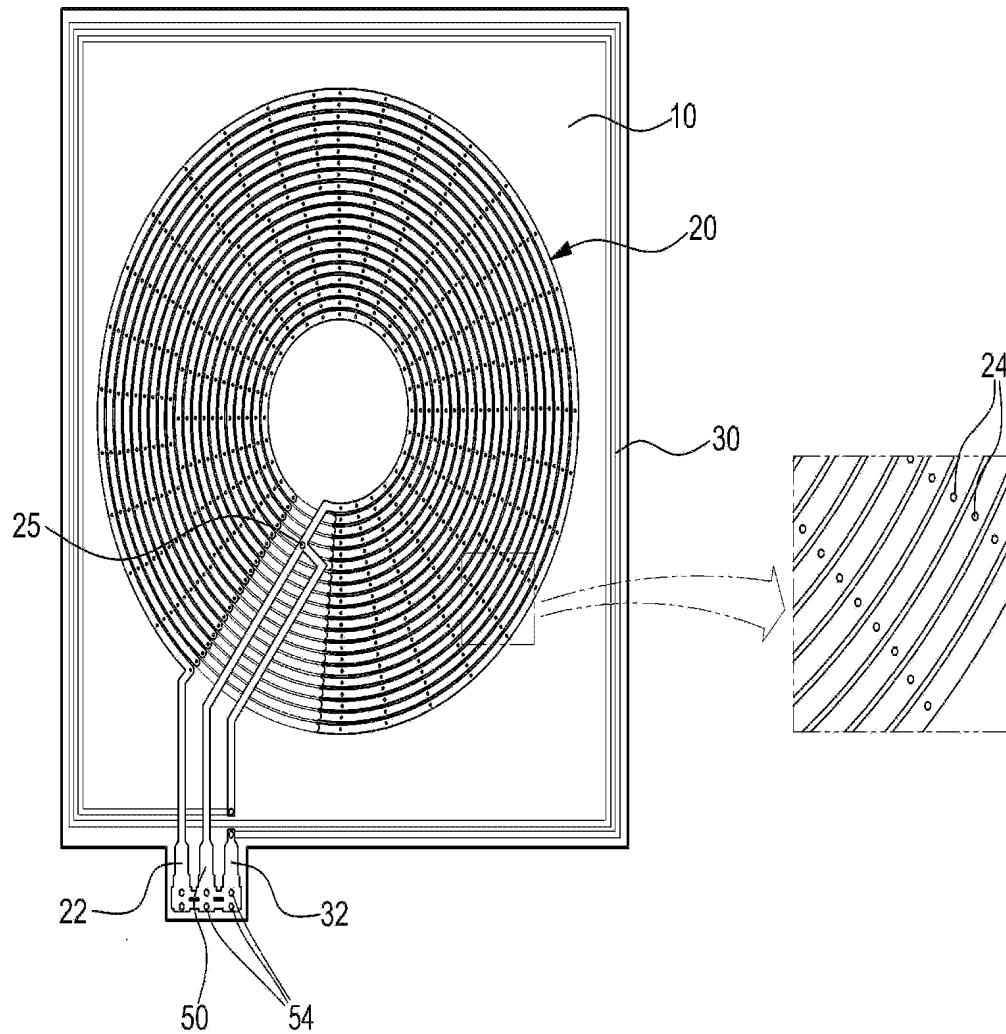
20: 무선충전안테나부

30: 엠에프씨안테나부

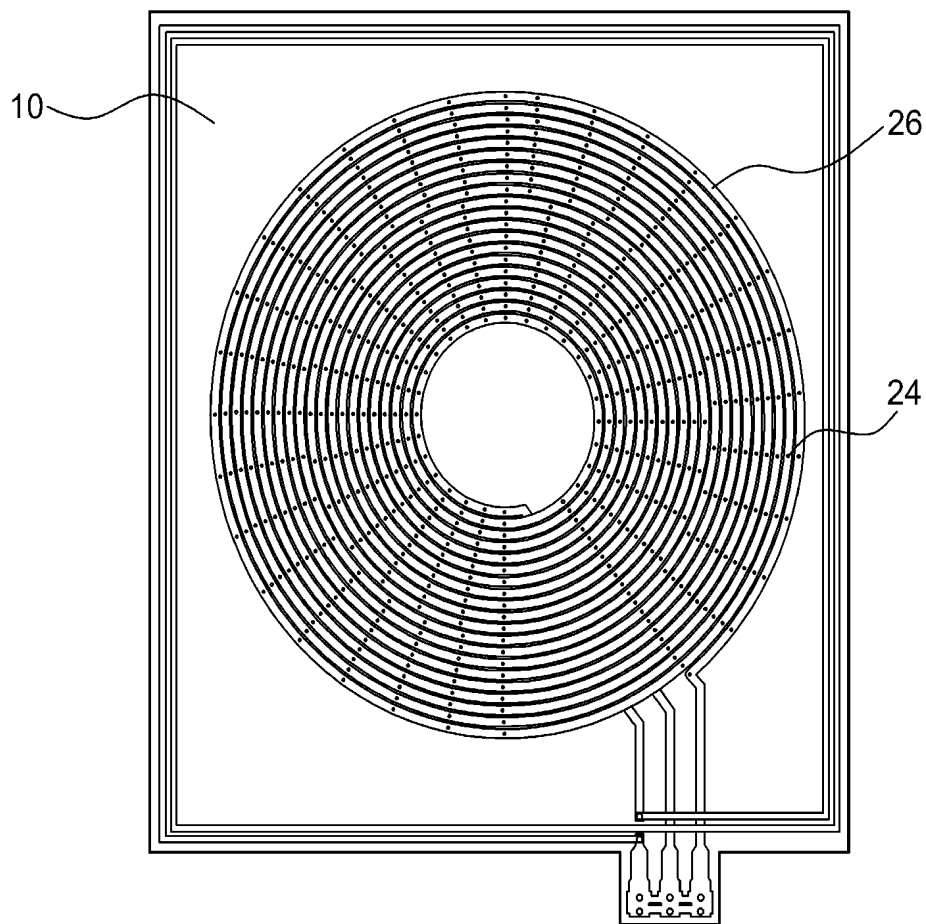
40: 단자부

도면

도면1



도면2



Wireless communication multiplex antenna for portable electronic appliance
List of publications
Publication date



- Application number 2014KR-0181639 Date 2014-12-16 [Register](#)
 - KR10-1574322 B1 Patent specification 2015-12-04

English Title

Wireless communication multiplex antenna for portable electronic appliance

Other Title

휴대 단말기용 무선통신 다중 안테나

English Abstract (Native or MT)

The present invention relates to a wireless communication multiplex antenna for a portable terminal. The wireless communication multiplex antenna improves wireless communication efficiency by using a second mode wireless communication (T2) and third mode wireless communication (T3) to an outer loop pattern (10), a middle loop pattern (30), and a center loop pattern (50), and also reducing the length and size of a pattern, further reducing the entire size of a base film (B). So, the total occupation space can be relatively reduced and also wireless communication efficiency can be maximized.

Other Abstracts

본 발명은 제 2 모드 무선통신(T2) 및 제 3 모드 무선통신(T3)을 외곽 루프패턴(10), 미들 루프패턴(30) 그리고 센터 루프패턴(50)으로 확장 활용토록 하여 무선통신 효율의 배가된 보장은 물론이거니와 패턴의 길이 및 크기의 축소 더 나아가 베이스필름(B) 전체 면적의 축소까지 실현케 하여 전체 점유공간을 상대적으로 줄일 수 있으면서도 무선통신 효율은 극대화시킬 수 있는 휴대 단말기용 무선 통신 다중 안테나에 관한 것이다.

Application Language KOREAN (KOR)

Inventor(s) PARK, JUNG-IL
PARK, JONG-JIN

Inventor(s) 박정일
박종진

Applicant/Assignee IMTECH

Assignee 주식회사 아이엠텍
Reg. Nb: 120010259405

Patent Assignee History IMTECH INC.

Representative WON, EUN SUP
Reg. Nb: 919980004162

Representative Address WON, EUN SUP , 919980004162

Representative 원은섭
Reg. Nb: 919980004162

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CPC codes H01Q-001/22/16 H01Q-001/24/3* H01Q-001/38 H01Q-007/00 H02J-050/12 H02J-050/005

CPC codes history H01Q-001/22/16 H01Q-001/24/3* H01Q-001/38 H01Q-007/00 H02J-050/12 H02J-050/005

Notes Number of Claims: 12

Cited Patents Examiner citations
-KR101118471 (B1) [KR101118471]; -KR1020140021693 (A) [KR1020140021693]; -KR1020130015618 (A) [KR1020130015618]; -KR1020140057973 (A) [KR1020140057973];

Description

TECHNICAL FIELD

[0001] The present invention relates to a wireless communication multiple antenna for a mobile terminal, and more particularly, to a wireless communication multiple antenna for a mobile terminal, in which a doubled guarantee of wireless communication efficiency is realized to reduce a length and size of a pattern and further to reduce a total area of a base film, thereby relatively reducing a total occupied space and relatively maximizing wireless communication efficiency.

BACKGROUND ART

[0002] In general, the mobile terminal may include, for example, a smart phone and various applications (application programs) while viewing a window for displaying a screen as an intelligent terminal to which computer assistance functions such as Internet communication and information retrieval are added to the mobile phone.

[0003] Publication No. 2013-0113222 (antenna and mobile terminal equipped with the same) can be introduced as prior art document 1.

[0004] FIG. 1A is a block diagram of a mobile terminal associated with prior art document 1.

[0005] The mobile terminal 100 may include a wireless communication unit 110, an Audio/Video (a/V) input unit 120, a user input unit 130, a sensing unit 140, an output unit 150, a memory 160, an interface unit 170, a control unit 180, a power supply unit 190, and the like, as illustrated in FIG. 1A.

[0006] The wireless communication unit 110 may include a broadcast reception module 111, a mobile communication module 112, a wireless Internet module 113, a near field communication module 114, a location information module 115, and so on, an audio/video (a/V) input unit 120 is for inputting an audio signal or a video signal, A camera 121, a microphone 122, and the like may be included, and the user input unit 130 may be configured by a button 136, a touch sensor (static pressure/static) 137 disposed on a front surface, a rear surface, or a side surface of the mobile terminal 100.

[0007] The sensing unit 140 generates a sensing signal for controlling an operation of the mobile terminal 100 by sensing a current state of the mobile terminal 100 such as an open/close state of the mobile terminal 100, a position of the mobile terminal 100, presence/absence of a user contact, an orientation of the mobile terminal, acceleration/deceleration of the mobile terminal, and so on, The output 150 may include a proximity sensor 141, and the output 150 may be for generating output related to visual, audio, tactile, or the like, including a display unit 151, an acoustic output module 152, an alarm unit 153, a haptic module 154, and the like.

[0008] The memory unit 160 may store a program for processing and controlling the control unit 180, or may perform a function for temporary storage of input/output data (e.g., phone book unit, message, audio, still image, moving image, etc.).

[0009] The interface unit 170 serves as a passage with all external devices connected to the mobile terminal 100. The interface unit 170 may receive data from the external device, receive power and transmit the received data to each component in the mobile terminal 100, or transmit the data in the mobile terminal 100 to the external device. For example, a wired/wireless headset port, an external charger port, a wired/wireless data port, a memory card port, a port connecting a device provided with an identification module, an audio input/output (I/o) port, a video input/output (I/o) port, an earphone port, and the like may be included in the interface unit 170.

[0010] A controller 180 typically controls the overall operation of the mobile terminal. Related controls and processes are performed, for example, for voice calls, data communications, video calls, and the like. The control unit 180 may include a multimedia module 181 for multi-media playback.

[0011] The power supply 190 receives external power and internal power under control of the control unit 180, and supplies power necessary for operation of the respective components.

[0012] The power supply 190 may include, for example, a battery, a connection port, a power supply controller, and a charge monitoring unit.

[0013] FIG. 1B is a rear perspective view of a mobile terminal according to prior art document 1.

[0014] Referring to FIG. 1B, the rear face of the terminal body, i.e., the rear case 102, may be further equipped with a camera 121 '. Adjacent to camera 121 ', flash 123 and mirror 124 may be further disposed. The flash 123 shines light toward the subject when photographing the subject with the camera 121 '.

[0015] FIG. 1C is a top view illustrating attachment of an antenna 200 according to the prior art document to a rear cover 103 of a mobile terminal 100.

[0016] Referring to figs. 1A-1C, shown are front case 101, rear case 102, rear cover (or battery cover) 103, camera 121 ', interface 170, microphone 122, sound output 152', battery 191, battery mount 104, USIM card mount 105, memory card mount 106.

[0017] A space may be provided on a surface of the rear case 102 to mount external components such as the battery mounting unit 104, the USIM card mounting unit 105, and the memory card mounting unit 106. The exterior parts mounted on the surface of the rear case (102) are generally

intended to enable the functions of the mobile terminal (100) to be diversified and expand the functions of the mobile terminal (100) to meet diversified consumer needs.

[0018] The antenna 200 has increased need for wireless communication with external devices and servers while diversifying functions of the mobile terminal 100. For example, an antenna (200) for receiving broadcast information such as Electronic Program Guide (EPG) of Digital Multimedia Broadcasting (DMB) or Electronic Service Guide (ESG) of Digital Video Broadcast-Handheld (DVB-H), Wibro, HSDPA, GSM, CDMA, WCDMA, an antenna (200) for wireless Internet such as LTE, etc., an antenna (200) for wireless Internet such as Bluetooth, Radio Frequency Identification (RFID), an antenna 200 for infrared data association (IrDA), Ultra Wideband (uwb), ZigBee near field communication, and the like is needed.

[0019] Such an antenna (200) is preferably formed in a large area for reception of radio waves and is preferably located on the surface side of the mobile terminal (100) so as not to be affected by other electronic components. Accordingly, as illustrated in FIG. 1C, the antenna 200 is disposed on the rear cover 103, which generally does not mount an electronic component and can secure a large area.

[0020] The antenna 200 of prior art document 1 mainly constitutes a flexible substrate 210, two kinds of patterns, and a magnetic sheet 230 as shown in FIG. 1 (c).

[0021] The pattern is divided into two kinds of high-frequency patterns 220 and low-frequency patterns 225. That is, the high-frequency pattern 220 is suitable for wireless communication, and the low-frequency pattern 225 is mainly suitable for wireless charging of the battery.

[0022] Radiocharger techniques used in mobile terminals (100) utilize electromagnetic induction principles.

[0023] Electromagnetic induction causes a current to flow to form a magnetic field, and when the mobile terminal 100 is placed thereon, a current flows through a low-frequency pattern mounted on the mobile terminal 100, i.e., a wireless charging coil 225, to charge.

[0024] The frequency may vary depending on the amount of power transmitted, but generally, the power used in small household appliances such as mobile terminal 100 may use a relatively low frequency to hundreds of kHz or less.

[0025] The wireless communication requires an antenna to perform functions such as Near Field Communication (NFC), Radio Frequency Identification (RFID), etc., in addition to transmission of radio waves for telephone calls, as a function of the mobile terminal 100 diversified. In particular, the frequencies used according to the wireless communication technology are different, and a relatively high frequency is used as compared to the frequencies used for wireless charging to transmit a large amount of data.

[0026] An example of a communication scheme in which the wireless communication antenna 200 of prior art document 1 is used includes Near Field Communication (NFC). Near field wireless communication is a contactless wireless communication module that utilizes about a 13.56 MHz frequency band as a kind of electronic tag (RFID).

[0027] A technology for transmitting data between terminals (100) at a close distance of approximately 10 to 40 cm is disclosed, which is a next-generation short-range communication technology having relatively excellent security and low cost because of a short communication distance. Both data reading and writing can be used, setting is not necessary for a device period like Bluetooth, and a near field communication function is added to the mobile terminal 100 in recent years.

[0028] However, since the mobile terminal 100 according to prior art document 1 is disposed in a state in which the high-frequency pattern 220 and the low-frequency pattern 200 are physically completely isolated from each other, the overall area thereof is relatively large. In particular, the high-frequency pattern 220 has a relatively greater patterning length than the low-frequency pattern 200 so as to increase the efficiency of electromagnetic induction at a distance of 10-40 cm, and it has a problem that the high-frequency pattern 220 does not have to be wound larger while being spaced apart from the low-frequency pattern 200, and thus it is possible to occupy a wide and large occupation space.

[0029] FIG. 2 (a) is an exemplary diagram showing an on-plane arrangement of an NFC antenna and a wpt resonator in a resonance type wireless power receiving system to which prior art document 2 (Publication No. 2013-0123310; resonance stage arrangement in a resonance type wireless power receiving system) is applied, and FIG. 2 (b) shows an arrangement of an NFC antenna and a wpt resonator on a portable terminal.

[0030] Referring to Figs. 2A and 2B, looking first at mechanical mounting states of NFC antenna 10 and WPT resonator 20 in a wireless power receiving system to which Prior Art Document 2 is applied, for example, a portable terminal, planarly a looped antenna structure is installed so that NFC antenna 10 is located inside WPT resonator 20 having a looped antenna structure.

[0031] In addition, NFC antenna 10 can be installed on the rear surface of main body 1 of the portable terminal (at a battery portion that can be detachably installed), and wpt antenna 20 can be installed on the rear surface cover 2 of the portable terminal.

[0032] In this case, isolation distances (isolation d, isolation h) may occur between the NFC antenna 10 and the WPT resonator 20. This separation distance mechanically determines isolation characteristics of both frequencies (13.56 MHz, 6.78 MHz) of NFC antenna (10) and WPT resonator (20).

[0033] FIG. 2C is a circuit diagram of a resonant stage device in a resonant type wireless power receiving system according to one embodiment of prior art document 2, and numeral 20 is a high impedance circuit.

[0034] Referring to Fig. 2c, a resonant stage device according to the features of prior art document 2 may connect shunt capacitors 40 to WPT resonator 20 to prevent harmonics emitted from WPT Power Amplifier (PA) (not shown) from radiating outwards.

[0035] Meanwhile, in the resonant type wireless power receiving system according to prior art document 2, the resonant end device also has the disadvantage that because the NFC antenna 10 and the WPT resonator 20 are disposed in a state in which the NFC antenna 10 and the WPT resonator 20 are physically completely isolated from each other, the overall area cannot be relatively large, and the occupation space cannot be widely occupied.

[0036] FIG. 3 is a circuit diagram of a wireless power transfer control device 100 when using a power supply frequency band of 6.78 MHz according to an embodiment of prior art document 3 (published patent publication 2013-0027403).

[0037] Referring to FIG. 3, the wireless power transmission control apparatus 100 uses the 13.56 MHz band as the communication frequency band and uses the power supply frequency band different from the communication frequency band, so that regulation is not affected even if the strength of the power supply signal and the communication signal is increased.

[0038] Further, when the 13.56 MHz band is used as the communication frequency band and the power supply frequency band is used different from the communication frequency band according to the prior art document 3 embodiment, the specific circuit configuration of the wireless power transmission control apparatus 100 may be configured differently.

[0039] For example, a separate configuration may be provided external to Power IC 120 for wireless power transfer control signal transmission and reception with NFC IC 140 as FIG. 3.

[0040] More specifically, referring to FIG. 3, a circuit of the wireless power transfer control apparatus 100 may include a WPT coil 410, an NFC coil 440, a Power IC 420, a General Purpose Input/Output (GPIO) Expander 422, an Analog Digital Converter (ADC) 424, and an NFC IC 430.

[0041] The WPT coil 410 may be connected with the power IC 420, resonates in a frequency band of 6.78 MHz, and receives power from the power supply TX and provides the power to the power IC 420. The power IC 420 generates various signals necessary for wireless power reception and operates in accordance with a wireless power transfer control signal according to a message received from the power supply TX. The Power IC (420) activates the overall operation of the wireless power transfer control device (100) by using a voltage according to the power received by the WPT coil (410). Further, while being supplied with power, current and voltage obtained by the supplied power are measured and regulated, and a constant voltage VDC_out is output.

[0042] GPIO Expander 422 is an input/output module that allows a signal output by power IC 420 to be input to NFC IC 430 between power IC 420 and NFC IC 430, and allows a signal output by NFC IC 430 to be input to power IC 420. ADC 424 converts an analog signal into a digital signal with respect to a signal transmitted/received by power IC 420 and NFC IC 430, and converts a digital signal into an analog signal to control signal transmission/reception between power IC 420 and NFC IC 430.

[0043] NFC IC 430 operates in accordance with the power provided by Power IC 420 and performs NFC communication with power supply TX via NFC coil 440. Here, the NFC coil 440 may be configured as an NFC coil (Coil) capable of radio wave radiation and radio wave reception in the 13.56 MHz band.

[0044] NFC IC 430 analyzes the signal received from power supply TX via NFC antenna 440 and transfers a wireless power transfer control signal to Power IC 420 using NFC IC input/output 431 according to the received signal. In this case, the NFC IC input/output unit 431 may include an SDA terminal and an SDC terminal. The SDA terminal receives or outputs data for wireless power transfer control, and the SDC terminal outputs a clock. In addition, according to the embodiment of the prior art document 3, the wireless power transfer control signal is a control signal necessary for wireless power transfer, and can adjust voltage, current, temperature, and the like.

[0045] Meanwhile, in the embodiment of prior art document 3 described above, a power supply frequency band is used at 6.78 MHz and a 13.56 MHz band is used as a communication frequency band, but the power supply frequency band may be used at 100 to 200 kHz.

[0046] Meanwhile, the wireless power transfer control apparatus according to prior art document 3 also knows a limitation that because the WPT coil 410 and the NFC coil 440 are disposed in a state where the WPT coil 410 and the NFC coil 440 are physically completely isolated from each other, the overall area can be relatively large and occupied space can also be widely occupied.

CITATION LIST

PATENT LITERATURE

[0047] Prior Art Document 1-Publication No. 10-2013-0113222 (Antenna and Mobile Terminal equipped with the Same)

Prior Art Document 2-Publication No. 2013-0123310 (Resonant Stage Device in Resonant Type Wireless Power Receiving System)

Prior Art Document 3-Laid-open Patent No. 2013-0027403 (Wireless Power Transfer Control Device)

SUMMARY OF INVENTION

TECH PROBLEM

[0048] An object of the present invention is to provide a wireless communication multiple antenna for a mobile terminal, which can not only make the number of times of patterns wound around a base film relatively large, but also make the overall length relatively long, i.e., enlarging inductance to maximize wireless communication efficiency.

[0049] An object of the present invention is to provide a wireless communication multiple antenna for a mobile terminal capable of ensuring doubling of wireless communication efficiency with an extended non-contact magnetic induction coupling force.

[0050] An object of the present invention is to provide a wireless communication multiple antenna for a mobile terminal, which makes it possible to realize reduction of the length and size of a pattern and further reduction of the overall area of a base film, thereby relatively reducing the occupied space and maximizing wireless communication efficiency.

TECH SOLUTION

[0051] In order to achieve the above object, the present invention provides a process comprising:

[0052] A flexible base film, an outer loop pattern wound around an edge of the base film starting from an outer start terminal, an outer connection pattern extending from the outer loop pattern to an inside of the base film, a middle loop pattern extending from the outer loop pattern to the middle region of the base film, an inner connection pattern extending from the middle loop pattern to the inside of the base film, a center loop pattern extending from the inner connection pattern, wound around a center region of the base film, and then connected to an external center end terminal, an outer common terminal joined to the outer connection pattern and drawn out to the outside, and an inner common terminal joined to the inner connection pattern and drawn out to the outside,

[0053] Wherein the outer loop pattern extending from the outer start terminal to the outer common terminal implements first mode wireless communication, and

[0054] Wherein the center loop pattern in addition to the middle loop pattern extending from the outer common terminal to the center end terminal through the inner connection pattern,

[0055] Wherein the outer loop pattern, the middle loop pattern, and the center loop pattern extending from the outer start terminal to the center end terminal through the outer connection pattern and the inner connection pattern are configured to maximally expand and implement third mode wireless communication.

[0056] In order to achieve the above object, the present invention provides a process comprising:

[0057] A flexible base film, an outer loop pattern wound around an edge of the base film starting from an outer start terminal and then connected to an outer end terminal, a middle loop pattern wound around a middle region of the base film starting from an outer middle start terminal, an inner connection pattern extending from the middle loop pattern to the inside of the base film, a center loop pattern extending from the inner connection pattern, wound around a center region of the base film, and then connected to an external center end terminal, and an inner common terminal joined to the inner connection pattern and drawn out to the outside,

[0058] Wherein the outer loop pattern extending from the outer start terminal to the outer end terminal implements first mode wireless communication,

[0059] Wherein the center loop pattern extending from the inner common terminal to the center end terminal implements second mode wireless communication,

[0060] Wherein the middle loop pattern and the center loop pattern extending from the middle start terminal to the center end terminal through the inner connection pattern are extended and implemented in a third mode wireless communication.

ADVANTAGEOUS EFFECTS

[0061] According to the present invention, a first mode wireless communication is implemented as an outer loop pattern, a second mode wireless communication is implemented as an extension of a middle loop pattern and a center loop pattern, and a third mode wireless communication is implemented as a maximum extension of the outer loop pattern, the middle loop pattern and the center loop pattern, Not only can the number of wound patterns according to the second mode wireless communication and the third mode wireless communication be relatively large compared to the same area base film, but also can the overall length be relatively long, i.e., the inductance is enlarged, thereby maximizing the wireless communication efficiency.

[0062] According to the present invention, the first mode wireless communication enables the non-contact magnetic induction coupling force to be realized by the inductance L1 value of the outer loop pattern itself between the outer start terminal and the outer common terminal, The second mode radio communication makes it possible to ensure doubling of radio communication efficiency with an extended non-contact magnetic-induction coupling force incorporating inductance L3 values as well as inductance L2 values by the center loop pattern between the outer common terminal and the center end terminal, Furthermore, the third mode wireless communication can ensure greater doubling of wireless communication efficiency with an extended non-contact magnetic-induction coupling force incorporating inductance L1 values by outer loop patterns, inductance L2 values by middle loop patterns, and inductance L3 values by center loop patterns between outer start terminals and center end terminals.

[0063] The present invention relates to a method of controlling a second mode wireless communication and a third mode wireless communication, A doubled wireless communication efficiency can be ensured by extending and utilizing the middle loop pattern and the center loop pattern as well as reducing the length and size of the patterns and further reducing the total area of the base film, thereby

relatively reducing the total occupied space and relatively maximizing the wireless communication efficiency.

[0064] According to the present invention, a first mode wireless communication is implemented as an outer loop pattern, a second mode wireless communication is implemented as a center loop pattern, and a third mode wireless communication is implemented as an extension of a middle loop pattern and a center loop pattern, Not only can the number of wound patterns according to the third mode wireless communication be relatively large compared to the same area base film, but also can the total length be relatively long, i.e., the inductance is enlarged, thereby maximizing the wireless communication efficiency.

[0065] According to the present invention, the first mode wireless communication enables the non-contact magnetic induction coupling force to be realized with the inductance L1 of the outer loop pattern itself between the outer start terminal and the outer end terminal, the second mode wireless communication enables the non-contact magnetic induction coupling force to be realized with the inductance L2 of the middle loop pattern between the middle start terminal and the inner common terminal, The third mode wireless communication can ensure a greater doubling of wireless communication efficiency with an extended non-contact magnetic-induction coupling force incorporating inductance L2 values due to the middle loop pattern and inductance L3 values due to the center loop pattern between the middle start terminal and the center end terminal.

[0066] According to the present invention, it is possible to ensure that the wireless communication efficiency is multiplied by utilizing the third mode wireless communication as a middle loop pattern and a center loop pattern, thereby reducing the length and size of the pattern and further reducing the total area of the base film, thereby relatively reducing the total occupied space and relatively maximizing the wireless communication efficiency.

DESCRIPTION OF DRAWINGS

[0067] Fig. 1A is a block schematic diagram of a mobile terminal in connection with prior art document 1. FIG. 1B is a rear perspective view of a mobile terminal according to prior art document 1. FIG. 1C is a plan view showing the antenna according to prior art document 1 attached to the rear cover of the mobile terminal. FIG. 2A is an exemplary diagram illustrating an on-plane arrangement of an NFC antenna and a WPT resonator in a resonant type wireless power receiving system to which prior art document 2 is applied. FIG. 2B is a structure diagram showing an arrangement structure of NFC antenna and WPT resonator of prior art document 2 on a portable terminal. FIG. 2C is a circuit diagram of a resonant stage device in a resonant type wireless power receiving system according to one embodiment of prior art document 2. FIG. 3 is a circuit diagram of a wireless power transmission control apparatus when using a power supply frequency band of 6.78 MHz according to an embodiment of prior art

document 3. FIG. 4 is a plan view illustrating a radio communication multiple antenna for a general mobile terminal derivable from prior documents to the present disclosure. FIG. 5A is a plan view showing a radio communication multiple antenna for a mobile terminal according to the first embodiment of the present invention. FIG. 5B is an equivalent circuit diagram showing a radio communication multiple antenna for a mobile terminal according to the first embodiment of the present invention. FIG. 6A is a plan view showing a radio communication multiple antenna for a mobile terminal according to a second embodiment of the present invention. Fig. 6b is an equivalent circuit diagram showing a radio communication multiple antenna for a mobile terminal according to the second embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0068] Hereinafter, a preferred embodiment of a wireless communication multiple antenna for a mobile terminal according to the present invention will be described with reference to the drawings, and there may be a plurality of embodiments, and objects, features, and advantages of the present invention can be better understood through such embodiments.

[0069] FIG. 4 (a) is a top view illustrating a radio communication multiple antenna for a general mobile terminal derivable from prior documents in contrast to the present invention, and FIG. 4 (b) is an equivalent circuit diagram of FIG. 4 (a).

[0070] As shown in figs. 4 a and 4 b, a general radio communication multiple antenna for mobile terminals is based on a flexible base film b, and is independently provided with an outer loop pattern 10 connected to an outer start terminal 11 and an outer end terminal 12 and wound around an edge of the base film b, And a middle loop pattern (30) wound around a middle region of the base film (b) which is respectively connected to the outer middle start terminal (31) and the middle end terminal (32) and is spaced apart from the outer loop pattern (10), And a center loop pattern 50 wound around a center region of the base film b connected to an external center start terminal 51 and a center end terminal 52 and spaced apart from the middle loop pattern 30.

[0071] The outer loop pattern includes Near Field Communication (NFC) for transmitting data between external terminals using Non-Contact Magnetic Inductive Coupling Power in a frequency band of 13.56 MHz at a close distance of approximately 10 cm to 40 cm, Utilize Radio Frequency Identification (RFID) as a first mode radio T1; The middle loop pattern 30 can utilize magnetic secure transmission (MST) for transmitting external terminal data with non-contact magnetic induction coupling force in a frequency band of 13.56 MHz at a near field of 10 to 200 cm as the second mode radio communication T2, and the center loop pattern 50 has an electromagnetic induction principle, That is, a wireless power transfer (WPT) that enables charging of a battery with non-contact magnetic induction coupling force

implemented in a band of 100 to 200 kHz may be utilized as the third mode wireless communication (T3) by flowing a current according to the induced magnetic field principle to form a magnetic field.

[0072] However, in a general wireless communication multiple antenna for mobile terminals, an outer loop pattern 10 is independently provided on an outer periphery of a base film b by an outer start terminal 11 and an outer end terminal 12, a middle loop pattern 30 is independently provided on a center region of the base film b by a middle start terminal 31 and a middle end terminal 32, Furthermore, the center loop pattern 50 is independently provided at the center of the base film b by the center start terminal 51 and the center end terminal 52, The first mode radio (T1), the second mode radio (T2), and the third mode radio (T3) depend on non-contact magnetic induction coupling forces according to inductance L1 values, L2 values, and L3 values, respectively, so that the limitation of preventing maximization of radio communication efficiency is ensured.

[0073] Specifically, since the second mode radio communication T2 of the MST and the third mode radio T3 of the WPT are each composed of independent middle loop patterns 30 and center loop patterns 50, the number of turns is not only small, but the overall length is not only small, i.e., the inductance is small, and thus the wireless communication efficiency is not maximized.

[0074] FIG. 5A is a top view showing a radio communication multiple antenna for a mobile terminal according to the first embodiment of the present invention, and FIG. 5B is an equivalent circuit view showing a radio communication multiple antenna for a mobile terminal according to the first embodiment of the present invention.

[0075] A wireless communication multiple antenna for a mobile terminal according to a first embodiment of the present invention is patterned on a base film b in which an outer loop pattern 10, a middle loop pattern 30, and a center loop pattern 50 are flexible in one line from an outer start terminal 11 to a center end terminal 52 as shown in figs. 5 a and 5 b.

[0076] More specifically, a wireless communication multiple antenna for a mobile terminal according to a first embodiment of the present invention includes a flexible base film b, an outer loop pattern 10 wound around an edge of the base film b starting from an outer start terminal 11, an outer connection pattern (20) extending from the outer loop pattern (10) to the inside of the base film (b), a middle loop pattern (30) extending to the outer connection pattern (20) and wound around to a middle region of the base film (b), an inner connection pattern 40 connected to the inside of the base film b from the middle loop pattern 30, a center loop pattern 50 connected to the inner connection pattern 40, wound to a center region of the base film b, and then connected to an external center end terminal 52, an outer common terminal 21 joined to the outer connection pattern 20 and drawn out to the outside, and an inner common terminal 41 joined to the inner connection pattern 40 and drawn out to the outside.

[0077] Preferably, in a state where the outer loop pattern 10, the middle loop pattern 30, and the center loop pattern 50 are entirely connected to the flexible base film b, the outer loop pattern 10 extending from the outer start terminal 11 to the outer common terminal 21 enables the first mode wireless communication T1 to be implemented, A center loop pattern 50 together with a middle loop pattern 30 extending from an outer common terminal 21 to an inner connection pattern 40 to a center end terminal 52 allows the second mode radio communication T2 to be extended and implemented, The outer loop pattern 10, the middle loop pattern 30, and the center loop pattern 50 from the outer start terminal 11 to pass through the outer connection pattern 20 and the inner connection pattern 40 to the center end terminal 52 are characterized in that the third mode wireless communication T3 can be implemented with maximum extension.

[0078] As described above, the first mode wireless communication T1 is implemented by the outer loop pattern 10, the second mode wireless communication T2 is extended by the middle loop pattern 30 and the center loop pattern 50, and the third mode wireless communication T3 is extended by the outer loop pattern 10, the middle loop pattern 30 and the center loop pattern 50, The number of wound patterns according to the second mode radio communication T2 and the third mode radio communication T3 compared to the same area base film b can be made relatively large compared to independent figs. 4a and 4b, and the overall length can be made relatively long, i.e., can expand inductance, thereby maximizing wireless communication efficiency.

[0079] That is, the first mode radio communication T1 enables the non-contact magnetic induction coupling force to be realized with the inductance L1 value of the outer loop pattern 10 itself between the outer start terminal 11 and the outer common terminal 21 as illustrated in FIG. 5 (b), The second mode radio communication T2 ensures doubling of radio communication efficiency with extended non-contact magnetic induction coupling force incorporating inductance L3 values by center loop pattern 50 as well as inductance L2 values by middle loop pattern 30 between outer common terminal 21 and center end terminal 52 as shown in FIG. 5 (b), Further, the third mode radio communication T3 may determine an inductance L1 value by the outer loop pattern 10 between the outer start terminal 11 and the center end terminal 52 as shown in FIG. 5B, To make it possible to ensure greater doubling of wireless communication efficiency with an extended non-contact magnetic-induction coupling force incorporating inductance L2 values by the middle loop pattern 30 and inductance L3 values by the center loop pattern 50.

[0080] Thus, in the first embodiment of the present invention, the second mode wireless communication T2 and the third mode wireless communication T3 are transmitted through the outer loop pattern 10, by extending and utilizing the middle loop pattern 30 and the center loop pattern 50, a doubled wireless communication efficiency can be ensured to reduce the length and size of the pattern and further to reduce the overall area of the base film b, thereby relatively reducing the overall occupied space and maximizing wireless communication efficiency.

[0081] In this case, the first mode radio T1 may be Near Field Communication (NFC) or Radio Frequency Identification (RFID), the second mode radio T2 may be Wireless Power Transfer (WPT), and the third mode radio T3 may be Magnetic Secure Transmission (MST).

[0082] Further, the first mode radio T1 may be a magnetic secure transfer (MST), the second mode radio T2 may be a wireless power transfer (WPT), and the third mode radio T3 may be a near field communication (NFC) or a radio frequency identification (RFID).

[0083] Furthermore, the first mode radio (T1) is a wireless power transfer (WPT), the second mode radio (T2) is a magnetic secure transfer (MST), The third mode radio T3 may be Near Field Communication (NFC) or Radio Frequency Identification (RFID).

[0084] Furthermore, the first mode radio (T1) is a wireless power transfer (WPT), the second mode radio (T2) is a near field communication (NFC) or a radio frequency identification (RFID), The third mode radio T3 may be a magnetic secure transmission (MST).

[0085] NFC or RFID, MST, and WPT may be selectively applied as the first mode radio T1, the second mode radio T2, and the third mode radio T3, and such implementation may be performed by user selection according to communication environment.

[0086] Here, NFC and RFID enable transmission of external terminal data in the 13.56 to 15 MHz frequency band at a close distance of approximately 10 to 40 cm as already known, transmission of external terminal data in the 13.56 to 15 MHz frequency band at a close distance of approximately 10 to 100 cm as also already known, The WPT is also known, and it is possible to flow a current according to the electromagnetic induction principle, that is, the induction field principle, to form a magnetic field and place a mobile terminal thereon to enable charging of a battery in the 100 to 200 kHz band.

[0087] Meanwhile, it is of course possible that the first mode radio T1, the second mode radio T2 and the third mode radio T3 may realize radio communication through non-contact magnetic induction coupling.

[0088] On the other hand, a radio communication multiple antenna for a mobile terminal according to a first embodiment of the present invention is composed of four terminals, an outer start terminal 11, an outer common terminal 21, an inner common terminal 41 and a center end terminal 52, That is, an auxiliary terminal may be branched to each of the outer start terminal 11, the outer common terminal

21, the inner common terminal 41, and the center end terminal 52 so as to be compatible with eight terminals of the main circuit board shown above, and a total of eight terminals may be provided.

[0089] FIG. 6A is a top view showing a radio communication multiple antenna for a mobile terminal according to the second embodiment of the present invention, and FIG. 6B is an equivalent circuit view showing a radio communication multiple antenna for a mobile terminal according to the second embodiment of the present invention.

[0090] A wireless communication multiple antenna for a mobile terminal according to a second embodiment of the present invention is patterned into a structure in which an outer loop pattern 10 is independently patterned into a flexible base film b, as illustrated in figs. 6 a and 6 b, while connecting a middle loop pattern 30 and a center loop pattern 50 by an inner connection pattern 40.

[0091] More specifically, a wireless communication multiple antenna for a mobile terminal according to a second embodiment of the present invention includes a flexible base film b, an outer loop pattern 10 wound around an edge of the base film b starting from the outer outer start terminal 11 and then connected to the outer end terminal 12, a middle loop pattern 30 wound around to a middle region of the base film b starting from the outer middle start terminal 31, an inner connection pattern 40 extending inward of the base film b from the middle loop pattern 30, a center loop pattern 50 connected to the inner connection pattern 40, wound around to a center region of the base film b, and then connected to an external center end terminal 52, and an inner common terminal 41 joined to the inner connection pattern 40 and led out to the outside.

[0092] Preferably, the outer loop pattern (10) is independently patterned on the flexible base film (b), while the outer loop pattern (10) extending from the outer start terminal (11) to the outer end terminal (12) in a state where the middle loop pattern (30) and the center loop pattern (50) are connected to each other, A center loop pattern (50) extending from an inner common terminal (41) to a center end terminal (52) implements a second mode radio communication (T2), The middle loop pattern 30 and the center loop pattern 50 from the middle start terminal 31 to pass through the inner connection pattern 40 to the center end terminal 52 are key characterized in that the middle loop pattern 30 and the center loop pattern 50 extend and implement the third mode radio communication T3.

[0093] As described above, the first mode radio (T1) is implemented as an outer loop pattern (10), the second mode radio (T2) is implemented as a center loop pattern (50), and the third mode radio (T3) is implemented as an extension of the middle loop pattern (30) and the center loop pattern (50), The number of wound patterns according to the third mode radio communication T3 compared to the base film b of the same area can be relatively large compared to the independent figs. 4a and 4b, and the

overall length can be relatively long, i.e., can expand inductance, thereby maximizing wireless communication efficiency.

[0094] That is, The first mode radio communication T1 enables the non-contact magnetic induction coupling force to be realized with the inductance L1 value of the outer loop pattern 10 itself between the outer start terminal 11 and the outer end terminal 12 as shown in FIG. 6 (b), The second mode radio communication T2 enables the non-contact magnetic induction coupling force to be realized with an inductance L2 value by the middle loop pattern 30 between the middle start terminal 31 and the inner common terminal 41 as shown in FIG. 6 (b), The third mode radio communication T3 can ensure greater doubling of radio communication efficiency with extended non-contact magnetic induction coupling force incorporating inductance L2 values by the middle loop pattern 30 and inductance L3 values by the center loop pattern 50 between the middle start terminal 31 and the center end terminal 52 as shown in FIG. 6 (b).

[0095] As such, In the second embodiment of the present invention, since the third mode radio communication T3 is extended and utilized to the middle loop pattern 30 and the center loop pattern 50, it is of course possible to ensure that the wireless communication efficiency is multiplied by the length And reducing the size and further reducing the total area of the base film (b), so that the total occupied space can be relatively reduced and wireless communication efficiency can be maximized.

[0096] In this case, the first mode radio T1 may be Near Field Communication (NFC) or Radio Frequency Identification (RFID), the second mode radio T2 may be Wireless Power Transfer (WPT), and the third mode radio T3 may be Magnetic Secure Transmission (MST).

[0097] Further, the first mode radio T1 may be a magnetic secure transfer (MST), the second mode radio T2 may be a wireless power transfer (WPT), and the third mode radio T3 may be a near field communication (NFC) or a radio frequency identification (RFID).

[0098] Furthermore, the first mode radio (T1) is a wireless power transfer (WPT), the second mode radio (T2) is a magnetic secure transfer (MST), The third mode radio T3 may be Near Field Communication (NFC) or Radio Frequency Identification (RFID).

[0099] Furthermore, the first mode radio (T1) is a wireless power transfer (WPT), the second mode radio (T2) is a near field communication (NFC) or a radio frequency identification (RFID), The third mode radio T3 may be a magnetic secure transmission (MST).

[0100] NFC or RFID, MST, and WPT may be selectively applied as the first mode radio T1, the second mode radio T2, and the third mode radio T3, and such implementation may be performed by user selection according to communication environment.

[0101] Here, NFC and RFID enable transmission of external terminal data in the 13.56 to 15 MHz frequency band at a close distance of approximately 10 to 40 cm as already known, transmission of external terminal data in the 13.56 to 15 MHz frequency band at a close distance of approximately 10 to 100 cm as also already known, The WPT is capable of forming a magnetic field by flowing a current according to the electromagnetic induction principle, i.e., the induction field principle, and placing the mobile terminal thereon to enable charging of the battery in the 100 to 200 kHz band.

[0102] Meanwhile, it is of course possible that the first mode radio T1, the second mode radio T2 and the third mode radio T3 may realize radio communication through non-contact magnetic induction coupling.

[0103] On the other hand, a radio communication multiple antenna for a mobile terminal according to a second embodiment of the present invention is composed of five terminals: an outer start terminal, an outer end terminal, a middle start terminal, an inner common terminal and a center end terminal, Auxiliary terminals may be branched to each of the outer start terminal 11, the middle start terminal 31, and the center end terminal 52 so as to be compatible with eight terminals of the portable terminal itself, that is, eight terminals in total may be provided.

[0104] On the other hand, according to the present invention, the base film b may be a polyimide film, a pet film, or a PVC film, and may include an outer start terminal 11, an outer end terminal 12, a middle start terminal 31, an inner common terminal 41, Of course, the center end terminal 52, the outer loop pattern 10, the middle loop pattern 30, and the center loop pattern 50 may be patterned separately on an upper surface, a lower surface, or both surfaces of the base film b through a via hole or the like so as not to cross each other.

INDUSTRIAL APPLICABILITY

[0105] The present disclosure may be used in the industry of mobile terminals such as tablet PC, smart phone, and the like. however, the present disclosure refers to an outer loop pattern, a middle loop pattern, and a center middlepattern, but it is possible to add a loop pattern as necessary, and such addition of a loop pattern may be performed within the scope of the present disclosure.

REFERENCE SIGNS LIST

[0106] 10: outer loop pattern 11: outer start terminal 12: outer end terminal 20: outer connection pattern 21: outer common terminal 30: middle loop pattern 31: middle start terminal 32: middle end terminal 40: Inner connection pattern 41: inner common terminal 50: center loop pattern 51: center start terminal 52: center end terminal b: base film T1: first mode wireless communication T2: second mode wireless communication T3: third mode wireless communication

Description



(19) 대한민국특허청(KR)
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(73) 특허권자
주식회사 아이엠텍
경기도 파주시 월롱면 엘지로 274-43
(72) 발명자
박정일
경기 성남시 분당구 궁내로40번길 36
박종진
전북 전주시 완산구 신촌2길 20, 4동 302호 (중화
산동2가, 한신코아아파트)
(74) 대리인
원은섭

전체 청구항 수 : 총 12 항

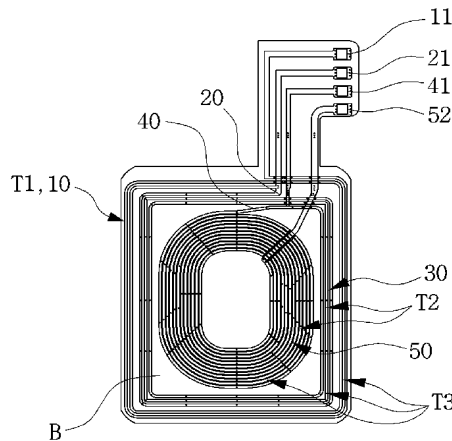
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(54) 발명의 명칭 휴대 단말기용 무선통신 다중 안테나

(57) 요약

본 발명은 제 2 모드 무선통신(T2) 및 제 3 모드 무선통신(T3)을 외곽 루프패턴(10), 미들 루프패턴(30) 그리고 센터 루프패턴(50)으로 확장 활용토록 하여 무선통신 효율의 배가된 보장은 물론이거니와 패턴의 길이 및 크기의 축소 더 나아가 베이스필름(B) 전체 면적의 축소까지 실현케 하여 전체 점유공간을 상대적으로 줄일 수 있으면서도 무선통신 효율은 극대화시킬 수 있는 휴대 단말기용 무선 통신 다중 안테나에 관한 것이다.

도면 - 도5a



명세서

청구범위

청구항 1

플렉시블한 베이스필름(B)과, 외부의 외곽 스타트단자(11)로부터 시작하여 상기 베이스필름(B)의 가장자리에 권회되는 외곽 루프패턴(10)과, 상기 외곽 루프패턴(10)으로부터 상기 베이스필름(B)의 안쪽으로 이어지는 아우터 연결패턴(20)과, 상기 아우터 연결패턴(20)에 이어져 상기 베이스필름(B)의 미들영역으로 권회되는 미들 루프패턴(30)과, 상기 미들 루프패턴(30)으로부터 상기 베이스필름(B)의 안쪽으로 이어지는 이너 연결패턴(40)과, 상기 이너 연결패턴(40)에 이어져 상기 베이스필름(B)의 센터영역으로 권회된 후 외부의 센터 엔드단자(52)에 연결되는 센터 루프패턴(50)과, 상기 아우터 연결패턴(20)에 조인되어 외부로 인출되는 아우터 공통단자(21)와, 상기 이너 연결패턴(40)에 조인되어 외부로 인출되는 이너 공통단자(41)를 포함하고,

상기 외곽 스타트단자(11)로부터 상기 아우터 공통단자(21)에 이르는 상기 외곽 루프패턴(10)은 제 1 모드 무선통신(T1)을 구현하고,

상기 아우터 공통단자(21)로부터 상기 이너 연결패턴(40)을 지나 상기 센터 엔드단자(52)에 이르는 상기 미들 루프패턴(30)과 더불어 센터 루프패턴(50)은 제 2 모드 무선통신(T2)을 확장 구현하고,

상기 외곽 스타트단자(11)로부터 상기 아우터 연결패턴(20) 및 이너 연결패턴(40)을 지나 상기 센터 엔드단자(52)에 이르는 상기 외곽 루프패턴(10), 미들 루프패턴(30) 및 센터 루프패턴(50)은 제 3 모드 무선통신(T3)을 최대 확장 구현하는 것을 특징으로 하는 휴대 단말기용 무선통신 다중 안테나.

청구항 2

제 1 항에 있어서,

상기 제 1 모드 무선통신(T1)은 NFC(Near Field Communication) 또는 RFID(Radio Frequency Identification)이고,

상기 제 2 모드 무선통신(T2)은 WPT(Wireless Power Transfer)이고,

상기 제 3 모드 무선통신(T3)은 MST(Magnetic Secure Transmission)인 것을 특징으로 하는 휴대 단말기용 무선통신 다중 안테나.

청구항 3

제 1 항에 있어서,

상기 제 1 모드 무선통신(T1)은 MST(Magnetic Secure Transmission)이고,

상기 제 2 모드 무선통신(T2)은 WPT(Wireless Power Transfer)이고,

상기 제 3 모드 무선통신(T3)은 NFC(Near Field Communication) 또는 RFID(Radio Frequency Identification)인 것을 특징으로 하는 휴대 단말기용 무선통신 다중 안테나.

청구항 4

제 1 항에 있어서,

상기 제 1 모드 무선통신(T1)은 WPT(Wireless Power Transfer)이고,

상기 제 2 모드 무선통신(T2)은 MST(Magnetic Secure Transmission)이고,

상기 제 3 모드 무선통신(T3)은 NFC(Near Field Communication) 또는 RFID(Radio Frequency Identification)인 것을 특징으로 하는 휴대 단말기용 무선통신 다중 안테나.

청구항 5

제 1 항에 있어서,

상기 제 1 모드 무선통신(T1)은 WPT(Wireless Power Transfer)이고,

상기 제 2 모드 무선통신(T2)은 NFC(Near Field Communication) 또는 RFID(Radio Frequency Identification)이고,

상기 제 3 모드 무선통신(T3)은 MST(Magnetic Secure Transmission)인 것을 특징으로 하는 휴대 단말기용 무선통신 다중 안테나.

청구항 6

제 1 항 내지 제 5 항 중 어느 한 항에 있어서,

상기 제 1 모드 무선통신(T1), 제 2 모드 무선통신(T2) 및 제 3 모드 무선통신(T3)은 비접촉 자기유도 결합(Non-Contact Magnetic Inductive Coupling Power)을 통해 무선통신을 실현하는 것을 특징으로 하는 휴대 단말기용 무선통신 다중 안테나.

청구항 7

플렉시블한 베이스필름(B)과, 외부의 외곽 스타트단자(11)로부터 시작하여 상기 베이스필름(B)의 가장자리에 권회된 후 외부의 외곽 엔드단자(12)에 연결되는 외곽 루프패턴(10)과, 외부의 미들 스타트단자(31)로부터 시작하여 상기 베이스필름(B)의 미들영역으로 권회되는 미들 루프패턴(30)과, 상기 미들 루프패턴(30)으로부터 상기 베이스필름(B)의 안쪽으로 이어지는 이너 연결패턴(40)과, 상기 이너 연결패턴(40)에 이어져 상기 베이스필름(B)의 센터영역으로 권회된 후 외부의 센터 엔드단자(52)에 연결되는 센터 루프패턴(50)과, 상기 이너 연결패턴(40)에 조인되어 외부로 인출되는 이너 공통단자(41)를 포함하고,

상기 외곽 스타트단자(11)로부터 상기 외곽 엔드단자(12)에 이르는 상기 외곽 루프패턴(10)은 제 1 모드 무선통신(T1)을 구현하고,

상기 이너 공통단자(41)로부터 상기 센터 엔드단자(52)에 이르는 상기 센터 루프패턴(50)은 제 2 모드 무선통신(T2)을 구현하고,

상기 미들 스타트단자(31)로부터 상기 이너 연결패턴(40)을 지나 상기 센터 엔드단자(52)에 이르는 상기 미들 루프패턴(30) 및 센터 루프패턴(50)은 제 3 모드 무선통신(T3)을 확장 구현하는 것을 특징으로 하는 휴대 단말기용 무선통신 다중 안테나.

청구항 8

제 7 항에 있어서,

상기 제 1 모드 무선통신(T1)은 NFC(Near Field Communication) 또는 RFID(Radio Frequency Identification)이고,

상기 제 2 모드 무선통신(T2)은 WPT(Wireless Power Transfer)이고,

상기 제 3 모드 무선통신(T3)은 MST(Magnetic Secure Transmission)인 것을 특징으로 하는 휴대 단말기용 무선통신 다중 안테나.

청구항 9

제 7 항에 있어서,

상기 제 1 모드 무선통신(T1)은 MST(Magnetic Secure Transmission)이고,

상기 제 2 모드 무선통신(T2)은 WPT(Wireless Power Transfer)이고,

상기 제 3 모드 무선통신(T3)은 NFC(Near Field Communication) 또는 RFID(Radio Frequency Identification)인 것을 특징으로 하는 휴대 단말기용 무선통신 다중 안테나.

청구항 10

제 7 항에 있어서,

상기 제 1 모드 무선통신(T1)은 WPT(Wireless Power Transfer)이고,

상기 제 2 모드 무선통신(T2)은 MST(Magnetic Secure Transmission)이고,

상기 제 3 모드 무선통신(T3)은 NFC(Near Field Communication) 또는 RFID(Radio Frequency Identification)인 것을 특징으로 하는 휴대 단말기용 무선통신 다중 안테나.

청구항 11

제 7 항에 있어서,

상기 제 1 모드 무선통신(T1)은 WPT(Wireless Power Transfer)이고,

상기 제 2 모드 무선통신(T2)은 NFC(Near Field Communication) 또는 RFID(Radio Frequency Identification)이고,

상기 제 3 모드 무선통신(T3)은 MST(Magnetic Secure Transmission)인 것을 특징으로 하는 휴대 단말기용 무선통신 다중 안테나.

청구항 12

제 7 항 내지 제 11 항 중 어느 한 항에 있어서,

상기 제 1 모드 무선통신(T1), 제 2 모드 무선통신(T2) 및 제 3 모드 무선통신(T3)은 비접촉 자기유도 결합(Non-Contact Magnetic Inductive Coupling Power)을 통해 무선통신을 실현하는 것을 특징으로 하는 휴대 단말기용 무선통신 다중 안테나.

발명의 설명

기술 분야

[0001] 본 발명은 휴대 단말기용 무선통신 다중 안테나에 관한 것으로, 더욱 상세하게는 무선통신 효율의 배가된 보장은 물론이거니와 패턴의 길이 및 크기의 축소 더 나아가 베이스필름 전체 면적의 축소까지 실현케 하여 전체 점유공간을 상대적으로 줄일 수 있으면서도 무선통신 효율은 상대적으로 극대화시킬 수 있는 휴대 단말기용 무선통신 다중 안테나에 관한 것이다.

배경 기술

[0002] 일반적으로 휴대 단말기는 휴대전화에 인터넷 통신과 정보검색 등 컴퓨터 지원 기능을 추가한 지능형 단말기로써 화면을 디스플레이하는 윈도우를 보면서 인터넷 및 다양한 애플리케이션(응용프로그램)을 활용할 수 있도록 하는 스마트폰 등을 한 예로 들 수 있다.

[0003] 선행기술문헌 1로서 공개특허 제2013-0113222호(안테나 및 이를 구비한 이동 단말기)를 소개할 수 있다.

[0004] 도 1a는 선행기술문헌 1과 관련된 이동 단말기의 블록 구성도(block diagram)이다.

[0005] 이동 단말기(100)는 도 1a에 도시된 바와 같이 무선 통신부(110), A/V(Audio/Video) 입력부(120), 사용자 입력부(130), 센싱부(140), 출력부(150), 메모리(160), 인터페이스부(170), 제어부(180) 및 전원 공급부(190) 등을 포함할 수 있다.

[0006] 무선 통신부(110)는 방송 수신 모듈(111), 이동통신 모듈(112), 무선 인터넷 모듈(113), 근거리 통신 모듈(114) 및 위치정보 모듈(115) 등을 포함할 수 있고, A/V(Audio/Video) 입력부(120)는 오디오 신호 또는 비디오 신호 입력을 위한 것으로, 카메라(121)와 마이크(122) 등이 포함될 수 있으며, 사용자 입력부(130)는 이동 단말기(100)의 전·후면 또는 측면에 위치하는 버튼(136), 터치 센서(정압/정전)(137)로 구성될 수 있다.

- [0007] 센싱부(140)는 이동 단말기(100)의 개폐 상태, 이동 단말기(100)의 위치, 사용자 접촉 유무, 이동 단말기의 방위, 이동 단말기의 가속/감속 등과 같이 이동 단말기(100)의 현 상태를 감지하여 이동 단말기(100)의 동작을 제어하기 위한 센싱 신호를 발생시키고, 근접 센서(141)를 포함할 수 있으며, 출력부(150)는 시각, 청각 또는 촉각 등과 관련된 출력을 발생시키기 위한 것으로, 이에는 디스플레이부(151), 음향 출력 모듈(152), 알람부(153) 및 햅틱 모듈(154) 등이 포함될 수 있다.
- [0008] 메모리부(160)는 제어부(180)의 처리 및 제어를 위한 프로그램이 저장될 수도 있고, 입/출력되는 데이터들(예를 들어, 전화번호부, 메시지, 오디오, 정지영상, 동영상 등)의 임시 저장을 위한 기능을 수행할 수도 있다.
- [0009] 인터페이스부(170)는 이동 단말기(100)에 연결되는 모든 외부기기와의 통로 역할을 한다. 인터페이스부(170)는 외부 기기로부터 데이터를 전송받거나, 전원을 공급받아 이동 단말기(100) 내부의 각 구성 요소에 전달하거나, 이동 단말기(100) 내부의 데이터가 외부 기기로 전송되도록 한다. 예를 들어, 유/무선 헤드셋 포트, 외부 충전기 포트, 유/무선 데이터 포트, 메모리 카드(memory card) 포트, 식별 모듈이 구비된 장치를 연결하는 포트, 오디오 I/O(Input/Output) 포트, 비디오 I/O(Input/Output) 포트, 이어폰 포트 등이 인터페이스부(170)에 포함될 수 있다.
- [0010] 제어부(controller)(180)는 통상적으로 이동 단말기의 전반적인 동작을 제어한다. 예를 들어 음성 통화, 데이터 통신, 화상 통화 등을 위한 관련된 제어 및 처리를 수행한다. 제어부(180)는 멀티 미디어 재생을 위한 멀티미디어 모듈(181)을 구비할 수도 있다.
- [0011] 전원 공급부(190)는 제어부(180)의 제어에 의해 외부의 전원, 내부의 전원을 인가받아 각 구성요소들의 동작에 필요한 전원을 공급한다.
- [0012] 전원 공급부(190)는 예를 들어 배터리, 연결포트, 전원공급제어부 및 충전모니터링부를 포함할 수 있다.
- [0013] 도 1b는 선행기술문헌 1에 따른 이동 단말기의 후면 사시도이다.
- [0014] 도 1b를 참조하면, 단말기 바디의 후면 측, 리어 케이스(102)에는 카메라(121')가 추가로 장착될 수 있다. 카메라(121')에 인접하게는 플래쉬(123)와 거울(124)이 추가로 배치될 수 있다. 플래쉬(123)는 카메라(121')로 피사체를 촬영하는 경우에 피사체를 향해 빛을 비추게 된다.
- [0015] 도 1c는 선행기술문헌에 따른 안테나(200)가 이동 단말기(100)의 후면커버(103)에 부착된 것을 도시한 평면도이다.
- [0016] 도 1a 내지 도 1c를 참조하면, 프론트 케이스(101), 리어 케이스(102), 후면커버(또는 배터리 커버)(103), 카메라(121'), 인터페이스부(170), 마이크(122), 음향출력부(152'), 배터리(191), 배터리 장착부(104), USIM카드 장착부(105), 메모리카드 장착부(106)가 도시되어 있다.
- [0017] 리어 케이스(102) 표면에는 배터리 장착부(104), USIM카드 장착부(105) 및 메모리카드 장착부(106)와 같은 외장부품이 실장될 수 있는 공간을 구비할 수 있다. 일반적으로 리어 케이스(102)의 표면에 실장되는 외장부품은 이동 단말기(100)의 기능이 다양화되고 다양해진 소비자의 요구를 충족시키기 위해 이동 단말기(100)의 기능을 확장할 수 있도록 하기 위함이다.
- [0018] 안테나(200)는 이동 단말기(100)의 기능이 다양화되면서 외부 장치 및 서버와 무선 통신을 할 필요성이 높아졌다. 예를 들면, DMB(Digital Multimedia Broadcasting)의 EPG(Electronic Program Guide) 또는 DVB-H(Digital Video Broadcast-Handheld)의 ESG(Electronic Service Guide) 등의 방송정보를 수신하기 위한 안테나(200), Wibro, HSDPA, GSM, CDMA, WCDMA, LTE 등 무선인터넷을 위한 안테나(200), 근거리 통신(short range communication) 기술로 블루투스(Bluetooth), RFID(Radio Frequency Identification), 적외선 통신(IrDA, infrared Data Association), UWB(Ultra Wideband), ZigBee 근거리 무선통신을 위한 안테나(200) 등이 필요하다.
- [0019] 이러한 안테나(200)는 전파의 수신을 위해 넓은 면적에 형성하는 것이 바람직하고 다른 전자부품들의 영향을 받지 않기 위해 이동 단말기(100)의 표면 쪽에 위치함이 바람직하다. 따라서, 도 1c에 도시된 바와 같이 일반적으로 전자부품이 실장되지 않아 넓은 면적을 확보할 수 있는 후면커버(103)에 상기 안테나(200)를 배치한다.
- [0020] 선행기술문헌 1의 안테나(200)는 도 1c에 도시된 바와 같이 연성기판(210), 2가지 종류의 패턴, 자성시트(230)를 주요구성으로 한다.
- [0021] 패턴은 크게 2가지 종류로 고주파용 패턴(220)과 저주파용 패턴(225)으로 구분된다. 즉, 서로 다른 주파수 대역

을 이용하는 것을 특징으로 하며, 고주파용 패턴(220)은 무선통신에 적합하고, 저주파용 패턴(225)은 주로 배터리의 무선충전에 적합하다.

- [0022] 이동 단말기(100)에 이용되는 무선충전기술은 전자기 유도 원리를 이용한다.
- [0023] 전자기 유도는 전류를 흘려 자기장을 형성하고, 그 위에 이동 단말기(100)를 놓으면 이동 단말기(100)에 장착된 저주파용 패턴, 즉 무선 충전용 코일(225)에 전류가 흘러 충전이 된다.
- [0024] 전송하는 전력량에 따라 주파수가 달라질 수 있으나, 일반적으로 이동 단말기(100)와 같은 소형 가전제품에 이용되는 전력은 수백 μ W 이하로 비교적 낮은 주파수를 이용한다.
- [0025] 무선통신은 이동 단말기(100)의 기능이 다양화되면서, 전화통화를 위한 전파의 전송 이외에 NFC(Near Field Communication), RFID(Radio Frequency Identification) 등의 기능을 위해서도 안테나가 필요하다. 특히 무선 통신 기술에 따라 이용하는 주파수는 다르며, 많은 양의 데이터를 전송하기 위해 무선 충전에 이용되는 주파수에 비해 상대적으로 고주파를 이용한다.
- [0026] 선행기술문헌 1의 무선 통신용 안테나(200)가 이용되는 통신 방식의 예로 근거리 무선통신(NFC: Near Field Communication)을 들 수 있다. 근거리 무선통신은 전자태그(RFID)의 일종으로 약 13.56MHz 주파수 대역을 이용하는 비접촉식 무선통신 모듈이다.
- [0027] 대략 10~40cm의 가까운 거리에서 단말기(100) 간의 데이터를 전송하는 기술로서, 통신거리가 짧기 때문에 상대적으로 보안이 우수하고 가격이 저렴해 주목받는 차세대 근거리 통신기술이다. 데이터 읽기와 쓰기를 모두 이용할 수 있으며, 블루투스처럼 기기간에 설정이 필요 없어 최근 이동 단말기(100)에 근거리 무선통신 기능을 부가하고 있다.
- [0028] 그런데, 선행기술문헌 1에 따른 이동 단말기(100)는 고주파용 패턴(220)과 저주파용 패턴(200)이 서로 물리적으로 완전 격리된 상태로 배치되므로 인하여 전체 면적이 상대적으로 커질 수밖에 없고, 특히 고주파용 패턴(220)은 10~40cm의 거리에서 전자기 유도작용의 효율을 높일 수 있도록 저주파용 패턴(220)보다 상대적으로 패턴닝 길이가 커야만 하는데 저주파용 패턴(200)과의 이격된 상태에서 더 크게 권회되어야만 하여 점유공간을 넓고 크게 차지할 수밖에 없는 문제점을 안고 있다.
- [0029] 도 2a는 선행기술문헌 2(공개특허 제2013-0123310호; 공진 방식 무선 전력 수신 시스템에서 공진단 장치)가 적용되는 공진 방식 무선 전력 수신 시스템에서 NFC 안테나 및 WPT 공진기의 평면상 배치 구조를 나타낸 예시도이며, 도 2b는 NFC 안테나 및 WPT 공진기의 휴대용 단말기 상에서의 배치 구조를 나타낸다.
- [0030] 도 2a 및 도 2b를 참조하여, 먼저 선행기술문헌 2가 적용되는 무선 전력 수신 시스템, 예를 들어 휴대용 단말기에서 NFC 안테나(10) 및 WPT 공진기(20)의 기구적인 실장 상태를 살펴보면, 평면적으로 루프형 안테나 구조를 NFC 안테나(10)는 마찬가지로 루프형 안테나 구조를 가지는 WPT 공진기(20)의 내측에 위치하도록 설치된다.
- [0031] 또한, NFC 안테나(10)는 휴대용 단말기의 본체(1) 뒷면에서 (착탈 가능하게 설치될 수 있는 배터리 부위에) 설치될 수 있으며, WPT 안테나(20)는 휴대용 단말기의 뒷면 커버(2)에 설치될 수 있다.
- [0032] 이때, NFC 안테나(10)와 WPT 공진기(20) 사이에는 아이솔레이션 특성확보를 위해 적절히 설계된 이격 거리(Isolation d, Isolation h)가 발생한다. 이와 같은 이격 거리에 의해 NFC 안테나(10)와 WPT 공진기(20) 두 주파수(13.56MHz, 6.78MHz)의 아이솔레이션 특성이 기구적으로 결정된다.
- [0033] 도 2c는 선행기술문헌 2의 일 실시예에 따른 공진 방식 무선 전력 수신 시스템에서 공진단 장치의 회로도이고, 부호 20은 고임피던스 회로이다.
- [0034] 도 2c를 참조하여, 선행기술문헌 2의 특징에 따른 공진단 장치는 WPT 전력용 증폭기(Power Amplifier: PA)(미도시)에서 방출되는 체배 성분(harmonics)이 외부로 방사되지 않도록 하기 위하여 WPT 공진기(20)에 션트 캐패시터(shunt capacitor)(40)를 연결할 수 있다.
- [0035] 그런데, 선행기술문헌 2에 따른 공진 방식 무선 전력 수신 시스템에서 공진단 장치 역시 NFC 안테나(10)와 WPT 공진기(20)가 서로 물리적으로 완전 격리된 상태로 배치되므로 인하여 전체 면적이 상대적으로 커질 수밖에 없으며 점유공간 또한 넓고 크게 차지할 수밖에 없는 단점을 지니고 있다.

- [0036] 도 3은 선행기술문헌 3(공개특허 제2013-0027403호)의 실시예에 따라 전력 공급 주파수 대역을 6.78MHz를 이용하는 경우 무선 전력전송 제어 장치(100)의 회로도이다.
- [0037] 도 3을 참조하면, 무선 전력 전송 제어 장치(100)는 13.56MHz 대역을 통신 주파수 대역으로 이용하고, 전력 공급 주파수 대역을 통신 주파수 대역과 다른 6.78MHz 대역을 이용함으로써, 전력 공급 신호와 통신 신호의 세기를 높 이더라도 규제에 영향을 받지 않게 된다.
- [0038] 또한, 선행기술문헌 3의 실시예에 따라 13.56MHz 대역을 통신 주파수 대역으로 이용하고, 전력 공급 주파수 대역 을 통신 주파수 대역과 다른 6.78MHz 대역을 이용하는 경우 무선 전력 전송 제어 장치(100)의 구체적인 회로의 구성은 다르게 구성될 수 있다.
- [0039] 예를 들면, 도 3과 같이 Power IC(120) 외부에 NFC IC(140)와의 무선 전력 전송제어 신호 송수신을 위한 별도의 구성이 구비될 수 있다.
- [0040] 더욱 구체적으로, 도 3을 참조하면 무선 전력 전송 제어 장치(100)의 회로는 WPT 코일(410), NFC 코일(440), Power IC(420), GPIO(General Purpose Input/Output) Expander(422), ADC(Analog Digital Converter)(424), NFC IC(430)를 포함하여 구성될 수 있다.
- [0041] WPT 코일(410)은 POWER IC(420)와 연결될 수 있으며, 6.78MHz의 주파수 대역에서 공진하여, 전력 공급 장치(TX) 로부터 전력을 공급받아 POWER IC(420)로 제공한다. Power IC(420)는 무선 전력 수신에 필요한 각종 신호를 생 성하고, 전력 공급 장치(TX)로부터 수신된 메시지에 따른 무선 전력 전송 제어 신호에 따라 동작한다. 그리고, Power IC(420)는 WPT 코일(410)을 수신한 전력에 따른 전압을 이용하여 무선 전력 전송 제어 장치(100)의 전반 적인 동작을 활성화시킨다. 또한, 전력을 공급받는 동안, 공급되는 전력에 의해 얻어지는 전류 및 전압을 측정 및 조절하고, 일정 전압(VDC_out)을 출력한다.
- [0042] GPIO Expander(422)는 입출력 모듈로서, POWER IC(420)와 NFC IC(430)사이에서 POWER IC(420)에 의해 출력되는 신호를 NFC IC(430)로 입력되도록 하고, NFC IC(430)에 의해 출력되는 신호를 POWER IC(420)에 입력되도록 한 다. ADC(424)는 POWER IC(420)와 NFC IC(430)가 주고받는 신호에 대해 아날로그 신호를 디지털 신호로 변환하고, 디지털 신호를 아날로그 신호로 변환하여 POWER IC(420)와 NFC IC(430)간에 신호 송수신을 조절한다.
- [0043] NFC IC(430)는 Power IC(420)에 의해 제공되는 전력에 따라 동작하며, NFC 코일(440)을 통해 전력 공급 장치 (TX)와 NFC 통신을 수행한다. 이때 NFC 코일(440)은 13.56MHz 대역에서 전파 방사 및 전파 수신이 가능한 NFC 코 일(Coil)로 구성될 수 있다.
- [0044] NFC IC(430)는 NFC 안테나(440)를 통해 전력 공급 장치(TX)로부터 수신된 신호를 분석하고, 수신된 신호에 따라 무선 전력 전송 제어 신호를 NFC IC 입출력부(431)를 이용하여 Power IC(420)로 전달한다. 이때 NFC IC 입출력 부(431)는 SDA 단자와 SDC 단자를 포함할 수 있다. SDA 단자는 무선 전력 전송 제어를 위한 데이터를 입력받거 나 출력하고, SDC 단자는 클럭을 출력한다. 또한 선행기술문헌 3의 실시예에 따르면 무선전력 전송 제어 신호는 무선 전력 전송에 필요한 제어 신호로서, 전압, 전류, 온도 등의 조절이 가능하다.
- [0045] 한편, 상기한 선행기술문헌 3의 실시예에서는 전력 공급 주파수 대역을 6.78MHz를 이용하고, 13.56MHz 대역을 통 신 주파수 대역으로 이용하는 경우를 예를 들었지만, 전력 공급 주파수 대역을 100~200kHz로 이용할 수도 있 다.
- [0046] 그런데, 선행기술문헌 3에 따른 무선 전력전송 제어 장치 역시 WPT 코일(410)과 NFC 코일(440)이 서로 물리적으 로 완전 격리된 상태로 배치되므로 인하여 전체 면적이 상대적으로 커질 수밖에 없으며 점유공간 또한 넓고 크 게 차지할 수밖에 없는 한계를 안고 있다.

선행기술문헌

특허문헌

- [0047] (특허문헌 0001) 선행기술문헌 1 - 공개특허 10-2013-0113222(안테나 및 이를 구비한 이동 단말기)
- (특허문헌 0002) 선행기술문헌 2 - 공개특허 제2013-0123310호(공진 방식 무선 전력 수신 시스템에서 공진단 장 치)

(특허문헌 0003) 선행기술문헌 3 - 공개특허 제2013-0027403호(무선 전력전송 제어 장치)

발명의 내용

해결하려는 과제

- [0048] 본 발명의 목적은 베이스필름에 권회되는 패턴의 횡수를 상대적으로 많게 할 수 있을 뿐만 아니라 전체 길이 역시 상대적으로 길어지게 하여, 즉 인덕턴스를 확대시켜 무선통신 효율을 극대화시킬 수 있는 휴대 단말기용 무선통신 다중 안테나를 제공함에 있다.
- [0049] 본 발명의 목적은 확장된 비접촉 자기유도 결합력으로 무선통신 효율의 배가를 보장할 수 있는 휴대 단말기용 무선통신 다중 안테나를 제공함에 있다.
- [0050] 본 발명의 목적은 무선통신 효율의 배가된 보장은 물론이거니와 패턴의 길이 및 크기의 축소 나아가 베이스필름 전체 면적의 축소까지 실현케 하여 점유공간을 상대적으로 줄일 수 있으면서도 무선통신 효율은 극대화시킬 수 있는 휴대 단말기용 무선통신 다중 안테나를 제공함에 있다.

과제의 해결 수단

- [0051] 상기 목적을 달성하기 위한 본 발명은,
- [0052] 플렉시블한 베이스필름과, 외부의 외곽 스타트단자로부터 시작하여 상기 베이스필름의 가장자리에 권회되는 외곽 루프패턴과, 상기 외곽 루프패턴으로부터 상기 베이스필름의 안쪽으로 이어지는 아우터 연결패턴과, 상기 아우터 연결패턴에 이어져 상기 베이스필름의 미들영역으로 권회되는 미들 루프패턴과, 상기 미들 루프패턴으로부터 상기 베이스필름의 안쪽으로 이어지는 이너 연결패턴과, 상기 이너 연결패턴에 이어져 상기 베이스필름의 센터영역으로 권회된 후 외부의 센터 엔드단자에 연결되는 센터 루프패턴과, 상기 아우터 연결패턴에 조인되어 외부로 인출되는 아우터 공통단자와, 상기 이너 연결패턴에 조인되어 외부로 인출되는 이너 공통단자를 포함하고,
- [0053] 상기 외곽 스타트단자로부터 상기 아우터 공통단자에 이르는 상기 외곽 루프패턴은 제 1 모드 무선통신을 구현하고,
- [0054] 상기 아우터 공통단자로부터 상기 이너 연결패턴을 지나 상기 센터 엔드단자에 이르는 상기 미들 루프패턴과 더불어 센터 루프패턴은 제 2 모드 무선통신을 확장 구현하고,
- [0055] 상기 외곽 스타트단자로부터 상기 아우터 연결패턴 및 이너 연결패턴을 지나 상기 센터 엔드단자에 이르는 상기 외곽 루프패턴, 미들 루프패턴 및 센터 루프패턴은 제 3 모드 무선통신을 최대 확장 구현하는 것을 그 기술적 구성상의 기본 특징으로 한다.
- [0056] 상기 목적을 달성하기 위한 본 발명은,
- [0057] 플렉시블한 베이스필름과, 외부의 외곽 스타트단자로부터 시작하여 상기 베이스필름의 가장자리에 권회된 후 외부의 외곽 엔드단자에 연결되는 외곽 루프패턴과, 외부의 미들 스타트단자로부터 시작하여 상기 베이스필름의 미들영역으로 권회되는 미들 루프패턴과, 상기 미들 루프패턴으로부터 상기 베이스필름의 안쪽으로 이어지는 이너 연결패턴과, 상기 이너 연결패턴에 이어져 상기 베이스필름의 센터영역으로 권회된 후 외부의 센터 엔드단자에 연결되는 센터 루프패턴과, 상기 이너 연결패턴에 조인되어 외부로 인출되는 이너 공통단자를 포함하고,
- [0058] 상기 외곽 스타트단자로부터 상기 외곽 엔드단자에 이르는 상기 외곽 루프패턴은 제 1 모드 무선통신을 구현하고,
- [0059] 상기 이너 공통단자로부터 상기 센터 엔드단자에 이르는 상기 센터 루프패턴은 제 2 모드 무선통신을 구현하고,
- [0060] 상기 미들 스타트단자로부터 상기 이너 연결패턴을 지나 상기 센터 엔드단자에 이르는 상기 미들 루프패턴 및 센터 루프패턴은 제 3 모드 무선통신을 확장 구현하는 것을 그 기술적 구성상의 기본 특징으로 한다.

발명의 효과

- [0061] 본 발명에 따라 제 1 모드 무선통신은 외곽 루프패턴으로 구현케 하고, 제 2 모드 무선통신은 미들 루프패턴 및 센터 루프패턴으로 확장 구현케 하고, 제 3 모드 무선통신은 외곽 루프패턴, 미들 루프패턴 및 센터 루프패턴으로 최대 확장 구현케 하여, 동일 면적의 베이스필름 대비 제 2 모드 무선통신 및 제 3 모드 무선통신에 따른 권회되는 패턴의 횡수를 상대적으로 많게 할 수 있을 뿐만 아니라 전체 길이 역시 상대적으로 길어지게 하여, 즉 인덕턴스를 확대시켜 무선통신 효율을 극대화시킬 수 있는 효과가 있다.
- [0062] 본 발명에 따라 제 1 모드 무선통신은 외곽 스타트단자 및 아우터 공통단자 사이의 외곽 루프패턴 자체의 인덕턴스 L1값으로 비접촉 자기유도 결합력을 구현시킬 수 있도록 하는 반면, 제 2 모드 무선통신은 아우터 공통단자 및 센터 엔드단자 사이의 미들 루프패턴에 의한 인덕턴스 L2값뿐만 아니라 센터 루프패턴에 의한 인덕턴스 L3값을 합제한 확장된 비접촉 자기유도 결합력으로 무선통신 효율의 배가를 보장할 수 있도록 하고, 나아가 제 3 모드 무선통신은 외곽 스타트단자 및 센터 엔드단자 사이의 외곽 루프패턴에 의한 인덕턴스 L1값, 미들 루프패턴에 의한 인덕턴스 L2값 그리고 센터 루프패턴에 의한 인덕턴스 L3값을 합제한 확장된 비접촉 자기유도 결합력으로 무선통신 효율의 배가를 더욱 크게 보장할 수 있도록 하는 효과가 있다.
- [0063] 본 발명은 제 2 모드 무선통신 및 제 3 모드 무선통신을 외곽 루프패턴, 미들 루프패턴 그리고 센터 루프패턴으로 확장 활용토록 하여 무선통신 효율의 배가된 보장은 물론이거니와 패턴의 길이 및 크기의 축소 더 나아가 베이스필름 전체 면적의 축소까지 실현케 하여 전체 점유공간을 상대적으로 줄일 수 있으면서도 무선통신 효율은 상대적으로 극대화시킬 수 있는 효과가 있다.
- [0064] 본 발명에 따라 제 1 모드 무선통신은 외곽 루프패턴으로 구현케 하고, 제 2 모드 무선통신은 센터 루프패턴으로 구현케 하고, 제 3 모드 무선통신은 미들 루프패턴 및 센터 루프패턴으로 확장 구현케 하여, 동일 면적의 베이스필름 대비 제 3 모드 무선통신에 따른 권회되는 패턴의 횡수를 상대적으로 많게 할 수 있을 뿐만 아니라 전체 길이 역시 상대적으로 길어지게 하여, 즉 인덕턴스를 확대시켜 무선통신 효율의 극대화를 도모할 수 있는 효과가 있다.
- [0065] 본 발명에 따라 제 1 모드 무선통신은 외곽 스타트단자 및 외곽 엔드단자 사이의 외곽 루프패턴 자체의 인덕턴스 L1값으로 비접촉 자기유도 결합력을 구현시킬 수 있도록 하고, 제 2 모드 무선통신은 미들 스타트단자 및 이너 공통단자 사이의 미들 루프패턴에 의한 인덕턴스 L2값으로 비접촉 자기유도 결합력을 구현시킬 수 있도록 하고, 제 3 모드 무선통신은 미들 스타트단자 및 센터 엔드단자 사이의 미들 루프패턴에 의한 인덕턴스 L2값 및 센터 루프패턴에 의한 인덕턴스 L3값을 합제한 확장된 비접촉 자기유도 결합력으로 무선통신 효율의 배가를 더욱 크게 보장할 수 있는 효과가 있다.
- [0066] 본 발명은 제 3 모드 무선통신을 미들 루프패턴 및 센터 루프패턴으로 확장 활용토록 하여 무선통신 효율의 배가된 보장은 물론이거니와 패턴의 길이 및 크기의 축소 더 나아가 베이스필름 전체 면적의 축소까지 실현케 하여 전체 점유공간을 상대적으로 줄일 수 있으면서도 무선통신 효율은 상대적으로 극대화시킬 수 있는 효과가 있다.

도면의 간단한 설명

- [0067] 도 1a는 선행기술문헌 1과 관련된 이동 단말기의 블록 구성도.
 도 1b는 선행기술문헌1에 따른 이동 단말기의 후면 사시도.
 도 1c는 선행기술문헌 1에 따른 안테나가 이동 단말기의 후면커버에 부착된 것을 도시한 평면도.
 도 2a는 선행기술문헌 2가 적용되는 공진 방식 무선 전력 수신 시스템에서 NFC 안테나 및 WPT 공진기의 평면상 배치 구조를 나타낸 예시도.
 도 2b는 선행기술문헌 2의 NFC 안테나 및 WPT 공진기의 휴대용 단말기 상에서의 배치 구조를 나타내는 구조도.
 도 2c는 선행기술문헌 2의 일 실시예에 따른 공진 방식 무선 전력 수신 시스템에서 공진단 장치의 회로도.
 도 3은 선행기술문헌 3의 실시예에 따라 전력 공급 주파수 대역을 6.78MHz를 이용하는 경우 무선 전력전송 제어 장치의 회로도.

도 4는 선행문헌들에서 도출해 낼 수 있는 일반적인 휴대 단말기용 무선통신 다중 안테나를 본 발명에 대비되도록 나타낸 평면도.

도 5a는 본 발명의 제 1 실시예에 따른 휴대 단말기용 무선통신 다중 안테나를 나타내는 평면도.

도 5b는 본 발명의 제 1 실시예에 따른 휴대 단말기용 무선통신 다중 안테나를 나타내는 등가 회로도.

도 6a는 본 발명의 제 2 실시예에 따른 휴대 단말기용 무선통신 다중 안테나를 나타내는 평면도.

도 6b는 본 발명의 제 2 실시예에 따른 휴대 단말기용 무선통신 다중 안테나를 나타내는 등가 회로도.

발명을 실시하기 위한 구체적인 내용

- [0068] 이하, 본 발명에 따른 휴대 단말기용 무선통신 다중 안테나의 바람직한 실시예를 도면을 참조하여 설명하기로 하고, 그 실시예로는 다수 개가 존재할 수 있으며, 이러한 실시예를 통하여 본 발명의 목적, 특징 및 이점들을 더욱 잘 이해할 수 있게 된다.
- [0069] 도 4a는 선행문헌들에서 도출해 낼 수 있는 일반적인 휴대 단말기용 무선통신 다중 안테나를 본 발명에 대비되도록 나타낸 평면도이고, 도 4b는 도 4a의 등가 회로도이다.
- [0070] 도 4a 및 도 4b에 도시된 바와 같이 일반적인 휴대 단말기용 무선통신 다중 안테나는 플렉시블한 베이스필름(B)을 기본으로 하면서, 외부의 외곽 스타트단자(11) 및 외곽 엔드단자(12)에 연결되어 베이스필름(B)의 가장자리에 권회되는 외곽 루프패턴(10)을 독립적으로 구비하고, 외부의 미들 스타트단자(31) 및 미들 엔드단자(32)에 각각 연결되어 외곽 루프패턴(10)으로부터 이격되는 베이스필름(B)의 미들영역에 권회되는 미들 루프패턴(30)을 독립적으로 구비하고, 외부의 센터 스타트단자(51) 및 센터 엔드단자(52)에 연결되어 미들 루프패턴(30)으로부터 이격되는 베이스필름(B)의 센터영역에 권회되는 센터 루프패턴(50)을 독립적으로 구비한 구조로 이루어진다.
- [0071] 외곽 루프패턴(10)은 대략 10~40cm의 가까운 거리에서 13.56MHz 주파수 대역의 비접촉 자기유도 결합력(Non-Contact Magnetic Inductive Coupling Power)으로 외부의 단말기 상호간 데이터를 전송기 위한 NFC(Near Field Communication), RFID(Radio Frequency Identification)를 제 1 모드 무선통신(T1)으로 활용토록 할 수 있고, 미들 루프패턴(30)은 10~200cm의 근거리에서 13.56MHz 주파수 대역의 비접촉 자기유도 결합력으로 외부의 단말기 상호간 데이터를 전송기 위한 MST(Magnetic Secure Transmission)를 제 2 모드 무선통신(T2)으로 활용토록 할 수 있고, 센터 루프패턴(50)은 전자기 유도원리, 즉 유도자기 원리에 따라 전류를 흘려 자기장을 형성하고 그 위에 휴대 단말기를 놓으면 100~200kHz 대역에서 구현되는 비접촉 자기유도 결합력으로 배터리의 충전을 가능케 하는 WPT(Wireless Power Transfer)를 제 3 모드 무선통신(T3)으로 활용케 할 수 있다.
- [0072] 그런데, 일반적인 휴대 단말기용 무선통신 다중 안테나는 외곽 루프패턴(10)이 외곽 스타트단자(11) 및 외곽 엔드단자(12)에 의해 베이스필름(B)의 외곽에 독립적으로 구비되고, 나아가 미들 루프패턴(30)이 미들 스타트단자(31) 및 미들 엔드단자(32)에 의해 베이스필름(B)의 센터영역에 독립적으로 구비되고, 더 나아가 센터 루프패턴(50)이 센터 스타트단자(51) 및 센터 엔드단자(52)에 의해 베이스필름(B)의 중심에 독립적으로 구비되어, 제 1 모드 무선통신(T1) 및 제 2 모드 무선통신(T2) 및 제 3 모드 무선통신(T3)이 각각의 인덕턴스 L1값, L2값 및 L3값에 따른 비접촉 자기유도 결합력에 의존되어 무선통신 효율을 극대화시키지 못하는 한계를 안고 있다.
- [0073] 특히, MST의 제 2 모드 무선통신(T2) 및 WPT의 제 3 모드 무선통신(T3)이 각각 독립적인 미들 루프패턴(30) 및 센터 루프패턴(50)으로 이루어지므로 인하여 권회되는 회로가 적을 뿐만 아니라 전체 길이 역시 짧을 수밖에 없어, 즉 인덕턴스가 작아 무선통신 효율을 극대화시키지 못하고 있는 것이다.
- [0074] 도 5a는 본 발명의 제 1 실시예에 따른 휴대 단말기용 무선통신 다중 안테나를 나타내는 평면도이고, 도 5b는 본 발명의 제 1 실시예에 따른 휴대 단말기용 무선통신 다중 안테나를 나타내는 등가 회로도이다.
- [0075] 본 발명의 제 1 실시예에 따른 휴대 단말기용 무선통신 다중 안테나는 도 5a 및 도 5b에 도시된 바와 같이 외곽 루프패턴(10), 미들 루프패턴(30) 및 센터 루프패턴(50)이 외곽 스타트단자(11)로부터 센터 엔드단자(52)에 이르기까지 하나의 라인으로 플렉시블한 베이스필름(B)에 패턴된다.
- [0076] 더욱 구체적으로, 본 발명의 제 1 실시예에 따른 휴대 단말기용 무선통신 다중 안테나는 플렉시블한 베이스필름(B)과, 외부의 외곽 스타트단자(11)로부터 시작하여 베이스필름(B)의 가장자리에 권회되는 외곽 루프패턴(10)과, 외곽 루프패턴(10)으로부터 베이스필름(B)의 안쪽으로 이어지는 아우터 연결패턴(20)과, 아우

터 연결패턴(20)에 이어져 베이스필름(B)의 미들영역으로 권회되는 미들 루프패턴(30)과, 미들 루프패턴(30)으로부터 베이스필름(B)의 안쪽으로 이어지는 이너 연결패턴(40)과, 이너 연결패턴(40)에 이어져 베이스필름(B)의 센터영역으로 권회된 후 외부의 센터 엔드단자(52)에 연결되는 센터 루프패턴(50)과, 아우터 연결패턴(20)에 조인되어 외부로 인출되는 아우터 공통단자(21)와, 이너 연결패턴(40)에 조인되어 외부로 인출되는 이너 공통단자(41)를 포함한다.

[0077] 바람직하게, 플렉시블한 베이스필름(B)에 외곽 루프패턴(10), 미들 루프패턴(30) 및 센터 루프패턴(50)이 전체적으로 연결된 상태에서, 외곽 스타트단자(11)로부터 아우터 공통단자(21)에 이르는 외곽 루프패턴(10)은 제 1 모드 무선통신(T1)을 구현케 하고, 아우터 공통단자(21)로부터 이너 연결패턴(40)을 지나 센터 엔드단자(52)에 이르는 미들 루프패턴(30)과 더불어 센터 루프패턴(50)은 제 2 모드 무선통신(T2)을 확장 구현케 하고, 외곽 스타트단자(11)로부터 아우터 연결패턴(20) 및 이너 연결패턴(40)을 지나 센터 엔드단자(52)에 이르는 외곽 루프패턴(10), 미들 루프패턴(30) 및 센터 루프패턴(50)은 제 3 모드 무선통신(T3)을 최대 확장 구현케 하는 것을 본 발명에 따른 제 1 실시예의 핵심 특징으로 한다.

[0078] 이와 같이, 제 1 모드 무선통신(T1)은 외곽 루프패턴(10)으로 구현케 하고, 제 2 모드 무선통신(T2)은 미들 루프패턴(30) 및 센터 루프패턴(50)으로 확장 구현케 하고, 제 3 모드 무선통신(T3)은 외곽 루프패턴(10), 미들 루프패턴(30) 및 센터 루프패턴(50)으로 최대 확장 구현케 하여, 동일 면적의 베이스필름(B) 대비 제 2 모드 무선통신(T2) 및 제 3 모드 무선통신(T3)에 따른 권회되는 패턴의 횡수가 독립적인 도 4a 및 도 4b에 비해 상대적으로 많게 할 수 있을 뿐만 아니라 전체 길이 역시 상대적으로 길어지게 되어, 즉 인덕턴스를 확대할 수 있게 되어 무선통신 효율의 극대화를 도모할 수 있도록 하는 것이다.

[0079] 즉, 제 1 모드 무선통신(T1)은 도 5b에 도시된 바와 같이 외곽 스타트단자(11) 및 아우터 공통단자(21) 사이의 외곽 루프패턴(10) 자체의 인덕턴스 L1값으로 비접촉 자기유도 결합력을 구현시킬 수 있도록 하는 반면, 제 2 모드 무선통신(T2)은 도 5b에 도시된 바와 같이 아우터 공통단자(21) 및 센터 엔드단자(52) 사이의 미들 루프패턴(30)에 의한 인덕턴스 L2값뿐만 아니라 센터 루프패턴(50)에 의한 인덕턴스 L3값을 합제한 확장된 비접촉 자기유도 결합력으로 무선통신 효율의 배가를 보장할 수 있도록 하고, 나아가 제 3 모드 무선통신(T3)은 도 5b에 도시된 바와 같이 외곽 스타트단자(11) 및 센터 엔드단자(52) 사이의 외곽 루프패턴(10)에 의한 인덕턴스 L1값, 미들 루프패턴(30)에 의한 인덕턴스 L2값 그리고 센터 루프패턴(50)에 의한 인덕턴스 L3값을 합제한 확장된 비접촉 자기유도 결합력으로 무선통신 효율의 배가를 더욱 크게 보장할 수 있도록 하는 것이다.

[0080] 이와 같이, 본 발명의 제 1 실시예에서는 제 2 모드 무선통신(T2) 및 제 3 모드 무선통신(T3)을 외곽 루프패턴(10), 미들 루프패턴(30) 그리고 센터 루프패턴(50)으로 확장 활용토록 하여 무선통신 효율의 배가된 보장은 물론이거니와 패턴의 길이 및 크기의 축소 더 나아가 베이스필름(B) 전체 면적의 축소까지 실현케 하여 전체 점유 공간을 상대적으로 줄일 수 있으면서도 무선통신 효율은 극대화시킬 수 있도록 한다.

[0081] 이때, 제 1 모드 무선통신(T1)은 NFC(Near Field Communication) 또는 RFID(Radio Frequency Identification)이고, 제 2 모드 무선통신(T2)은 WPT(Wireless Power Transfer)이고, 제 3 모드 무선통신(T3)은 MST(Magnetic Secure Transmission)일 수 있다.

[0082] 또한, 제 1 모드 무선통신(T1)은 MST(Magnetic Secure Transmission)이고, 제 2 모드 무선통신(T2)은 WPT(Wireless Power Transfer)이고, 제 3 모드 무선통신(T3)은 NFC(Near Field Communication) 또는 RFID(Radio Frequency Identification)일 수 있다.

[0083] 나아가, 제 1 모드 무선통신(T1)은 WPT(Wireless Power Transfer)이고, 제 2 모드 무선통신(T2)은 MST(Magnetic Secure Transmission)이고, 제 3 모드 무선통신(T3)은 NFC(Near Field Communication) 또는 RFID(Radio Frequency Identification)일 수 있다.

[0084] 더 나아가, 제 1 모드 무선통신(T1)은 WPT(Wireless Power Transfer)이고, 제 2 모드 무선통신(T2)은 NFC(Near Field Communication) 또는 RFID(Radio Frequency Identification)이고, 제 3 모드 무선통신(T3)은 MST(Magnetic Secure Transmission)일 수 있다.

[0085] 제 1 모드 무선통신(T1), 제 2 모드 무선통신(T2), 제 3 모드 무선통신(T3)으로서 NFC 또는 RFID, MST, WPT를 선택적으로 적용할 수 있는데, 이러한 구현은 통신환경에 따라 사용자의 선택에 의해 이루어질 수 있음은 물론이다.

[0086] 이때, NFC, RFID는 이미 공지된 것으로서 대략 10~40cm의 가까운 거리에서 13.56~15MHz 주파수 대역으로 외부의 단말기간 데이터를 전송할 수 있도록 하고, WPT 역시 이미 공지된 것으로서 대략 10~100cm의 가까운 거리에

서 13.56~15MHz 주파수 대역으로 외부의 단말기간 데이터를 전송할 수 있도록 하고, WPT 또한 이미 공지된 것으로서 전자기 유도원리, 즉 유도자기 원리에 따라 전류를 흘려 자기장을 형성하고 그 위에 휴대 단말기를 놓아 100~200kHz 대역에서 배터리의 충전을 가능케 하는 것이다.

[0087] 한편, 제 1 모드 무선통신(T1), 제 2 모드 무선통신(T2) 및 제 3 모드 무선통신(T3)은 비접촉 자기유도 결합(Non-Contact Magnetic Inductive Coupling Power)을 통해 무선통신을 실현케 할 수 있음은 물론이다.

[0088] 다른 한편으로, 본 발명의 제 1 실시예에 따른 휴대 단말기용 무선통신 다중 안테나는 외곽 스타트단자(11), 아우터 공통단자(21), 이너 공통단자(41) 및 센터 엔드단자(52)라는 4개의 단자로 구성되어 있는데, 휴대 단말기 자체의, 즉 미 도시된 메인회로기판의 8단자와 호환이 될 수 있도록 외곽 스타트단자(11), 아우터 공통단자(21), 이너 공통단자(41) 및 센터 엔드단자(52) 각각에 보조단자를 분기시켜 총 8개의 단자를 부여할 수도 있다.

[0089] 도 6a는 본 발명의 제 2 실시예에 따른 휴대 단말기용 무선통신 다중 안테나를 나타내는 평면도이고, 도 6b는 본 발명의 제 2 실시예에 따른 휴대 단말기용 무선통신 다중 안테나를 나타내는 등가 회로도이다.

[0090] 본 발명의 제 2 실시예에 따른 휴대 단말기용 무선통신 다중 안테나는 도 6a 및 도 6b에 도시된 바와 같이 플렉시블한 베이스필름(B)에 외곽 루프패턴(10)을 독립적으로 패터닝시키는 반면, 미들 루프패턴(30) 및 센터 루프패턴(50)을 이너 연결패턴(40)으로 연결시키는 구조로 패터닝된다.

[0091] 더욱 구체적으로, 본 발명의 제 2 실시예에 따른 휴대 단말기용 무선통신 다중 안테나는 플렉시블한 베이스필름(B)과, 외부의 외곽 스타트단자(11)로부터 시작하여 베이스필름(B)의 가장자리에 권회된 후 외부의 외곽 엔드단자(12)에 연결되는 외곽 루프패턴(10)과, 외부의 미들 스타트단자(31)로부터 시작하여 베이스필름(B)의 미들영역으로 권회되는 미들 루프패턴(30)과, 미들 루프패턴(30)으로부터 베이스필름(B)의 안쪽으로 이어지는 이너 연결패턴(40)과, 이너 연결패턴(40)에 이어져 베이스필름(B)의 센터영역으로 권회된 후 외부의 센터 엔드단자(52)에 연결되는 센터 루프패턴(50)과, 이너 연결패턴(40)에 조인되어 외부로 인출되는 이너 공통단자(41)를 포함한다.

[0092] 바람직하게, 플렉시블한 베이스필름(B)에 외곽 루프패턴(10)을 독립적으로 패터닝시키는 반면, 미들 루프패턴(30) 및 센터 루프패턴(50)을 연결시킨 상태에서, 외곽 스타트단자(11)로부터 외곽 엔드단자(12)에 이르는 외곽 루프패턴(10)은 제 1 모드 무선통신(T1)을 구현케 하고, 이너 공통단자(41)로부터 센터 엔드단자(52)에 이르는 센터 루프패턴(50)은 제 2 모드 무선통신(T2)을 구현케 하고, 미들 스타트단자(31)로부터 이너 연결패턴(40)을 지나 센터 엔드단자(52)에 이르는 미들 루프패턴(30) 및 센터 루프패턴(50)은 제 3 모드 무선통신(T3)을 확장 구현케 하는 것을 본 발명의 제 2 실시예의 핵심 특징으로 한다.

[0093] 이와 같이, 제 1 모드 무선통신(T1)은 외곽 루프패턴(10)으로 구현케 하고, 제 2 모드 무선통신(T2)은 센터 루프패턴(50)으로 구현케 하고, 제 3 모드 무선통신(T3)은 미들 루프패턴(30) 및 센터 루프패턴(50)으로 확장 구현케 하여, 동일 면적의 베이스필름(B) 대비 제 3 모드 무선통신(T3)에 따른 권회되는 패턴의 횟수가 독립적인 도 4a 및 도 4b에 비해 상대적으로 많게 할 수 있을 뿐만 아니라 전체 길이 역시 상대적으로 길어지게 되어, 즉 인덕턴스를 확대할 수 있게 되어 무선통신 효율의 극대화를 도모할 수 있도록 하는 것이다.

[0094] 즉, 제 1 모드 무선통신(T1)은 도 6b에 도시된 바와 같이 외곽 스타트단자(11) 및 외곽 엔드단자(12) 사이의 외곽 루프패턴(10) 자체의 인덕턴스 L1값으로 비접촉 자기유도 결합력을 구현시킬 수 있도록 하고, 제 2 모드 무선통신(T2)은 도 6b에 도시된 바와 같이 미들 스타트단자(31) 및 이너 공통단자(41) 사이의 미들 루프패턴(30)에 의한 인덕턴스 L2값으로 비접촉 자기유도 결합력을 구현시킬 수 있도록 하고, 제 3 모드 무선통신(T3)은 도 6b에 도시된 바와 같이 미들 스타트단자(31) 및 센터 엔드단자(52) 사이의 미들 루프패턴(30)에 의한 인덕턴스 L2값 및 센터 루프패턴(50)에 의한 인덕턴스 L3값을 합제한 확장된 비접촉 자기유도 결합력으로 무선통신 효율의 배가를 더욱 크게 보장할 수 있도록 하는 것이다.

[0095] 이와 같이, 본 발명의 제 2 실시예에서는 제 3 모드 무선통신(T3)을 미들 루프패턴(30) 및 센터 루프패턴(50)으로 확장 활용토록 하여 무선통신 효율의 배가된 보장은 물론이거니와 패턴의 길이 및 크기의 축소 더 나아가 베이스필름(B) 전체 면적의 축소까지 실현케 하여 전체 점유공간을 상대적으로 줄일 수 있으면서도 무선통신 효율은 극대화시킬 수 있도록 하는 것이다.

[0096] 이때, 제 1 모드 무선통신(T1)은 NFC(Near Field Communication) 또는 RFID(Radio Frequency Identification)

이고, 제 2 모드 무선통신(T2)은 WPT(Wireless Power Transfer)이고, 제 3 모드 무선통신(T3)은 MST(Magnetic Secure Transmission)일 수 있다.

[0097] 또한, 제 1 모드 무선통신(T1)은 MST(Magnetic Secure Transmission)이고, 제 2 모드 무선통신(T2)은 WPT(Wireless Power Transfer)이고, 제 3 모드 무선통신(T3)은 NFC(Near Field Communication) 또는 RFID(Radio Frequency Identification)일 수 있다.

[0098] 나아가, 제 1 모드 무선통신(T1)은 WPT(Wireless Power Transfer)이고, 제 2 모드 무선통신(T2)은 MST(Magnetic Secure Transmission)이고, 제 3 모드 무선통신(T3)은 NFC(Near Field Communication) 또는 RFID(Radio Frequency Identification)일 수 있다.

[0099] 더 나아가, 제 1 모드 무선통신(T1)은 WPT(Wireless Power Transfer)이고, 제 2 모드 무선통신(T2)은 NFC(Near Field Communication) 또는 RFID(Radio Frequency Identification)이고, 제 3 모드 무선통신(T3)은 MST(Magnetic Secure Transmission)일 수 있다.

[0100] 제 1 모드 무선통신(T1), 제 2 모드 무선통신(T2), 제 3 모드 무선통신(T3)으로서 NFC 또는 RFID, MST, WPT를 선택적으로 적용할 수 있는데, 이러한 구현은 통신환경에 따라 사용자의 선택에 의해 이루어질 수 있음은 물론이다.

[0101] 이때, NFC, RFID는 이미 공지된 것으로서 대략 10~40cm의 가까운 거리에서 13.56~15MHz 주파수 대역으로 외부의 단말기간 데이터를 전송할 수 있도록 하고, WPT 역시 이미 공지된 것으로서 대략 10~100cm의 가까운 거리에서 13.56~15MHz 주파수 대역으로 외부의 단말기간 데이터를 전송할 수 있도록 하고, WPT는 전자기 유도원리, 즉 유도자기에 원리에 따라 전류를 흘려 자기장을 형성하고 그 위에 휴대 단말기를 놓아 100~200kHz 대역에서 배터리의 충전을 가능케 하는 것이다.

[0102] 한편, 제 1 모드 무선통신(T1), 제 2 모드 무선통신(T2) 및 제 3 모드 무선통신(T3)은 비접촉 자기유도 결합(Non-Contact Magnetic Inductive Coupling Power)을 통해 무선통신을 실현케 할 수 있음은 물론이다.

[0103] 다른 한편으로, 본 발명의 제 2 실시예에 따른 휴대 단말기용 무선통신 다중 안테나는 외곽 스타트단자(11), 외곽 엔드단자(12), 미들 스타트단자(31), 이너 공통단자(41) 및 센터 엔드단자(52)라는 5개의 단자로 구성되어 있는데, 휴대 단말기 자체의, 즉 미 도시된 메인회로기판의 8단자와 호환이 될 수 있도록 외곽 스타트단자(11), 미들 스타트단자(31), 센터 엔드단자(52) 각각에 보조단자를 분기시켜 총 8개의 단자를 부여할 수도 있다.

[0104] 또 다른 한편으로, 본 발명에 따라 베이스필름(B)은 폴리이미드필름, PET필름 또는 PVC필름일 수 있고, 외곽 스타트단자(11), 외곽 엔드단자(12), 미들 스타트단자(31), 이너 공통단자(41), 센터 엔드단자(52), 외곽 루프패턴(10), 미들 루프패턴(30), 센터 루프패턴(50)은 상호간 크로스(Cross)되지 않도록 비아홀(Via Hall) 등을 통해 베이스필름(B)의 상면, 하면 또는 양면에 나누어 패터닝시킬 수 있음은 물론이다.

산업상 이용가능성

[0105] 본 발명은 테블릿 PC나 스마트 폰 등과 같은 휴대 단말기 산업분야에 이용될 수 있고, 본 발명에서 외곽 루프패턴, 미들 루프패턴 및 센터 미들패턴으로 언급하고 있으나 필요에 따라 루프패턴을 추가할 수 있고, 이러한 루프패턴의 추가는 본 발명의 범주 내에서 이루어질 수 있는 것으로 한다.

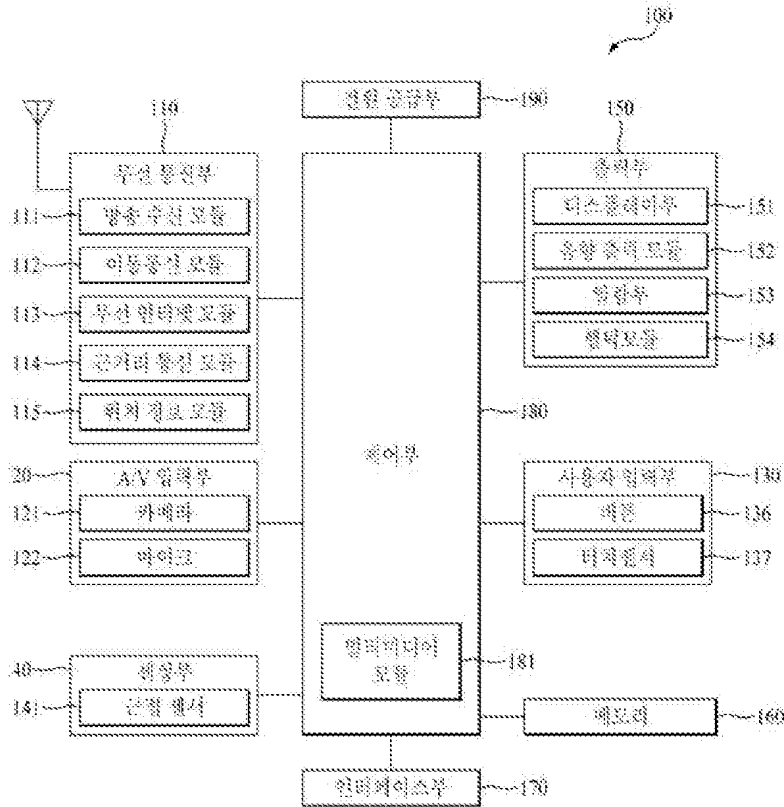
부호의 설명

[0106]	10 : 외곽 루프패턴	11 : 외곽 스타트단자
	12 : 외곽 엔드단자	20 : 아우터(Outer) 연결패턴
	21 : 아우터 공통단자	30 : 미들 루프패턴
	31 : 미들 스타트단자	32 : 미들 엔드단자
	40 : 이너(Inner) 연결패턴	41 : 이너 공통단자

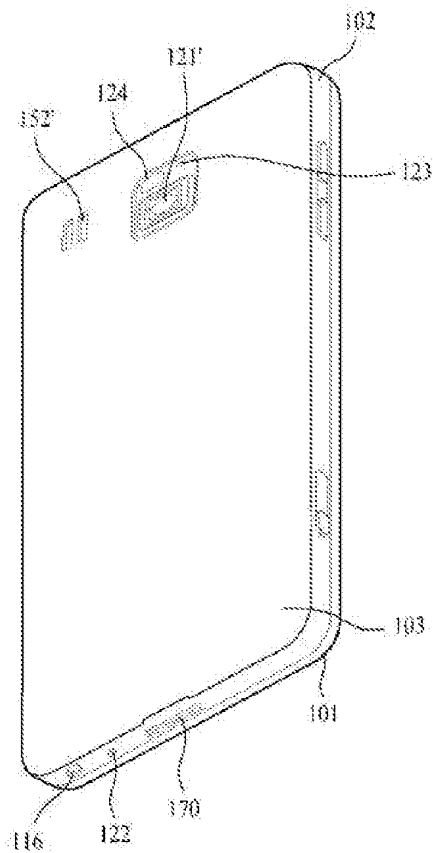
- 50 : 센터 루프패턴
 51 : 센터 스타트단자
 B : 베이스필름
 T1 : 제 1 모드 무선통신
 T2 : 제 2 모드 무선통신
 T3 : 제 3 모드 무선통신

도면

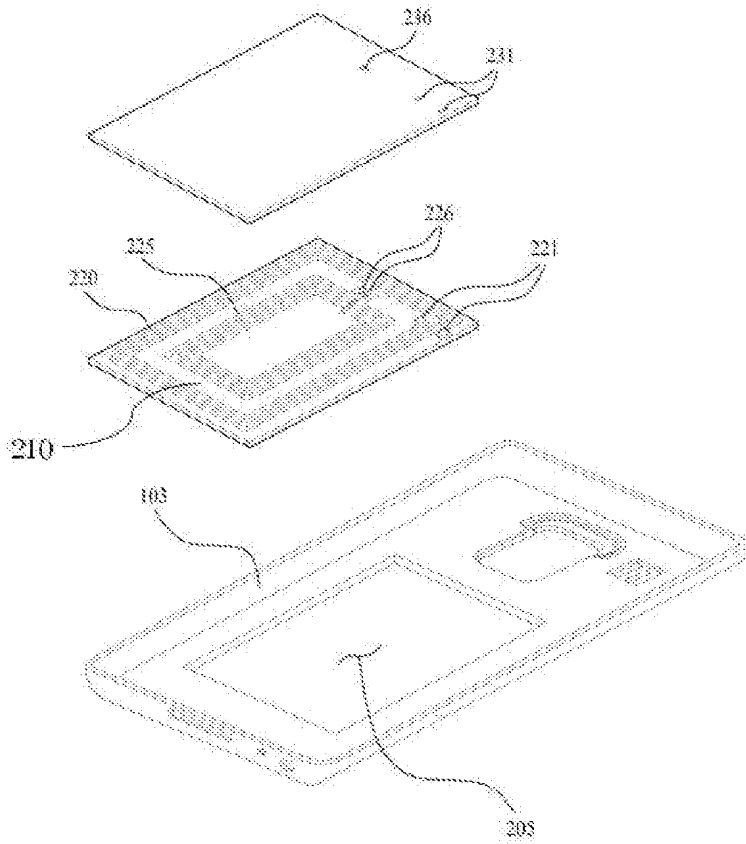
도면 1a



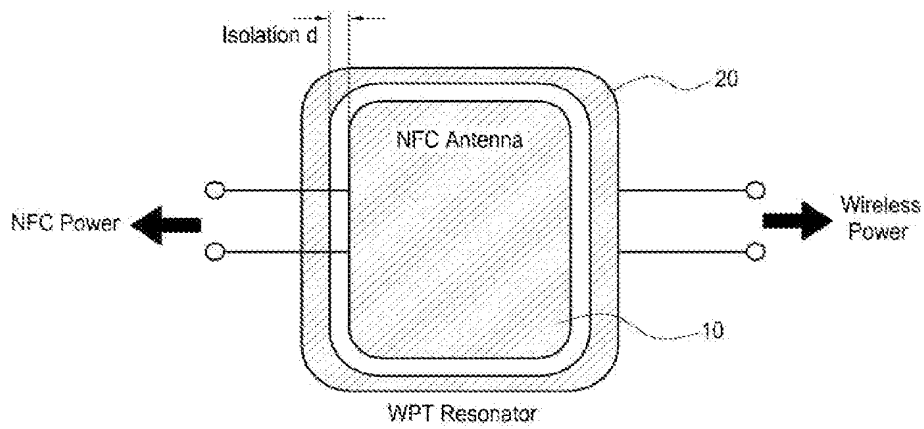
도면 1b



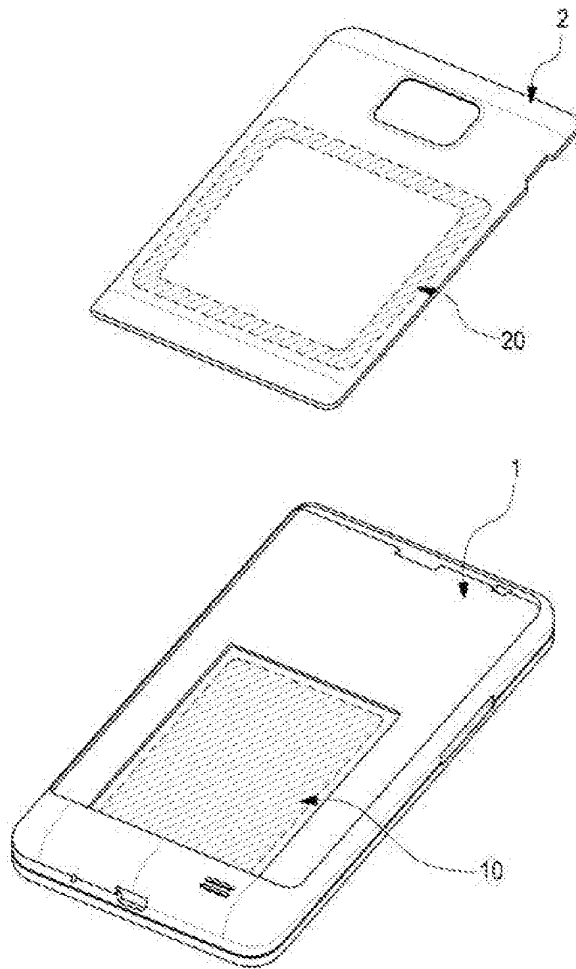
도면 1c



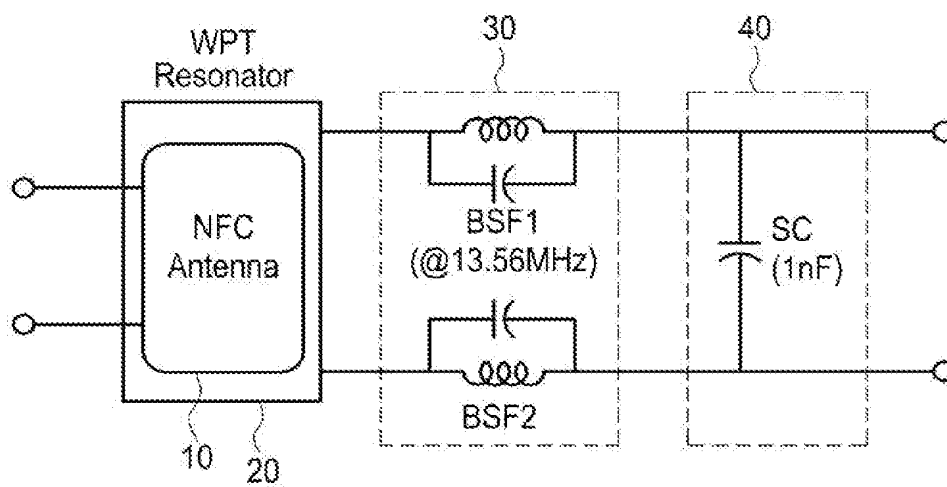
도면 2a



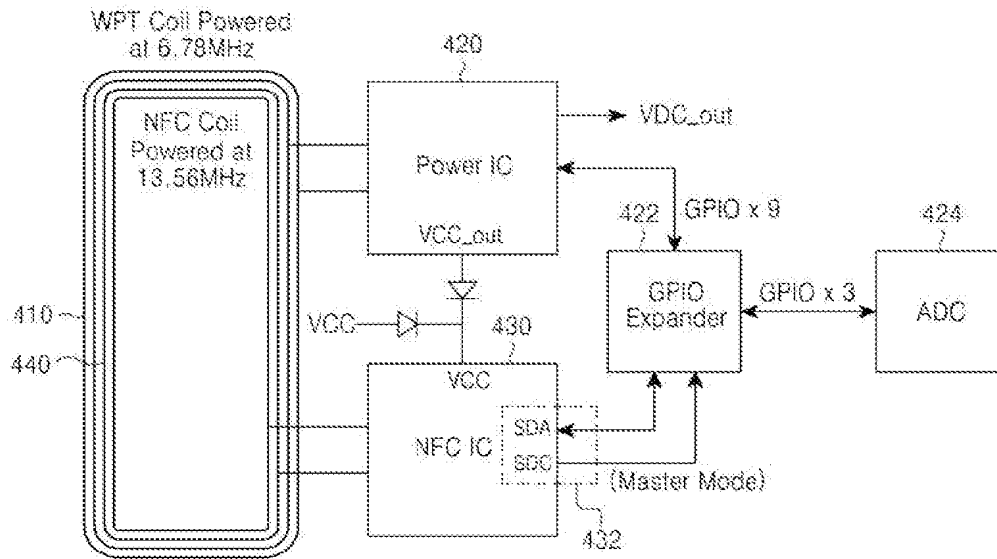
도면2b



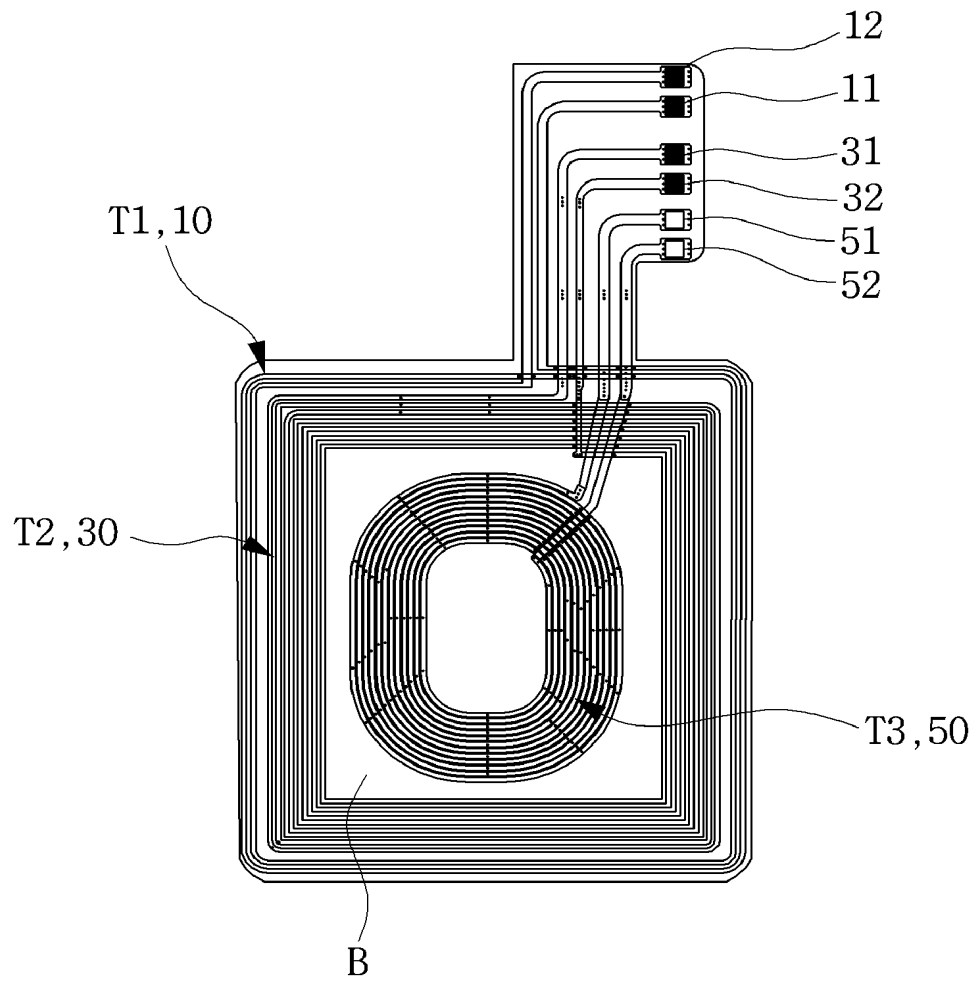
도면2c



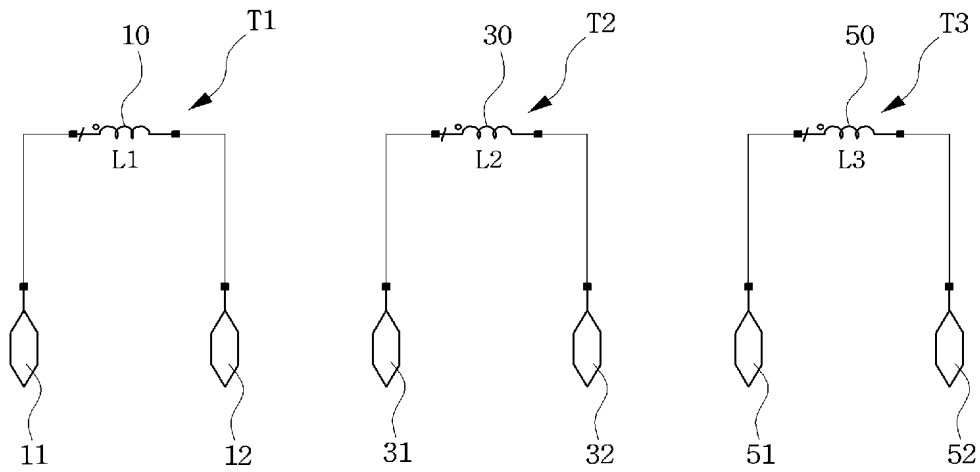
도면3



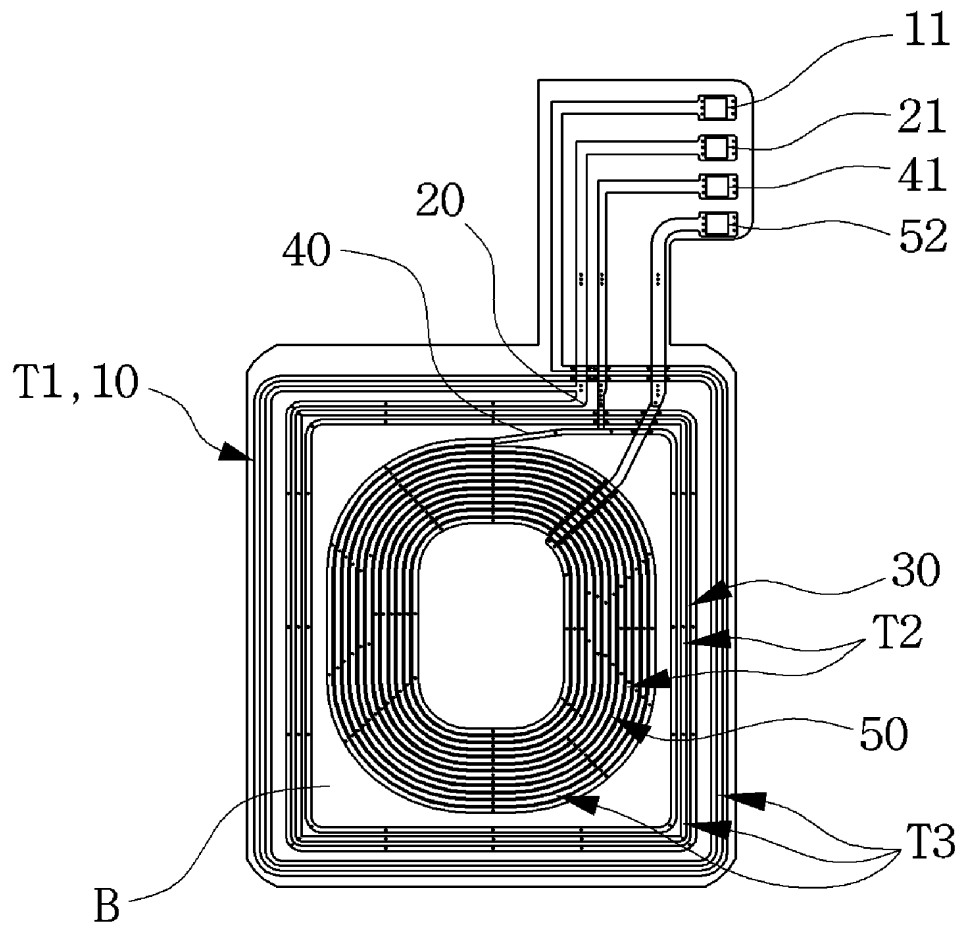
도 4a



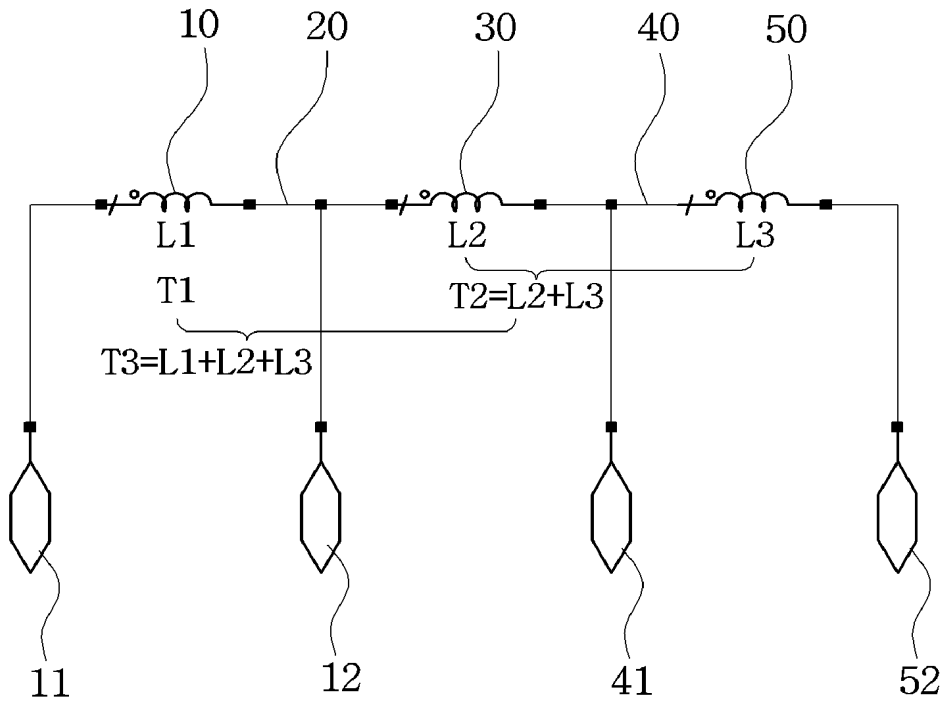
도면 4b



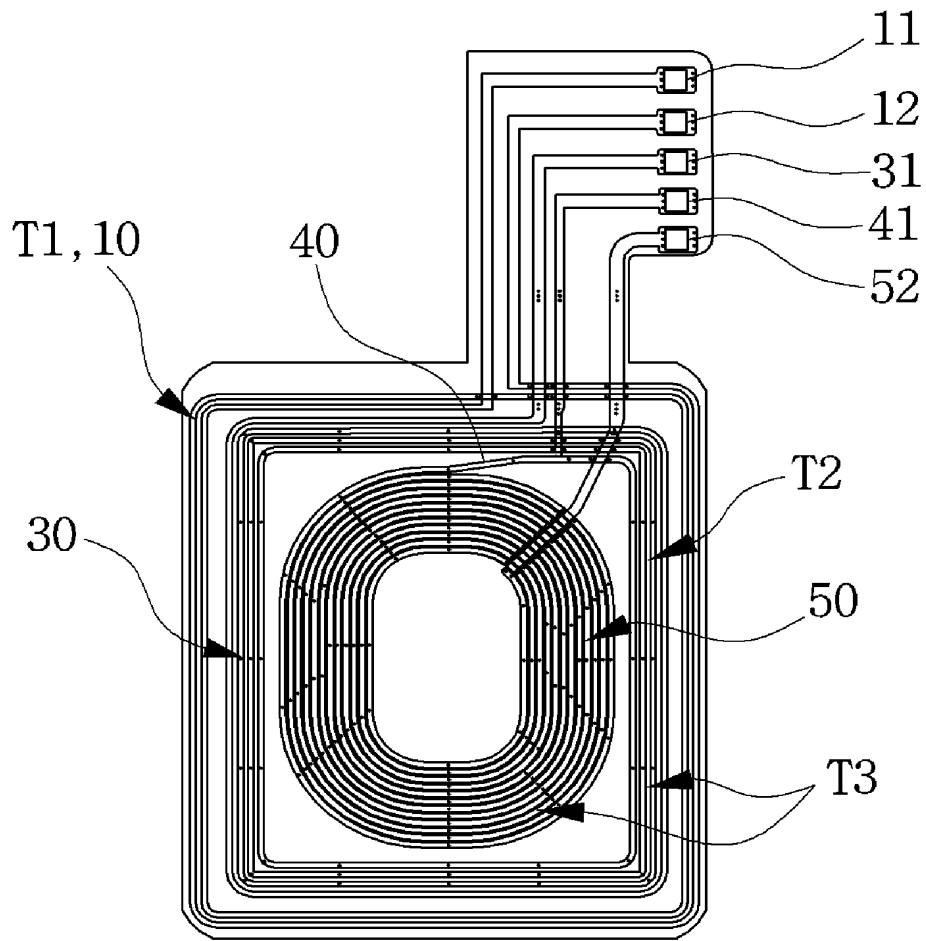
도면 5a



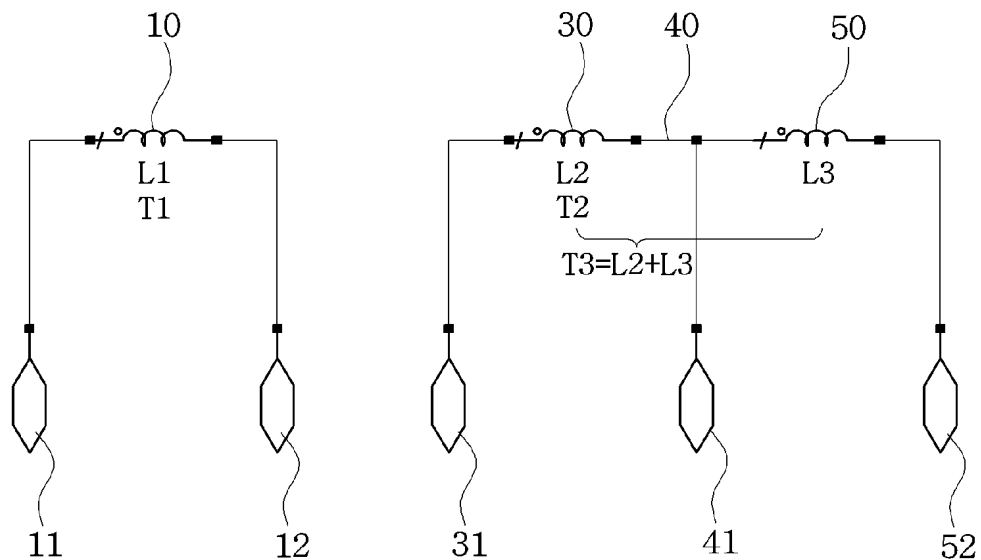
도면5b



Ex100a



도면 6b



Wireless charger receiver with good compatibility
List of publications
Publication date



- Application number 2013CN-0146790 Date 2013-04-22 [Register](#)
 - CN103219808 A Published application 2013-07-24

English Title

Wireless charger receiver with good compatibility

Other Title

一种兼容性好的无线充电器接收器

English Abstract (Native or MT)

A wireless charger receiver with good compatibility comprises a printed circuit board and a magnetic field conversion chip arranged on the printed circuit board. Induced electromotive force is produced according to changes of magnetic flux of a surrounding magnetic field, and magnetic energy is converted to electric energy. The magnetic field conversion chip integrates a rectifying circuit, an alternating current/ direct current conversion circuit and a voltage stabilization current limit circuit. The wireless charger receiver is characterized in that the printed circuit board is a flexible circuit board, a coil of an NFC antenna is formed on the printed circuit board and is in parallel with a coil formed on the printed circuit board, and the NFC antenna is connected with an NFC module through a capacitor. A wireless charger receiving end is manufactured by means of the flexible circuit board, and accordingly the wireless charger receiver has the advantages of being small in thickness, good in performance uniformity and convenient to manufacture; and additionally, the coil of the NFC antenna of the NFC module is arranged on the periphery of the wireless charger receiving end, accordingly the compatibility of the wireless charger receiving end and the NFC antenna of the NFC module is good and functions of the wireless charger receiving end and functions of the NFC antenna of the NFC module are not influenced.

Other Abstracts

一种兼容性好的无线充电器接收器，包括一印制电路板以及置于其上的磁场转换芯片，以根据周围磁场的磁通量变化产生感应电动势，将磁能转换成电能，其中，所述磁场转换芯片集成有整流电路、交流/直流转换电路以及稳压限流电路，其特征在于：所述印制电路板为柔性线路板，还包括一NFC天线的线圈形成于所述印制电路板上，和所述印制电路板形成的线圈并列，NFC天线通过电容连接NFC模块。由于发明借由柔性路板制成无线充电器接收端，使其具有厚度较薄、性能一致性好以及制作方便的优点；同时由于本发明利用NFC模块天线的线圈置于无线充电器接收端的外围，这样无线充电器接收端和NFC模块天线的兼容性好，两者功能不受影响。

Application
Language

CHINESE (CHI)

Inventor(s) JIANG SHIZHENG
CHEN MIN
WU JIANGYOU

Inventor(s) 蒋石正
陈敏
吴江又

Applicant/Assignee SHENZHEN SUNSHINE GOOD ELECTRONICS
owned by ZHUHAI GOOD GOOD ELECTRONICS

Assignee 深圳市实佳电子有限公司

Patent Assignee History SHENZHEN SUNSHINE GOOD ELECTRONICS CO LTD

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Description

TECHNICAL FIELD

[0002] The present invention relates to wireless communication technologies, and in particular, to a wireless charger receiver with good compatibility.

BACKGROUND ART

[0003] Technical Field

[0004] The wireless charging is a new charging technology without the need of wire connection or plug-in connection. The technology can enhance the safety of electricity utilization, and can not generate faults such as poor contact of connecting pieces and the like, thereby being deeply concerned by researchers in various countries.

[0005] In the existing wireless power device technology, the reachable distance is short, the electric appliance cannot be far away from the reflector, the wireless function cannot be played at all, and the output energy is small, so that the wireless power device is only suitable for the electric appliance with small electric quantity requirement; yet to be further improved.

[0006] The traditional wireless charger receiving end generally adopts a winding type, in order to increase the transmission distance and the electric quantity, the thickness of the winding needs to be increased, and the performance consistency of the wireless charger receiving end is poor.

[0007] NFC (near field contactless technology) technology, which is independent of "contactless radio frequency identification" (RFID) and interconnection technologies between wireless devices, can satisfy information exchange, content access, service exchange between any two wireless devices, and makes it simpler.

DISCLOSURE

[0008] Disclosure of Invention

[0009] The invention aims to provide a wireless charger receiver which is thin in thickness, good in performance consistency, convenient to manufacture and reduced in size.

[0010] In order to achieve the above object, the present invention provides a wireless charger receiver with good compatibility, which includes a printed circuit board and a magnetic field conversion chip disposed thereon, so as to generate induced electromotive force according to the magnetic flux change of the surrounding magnetic field, and convert the magnetic energy into electric energy, wherein the magnetic field conversion chip integrates a rectification circuit, an ac/dc conversion circuit and a voltage stabilization current limiting circuit, and is characterized in that: the printed circuit board is a flexible circuit board, and the NFC antenna is formed on the printed circuit board in parallel with a coil formed on the printed circuit board and connected with the NFC module through a capacitor.

[0011] Wherein, the preferred scheme is as follows: the flexible circuit board comprises a base material layer, a first conducting layer, a second conducting layer and a shielding layer, wherein the first conducting layer and the second conducting layer are arranged on the upper layer and the lower layer of the base material layer respectively, and the shielding layer is arranged on the first conducting layer.

[0012] Wherein, the preferred scheme is as follows: and the coil part formed by the metal copper wire layer of the first conducting layer and the metal copper wire layer of the second conducting layer forms an induction coil of the wireless charger receiver, and the coil of the NFC antenna is arranged on the periphery of the induction coil of the wireless charger receiver.

[0013] Wherein, the preferred scheme is as follows: the substrate layer is a polyester or polyester-imide substrate layer.

[0014] Wherein, the preferred scheme is as follows: and the first conducting layer and the second conducting layer are sequentially provided with a metal copper wire, a gold/nickel layer and a covering layer along the upper part and the lower part of the base material layer.

[0015] Wherein, the preferred scheme is as follows: the shielding layer is composed of a shielding material and is disposed on the covering layer of the first conductive layer.

[0016] The invention has the advantages that: because the receiving end of the wireless charger is manufactured by the flexible circuit board, the receiving end of the wireless charger has the advantages of thin thickness, good performance consistency and convenient manufacture; meanwhile, the coil of the NFC module antenna is arranged on the periphery of the receiving end of the wireless charger, so that the receiving end of the wireless charger and the NFC module antenna are good in compatibility, and the functions of the receiving end of the wireless charger and the NFC module antenna are not affected.

DRAWINGS DESCRIPTION

[0018] Fig. 1a and 1b are schematic structural diagrams of a wireless charger receiver with good compatibility according to the present invention.

[0019] Fig. 2 is a schematic structural diagram of a flexible circuit board 11 of a wireless charger receiver with good compatibility according to the present invention.

[0020] Fig. 3 is a schematic diagram of a wireless charger receiver with good compatibility according to the present invention.

INVENTION MODE

[0021] Detailed Description

[0022] The following detailed description of embodiments of the invention refers to the accompanying drawings.

[0023] Fig. 1a and 1b are schematic structural diagrams of a wireless charger receiver with good compatibility according to the present invention, as shown in fig. 1a and 1 b: a wireless charger receiving end 10 with a flexible circuit board comprises a printed circuit board 11 and a magnetic field conversion chip 12 arranged on the printed circuit board to generate induced electromotive force according to the magnetic flux change of a surrounding magnetic field and convert magnetic energy into electric energy, wherein the magnetic field conversion chip is integrated with a rectifying circuit 13, an alternating current/direct current conversion circuit 14 and a voltage-stabilizing current-limiting circuit 15, the printed circuit board 11 is the flexible circuit board, a coil 31 of an NFC antenna 30 is formed on the printed circuit board 11 and is parallel to an induction coil 16 formed by a wireless charger receiver, and the NFC antenna 30 is connected with an NFC module through a capacitor.

[0024] As shown in fig. 2: the flexible circuit board 11 includes a substrate layer 111, a first conductive layer 112, a second conductive layer 113, and a shielding layer 114, the first conductive layer 112 and the second conductive layer 113 are respectively disposed on the upper and lower layers of the substrate layer 111, and the shielding layer 114 is disposed on the first conductive layer 112.

[0025] Wherein, the substrate layer 111 is a Polyester (PET) or Polyimide (PI) substrate layer, and the thickness is 25 μm .

[0026] Wherein, first conducting layer 112, second conducting layer 113 distribute along substrate layer 111 from top to bottom in proper order has the metal copper line layer, and thickness is 50 μm , gold/nickel layer, and thickness is 0.1 to 0.5 μm , cover the rete, and thickness is 0.0275 mm. Wherein, the metal copper wire layer plays a conductive function layer, and the gold/nickel layer is a welding connection layer.

[0027] Wherein the shielding layer 114 is made of a shielding material, has a thickness of 0.15mm, and is disposed on the covering layer of the first conductive layer.

[0028] The carrier tape is exemplified as follows, as shown in fig. 3: the receiving terminal receives energy through a coil formed by the metal copper wire layer of the first conducting layer 112 and the metal copper wire layer of the second conducting layer 113, the filtering capacitors C4, C5, C6 and the rectifying capacitors C7 and C8 of the metal copper wire layer of the first conducting layer 112 are transmitted to the No. 2 pin and the No. 19 pin of the magnetic field conversion chip 12, and the magnetic field conversion chip 12 works through the peripheral circuits C9, C10, C11, C14, C15, C16, C12, C13, C17, R1, R2 and R3 on the metal copper wire layer of the first conducting layer 112. The peripheral circuit device C9 connected to the 3rd pin of the magnetic field switching chip 12 through the metal copper wire layer of the second conductive layer 113, the peripheral circuit device C10 connected to the 5th pin of the magnetic field switching chip 12 through the metal copper wire layer of the second conductive layer 113, the peripheral circuit device C11 connected to the 6th pin of the magnetic field switching chip 12 through the metal copper wire layer of the second conductive layer 113, the peripheral circuit device C12 connected to the 17th pin of the magnetic field switching chip 12 through the metal copper wire layer of the second conductive layer 113, the peripheral circuit device C13 connected to the 16th pin of the magnetic field switching chip 12 through the metal copper wire layer of the second conductive layer 113, the peripheral circuit device C17 connected to the 15th pin of the magnetic field switching chip 12 through the metal copper wire layer of the second conductive layer 113, the peripheral circuit device R1 connected to the 13th pin of the magnetic field switching chip 1 through the metal copper wire layer of the second conductive layer 113, the peripheral circuit devices C14, C15 and C16 are connected with the 18th pin of the magnetic field conversion chip 12 through the metal copper wire layer of the first conducting layer 112, the peripheral circuit device R2 is connected with the 14th pin of the magnetic field conversion chip 12 through the metal copper wire layer of the first conducting layer 112, the peripheral circuit device R3 is connected with the 12th pin of the magnetic field conversion chip 12 through the metal copper wire layer of the first conducting layer 112, the metal copper wire layer of the first conducting layer 112 and the metal copper wire layer of the second conducting layer 113 are paved to form the negative pole of the output power supply of the wireless charger receiving end, the 4th pin of the magnetic field conversion chip 12 forms the positive pole of the output power supply of the wireless charger receiving end, and the devices C2 and C3 of the metal copper wire layer of the first conducting layer 112 form the rectification circuit.

[0029] The invention has the advantages that: because the receiving end of the wireless charger is manufactured by the flexible circuit board, the receiving end of the wireless charger has the advantages of thin thickness, good performance consistency and convenient manufacture; meanwhile, the coil of the NFC module antenna is arranged on the periphery of the receiving end of the wireless charger, so that the receiving end of the wireless charger and the NFC module antenna are good in compatibility, and the functions of the receiving end of the wireless charger and the NFC module antenna are not affected.

[0030] The above description is only for the purpose of illustrating the preferred embodiments of the present invention and is not to be construed as limiting the scope of the present invention, but rather as embodying the invention in a wide variety of equivalent variations and modifications within the scope of the appended claims.

Description



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(71) 申请人 深圳市实佳电子有限公司

地址 518000 广东省深圳市宝安区西乡街道
劳动居委第二工业区第 1 号二楼 B

(72) 发明人 蒋石正 陈敏 吴江又

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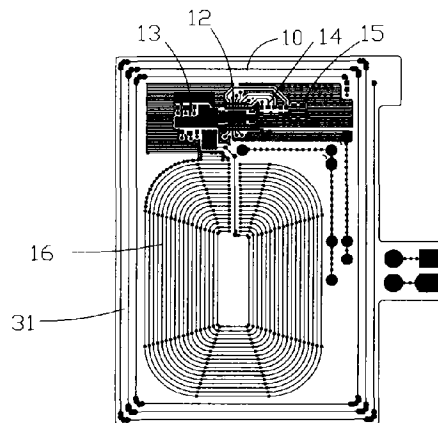
权利要求书1页 说明书3页 附图2页

(54) 发明名称

一种兼容性好的无线充电器接收器

(57) 摘要

一种兼容性好的无线充电器接收器,包括一印制电路板以及置于其上的磁场转换芯片,以根据周围磁场的磁通量变化产生感应电动势,将磁能转换成电能,其中,所述磁场转换芯片集成有整流电路、交流/直流转换电路以及稳压限流电路,其特征在于:所述印制电路板为柔性线路板,还包括一 NFC 天线的线圈形成于所述印制电路板上,和所述印制电路板形成的线圈并列, NFC 天线通过电容连接 NFC 模块。由于发明借由柔性线路板制成无线充电器接收端,使其具有厚度较薄、性能一致性好以及制作方便的优点;同时由于本发明利用 NFC 模块天线的线圈置于无线充电器接收端的外围,这样无线充电器接收端和 NFC 模块天线的兼容性好,两者功能不受影响。



1. 一种兼容性好的无线充电器接收器,包括一印制电路板以及置于其上的磁场转换芯片,以根据周围磁场的磁通量变化产生感应电动势,将磁能转换成电能,其中,所述磁场转换芯片集成有整流电路、交流 / 直流转换电路以及稳压限流电路,其特征在于:所述印制电路板为柔性线路板,还包括一 NFC 天线的线圈形成于所述印制电路板上,和所述印制电路板形成的线圈并列, NFC 天线通过电容连接 NFC 模块。
2. 如权利要求 1 所述的一种兼容性好的无线充电器接收器,其特征在于:所述柔性线路板包括基材层、第一传导层、第二传导层以及屏蔽层,所述基材层的上下层分别设置有第一传导层、第二传导层,所述屏蔽层置于所述第一传导层上。
3. 如权利要求 1 或 2 所述的兼容性好的无线充电器接收器,其特征在于:所述第一传导层的金属铜线层和第二传导层的金属铜线层形成的线圈部分构成无线充电器接收器的感应线圈。
4. 如权利要求 1 或 2 所述的兼容性好的无线充电器接收器,其特征在于:所述 NFC 天线的线圈置于无线充电器接收器的感应线圈的外围。
5. 如权利要求 2 所述的兼容性好的无线充电器接收器,其特征在于:基材层为聚酯或聚酯亚胺基材层。
6. 如权利要求 2 所述的兼容性好的无线充电器接收器,其特征在于:所述第一传导层、第二传导层依次沿着基材层上下分布有金属铜线、金 / 镍层、覆盖层。
7. 如权利要求 2 所述的兼容性好的无线充电器接收器,其特征在于:所述屏蔽层由屏蔽材料组成,置于所述第一传导层的覆盖层上。

一种兼容性好的无线充电器接收器

技术领域

[0001] 本发明涉及到无线通讯技术,尤其涉及一种兼容性好的无线充电器接收器。

技术背景

[0002] 无线充电是一种不需要通过导线连接,或插接件插接的充电新技术。应用该技术可增强用电的安全性,且不会出现连接件接触不良等故障,因此深受各国研究者的关注。

[0003] 现有无线的电力装置技术中,能传达的距离短,电器不能离开反射器太远,根本发挥不到无线的作用,而且其输出的能量小,只适合于电量需求小的电器;还有待于进一步提高。

[0004] 传统的无线充电器接收端一般采用绕线式,为了增加传达的距离和电量,需要增加绕线的厚度,这种无线充电器接收端的性能一致性差。

[0005] NFC(近距离非接触技术)技术脱胎于无线设备间的“非接触式射频识别”(RFID)及互连技术,它可以满足任何两个无线设备间的信息交换、内容访问、服务交换,并且使之更为简约。

发明内容

[0006] 本发明的目的在于提供一种厚度较薄,性能一致性好,制作方便,尺寸缩小的无线充电器接收器。

[0007] 为了实现上述目的,本发明提供一种兼容性好的无线充电器接收器,包括一印制电路板以及置于其上的磁场转换芯片,以根据周围磁场的磁通量变化产生感应电动势,将磁能转换成电能,其中,所述磁场转换芯片集成有整流电路、交流/直流转换电路以及稳压限流电路,其特征在于:所述印制电路板为柔性线路板,还包括一 NFC 天线的线圈形成于所述印制电路板上,和所述印制电路板形成的线圈并列, NFC 天线通过电容连接 NFC 模块。

[0008] 其中,优选方案为:所述柔性线路板包括基材层、第一传导层、第二传导层以及屏蔽层,所述基材层的上下层分别设置有第一传导层、第二传导层,所述屏蔽层置于所述第一传导层上。

[0009] 其中,优选方案为:所述第一传导层的金属铜线层和第二传导层的金属铜线层形成的线圈部分构成无线充电器接收器的感应线圈,所述 NFC 天线的线圈置于无线充电器接收器的感应线圈的外围。

[0010] 其中,优选方案为:所述基材层为聚酯或聚酯亚胺基材层。

[0011] 其中,优选方案为:所述第一传导层、第二传导层依次沿着基材层上下分布有金属铜线、金/镍层、覆盖层。

[0012] 其中,优选方案为:所述屏蔽层由屏蔽材料组成,置于所述第一传导层的覆盖层上。

[0013] 本发明的优点为:由于发明借由柔性路板制成无线充电器接收端,使其具有厚度较薄、性能一致性好以及制作方便的优点;同时由于本发明利用 NFC 模块天线的线圈置于

无线充电器接收端的外围,这样无线充电器接收端和 NFC 模块天线的兼容性好,两者功能不受影响。

附图说明

[0014] 图 1a、1b 为本发明一种兼容性好的无线充电器接收器的结构示意图。

[0015] 图 2 为本发明一种兼容性好的无线充电器接收器的柔性线路板 11 的结构示意图。

[0016] 图 3 为本发明一种兼容性好的无线充电器接收器的原理图。

具体实施方式

[0017] 以下结合附图详细描述本发明的具体实施方式。

[0018] 图 1a、1b 为本发明兼容性好的无线充电器接收器的结构示意图,如图 1a、1b 所示:一种具有柔性线路板的无线充电器接收端 10,包括一印制电路板 11 以及置于其上的磁场转换芯片 12,以根据周围磁场的磁通量变化产生感应电动势,将磁能转换成电能,其中,所述磁场转换芯片集成有整流电路 13、交流 / 直流转换电路 14 以及稳压限流电路 15,其中,所述印制电路板 11 为柔性线路板,还包括一 NFC 天线 30 的线圈 31 形成于所述印制电路板 11 上,和所述无线充电器接收器的形成的感应线圈 16 并列, NFC 天线 30 通过电容连接 NFC 模块。

[0019] 如图 2 所示:所述柔性线路板 11 包括基材层 111、第一传导层 112、第二传导层 113 以及屏蔽层 114,所述基材层 111 的上下层分别设置有第一传导层 112、第二传导层 113,所述屏蔽层 114 置于所述第一传导层 112 上。

[0020] 其中,基材层 111 为聚酯 (PET) 或聚酰亚胺 (PI) 基材层,厚度为 25 μ m。

[0021] 其中,所述第一传导层 112、第二传导层 113 依次沿着基材层 111 上下分布有金属铜线层,厚度为 50 μ m、金 / 镍层,厚度为 0.1 到 0.5 μ m、覆盖膜层,厚度为 0.0275mm。其中,金属铜线层起到导电功能层,金 / 镍层为焊接连接层。

[0022] 其中,所述屏蔽层 114 由屏蔽材料组成,厚度为 0.15mm,置于所述第一传导层的覆盖层上。

[0023] 如下对于该载带进行举例说明,如图 3 所示:其中,接收端通过第一传导层 112 的金属铜线层和第二传导层 113 的金属铜线层形成的线圈接收能量,通过第一传导层 112 的金属铜线层滤波电容 C4、C5、C6、整流电容 C7、C8 传递给磁场转换芯片 12 的第 2 脚和第 19 脚,磁场转换芯片 12 通过第一传导层 112 的金属铜线层上的外围电路 C9、C10、C11、C14、C15、C16、C12、C13、C17、R1、R2、R3 实现工作。外围电路器件 C9、通过第二传导层 113 的金属铜线层与磁场转换芯片 12 的引脚第 3 脚相连,外围电路器件 C10 通过第二传导层 113 的金属铜线层与磁场转换芯片 12 的第 5 引脚相连,外围电路器件 C11 通过第二传导层 113 的金属铜线层与磁场转换芯片 12 的第 6 引脚相连,外围电路器件 C12 通过第二传导层 113 的金属铜线层与磁场转换芯片 12 的第 17 引脚相连,外围电路器件 C13 通过第二传导层 113 的金属铜线层与磁场转换芯片 12 的第 16 引脚相连,外围电路器件 C17 通过第二传导层 113 的金属铜线层与磁场转换芯片 12 的第 15 引脚相连,外围电路器件 R1 通过第二传导层 113 的金属铜线层与磁场转换芯片 1 的第 13 引脚相连,外围电路器件 C14、C15、C16 通过第一传导层 112 的金属铜线层与磁场转换芯片 12 的第 18 引脚相连,外围电路器件 R2 通过第一传

导层 112 的金属铜线层与磁场转换芯片 12 的第 14 引脚相连,外围电路器件 R3 通过第一传导层 112 的金属铜线层与磁场转换芯片 12 第 12 引脚相连,第一传导层 112 的金属铜线层和第二传导层 113 的金属铜线层铺地线构成无线充电器接收端输出电源负极,磁场转换芯片 12 的第 4 引脚构成无线充电器接收端输出电源正极,第一传导层 112 的金属铜线层的器件 C2、C3 构成无线充电器接收端输出电源整流电路。

[0024] 本发明的优点在于:由于发明借由柔性路板制成无线充电器接收端,使其具有厚度较薄、性能一致性好以及制作方便的优点;同时由于本发明利用 NFC 模块天线的线圈置于无线充电器接收端的外围,这样无线充电器接收端和 NFC 模块天线的兼容性好,两者功能不受影响。

[0025] 以上所述者,仅为本发明最佳实施例而已,并非用于限制本发明的范围,凡依本发明申请专利范围所作的等效变化或修饰,皆为本发明所涵盖。

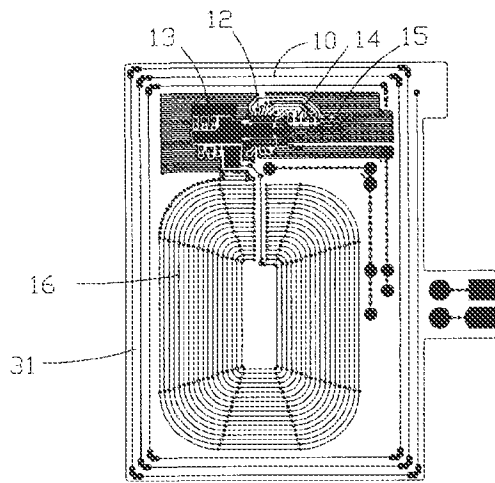


图 1a

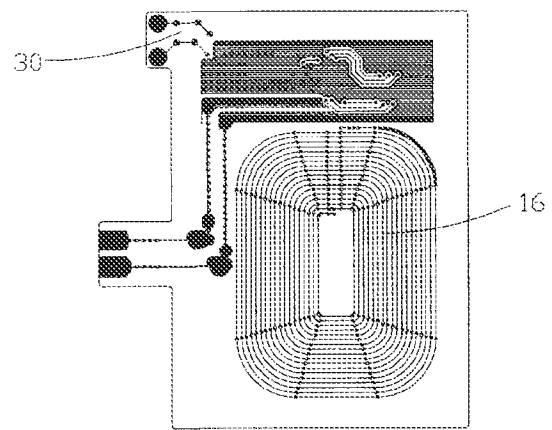


图 1b

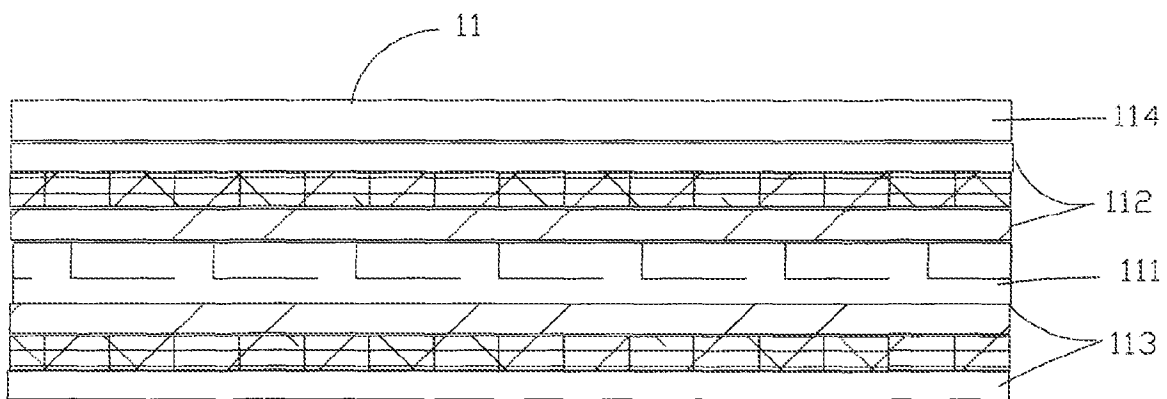
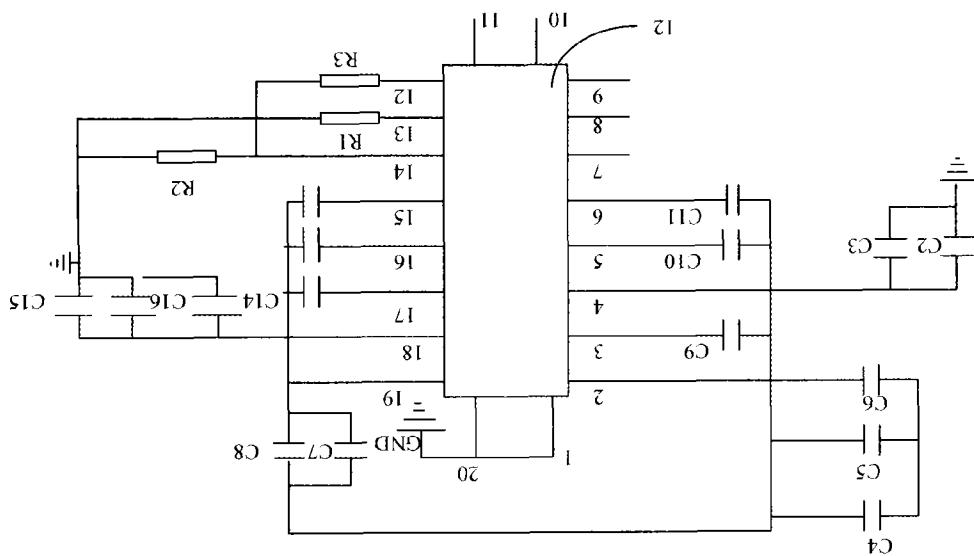


图 2

 $\mathfrak{E} \boxtimes$

Antenna unit with dummy pattern
List of publications
Publication date



- Application number 2018KR-0010724 Date 2018-01-29 [Register](#)
 - KR10-1991011 B1 Patent specification 2019-06-19

English Title

Antenna unit with dummy pattern

Other Title

더미패턴을 가지는 안테나 유닛

English Abstract (Native or MT)

The present invention discloses an antenna unit having a dummy pattern, which forms an NFC antenna pattern portion for short-range wireless communication on the other surface of a substrate. After forming a dummy pattern on one surface of the substrate facing the NFC antenna pattern portion, a shielding layer is formed thereon. Accordingly, by separating the substrate and the shielding layer to reduce the investment loss, a voltage standing wave ratio (VSWR) in accordance with the near field communication of the NFC antenna pattern portion.

Other Abstracts

본 발명은 더미 패턴을 가지는 안테나 유닛을 개시한 것으로, 이러한 본 발명은 기판의 타면에 근거리 무선 통신을 위한 NFC용 안테나 패턴부를 형성하고, NFC용 안테나 패턴부와 대향되는 상기 기판의 일면에는 더미패턴을 형성한 후 그 위에 차폐층을 형성한 것이며, 이에따라 기판과 차폐층을 이격시키면서 투자 손실을 줄여 NFC용 안테나 패턴부의 근거리 무선 통신에 따른 전압정재파비(VSWR)를 개선하는 것이다.

Application Language KOREAN (KOR)

Inventor(s) KIM, JIN-KYOUNG

Inventor(s) 김진경

Applicant/Assignee HANSOL TECHNICS | \$ 1 126 M

Assignee 한솔테크닉스(주) [KR]

Applicant/Assignee Address HANSOL TECHNICS INC. , KR

Patent Assignee History HANSOL TECHNICS INC. [KR]

Representative CHOI, YEONG BOK

Representative 최영복

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-KR20170053142 (A) [KR20170053142] AMOTECH CO LTD;
Applicant citations
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KR101577425 (B1) [KR101577425] AMOSENSE CO LTD; -
KR101627844 (B1) [KR101627844] AMOSENSE CO LTD; -
KR20160086248 (A) [KR20160086248] AMOSENSE CO LTD;

Description

TECHNICAL FIELD

[0001] The present invention relates to an antenna unit applied to a portable electronic device such as a mobile phone, PDA, pmp, tablet, multimedia device, and the like, More particularly, to an antenna unit having a dummy pattern intended to reduce investment loss of an NFC antenna pattern portion for near field communication and improve near field communication performance of an NFC antenna pattern portion for near field communication.

BACKGROUND ART

[0002] In recent years, an antenna unit applied to portable electronic devices such as mobile phones, PDA, pmp, tablet, multimedia device, etc., patterns a conductor such as copper foil in a loop form or forms a loop-shaped metal pattern on a flexible circuit board (FPCB) made of synthetic resin such as polyimide (PI) or pet, And a connection terminal for electrical connection with a main circuit board of an electronic device is provided on an end side of the flexible circuit board.

[0003] In addition, the conductor or metal pattern forming the loop shape may be an antenna pattern portion formed on one surface of the substrate, which may include an antenna pattern portion 200 for magnetic secure transmission (MST) for wireless electronic payment on one surface or both surfaces of the substrate 100 as illustrated in figs. 1 to 3, And/or WPT (Wireless Power Transfer) antenna pattern unit 300 for wireless charging, an antenna pattern portion 400 for near field communication (NFC) for near field communication is formed on the other surface of the substrate 100, and a shielding layer 500 for reducing noise such as electromagnetic interference (EMI) and frequency interference (rfi) is formed on one surface or both surfaces of the substrate 100.

[0004] However, in such an antenna unit, when a shielding layer (500) is formed on one surface of the substrate (100), the shielding layer (500) is a sheet layer including particles having permeability, a loss of investment occurs in the NFC antenna pattern portion (300) formed on the other surface of the substrate (100), Accordingly, there has been a problem that data transmission/reception is prevented from being properly performed during near field communication by the NFC antenna pattern portion 300 formed on the other surface of the substrate 100.

[0005] That is, due to the shielding layer 500 formed on one surface of the substrate 100, a voltage standing wave ratio (VSWR; Voltage Standing Wave Ratio) is farther from '1', which is a reference voltage standing wave ratio (VSWR) (VSWR 1.70), so that loss of transmission/reception data according to near field communication may not occur.

CITATION LIST

PATENT LITERATURE

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SUMMARY OF INVENTION

TECH PROBLEM

[0007] Therefore, the present disclosure provides an improvement in the related art. the present disclosure provides an NFC (Near Field Communication) antenna pattern part for near field communication on the other surface of a substrate, a dummy pattern is formed on one surface of the substrate at a position opposite to the NFC antenna pattern part, and then a shielding layer is formed thereon, an object of the present invention is to provide an antenna unit having a dummy pattern which reduces investment loss while spacing between a substrate and a shielding layer, so that a voltage standing wave ratio (VSWR) according to near-field communication of an NFC antenna pattern portion approaches a reference voltage standing wave ratio (VSWR) to prevent loss of transmission/reception data.

TECH SOLUTION

[0008] An antenna unit having a dummy pattern includes a substrate having a connection terminal electrically connected to a main circuit board of an electronic device on an end side thereof, an MST antenna pattern part for wireless electronic payment disposed on one surface or both surfaces of the substrate, an NFC antenna pattern part for short-range wireless communication disposed on an edge side of the other surface of the substrate, A shielding layer formed on one surface or both surfaces of the substrate to reduce noise between electromagnetic interference (EMI) and frequency interference (rfi), And a dummy pattern portion for NFC separating the substrate and the shielding layer from each other so as to improve a voltage standing wave ratio (VSWR) of the antenna pattern portion for NFC is formed on an edge side of one surface of the substrate facing a position of the antenna pattern portion for NFC.

[0009] Further, the substrate is a curable or plastic film made of a synthetic resin such as polyimide (PI) or pet, or FR4.

[0010] Further, the substrate may be formed of any one of metal polymer, ferrite, nanocrystal, and amopulse including particles having permeability as a shielding sheet.

[0011] In addition, the dummy pattern portion for NFC is a copper foil etched from an edge side of one surface of the substrate and continuously formed at certain intervals.

[0012] In addition, the dummy pattern portion for NFC is a polyimide (PI) film seamlessly and continuously formed on an edge side of one surface of the substrate.

[0013] Further, the shielding layer may be amorphous metals, which may be silicon steel plate, or any one of ammo pulse, nanocrystal, and metal polymer including particles having permeability.

[0014] In addition, a WPT antenna pattern part for wireless charging is formed on one surface or both surfaces of the substrate.

ADVANTAGEOUS EFFECTS

[0015] As such, the antenna unit having the dummy pattern of the present invention forms an NFC antenna pattern part for near field communication on the other surface of the substrate, forms the dummy pattern on one surface of the substrate opposite to the position of the NFC antenna pattern part and then forms a shielding layer on the dummy pattern part, As a result, it is possible to improve the voltage standing wave ratio (VSWR) according to the near field communication of the NFC antenna pattern unit while spacing the substrate and the shielding layer apart from each other, thereby preventing loss of transmission/reception data according to the near field communication.

[0016] The effects of the present invention are not limited to those mentioned above, and other effects that are not mentioned above may be clearly understood to those skilled in the art from the description of the claims.

DESCRIPTION OF DRAWINGS

[0017] FIG. 1 is a planar transparent schematic view illustrating a structure of a conventional antenna unit. FIG. 2 is a bottom schematic view illustrating a structure of a conventional antenna unit. FIG. 3 is an a-a line cross-sectional schematic diagram for a conventional FIG. 2. FIG. 4 is a graph of measuring a

voltage standing wave ratio (VSWR) of an antenna pattern for NFC using a conventional VSWR meter. FIG. 5 is a plan view perspective schematic view illustrating a structure of an antenna unit having a dummy pattern continuously formed at certain intervals according to an embodiment of the present disclosure. FIG. 6 is a planar-perspective schematic view illustrating a structure of an antenna unit having a dummy pattern seamlessly and continuously formed with an embodiment of the present disclosure. FIG. 7 is a bottom schematic view illustrating a structure of an antenna unit having dummy patterns according to an embodiment of the present disclosure. FIG. 8 is a B-B line cross-sectional schematic diagram for FIG. 7 with an embodiment of the invention. FIG. 9 is a graph of measuring a voltage standing wave ratio (VSWR) of an antenna pattern portion for NFC using a VSWR meter according to an embodiment of the present disclosure.

DESCRIPTION OF EMBODIMENTS

[0018] Advantages and features of the present invention, and methods of achieving the same, will become apparent with reference to the embodiments described in detail below in conjunction with the accompanying drawings. However, in the embodiments of the technical concept of the present disclosure, it is not limited to the embodiments disclosed hereinbelow, but may be embodied in various different forms from each other, and only the present embodiments allow the disclosure of the present disclosure to be complete. The present disclosure is provided to completely inform those skilled in the art of the invention, and in the examples of the technical concept of the present disclosure, it is only defined by the scope of the claims.

[0019] The terminology used herein is for the purpose of describing the embodiments and is not intended to be limiting of the invention. Herein, the singular also includes the plural unless specifically stated in the phrase.

[0020] In the specification, terms "comprise" or "have" or the like are intended to designate that there is a feature, number, step, operation, component, part, or combination thereof described herein, and should be understood as not precluding in advance the possibility of the presence or addition of one or more other features or numbers, steps, operations, components, parts, or combination thereof.

[0021] Further, the embodiments described herein will be described with reference to cross-sectional and/or top views, which are idealized illustrative views of the invention. Accordingly, embodiments of the invention are not limited to the particular form shown, but also include changes in form produced or necessary depending on the manufacturing process. For example, the area shown at right angles may be rounded or shaped to have a curvature. Accordingly, the regions illustrated in the figures have schematic attributes, and the shape of the regions illustrated in the figures is intended to illustrate the particular form of the region of the device and not limit the scope of the invention.

[0022] Like reference numerals refer to like elements throughout the specification. Accordingly, like reference numerals or similar reference numerals may be described with reference to other figures, even if not referenced or described in that figure. Furthermore, even if no reference numerals are indicated, they may be described with reference to other figures.

[0023] Hereinafter, embodiments of the present disclosure will be described with reference to the accompanying drawings.

[0024] FIG. 5 is a plane-perspective schematic view illustrating a structure of an antenna unit having dummy patterns continuously formed at certain intervals according to an embodiment of the present disclosure, FIG. 6 is a plane-perspective schematic view illustrating a structure of an antenna unit having dummy patterns continuously formed seamlessly according to an embodiment of the present disclosure, FIG. 7 is a bottom schematic view illustrating a structure of an antenna unit having dummy patterns according to an embodiment of the present disclosure, and FIG. 8 is a schematic view illustrating a B-B section view of FIG. 7 according to an embodiment of the present disclosure.

[0025] Referring to figs. 4 to 8 attached, an antenna unit having a dummy pattern according to an exemplary embodiment may further include a substrate 10, an antenna pattern portion for MST 20, an antenna pattern portion for NFC 30, a shielding layer 40, a dummy pattern portion for NFC 50, and in addition thereto an antenna pattern portion for WPT 60.

[0026] The substrate 10 is a curable or plastic film made of synthetic resin such as polyimide (PI), pet, or the like, or FR4, but on the other hand is a metal polymer containing particles having permeability as a shielding sheet, A PCB or FPCB which may be composed of any one of ferrite, nanocrystal, and amorphous pulse, and a connection terminal 11 for electrical connection with a main circuit board of an electronic device is formed on an end side thereof.

[0027] Here, the connection terminal (11) includes a wireless electronic payment connection terminal connected to the MST antenna pattern portion (20) and an NFC communication terminal connected to the NFC antenna pattern portion (30), The wireless electronic payment connection terminal and the NFC communication terminal may be connected to a charging-related component such as a battery pack of an electronic device (e.g., a portable terminal), which is a general connection structure, and specific explanation thereof will be omitted hereinafter.

[0028] In this case, shielding layers 40 are stacked on one surface or both surfaces of the substrate 10 where the MST antenna pattern portion 20 is positioned.

[0029] The shielding layer 40 effectively reduces noise such as electromagnetic interference (EMI) and frequency interference (rfi), which are amorphous metals, uses any one of amorphous metals, nanocrystals, and metal polymers which are silicon steel plates or contain particles having permeability.

[0030] Here, the shielding layer 40 may have a shielding function changed according to a change in thickness. accordingly, shielding performance may be increased as much as the thickness of the shielding layer 40 is increased, and shielding performance may be decreased as much as the thickness of the shielding layer 40 is decreased as much as the thickness of the shielding layer 40 is decreased.

[0031] The NFC antenna pattern unit 30 is configured to perform near field communication while being disposed on an edge side of the other surface of the substrate 10.

[0032] That is, the NFC antenna pattern unit 30 implements a communication technology that transmits and receives various wireless data at a close distance within 10 cm.

[0033] The dummy pattern portion (50) for NFC is formed on a side of one surface of the substrate (10) opposite to a position of the antenna pattern portion (30) for NFC, which comprises, as a curable or plastic film, the shielding layer (40) including particles having permeability with the substrate (10) made of a synthetic resin such as polyimide (PI) or pet, Or the substrate (10) including particles having permeability and the shielding layer (40) are separated from each other to improve the voltage standing wave ratio (VSWR) of the NFC antenna pattern portion (30).

[0034] In this case, the dummy pattern portion 50 for NFC may be formed of a copper foil which is etched from the edge side of the one surface of the substrate 10 as in FIG. 5 attached, and is formed of a polyimide (PI) film which is seamlessly and continuously formed on the edge side of the one surface of the substrate 10 as in FIG. 6 attached.

[0035] That is, the dummy pattern portion 50 for NFC separates the substrate 10 from the shielding layer 40 including particles having permeability, thereby reducing investment loss, The voltage standing wave ratio (VSWR) according to near field communication of the NFC antenna pattern unit 30 is brought close to '1', which is a reference voltage standing wave ratio (VSWR), to prevent loss of transmission/reception data according to near field communication.

[0036] Meanwhile, the WPT antenna pattern unit 60 is for wireless charging, which may be formed on one surface or both surfaces of the substrate 10.

[0037] As described above, the antenna unit according to an exemplary embodiment of the present invention includes an MST antenna pattern unit 20 and/or a WPT antenna pattern unit 60 on one surface or both surfaces of the substrate 10, and an NFC antenna pattern unit 30 on an edge side of the other surface of the substrate 10. After forming a dummy pattern portion 50 for NFC that is continuously formed at certain intervals or continuously formed on an edge side of one surface of the substrate 10 facing the antenna pattern portion 30 for NFC, a shielding layer 40 is laminated on one surface of the substrate 10.

[0038] Then, the dummy pattern portion 50 for NFC separates the shielding layer 40 including particles having permeability from the substrate 10 to prevent loss due to the permeability, thereby improving a voltage standing wave ratio VSWR due to near field communication of the antenna pattern portion 30 for NFC.

[0039] That is, when the dummy pattern portion 50 for NFC according to an exemplary embodiment is not formed in a conventional antenna unit as illustrated in figs. 1 to 3 attached, and thus the shielding layer 500 including particles having permeability is in contact with the substrate 100, As in the attached FIG. 4, the voltage standing wave ratio (VSWR) according to near field communication of the NFC antenna pattern portion 400 was measured to have VSWR 1.70 away from a reference '1'.

[0040] On the other hand, as illustrated in figs. 4 to 8, when the dummy pattern portion 50 for NFC is formed in the antenna unit according to an exemplary embodiment to space the shielding layer 40 including particles having permeability from the substrate 10, As shown in FIG. 9 attached, the voltage standing wave ratio (VSWR) according to near field communication of the NFC antenna pattern portion 30 is measured to be improved to VSWR 1.42 close to a reference '1', thereby preventing loss of transmission/reception data when near field communication is performed through the NFC antenna pattern portion 30 according to an exemplary embodiment of the present invention.

[0041] Although the description of the antenna unit having the dummy pattern of the present disclosure has been described in conjunction with the accompanying drawings, this is an illustration of the best embodiment of the present disclosure and is not limited to the present disclosure.

[0042] Therefore, the present disclosure is not limited to the specific preferred embodiments described above, and it is of course possible for any person skilled in the art to practice various modifications without departing from the spirit and scope of the invention claimed in the claims.

REFERENCE SIGNS LIST

[0043] 10; substrate 11; connection terminal 20; antenna pattern portion 30 for MST; antenna pattern portion 40 for NFC; shielding layer 50; dummy pattern portion 60 for NFC;



(19) 대한민국특허청(KR)

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(73) 특허권자

한솔테크닉스(주)

서울특별시 중구 을지로 100 (을지로2가)

(72) 발명자

김진경

경기도 용인시 기흥구 덕영대로2077번길 53, 204
동 1804호(영덕동, 태영데시앙아파트)

(74) 대리인

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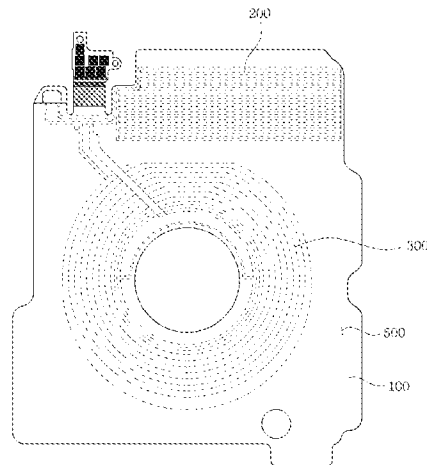
심사관 : 김정석

(54) 발명의 명칭 더미패턴을 가지는 안테나 유닛

(57) 요약

본 발명은 더미 패턴을 가지는 안테나 유닛을 개시한 것으로, 이러한 본 발명은 기판의 타면에 근거리 무선 통신을 위한 NFC용 안테나 패턴부를 형성하고, NFC용 안테나 패턴부와 대향되는 상기 기판의 일면에는 더미패턴을 형성한 후 그 위에 차폐층을 형성한 것이며, 이에 따라 기판과 차폐층을 이격시키면서 투자 손실을 줄여 NFC용 안테나 패턴부의 근거리 무선 통신에 따른 전압정재파비(VSWR)를 개선하는 것이다.

도면 - 도1



(52) CPC특허분류

H01Q 1/38 (2018.05)

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발명서

청구범위

청구항 1

단부측에 전자기기의 메인회로기판과 전기적인 연결을 위한 연결단자가 형성되는 기판; 상기 기판의 일면 또는 양면에 배치되는 무선 전자 결제를 위한 MST용 안테나 패턴부; 상기 기판의 타면 가장자리측에 배치되는 근거리 무선 통신을 위한 NFC용 안테나 패턴부; 및, 상기 기판의 일면 또는 양면에 적층되는 것으로 전자기 간섭(EMI)과 주파수 간섭(RFI)의 노이즈를 저감시키는 차폐층;을 포함하여 구성하고,

상기 NFC용 안테나 패턴부의 위치에 대향되는 상기 기판의 일면 가장자리측에는 상기 NFC용 안테나 패턴부의 전압정재파비(VSWR)를 개선시키도록 상기 기판과 상기 차폐층을 이격시키는 NFC용 더미패턴부를 형성하되,

상기 NFC용 더미패턴부는 상기 기판의 일면 가장자리측에서 예칭되어 일정간격을 두고 연속 형성되는 동박인 것을 특징으로 하는 더미 패턴을 가지는 안테나 유닛.

청구항 2

제 1 항에 있어서,

상기 기판은 경화성 또는 가소성 필름으로서 폴리이미드(PI)나 PET와 같은 합성수지 또는 FR4로 구성하는 것을 특징으로 하는 더미 패턴을 가지는 안테나 유닛.

청구항 3

제 1 항에 있어서,

상기 기판은 차폐시트로서 투자율을 가지는 입자를 포함하는 메탈폴리머, 페라이트, 나노크리스탈, 아모필스 중 어느 하나로 구성하는 것을 특징으로 하는 더미 패턴을 가지는 안테나 유닛.

청구항 4

제 2 항 또는 제 3 항에 있어서,

상기 차폐층은 비정질 금속류로서, 규소강판이거나 또는 투자율을 가지는 입자를 포함하는 아모필스, 나노크리스탈, 메탈폴리머 중 어느 하나인 것을 특징으로 하는 더미 패턴을 가지는 안테나 유닛.

청구항 5

삭제

청구항 6

삭제

청구항 7

제 1 항에 있어서,

상기 기판의 일면 또는 양면에는 무선 충전을 위한 WPT용 안테나 패턴부를 형성하는 것을 특징으로 하는 더미 패턴을 가지는 안테나 유닛.

발명의 설명

기술 분야

[0001]

본 발명은 휴대폰, PDA, PMP, 태블릿, 멀티미디어 기기 등과 같은 휴대용 전자기기에 적용되는 안테나 유닛에 관한 것으로, 보다 상세하게는 근거리 무선 통신을 위한 NFC(Near Field Communication)용 안테나 패턴부의 투자 손실을 줄여, NFC용 안테나 패턴부의 근거리 무선 통신 성능을 개선하고자 하는 더미 패턴을 가지는 안테나

유닛에 관한 것이다.

배경 기술

- [0002] 최근 휴대폰, PDA, PMP, 태블릿, 멀티미디어 기기 등과 같은 휴대용 전자기기에 적용되는 안테나 유닛은 폴리이미드(PI)나 PET 등과 같은 합성수지로 이루어진 연성회로기판(FPCB)에 동박 등과 같은 전도체를 루프 형태로 패터닝하거나 전도성 잉크를 사용하여 연성회로기판에 루프 형상의 금속패턴을 형성하는 한편, 상기 연성회로기판의 단부측에는 전자기기의 메인회로기판과 전기적인 연결을 위한 연결단자를 구비하는 것이다.
- [0003] 그리고, 상기 루프 형태를 이루는 상기 전도체 또는 금속 패턴은 기판의 일면에 형성되는 안테나 패턴부로, 이는 첨부된 도 1 내지 도 3에서와 같이 기판(100)의 일면 또는 양면에 무선 전자 결제를 위한 MST(Magnetic Secure Transmission)용 안테나 패턴부(200), 및/또는 무선 충전을 위한 WPT(Wireless Power Transfer)용 안테나 패턴부(300)를 형성하는 한편, 상기 기판(100)의 타면에는 근거리 무선 통신을 위한 NFC(Near Field Communication)용 안테나 패턴부(400)를 형성하고, 상기 기판(100)의 일면 또는 양면에는 전자기 간섭(EMI) 및 주파수 간섭(RFI)과 같은 노이즈를 저감시키기 위한 차폐층(500)을 형성하도록 하였다.
- [0004] 그러나, 상기와 같은 안테나 유닛에서, 상기 기판(100)의 일면에 차폐층(500)을 구성시, 상기 차폐층(500)은 투자율을 가지는 입자가 포함된 시트종인 관계로, 상기 기판(100)의 타면에 형성되는 상기 NFC용 안테나 패턴부(300)에서는 투자 손실이 발생하게 되고, 이에 따라 상기 기판(100)의 타면에 형성되는 상기 NFC용 안테나 패턴부(300)에 의한 근거리 무선 통신시 데이터 송수신이 제대로 이루어지지 못하는 문제점이 있었다.
- [0005] 즉, 상기 기판(100)의 일면에 형성되는 상기 차폐층(500)으로 인해, 상기 기판(100)의 타면에 형성되는 상기 NFC용 안테나 패턴부(300)에서 근거리 무선 통신시 첨부된 도 4에서와 같이, 전압정재파비(VSWR; Voltage Standing Wave Ratio)가 기준이 되는 전압정재파비(VSWR)인 '1'로부터 멀어져(VSWR 1.70), 근거리 무선 통신에 따른 송수신 데이터의 손실이 발생할 수 밖에 없었던 것이다.

선행기술문헌

특허문헌

- [0006] (특허문헌 0001) 등록특허공보 제10-1574214호(공고일 2015.12.04)
(특허문헌 0002) 등록특허공보 제10-1577425호(공고일 2015.12.28)
(특허문헌 0003) 등록특허공보 제10-1627844호(공고일 2016.06.07)
(특허문헌 0004) 공개특허공보 제10-2016-0086248호(공개일 2016.07.19)

발명의 내용

해결하려는 과제

- [0007] 따라서, 본 발명은 상기와 같은 종래의 문제점을 개선하기 위한 것으로, 기판의 타면에 근거리 무선 통신을 위한 NFC(Near Field Communication)용 안테나 패턴부를 형성하고, NFC용 안테나 패턴부와 대향되는 위치인 상기 기판의 일면에는 더미패턴을 형성한 후 그 위에 차폐층을 형성함으로써, 기판과 차폐층을 이격시키면서 투자 손실을 줄여 NFC용 안테나 패턴부의 근거리 무선 통신에 따른 전압정재파비(VSWR)가 기준이 되는 전압정재파비(VSWR)에 근접될 수 있도록 하여 송수신 데이터의 손실을 방지시킬 수 있도록 하는 더미 패턴을 가지는 안테나 유닛을 제공함에 그 목적이 있는 것이다.

과제의 해결 수단

- [0008] 상기 목적 달성을 위한 본 발명의 더미 패턴을 가지는 안테나 유닛은, 단부측에 전자기기의 메인회로기판과 전기적인 연결을 위한 연결단자가 형성되는 기판; 상기 기판의 일면 또는 양면에 배치되는 무선 전자 결제를 위한 MST용 안테나 패턴부; 상기 기판의 타면 가장자리측에 배치되는 근거리 무선 통신을 위한 NFC용 안테나 패턴부; 및, 상기 기판의 일면 또는 양면에 형성되는 것으로 전자기 간섭(EMI)과 주파수 간섭(RFI)의 노이즈를 저감시키는 차폐층; 을 포함하여 구성하고, 상기 NFC용 안테나 패턴부의 위치에 대향되는 상기 기판의 일면 가장자리측

에는 상기 NFC용 안테나 패턴부의 전압정재파비(VSWR)를 개선시키도록 상기 기판과 상기 차폐층을 이격시키는 NFC용 더미패턴부를 형성하는 것이다.

[0009] 또한, 상기 기판은 경화성 또는 가소성 필름으로서 폴리이미드(PI)나 PET와 같은 합성수지 또는 FR4로 구성되는 것이다.

[0010] 또한, 상기 기판은 차폐시트로서 투자율을 가지는 입자를 포함하는 메탈폴리머(Metal Polymer), 페라이트, 나노 크리스탈, 아모펄스 중 어느 하나로 구성되는 것이다.

[0011] 또한, 상기 NFC용 더미패턴부는 상기 기판의 일면 가장자리측에서 에칭되어 일정간격을 두고 연속 형성되는 동박인 것이다.

[0012] 또한, 상기 NFC용 더미패턴부는 상기 기판의 일면 가장자리측에 끊임없이 연속 형성되는 폴리이미드(PI) 필름인 것이다.

[0013] 또한, 상기 차폐층은 비정질 금속류로서, 규소강판(silicon steel plate)이거나 또는 투자율을 가지는 입자를 포함하는 아모펄스(ammo pulse), 나노크리스탈, 메탈폴리머(Metal Polymer) 중 어느 하나인 것이다.

[0014] 또한, 상기 기판의 일면 또는 양면에는 무선 충전을 위한 WPT용 안테나 패턴부를 형성하는 것이다.

발명의 효과

[0015] 이와 같이, 본 발명의 더미패턴을 가지는 안테나 유닛은 기판의 타면에 근거리 무선 통신을 위한 NFC용 안테나 패턴부를 형성하고, NFC용 안테나 패턴부의 위치에 대향되는 상기 기판의 일면에는 더미패턴을 형성한 후 그 위에 차폐층을 형성한 것이며, 이를 통해 기판과 차폐층을 이격시키면서 투자 손실을 줄여 NFC용 안테나 패턴부의 근거리 무선 통신에 따른 전압정재파비(VSWR)를 개선하면서 근거리 무선통신에 따른 송수신 데이터의 손실을 방지하는 효과를 기대할 수 있는 것이다.

[0016] 본 발명의 효과들은 이상에서 언급한 효과들로 제한되지 않으며, 언급되지 않은 또 다른 효과들은 청구범위의 기재로부터 당업자에게 명확하게 이해될 수 있을 것이다.

도면의 간단한 설명

[0017] 도 1은 종래 안테나 유닛의 구조를 보인 평면 투시 개략도.

도 2는 종래 안테나 유닛의 구조를 보인 저면 개략도.

도 3은 종래 도 2에 대한 A-A선 단면 개략도.

도 4는 종래 VSWR 미터를 이용하여 NFC용 안테나 패턴부의 전압정재파비(VSWR)를 측정한 그래프.

도 5는 본 발명의 실시예로 일정간격을 두고 연속 형성되는 더미패턴을 가진 안테나 유닛의 구조를 보인 평면 투시 개략도.

도 6은 본 발명의 실시예로 끊임없이 연속 형성되는 더미패턴을 가진 안테나 유닛의 구조를 보인 평면 투시 개략도.

도 7은 본 발명의 실시예로 더미패턴을 가지는 안테나 유닛의 구조를 보인 저면 개략도.

도 8은 본 발명의 실시예로 도 7에 대한 B-B선 단면 개략도.

도 9는 본 발명의 실시예로 VSWR 미터를 이용하여 NFC용 안테나 패턴부의 전압정재파비(VSWR)를 측정한 그래프.

발명을 실시하기 위한 구체적인 내용

[0018] 본 발명의 이점 및 특징, 그리고 그것들을 달성하는 방법은 첨부되는 도면과 함께 상세하게 후술되어 있는 실시 예를 참조하면 명확해질 것이다. 그러나 본 발명 기술적 사상의 실시예에 있어서 이하에서 개시되는 실시 예에 한정되는 것이 아니라 서로 다른 다양한 형태로 구현될 수 있으며, 단지 본 실시 예는 본 발명의 개시가 완전하도록 하고, 본 발명이 속하는 기술분야에서 통상의 지식을 가진 자에게 발명의 범주를 완전하게 알려주기 위해 제공되는 것이며, 본 발명 기술적 사상의 실시예에 있어서 청구항의 범주에 의해 정의될 뿐이다.

[0019] 본 명세서에서 사용된 용어는 실시 예들을 설명하기 위한 것이며 본 발명을 제한하고자 하는 것은 아니다. 본

명세서에서, 단수형은 문구에서 특별히 언급하지 않는 한 복수형도 포함한다.

- [0020] 본 명세서에서, "포함하다" 또는 "가지다" 등의 용어는 명세서상에 기재된 특정, 숫자, 단계, 동작, 구성요소, 부분품 또는 이들을 조합한 것이 존재함을 지정하려는 것이지, 하나 또는 그 이상의 다른 특징들이나 숫자, 단계, 동작, 구성요소, 부분품 또는 이들을 조합한 것들의 존재 또는 부가 가능성을 미리 배제하지 않는 것으로 이해되어야 한다.
- [0021] 또한, 본 명세서에서 기술하는 실시예들은 본 발명의 이상적인 예시도인 단면도 및/또는 평면도들을 참고하여 설명될 것이다. 따라서, 본 발명의 실시예들은 도시된 특정 형태로 제한되는 것이 아니라 제조 공정에 따라 생성되거나 필요한 형태의 변화도 포함하는 것이다. 예를 들면, 직각으로 도시된 영역은 라운드 지거나 소정 곡률을 가지는 형태일 수 있다. 따라서, 도면에서 예시된 영역들은 개략적인 속성을 가지며, 도면에서 예시된 영역들의 모양은 장치의 영역의 특정 형태를 예시하기 위한 것이며 발명의 범주를 제한하기 위한 것이 아니다.
- [0022] 명세서 전문에 걸쳐 동일 참조 부호는 동일 구성 요소를 지칭한다. 따라서, 동일한 참조 부호 또는 유사한 참조 부호들은 해당 도면에서 언급 또는 설명되지 않았더라도, 다른 도면을 참조하여 설명될 수 있다. 또한, 참조 부호가 표시되지 않았더라도, 다른 도면들을 참조하여 설명될 수 있다.
- [0023] 이하, 첨부된 도면을 참조하여 본 발명의 실시예를 설명하기로 한다.
- [0024] 도 5는 본 발명의 실시예로 일정간격을 두고 연속 형성되는 터미페턴을 가진 안테나 유닛의 구조를 보인 평면 투시 개략도이고, 도 6은 본 발명의 실시예로 끊임없이 연속 형성되는 터미페턴을 가진 안테나 유닛의 구조를 보인 평면 투시 개략도이며, 도 7은 본 발명의 실시예로 터미페턴을 가지는 안테나 유닛의 구조를 보인 저면 개략도이고, 도 8은 본 발명의 실시예로 도 7에 대한 B-B선 단면 개략도를 도시한 것이다.
- [0025] 첨부된 도 4 내지 도 8을 참조하면, 본 발명의 실시예에 따른 터미페턴을 가지는 안테나 유닛은, 기판(10), MST용 안테나 패턴부(20), NFC용 안테나 패턴부(30), 차폐층(40), NFC용 터미페턴부(50), 그리고 이에 더하여 WPT용 안테나 패턴부(60)를 더 포함하여 구성할 수 있는 것이다.
- [0026] 상기 기판(10)은 경화성 또는 가소성 필름으로서 폴리이미드(PI)나 PET 등과 같은 합성수지 또는 FR4로 이루어지는 것이지만, 다른 한편으로는 자재로서 투자율을 가지는 입자를 포함하는 메탈폴리머(Metal Polymer), 페라이트, 나노크리스탈, 아모퍼스 중 어느 하나로 구성될 수도 있는 PCB 또는 FPCB로서, 단부측에 전자기기의 메인회로기판과 전기적인 연결을 위한 연결단자(11)를 형성하여둔 것이다.
- [0027] 여기서, 상기 연결단자(11)는 상기 MST용 안테나 패턴부(20)에 연결되는 무선전자결체 연결단자와, 상기 NFC용 안테나 패턴부(30)에 연결되는 NFC 통신단자를 포함하는 것이고, 상기 무선전자결체 연결단자와 NFC통신단자는 전자기기(예: 휴대용 단말기)의 배터리팩 등의 충전 관련 부품과 연결이 되는 것이며, 이는 통상적인 연결구조로서 이하에서는 그 구체적인 설명은 생략하기로 한다.
- [0028] 이때, 상기 MST용 안테나 패턴부(20)가 위치하게 되는 상기 기판(10)의 일면 또는 양면에는 차폐층(40)이 적층 구성되는 것이다.
- [0029] 상기 차폐층(40)은 전자기 간섭(EMI) 및 주파수 간섭(RFI)과 같은 노이즈를 효과적으로 저감시키는 것으로, 이는 비경질 금속류로서, 규소강판(silicon steel plate)이거나 또는 투자율을 가지는 입자를 포함하는 아모퍼스(amorphous), 나노크리스탈, 메탈폴리머(Metal Polymer) 중 어느 하나를 사용하는 것이다.
- [0030] 여기서, 상기 차폐층(40)은 두께 변화에 따라 차폐기능이 변화될 수 있는 것으로, 상기 차폐층(40)의 두께를 두껍게 하면 그만큼 차폐 성능은 높아지고, 상기 차폐층(40)의 두께를 얇게 하면 그만큼 차폐 성능은 낮아질 수 있다.
- [0031] 상기 NFC용 안테나 패턴부(30)는 상기 기판(10)의 타면 가장자리측에 배치되면서 근거리 무선 통신을 수행하도록 구성하여둔 것이다.
- [0032] 즉, 상기 NFC용 안테나 패턴부(30)는 10cm 이내의 가까운 거리에서 다양한 무선 데이터를 주고받는 통신 기술을 구현하는 것이다.
- [0033] 상기 NFC용 터미페턴부(50)는 상기 NFC용 안테나 패턴부(30)의 위치에 대향되는 상기 기판(10)의 일면 가장자리측에 형성되는 것으로, 이는 경화성 또는 가소성 필름으로서 폴리이미드(PI)나 PET 등과 같은 합성수지 또는 FR4로 이루어진 상기 기판(10)과 투자율을 가지는 입자를 포함하는 상기 차폐층(40), 또는 투자율을 가지는 입자를 포함하는 상기 기판(10)과 상기 차폐층(40)을 이격시켜, 상기 NFC용 안테나 패턴부(30)의 전압정계파비

(VSWR)를 개선하도록 구성하여둔 것이다.

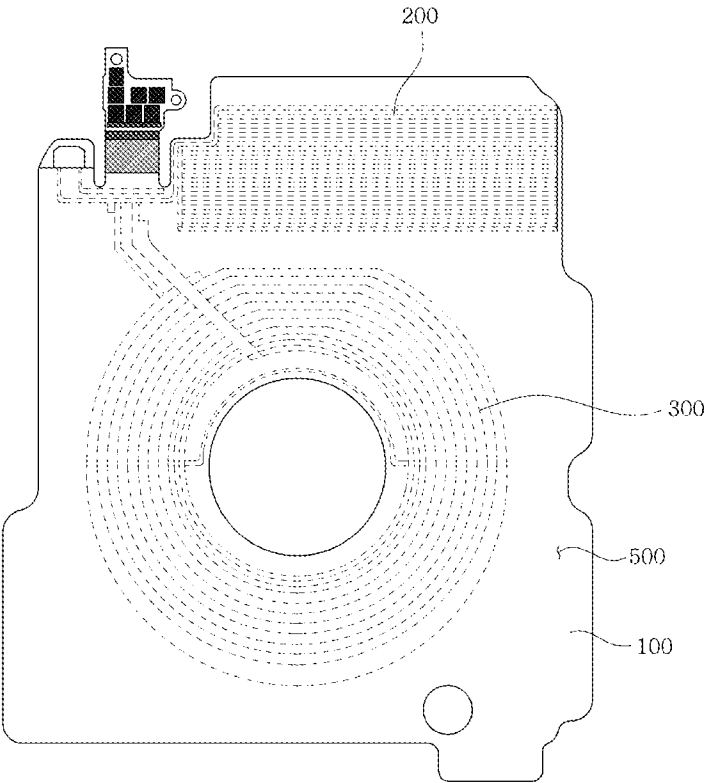
- [0034] 이때, 상기 NFC용 더미패턴부(50)는 첨부된 도 5에서와 같이 상기 기판(10)의 일면 가장자리측에서 예칭되어 일정간격을 두고 연속 형성되는 동박으로 구성하거나, 또는 첨부된 도 6에서와 같이 상기 기판(10)의 일면 가장자리측에窪陷없이 연속 형성되는 폴리이미드(PI) 필름으로 구성할 수 있는 것이다.
- [0035] 즉, 상기 NFC용 더미패턴부(50)는 상기 기판(10)과 투자율을 가지는 입자를 포함하는 상기 차폐층(40)을 이격시켜 투자 손실을 줄이면서, 상기 NFC용 안테나 패턴부(30)의 근거리 무선 통신에 따른 전압정재파비(VSWR)를 기준이 되는 전압정재파비(VSWR)인 '1'에 근접시켜, 근거리 무선통신에 따른 송수신 데이터의 손실을 방지시키도록 구성하여둔 것이다.
- [0036] 한편, 상기 WPT용 안테나 패턴부(60)는 무선 충전을 위한 것으로, 이는 상기 기판(10)의 일면 또는 양면에 형성될 수 있는 것이다.
- [0037] 이와 같이, 본 발명의 실시예에 따른 안테나 유닛은 첨부된 도 5 내지 도 9에서와 같이, 기판(10)의 일면 또는 양면에 MST용 안테나 패턴부(20) 및/또는 WPT용 안테나 패턴부(60)를 구성하고, 상기 기판(10)의 타면 가장자리측에는 NFC용 안테나 패턴부(30)를 구성하여둔 상태에서, 상기 NFC용 안테나 패턴부(30)와 대향되는 상기 기판(10)의 일면 가장자리측에 일정간격을 두고 연속 형성되거나 또는窪陷없이 연속 형성되는 NFC용 더미패턴부(50)를 형성한 후, 상기 기판(10)의 일면에 차폐층(40)을 적층 구성하여둔다.
- [0038] 그러면, 상기 NFC용 더미패턴부(50)는 상기 기판(10)과 투자율을 가지는 입자를 포함하는 상기 차폐층(40)을 이격시켜, 상기 투자율에 따른 손실을 방지시키게 되면서, 상기 NFC용 안테나 패턴부(30)의 근거리 무선통신에 따른 전압정재파비(VSWR)를 개선할 수 있는 것이다.
- [0039] 즉, 첨부된 도 1 내지 도 3과 같이 종래 안테나 유닛에 본 발명의 실시예에 따른 NFC용 더미패턴부(50)를 형성하지 않아 상기 기판(100)과 투자율을 가지는 입자를 포함하는 상기 차폐층(500)이 밀착되어 있을 경우, 첨부된 도 4에서와 같이 상기 NFC용 안테나 패턴부(400)의 근거리 무선 통신에 따른 전압정재파비(VSWR)는 기준이 되는 '1'로부터 멀어지는 VSWR 1.70을 가지는 것으로 측정되었다.
- [0040] 반면, 첨부된 도 4 내지 도 8과 같이 본 발명의 실시예에 따른 안테나 유닛에 NFC용 더미패턴부(50)를 형성하여 상기 기판(10)과 투자율을 가지는 입자를 포함하는 상기 차폐층(40)을 이격시키는 경우, 첨부된 도 9에서와 같이 상기 NFC용 안테나 패턴부(30)의 근거리 무선 통신에 따른 전압정재파비(VSWR)는 기준이 되는 '1'에 근접하는 VSWR 1.42로 개선되는 것으로 측정되었으며, 이에따라 본 발명의 실시예에 따른 NFC용 안테나 패턴부(30)를 통해 근거리 무선 통신이 이루어질 때 송수신 데이터의 손실을 방지시킬 수 있게 되는 것이다.
- [0041] 이상에서 본 발명의 더미패턴을 가지는 안테나 유닛에 대한 기술사상을 첨부도면과 함께 서술하였지만, 이는 본 발명의 가장 양호한 실시예를 예시적으로 설명한 것이지 본 발명을 한정하는 것은 아니다.
- [0042] 따라서, 본 발명은 상술한 특징의 바람직한 실시예에 한정되지 아니하며, 청구범위에서 청구하는 본 발명의 요지를 벗어남이 없이 당해 발명이 속하는 기술분야에서 통상의 지식을 가진 자라면 누구든지 다양한 변형 실시가 가능한 것은 물론이고, 그와같은 변경은 청구범위 기재의 범위내에 있게 된다.

429 48

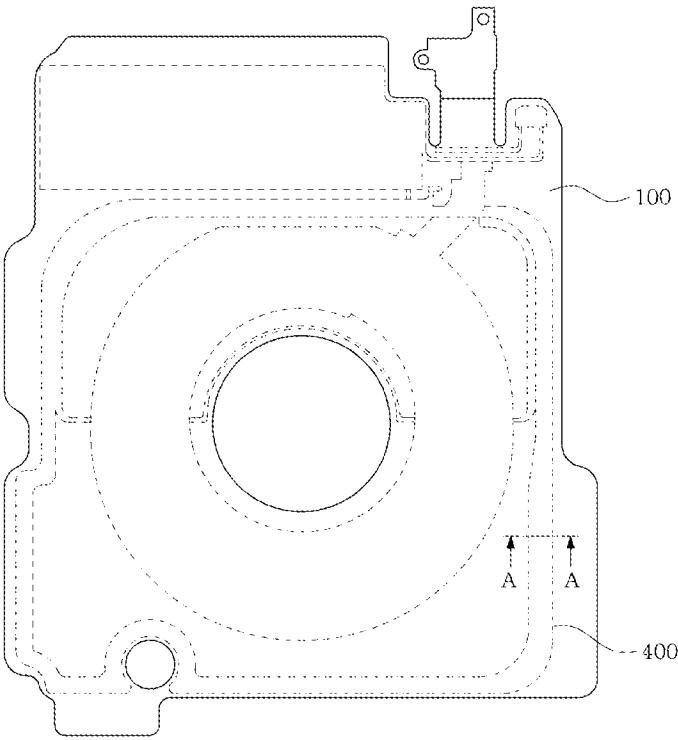
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| | 20; MST용 안테나 패턴부 | 30; NFC용 안테나 패턴부 |
| | 40; 차폐층 | 50; NFC용 더미패턴부 |
| | 60; WPT용 안테나 패턴부 | |

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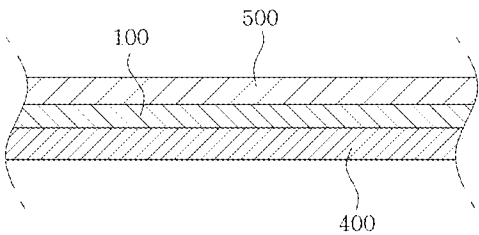
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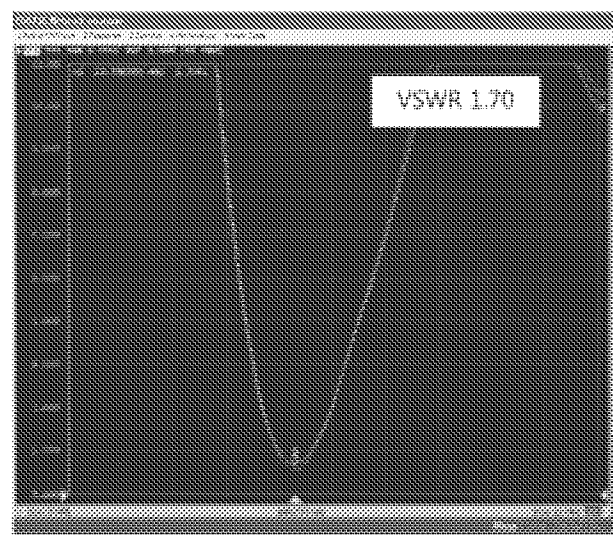


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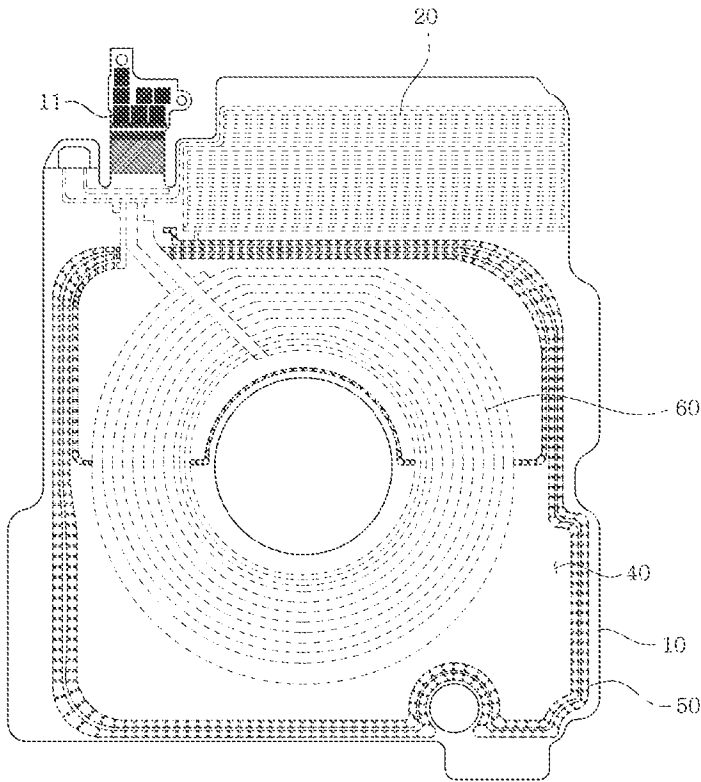


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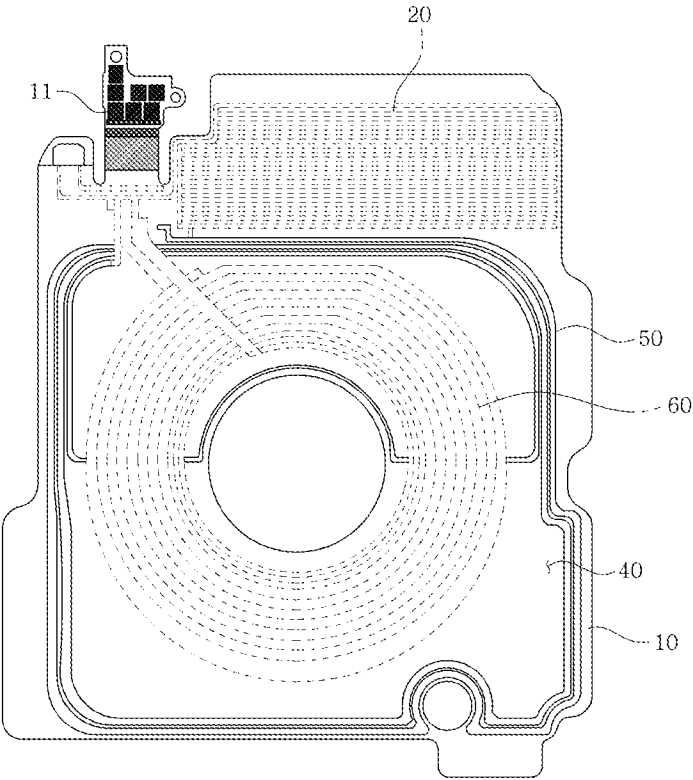
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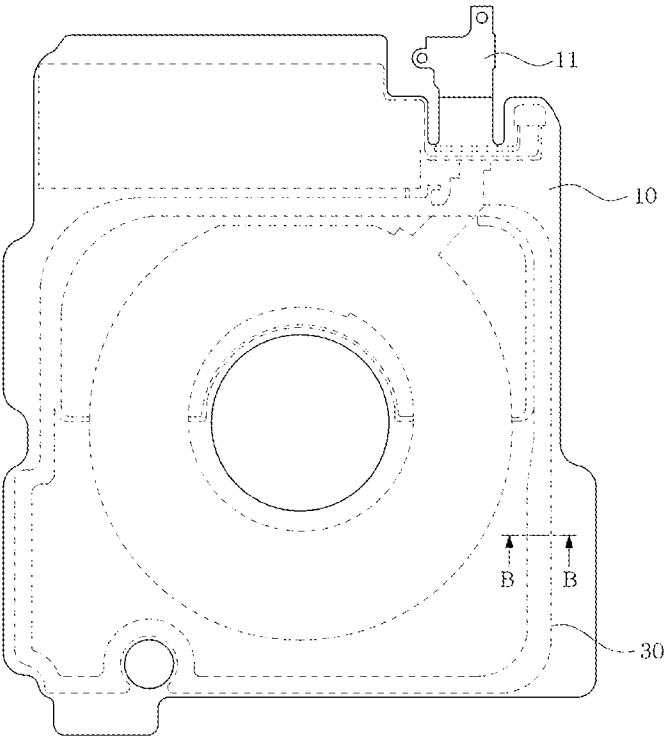
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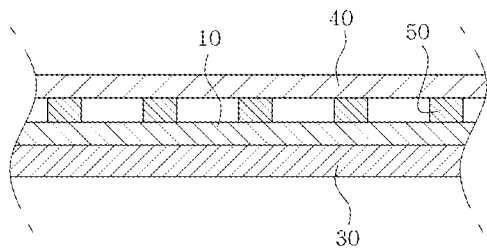
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도면7

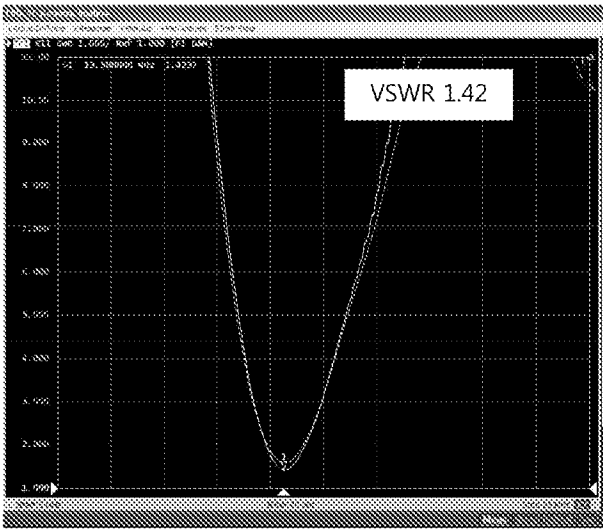


도면8



도면9

더미패턴 유(본 발명)



Flexible electromagnetic wave-absorption sheet for complex communication antenna and receiving module for wireless charger by magnetic induction

List of publications

Publication date

Application number 2016KR-0141258 Date 2016-10-27 Register

KR10-2018-0046243 A Published application 2018-05-08

English Title

Flexible electromagnetic wave-absorption sheet for complex communication antenna and receiving module for wireless charger by magnetic induction

Other Title 복합통신안테나용 플렉서블 전자파 흡수시트, 이를 포함하는 자기유도방식 무선충전용 수신모듈

English Abstract (Native or MT)

The present invention relates to a flexible electromagnetic wave absorption sheet for a complex communication antenna and a receiving module for magnetic induction-based wireless charging including the same. In particular, the present invention relates to a flexible electromagnetic wave absorption sheet for a complex communication antenna, which improves the intensity of each frequency of a multi-communication antenna having two or more kinds of signals for each communication frequency, such as wireless power charging (WPC), near field communication (NFC), Wi-Fi, PMA, 2G, 3G, LTE, etc., while being thinned compared to a conventional electromagnetic absorption sheet, and is applied to a receiving module for magnetic induction-based wireless charging to enhance charging efficiency; and a receiving module for magnetic induction-based wireless charging including the same. Here, the flexible electromagnetic wave absorption sheet comprises first and second electromagnetic wave absorption layers. The receiving module is suitable for application to a flexible small electronic device such as a smartphone, a phablet, a tablet, a smart watch, smart clothes, etc.

Other Abstracts

본 발명은 복합통신안테나용 플렉서블 전자파 흡수시트, 이를 포함하는 자기유도방식 무선충전용 수신모듈에 관한 것으로서, 좀 더 구체적으로 설명하면, 기존 전자파 흡수시트 보다

박편화 되어 있으면서도 WPC, NFC, MST, Wi-Fi, PMA, 2G, 3G, LTE 등 통신 주파수별 신호 2종 이상을 갖는 다중 통신안테나의 각 주파수별 강도를 개선하면서도, 자기유도방식 무선충전의 수신모듈에 적용하여 충전 효율을 증대시킬 수 있는 플렉서블 전자파 흡수시트, 이를 포함하는 자기유도방식 무선충전용 수신모듈에 관한 것이며, 상기 수신모듈은 플렉서블 소형 전자기기(스마트폰, 패블릿, 태블릿, 스마트워치, 스마트 의류 등)에 적용하기에 적합한 발명에 관한 것이다.

Application Language KOREAN (KOR)

Inventor(s) JUNG, Chul Hwa

SHIN, UN SEO

CHEON HAN JIN

LEE, SANGWON

KIM, YONG-WOO

KIM, JAEYOUNG

Inventor(s) 정철화

신운서

천한진

이상원

김용우

김재영

Applicant/Assignee

DOOSUNG INDUSTRIAL

owned by CHIL SUNG INDUSTRIAL

Assignee 두성산업 주식회사

Reg. Nb: 120070230217

Applicant/Assignee Address DOOSUNG INDUSTRIAL CO.,LTD , 120070230217

Patent Assignee History DOOSUNG INDUSTRIAL CO.,LTD

Representative ERUUM & LEEON INTELLECTUAL PROPERTY LAW FIRM

Reg. Nb: 920161000615

Representative Address ERUUM & LEEON INTELLECTUAL PROPERTY LAW FIRM , 920161000615

Representative 특허법인이룸리온

Reg. Nb: 920161000615

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Telecommunications

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CPC codes

C08K-003/10 C08K-003/34 H01Q-017/00* H05K-009/00/88

CPC codes history

C08K-003/10 C08K-003/34 H01Q-017/00* H05K-009/00/88

Notes Number of Claims: 15

Description

TECHNICAL FIELD

[0001] The present invention relates to a wireless power charging (wpc), near field communication (NFC), Wi-Fi, magnetic secure transmission (MST), 2G, 3G, Disclosed are a flexible electromagnetic wave absorbing sheet for a composite communication antenna, which can improve strength per frequency of each of two or more types of multi-communication antennas signal per communication frequency such as LTE, and

can increase charging efficiency by being applied to a receiving module of self-induction type wireless charging, and a receiving module for self-induction type wireless charging using the same.

BACKGROUND ART

[0002] Recently, as industry developments have increased use of digital electronic devices, digital electronic devices are becoming highlighted, highlighted, and highlighted at circuit signal processing speeds of electronic devices, and demands for miniaturization, lightweight, and thinning of product sizes are becoming further accelerated. As circuits are multilayered and densified to accommodate these needs, problems due to serious electromagnetic waves have emerged as new interest.

[0003] In particular, the amount of exposure of electromagnetic waves to the human body has also increased as portable electronic equipment increases with miniaturization, lightweight, and thinning. As such research results for human body hazard appearing when electromagnetic waves are exposed to the human body, research for regulating adverse effects on electromagnetic waves is actively underway in advanced countries. With many problems arising from electromagnetic waves, the product itself generating electromagnetic waves in accordance with KS (Korean Industrial Standards) is stipulated to produce the product by defining limitations on the product itself, and in an advanced station, regulations (EMI, Electromagnetic interference) as well as electromagnetic susceptibility (EMS) that does not cause malfunction even when receiving electromagnetic waves from the outside are examined. As an example of a countermeasure for suppressing electromagnetic wave interference and adverse effects, development of high-performance sheets for absorbing electromagnetic waves is actively driven, and some have already been practiced. Specifically, a conventional electromagnetic wave absorbing sheet mainly mixes soft magnetic metal powder or the like with an organic binder to prepare a slurry and then forms it into a sheet by itself, or coats the slurry on a polymer film such as a release treated pet film and the like, and then peels off the coating layer and then uses it as an electromagnetic wave absorbing agent. The electromagnetic wave absorbing sheet manufactured by the methods has a relatively low density, and thus there is a problem that excellent radio wave absorption characteristics and permeability are not realized.

[0004] Recently, various mobile terminals (for example, smartphones, PDAs, phablets, tablets, and the like) have been equipped with near field communication functions and wireless charging functions. in view of trying to solve security problems, wireless charging has been equipped with near field communication and wireless charging functions together with the mobile terminal in terms of convenience of user, and research and development continuously progress. However, in order to simultaneously perform near-field communication and wireless charging functions, a mobile terminal must be mounted with respective coils for near-field communication and wireless charging, and thus there is difficulty in mounting both functions together in light of the miniaturization of the mobile terminal. In order to fabricate a near-field communication antenna and a wireless charging antenna, separate magnetic sheets must be used, and small electronic

devices such as mobile terminals have a small size, so that one magnetic sheet needs to be used, and requests for these are increasing. However, when one magnetic sheet is used, it is difficult to satisfy all characteristics of the magnetic sheets necessary for near field communication (NFC) and wireless charging (wpc, PMA), and various problems may occur. Specifically, both functions of near field communication and wireless charging have a common point of using electromagnetic fields, but frequencies used with each other are different from each other, and generally, a frequency of 13.56 MHz is used for near field communication and a frequency of 100 to 205 kHz is used for wireless charging. Various problems may arise from the fact that the characteristics required for the communication method of the near-field communication antenna and the characteristics required for the wireless charging antenna must be satisfied in one layer, for example, A Ni-Zn ferrite sheet generally used in a near-field communication antenna has a disadvantage that the thickness of the sheet needs to be thick in order to satisfy electromagnetic characteristics necessary for wireless charging because magnetic permeability and saturation magnetic flux density are too low in a wireless charging frequency region. When the Mn-Zn ferrite sheet being used as a sheet for wireless charging is used as one sheet for short-range communication and wireless charging simultaneously, there is a problem in that it is difficult to implement short-range communication characteristics due to a large change in permeability in the 13.56 MHz region.

[0005] In addition, in recent years, mobile devices have reduced thickness along with miniaturization and demanding flexible characteristics, and components used therein must also have flaking and flexible characteristics, and existing electromagnetic wave absorbing sheets lack such characteristics, and thus have limitations on application thereof.

CITATION LIST

PATENT LITERATURE

[0007] Korean Registered Patent No. 10-0888048 (published March 10, 2009)
Korean Patent Publication No. 10-2015-0051953 issued May 13, 2015
Korean Registration No. 10-1458833 (published on February 31, 2014)

SUMMARY OF INVENTION

TECH PROBLEM

[0008] The present disclosure is designed to solve the problems of the related art, and the object of the present disclosure is to be solved by the present disclosure, and thus the present disclosure is flaked over existing electromagnetic wave absorbing sheets and has excellent electromagnetic wave absorption. Provided are a flexible electromagnetic wave absorbing sheet capable of protecting a circuit of a composite antenna such as an MST,

preventing mutual interference due to eddy currents, and improving inductance (Ls), and a receiving module for self-induction wireless charging using the same.

TECH SOLUTION

[0010] A flexible electromagnetic wave absorbing sheet for a composite communication antenna includes: a first electromagnetic wave absorbing layer including a mixture of sendust flakes and sendust powders, and a polymer binder resin; and a second electromagnetic wave absorbing layer including a powder including at least one selected from amorphous Fe-based powder, permalloy powder, and amorphous Cr-based alloy powder, and a polymer binder resin.

[0011] According to a preferred embodiment of the present disclosure, the flexible electromagnetic wave absorbing sheet of the present disclosure may be an electromagnetic wave absorbing sheet for a composite communication antenna including two or more antennas selected from a wireless power charging (wpc) antenna, a near field communication (NFC) antenna, and a magnetic secure transmission (MST) antenna.

[0012] According to a preferred embodiment of the present invention, the flexible electromagnetic wave absorbing sheet of the present invention may be integrally laminated with a second electromagnetic wave absorbing layer and a first electromagnetic wave absorbing layer in an upper end direction of the composite communication antenna.

[0013] In a preferred embodiment of the present invention, the sendust flakes and sendust powders of the first electromagnetic wave absorbing layer may be pulverized products of a sendust alloy including 75-10 % by weight of Fe, 1-10 % by weight of Si, and 1-15 % by weight of Al.

[0014] In a preferred embodiment of the present disclosure, the polymer binder resin of the first electromagnetic wave-absorbing layer and the second electromagnetic wave-absorbing layer may include one or more selected from silicone resin, urethane resin, rubber resin and acrylic resin.

[0015] In a preferred embodiment of the present disclosure, the first electromagnetic wave absorbing layer may include 65 % by weight to 95 % by weight of the mixture and 5 % by weight to 35 % by weight of a polymer binder resin.

[0016] In a preferred embodiment of the present disclosure, the amorphous Cr-based alloy powder of the second electromagnetic wave absorbing layer may include 65 % by weight to 95 % by weight of Fe, 2 % by weight to 15 % by weight of Si, and 1.5 % by weight to 20 % by weight of Cr.

[0017] In a preferred embodiment of the present disclosure, the second electromagnetic wave absorbing layer may include 65-80 % by weight of the powder and 20-35 % by weight of a polymer binder resin.

[0018] In a preferred embodiment of the present disclosure, the powder of the second electromagnetic wave absorbing layer may include amorphous Fe-based alloy powder and permalloy powder at a weight ratio of 1: 0.15 ~ 0.6.

[0019] In a preferred embodiment of the present disclosure, the powder of the second electromagnetic wave absorbing layer may include amorphous Cr-based alloy powder and permalloy powder at a weight ratio of 1: 0.08 ~ 0.4.

[0020] According to a preferred embodiment of the present disclosure, the second electromagnetic wave absorbing layer may further include platinum.

[0021] In a preferred embodiment of the present invention, the flexible electromagnetic wave absorbing sheet of the present invention may have a total thickness of 0.08 mm to 0.12 mm.

[0022] In a preferred embodiment of the present invention, in the flexible electromagnetic wave absorbing sheet of the present invention, the first electromagnetic wave absorbing layer and the second electromagnetic wave absorbing layer may have a thickness ratio of 1: 0.5 to 1.

[0023] In a preferred embodiment of the present invention, the flexible electromagnetic wave absorbing sheet of the present invention may have a permeability of 100 to 160, an inductance (Ls) in a frequency band of 100 kHz to 210 kHz of 6.50 to 7.20, and an inductance in a frequency band of 13.56 MHz of 2.00 to 2.20.

[0024] In a preferred embodiment of the present invention, the flexible electromagnetic wave absorbing sheet of the present invention may have an inductance (Ls) of 11.30 to 12.30 in the frequency band of the MST antenna.

[0026] Another object of the present invention is to relate to a receiving module for self-induction wireless charging, and includes various types of flexible electromagnetic wave absorbing sheets for composite communication antennas described above.

[0027] According to a preferred embodiment of the present invention, the receiving module for magnetic induction type wireless charging of the present invention is capable of NFC recognition even when a separation distance from the transmitting module for magnetic induction type wireless charging to the receiving module is 16.0 mm to 18.80 mm.

[0028] According to a preferred embodiment of the present invention, when a separation distance from a transmission module for magnetic induction type wireless charging of the present invention from the reception module for magnetic induction type wireless

charging is 16.0 mm to 18.80 mm, charging efficiency may be 95% or more when charging for 2 hours.

ADVANTAGEOUS EFFECTS

[0030] In order to solve the aforementioned problems of the present invention, the electromagnetic wave absorbing sheet has a thickness thinner than that of an existing electromagnetic wave absorbing sheet and has a proper permeability, so that antennas such as wpc, NFC, MST can prevent mutual interference due to eddy currents and improve inductance (Ls). When the electromagnetic wave absorbing sheet of the present invention is introduced into a receiving module for self-induction wireless charging to which a composite communication antenna including NFC and/or MST is applied, a high charging rate can be secured, and an NFC recognition distance can be increased compared to a receiving module including an NFC antenna to which an existing electromagnetic wave absorbing sheet is applied. In addition, since the electromagnetic wave absorbing sheet of the present invention is excellent in flexibility, it is suitable for application to modern flexible small electronic devices (smart phones, phablets, tablets, smart watches, smart clothing, and the like) in which flexibility is highly required.

DESCRIPTION OF DRAWINGS

[0032] Fig. 1 is one preferred embodiment of the electromagnetic wave absorbing sheet for a composite communication antenna of the present invention, and is a photograph taken of the electromagnetic wave absorbing sheet for a composite communication antenna prepared in Example 4. FIG. 2 is a schematic view of a reception module of a smartphone currently sold on the market used in experimental examples, FIG. 3 is a view of identifying an antenna applied to the reception module, in which 1 is a wpc antenna, 2 is an NFC antenna, 3 is an MST antenna, and after applying electromagnetic wave absorbing sheets of Examples and Comparative Examples to the top of the receiving module of FIG. 3, inductance, charging rate, and NFC recognition distance were measured. Figs. 4A and 4B are photographs taken of the measurement instrument used for NFC recognition distance and charging efficiency in Example 2. FIG. 5 is a graph in which the charging rate of a smartphone to which the electromagnetic wave absorbing sheet of Comparative Example 1 was applied was measured at 15 minute intervals. Fig. 6 is a graph in which the filling rate of a smartphone to which each of the electromagnetic wave absorbing sheets of Example 2, Example 4, Comparative Example 2, and Comparative Example 3 is applied is measured at 15 minute intervals.

DESCRIPTION OF EMBODIMENTS

[0033] Hereinafter, the present invention will be described in more detail.

[0034] The electromagnetic wave absorbing sheet of the present invention relates to an electromagnetic wave absorbing sheet which is flexible and thus applicable to flexible electronic and electric devices and to a composite communication antenna having various antennas, and more particularly, The electromagnetic wave absorbing sheet of the present

invention is a sheet in which a second electromagnetic wave absorbing layer and a first electromagnetic wave absorbing layer are laminated and integrated in the upper end direction of the composite communication antenna, and a photograph taken of the appearance of the electromagnetic wave absorbing sheet of the present invention is shown in FIG. 1.

[0035] According to the present disclosure, the first electromagnetic wave absorbing layer may include a mixture of sendust flakes and sendust powders, and a polymer binder resin, preferably, 65 % by weight to 95 % by weight of the mixture and 5 % by weight to 35 % by weight of the polymer binder resin, more preferably, 75 % by weight to 87 % by weight of the mixture and 13 % by weight to 25 % by weight of the polymer binder resin. In this case, when the content of the mixture is less than 65 % by weight, there may be a problem that proper inductance for the frequency band of 100 kHz to 210 kHz cannot be secured. when the content of the mixture is less than 65 % by weight, there may be a problem that a relatively small amount of the polymer binder resin is used to secure flexibility of the absorbent sheet, and there may be a problem that sendust powder falls from the sheet.

[0036] The sendust flakes and sendust powders in the first electromagnetic wave absorbing layer are pulverized products of sendust alloys containing 75-92% by weight of Fe, 1-10% by weight of Si and 1-15% by weight of Al, Si 3 to 7.5% by weight and Al 5 to 12% by weight, and more preferably Fe 84 to 88.5% by weight, Si 3 to 7.5% by weight and Al 5 to 12% by weight. In this case, when the sendust alloy deviates from the composition ratio, there may be a problem of not ensuring proper permeability in a range of 100 to 250. In addition, the sendust flakes and sendust powders may be used, each having an average particle diameter of 20 μ m to 150 μ m.

[0038] According to the present disclosure, the second electromagnetic wave absorbing layer includes: a powder including at least one selected from amorphous Fe-based powder, permalloy powder, and amorphous Cr-based alloy powder; and a polymer binder resin, Preferably 65 to 80 % by weight of the powder and 20 to 35 % by weight of a polymer binder resin, and more preferably 70 to 80 % by weight of the mixture and 20 to 30 % by weight of a polymer binder resin. In this case, when the content of the mixture is less than 65 % by weight, there may be a problem that proper inductance for the frequency band of 13.56 MHz cannot be secured. when the content of the mixture is less than 65 % by weight, there may be a problem that the amount of the polymer binder resin used is relatively small, thus making it difficult to secure flexibility of the absorbent sheet, and there may be a problem that amorphous Fe-based powder and the like fall from the sheet.

[0039] In the second electromagnetic wave absorbing layer, the powder may use a powder in which amorphous Fe-based alloy powder and permalloy powder are mixed at a weight ratio of 1: 0.15 to 0.6, preferably at a weight ratio of 1: 0.18 to 0.4, and more preferably at a weight ratio of 1: 0.18 to 0.35.

[0040] Further, in the second electromagnetic wave absorbing layer, the powder may use a powder in which amorphous Cr-based alloy powder and permalloy powder are mixed at a weight ratio of 1: 0.08 to 0.4, preferably, at a weight ratio of 1: 0.10 to 0.25, and more preferably, at a weight ratio of 1: 0.12 to 0.23. In addition, the amorphous Cr-based alloy powder is advantageous in terms of proper magnetic permeability to use an amorphous Cr-based alloy powder containing 65 to 95 % by weight of Fe, 2 to 15 % by weight of Si and 1.5 to 20 % by weight of Cr, preferably 82 to 87 % by weight of Fe, 4 to 8 % by weight of Si and 6 to 10 % by weight of Cr.

[0041] In addition, each of the amorphous Fe-based alloy powder, the permalloy powder and the amorphous Cr-based alloy powder is preferable in terms of even dispersion in the second electromagnetic wave absorbing layer to use those having an average particle diameter of 20 μm to 100 μm , preferably those having an average particle diameter of 20 μm to 80 μm , and more preferably those having an average particle diameter of 25 μm to 50 μm .

[0042] In addition, the second electromagnetic wave absorbing layer is for increasing the recognition distance such as RFID or NFC, and may further include platinum in addition to the powder and the polymer binder resin, and the content thereof may include 0.01 to 1 part by weight, preferably 0.02 to 0.7 parts by weight, and more preferably 0.020 to 0.5 parts by weight, based on 100 parts by weight of the powder. In this case, when the platinum content is less than 0.01 parts by weight, the amount of use thereof is too small to see a perceptual-distance-increasing effect, and when the platinum content is less than 0.01 parts by weight, it is preferable to use the same within the above range because it is a problem that economic efficiency is reduced by increasing manufacturing costs.

[0043] Further, although the polymer binder resins of the first electromagnetic wave absorbing layer and the second electromagnetic wave absorbing layer may use a general polymer binder resin used in the art, preferably, It is preferable to use at least one member selected from a rubber resin and an acrylic resin, and more preferably a silicone resin having favorable adhesion in terms of integration between the first electromagnetic wave-absorbing layer and the second electromagnetic wave-absorbing layer.

[0044] A first electromagnetic wave sheet constituting the first electromagnetic wave absorbing layer and a second electromagnetic wave sheet constituting the second electromagnetic wave absorbing layer described above are sheet-formed by a general method in the art, respectively, then the first electromagnetic wave sheet and the second electromagnetic wave sheet are laminated. The integrated flexible electromagnetic wave absorbing sheet can be manufactured by pressing at 150 to 200 kgf/cm² with a hot press of 150 °C. to 250 °C., preferably 180 °C. to 230 °C.

[0045] In addition, the first electromagnetic wave sheet and the second electromagnetic wave sheet may be laminated in multiple layers and then heat-pressed. in one example, each of the first electromagnetic wave sheet and the second electromagnetic wave sheet may be used as a layer, When expressed as Layer b, the a Layer-B Layer, the a Layer-B Layer -a Layer-B Layer, the a Layer-B Layer-A Layer-B Layer, the a Layer-B Layer-A

Layer-B Layer -a Layer-B Layer, and the like are laminated in this order, and then heat-pressed to produce an integrated flexible electromagnetic wave absorbing sheet.

[0046] The hot-pressed flexible electromagnetic wave-absorbing sheet can be rapidly cooled to produce a high-density flexible electromagnetic wave-absorbing sheet. At this time, the cooling means can cool the squeezing die by cooling water or cold air. In addition, the cooling may not be accomplished in the compression frame, but may also be accomplished by providing separate independent cooling and compression means.

[0048] The flexible electromagnetic wave absorbing sheet of the present invention manufactured by the above-described configuration and method can vary in thickness depending on the application product thereof, and in a preferred embodiment, the flexible electromagnetic wave absorbing sheet can be manufactured to have a total thickness of 0.08 mm to 0.12 mm when applied to a receiving module of a smartphone. The first electromagnetic wave absorbing layer and the second electromagnetic wave absorbing layer have a thickness ratio of 1: 0.5 to 1, preferably 1: 0.5 to 0.75, is advantageous in terms of proper permeability of the electromagnetic wave absorbing sheet, It is also advantageous in terms of 6.50 to 7.20 inductance in the 100 kHz to 210 kHz frequency band, 2.00 to 2.20 inductance in the 13.56 MHz frequency band, and 11.30 to 12.30 inductance in the MST frequency band.

[0049] The flexible electromagnetic wave absorbing sheet of the present invention is applied in an upper direction of a composite communication antenna including two or more antennas selected from a wireless power charging (wpc) antenna, a near field communication (NFC) antenna, and a magnetic secure transmission (MST) antenna, Here, the flexible electromagnetic wave absorbing sheet may be applied so that the second electromagnetic wave absorbing layer is positioned at a shortest distance from the composite communication antenna.

[0051] The reception module for magnetic induction type wireless charging using the flexible electromagnetic wave absorption sheet of the present invention includes a wireless power charging (wpc) antenna, A Near Field Communication (NFC) antenna and a magnetic secure transmission (MST) antenna, and preferably, the wpc antenna, NFC antenna and MST antenna may be included.

[0052] In addition, although the reception module for magnetic induction type wireless charging to which an existing electromagnetic wave absorption sheet is applied has an NFC recognition distance of 10 mm to less than 11 mm, the reception module for magnetic induction type wireless charging to which a flexible electromagnetic wave absorption sheet is applied can be NFC recognized even when a distance from the transmission module for magnetic induction type wireless charging to the reception module is 16.0 mm to 18.80 mm.

[0053] In addition, when charging for 2 hours at the separation distance, charging efficiency may have a high charging efficiency of 95% or more, preferably 98% or more.

[0055] The present invention will be described more particularly through the following examples. However, the following examples are intended to aid in understanding of the present disclosure, and should not be construed as limiting the present disclosure.

[0056] [Practical Examples]

[0057] Preparation Example 1-1: Preparation of electromagnetic wave absorbing sheet for wpc

[0058] Sendust flakes having a particle diameter of 20 μm to 100 μm and containing 87.5% by weight of Fe, 5.2% by weight of Si and 7.3% by weight of Al, and sendust powder mixed flakes and powders were prepared by grinding processing with an attack milling machine. Next, 85 % by weight of the mixture and 15 % by weight of a silicone resin as a polymer binder resin were mixed, and then processed into a sheet shape.

[0059] It was then prepared into an electromagnetic wave absorbing sheet for wpc having a thickness of 0.03 t by first curing by applying heat at 180 °C for 2 minutes in a pressurized state, and then secondarily curing by applying heat at 195 °C in an atmospheric pressure and air atmosphere.

[0061] Preparatory Example 1-2

[0062] An electromagnetic wave absorbing sheet for wpc was manufactured with the same method as Preparation Example 1-1 above, but was manufactured as an electromagnetic wave absorbing sheet for wpc having a thickness of 0.05 T.

[0064] Preparatory Examples 1-3

[0065] An electromagnetic wave absorbing sheet for wpc was manufactured with the same method as Preparation Example 1-1 above, but was manufactured as an electromagnetic wave absorbing sheet for wpc having a thickness of 0.06 T.

[0067] Preparatory Examples 1-4

[0068] An electromagnetic wave absorbing sheet for wpc was manufactured with the same method as Preparation Example 1-1 above, but was manufactured as an electromagnetic wave absorbing sheet for wpc having a thickness of 0.1 T.

[0070] Preparation Example 2-1: Preparation of electromagnetic wave absorbing sheet for NFC

[0071] Amorphous Fe-based powder having an average particle diameter of 32-38 μm and Permalloy powder 1: 0.2 weight ratio of 39-42 μm , and then pulverizedly processed with an Attrition Milling machine at a rotational speed of 480 rpm to prepare a mixture in which flakes and powder were mixed. Next, 74.97 wt.% of a powder mixture including the amorphous Fe-based powder and permalloy powder at a weight ratio of 1: 0.3 and 25

wt.% of a silicone resin as a polymer binder resin were mixed, and then processed into a sheet shape.

[0072] It was then prepared into an electromagnetic wave absorbing sheet for NFC having a thickness of 0.02 t by first curing by applying heat at 190 °C for 2 minutes in a pressurized state, and then second curing by applying heat at 210 °C in an atmospheric pressure and an air atmosphere. Where t is in mm.

[0074] Preparation Example 2-2

[0075] With the same method as in Preparation Example 2-1, an electromagnetic wave absorbing sheet for NFC was prepared, but was prepared as an electromagnetic wave absorbing sheet for NFC having a thickness of 0.04 T.

[0077] Preparation Example 3-1

[0078] An amorphous Cr-based alloy powder having a particle diameter of 30-50 μm and containing 84.7 % by weight Fe, 6.8 % by weight Si and 8.5 % by weight Cr, and a particle diameter of 30-70 μm were mixed at a permalloy powder 1: 0.15 weight ratio, which was then subjected to grinding processing with an attrition milling machine at a rotational speed of 480 rpm to prepare a mixture in which flakes and powders were mixed. Next, 73.25 wt.% of a powder mixture including the amorphous Fe and permalloy mixture at a weight ratio of 1: 0.5, 26.73 wt.% of a silicone resin as a polymer binder resin, and 0.02 wt.% of platinum were mixed, and then processed into a sheet shape.

[0079] It was then prepared into an electromagnetic wave absorbing sheet for NFC having a thickness of 0.02 t by first curing by applying heat at 190 °C for 2 minutes in a pressurized state, and then second curing by applying heat at 220 °C in an atmospheric pressure and an air atmosphere.

[0081] Preparatory Example 3-2

[0082] An electromagnetic wave absorbing sheet for NFC was manufactured with the same method as in Preparation Example 3-1 above, but was manufactured as an electromagnetic wave absorbing sheet for NFC having a thickness of 0.04 T.

[0084] Comparative Preparatory Example 1

[0085] Sendust flakes having a particle diameter of 20 μm to 100 μm and containing 87.5% by weight of Fe, 5.2% by weight of Si and 7.3% by weight of Al, and sendust powder mixed flakes and powders were prepared by grinding processing with an attack milling machine. Next, 85 % by weight of the mixture and 15 % by weight of a silicone resin as a polymer binder resin were mixed, and then processed into a sheet shape.

[0086] It was then prepared into an electromagnetic wave absorbing sheet for wpc having a thickness of 0.03 t by first curing by applying heat at 180 °C for 2 minutes in a

pressurized state, and then secondarily curing by applying heat at 195 °C in an atmospheric pressure and air atmosphere.

[0088] Comparative Preparatory Example 2

[0089] A sheet was prepared by the same method as Comparative Example 1, but an electromagnetic wave absorbing sheet for wpc having a thickness of 0.06 T.

[0091] Comparative Preparation Example 3

[0092] With the same method as in Preparation Examples 1-3, the electromagnetic wave absorbing sheet for wpc is prepared, wherein sendust flakes having a particle diameter of 20 μm to 100 μm and containing 76.8 % by weight Fe, 5.2 % by weight Si and 18 % by weight Al, and sendust powder a 0.06 t thick electromagnetic wave absorbing sheet for wpc was prepared by grinding with an attack milling machine using a mixed mixture of flakes and powders.

[0094] Comparative Preparation Example 4

[0095] With the same method as in Preparation Example 3-2 described above, an electromagnetic wave absorbing sheet for NFC was prepared, but using amorphous Cr-based alloy powder containing 71.8 % by weight Fe, 5.2 % by weight Si and 23 % by weight Al, and the permalloy powder for NFC.

TABLE 1

Electromagnetic wave absorber (fmp) for wpc	Thickness	Electromagnetic wave absorber (WP) for NFC	Thickness	Electromagnetic wave absorber (RQ) for NFC	Thickness
Preparation Example 1	10.03T	Preparation Example 2	10.02T	Preparation Example 3	10.02T
Preparatory Example 1	20.05T	Preparation Example 2	20.04T	Preparatory Example 3	20.04T
Preparatory Examples 1-3	0.06T	Preparatory Examples 1-3	0.06T	Preparatory Examples 1-3	0.06T
Electromagnetic wave absorber for wpc (N2)	Thickness	Electromagnetic wave absorber (WP) for NFC	Thickness	Electromagnetic wave absorber (RQ) for NFC	Thickness
Comparative Preparatory Example 10	0.03T	Comparative Preparatory Example 10	0.03T	Comparative Preparatory Example 10	0.03T
Comparative Preparatory Example 20	0.06T	Comparative Preparatory Example 20	0.06T	Comparative Preparatory Example 20	0.06T
Comparative Preparatory Example 30	0.06T	Comparative Preparatory Example 30	0.06T	Comparative Preparatory Example 30	0.06T

[0098] Example 2~ Example 4

[0099] Examples 2 to 4 were each performed by manufacturing an electromagnetic wave-absorbing sheet with the same method as Example 1, but different types of the second electromagnetic wave-absorbing layer and the first electromagnetic wave-absorbing layer as in Table 2 below.

[0101] Comparative Example 1

[0102] A sheet was prepared by separating an electromagnetic wave absorbing sheet from a receiving module of a state of the art smartphone (purchased November 2015) currently sold on the market, wherein the electromagnetic wave shielding sheet was a sheet of multilayer structure and had a thickness of 0.15 T.

[0104] Comparative Examples 2-7

[0105] An electromagnetic wave-absorbing sheet was manufactured by manufacturing an electromagnetic wave-absorbing sheet with the same method as in Example 1, but performing Comparative Examples 2 to 7 with different types of the second electromagnetic wave-absorbing layer and the first electromagnetic wave-absorbing layer as in Table 2 below.

[0107] Example 1: Preparation of Electromagnetic Wave Absorbing Sheet

[0108] A two-layer electromagnetic wave absorbing sheet (thickness 0.05 t) having a thickness of 0.05 t) was prepared by laminating the wpc electromagnetic wave absorbing sheet of Preparation Example 1-1 on one surface of the NFC electromagnetic wave absorbing sheet of Preparation Example 2-1, pressing with a press at a pressure of about 200 kgf/cm² under 210 °C, and then quenching the two sheets.

TABLE 2

Classification	Second electromagnetic wave absorbing layer (electromagnetic wave absorbing sheet for wpc)	First electromagnetic wave absorbing layer (electromagnetic wave absorbing sheet for NFC)	Overall Thickness
Example 1	Preparation Example 2-1 (0.02 t)	Preparation Example 1-1 (0.03 t)	0.05T
Ex.2	Preparation Example 2-1 (0.04 t)	Preparation Example 1-3 (0.06 t)	0.1T
Ex.3	Preparation Example 3-1 (0.02 t)	Preparation Example 1-1 (0.03 t)	0.05T
Ex.4	Preparatory Example 3-2 (0.04 t)	Preparation Example 1-3 (0.06 t)	0.05T
Comparative Example 1	0.15T	Comparative Example 2	Preparatory Example 1-2 (0.05 t)-0.05T
Comparative Example 3	Preparatory Example 1-4 (0.1 t)-0.1T	Comp.Ex.4	Preparation Example 3-1 (0.02 t)
Preparation Example 1-1	(0.03 t)	0.05T	CE5
Preparatory Example 3-2	(0.04 t)	Preparation Example 1-3	(0.06 t)
0.1T	Comp.6	Preparation Example 2-1	(0.04 t)
Comparative Preparation Example 3	(0.06 t)	0.1T	CE7
Comparative Preparation Example 4	(0.04 t)	Preparation Example 1-3	(0.06 t)
0.1T			

[0111] Experimental Example 1: Measurement of permeability and inductance of electromagnetic wave absorbing sheet

[0112] After each of the electromagnetic wave absorbing sheets of the above Examples and Comparative Examples was laminated to a receiving module (see Figs. 2 and 3) of the smartphone of Comparative Example 1 (purchased from November 2015), inductance was measured through measurement equipment and measurement method as follows, and the results thereof are shown in Table 3 below.

[0113] (1) Permeability Measurement

[0114] After a measurement sample was prepared by processing into a core having an outer diameter of 18 mm and an inner diameter of 7 mm, it was performed, and the permeability of the sample after test Fixture (16454 a) connection was measured. And permeability was Calibrated with Impedance Analyzer (E4991A).

[0115] (2) Inductance Measurement

[0116] The measuring instrument used HIOKI 3522-50 as the LCR meter (meter) machine, the Probe used HIOKI 9143, and the measuring method used the Probe of the LCR meter at 100.0 kHz, After graduating to 1 V, the electromagnetic wave absorbing sheet is fastened to the coil Rx Coil of the receiving module, and then the I/o terminals of the Rx coil were measured by probes, respectively, to check the inductance Ls value. At this time, inductance values were measured via the wpc antenna coil (1,1 'in FIG. 3), NFC antenna coil (2,2'), and Magnetic Secure Transmission (MST) antenna coil (3,3 ').

TABLE 3

Classification	Structure	Thickness (t=mm)	Permeability (μ')	Inductance (Ls, μ H)	WPC NFC
MST	Example 1	Two-layer Integration	0.05 T1206.361.9811.05	Ex.20.1	
	T1207.012.0811.95	Ex.3	Two-layer Integration	0.05 T1406.481.9811.24	Ex.40.1
	T1407.032.0312.11	Comparative Example 1	Multilayer	0.15	TUnmeasurable7.931.9512.89
	Comparative Example 2	Bilayer	0.05		
	T2206.762.0411.64	Comparative Example 3	0.1	T2207.292.1612.41	Comp.Ex.4
	Two-layer Integration	0.05	T655.671.910.04	CE50.1	T656.181.9810.85
	Comp.60.1				
	T1087.141.9211.37	CE70.1	T1026.452.0212.20		

[0119] In the case of the electromagnetic wave absorbing sheet of Comparative Example 1, the inner powder broken and crushed and unable to measure permeability. And for Comparative Example 6, the inductance value for the NFC antenna showed a low result when compared with Example 4, and for Comparative Example 7, the inductance value for the wpc antenna showed a low inductance value for the wpc antenna when compared with Example 2.

[0121] Experimental Example 2: Charging Efficiency and NFC Recognition Measurement

[0122] After applying the electromagnetic wave absorbing sheets of Examples 1 to 4 and Comparative Examples 1 to 5 to the smart phone used in the Experimental Example 1, the wireless charging efficiency and NFC recognition distance were measured, and the results are shown in Table 2 below.

[0123] Further, wireless charging efficiency measurement data of Examples 1-3 and Comparative Examples 1-2 are shown in figs. 5 and 6, respectively.

[0124] (1) Wireless Charging Efficiency Measurement

[0125] The wireless charging transmitter used the PV920I product, traverses the standard of electromagnetic wave absorbing sheets of Examples and Comparative Examples so that the longitudinal direction of the electromagnetic wave absorbing sheets was 50.8 mm × 62.2 mm, the electromagnetic wave absorbing sheets were fastened to the receiving module of the smartphone used in Experimental Example 1, and then the battery was set to 20% remaining amount.

[0126] Next, charging efficiency was measured at 15 minute intervals for 2 hours and graphs measured using a battery log program are shown in Figs. 5 and 6.

[0127] (1) NFC Recognition Measurement

[0128] To the same size as the wireless charging efficiency measurement, after cutting the electromagnetic wave absorbing sheets of the Examples and Comparative Examples, each of the electromagnetic wave absorbing sheets was fastened to a receiving module of the smartphone used in the Experimental Example 1.

[0129] And, the product name ACR112U-A2NR was used as the NFC reader, and a photograph thereof was shown in FIG. 4A, and a measurement device as shown in the photograph of FIG. 4B was used to measure the maximum distance at which NFC recognition was made while changing the distance interval between the smartphone and the NFC card reader, and the results are shown in Table 4 below.

TABLE 4

Classification	Structure	Thickness (t=mm)	Fill Factor (%)	NFC recognition maximum distance (mm)
Example 1	Two-layer Integration	0.05	T8310.56	Ex.20.1 T9818.02
Ex.3	Two-layer Integration	0.05	T8513.47	Ex.40.1 T9918.82
Comparative Example 1	Multilayer	0.15	T989.98	Comparative Example 21 Layer0.05 T8513.46
Comparative Example 30.1	T100	15.57	Comp.Ex.4	Two-layer Integration0.05 TUnfilled1.85
CE50.1	T88	11.74		

[0132] Looking at the experimental results of Table 2 above, there was poor filling factor of less than 90% for Practical Examples 1, 3 and 2 having a total thickness of 0.05 t, and there was a problem of not filling in Comparative Example 3.

[0133] However, for Practical Examples 2, 4, 1, and 2 in which the total thickness of the electromagnetic wave absorbing sheet is 0.1 t or more, the fill factor was 98% or more, and in particular, for Practical Examples 2 and 4, the NFC recognition maximum distance exhibited 16 mm or more, preferably 18 mm or more. In contrast, in the case of Comparative Example 1, the charging rate was good, but the NFC recognition maximum distance was very short less than 10 mm, and in the case of Comparative Example 2, the NFC recognition distance showed a short result when compared to Practical Examples 1

to 2, and in the case of Comparative Example 3, the charging rate and the NFC recognition maximum distance both showed poor results.

[0135] Through the above embodiments and experimental examples, it can be confirmed that the electromagnetic wave absorbing sheet of the present invention has proper permeability and high inductance, thereby improving the strength per frequency of each of two or more kinds of multi-communication antennas per communication frequency signals such as wpc, NFC, MST, and the like, thereby increasing the magnetic induction type wireless charging efficiency and increasing the NFC recognition distance. The electromagnetic wave absorbing sheet of the present invention is composed of only two layers and has excellent flexibility, and thus can be applied to electronic devices in which functions such as wpc, NFC, MST are combined, and further flexible electronic devices.

Description



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두성산업 주식회사

경기도 안산시 상록구 오목로13길 12 (본오동)

(72) 발명자

정철화

경기도 군포시 삼성로20번길 3-34 (부곡동)

신운서

경기도 안산시 상록구 오목로13길 12 (본오동)

(뒷면에 계속)

(74) 대리인

특허법인이플리온

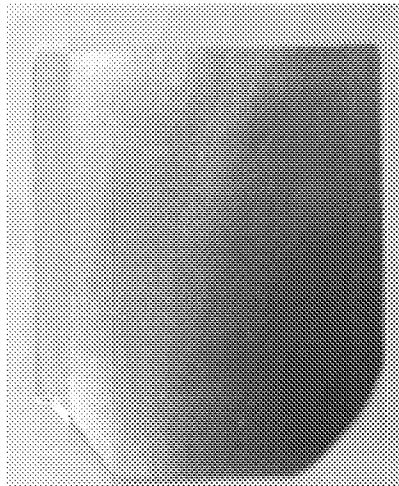
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(54) 발명의 명칭 복합통신안테나용 플렉서블 전자파 흡수시트, 이를 포함하는 자기유도방식 무선충전용 수신모듈

(57) 요약

본 발명은 복합통신안테나용 플렉서블 전자파 흡수시트, 이를 포함하는 자기유도방식 무선충전용 수신모듈에 관한 것으로서, 좀 더 구체적으로 설명하면, 기존 전자파 흡수시트 보다 박편화 되어 있으면서도 WPC, NFC, MST, Wi-Fi, PMA, 2G, 3G, LTE 등 통신 주파수별 신호 2종 이상을 갖는 다중 통신안테나의 각 주파수별 강도를 개선하면서도, 자기유도방식 무선충전의 수신모듈에 적용하여 충전 효율을 증대시킬 수 있는 플렉서블 전자파 흡수시트, 이를 이를 포함하는 자기유도방식 무선충전용 수신모듈에 관한 것이며, 상기 수신모듈은 플렉서블 소형 전자기기(스마트폰, 패블릿, 태블릿, 스마트워치, 스마트 의류 등)에 적용하기에 적합한 발명에 관한 것이다.

도 1



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(72) 발명자

천한진

경기도 군포시 산본천로 34-46, 636동 1306호 (산본동)

이상원

부산광역시 부산진구 엄광로 52-7 (개금동)

김용우

경기도 군포시 고산로517번길 20, 907동 1601호 (산본동, 금강1차아파트)

김재영

충청남도 부여군 부여읍 삼충로 205

명세서

청구범위

청구항 1

복합통신안테나용 플렉서블 전자과 흡수시트로서,

센더스트 플레이트와 센더스트 분말의 혼합물 및 고분자 바인더 수지를 포함하는 제1전자과 흡수층; 및

비정질 Fe계 분말, 퍼멀로이 분말 및 비정질 Cr계 합금분말 중에서 선택된 1종 이상을 포함하는 분말 및 고분자 바인더 수지를 포함하는 제2전자과 흡수층;을 포함하며,

상기 복합통신안테나는 WPC(Wireless Power Charging) 안테나, NFC(Near Field Communication) 안테나 및 MST(magnetic secure transmission) 안테나 중에서 선택된 2종 이상의 안테나를 포함하는 것을 특징으로 하는 복합통신안테나용 플렉서블 전자과 흡수시트.

청구항 2

제1항에 있어서, 복합통신안테나의 상단 방향으로 제2전자과 흡수층 및 제1전자과 흡수층이 적층 및 일체화되어 있는 것을 특징으로 하는 복합통신안테나용 플렉서블 전자과 흡수시트.

청구항 3

제1항에 있어서, 상기 센더스트 플레이트 및 센더스트 분말은

Fe 75 ~ 92 중량%, Si 1 ~ 10 중량% 및 Al 1 ~ 15 중량%를 포함하는 센더스트 합금의 분쇄물인 것을 특징으로 하는 복합통신안테나용 플렉서블 전자과 흡수시트.

청구항 4

제1항에 있어서, 상기 제1전자과 흡수층 및 제2전자과 흡수층의 고분자 바인더 수지는 실리콘 수지, 우레탄 수지, 고무 수지 및 아크릴 수지 중에서 선택된 1종 이상을 포함하는 것을 특징으로 하는 복합통신안테나용 플렉서블 전자과 흡수시트.

청구항 5

제1항에 있어서, 상기 제1전자과 흡수층은 상기 혼합물 65 ~ 95 중량% 및 고분자 바인더 수지 5 ~ 35 중량%를 포함하는 것을 특징으로 하는 복합통신안테나용 플렉서블 전자과 흡수시트.

청구항 6

제1항에 있어서, 상기 비정질 Cr계 합금분말은 Fe 65 ~ 95 중량%, Si 2 ~ 15 중량% 및 Cr 1.5 ~ 20 중량%를 포함하는 것을 특징으로 하는 복합통신안테나용 플렉서블 전자과 흡수시트.

청구항 7

제1항에 있어서, 제2전자과 흡수층은 상기 분말 65 ~ 80 중량% 및 고분자 바인더 수지 20 ~ 35 중량%를 포함하는 것을 특징으로 하는 복합통신안테나용 플렉서블 전자과 흡수시트.

청구항 8

제7항에 있어서, 상기 제2전자와 흡수층은 백금을 더 포함하는 것을 특징으로 하는 복합통신안테나용 플렉서블 전자파 흡수시트.

청구항 9

제7항에 있어서, 상기 분말은 비정질 Fe계 합금분말 및 퍼멀로이 분말을 1 : 0.15 ~ 0.6 중량비로 포함하는 것을 특징으로 하는 복합통신안테나용 플렉서블 전자파 흡수시트.

청구항 10

제7항에 있어서, 상기 분말은 비정질 Cr계 합금분말 및 퍼멀로이 분말을 1 : 0.08 ~ 0.4 중량비로 포함하는 것을 특징으로 하는 복합통신안테나용 플렉서블 전자파 흡수시트.

청구항 11

제1항에 있어서, 전자파 흡수시트의 전체 두께는 0.08 mm ~ 0.12 mm이고,

상기 제1전자와 흡수층 및 제2전자와 흡수층은 1 : 0.5 ~ 1의 두께비를 갖는 것을 특징으로 하는 복합통신안테나용 플렉서블 전자파 흡수시트.

청구항 12

제1항에 있어서, 투자율이 100 ~ 160이고,

100 kHz ~ 210 kHz 주파수 대역에 대한 인덕턴스(Ls)가 6.50 ~ 7.20이고,

13.56 MHz 주파수 대역에 대한 인덕턴스가 2.00 ~ 2.20인 것을 특징으로 하는 복합통신안테나용 플렉서블 전자파 흡수시트.

청구항 13

제12항의 복합통신안테나용 플렉서블 전자파 흡수시트를 포함하는 자기유도방식 무선충전용 수신모듈.

청구항 14

제13항에 있어서, 자기유도방식 무선충전용 송신모듈로부터 상기 수신모듈과의 이격거리 16.0mm ~ 18.80 mm에서 NFC 인식이 가능한 자기유도방식 무선충전용 수신모듈.

청구항 15

제15항에 있어서, 상기 이격거리에서 2시간 충전시, 충전효율이 95% 이상인 것을 특징으로 하는 자기유도방식 무선충전용 수신모듈.

발명의 설명

기술 분야

[0001] 본 발명은 WPC(Wireless Power Charging), NFC(Near Field Communication), Wi-Fi, MST(magnetic secure transmission), 2G, 3G, LTE 등 통신 주파수별 신호 2종 이상의 다중 통신안테나의 각 주파수별 강도를 개선할 수 있고, 자기유도방식 무선충전의 수신모듈에 적용하여 충전 효율을 증대시킬 수 있는 복합통신안테나용 플렉서블 전자파 흡수시트 및 이를 이용한 자기유도방식 무선충전용 수신모듈에 관한 것이다.

배경기술

[0002] 최근, 산업의 발달로 디지털 전자기기의 사용이 증대되고 있고, 디지털 전자기기는 전자장치의 회로 신호처리속도의 고속화, 고주파화, 고기능화 되고 있으며, 제품 크기도 소형화, 경량화, 박형화에 대한 요구가 더욱 가속화되고 있다. 이들 요구에 부응하기 위하여 회로가 다층화, 고밀화됨에 따라, 심각한 전자파로 인한 문제가 새로운 관심의 대상으로 등장하게 되었다.

[0003] 특히, 소형화, 경량화, 박형화로 휴대용 전자기기가 증가함에 따라 전자파가 인체에 노출되는 양도 증가하였다. 이러한 전자파가 인체에 노출되었을 때 나타나는 인체 유해성에 대한 연구결과가 발표됨에 따라 선진국에서는 전자파에 대한 악영향을 규제하기 위한 연구가 활발히 진행되고 있다. 전자파에 대한 많은 문제가 제기되면서 국내에서는 한국공업규격(KS)에 의거하여 전자파를 발생하는 제품 자체에서 그 한계를 정하여 제품을 생산하도록 규정하고 있으며, 선진국에서는 전자파 발생을 제한하는 규제(EMI, electromagnetic interference)뿐만 아니라 외부로부터 전자파를 받아들여도 오동작을 일으키지 않도록 하는 전자파 내성(EMS, electromagnetic susceptibility)까지도 제품의 규격에 포함시킬 것을 검토하고 있다. 이에 맞는 전자파 간섭과 악영향을 억제하기 위한 대책의 일례로 전자파를 흡수하는 고성능 시트 개발이 활발하게 추진되고 있으며, 일부는 이미 실용화되고 있다. 구체적으로 종래의 전자파 흡수시트는 주로 연자성체 금속분말 등을 유기 박인터와 혼합하고 슬러리를 제조한 후 이를 그 자체로 시트로 성형하거나, 이형처리된 PET 필름 등의 고분자 필름에 슬러리를 코팅하고 성형 후 코팅층을 박리하여 이를 전자파 흡수체로 사용하였다. 이러한 방법들을 통해 제조된 전자파 흡수시트는 상대적으로 밀도가 낮아 우수한 전파흡수 특성 및 투자율이 구현되지 않는 문제가 있다.

[0004] 근래에 각종 휴대 단말기(예를 들면, 스마트폰, PDA, 패블릿, 태블릿 등)에 근거리 통신 기능과 무선 충전 기능이 탑재되고 있는데, 근거리 통신은 보안 문제를 해결하려는 측면에서, 무선 충전은 사용자의 편리성 측면에서 근거리 통신과 무선 충전 기능을 함께 휴대 단말기에 탑재되고 있으며, 이에 대한 연구 개발이 지속적으로 진행되고 있다. 그런데, 근거리 통신 및 무선 충전 기능을 동시에 위해서는 휴대 단말기에 근거리 통신과 무선 충전을 위한 각각의 코일을 탑재하여야 하는바, 휴대 단말기의 소형성에 비추어 두 가지 기능을 함께 탑재하는 데 어려움이 있다. 근거리 통신 안테나 및 무선 충전 안테나를 제작하기 위해서는 각각 별도의 자성 시트를 사용해야 하는데, 휴대 단말기 등의 소형 전자기기는 그 크기가 작기 때문에 1 개의 자성 시트를 사용할 필요가 있으며 이에 대한 요청이 증대되고 있다. 그러나 1 개의 자성 시트를 사용하는 경우에는 근거리 통신(NFC) 및 무선충전(WPC, PMA)에 필요한 자성 시트의 특성을 모두 만족시키기 어려우며 여러 가지 문제점이 발생할 수 있다. 구체적으로, 근거리 통신과 무선 충전 두 기능 모두 전자기장을 활용하는 공통점을 가지고 있으나, 서로 사용하는 주파수가 서로 다르며, 일반적으로 근거리 통신에는 13.56MHz 주파수를 이용하고 무선 충전에는 100 ~ 205 kHz를 이용하는데, 근거리 통신용 안테나의 통신방식과 무선 충전용 안테나에 필요한 특성을 한 개의 층(layer)으로 구성하기 위해서는 이 두 주파수에서의 특성을 모두 만족해야 한다는 점으로부터 여러 가지 문제점이 발생할 수 있으며, 예를 들어, 일반적으로 근거리 통신용 안테나에 사용되는 Ni-Zn 페라이트(ferrite) 시트는 무선 충전 주파수 영역에서는 투자율 및 포화자속밀도 등이 너무 낮기 때문에 무선 충전에 필요한 전자기적 특성을 만족시키기 위하여는 시트의 두께가 두꺼워져야 한다는 단점이 있고, 무선 충전용 시트로 사용되는 Mn-Zn 페라이트 시트를 근거리 통신 및 무선 충전 동시 구현용 1 장의 시트로 사용하는 경우에는 13.56MHz 영역에서 투자율의 변화가 많아 근거리 통신 특성을 구현하기 어려운 문제가 있다.

[0005] 또한, 최근 모바일 기기는 소형화와 함께 그 두께가 얇아지고, 플렉서블(flexible)한 특성이 요구되고 있는 바, 이에 사용되는 부품 또한 박편화 및 플렉서블한 특성을 가져야 하는데, 기존의 전자파 흡수시트는 이러한 특성이 부족하여 그 적용의 한계가 있었다.

선행기술문헌

특허문헌

[0007] (특허문헌 0001) 대한민국 등록특허 제10-0888048호(공고일 2009.03.10)

(특허문헌 0002) 대한민국 공개특허 제10-2015-0051953호(공개일 2015.05.13)

(특허문헌 0003) 대한민국 등록특허 제10-1458833호(공고일 2014.10.31)

발명의 내용

해결하려는 과제

- [0008] 본 발명은 상기와 같은 문제점을 해결하기 위하여 안출된 것으로, 본 발명이 해결하려는 과제는 기존의 전자파 흡수시트 보다 박편화되면서도 전자파 흡수가 우수하여, WPC, NFC, MST 등의 복합안테나의 회로 보호, 와전류로 인한 상호간섭 방지 및 인덕턴스(Ls)를 향상시킬 수 있는 플렉서블 전자파 흡수시트, 이를 이용한 자기유도방식 무선충전용 수신모듈을 제공하고자 한다.

과제의 해결 수단

- [0010] 상기 과제를 해결하기 위한 본 발명은 복합통신안테나용 플렉서블 전자파 흡수시트로서, 샌더스트 플레이크와 샌더스트 분말의 혼합물 및 고분자 바인더 수지를 포함하는 제1전자파 흡수층; 및 비정질 Fe계 분말, 퍼멀로이 분말 및 비정질 Cr계 합금분말 중에서 선택된 1종 이상을 포함하는 분말 및 고분자 바인더 수지를 포함하는 제2 전자파 흡수층;을 포함한다.
- [0011] 본 발명의 바람직한 일실시예로서, 본 발명의 플렉서블 전자파 흡수시트는 WPC(Wireless Power Charging) 안테나, NFC(Near Field Communication) 안테나 및 MST(magnetic secure transmission) 안테나 중에서 선택된 2종 이상의 안테나를 포함하는 복합통신안테나용 전자파 흡수시트일 수 있다.
- [0012] 본 발명의 바람직한 일실시예로서, 본 발명의 플렉서블 전자파 흡수시트는 복합통신안테나의 상단 방향으로 제2 전자파 흡수층 및 제1전자파 흡수층이 적층되어 일체화되어 있을 수 있다.
- [0013] 본 발명의 바람직한 일실시예로서, 제1전자파 흡수층의 상기 샌더스트 플레이크 및 샌더스트 분말은 Fe 75 ~ 92 중량%, Si 1 ~ 10 중량% 및 Al 1 ~ 15 중량%를 포함하는 샌더스트 합금의 분쇄물일 수 있다.
- [0014] 본 발명의 바람직한 일실시예로서, 상기 제1전자파 흡수층 및 제2전자파 흡수층의 고분자 바인더 수지는 실리콘 수지, 우레탄 수지, 고무 수지 및 아크릴 수지 중에서 선택된 1종 이상을 포함할 수 있다.
- [0015] 본 발명의 바람직한 일실시예로서, 상기 제1전자파 흡수층은 상기 혼합물 65 ~ 95 중량% 및 고분자 바인더 수지 5 ~ 35 중량%를 포함할 수 있다.
- [0016] 본 발명의 바람직한 일실시예로서, 제2전자파 흡수층의 상기 비정질 Cr계 합금분말은 Fe 65 ~ 95 중량%, Si 2 ~ 15 중량% 및 Cr 1.5 ~ 20 중량%를 포함할 수 있다.
- [0017] 본 발명의 바람직한 일실시예로서, 제2전자파 흡수층은 상기 분말 65 ~ 80 중량% 및 고분자 바인더 수지 20 ~ 35 중량%를 포함할 수 있다.
- [0018] 본 발명의 바람직한 일실시예로서, 제2전자파 흡수층의 상기 분말은 비정질 Fe계 합금분말 및 퍼멀로이 분말을 1 : 0.15 ~ 0.6 중량비로 포함할 수 있다.
- [0019] 본 발명의 바람직한 일실시예로서, 제2전자파 흡수층의 상기 분말은 비정질 Cr계 합금분말 및 퍼멀로이 분말을 1 : 0.08 ~ 0.4 중량비로 포함할 수 있다.
- [0020] 본 발명의 바람직한 일실시예로서, 제2전자파 흡수층은 백금을 더 포함할 수 있다.
- [0021] 본 발명의 바람직한 일실시예로서, 본 발명의 플렉서블 전자파 흡수시트의 전체 두께는 0.08 mm ~ 0.12 mm일 수 있다.
- [0022] 본 발명의 바람직한 일실시예로서, 본 발명의 플렉서블 전자파 흡수시트에 있어서, 상기 제1전자파 흡수층 및 제2전자파 흡수층은 1 : 0.5 ~ 1의 두께비를 갖을 수 있다.
- [0023] 본 발명의 바람직한 일실시예로서, 본 발명의 플렉서블 전자파 흡수시트 투자율이 100 ~ 160이고, 100 kHz ~ 210 kHz 주파수 대역에 대한 인덕턴스(Ls)가 6.50 ~ 7.20이고, 13.56 MHz 주파수 대역에 대한 인덕턴스가 2.00

~ 2.20일 수 있다.

[0024] 본 발명의 바람직한 일실시예로서, 본 발명의 플렉서블 전자과 흡수시트는 MST 안테나의 주파수 대역에서 인덕턴스(Ls)가 11.30 ~ 12.30일 수 있다.

[0026] 본 발명의 다른 목적은 자기유도방식 무선충전용 수신모듈에 관한 것으로서, 앞서 설명한 다양한 형태의 복합통신안테나용 플렉서블 전자과 흡수시트를 포함한다.

[0027] 본 발명의 바람직한 일실시예로서, 본 발명의 자기유도방식 무선충전용 수신모듈은 자기유도방식 무선충전용 송신모듈로부터 상기 수신모듈과의 이격거리가 16.0mm ~ 18.80 mm일 때도 NFC 인식이 가능하다.

[0028] 본 발명의 바람직한 일실시예로서, 본 발명의 자기유도방식 무선충전용 수신모듈은 자기유도방식 무선충전용 송신모듈로부터 상기 수신모듈과의 이격거리가 16.0mm ~ 18.80 mm일 때, 2시간 충전시, 충전효율이 95% 이상일 수 있다.

발명의 효과

[0030] 본 발명의 상술한 과제를 해결하기 위해 본 발명은 전자과 흡수시트는 기존 전자과 흡수시트 보다 두께가 얇고 적정 투자율을 갖는 바, WPC, NFC, MST 등의 안테나가 와전류로 인한 상호간섭 방지 및 인덕턴스(Ls)를 향상시킬 수 있으며, 나아가 WPC, NFC 및/또는 MST 등을 포함하는 복합통신안테나가 적용된 자기유도방식 무선충전용 수신모듈에 본 발명의 전자과 흡수시트 도입시, 높은 충전율을 확보할 수 있으면서도, 기존 전자과 흡수시트를 적용한 NFC 안테나를 포함하는 수신모듈 보다 NFC 인식거리를 증가시킬 수 있는 효과가 있다. 또한, 본 발명의 전자과 흡수시트는 유연성도 우수하기 때문에, 유연성이 크게 요구되는 최신 플렉서블 소형 전자기기(스마트폰, 패블릿, 태블릿, 스마트워치, 스마트 의류 등)에 적용하기에 적합하다.

도면의 간단한 설명

[0032] 도 1은 본 발명의 복합통신안테나용 전자과 흡수시트의 바람직한 일실시예로서, 실시예 4에서 제조한 복합통신안테나용 전자과 흡수시트를 찍은 사진이다.

도 2는 실험예에서 사용한 현재 시중에 판매되고 있는 스마트폰의 수신모듈의 개략도이며, 도 3은 수신모듈에 적용된 안테나를 확인할 수 있는 도면으로서, 도 3에서 1은 WPC 안테나이고, 2는 NFC 안테나이며, 3은 MST 안테나이고, 도 3의 수신모듈 상단에 실시예 및 비교예의 전자과 흡수시트를 적용한 후, 인덕턴스, 충전율 및 NFC 인식거리를 측정하였다.

도 4a 및 도 4b는 실험예 2에서 NFC 인식 거리 및 충전 효율에 사용된 측정기기를 찍은 사진이다.

도 5는 비교예 1의 전자과 흡수시트를 적용한 스마트폰의 충전율을 15분 간격으로 측정한 그래프이다.

도 6은 실시예 2, 실시예 4, 비교예 2 및 비교예 3의 전자과 흡수시트 각각을 적용한 스마트폰의 충전율을 15분 간격으로 측정한 그래프이다.

발명을 실시하기 위한 구체적인 내용

[0033] 이하, 본 발명을 보다 상세하게 설명한다.

[0034] 본 발명의 전자과 흡수시트는 플렉서블(flexible)하며 플렉서블 전자, 전자기기에 적용이 가능하면서도 다양한 안테나를 구비한 복합통신안테나에 적용이 가능한 전자과 흡수시트에 관한 것으로서, 본 발명의 전자과 흡수시트는 복합통신안테나의 상단 방향으로 제2전자과 흡수층 및 제1전자과 흡수층이 적층되어 일체화된 형태의 시트이며, 본 발명의 전자과 흡수시트의 외관을 찍은 사진을 도 1에 나타내었다.

[0035] 본 발명에 있어서, 상기 제1전자과 흡수층은 셀러스트 플라이크와 셀러스트 분말의 혼합물 및 고분자 바인더 수지를 포함하며, 바람직하게는 상기 혼합물 65 ~ 95 중량% 및 고분자 바인더 수지 5 ~ 35 중량%를, 더욱 바람직하게는 상기 혼합물 75 ~ 87 중량% 및 고분자 바인더 수지 13 ~ 25 중량%를 포함할 수 있다. 이때, 혼합물의 함량이 65 중량% 미만이면 100 kHz ~ 210 kHz 주파수 대역에 대한 적정 인덕턴스를 확보할 수 없는 문제가 있을

수 있고, 95 중량%를 초과하면 상대적으로 고분자 바인더 수지의 사용량이 너무 적어서 흡수시트의 가요성을 확보하기 어렵고, 샌더스트 분말이 시트로부터 떨어지는 문제가 있을 수 있다.

[0036] 제1전자와 흡수층에서 상기 샌더스트 플레이크 및 샌더스트 분말은 Fe 75 ~ 92 중량%, Si 1 ~ 10 중량% 및 Al 1 ~ 15 중량%를 포함하는 샌더스트 합금의 분쇄물이며, 바람직하게는 Fe 82 ~ 90 중량%, Si 3 ~ 7.5 중량% 및 Al 5 ~ 12 중량%를, 더욱 바람직하게는 Fe 84 ~ 88.5 중량%, Si 3 ~ 7.5 중량% 및 Al 5 ~ 12 중량%를 포함하는 샌더스트 합금의 분쇄물일 수 있다. 이때, 상기 샌더스트 합금이 상기 조성비를 벗어나는 경우, 100 ~ 250 범위의 적정 투자율을 확보하지 못하는 문제가 있을 수 있다. 그리고, 샌더스트 플레이크 및 샌더스트 분말 각각은 평균입경 20 μ m ~ 150 μ m인 것을 사용할 수 있다.

[0038] 본 발명에 있어서, 상기 제2전자와 흡수층은 비정질 Fe계 분말, 퍼멀로이 분말 및 비정질 Cr계 합금분말 중에서 선택된 1종 이상을 포함하는 분말; 및 고분자 바인더 수지;를 포함하며, 바람직하게는 상기 분말 65 ~ 80 중량% 및 고분자 바인더 수지 20 ~ 35 중량%를, 더욱 바람직하게는 상기 혼합물 70 ~ 80 중량% 및 고분자 바인더 수지 20 ~ 30 중량%를 포함할 수 있다. 이때, 혼합물의 함량이 65 중량% 미만이면 13.56 MHz 주파수 대역에 대한 적정 인덕턴스를 확보할 수 없는 문제가 있을 수 있고, 80 중량%를 초과하면 상대적으로 고분자 바인더 수지의 사용량이 너무 적어서 흡수시트의 가요성을 확보하기 어렵고, 비정질 Fe계 분말 등이 시트로부터 떨어지는 문제가 있을 수 있다.

[0039] 상기 제2전자와 흡수층에서 상기 분말은 비정질 Fe계 합금분말 및 퍼멀로이 분말을 1 : 0.15 ~ 0.6 중량비로, 바람직하게는 1 : 0.18 ~ 0.4 중량비로, 더욱 바람직하게는 1 : 0.18 ~ 0.35 중량비로 혼합한 분말을 사용할 수 있다.

[0040] 또한, 상기 제2전자와 흡수층에서 상기 분말은 비정질 Cr계 합금분말 및 퍼멀로이 분말을 1 : 0.08 ~ 0.4 중량비로, 바람직하게는 1 : 0.10 ~ 0.25 중량비로, 더욱 바람직하게는 1 : 0.12 ~ 0.23 중량비로 혼합한 분말을 사용할 수도 있다. 그리고, 상기 비정질 Cr계 합금분말은 Fe 65 ~ 95 중량%, Si 2 ~ 15 중량% 및 Cr 1.5 ~ 20 중량%를, 바람직하게는 Fe 82 ~ 87 중량%, Si 4 ~ 8 중량% 및 Cr 6 ~ 10 중량%로 포함하는 비정질 Cr계 합금분말을 사용하는 것이 적정 투자율 확보면에서 유리하다.

[0041] 그리고, 상기 비정질 Fe계 합금분말, 퍼멀로이 분말 및 비정질 Cr계 합금분말 각각은 평균입경 20 μ m ~ 100 μ m인 것을, 바람직하게는 평균입경 20 μ m ~ 80 μ m인 것을, 더욱 바람직하게는 25 μ m ~ 50 μ m인 것을 사용하는 것이 제2전자와 흡수층 내 고른 분산 측면에서 바람직하다.

[0042] 또한, 제2전자와 흡수층은 RFID, NFC 같은 인식거리를 증대하기 위한 것으로서, 상기 분말 및 고분자 바인더 수지 외에 백금을 더 포함할 수 있으며, 그 함량은 상기 분말 100 중량부에 대하여, 0.01 ~ 1 중량부를, 바람직하게는 0.02 ~ 0.7 중량부를, 더욱 바람직하게는 0.020 ~ 0.5 중량부를 포함할 수 있다. 이때, 백금 함량이 0.01 중량부 미만이면 그 사용량이 너무 적어서 인식거리 증대 효과를 볼 수 없고, 1 중량부를 초과하면 제조 단가 증대로 경제성이 떨어지는 문제가 있으므로 상기 범위 내에서 사용하는 것이 좋다.

[0043] 그리고, 제1전자와 흡수층 및 제2전자와 흡수층의 상기 고분자 바인더 수지는 당업계에서 사용하는 일반적인 고분자 바인더 수지를 사용할 수 있으나, 바람직하게는 실리콘 수지, 우레탄 수지, 고무 수지 및 아크릴 수지 중에서 선택된 1종 이상을, 더욱 바람직하게는 제1전자와 흡수층과 제2전자와 흡수층간의 일체화 측면에서 접착력이 유리한 실리콘 수지를 사용하는 것이 좋다.

[0044] 앞서 설명한 제1전자와 흡수층을 구성하는 제1전자와 시트 및 제2전자와 흡수층을 구성하는 제2전자와 시트 각각을 당업계의 일반적인 방법으로 시트화 하여 제조한 후, 제1전자와 시트 및 제2전자와 시트를 적층시킨 후, 150 $^{\circ}$ C ~ 250 $^{\circ}$ C, 바람직하게는 180 $^{\circ}$ C ~ 230 $^{\circ}$ C의 가열 프레스로 150 ~ 200 kgf/cm ^{2} 로 가압하여 일체화된 플렉서블 전자와 흡수시트를 제조할 수 있다.

[0045] 또한, 상기 제1전자와 시트 및 제2전자와 시트를 다층으로 적층시킨 후, 가열 프레스시킬 수도 있으며, 일례를 들면, 제1전자와 시트 및 제2전자와 시트 각각을 A층, B층으로 표현하면 A층-B층, A층-B층-A층-B층, A층-B층-A층-B층-A층-B층 등의 순으로 적층시켜서 다층화시킨 후, 가열 프레스하여 일체화된 플렉서블 전자와 흡수시트를 제조할 수 있다.

[0046] 그리고, 가열 프레스(pressing)한 플렉서블 전자와 흡수시트를 급격하게 냉각시켜서 고밀도의 플렉서블 전자와 흡수시트를 제조할 수 있다. 이때, 냉각 수단은 냉각수, 또는 냉풍에 의해 압착들을 냉각시킬 수 있다. 또한 상

기 냉각은 압착을 내에서 이루어지지 않고 별도의 독립된 냉각 압착수단을 구비함으로써 이루어질 수도 있다.

[0048] 앞서 설명한 구성 및 방법으로 제조한 본 발명의 플렉서블 전자파 흡수시트는 그 적용 제품에 따라 두께를 달리 할 수 있으며, 바람직한 일례로, 스마트폰의 수신모듈에 적용시에는 전체 두께가 0.08 mm ~ 0.12 mm이 되도록 제조할 수 있다. 그리고, 제1전자파 흡수층 및 제2전자파 흡수층은 1 : 0.5 ~ 1의 두께비를 갖는 것이, 바람직 하계는 1 : 0.5 ~ 0.75의 두께비를 갖는 것이 전자파 흡수시트의 적정 투자율 측면에서 유리하며, 또한 100 kHz ~ 210 kHz 주파수 대역에서의 6.50 ~ 7.20의 인덕턴스, 13.56 MHz 주파수 대역에서 2.00 ~ 2.20의 인덕턴스 및 MST 주파수 대역에서 11.30 ~ 12.30 인덕턴스 확보면에서 유리하다.

[0049] 이러한, 본 발명의 플렉서블 전자파 흡수시트는 WPC(Wireless Power Charging) 안테나, NFC(Near Field Communication) 안테나 및 MST(magnetic secure transmission) 안테나 중에서 선택된 2종 이상의 안테나를 포 함하는 복합통신안테나의 상단 방향에 적용시키며, 이때, 복합통신안테나와 최단 근접거리에 제2전자파 흡수층 이 위치하도록 플렉서블 전자파 흡수시트를 적용할 수 있다.

[0051] 본 발명의 상기 플렉서블 전자파 흡수시트를 적용한 자기유도방식 무선충전용 수신모듈은 WPC(Wireless Power Charging) 안테나, NFC(Near Field Communication) 안테나 및 MST(magnetic secure transmission) 안테나 중예 서 선택된 2종 이상의 안테나를 포함하며, 바람직하게는 WPC 안테나, NFC 안테나 및 MST 안테나를 모두 포함할 수 있다.

[0052] 그리고, 기존 전자파 흡수시트를 적용한 자기유도방식 무선충전용 수신모듈은 NFC 인식거리가 10mm ~ 11mm 미만 이지만, 본 발명의 플렉서블 전자파 흡수시트를 적용한 자기유도방식 무선충전용 수신모듈은 자기유도방식 무선 충전용 송신모듈로부터 상기 수신모듈과의 이격거리가 16.0mm ~ 18.80 mm일 때도 NFC 인식이 가능하다.

[0053] 또한, 상기 이격거리에서 2시간 충전시, 충전효율이 95% 이상, 바람직하게는 98% 이상의 높은 충전효율을 가질 수도 있다.

[0055] 이하 실시예를 통하여 본 발명을 더욱 구체적으로 설명을 한다. 그러나, 하기 실시예는 본 발명의 이해를 돕기 위한 것으로서, 이에 본 발명을 한정하여 해석해서는 안된다.

[0056] [실시예]

[0057] 준비예 1-1 : WPC용 전자파 흡수시트의 제조

[0058] Fe 87.5 중량%, Si 5.2 중량% 및 Al 7.3 중량%로 포함하는 입경 20 μ m ~ 100 μ m의 섀터스트 플레이크 및 섀터스트 분말을 어트리션 밀링 머신으로 분쇄 가공하여 플레이크와 분말이 혼재된 혼합물을 준비하였다. 다음으로 상기 혼합물 85 중량% 및 고분자 바인더 수지인 실리콘 수지를 15량%를 혼합한 후, 이를 시트 형상으로 가공하였다.

[0059] 다음으로 이를 가압 상태에서 180℃의 열을 2분 동안 열을 가하여 1차 경화시킨 다음, 대기압 및 공기 분위기예 서 195℃의 열을 가하여 2차 경화시켜서, 0.03T 두께의 WPC용 전자파 흡수시트로 제조하였다.

[0061] 준비예 1-2

[0062] 상기 준비예 1-1과 동일한 방법으로 WPC용 전자파 흡수시트를 제조하되, 0.05T 두께의 WPC용 전자파 흡수시트로 제조하였다.

[0064] 준비예 1-3

[0065] 상기 준비예 1-1과 동일한 방법으로 WPC용 전자파 흡수시트를 제조하되, 0.06T 두께의 WPC용 전자파 흡수시트로 제조하였다.

[0067] 준비예 1-4

- [0068] 상기 준비예 1-1과 동일한 방법으로 WPC용 전자과 흡수시트를 제조하되, 0.1T 두께의 WPC용 전자과 흡수시트로 제조하였다.
- [0070] 준비예 2-1 : NFC용 전자과 흡수시트의 제조
- [0071] 평균입경 $32\mu\text{m} \sim 38\mu\text{m}$ 의 비정질 Fe계 분말 및 평균입경 $39\mu\text{m} \sim 42\mu\text{m}$ 의 퍼멀로이 분말 1 : 0.2 중량비로 혼합한 후, 이를 어트리션 밀링(Attrition Milling) 머신으로 회전속도 480 rpm 조건에서 분쇄 가공하여 플레이크와 분말이 혼재된 혼합물을 준비하였다. 다음으로 상기 비정질 Fe계 분말 및 퍼멀로이 분말을 1 : 0.3 중량비로 포함하는 분말 혼합물 74.97 중량%, 고분자 바인더 수지인 실리콘 수지 25 중량% 혼합한 후, 이를 시트 형상으로 가공하였다.
- [0072] 다음으로 이를 가압 상태에서 190°C 의 열을 2분 동안 열을 가하여 1차 경화시킨 다음, 대기압 및 공기 분위기에서 210°C 의 열을 가하여 2차 경화시켜서, 0.02T 두께의 NFC용 전자과 흡수시트로 제조하였다. 여기서 T는 mm 단위이다.
- [0074] 준비예 2-2
- [0075] 상기 준비예 2-1과 동일한 방법으로 NFC용 전자과 흡수시트를 제조하되, 0.04T 두께의 NFC용 전자과 흡수시트로 제조하였다.
- [0077] 준비예 3-1
- [0078] Fe 84.7 중량%, Si 6.8 중량% 및 Cr 8.5 중량%로 포함하는 입경 $30\mu\text{m} \sim 50\mu\text{m}$ 의 비정질 Cr계 합금분말 및 입경 $30\mu\text{m} \sim 70\mu\text{m}$ 의 퍼멀로이 분말 1 : 0.15 중량비로 혼합한 후, 이를 어트리션 밀링 머신으로 회전속도 480 rpm 조건에서 분쇄 가공하여 플레이크와 분말이 혼재된 혼합물을 준비하였다. 다음으로 상기 비정질 Fe 및 퍼멀로이 혼합물을 1 : 0.5 중량비로 포함하는 분말 혼합물 73.25 중량%, 고분자 바인더 수지인 실리콘 수지 26.73 중량% 및 백금 0.02 중량%를 혼합한 후, 이를 시트 형상으로 가공하였다.
- [0079] 다음으로 이를 가압 상태에서 190°C 의 열을 2분 동안 열을 가하여 1차 경화시킨 다음, 대기압 및 공기 분위기에서 220°C 의 열을 가하여 2차 경화시켜서, 0.02T 두께의 NFC용 전자과 흡수시트로 제조하였다.
- [0081] 준비예 3-2
- [0082] 상기 준비예 3-1과 동일한 방법으로 NFC용 전자과 흡수시트를 제조하되, 0.04T 두께의 NFC용 전자과 흡수시트로 제조하였다.
- [0084] 비교준비예 1
- [0085] Fe 87.5 중량%, Si 5.2 중량% 및 Al 7.3 중량%로 포함하는 입경 $20\mu\text{m} \sim 100\mu\text{m}$ 의 샌더스트 플레이크 및 샌더스트 분말을 어트리션 밀링 머신으로 분쇄 가공하여 플레이크와 분말이 혼재된 혼합물을 준비하였다. 다음으로 상기 혼합물 85 중량% 및 고분자 바인더 수지인 실리콘 수지를 15 중량%를 혼합한 후, 이를 시트 형상으로 가공하였다.
- [0086] 다음으로 이를 가압 상태에서 180°C 의 열을 2분 동안 열을 가하여 1차 경화시킨 다음, 대기압 및 공기 분위기에서 195°C 의 열을 가하여 2차 경화시켜서, 0.03T 두께의 WPC용 전자과 흡수시트로 제조하였다.
- [0088] 비교준비예 2
- [0089] 비교준비예 1과 동일한 방법으로 시트를 제조하되, 0.06T 두께의 WPC용 전자과 흡수시트를 제조하였다.

[0091] 비교준비예 3

[0092] 상기 준비예 1-3과 동일한 방법으로 WPC용 전자과 흡수시트를 제조하되, Fe 76.8 중량%, Si 5.2 중량% 및 Al 18 중량%로 포함하는 입경 20 μ m ~ 100 μ m의 샌더스트 플레이크 및 샌더스트 분말을 어트리션 밀링 머신으로 분쇄 가공하여 플레이크와 분말이 혼합된 혼합물을 사용하여 0.06T 두께의 WPC용 전자과 흡수시트로 제조하였다.

[0094] 비교준비예 4

[0095] 상기 준비예 3-2와 동일한 방법으로 NFC용 전자과 흡수시트를 제조하되, Fe 71.8 중량%, Si 5.2 중량% 및 Al 23 중량%로 포함하는 비정질 Cr계 합금분말 및 상기 퍼멀로이 분말을 사용하여, 0.02T 두께의 NFC용 전자과 흡수시트로 제조하였다.

표 1

WPC용 전자과흡수 채(FMP)	두께	NFC용 전자과흡수 채(WP)	두께	NFC용 전자과흡수 채(RQ)	두께
준비예 1-1	0.03T	준비예 2-1	0.02T	준비예 3-1	0.02T
준비예 1-2	0.05T	준비예 2-2	0.04T	준비예 3-2	0.04T
준비예 1-3	0.06T	-	-	-	-
준비예 1-4	0.1T	-	-	-	-
WPC용 전자과흡수 채(N2)	두께	NFC용 전자과흡수 채(WP)	두께	NFC용 전자과흡수 채(RQ)	두께
비교준비예1	0.03T	-	-	비교준비예4	0.04T
비교준비예2	0.06T	-	-	-	-
비교준비예3	0.06T	-	-	-	-

[0093] 실시예 2 ~ 실시예 4

[0099] 실시예 1과 동일한 방법으로 전자과 흡수시트를 제조하되 하기 표 2와 같이 제2전자과 흡수층 및 제1전자과 흡수층의 종류를 달리하여 실시예 2 ~ 4를 각각 실시하였다.

[0101] 비교예 1

[0102] 현재 시중에 판매되고 있는 최신행 스마트폰(구입시기:2015년 11월)의 수신모듈로부터 전자과 흡수시트를 분리하여 시트를 준비하였으며, 이때, 상기 전자과 차폐시트는 다층 구조의 시트였으며, 두께는 0.15T였다.

[0104] 비교예 2 ~ 비교예 7

[0105] 실시예 1과 동일한 방법으로 전자과 흡수시트를 제조하되, 하기 표 2와 같이 제2전자과 흡수층 및 제1전자과 흡수층의 종류를 달리하여 비교예 2 ~ 7을 각각 실시하여 전자과 흡수시트를 제조하였다.

[0107] 실시예 1 : 전자과 흡수시트의 제조

[0108] 상기 준비예 2-1의 NFC용 전자과 흡수시트의 일면에 상기 준비예 1-1의 WPC용 전자과 흡수시트를 적층시킨 후, 210℃ 하에서 프레스로 약 200 kgf/cm²의 압력으로 가압한 후, 급냉시켜 2 시트를 일체화시켜서 2층 구조의 전자과 흡수시트(두께 0.05T)를 제조하였다.

표 2

구분	제2전자과 흡수층 (WPC용 전자과 흡수시트)	제1전자과 흡수층 (NFC용 전자과 흡수시트)	전체두께
실시예 1	준비예 2-1 (0.02T)	준비예 1-1 (0.03T)	0.05T
실시예 2	준비예 2-1 (0.04T)	준비예 1-3 (0.06T)	0.1T

실시예 3	준비예 3-1 (0.02T)	준비예 1-1 (0.03T)	0.05T
실시예 4	준비예 3-2 (0.04T)	준비예 1-3 (0.06T)	0.05T
비교예 1	-		0.15T
비교예 2	준비예 1-2 (0.05T)	-	0.05T
비교예 3	준비예 1-4 (0.1T)	-	0.1T
비교예 4	준비예 3-1 (0.02T)	준비예 1-1 (0.03T)	0.05T
비교예 5	준비예 3-2 (0.04T)	준비예 1-3 (0.06T)	0.1T
비교예 6	준비예 2-1 (0.04T)	비교준비예 3 (0.06T)	0.1T
비교예 7	비교준비예 4 (0.04T)	준비예 1-3 (0.06T)	0.1T

[0111] 실험예 1 : 전자파 흡수시트의 투자율 및 인덕턴스 측정

[0112] 상기 실시예 및 비교예의 전자파 흡수시트 각각을 비교예 1의 상기 스마트폰(구입시기:2015년 11월)의 수신모듈(도 2 및 도 3 참조)에 적층시킨 후, 인덕턴스를 하기와 같은 측정장비 및 측정방법을 통해서 측정하였고, 그 결과를 하기 표 3에 나타내었다.

[0113] (1) 투자율 측정

[0114] 측정시료는 외경 18mm, 내경 7mm의 코어로 가공하여 준비한 후, 이를 하였으며, TEST Fixture(16454A) 연결 후 샘플의 투자율을 측정하였다. 그리고, 투자율은 임피던스 애널라이저(Impedance Analyzer, E4991A)로 보정을 실시(Calibration 설정)하였다.

[0115] (2) 인덕턴스 측정

[0116] 측정장비는 LCR 미터(METER)기로서 HIOKI 3522-50을 사용하였고, 프로브(Probe)는 HIOKI 9143를 사용하였으며, 측정방법은 LCR 미터기의 포로브(Probe)를 100.0kHz, 1V로 눈금을 맞춘 후, 수신모듈의 코일(Rx Coil)에 전자파 흡수시트를 체결한 다음, 프로브로 각각 Rx 코일의 I/O단자 측정하여 인덕턴스(Ls) 값을 확인하였다. 이때, WPC 안테나 코일(도 3의 1,1'), NFC 안테나 코일(2,2'), MST(Magnetic Secure Transmission) 안테나 코일(3,3')을 통해서 인덕턴스 값을 측정하였다.

표 3

구분	구조	두께 (T= mm)	투자율 (μ')	인덕턴스 (Ls, μH)		
				WPC	NFC	MST
실시예 1	2층 일체화	0.05 T	120	6.36	1.98	11.05
실시예 2		0.1 T	120	7.01	2.08	11.95
실시예 3	2층 일체화	0.05 T	140	6.48	1.98	11.24
실시예 4		0.1 T	140	7.03	2.03	12.11
비교예 1	다층	0.15T	측정불가	7.93	1.95	12.89
비교예 2	2층	0.05 T	220	6.76	2.04	11.64
비교예 3		0.1 T	220	7.29	2.16	12.41
비교예 4	2층 일체화	0.05 T	65	5.67	1.9	10.04
비교예 5		0.1 T	65	6.18	1.98	10.85
비교예 6		0.1 T	103	7.14	1.92	11.37
비교예 7		0.1 T	102	6.45	2.02	12.20

[0119] 비교예 1의 전자파 흡수시트의 경우, 내부 파우더가 깨지고, 으스러져서 투자율 측정이 불가능하였다. 그리고, 비교예 6의 경우, 실시예 4와 비교할 때, NFC 안테나에 대한 인덕턴스 수치가 낮은 결과를 보였으며, 비교예 7의 경우 실시예 2와 비교할 때, WPC 안테나에 대한 낮은 인덕턴스 수치를 보였다.

[0121] 실험예 2 : 충전효율 및 NFC 인식거리 측정

[0122] 상기 실험에 1에서 사용한 상기 스마트 폰에 상기 실시예 1 ~ 4 및 비교예 1 ~ 5의 전자파 흡수시트를 각각 적용한 후, 무선충전효율 및 NFC 인식거리를 측정하였으며, 그 결과를 하기 표 2에 나타내었다.

[0123] 또한, 실시예 1 ~ 3 및 비교예 1 ~ 2의 무선충전효율 측정 데이터를 도 5 및 도 6에 각각 나타내었다.

[0124] (1) 무선충전효율 측정

[0125] 무선충전 송신기는 PV920I 제품을 사용하였고, 실시예 및 비교예의 전자파 흡수시트 규격을 가로, 세로가 50.8mm×62.2mm 이 되도록 한 후, 이를 상기 실험에 1에서 사용한 스마트폰의 수신모듈에 상기 전자파 흡수시트 각각을 체결한 다음, 배터리가 잔량이 20% 되도록 세팅하였다.

[0126] 다음으로, 2시간 동안 15분 간격으로 충전효율을 측정하였고 배터리 로그 프로그램(battery log program)을 이용하여 측정한 그래프를 도 5 및 도 6에 나타내었다.

[0127] (1) NFC 인식거리 측정

[0128] 상기 무선충전효율 측정과 동일한 크기로 실시예 및 비교예의 전자파 흡수시트를 절단한 후, 상기 실험에 1에서 사용한 스마트폰의 수신모듈에 상기 전자파 흡수시트 각각을 체결하였다.

[0129] 그리고, NFC 리더기로는 상품명 ACR112U-A2NR을 사용하였으며, 이의 사진을 도 4a에 나타내었으며, 도 4b의 사진에 나타난 바와 같은 측정 장치를 이용하여 스마트폰과 NFC 카드 리더기와의 거리 간격에 변화를 주면서 NFC 인식이 되는 최대 거리를 측정하였으며, 그 결과를 하기 표 4에 나타내었다.

표 4

구분	구조	두께 (T= mm)	충전율(%)	NFC 인식 최대 거리(mm)
실시예 1	2층 일체화	0.05 T	83	10.56
실시예 2		0.1 T	98	18.02
실시예 3	2층 일체화	0.05 T	85	13.47
실시예 4		0.1 T	99	18.82
비교예 1	다층	0.15T	98	9.98
비교예 2	1층	0.05 T	85	13.46
비교예 3		0.1 T	100	15.57
비교예 4	2층 일체화	0.05 T	충전 안됨	1.85
비교예 5		0.1 T	88	11.74

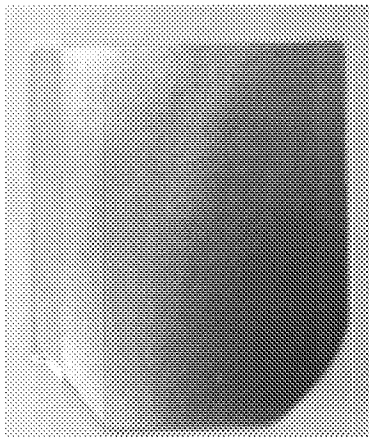
[0132] 상기 표 2의 실험결과를 살펴보면, 총 두께가 0.05T인 실시예 1, 실시예 3 및 비교예 2의 경우 충전율이 90% 미만으로 좋지 못했으며, 비교예 3의 경우 충전이 되지 않은 문제가 있었다.

[0133] 그러나, 전자파 흡수시트의 총 두께가 0.1T 이상인 실시예 2, 실시예 4, 비교예 1, 비교예 2의 경우, 충전율이 98% 이상이었으며, 특히, 실시예 2 및 실시예 4의 경우, NFC 인식 최대 거리가 16 mm 이상, 바람직하게는 18 mm 이상을 보였다. 이에 반해, 비교예 1의 경우, 충전율은 우수하나, NFC 인식 최대 거리가 10 mm 미만으로 매우 짧았으며, 1층인 비교예 2의 경우, 실시예 1 ~ 2와 비교할 때, NFC 인식 거리가 짧은 결과를 보였으며, 비교예 3의 경우, 충전율 및 NFC 인식 최대 거리가 모두 좋지 않은 결과를 보였다.

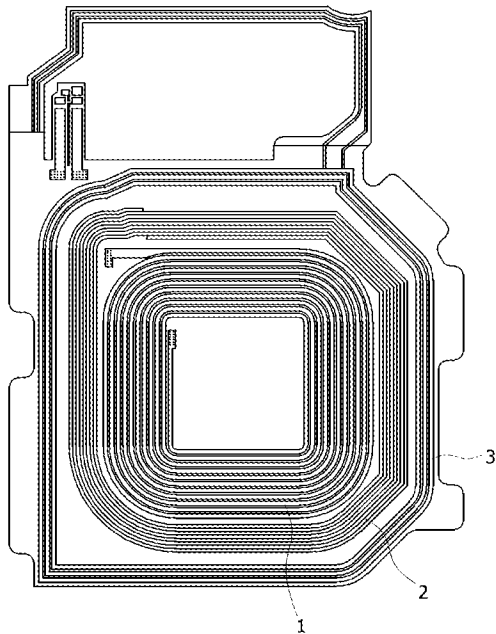
[0135] 상기 실시예 및 실험예를 통하여, 본 발명의 전자파 흡수시트가 적정 투자율 및 높은 인덕턴트를 가지고 있어서, WPC, NFC, MST 등 통신 주파수별 신호 2종 이상의 다중 통신안테나의 각 주파수별 강도를 개선시켜서, 자기유도방식 무선충전효율을 증대시킬 뿐만 아니라, NFC 인식 거리를 증대시킬 수 있음으로 확인할 수 있었다. 이러한, 본 발명의 전자파 흡수시트는 2개의 층으로만 구성되어 유연성도 우수한 바, WPC, NFC, MST 등의 기능이 복합화된 전자기기, 나아가 플렉서블 전자기기에 적용할 수 있다.

도면

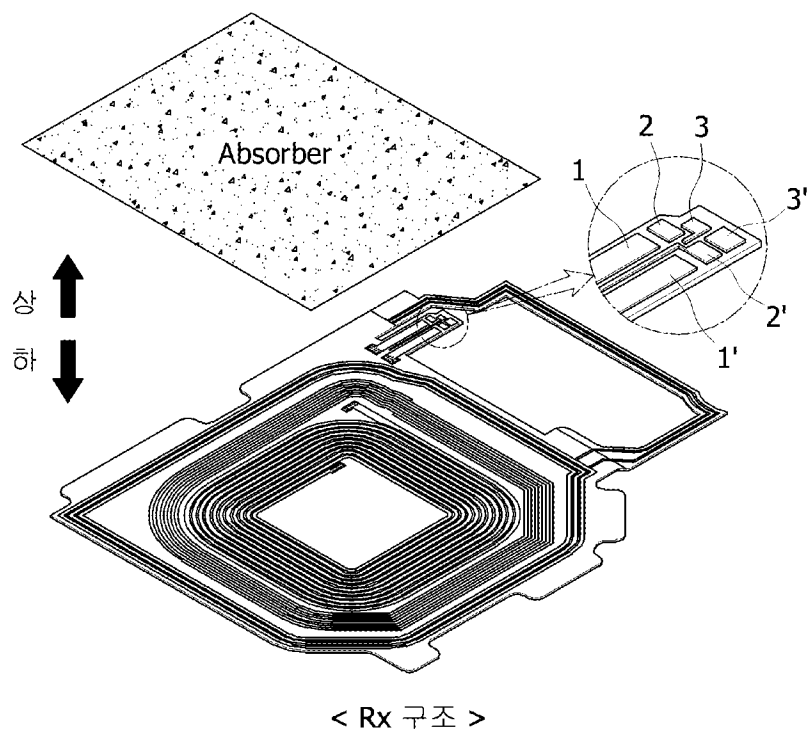
도면1



도면2



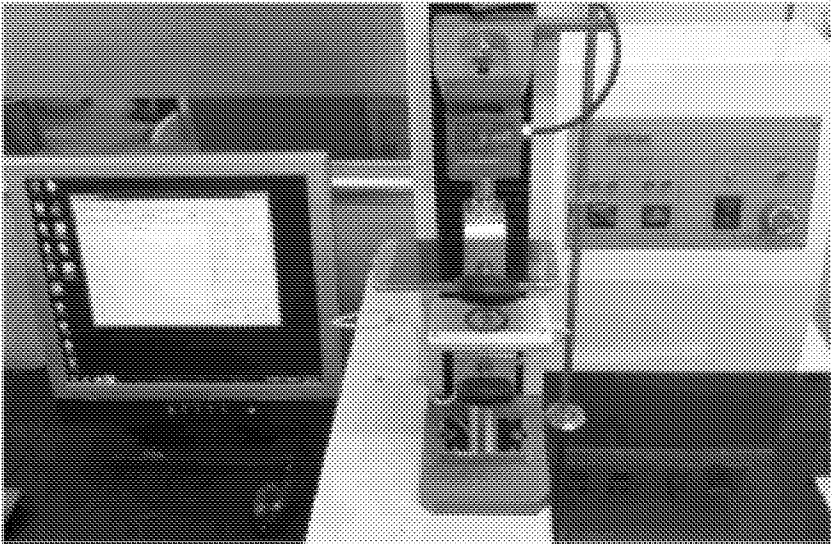
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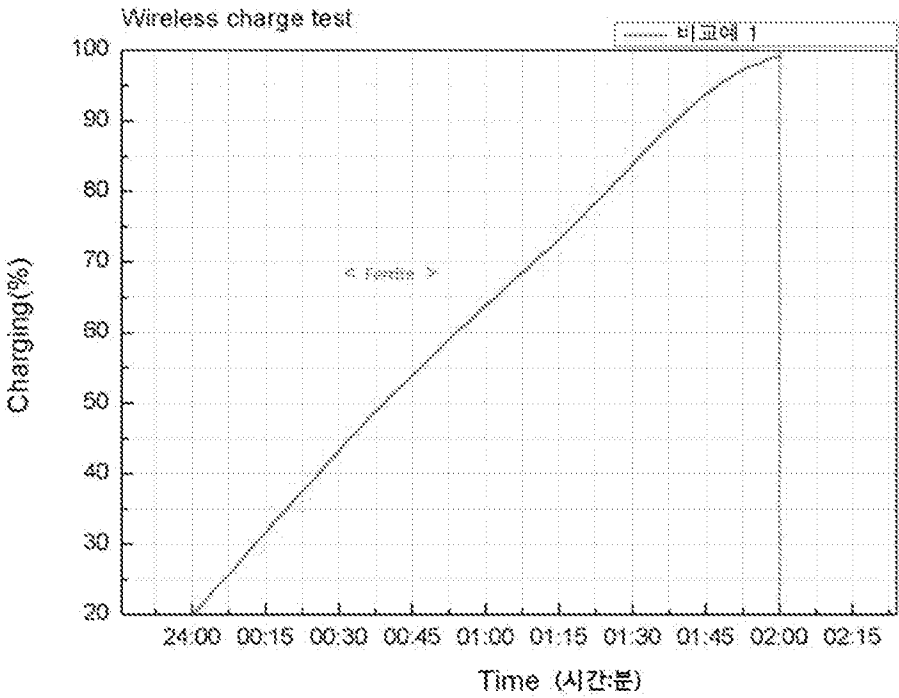
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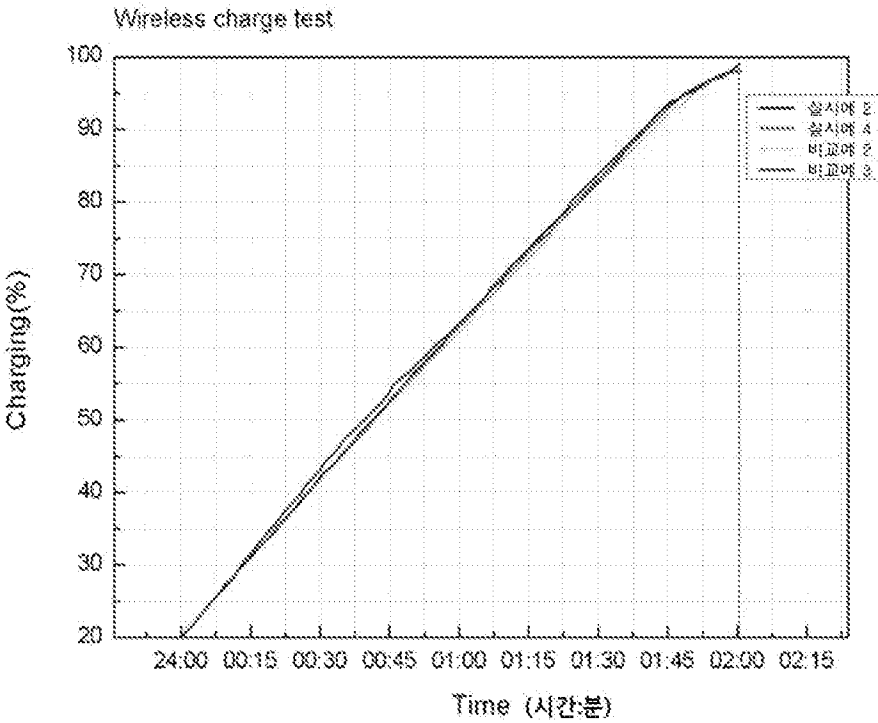
도면4b



도면5



도면6



Wireless charging transmission module for car

List of publications

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English Title

Wireless charging transmission module for car

Other Title 차량용 무선충전 송신모듈

English Abstract (Native or MT)

According to the present invention, provided is a wireless charging transmission module for a vehicle. According to one embodiment of the present invention, the module comprises: an antenna unit including a first wireless charging transmission antenna operated in a magnetic induction type, a second wireless charging transmission antenna operated in a magnetic resonance type, and a near field communication (NFC) antenna for short range communication; and a shield unit including a first sheet installed in a region corresponding to the first wireless charging transmission antenna to improve characteristics of the first wireless charging transmission antenna and a second sheet installed in a region corresponding to the second wireless charging transmission antenna to improve characteristics of the second wireless charging transmission antenna. One surface having the first wireless charging transmission antenna of the first sheet is installed to form a stepped surface having a height difference with respect to one surface having the second wireless charging transmission antenna of the second sheet. Thus, since two wireless charging transmission antennas having different charging types are installed at the same time, wireless charging can be performed in both of the magnetic induction and resonance types, so compatibility and use convenience can be increased. Moreover, since a separation distance between a contact surface in contact with a portable device to be charged and the corresponding wireless charging transmission antenna is differently set, charging efficiency of both of the magnetic induction and resonance type can be increased.

Other Abstracts

차량용 무선충전 송신모듈이 제공된다. 본 발명의 일 실시예에 의한 차량용 무선충전 송신모듈은 자기유도 방식으로 작동하는 제1무선충전용 안테나, 자기공진 방식으로 작동하는 제2무선충전용 안테나 및 근거리 데이터 통신을 위한 NFC 안테나가 구비되는 안테나유닛; 및 상기 제1무선충전용 안테나와 대응되는 영역에 배치되어 상기 제1무선충전용 안테나의 특성을 향상시키는 제1시트 및 상기 제2무선충전용 안테나와 대응되는 영역에 배치되어 상기 제2무선충전용 안테나의 특성을 향상시키는 제2시트가 구비되는 차폐유닛;을 포함하고, 상기 제1시트는 상기 제1무선충전용 안테나가 배치되는 일면이 상기 제2무선충전용 안테나가 배치되는 제2시트의 일면에 대하여 높이차를 갖는 단차면을 형성하도록 배치된다. 이에 의하면, 충전방식이 상이한 두 개의 무선충전용 안테나를 동시에 배치함으로써 자기유도방식과 자기공진방식을 모두 사용하여 무선충전을 수행할 수 있어 호환성을 높이고 사용편의성을 높일 수 있으며, 충전대상인 휴대기기가 접촉하는 접촉면과 해당 무선충전용 안테나와의 이격거리를 서로 다르게 배치함으로써 자기유도방식과 자기공진방식 모두 충전효율을 높일 수 있다.

Application Language KOREAN (KOR)

Inventor(s) JIN, Byoung-Su

Inventor(s) 진병수

Applicant/Assignee

AMOSENSE

| \$ 48 M

Assignee 주식회사 아모센스

Reg. Nb: 120080489437

Patent Assignee History AMOSENSE CO., LTD.

Representative LEEON INTELLECTUAL PROPERTY LAW FIRM

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Reg. Nb: 920161000615

Representative Address LEEON INTELLECTUAL PROPERTY LAW FIRM , 920091001212

ERUUM & LEEON INTELLECTUAL PROPERTY LAW FIRM , 920161000615

Representative 특허법인리온

Reg. Nb: 920091001212; 특허법인이룸리온

Reg. Nb: 920161000615

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-JP2014011852 (A) [JP2014011852] PANASONIC CORP; -KR20130072181 (A) [KR20130072181] AMOSENSE CO LTD; -KR20140044022 (A) [KR20140044022] LG INNOTEK CO LTD; -KR20140142163 (A) [KR20140142163] LG ELECTRONICS INC;

Applicant citations

-KR20150159465 (A) [KR20150159465];

Description

TECHNICAL FIELD

[0001] The present invention relates to a wireless charging transmission module for a vehicle, and more particularly, to a wireless charging transmission module for a vehicle, which can perform wireless charging using both magnetic induction methods and magnetic resonance methods having different charging methods, and can increase charging efficiency by maintaining proper distance between respective wireless charging antennas and electronic devices.

BACKGROUND ART

[0002] Recently, the use of electric devices that charge and use batteries with external power, such as mobile terminals such as mobile phones, smart phones, tablet PCs, notebooks, digital broadcasting terminals, personal digital assistants (PDAs), Portable Multimedia Players (pmp), navigation, and so on, is increasing.

[0003] Accordingly, the surrounding environment associated with the use of the mobile terminal tends to spread to a dynamic space such as a vehicle.

[0004] In other words, the use of a charger capable of simply charging a battery of a terminal even in a vehicle is increasing.

[0005] When charging a battery in a vehicle, a charger and a terminal (or battery) are electrically connected to each other, a charger connected to a vehicle power source is connected to the terminal through a contact terminal or a cable to supply electrical energy.

[0006] Among these, when exposed to moisture is exposed to a terminal, charging energy is dissipated, or there is a concern of occurrence of fire due to a momentary discharge phenomenon at the time of contact/separation, and charging operation is not smoothly performed due to failure of contact.

[0007] Therefore, there is provided a contactless charging system using a wireless power transfer system without configuring a contact terminal.

[0008] The contactless charging system supplies electric energy supplied from a vehicle power source in a wireless transmission method, and includes a wireless charging transmission module embedded in a vehicle, and a wireless charging reception module on a terminal side receiving electric energy from the wireless charging transmission module.

[0009] The wireless charging of the contactless method is classified into a magnetic induction method and a magnetic resonance method, and the wireless charging of the contactless method is classified into a PMA method and a Qi method according to a

method of sensing an approach of the wireless charging receiving module to the wireless charging transmitting module.

[0010] The magnetic induction method or magnetic resonance method described above is the same in that a magnetic field is used, and an electromagnetic field is generated using a coil and power is transmitted through the same. However, the magnetic induction scheme uses electromagnetic induction phenomenon between coils, and it is different in that magnetic resonance can be used to send away from each other despite a low coupling coefficient between coils.

[0011] That is, when coils made of the same frequency are stacked on each other, the magnetic induction method is characterized in that the magnetic field generated by the primary coil flows an induction current to the secondary coil to supply energy, and the magnetic resonance method is characterized in that power can be transmitted without directly contacting the charging mat. The magnetic resonance scheme is basically similar to the magnetic induction scheme until the current is turned through the coil to the electron, but differs from sending it away from the resonance frequency.

[0012] In addition, the magnetic induction method has advantages of having high transmission efficiency and capable of transmitting large power, and the magnetic resonance method can simultaneously charge a plurality of devices at a time. Although the magnetic induction method and the magnetic resonance method exist with advantages of each other, operating frequencies used for each other are different from each other.

[0013] In one example, the magnetic induction method has an operating frequency of 100 to 350 kHz band, and the magnetic resonance method has an operating frequency of 6.765 MHz to 6.795 MHz band.

[0014] Accordingly, there is a problem that the magnetic induction method and the magnetic resonance method are incompatible with each other because operating frequencies are different from each other.

[0015] On the other hand, in the case of a self-resonance system operating in a band of 6.765 MHz to 6.795 MHz which is a high frequency band, splits are generated when the coupling coefficient between coils is excessively high, and in the case of a self-induction system operating in a band of 100 to 350 kHz which is a low frequency band, the charging efficiency is increased as the coupling coefficient is increased.

[0016] Accordingly, when a magnetic induction method and a magnetic resonance method are simultaneously applied, there is a need for a method for improving charging efficiency of an antenna operating in a magnetic induction method and an antenna operating in a magnetic resonance method.

CITATION LIST

PATENT LITERATURE

SUMMARY OF INVENTION

TECH PROBLEM

[0018] In view of the foregoing, the present invention aims to provide a wireless charging transmission module for a vehicle capable of performing wireless charging using both a magnetic induction method and a magnetic resonance method by simultaneously arranging at least two wireless charging antennas having different charging methods.

[0019] In addition, the present invention provides a wireless charging transmission module for a vehicle, which is configured to include both Qi method and PMA method antennas, so that all of Qi method, PMA method and magnetic resonance method can be used through one module.

[0020] Furthermore, the present invention provides a wireless charging transmission module for a vehicle, which can implement multi-functionalization by enabling transmission and reception of data as well as wireless charging through one module by including an NFC antenna for near-field communication in an antenna unit.

[0021] On the other hand, the present invention has another object to provide a wireless charging transmission module for a vehicle, in which charging efficiency can be increased by arranging a distance between a contact surface with which a portable device to be charged contacts and a corresponding wireless charging antenna differently from each other.

TECH SOLUTION

[0022] In order to achieve the object described above, the present invention provides an antenna unit including a first wireless charging antenna operating in a magnetic induction manner, a second wireless charging antenna operating in a magnetic resonance manner, and an NFC antenna for near field data communication; an antenna unit including a first sheet disposed in a region corresponding to the first wireless charging antenna, A shielding unit including a second sheet disposed in a region corresponding to the second wireless charging antenna and the NFC antenna; and a housing including an upper plate having an internal space for accommodating the antenna unit and the shielding unit and spaced apart from each other at an upper side of the antenna unit by an interval, A first separation distance from an outer surface of the upper plate which is a contact surface of the electronic device to the first wireless charging antenna is set such that a coupling coefficient between a receiving coil provided in the electronic device and the first wireless charging antenna is 0.7 or more, Wherein a second separation distance from the outer surface of the upper plate to the second antenna for wireless charging is set such that a coupling coefficient between a receiving coil included in the electronic device and the second antenna for wireless charging is less than 0.2, Wherein one surface of the first sheet on which the first wireless charging antenna is disposed is formed as a stepped

surface having a height difference with respect to one surface of the second sheet on which the second wireless charging antenna and the NFC antenna are disposed so that the first separation distance is shorter than the second separation distance.

[0023] The first wireless charging antenna may include a first antenna operating in a Qi method and a second antenna operating in a PMA method.

[0024] In addition, the stepped surface may be disposed such that one surface of the first sheet protrudes from one surface of the second sheet by a predetermined height.

[0025] AMEND STATUS: Delete

[0026] In addition, the first sheet may be disposed inside the second sheet, and the first sheet may be provided to have a relatively narrower area than the second sheet, and may be stacked on an upper surface of the second sheet.

[0027] In addition, a receiving portion for receiving a partial thickness of the first sheet may be provided in the second sheet, and the receiving portion may be formed as a receiving groove recessed from one surface of the second sheet by a predetermined depth, or may be formed as a through-hole penetrating through the second sheet.

[0028] Further, the first distance may be 2 mm to 5 mm, and the second distance may be 10 mm to 50 mm.

[0029] Further, the first sheet may be provided to have a relatively higher permeability than the second sheet in a frequency band having an operating frequency of 100 kHz to 350 kHz, When the first sheet has the same permeability as the second sheet in a frequency band having an operating frequency of 100 kHz to 350 kHz, the permeability loss of the first sheet is relatively smaller than the permeability loss of the second sheet.

[0030] Further, the second sheet may be provided to have a relatively higher permeability than the first sheet at a frequency band having an operating frequency of 6.765 MHz to 6.795 MHz and a frequency of 13.56 MHz, When the second sheet has the same permeability as that of the first sheet in a frequency band having an operating frequency of 6.765 MHz to 6.795 MHz and a frequency of 13.56 MHz, the second sheet has a relatively smaller value than that of the first sheet.

[0031] The first sheet is made of a material having a permeability of 300 to 3500 in a frequency band having an operating frequency of 100 kHz to 350 kHz, a Tan Delta ($=\mu' / \mu''$) of 0.05 or less, and a saturation flux density of 0.25 t or more, the second sheet has a permeability of 30 to 350 in a frequency band having an operating frequency of 6.765 MHz to 6.795 MHz and a frequency of 13.56 MHz, A Delta ($=\mu' / \mu''$) of 0.05 or less and a magnetic flux density of 0.25 t or more in a frequency band having an operating frequency of 6.765 MHz to 6.795 MHz (where μ' is a permeability and μ'' is a permeability loss).

[0032] Further, the first sheet is any one of Mn-Zn ferrite having a permeability of 2000 to 3500 and a Tan Delta ($=\mu'/\mu''$) of 0.05 or less in a frequency band of 100 kHz to 350 kHz, and Ni-Zn ferrite having a permeability of 300 to 1500 and a Delta ($=\mu'/\mu''$) of 0.05 or less in a frequency band of 100 kHz to 350 kHz, And the second sheet has a permeability of 100 to 350 and a Tan Delta ($=\mu'/\mu''$) of 0.05 or less at a frequency band of 6.765 MHz to 6.795 MHz and a frequency of 13.56 MHz. A metal polymer having a permeability of 30 to 70 and a Tan Delta ($=\mu'/\mu''$) of 0.05 or less at a frequency of 765 MHz to 6.795 MHz and a frequency of 13.56 MHz.

[0033] Further, the first sheet and the second sheet may include any one of a ribbon sheet formed of an amorphous alloy or a nanograin alloy, a sintered ferrite sheet, and a metal polymer sheet.

[0034] Further, the metal polymer may be any one of a Fe—Si—Cr metal polymer and a Fe—Si—Al metal polymer, and the ribbon sheet may be formed by stacking ribbon sheets of a plurality of amorphous alloys or nanograin alloys.

[0035] In addition, the shielding unit may be divided into a plurality of fine pieces.

[0036] Further, the plurality of fine pieces may be entirely insulated or partially insulated between neighboring fine pieces, the plurality of fine pieces may have a size of 1 μm to 3 mm, and the plurality of fine pieces may be formed in an irregular shape.

ADVANTAGEOUS EFFECTS

[0037] According to the present invention, by simultaneously arranging at least two wireless charging antennas having different charging methods, wireless charging can be performed using both magnetic induction methods and magnetic resonance methods, and all of Qi methods, PMA methods, and magnetic resonance methods can be used, thereby improving compatibility and ease of use.

[0038] In addition, since NFC antennas for near-field communication are included in the antenna unit, it is possible to transmit and receive data as well as wirelessly charge through one module, thus implementing multi-functionalization.

[0039] Furthermore, the present invention can improve charging efficiency by arranging a distance between a contact surface with which an electronic device to be charged contacts and a corresponding antenna for wireless charging differently from each other, thereby improving charging efficiency.

DESCRIPTION OF DRAWINGS

[0040] FIG. 1 is a schematic view illustrating a wireless charging transmission module for a vehicle according to one embodiment of the present invention, FIG. 2 is a bottom view of FIG. 1, FIG. 3 is a cross-sectional view a-a of FIG. 1, FIG. 4 is a view illustrating a case where a receiving unit is formed in a second sheet in a wireless charging

transmission module for a vehicle according to one embodiment of the present invention, wherein a) is a case where the receiving unit is formed into a through-hole, When the receiving unit is formed into a receiving groove, FIG. 5 is a view illustrating a form in which a shielding sheet is stacked with a plurality of ribbon sheets of amorphous alloys or nanograin alloys in a wireless charging transmission module for a vehicle according to one embodiment of the present invention, and FIG. 6 is a schematic view illustrating a case in which three first wireless charging antennas are provided in a wireless charging transmission module for a vehicle according to one embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0041] Hereinafter, exemplary embodiments of the present disclosure will be described in detail with reference to the accompanying drawings so that a person skilled in the art can be easily performed. The present invention may be embodied in a variety of different forms and is not limited to the embodiments described herein. In order to explain the present disclosure clearly, parts without reference to the drawings, and like reference numerals will be added to like or similar elements throughout the specification.

[0042] The wireless charging transmission module 100 for a vehicle according to one embodiment of the present invention is for transmitting a wireless signal to an electronic device installed in the vehicle and intended to be charged, and includes a housing 130, an antenna unit 110, and a shielding unit 120 as shown in figs. 1 to 3.

[0043] The housing 130 may be provided in a box shape having an inner space for receiving the antenna unit 110 and the shielding unit 120.

[0044] In this case, although not illustrated in the interior of the housing 130, normal components for basically performing a function as a charger, that is, a power supply circuit unit configured to receive power from a vehicle power supply, an antenna driving circuit unit configured to transmit the power supplied through the power supply circuit unit to the antenna unit 110 and transmit the power to the electronic device to be charged, a control circuit unit configured to control a full operation including driving control and power transmission control of the antenna driving circuit unit, and so on.

[0045] Here, the electronic device may be a mobile phone, PDA, pmp, tablet, multimedia device, and so on.

[0046] The antenna unit 110 may include a plurality of wireless charging antennas 111, 112 operating in different manners at different operating frequencies, and may transmit wireless signals in a corresponding operating frequency band, thereby transferring power required by the electronic device described above.

[0047] In this case, the wireless charging transmission module 100 for the vehicle according to the present invention includes an NFC antenna 113 in the antenna unit 110 to enable data transmission and reception in addition to the wireless charging capability.

[0048] Here, the plurality of antennas 111, 112, 113 may be configured as a plate coil having a circular, elliptical or rectangular shape in which a conductive member having a predetermined length is wound a plurality of times in a clockwise direction or a counterclockwise direction, and may be fixed to one surface of the shielding unit 120. In this case, the conductive member may be a metal material having conductivity such as copper, and may be provided in a form in which a plurality of strands having a predetermined diameter are twisted along a longitudinal direction. Furthermore, when the plurality of antennas 111, 112, 113 are configured as flat plate coils, respective lead wires 114 a, 114 b, 114 c, 114 d for electrically connecting the respective antennas 111, 112, 113 may be formed on a bottom surface of the shielding unit 120 (see FIG. 2).

[0049] Further, the plurality of antennas 111, 112, 113 may be configured by patterning a conductor such as copper foil or the like in a loop form or forming a loop-shaped metal pattern using conductive ink on at least one surface of a circuit board made of synthetic resin such as polyimide (PI) or pet.

[0050] Furthermore, the plurality of antennas 111, 112, 113 may be provided in a form of combining a flat plate coil in which a conductive member is wound a plurality of times and an antenna pattern printed on one surface of the circuit board.

[0051] The plurality of wireless charging antennas includes a first wireless charging antenna (111) operating in a magnetic induction manner and a second wireless charging antenna (112) operating in a magnetic resonance manner.

[0052] In one example, the first wireless charging antenna 111 may be a Qi or PMA antenna operating in a magnetic induction method in a frequency band having an operating frequency of 100 kHz to 350 kHz, and the second wireless charging antenna 112 may be a A4WP antenna operating in a self-resonance method in a frequency band having an operating frequency of 6.765 MHz to 6.795 MHz.

[0053] That is, according to the present disclosure, since the antenna unit 110 includes a first antenna 111 for wireless charging and a second antenna 112 for wireless charging, respectively, operating in a magnetic induction method and a magnetic resonance method, both wireless charging of the two methods can be performed through one module.

[0054] Here, the first antenna 111 for wireless charging operating in the magnetic induction method may be a Qi antenna or a PMA antenna, and preferably may be provided with a first antenna 111 a operating in the Qi method and a second antenna 111 b operating in the PMA method. Further, there may be three first wireless charging antennas 111, and one antenna may be arranged to partially overlap the other two antennas (see FIG. 6). Furthermore, it is found that the first wireless charging antenna 111 may integrate Qi method and PMA method through one coil.

[0055] Accordingly, the wireless charging transmission module 100 for a vehicle according to the present invention is installed in the vehicle and has a Qi method in which

an operation frequency or operation method is different, Since charging can be performed using both the PMA method and the A4WP method, wireless charging can be performed using an antenna matching whether a charging method of an electronic device such as a mobile phone to be charged is a magnetic induction method or a magnetic resonance method, wireless charging of all methods can be performed without having to replace a wireless charging transmission module installed in a vehicle.

[0056] Meanwhile, the antenna unit 110 includes an NFC antenna 113 for near-field communication between the first antenna 111 and the second antenna 112 for wireless charging.

[0057] That is, the antenna unit 110 according to the present invention is provided in a combo shape including a Near Field Communicatio (NFC) antenna 113 for near field communication between the first wireless charging antenna 111 and the second wireless charging antenna 112.

[0058] Accordingly, the antenna unit 110 according to the present invention can perform a function of a composite antenna capable of performing short-range data communication as well as wireless charging of a magnetic induction type and wireless charging of a magnetic resonance type.

[0059] Here, the data transmitted and received through the NFC antenna 113 may be various pieces of information on a vehicle state such as a main flow rate, a wear state of various vehicle consumables, and whether a brake is normally operated, and data exchange may be performed with an electronic device such as the mobile phone described above.

[0060] The shielding unit 120 is provided to prevent external leakage by shielding the magnetic field generated in the antenna unit 110, and to enhance the characteristics of the corresponding antenna by focusing in the required direction.

[0061] The shielding unit 120 shields a magnetic field generated when the antenna unit 110 transmits a wireless signal in a predetermined frequency band, thereby increasing the focus of the magnetic field in the required direction, thereby increasing the characteristic of an antenna operating in a predetermined frequency band.

[0062] To achieve this, the shielding unit 120 may be formed of a magnetism material to shield the magnetic field generated from the antenna unit 110. Here, the shielding unit 120 may be provided only with a plate-shaped shielding sheet 121,122 formed of a magnetic material and having a certain area, or may include a protective film 125 attached to at least one surface of the shielding sheet 121,122 to protect the shielding sheet 121,122.

[0063] In one example, the shielding sheet 121,122 may include a ribbon sheet, a ferrite sheet, a polymer sheet, or the like of amorphous alloy or nanograin alloy, and the

saturation magnetic flux density may be tesler or higher in frequency bands of 100 kHz to 350 kHz and 6.765 MHz to 6.795 MHz.

[0064] Preferably, saturation magnetic flux density may be 0.35 tesler or more in frequency bands of 100 kHz to 350 kHz and 6.765 MHz to 6.795 MHz at which each of the wireless charging antennas 111, 112 operates. This is because the saturation of the shielding sheet is later generated as the saturation magnetic flux density of the shielding sheet is higher, and therefore, a thinner thickness can be used as compared with the shielding sheet having a lower saturation magnetic flux density.

[0065] Further, the shielding sheet 121, 122 may be formed of a material having a $\tan \delta$ ($=\mu''/\mu'$) of 0.05 or less in frequency bands of 100 kHz ~ 350 kHz, 6.765 MHz ~ 6.795 MHz, and 13.56 MHz (μ' is a permeability coefficient, and μ'' is a permeability loss coefficient) in which each antenna 111, 112, 113 operates.

[0066] Here, the ferrite sheet may be a sintered ferrite sheet, and Ni-Zn ferrite or Mn-Zn ferrite may be used. Furthermore, in the amorphous alloy or nanograin alloy, Fe-based or Co-based magnetic alloy may be used. Furthermore, the polymer sheet may be an Fe—Si—Al-based metal polymer or an Fe—Si—Cr-based metal polymer.

[0067] Further, as illustrated in FIG. 5, the shielding sheet 121, 122 may be configured in a stacked form of ribbon sheets 123 a, 123 b, 123 c of a plurality of amorphous alloys or nanograin alloys.

[0068] Furthermore, the shielding sheet 121, 122 may be separated into a plurality of fine pieces to suppress occurrence of eddy currents by increasing resistance, and the plurality of fine pieces may be provided to be entirely insulated or partially insulated between adjacent fine pieces.

[0069] In this case, the plurality of fine pieces may be provided in a size of 1 μm to 3 mm, and each piece may be randomly formed in an irregular shape.

[0070] And when a plurality of sheets 123 a, 123 b, 123 c separated into fine pieces are stacked to constitute a shielding sheet 121, 122, each of the sheets 123 a, 123 b, 123 c) such that an adhesive layer 123 d made of a non-conductive material is disposed between a pair of sheets stacked on each other, so that the adhesive layer 123 d may serve to insulate a plurality of fine pieces constituting each sheet. In this case, the adhesive layer 123 d may be provided as an adhesive, or may be provided in a form in which an adhesive is applied to one surface or both surfaces of a film-like substrate.

[0071] Meanwhile, when the antenna unit 110 includes the first antenna 111 for wireless charging and the second antenna 112 for wireless charging operating in different frequency bands, the shielding sheet may be formed of one sheet. And a plurality of sheets 121, 122 having different characteristics so as to increase characteristics of the first antenna 111 and the second antenna 112 for wireless charging operating in different frequency bands, respectively.

[0072] In one example, the shielding sheet may be formed of a first sheet 121 and a second sheet 122 having different characteristics from each other in a predetermined frequency band so as to improve characteristics of a first antenna 111 and a second antenna 112 for wireless charging, respectively, which operate in a magnetic induction method and a magnetic resonance method in different frequency bands.

[0073] In this case, the NFC antenna 113 may be properly arranged on the first sheet 121 or the second sheet 122, but may be arranged on one surface of the second sheet 122 on which the second wireless charging antenna 112 operating in a self-resonant manner is arranged.

[0074] This is such that antennas whose operating frequencies are close to each other can improve both characteristics of two antennas whose operating frequencies are close to each other through one shielding sheet.

[0075] That is, the NFC antenna 113 having an operating frequency of 13.56 MHz is disposed on the second sheet 122 on which the second wireless charging antenna 112 having an operating frequency of 6.765 MHz to 6.795 MHz is disposed.

[0076] Specifically, the first sheet 121 is disposed in a region corresponding to the first wireless charging antenna 111 to increase characteristics of the first wireless charging antenna 111 operating by a magnetic induction method in a low frequency band. The second sheet 122 is disposed in regions corresponding to the second wireless charging antenna 112 and the NFC antenna 113 to simultaneously increase characteristics of the second wireless charging antenna 112 and the NFC antenna 113 operating by a self-resonance method in a high frequency band.

[0077] Here, the first sheet 121 is provided to have an area including the first antenna 111 for wireless charging, and the second sheet 122 is provided to have an area including the second antenna 112 for wireless charging and an NFC antenna 113.

[0078] In one example, when the first wireless charging antenna 111 is disposed inside the second wireless charging antenna 112, the first sheet 121 is disposed inside the second sheet 122.

[0079] In this case, as shown in FIG. 3, the first sheet 121 may be provided to have a relatively narrower area than the second sheet 122, and may be stacked on one surface of the second sheet 122.

[0080] Furthermore, as illustrated in figs. 4A and 4B, the shielding unit 120 may be provided in a form of receiving a portion of a thickness of the first sheet 121 by providing a receiving portion inside the second sheet 122.

[0081] That is, as shown in FIG. 4A, the receiving portion may be provided in a form of a through-hole 126 penetrating through the second sheet 122, and the first sheet 121 may be inserted into the through-hole 126. The receiving portion may be provided in a form

of a receiving recess 126 b recessed from one surface of the second sheet 122 by a certain depth, and the first sheet 121 may be provided in a form of being seated in the receiving recess 126 b.

[0082] In this case, the first sheet 121 and the second sheet 122 may be provided to have different magnetic permeability or different saturation magnetic fields in a predetermined frequency band, or may be provided to have different values when the magnetic permeability of the first sheet 121 and the second sheet 122 are the same in the predetermined frequency band.

[0083] Specifically, the first sheet 121 may be provided to have a relatively higher permeability than the second sheet in a frequency band of 100 to 350 kHz, which is a low frequency band, and may be provided to have a relatively higher saturation magnetic field than the second sheet in a frequency band of 100 to 350 kHz. When the first sheet 121 and the second sheet 122 have the same permeability as each other in a frequency band of 100 to 350 kHz, the permeability of the first sheet 121 is relatively smaller than the permeability of the second sheet 122.

[0084] Here, the first sheet 121 may be formed of a material having a magnetic permeability of 300 to 3500 in a frequency band of 100 to 350 kHz, which is a low frequency band, a Tan Delta ($=\mu''/\mu'$) of 0.05 or less, and a saturation magnetic flux density of 0.25 t or more.

[0085] In one example, in the first sheet 121, Mn-Zn ferrite having a permeability of 2000 to 3500 and a Tan Delta ($=\mu''/\mu'$) of 0.05 or less may be used in a frequency band of 100 kHz to 350 kHz, and Ni-Zn ferrite having a permeability of 300 to 1500 and a Tan Delta ($=\mu''/\mu'$) of 0.05 or less may be used in a frequency band of 100 kHz to 350 kHz.

[0086] Furthermore, the second sheet 122 may be provided to have a relatively higher permeability than the first sheet at 6.765 MHz to 6.795 MHz and 13.56 MHz of high frequency bands. When the first sheet 121 and the second sheet 122 have the same permeability in frequency bands of 6.765 MHz to 6.795 MHz and 13.56 Hz, the permeability of the second sheet 122 is relatively smaller than the permeability of the first sheet 121.

[0087] Here, the second sheet 122 may be formed of a material having a magnetic permeability of 30 to 350 at an operating frequency of 6.765 MHz to 6.795 MHz and 13.56 MHz, a Tan Delta ($=\mu''/\mu'$) of 0.05 or less, and a saturation magnetic flux density of 0.25 t or more.

[0088] In one example, Ni-Zn ferrite having a permeability of 100 to 350 and a Tan Delta ($=\mu''/\mu'$) of 0.05 or less may be used at 6.765 MHz to 6.795 MHz and 13.56 MHz, and a metal polymer having a permeability of 30 to 70 and a Tan Delta ($=\mu''/\mu'$) of 0.05 or less may be used at 6.765 MHz to 6.795 MHz and 13.56 MHz.

[0089] Since the first sheet (121) has a relatively higher permeability than the second sheet (122) in a frequency band of 100 to 350 kHz, an alternating magnetic field generated in the first wireless charging antenna (111) is induced toward the first sheet (121) having a relatively higher permeability during wireless charging by a magnetic induction method. In this case, since the first sheet 121 is disposed in a region corresponding to the first wireless charging antenna 111, the alternating magnetic field induced toward the first sheet 121 is shielded by the first sheet 121 and focused in a required direction, thereby efficiently transmitting the alternating magnetic field to the wireless charging receiving module.

[0090] In addition, since the second sheet 122 has a relatively higher permeability than the first sheet 121 at 6.765 MHz to 6.795 MHz, an alternating magnetic field generated in the second wireless charging antenna 112 is induced toward the second sheet 122 having a relatively higher permeability during wireless charging by the magnetic resonance method. In this case, since the second sheet 122 is disposed in a region corresponding to the second wireless charging antenna 112, the alternating magnetic field induced toward the second sheet 122 is shielded by the second sheet 122 and focused in a required direction, thereby efficiently transmitting the alternating magnetic field to the wireless charging receiving module.

[0091] In addition, since the second sheet (122) has a relatively higher permeability than the first sheet (121) at a frequency of 13.56 MHz even during data communication through the NFC antenna (113), a magnetic field generated during data communication is also directed toward the second sheet (122) having a relatively higher permeability. In this case, since the second sheet 122 is disposed in a region corresponding to the NFC antenna 113, the magnetic field induced toward the second sheet 122 is shielded by the second sheet 122 and focused in a required direction, thereby enhancing data transmission and reception sensitivity.

[0092] In addition, even if the first sheet (121) and the second sheet (122) have the same permeability as each other in a frequency band of 100 to 350 kHz, the permeability of the first sheet (121) is provided to have a relatively smaller value than the permeability of the second sheet (122), as a result, the loss of permeability due to the permeability during wireless charging operation is reduced.

[0093] Accordingly, an alternating magnetic field generated according to power transmission at an operating frequency in a range of 100 to 350 kHz is induced toward the first sheet 121 having a relatively high magnetic permeability, thereby inducing transmission to the wireless charging receiving module with high efficiency through a first wireless charging antenna 111 disposed in a region corresponding to the first sheet 121.

[0094] Likewise, Even if the first sheet (121) and the second sheet (122) have the same permeability as each other at frequencies of 6.765 MHz to 6.795 MHz and 13.56 MHz, the permeability loss of the second sheet (122) is relatively smaller than the permeability

loss of the first sheet (121), thereby reducing the loss of permeability due to the permeability loss in wireless charging or data communication.

[0095] Accordingly, since the magnetic field is induced toward the second sheet 122 having a relatively high magnetic permeability at frequencies of 6.765 MHz to 6.795 MHz and 13.56 MHz, wireless power can be transmitted through the second wireless charging antenna 112 and NFC antenna 113 disposed in a region corresponding to the second sheet 122 with high efficiency or data transmission and reception sensitivity can be enhanced.

[0096] Herein, it is described that Mn-Zn ferrite or Ni-Zn ferrite is used as the first sheet 121, and Ni-Zn ferrite or metal polymer is used as the second sheet 122, but exemplary embodiments are not limited thereto. It is found that the materials of the first sheet 121 and the second sheet 122 may be varied variously as long as the magnetic permeability, the saturation magnetic field, and the magnetic permeability loss rate satisfy the relative conditions with respect to each other in the corresponding frequency band.

[0097] For example, the first sheet 121 and the second sheet 122 may be formed of the same material having different magnetic permeability at operating frequencies of 100 to 350 kHz, 6.765 MHz to 6.795 MHz, and 13.56 MHz, and the first sheet 121 may include amorphous alloy or nanograin alloy ribbon sheets. This is because, even when made of the same material, it is possible to have different characteristics (magnetic permeability, saturation magnetic field, magnetic permeability loss rate, and so on) through changes in various conditions such as heat treatment temperature, lamination number, and so on.

[0098] Further, when at least one of the first sheet 121 and the second sheet 122 is used as a ribbon sheet of amorphous alloy or nanograin alloy, a single layer ribbon sheet may be used, but as illustrated in FIG. 5, the ribbon sheet may be formed of the first sheet 121 and/or the second sheet 122 in a stacked form of a plurality of ribbon sheets of amorphous alloy or nanograin alloy.

[0099] Meanwhile, the first sheet 121 and the second sheet 122 are disposed such that one surface on which the first wireless charging antenna 111 and the second wireless charging antenna 112 are disposed forms a stepped surface. In this case, the stepped surface is formed such that one surface of the first sheet 121 on which the first wireless charging antenna 111 is disposed protrudes by a predetermined height with respect to one surface of the second sheet 122 on which the second wireless charging antenna 112 is disposed.

[0100] This is to make a separation distance from a first wireless charging antenna 111 operating in a magnetic induction manner to an electronic device to be charged differ from a second wireless charging antenna 112 operating in a magnetic resonance manner to the electronic device to be charged.

[0101] Typically, as the distance between the transmission coil provided in the wireless charging transmission module and the reception coil provided in the wireless charging

reception module becomes closer to each other, the value of the coupling coefficient becomes greater.

[0102] Here, the antenna operating in a self-resonant manner uses a level where the coupling coefficient k between coils is less than 0.2, and the antenna operating in a self-inductive manner uses a level where the coupling coefficient k between coils is greater than 0.7.

[0103] In the self-resonance method, when the coupling coefficient between the coils becomes higher than or equal to 0.2, efficiency degradation caused by split occurs, and charging efficiency decreases, and therefore, it is necessary to separate the receiving coil and the transmitting coil from each other at an appropriate distance, thereby maintaining the coupling coefficient less than 0.2. However, in the case of the magnetic induction method, as the coupling coefficient between the coils increases, as opposed to the magnetic resonance method, charging efficiency increases proportionally, and therefore, the separation distance between the receiving coil and the transmitting coil needs to be kept close.

[0104] Accordingly, in the present disclosure, the first sheet 121 and the second sheet 122 are disposed to form a stepped surface, and the first sheet 121 and the second sheet 122 are disposed such that one surface of the first sheet 121 on which the first wireless charging antenna 111 operating in a magnetic induction method is disposed at a position lower than one surface of the second sheet 122 on which the second wireless charging antenna 112 operating in a magnetic resonance method is disposed.

[0105] That is, a first separation distance $d1$ from the first wireless charging antenna 111 to the upper plate of the housing 130 is shorter than a second separation distance $d2$ from the second wireless charging antenna 112 to the upper plate of the housing 130.

[0106] Here, the housing 130 is embedded in a deciboard or gearbox of a vehicle to expose the upper plate 132 to the outside, and the upper plate 132 forms a contact surface on which the electronic device to be charged is placed.

[0107] In this case, as illustrated in FIG. 3, the first and second separation distances $d1$, $d2$ refer to separation distances from an outer surface of an upper plate on which the electronic device is disposed, and the first separation distance $d1$ may be 2 mm to 5 mm, and the second separation distance $d2$ may be 10 mm to 50 mm.

[0108] Accordingly, when the user intends to charge the electronic device, the electronic device may maintain a distance very close to the first wireless charging antenna 111, for example, a distance of 2 mm to 5 mm apart from the second wireless charging antenna 112, and maintain a proper distance apart from the second wireless charging antenna 112, for example, a distance of 10 mm to 50 mm.

[0109] Accordingly, when the electronic device is a device charged in a magnetic induction manner, the first wireless charging antenna 111 and the electronic device

maintain a distance between the first wireless charging antenna 111 and the electronic device as much as possible to maintain a coupling coefficient of 0.7 or more, Even when the electronic device is a self-resonantly charged device, the second wireless charging antenna (112) and the electronic device maintain a properly spaced state and maintain a coupling coefficient of less than 0.2, thereby preventing split due to excessive coil coupling and obtaining even magnetic field distribution on the surface of the top plate (132) of the housing (130), thereby enhancing charging efficiency.

[0111] Although the embodiments of the present disclosure have been described above, the spirit of the present disclosure is not limited to the embodiments set forth in the specification. however, a person skilled in the art who understands the spirit of the present disclosure may readily suggest other embodiments by adding, changing, deleting, adding elements, and the like, within the scope of the present disclosure, it will also be understood that the scope of the present disclosure is within the scope of the present disclosure.

REFERENCE SIGNS LIST

[0113] 100,200: wireless charging transmission module for vehicle 110: antenna unit 111: first antenna for wireless charging 111 a: first antenna 111 b: second antenna 112: second antenna for wireless charging 120: shielding unit 121: first seat 122: Second sheets 123 a, 123 b, 123 c: ribbon of amorphous alloy or nanograin alloy, 123 d: adhesive layer 124: adhesive layer 125: protective film 126 a: through-hole 126 b: accommodation groove 130: housing 132: upper plate



(19) 대한민국특허청(KR)
(12) 등록특허공보(B1)

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(73) 특허권자
주식회사 아모센스
충청남도 천안시 서북구 직산읍 4산단5길 90, 천
안 제4지방산업단지 19-1블럭
(72) 발명자
진병수
경기도 수원시 영통구 동탄원천로915번길 36, 30
3동 1402호 (매탄동, 주공그린빌)
(74) 대리인
특허법인이룸리온, 특허법인리온

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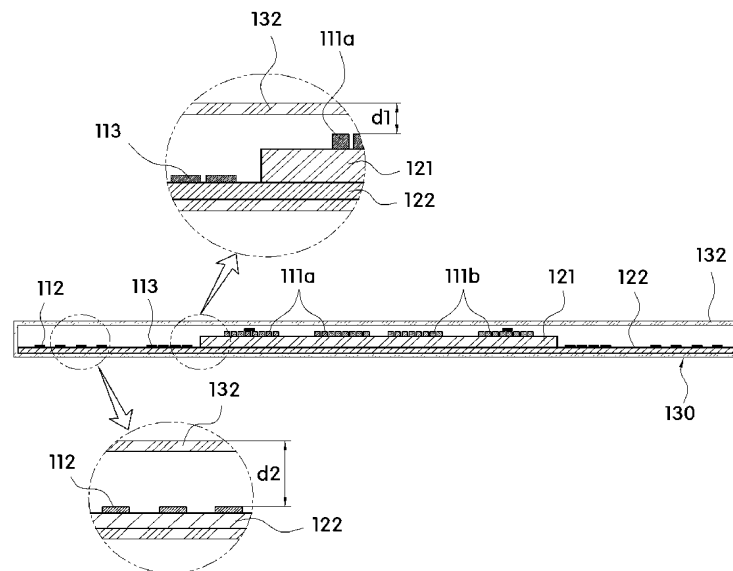
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(54) 발명의 명칭 차량용 무선충전 송신모듈

(57) 요약

차량용 무선충전 송신모듈이 제공된다. 본 발명의 일 실시예에 의한 차량용 무선충전 송신모듈은 자기유도 방식으로 작동하는 제1무선충전용 안테나, 자기공진 방식으로 작동하는 제2무선충전용 안테나 및 근거리 데이터 통신을 위한 NFC 안테나가 구비되는 안테나유닛; 및 상기 제1무선충전용 안테나와 대응되는 영역에 배치되어 상기 제 (뒷면에 계속)

도 3



1무선충전용 안테나의 특성을 향상시키는 제1시트 및 상기 제2무선충전용 안테나와 대응되는 영역에 배치되어 상기 제2무선충전용 안테나의 특성을 향상시키는 제2시트가 구비되는 차폐유닛;을 포함하고, 상기 제1시트는 상기 제1무선충전용 안테나가 배치되는 일면이 상기 제2무선충전용 안테나가 배치되는 제2시트의 일면에 대하여 높이차를 갖는 단차면을 형성하도록 배치된다. 이에 의하면, 충전방식이 상이한 두 개의 무선충전용 안테나를 동시에 배치함으로써 자기유도방식과 자기공진방식을 모두 사용하여 무선충전을 수행할 수 있어 호환성을 높이고 사용편의성을 높일 수 있으며, 충전대상인 휴대기기가 접촉하는 접촉면과 해당 무선충전용 안테나와의 이격거리를 서로 다르게 배치함으로써 자기유도방식과 자기공진방식 모두 충전효율을 높일 수 있다.

(52) CPC특허분류

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명세서

청구범위

청구항 1

자기유도 방식으로 작동하는 제1무선충전용 안테나, 자기공진 방식으로 작동하는 제2무선충전용 안테나 및 근거리 데이터 통신을 위한 NFC 안테나가 구비되는 안테나유닛;

상기 제1무선충전용 안테나와 대응되는 영역에 배치되는 제1시트와, 상기 제2무선충전용 안테나 및 NFC 안테나와 대응되는 영역에 배치되는 제2시트가 구비되는 차폐유닛; 및

상기 안테나유닛과 차폐유닛을 수용하기 위한 내부공간을 갖추고 상기 안테나유닛의 상부측에 간격을 두고 이격 배치되는 상판을 포함하는 하우징;을 포함하고,

전자기기의 접촉면인 상기 상판의 외부면으로부터 상기 제1무선충전용 안테나까지의 제1이격거리는 상기 전자기기에 구비되는 수신코일과 상기 제1무선충전용 안테나와의 결합계수가 0.7이상이 되도록 설정되고,

상기 상판의 외부면으로부터 상기 제2무선충전용 안테나까지의 제2이격거리는 상기 전자기기에 구비되는 수신코일과 제2무선충전용 안테나와의 결합계수가 0.2미만이 되도록 설정되며,

상기 제1이격거리는 상기 제2이격거리보다 짧은 길이를 갖도록 상기 제1무선충전용 안테나가 배치되는 제1시트의 일면이 상기 제2무선충전용 안테나 및 NFC 안테나가 배치되는 제2시트의 일면에 대하여 높이차를 갖는 단차면으로 형성되는 차량용 무선충전 송신모듈.

청구항 2

제 1항에 있어서,

상기 제1무선충전용 안테나는 Qi 방식으로 작동하는 제1안테나와 PMA 방식으로 작동하는 제2안테나를 포함하는 차량용 무선충전 송신모듈.

청구항 3

제 1항에 있어서,

상기 단차면은 상기 제2시트의 일면에 대하여 상기 제1시트의 일면이 일정높이 돌출되는 차량용 무선충전 송신모듈.

청구항 4

삭제

청구항 5

제 1항에 있어서,

상기 제1시트는 상기 제2시트의 내측에 배치되는 차량용 무선충전 송신모듈.

청구항 6

제 5항에 있어서,

상기 제1시트는 상기 제2시트에 비하여 상대적으로 좁은 면적을 갖도록 구비되고, 상기 제2시트의 상부면에 적층되는 차량용 무선충전 송신모듈.

청구항 7

제 5항에 있어서,

상기 제2시트의 내부에는 상기 제1시트의 일부두께를 수용하기 위한 수용부가 구비되는 차량용 무선충전 송신모

들.

청구항 8

제 7항에 있어서,

상기 수용부는 상기 제2시트의 일면으로부터 일정깊이 함몰되는 수용홈으로 형성되거나 상기 제2시트를 관통하는 관통구로 형성되는 차량용 무선충전 송신모듈.

청구항 9

삭제

청구항 10

제 1항에 있어서,

상기 제1이격거리는 2mm ~ 5mm이고, 상기 제2이격거리는 10mm ~ 50mm인 차량용 무선충전 송신모듈.

청구항 11

제 1항에 있어서,

상기 제1시트는 동작주파수가 100kHz~350kHz인 주파수 대역에서 상기 제2시트보다 상대적으로 높은 투자율을 갖도록 구비되는 차량용 무선충전 송신모듈.

청구항 12

제 1항에 있어서,

상기 제1시트는 동작주파수가 100kHz~350kHz인 주파수 대역에서 상기 제2시트와 동일한 투자율을 갖는 경우 상기 제1시트의 투자손실률이 상기 제2시트의 투자손실률보다 상대적으로 작은 값을 갖도록 구비되는 차량용 무선충전 송신모듈.

청구항 13

제 1항에 있어서,

상기 제2시트는 동작주파수가 6.765MHz ~ 6.795MHz인 주파수 대역 및 13.56MHz의 주파수에서 상기 제1시트보다 상대적으로 높은 투자율을 갖도록 구비되는 차량용 무선충전 송신모듈.

청구항 14

제 1항에 있어서,

상기 제2시트는 동작주파수가 6.765MHz ~ 6.795MHz인 주파수 대역 및 13.56MHz의 주파수에서 상기 제1시트와 동일한 투자율을 갖는 경우 상기 제2시트의 투자손실률이 상기 제1시트의 투자손실률보다 상대적으로 작은 값을 갖도록 구비되는 차량용 무선충전 송신모듈.

청구항 15

제 1항에 있어서,

상기 제1시트는 동작주파수가 100kHz~350kHz인 주파수 대역에서 300~3500의 투자율을 갖고, $\tan \delta (= \mu'' / \mu')$ 가 0.05이하이며, 자속밀도가 0.25T 이상인 재질로 이루어지고,

상기 제2시트는 동작주파수가 6.765MHz ~ 6.795MHz인 주파수 대역 및 13.56MHz의 주파수에서 30~350의 투자율을 갖고, $\tan \delta (= \mu'' / \mu')$ 가 0.05이하이며, 동작주파수가 6.765MHz ~ 6.795MHz인 주파수 대역에서 자속밀도가 0.25T 이상인 재질로 이루어지는 차량용 무선충전 송신모듈(여기서, μ' 은 투자율이고, μ'' 은 투자손실율임).

청구항 16

제 15항에 있어서,

상기 제1시트는 100kHz~350kHz 주파수대역에서 투자율이 2000~3500이고 $\tan \delta (= \mu'' / \mu')$ 가 0.05이하인 Mn-Zn 페라이트 또는 100kHz~350kHz 주파수대역에서 투자율이 300~1500이고 $\tan \delta (= \mu'' / \mu')$ 가 0.05이하인 Ni-Zn 페라이트 중 어느 하나이고,

상기 제2시트는 6.765MHz ~ 6.795MHz인 주파수 대역 및 13.56MHz의 주파수에서 투자율이 100~350이고 $\tan \delta (= \mu'' / \mu')$ 가 0.05이하인 Ni-Zn 페라이트 또는 6.765MHz ~ 6.795MHz인 주파수 대역에서 투자율이 30~70이고 $\tan \delta (= \mu'' / \mu')$ 가 0.05이하인 메탈 폴리머 중 어느 하나인 차량용 무선충전 송신모듈.

청구항 17

제 1항에 있어서,

상기 제1시트 및 제2시트는 비정질 합금 또는 나노 결정립 합금으로 이루어진 리본시트, 소결 페라이트 시트 또는 메탈 폴리머 시트 중 어느 하나를 포함하는 차량용 무선충전 송신모듈.

청구항 18

제 17항에 있어서,

상기 메탈 폴리머는 Fe-Si-Cr계 메탈 폴리머 또는 Fe-Si-Al계 메탈 폴리머 중 어느 하나인 차량용 무선충전 송신모듈.

청구항 19

제 17항에 있어서,

상기 리본시트는 복수 개의 비정질 합금 또는 나노 결정립 합금의 리본시트가 적층되어 구성되는 차량용 무선충전 송신모듈.

청구항 20

제 1항에 있어서,

상기 제1시트 및 제2시트 중 적어도 어느 하나는 복수 개의 미세 조각으로 분리형성되는 차량용 무선충전 송신모듈.

청구항 21

제 20항에 있어서,

상기 복수 개의 미세 조각들은 서로 이웃하는 미세 조각들 간에 전체적으로 절연되거나 부분적으로 절연되는 차량용 무선충전 송신모듈.

청구항 22

제 20항에 있어서,

상기 복수 개의 미세 조각은 1 μ m ~ 3mm의 크기인 차량용 무선충전 송신모듈.

청구항 23

제 20항에 있어서,

상기 복수 개의 미세 조각은 비정형으로 이루어지는 차량용 무선충전 송신모듈.

발명의 설명

기술 분야

본 발명은 차량용 무선충전 송신모듈에 관한 것으로, 보다 구체적으로는 충전방식이 상이한 자기유도방식과 자기공진방식을 모두 이용하여 무선충전을 수행할 수 있고 각각의 무선충전용 안테나와 전자기기와 의 적정거리가 유지되도록 함으로써 충전효율을 높일 수 있는 차량용 무선충전 송신모듈에 관한 것이다.

[0001]

배경 기술

- [0002] 최근 들어 외부의 전력으로 배터리를 충전하여 사용하는 전기기기, 예컨대 휴대폰이나 스마트폰, 태블릿 PC, 노트북, 디지털방송용 단말기, PDA(Personal Digital Assistants), PMP(Portable Multimedia Player) 및 내비게이션 등과 같은 이동단말기의 사용이 증가하고 있다.
- [0003] 이에 따라, 이동단말기의 사용과 관련된 주변 환경이 차량과 같은 동적인 공간까지 확산되고 있는 추세이다.
- [0004] 그 일환으로, 차량 내에서도 간편히 단말기의 배터리를 충전할 수 있는 충전기의 사용이 증가하고 있다.
- [0005] 차량 내 배터리 충전시 충전기와 단말기(또는 배터리)의 전기적 연결방식으로는 차량 전원에 연결된 충전기를 접촉단자 또는 케이블을 통해 단말기에 연결하여 전기에너지를 공급하는 방식이 있다.
- [0006] 이 중에서 충전기와 단말기에 접촉단자를 구비하는 단자공급방식에서는 습기에 노출될 경우 충전에너지가 소실되거나, 접촉/분리시 순간방전현상으로 인해 화재 발생의 우려가 있고, 접촉불량에 의해 충전동작이 원활하게 이루어지지 않는 경우도 발생한다.
- [0007] 따라서, 접촉단자를 구성하지 않고 무선 전력 전송방식을 이용하는 무접점 방식의 충전시스템이 제시되고 있다.
- [0008] 상기 무접점 방식의 충전시스템은 차량 전원에서 공급되는 전기에너지를 무선 전송방식으로 공급하는 것으로, 차량 내에 매립되는 무선충전 송신모듈과, 무선충전 송신모듈에서 전기에너지를 전송받는 단말기 측의 무선충전 수신모듈을 포함한다.
- [0009] 이러한 무접점 방식의 무선 충전은 자기유도 방식과 자기공진 방식으로 분류되기도 하며, 무선충전 송신모듈에 대한 무선충전 수신모듈의 접근을 감지하는 방식에 따라 PMA 방식과 Qi 방식으로 분류되기도 한다.
- [0010] 상술한 자기유도방식이나 자기공진방식은 자기장을 이용하는 것으로, 코일을 이용해서 전자기장을 만들고, 이를 통해 전력을 전달한다는 점에서 동일하다. 그러나 자기유도방식은 코일간의 전자기유도현상을 이용하는 것이고, 자기공진을 사용하여 코일간 낮은 결합계수에도 불구하고 멀리 보낼 수 있는 점이 다르다.
- [0011] 즉, 자기유도방식은 동일한 주파수로 만든 코일을 서로 포개면 1차 코일에서 생성된 자기장이 2차 코일에 유도 전류가 흘러 에너지를 공급하는 원리이며, 자기공진방식은 직접적으로 충전 매트와 접촉하지 않아도 전력을 전송할 수 있는 점이 특징이다. 자기 공명 방식은 기본적으로 코일을 통해서 전류가 전자기로 바뀌는 것까지는 자기유도 방식과 비슷하지만, 이를 공진 주파수에 실어 멀리 보내는 점이 다르다.
- [0012] 또한, 상기 자기유도방식은 전송효율이 높고 대전력의 전송이 가능하고 자기공진방식은 한 번에 복수 개의 기기를 동시에 충전할 수 있는 장점이 있다. 이와 같이 상기 자기유도방식과 자기공진방식은 서로의 특징점이 존재하지만, 서로 사용하는 동작주파수가 서로 상이하다.
- [0013] 일례로, 상기 자기유도방식은 동작주파수가 100~350kHz 대역이며, 자기공진방식은 동작주파수가 6.765MHz ~ 6.795MHz의 대역이다.
- [0014] 이에 따라, 자기유도방식과 자기공진방식은 각각 작동하는 동작주파수가 다르기 때문에 서로 호환되지 못하는 문제점이 있다.
- [0015] 한편, 고주파 대역인 6.765MHz ~ 6.795MHz의 대역에서 작동하는 자기공진방식의 경우에는 코일간의 결합계수가 과도하게 높을 경우 스플릿이 발생하여 충전효율이 떨어지게 되며, 저주파대역인 100~350kHz에서 작동하는 자기유도방식의 경우에는 결합계수가 높을수록 충전효율이 높아지게 된다.
- [0016] 따라서, 자기유도방식과 자기공진방식을 동시에 적용하는 경우 자기유도방식으로 작동하는 안테나와 자기공진방식으로 작동하는 안테나의 충전효율을 모두 높일 수 있는 방안이 요구되고 있다.

선행기술문헌

특허문헌

- [0017] (특허문헌 0001) KR10-2015-0159465A

발명의 내용

해결하려는 과제

- [0018] 본 발명은 상기와 같은 점을 감안하여 안출한 것으로, 충전방식이 상이한 적어도 두 개의 무선충전용 안테나를 동시에 배치함으로써 자기유도방식과 자기공진방식을 모두 사용하여 무선충전을 수행할 수 있는 차량용 무선충전 송신모듈을 제공하는데 그 목적이 있다.
- [0019] 또한, 본 발명은 자기유도방식으로 작동하는 안테나가 Qi 방식과 PMA 방식의 안테나를 모두 포함하도록 구성됨으로써 하나의 모듈을 통하여 Qi 방식, PMA 방식 및 자기공진방식을 모두 사용할 수 있는 차량용 무선충전 송신모듈을 제공하는데 다른 목적이 있다.
- [0020] 더불어, 본 발명은 안테나유닛에 근거리 통신을 위한 NFC 안테나가 포함됨으로써 하나의 모듈을 통해 무선충전 뿐만 아니라 데이터의 송,수신이 가능함으로써 다기능화를 구현할 수 있는 차량용 무선충전 송신모듈을 제공하는데 또 다른 목적이 있다.
- [0021] 한편, 본 발명은 충전대상인 휴대기기가 접촉하는 접촉면과 해당 무선충전용 안테나와의 이격거리를 서로 다르게 배치함으로써 자기유도방식과 자기공진방식 모두 충전효율을 높일 수 있는 차량용 무선충전 송신모듈을 제공하는데 다른 목적이 있다.

과제의 해결 수단

- [0022] 상술한 목적을 달성하기 위하여 본 발명은 자기유도 방식으로 작동하는 제1무선충전용 안테나, 자기공진 방식으로 작동하는 제2무선충전용 안테나 및 근거리 데이터 통신을 위한 NFC 안테나가 구비되는 안테나유닛; 상기 제1무선충전용 안테나와 대응되는 영역에 배치되는 제1시트와, 상기 제2무선충전용 안테나 및 NFC 안테나와 대응되는 영역에 배치되는 제2시트가 구비되는 차폐유닛; 및 상기 안테나유닛과 차폐유닛을 수용하기 위한 내부공간을 갖추고 상기 안테나유닛의 상부측에 간격을 두고 이격배치되는 상판을 포함하는 하우징;을 포함하고, 전자기기의 접촉면인 상기 상판의 외부면으로부터 상기 제1무선충전용 안테나까지의 제1이격거리는 상기 전자기기에 구비되는 수신코일과 상기 제1무선충전용 안테나와의 결합계수가 0.7이상인 되도록 설정되고, 상기 상판의 외부면으로부터 상기 제2무선충전용 안테나까지의 제2이격거리는 상기 전자기기에 구비되는 수신코일과 제2무선충전용 안테나와의 결합계수가 0.2 미만인 되도록 설정되며, 상기 제1이격거리는 상기 제2이격거리보다 짧은 길이를 갖도록 상기 제1무선충전용 안테나가 배치되는 제1시트의 일면이 상기 제2무선충전용 안테나 및 NFC 안테나가 배치되는 제2시트의 일면에 대하여 높이차를 갖는 단차면으로 형성되는 차량용 무선충전 송신모듈을 제공한다.
- [0023] 또한, 상기 제1무선충전용 안테나는 Qi 방식으로 작동하는 제1안테나와 PMA 방식으로 작동하는 제2안테나를 포함할 수 있다.
- [0024] 또한, 상기 단차면은 상기 제2시트의 일면에 대하여 상기 제1시트의 일면이 일정높이 돌출되도록 배치될 수 있다.
- [0025] 삭제
- [0026] 또한, 상기 제1시트는 상기 제2시트의 내측에 배치될 수 있으며, 상기 제1시트는 상기 제2시트에 비하여 상대적으로 좁은 면적을 갖도록 구비되어 상기 제2시트의 상부면에 적층될 수 있다.
- [0027] 또한, 상기 제2시트의 내부에는 상기 제1시트의 일부두께를 수용하기 위한 수용부가 구비될 수 있으며, 상기 수용부는 상기 제2시트의 일면으로부터 일정깊이 함몰되는 수용홈으로 형성되거나 상기 제2시트를 관통하는 관통구로 형성될 수 있다.
- [0028] 또한, 상기 제1이격거리는 2mm ~ 5mm일 수 있고, 상기 제2이격거리는 10mm ~ 50mm일 수 있다.
- [0029] 또한, 상기 제1시트는 동작주파수가 100kHz~350kHz인 주파수 대역에서 상기 제2시트보다 상대적으로 높은 투자율을 갖도록 구비될 수 있으며, 상기 제1시트는 동작주파수가 100kHz~350kHz인 주파수 대역에서 상기 제2시트와 동일한 투자율을 갖는 경우 상기 제1시트의 투자손실률이 상기 제2시트의 투자손실률보다 상대적으로 작은 값을 갖도록 구비될 수 있다.
- [0030] 또한, 상기 제2시트는 동작주파수가 6.765MHz ~ 6.795MHz인 주파수 대역 및 13.56MHz의 주파수에서 상기 제1시

트보다 상대적으로 높은 투자율을 갖도록 구비될 수 있으며, 상기 제2시트는 동작주파수가 6.765MHz ~ 6.795MHz인 주파수 대역 및 13.56MHz의 주파수에서 상기 제1시트와 동일한 투자율을 갖는 경우 상기 제2시트의 투자손실률이 상기 제1시트의 투자손실률보다 상대적으로 작은 값을 갖도록 구비될 수 있다.

[0031] 또한, 상기 제1시트는 동작주파수가 100kHz~350kHz인 주파수 대역에서 300~3500의 투자율을 갖고, $\tan \delta (= \mu'' / \mu')$ 가 0.05이하이며, 포화자속밀도가 0.25T 이상인 재질로 이루어지고, 상기 제2시트는 동작주파수가 6.765MHz ~ 6.795MHz인 주파수 대역 및 13.56MHz의 주파수에서 30~350의 투자율을 갖고, $\tan \delta (= \mu'' / \mu')$ 가 0.05이하이며, 동작주파수가 6.765MHz ~ 6.795MHz인 주파수 대역에서 자속밀도가 0.25T 이상인 재질로 이루어질 수 있다. (여기서, μ' 은 투자율이고, μ'' 은 투자손실율임).

[0032] 또한, 상기 제1시트는 100kHz~350kHz 주파수대역에서 투자율이 2000~3500이고 $\tan \delta (= \mu'' / \mu')$ 가 0.05이하인 Mn-Zn 페라이트 또는 100kHz~350kHz 주파수대역에서 투자율이 300~1500이고 $\tan \delta (= \mu'' / \mu')$ 가 0.05이하인 Ni-Zn 페라이트 중 어느 하나이고, 상기 제2시트는 6.765MHz ~ 6.795MHz인 주파수 대역 및 13.56MHz의 주파수에서 투자율이 100~350이고 $\tan \delta (= \mu'' / \mu')$ 가 0.05이하인 Ni-Zn 페라이트 또는 6.765MHz ~ 6.795MHz인 주파수 대역 및 13.56MHz의 주파수에서 투자율이 30~70이고 $\tan \delta (= \mu'' / \mu')$ 가 0.05이하인 메탈 폴리머 중 어느 하나일 수 있다.

[0033] 또한, 상기 제1시트 및 제2시트는 비정질 합금 또는 나노 결정립 합금으로 이루어진 리본시트, 소결 페라이트 시트 또는 메탈 폴리머 시트 중 어느 하나를 포함할 수 있다.

[0034] 또한, 상기 메탈 폴리머는 Fe-Si-Cr계 메탈 폴리머 또는 Fe-Si-Al계 메탈 폴리머 중 어느 하나일 수 있으며, 상기 리본시트는 복수 개의 비정질 합금 또는 나노 결정립 합금의 리본시트가 적층되어 구성될 수 있다.

[0035] 또한, 상기 차폐유닛은 복수 개의 미세 조각으로 분리형성될 수 있다.

[0036] 또한, 상기 복수 개의 미세 조각들은 서로 이웃하는 미세 조각들 간에 전체적으로 절연되거나 부분적으로 절연될 수 있고, 상기 복수 개의 미세 조각은 1 μ m ~ 3mm의 크기일 수 있으며, 상기 복수 개의 미세 조각은 비정형으로 이루어질 수 있다.

발명의 효과

[0037] 본 발명에 의하면, 충전방식이 상이한 적어도 두 개의 무선충전용 안테나를 동시에 배치함으로써 자기유도방식과 자기공진방식을 모두 사용하여 무선충전을 수행할 수 있으며, Qi방식, PMA 방식 및 자기공진방식을 모두 사용할 수 있어 호환성을 높이고 사용편의성을 높일 수 있다.

[0038] 또한, 본 발명은 안테나유닛에 근거리 통신을 위한 NFC 안테나가 포함됨으로써 하나의 모듈을 통해 무선충전뿐만 아니라 데이터의 송,수신이 가능하므로 다기능화를 구현할 수 있다.

[0039] 더욱이, 본 발명은 충전대상인 전자기기가 접촉하는 접촉면과 해당 무선충전용 안테나와의 이격거리를 서로 다르게 배치함으로써 자기유도방식과 자기공진방식 모두 충전효율을 높일 수 있다.

도면의 간단한 설명

[0040] 도 1은 본 발명의 일 실시예에 따른 차량용 무선충전 송신모듈을 나타낸 개략도,

도 2는 도 1의 저면도,

도 3은 도 1의 A-A 단면도,

도 4는 본 발명의 일 실시예에 따른 차량용 무선충전 송신모듈에서 제2시트에 수용부가 형성되는 경우를 나타낸 도면으로서, a)는 수용부가 관통구로 형성되는 경우이고, b)는 수용부가 수용홈으로 형성되는 경우,

도 5는 본 발명의 일 실시예에 따른 차량용 무선충전 송신모듈에서 차폐시트가 복수 개의 비정질 합금 또는 나노 결정립 합금의 리본시트가 적층된 형태를 나타낸 도면, 그리고,

도 6은 본 발명의 일 실시예에 따른 차량용 무선충전 송신모듈에서 제1무선충전용 안테나가 3개로 구비되는 경우를 나타낸 개략도이다.

발명을 실시하기 위한 구체적인 내용

[0041] 이하, 첨부한 도면을 참고로 하여 본 발명의 실시예에 대하여 본 발명이 속하는 기술분야에서 통상의 지식을 가

진 자가 용이하게 실시할 수 있도록 상세히 설명한다. 본 발명은 여러 가지 상이한 형태로 구현될 수 있으며 여기에서 설명하는 실시예에 한정되지 않는다. 도면에서 본 발명을 명확하게 설명하기 위해서 설명과 관계없는 부분은 생략하였으며, 명세서 전체를 통하여 동일 또는 유사한 구성요소에 대해서는 동일한 참조부호를 부가한다.

- [0042] 본 발명의 일 실시예에 따른 차량용 무선충전 송신모듈(100)은 차량 내에 설치되어 충전하고자 하는 전자기기 측으로 무선 신호를 송출하기 위한 것으로, 도 1 내지 도 3에 도시된 바와 같이 하우징(130), 안테나유닛(110) 및 차폐유닛(120)을 포함한다.
- [0043] 상기 하우징(130)은 상기 안테나유닛(110) 및 차폐유닛(120)을 수납하기 위한 내부공간을 갖는 함체형상으로 구비된다.
- [0044] 이때, 상기 하우징(130)의 내부에는 도시하지는 않았지만 기본적으로 충전기로서의 기능을 수행하기 위한 통상의 구성요소들, 즉 차량 전원으로부터 전력을 공급받는 전원회로부와, 상기 전원회로부를 통해 공급받은 전력을 안테나유닛(110)에 전달하여 충전대상인 전자기기 측으로 송출하는 안테나구동회로부와, 상기 안테나구동회로부의 구동제어 및 전력 전송제어를 포함하여 제반 작동을 제어하는 제어 회로부 등을 포함할 수 있다.
- [0045] 여기서, 상기 전자기기는 휴대폰, PDA, PMP, 태블릿, 멀티미디어 기기 등일 수 있다.
- [0046] 상기 안테나유닛(110)은 서로 다른 동작주파수에서 상이한 방식으로 작동하는 복수 개의 무선충전용 안테나(111, 112)가 구비되어 해당 동작주파수 대역에서 무선신호를 송출함으로써 상술한 전자기기가 필요로 하는 전력을 전달하기 위한 것이다.
- [0047] 이때, 본 발명에 따른 차량용 무선충전 송신모듈(100)은 무선충전기능에 더하여 데이터 송,수신이 가능하도록 상기 안테나유닛(110)에 NFC 안테나(113)가 포함된다.
- [0048] 여기서, 상기 복수 개의 안테나(111, 112, 113)는 일정길이를 갖는 도전성부재가 시계방향 또는 반시계 방향으로 복수 회 권선되는 원형, 타원형 또는 사각형상의 평판형 코일로 구성되어 상기 차폐유닛(120)의 일면에 고정되는 형태로 구비될 수 있다. 이때, 상기 도전성부재는 구리와 같은 도전성을 갖는 금속재질일 수 있으며, 소정의 선경을 갖는 복수 개의 가닥이 길이방향을 따라 꼬인 형태로 구비될 수도 있다. 더불어, 상기 복수 개의 안테나(111, 112, 113)가 평판형 코일로 구성되는 경우 상기 각각의 안테나(111, 112, 113)를 전기적으로 연결하기 위한 각각의 리드선(114a, 114b, 114c, 114d)이 상기 차폐유닛(120)의 저면에 형성될 수 있다(도 2 참조).
- [0049] 또한, 상기 복수 개의 안테나(111, 112, 113)는 폴리이미드(PI)나 PET 등과 같은 합성수지로 이루어진 회로기판의 적어도 일면에 동박 등과 같은 전도체를 루프 형태로 패터닝하거나 전도성 잉크를 사용하여 루프 형상의 금속 패턴을 형성하여 구성될 수도 있다.
- [0050] 더불어, 상기 복수 개의 안테나(111, 112, 113)는 도전성부재가 복수 회 권선된 평판형코일과 회로기판의 일면에 인쇄된 안테나 패턴이 상호 조합된 형태로 구비될 수도 있다.
- [0051] 이때, 상기 복수 개의 무선충전용 안테나는 자기유도 방식으로 작동하는 제1무선충전용 안테나(111) 및 자기공진 방식으로 작동하는 제2무선충전용 안테나(112)로 구성된다.
- [0052] 일례로, 상기 제1무선충전용 안테나(111)는 동작주파수가 100~350kHz인 주파수 대역에서 자기유도 방식으로 작동하는 Qi 또는 PMA 방식의 안테나일 수 있고, 상기 제2무선충전용 안테나(112)는 동작주파수가 6.765~6.795MHz인 주파수 대역에서 자기공진 방식으로 작동하는 A4WP 방식의 안테나일 수 있다.
- [0053] 즉, 본 발명에서는 상기 안테나유닛(110)이 자기유도방식과 자기공진방식으로 각각 작동하는 제1무선충전용 안테나(111) 및 제2무선충전용 안테나(112)가 각각 구비됨으로써 하나의 모듈을 통하여 두 가지 방식의 무선충전을 모두 수행할 수 있게 된다.
- [0054] 여기서, 자기유도방식으로 작동하는 상기 제1무선충전용 안테나(111)는 Qi 방식의 안테나일 수도 있고, PMA 방식의 안테나일 수도 있으며, 바람직하게는 Qi 방식으로 작동하는 제1안테나(111a)와 PMA 방식으로 작동하는 제2안테나(111b)가 각각 구비될 수 있다. 또한, 상기 제1무선충전용 안테나(111)는 3개로 구비되고 어느 하나의 안테나가 다른 두 개의 안테나와 일부 중첩되도록 배치될 수도 있다(도 6 참조). 더불어, 상기 제1무선충전용 안테나(111)는 하나의 코일을 통하여 Qi 방식 및 PMA 방식을 통합하여 사용할 수도 있음을 밝혀둔다.
- [0055] 이에 따라, 본 발명에 따른 차량용 무선충전 송신모듈(100)은 차량 내에 설치되어 동작주파수 또는 작동방식이 상이한 Qi 방식, PMA 방식 및 A4WP 방식을 모두 이용하여 충전을 수행할 수 있음으로써 충전대상인 휴대폰과 같은 전자기기의 충전방식이 자기유도방식이든 자기공진방식이든 매칭되는 안테나를 이용하여 무선충전을 수행할

수 있게 되므로 차량 내에 설치된 무선충전 송신모듈을 교체할 필요없이 모든 방식의 무선충전을 수행할 수 있게 된다.

- [0056] 한편, 상기 안테나유닛(110)은 상기 제1무선충전용 안테나(111) 및 제2무선충전용 안테나(112) 사이에 근거리 통신을 위한 NFC 안테나(113)가 구비된다.
- [0057] 즉, 본 발명에 따른 안테나유닛(110)은 상기 제1무선충전용 안테나(111) 및 제2무선충전용 안테나(112) 사이에 근거리 통신을 위한 NFC(Near Field Communicatio) 안테나(113)를 포함하는 콤보형으로 구비된다.
- [0058] 이에 따라, 본 발명에 따른 안테나유닛(110)은 자기유도방식의 무선충전과 자기공진방식의 무선충전뿐만 아니라, 근거리 데이터 통신도 수행할 수 있는 복합 안테나의 역할을 수행할 수 있게 된다.
- [0059] 여기서, 상기 NFC 안테나(113)를 통해 송,수신되는 데이터는 주유량, 각종 차량 소모품의 마모 상태, 브레이크의 정상작동 여부 등 차량의 상태에 대한 각종 정보일 수 있으며, 상술한 휴대폰 등과 같은 전자기기와 데이터 교환이 이루어질 수 있다.
- [0060] 상기 차폐유닛(120)은 상기 안테나유닛(110)에서 발생하는 자기장을 차폐하여 외부 누출을 방지함과 아울러 소요의 방향으로 집중시킴으로써 해당안테나의 특성을 높여주기 위한 것이다.
- [0061] 이러한 차폐유닛(120)은 상기 안테나유닛(110)이 소정의 주파수 대역에서 무선신호를 송신할 때 발생하는 자기장을 차폐하여 소요의 방향으로 자기장의 집중도를 높여줌으로써 소정의 주파수 대역에서 작동하는 안테나의 특성을 높여준다.
- [0062] 이를 위해, 상기 차폐유닛(120)은 상기 안테나유닛(110)에서 발생하는 자기장을 차폐할 수 있도록 자성을 갖는 재질로 이루어진다. 여기서, 상기 차폐유닛(120)은 자성체로 이루어지고 일정 면적을 갖는 판상의 차폐시트(121,122)만으로 구비될 수도 있고, 상기 차폐시트(121,122)의 적어도 일면에 부착되어 상기 차폐시트(121,122)를 보호하는 보호필름(125)을 포함할 수도 있다.
- [0063] 일례로, 상기 차폐시트(121,122)는 비정질 합금 또는 나노 결정립 합금의 리본시트, 페라이트 시트 또는 폴리머 시트 등이 사용될 수 있고, 100kHz ~ 350kHz 및 6.765MHz ~ 6.795MHz의 주파수 대역에서 포화자속밀도가 테슬라 이상일 수 있다.
- [0064] 바람직하게는 각각의 무선충전용 안테나(111,112)가 작동하는 100kHz ~ 350kHz 및 6.765MHz ~ 6.795MHz의 주파수 대역에서 포화자속밀도가 0.35테슬라 이상일 수 있다. 이는, 차폐시트의 포화자속밀도가 높을 수록 자기장에 의한 포화가 늦게 발생되므로 포화자속밀도가 낮은 차폐시트에 비하여 얇은 두께를 사용할 수 있기 때문이다.
- [0065] 또한, 상기 차폐시트(121,122)는 각각의 안테나(111,112,113)가 작동하는 100kHz ~ 350kHz, 6.765MHz ~ 6.795MHz 및 13.56MHz의 주파수 대역에서 $\tan \delta (= \mu'' / \mu')$ 가 0.05이하인 재질로 이루어질 수 있다(μ' 은 투자율이고, μ'' 은 투자손실율임).
- [0066] 여기서, 상기 페라이트 시트는 소결 페라이트 시트일 수 있으며, Ni-Zn 페라이트 또는 Mn-Zn 페라이트가 사용될 수 있다. 더불어, 상기 비정질 합금 또는 나노결정립 합금은 Fe계 또는 Co계 자성 합금이 사용될 수 있다. 더불어, 상기 폴리머 시트는 Fe-Si-Al계 메탈 폴리머 또는 Fe-Si-Cr계 메탈 폴리머일 수 있다.
- [0067] 또한, 상기 차폐시트(121,122)는 도 5에 도시된 바와 같이 복수 개의 비정질 합금 또는 나노 결정립 합금의 리본시트(123a,123b,123c)가 적층된 형태로 구성될 수도 있음을 밝혀둔다.
- [0068] 더불어, 상기 차폐시트(121,122)는 저항을 높여 와전류의 발생을 억제할 수 있도록 복수 개의 미세 조각으로 분리 형성될 수 있으며, 복수 개의 미세 조각들은 서로 이웃하는 미세 조각들 간에 전체적으로 절연되거나 부분적으로 절연되도록 구비될 수 있다.
- [0069] 이때, 상기 복수 개의 미세 조각은 1 μ m ~ 3mm의 크기로 구비될 수 있으며, 각각의 조각들은 비정형으로 랜덤하게 이루어질 수 있다.
- [0070] 그리고 미세조각으로 분리형성된 복수 개의 시트(123a,123b,123c)가 적층되어 차폐시트(121,122)를 구성하는 경우 각각의 시트(123a,123b,123c) 사이에는 비전도성 재질로 이루어진 접착층(123d)이 배치되어 서로 적층되는 한 쌍의 시트 사이에 스며들 수 있도록 함으로써 상기 접착층(123d)이 각각의 시트를 구성하는 복수 개의 미세 조각을 절연하는 역할을 수행할 수도 있다. 여기서, 상기 접착층(123d)은 접착제로 구비될 수도 있으며 필름 형태의 기재의 일면 또는 양면에 접착제가 도포된 형태로 구비될 수도 있다.

- [0071] 한편, 상기 차폐시트는 상기 안테나유닛(110)이 서로 다른 주파수 대역에서 작동하는 제1무선충전용 안테나(111) 및 제2무선충전용 안테나(112)로 구성되는 경우 하나의 시트로 이루어질 수도 있지만, 서로 다른 주파수 대역에서 작동하는 상기 제1무선충전용 안테나(111) 및 제2무선충전용 안테나(112)에 대응하여 해당 안테나의 특성을 각각 높여줄 수 있도록 서로 다른 특성을 갖는 복수 개의 시트(121, 122)로 구성될 수 있다.
- [0072] 일례로, 상기 차폐시트는 서로 다른 주파수 대역에서 자기유도방식과 자기공진방식으로 각각 작동하는 제1무선충전용 안테나(111) 및 제2무선충전용 안테나(112)의 특성을 각각 향상시킬 수 있도록 소정의 주파수 대역에서 서로 다른 특성을 갖는 제1시트(121) 및 제2시트(122)로 구성될 수 있다.
- [0073] 이때, 상기 NFC 안테나(113)는 제1시트(121) 또는 제2시트(122)에 적절하게 배치될 수 있지만, 자기공진방식으로 작동하는 상기 제2무선충전용 안테나(112)가 배치되는 제2시트(122)의 일면에 배치될 수 있다.
- [0074] 이는, 동작주파수가 서로 근접한 안테나가 하나의 차폐시트를 통하여 동작주파수가 근접한 두 개의 안테나의 특성을 모두 향상시킬 수 있도록 하기 위함이다.
- [0075] 즉, 동작주파수가 13.56MHz인 NFC 안테나(113)는 동작주파수가 6.765MHz ~ 6.795MHz인 상기 제2무선충전용 안테나(112)가 배치되는 제2시트(122)에 배치된다.
- [0076] 구체적으로 설명하면, 상기 제1시트(121)는 저주파 대역에서 자기유도방식에 의해 작동하는 상기 제1무선충전용 안테나(111)의 특성을 높여줄 수 있도록 상기 제1무선충전용 안테나(111)와 대응되는 영역에 배치되며, 상기 제2시트(122)는 고주파 대역에서 자기공진방식에 의해 작동하는 상기 제2무선충전용 안테나(112) 및 NFC 안테나(113)의 특성을 동시에 높여줄 수 있도록 상기 제2무선충전용 안테나(112) 및 NFC 안테나(113)와 대응되는 영역에 각각 배치된다.
- [0077] 여기서, 상기 제1시트(121)는 상기 제1무선충전용 안테나(111)를 포함하는 면적을 갖도록 구비되며, 상기 제2시트(122)는 상기 제2무선충전용 안테나(112) 및 NFC 안테나(113)를 포함하는 면적을 갖도록 구비된다.
- [0078] 일례로, 상기 제1무선충전용 안테나(111)가 제2무선충전용 안테나(112)의 내측에 배치되는 경우 상기 제1시트(121)는 상기 제2시트(122)의 내측에 배치되는 형태로 구비된다.
- [0079] 이때, 상기 제1시트(121)는 도 3에 도시된 바와 같이 상기 제2시트(122)보다 상대적으로 좁은 면적을 갖도록 구비되어 상기 제2시트(122)의 일면에 적층되는 형태로 구비될 수 있다.
- [0080] 더불어, 상기 차폐유닛(120)은 도 4a 및 도 4b에 도시된 바와 같이 상기 제2시트(122)의 내부에 수용부가 구비됨으로써 상기 제1시트(121)의 일부 두께를 수용하는 형태로 구비될 수도 있다.
- [0081] 즉, 도 4a에 도시된 바와 같이 상기 수용부는 상기 제2시트(122)를 관통하는 관통구(126a)의 형태로 구비되어 상기 제1시트(121)가 상기 관통구(126a)에 삽입되는 형태로 구비될 수도 있고, 상기 수용부가 제2시트(122)의 일면으로부터 일정깊이 함몰형성되는 수용홈(126b)의 형태로 구비되어 상기 제1시트(121)가 상기 수용홈(126b)에 안착되는 형태로 구비될 수도 있다.
- [0082] 이때, 상기 제1시트(121) 및 제2시트(122)는 소정의 주파수 대역에서 서로 다른 투자율이나 서로 다른 포화자기장을 갖도록 구비될 수도 있으며, 소정의 주파수 대역에서 상기 제1시트(121) 및 제2시트(122)의 투자율이 동일한 경우 투자손실률이 서로 다른 값을 갖도록 구비될 수도 있다.
- [0083] 구체적으로 설명하면, 상기 제1시트(121)는 저주파 대역인 100~350kHz의 주파수 대역에서 상기 제2시트보다 상대적으로 높은 투자율을 갖도록 구비될 수 있고, 100~350kHz의 주파수 대역에서 상기 제2시트보다 상대적으로 큰 포화자기장을 갖도록 구비될 수 있으며, 100~350kHz의 주파수 대역에서 상기 제1시트(121) 및 제2시트(122)가 서로 동일한 투자율을 갖는 경우 상기 제1시트(121)의 투자손실률이 상기 제2시트(122)의 투자손실률보다 상대적으로 작은 값을 갖도록 구비될 수 있다.
- [0084] 여기서, 상기 제1시트(121)는 저주파 대역인 100~350kHz의 주파수 대역에서 300~3500의 투자율을 갖고, $\tan \delta (= \mu'' / \mu')$ 가 0.05이하이며, 포화자속밀도가 0.25T 이상인 재질로 이루어질 수 있다.
- [0085] 일례로, 상기 제1시트(121)는 100kHz~350kHz 주파수대역에서 투자율이 2000~3500이고 $\tan \delta (= \mu'' / \mu')$ 가 0.05이하인 Mn-Zn 페라이트가 사용될 수 있고, 100kHz~350kHz 주파수대역에서 투자율이 300~1500이고 $\tan \delta (= \mu'' / \mu')$ 가 0.05이하인 Ni-Zn 페라이트가 사용될 수 있다.
- [0086] 더불어, 상기 제2시트(122)는 고주파대역인 6.765MHz ~ 6.795MHz 및 13.56MHz에서 상기 제1시트보다 상대적으로

높은 투자율을 갖도록 구비될 수 있고, 6.765MHz ~ 6.795MHz 및 13.56MHz의 주파수 대역에서 상기 제1시트(121) 및 제2시트(122)가 서로 동일한 투자율을 갖는 경우 상기 제2시트(122)의 투자손실률이 상기 제1시트(121)의 투자손실률보다 상대적으로 작은 값을 갖도록 구비될 수 있다.

[0087] 여기서, 상기 제2시트(122)는 동작주파수가 6.765MHz ~ 6.795MHz 및 13.56MHz에서 30~350의 투자율을 갖고, $\tan \delta (= \mu'' / \mu')$ 가 0.05이하이며, 포화자속밀도가 0.25T 이상인 재질로 이루어질 수 있다.

[0088] 일례로, 상기 제2시트(122)는 6.765MHz ~ 6.795MHz 및 13.56MHz에서 투자율이 100~350이고 $\tan \delta (= \mu'' / \mu')$ 가 0.05이하인 Ni-Zn 페라이트가 사용될 수 있고, 6.765MHz ~ 6.795MHz 및 13.56MHz에서 투자율이 30~70이고 $\tan \delta (= \mu'' / \mu')$ 가 0.05이하인 메탈 폴리머가 사용될 수 있다.

[0089] 이는, 상기 제1시트(121)가 100~350kHz의 주파수 대역에서 상기 제2시트(122)보다 상대적으로 높은 투자율을 갖기 때문에 자기유도방식에 의한 무선 충전시 상기 제1무선충전용 안테나(111)에서 생성되는 교류 자기장이 상대적으로 높은 투자율을 갖는 제1시트(121)측으로 유도된다. 이때, 상기 제1시트(121)가 제1무선충전용 안테나(111)와 대응되는 영역에 배치되어 있으므로 상기 제1시트(121)측으로 유도된 교류 자기장은 상기 제1시트(121)에 의해 차폐되어 소요의 방향으로 집중됨으로써 무선충전 수신모듈 측으로 효율적으로 송신할 수 있게 된다.

[0090] 또한, 상기 제2시트(122)의 경우 6.765MHz ~ 6.795MHz에서 상기 제1시트(121)보다 상대적으로 높은 투자율을 갖기 때문에 자기공진방식에 의한 무선 충전시 상기 제2무선충전용 안테나(112)에서 생성되는 교류 자기장이 상대적으로 높은 투자율을 갖는 제2시트(122)측으로 유도된다. 이때, 상기 제2시트(122)가 제2무선충전용 안테나(112)와 대응되는 영역에 배치되어 있으므로 상기 제2시트(122)측으로 유도된 교류 자기장은 상기 제2시트(122)에 의해 차폐되어 소요의 방향으로 집중됨으로써 무선충전 수신모듈 측으로 효율적으로 송신할 수 있게 된다.

[0091] 더하여, 상기 NFC 안테나(113)를 통한 데이터 통신시에도 13.56MHz의 주파수에서 상기 제2시트(122)가 제1시트(121)보다 상대적으로 높은 투자율을 갖기 때문에 데이터 통신시 발생하는 자기장 역시 상대적으로 높은 투자율을 갖는 제2시트(122)측으로 유도된다. 이때, 상기 제2시트(122)가 NFC 안테나(113)와 대응되는 영역에 배치되어 있으므로 상기 제2시트(122)측으로 유도된 자기장은 상기 제2시트(122)에 의해 차폐되어 소요의 방향으로 집중됨으로써 데이터의 송,수신 감도를 높일 수 있게 된다.

[0092] 더불어, 100~350kHz의 주파수 대역에서 상기 제1시트(121) 및 제2시트(122)가 서로 동일한 투자율을 갖더라도 상기 제1시트(121)의 투자손실률이 상기 제2시트(122)의 투자손실률보다 상대적으로 작은 값을 갖도록 구비되면 결과적으로 무선 충전 작동시 투자손실률에 의한 투자율의 손실이 줄어들게 된다.

[0093] 이에 따라, 100~350kHz 범위의 동작주파수의 전력 전송에 따라 생성되는 교류 자기장이 상대적으로 높은 투자율을 갖는 제1시트(121)측으로 유도됨으로써 상기 제1시트(121)와 대응되는 영역에 배치된 제1무선충전용 안테나(111)를 통해 무선충전 수신모듈 측으로 높은 효율로 송신될 수 있도록 유도하게 된다.

[0094] 마찬가지로, 6.765MHz ~ 6.795MHz 및 13.56MHz의 주파수에서 상기 제1시트(121) 및 제2시트(122)가 서로 동일한 투자율을 갖더라도 상기 제2시트(122)의 투자손실률이 상기 제1시트(121)의 투자손실률보다 상대적으로 작은 값을 갖도록 구비되면 결과적으로 무선 충전 또는 데이터 통신시 투자손실률에 의한 투자율의 손실이 줄어들게 된다.

[0095] 이에 따라, 6.765MHz ~ 6.795MHz 및 13.56MHz의 주파수에서 자기장이 상대적으로 높은 투자율을 갖는 제2시트(122)측으로 유도됨으로써 상기 제2시트(122)와 대응되는 영역에 배치된 제2무선충전용 안테나(112) 및 NFC 안테나(113)를 통해 무선 전력을 높은 효율로 송신하거나 데이터의 송,수신 감도를 높일 수 있게 된다.

[0096] 여기서, 상기 제1시트(121)로서 Mn-Zn 페라이트 또는 Ni-Zn 페라이트가 사용되고, 상기 제2시트(122)로서 Ni-Zn 페라이트 또는 메탈 폴리머가 사용되는 것으로 설명하였지만 이에 한정하는 것은 아니며, 투자율, 포화자기장 및 투자손실률이 해당 주파수 대역에서 서로의 시트에 대하여 상대적인 조건을 만족하기만 하면 상기 제1시트(121) 및 제2시트(122)의 재질은 다양하게 변경될 수 있음을 밝혀둔다.

[0097] 일례로, 상기 제1시트(121) 및 제2시트(122)는 100~350kHz, 6.765MHz ~ 6.795MHz 및 13.56MHz의 동작주파수에서 서로 다른 투자율을 갖는 동일한 재질로 이루어질 수도 있으며, 상기 제1시트(121)가 비정질 합금 또는 나노 결정립 합금의 리본시트가 사용될 수도 있다. 이는, 동일한 재질로 이루어지더라도 열처리 온도, 적층 수 등과 같은 여러가지 조건의 변화를 통해 서로 다른 특성(투자율, 포화자기장, 투자손실률 등)을 갖도록 제조될 수 있

기 때문이다.

- [0098] 더불어, 상기 제1시트(121) 및 제2시트(122) 중 적어도 어느 하나가 비정질 합금 또는 나노 결정립 합금의 리본시트가 사용되는 경우, 단층의 리본시트가 사용될 수도 있지만, 도 5에 도시된 바와 같이 복수 개의 비정질 합금 또는 나노 결정립 합금의 리본시트가 적층된 형태로 제1시트(121) 및/또는 제2시트(122)로 구성될 수도 있다.
- [0099] 한편, 상기 제1시트(121) 및 제2시트(122)는 상기 제1무선충전용 안테나(111) 및 제2무선충전용 안테나(112)가 배치되는 일면이 단차면을 형성하도록 배치된다. 이때, 상기 단차면은 상기 제2무선충전용 안테나(112)가 배치되는 제2시트(122)의 일면에 대하여 상기 제1무선충전용 안테나(111)가 배치되는 제1시트(121)의 일면이 일정높이 돌출되도록 형성된다.
- [0100] 이는, 자기유도 방식으로 작동하는 제1무선충전용 안테나(111)로부터 충전대상인 전자기기와의 이격거리와 자기공진 방식으로 작동하는 제2무선충전용 안테나(112)로부터 충전대상인 전자기기와와의 이격거리를 서로 다르게 하기 위함이다.
- [0101] 통상적으로, 무선충전 송신모듈에 구비되는 전송코일과 무선충전 수신모듈에 구비되는 수신코일간의 거리가 가까울수록 결합계수의 값이 커지게 된다.
- [0102] 이때, 자기공진방식으로 작동하는 안테나는 코일간의 결합계수(k)가 0.2미만인 수준을 사용하며 자기유도방식으로 작동하는 안테나는 코일간의 결합계수(k)가 0.7초과의 수준을 사용한다.
- [0103] 이는 자기공진방식의 경우 코일간의 결합계수가 0.2이상으로 높아지게 되면 스플릿(split)에 의한 효율저하가 발생되어 오히려 충전효율이 떨어지게 되므로 수신코일과 송신코일을 적정거리로 이격시켜 결합계수를 0.2미만으로 유지할 필요가 있다. 그러나, 자기유도방식의 경우 자기공진방식과는 반대로 코일간의 결합계수가 높을수록 충전 효율도 비례하여 올라가기 때문에 수신코일과 송신코일의 이격거리를 가깝게 유지할 필요가 있다.
- [0104] 이에 따라, 본 발명에서는 상기 제1시트(121) 및 제2시트(122)가 단차면을 형성하도록 배치하되, 자기유도방식으로 작동하는 제1무선충전용 안테나(111)가 배치되는 제1시트(121)의 일면이 자기공진방식으로 작동하는 제2무선충전용 안테나(112)가 배치되는 제2시트(122)의 일면보다 더 낮은 위치에 위치하도록 배치한다.
- [0105] 즉, 상기 제1무선충전용 안테나(111)로부터 상기 하우징(130)의 상판과의 제1이격거리(d1)는 상기 제2무선충전용 안테나(112)로부터 상기 하우징(130)의 상판과의 제2이격거리(d2)보다 짧은 길이를 갖게 된다.
- [0106] 여기서, 상기 하우징(130)은 상판(132)이 외부로 노출되도록 차량의 데시보드 또는 기어박스 등에 매립설치되며, 상기 상판(132)은 충전대상인 전자기기가 놓여지는 접촉면을 형성하게 된다.
- [0107] 이때, 상기 제1,2이격거리(d1,d2)는 도 3에 도시된 바와 같이 상기 전자기기가 놓여지는 상판의 외부면과의 이격거리를 의미하며, 상기 제1이격거리(d1)는 2mm ~ 5mm일 수 있으며, 상기 제2이격거리(d2)는 10mm ~ 50mm일 수 있다.
- [0108] 이에 따라, 사용자가 전자기기를 충전하고자 하는 경우 전자기기를 상기 하우징의 상판(132)에 올려놓게 되면, 전자기기는 제1무선충전용 안테나(111)와 매우 가까운 거리, 일례로 2mm ~ 5mm의 이격거리를 유지하게 되며, 제2무선충전용 안테나(112)와는 상대적으로 먼 적정 이격거리, 일례로 10mm ~ 50mm의 거리를 유지할 수 있게 된다.
- [0109] 이로 인해, 상기 전자기기가 자기유도방식으로 충전되는 기기일 경우에는 제1무선충전용 안테나(111)와 전자기기가 최대한 밀착된 거리를 유지하여 0.7이상의 결합계수를 유지할 수 있게 되므로 충전 효율을 높일 수 있으며, 상기 전자기기가 자기공진방식으로 충전되는 기기일 경우에도 제2무선충전용 안테나(112)와 전자기기가 적정거리 이격된 상태를 유지하여 0.2미만의 결합계수를 유지함으로써 과도한 코일결합에 의한 스플릿을 막고 하우징(130)의 상판(132) 표면에서의 고른 자기장 분포를 얻는데 유리하므로 충전효율을 높일 수 있게 된다.
- [0111] 이상에서 본 발명의 일 실시예에 대하여 설명하였으나, 본 발명의 사상은 본 명세서에 제시되는 실시 예에 제한되지 아니하며, 본 발명의 사상을 이해하는 당업자는 동일한 사상의 범위 내에서, 구성요소의 부가, 변경, 삭제, 추가 등에 의해서 다른 실시 예를 용이하게 제안할 수 있을 것이나, 이 또한 본 발명의 사상범위 내에 든다고 할 것이다.

부호의 설명

[0113] 100,200 : 차량용 무선충전 송신모듈

110 : 안테나윙넷

111 : 제1무선충전용 안테나

111a : 제1안테나

111b : 제2안테나

112 : 제2무선충전용 안테나

120 : 차폐유닛

121 : 제1시트

122 : 제2시트

123a, 123b, 123c : 비정질 합금 또는 나노 결정립 합금의 리본시트

123d : 접착층

124 : 접착층

125 : 보호필름

126a : 관통구

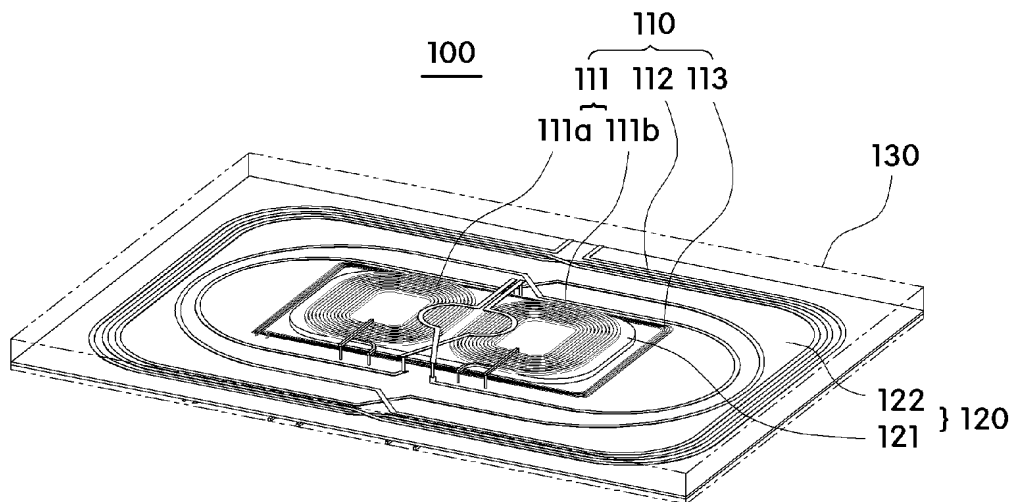
126b : 수용함

130 : 하우스징

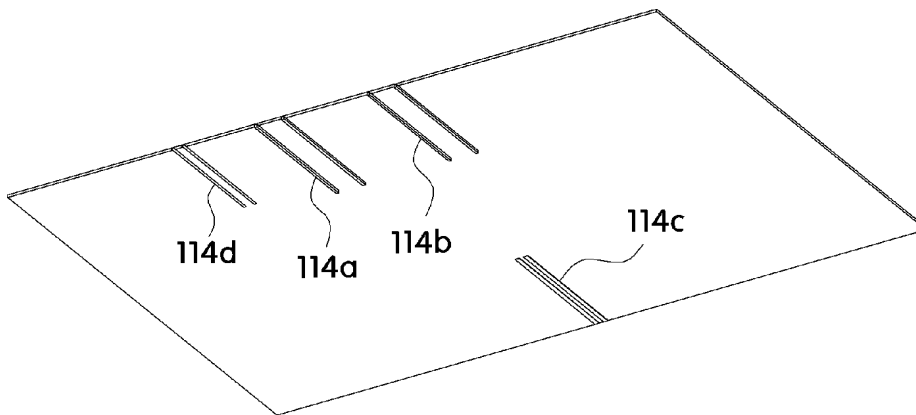
132 : 상판

59

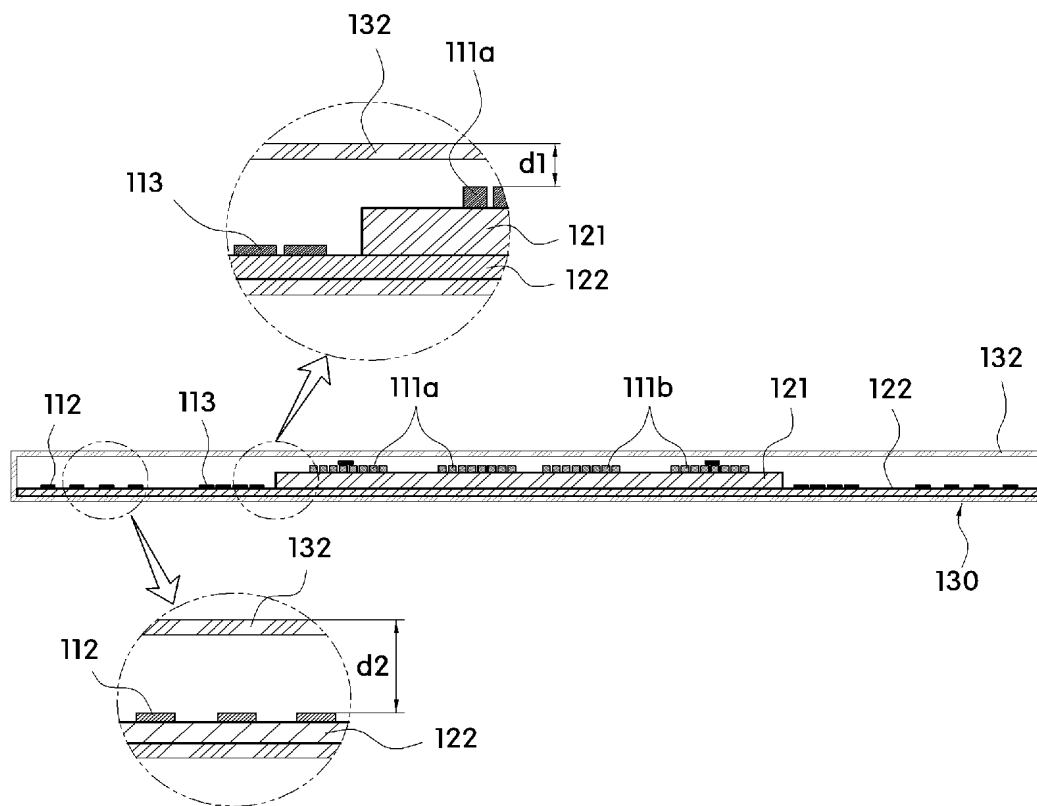
590



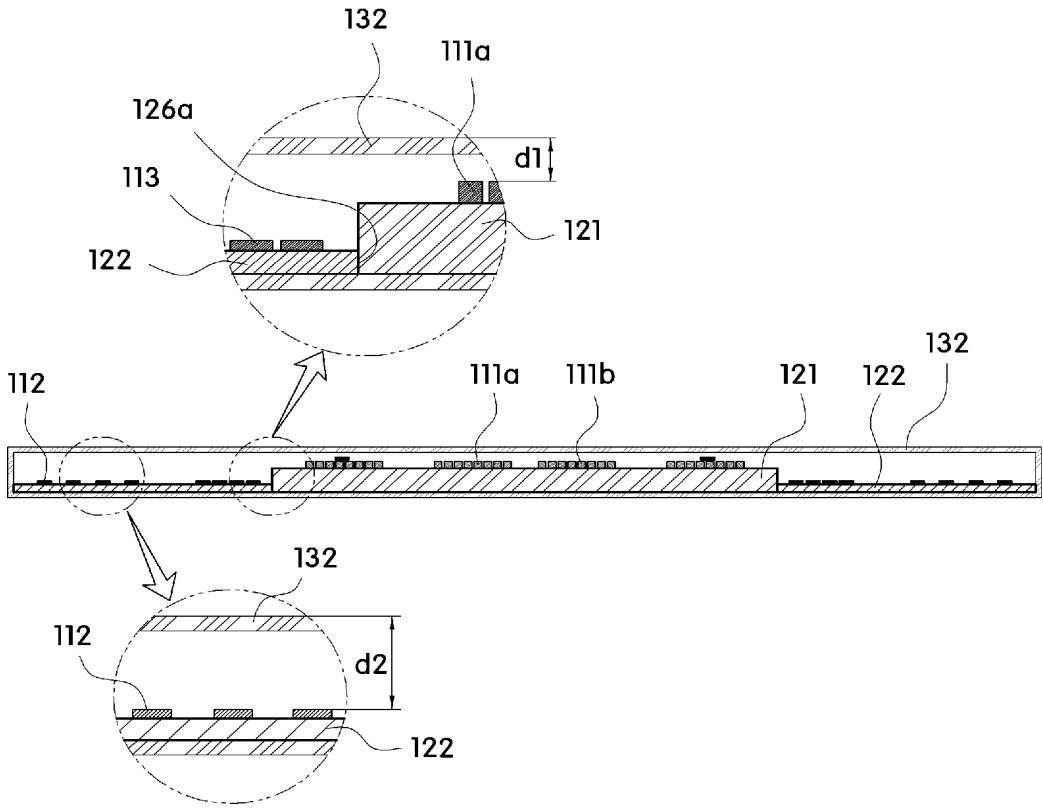
도 8b



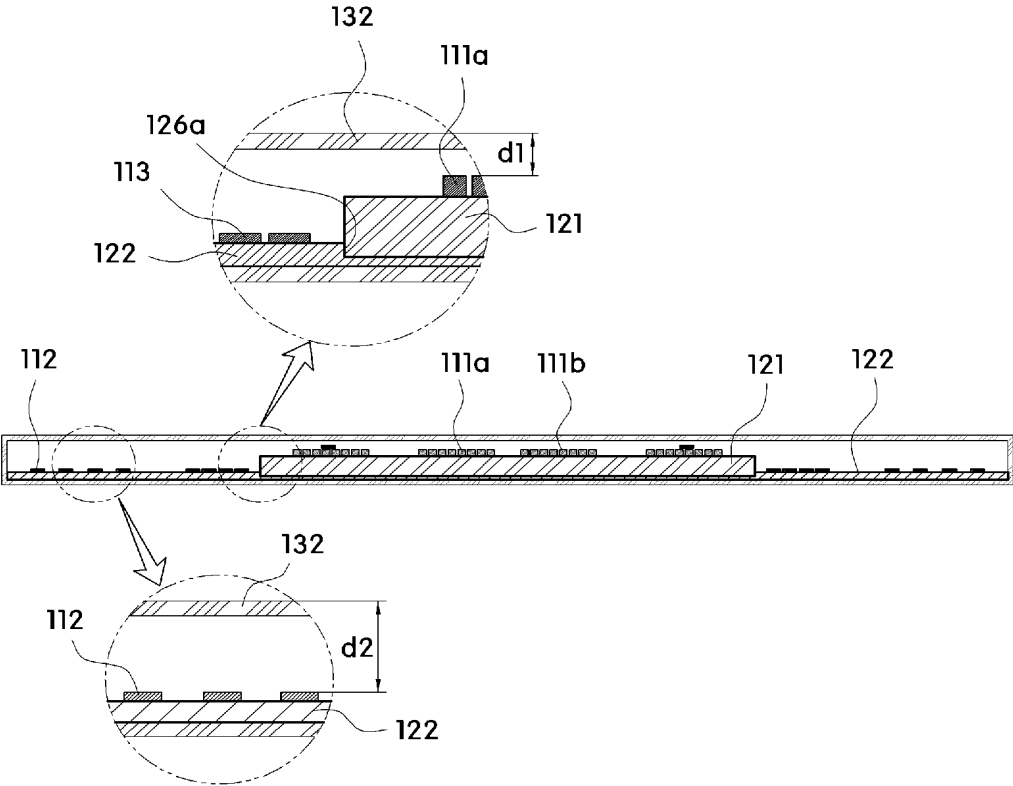
도 8c



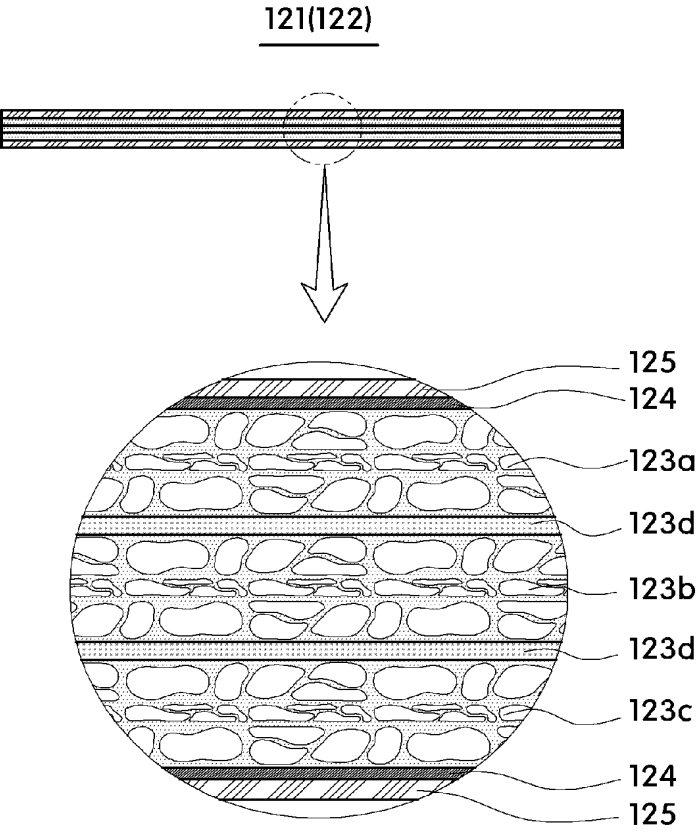
도 8/4a



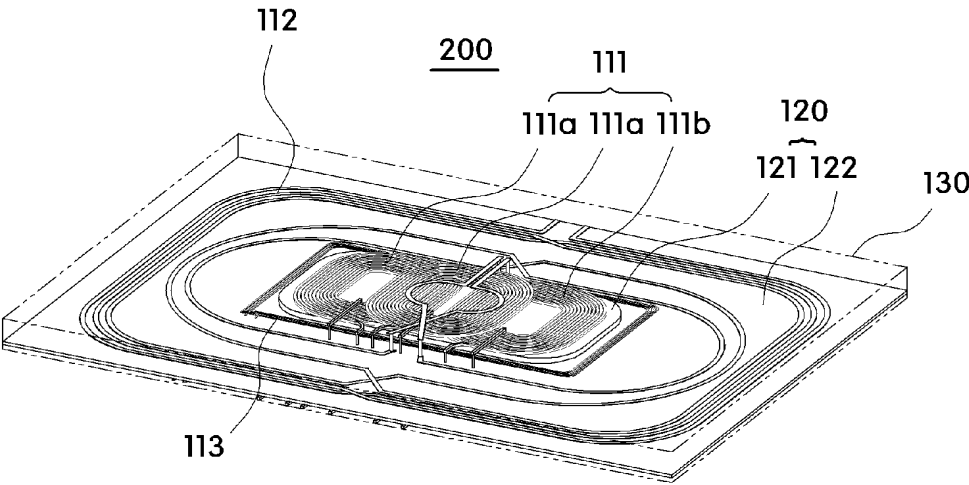
도면 4b



도 5



도 6



Magnetic sheet for communication module
List of publications
Publication date



- Application number 2015KR-0110038 Date 2015-08-04 [Register](#)
 - KR10-1719915 B1 Patent specification 2017-03-24

English Title

Magnetic sheet for communication module

Other Title

통신 모듈용 자성 시트

English Abstract (Native or MT)

The present invention relates to a magnetic sheet for a communication module made of a magnetic material, having cracks when the magnetic sheet is crushed. The magnetic sheet for the communication module comprises: a first area; and a second area which is adjacent to the first area wherein the first and second areas are crushed in different levels. As such, the present invention maximally uses a space, and simplifies a manufacturing process of the magnetic sheet.

Other Abstracts

본 발명은 자성 재료로 형성된 통신 모듈용 자성 시트에 있어서, 상기 자성 시트는 파쇄되어 크랙이 형성되고, 상기 자성 시트는 제 1 영역 및 상기 제 1 영역과 인접한 제 2 영역을 포함하며, 상기 제 1 및 제 2 영역은 파쇄되는 정도가 상이한 통신 모듈용 자성 시트에 관한 것이다.

Application Language

KOREAN (KOR)

Inventor(s)

LEE, SEUNG MIN
CHO, Jung Young
SO, JUNG-WOOK
PARK,DooHo

Inventor(s)

이승민
조중영
서정욱
박두호

Applicant/Assignee SAMSUNG ELECTRO MECHANICS| \$ 7 414 M

Assignee

삼성전기주식회사
Reg. Nb: 119980018064

Applicant/Assignee Address

SAMSUNG ELECTRO-MECHANICS CO., LTD. ,
119980018064

SAMSUNG ELECTRO-MECHANICS CO., LTD. ,
119980018064

Patent Assignee History SAMSUNG ELECTRO-MECHANICS CO., LTD.
SAMSUNG ELECTRO-MECHANICS CO., LTD.

Representative C&S PATENT & LAW OFFICE
Reg. Nb: 920031000651

Representative Address C&S PATENT & LAW OFFICE , 920031000651
C&S PATENT & LAW OFFICE , 920031000651

Representative 특허법인씨엔에스
Reg. Nb: 920031000651

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-KR20130060995 (A) [KR20130060995] LG INNOTEK CO LTD;

Description

TECHNICAL FIELD

[0001] The present invention relates to a magnetic sheet for a communication module.

BACKGROUND ART

[0002] Recently, wireless charging (wpc) function, near field communication (NFC) function, electronic payment (MST) function, and the like are adopted for mobile portable devices.

[0003] Wireless charging (wpc), near field communication (NFC), electronic payment (MST) technologies differ from operating frequency, data transfer rate, amount of power transferred, and the like.

[0004] Meanwhile, due to miniaturization and weight reduction of electronic devices, space utilization is becoming important when performing wireless charging (wpc) function, near field communication (NFC) function, and electronic payment (MST) function. However, since wireless charging (wpc), near field communication (NFC), and electronic payment (MST) technologies have different operating frequencies and different magnetic permeability of a required shield has been difficult to use respective magnetic sheets formed of different types of magnetic materials.

CITATION LIST

PATENT LITERATURE

[0005] Korean Patent Publication No. 2013-0060995

SUMMARY OF INVENTION

TECH PROBLEM

[0006] The present invention relates to a magnetic sheet for a communication module in which a magnetic sheet formed of the same type of magnetic material can be simultaneously applied to a shield for wireless charging (wpc), a shield for near field communication (NFC), and the like, thereby maximizing space utilization and simplifying a manufacturing process.

TECH SOLUTION

[0007] One embodiment of the present invention forms two or more regions having different degrees of fracturing in a magnetic sheet for a communication module formed of a magnetic material of the same kind.

ADVANTAGEOUS EFFECTS

[0008] According to the present invention, since the magnetic sheet formed of the same type of magnetic material can be simultaneously applied to a shield for wireless charging (wpc), a shield for near field communication (NFC), and the like, space utilization can be maximized and a manufacturing process can be simplified.

[0009] In addition, transmission efficiency at each operating frequency can be optimized to improve communication efficiency.

DESCRIPTION OF DRAWINGS

[0010] FIG. 1 is a cross-sectional view briefly illustrating an internal configuration of a general wireless charging (wpc) system. FIG. 2 is a top view schematically illustrating a magnetic sheet for a communication module according to an embodiment of the present invention. FIG. 3 is a top view schematically illustrating a magnetic sheet for a communication module according to another embodiment of the present invention. FIG. 4 is a diagram for explaining heights and inclinations of cracks formed in a magnetic sheet for a telecommunications module according to an embodiment of the present invention. FIG. 5 is a diagram for explaining the degree of formation of cracks formed in a magnetic sheet for a telecommunications module according to an embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0011] Hereinafter, embodiments of the present invention will be described with reference to specific embodiments and accompanying drawings. However, the embodiments of the present invention can be modified to various other forms, and the scope of the present invention is not limited to the embodiments described below. In addition, embodiments of the present invention are provided to more fully describe the present invention to those skilled in the art having average knowledge in the art. Accordingly, the shapes and sizes, etc. of elements in the drawings may be exaggerated for clarity of explanation, and elements indicated by like numerals in the drawings are like elements.

[0012] In addition, for clarity of explanation, the present disclosure is omitted, and thicknesses are enlarged in order to clearly represent various layers and regions. elements having the same functions within the same general scope will be described using the same reference numerals.

[0013] Throughout the specification, when a portion "comprises" a component, it is meant that, unless specifically stated to the contrary, it may further include other components rather than excluding other components.

[0014] magnetic sheet for communication module

[0015] FIG. 1 is a cross-sectional view briefly illustrating an internal configuration of a general wireless charging (wpc) system.

[0016] Referring to FIG. 1, a general wireless charging (wpc) system may be configured with a wireless power transmitter 10 and a wireless power receiver 20.

[0017] The wireless power transmitter 10 is a device for generating a magnetic field around the wireless power receiver 20, through which power is charged in a magnetic induction manner, and the wireless power receiver 20 may be implemented in various types of electronic devices such as mobile phones, notebooks, tablet PCs, and the like.

[0018] When viewing the inside of the wireless power transmitter 10, a transmitter coil 11 is formed on a substrate 12, so that when an alternating voltage is applied to the wireless power transmitter 10, a magnetic field is formed around it. Accordingly, electromotive force induced from the transmitter coil 11 is generated in the receiver coil 21 embedded in the wireless power receiver 20, and a battery 22 can be charged.

[0019] The transmitting unit coil 11 and the receiving unit coil 21 electromagnetically coupled to each other are wound with a metal wire such as copper, and the winding shape thereof may be circular, elliptical, square, diamond, and the like, and the overall size, the number of turns, and the like may be appropriately controlled and set according to desired characteristics.

[0020] A magnetic sheet 100, which is a shield for wireless charging (wpc), may be disposed between the receiver coil 21 and the battery 22. The magnetic sheet 100 is positioned between the receiver coil 21 and the battery 22, and serves to block the magnetic field generated in the receiver coil 21 from reaching the battery 22.

[0021] Although FIG. 2 illustrates a wireless charging (wpc) system, near-field communication (NFC), electronic payment (MST) system, and the like are similarly composed of a transmission device and a reception device, and a magnetic sheet may be disposed between a reception unit coil and a battery on the reception device side.

[0022] Meanwhile, for space utilization, the coil for wireless charging (wpc) and the coil for near field communication (NFC) are mounted adjacently on one substrate, or the coil for wireless charging (wpc) and the coil for near field communication (NFC) are simultaneously used. However, exemplary embodiments are not necessarily limited thereto.

[0023] However, since wireless charging (wpc), near field communication (NFC), and electronic payment (MST) technologies are different in operating frequency and required magnetic permeability of electromagnetic wave shields are different in electromagnetic wave shields, there has been difficulty in using respective magnetic sheets formed of different types of magnetic materials. For example, generally a ferrite magnetic sheet was used as shielding for near field communication (NFC), and a metal ribbon magnetic sheet was used as shielding for wireless charging (wpc), electronic payment (MST).

[0024] Accordingly, since each of the magnetic sheets is separately used, it has not only been possible to occupy much space, but it has also been possible to complicate sintering operations and increase the number of processes by using the magnetic sheets of different materials.

[0025] Accordingly, one embodiment of the present invention forms two or more regions in which the degree of fracturing is different in the magnetic sheet for a communication module formed of the same type of magnetic material. Accordingly, the magnetic sheet formed of the same type of magnetic material can be simultaneously applied to a shield for wireless charging (wpc), a shield for near field communication (NFC), etc., so that space utilization can be maximized and a manufacturing process can be simplified. Furthermore, transmission efficiency at each operating frequency of wireless charging (wpc), near field communication (NFC), etc., was optimized to improve communication efficiency.

[0026] FIG. 2 is a top view schematically illustrating a magnetic sheet for a communication module according to an embodiment of the present invention.

[0027] Referring to FIG. 2, a magnetic sheet 100 for a communication module according to one embodiment of the present disclosure includes a first region 110 and a second region 120 adjacent to the first region 110. The magnetic sheet 100 according to an embodiment of the present invention is fractured to form cracks, wherein the first and second regions 110, 120 have different degrees of fracturing.

[0028] The magnetic sheet 100 may be formed of the same type of magnetic material, and may be, for example, ferrite sintered sheet, thin metal ribbon formed of amorphous alloy or nanocrystal alloy, and so on.

[0029] In this case, the magnetic sheet 100 is formed of the same type of magnetic material, but since the first and second regions 110, 120 have different degree of fracturing, the first region 110 and the second region 120 have different magnetic permeability.

[0030] Meanwhile, when the magnetic sheet 100 is a metal ribbon, the first region 110 and the second region 120 may have different core loss rates.

[0031] Accordingly, the magnetic sheet 100 according to an embodiment of the present disclosure can be simultaneously applied as a shield to wireless charging (wpc), near field communication (NFC), etc. having different operating frequencies, and transmission efficiency at each operating frequency can be optimized.

[0032] The first region 110 of the magnetic sheet 100 according to an embodiment of the present invention may be a shield for wireless charging (wpc) and the second region 120 may be a shield for near field communication (NFC). Meanwhile, the second region 120 may be formed outside the first region 110.

[0033] FIG. 3 is a top view schematically illustrating a magnetic sheet for a communication module according to another embodiment of the present invention.

[0034] Referring to FIG. 3, a magnetic sheet 100 for a telecommunications module according to another embodiment of the present disclosure includes the first region 110 and the second region 120 having different degrees of fracturing, and further includes a third region 130 adjacent to the first region 110 or the second region 120 and having different degrees of fracturing.

[0035] According to the embodiment illustrated in FIG. 3, a third region 130 is formed outside the first region 110, and a second region 120 is formed outside the third region 130. Here, the first region 110 of the magnetic sheet 100 according to another embodiment of the present invention may be a shield for wireless charging (wpc), the second region 120 may be a shield for near field communication (NFC), and the third region 130 may be a shield for electronic payment (MST).

[0036] However, the exemplary embodiments are not necessarily limited hereto, and the present invention is applicable as long as it is possible to optimize transmission efficiency at each operating frequency of wireless charging (wpc), near field communication (NFC), electronic payment (MST), and so on. Further, figs. 2 and 3 divide the magnetic sheet into two or three regions, but exemplary embodiments are not necessarily limited thereto, and may be divided into more regions.

[0037] For example, an operating frequency of wireless charging (wpc) may be 110 kHz to 205 kHz, an operating frequency of near field communication (NFC) may be 13.56 MHz, an operating frequency of electronic payment (MST) may be 70 kHz, and an operating frequency of PMA may be 275 kHz to 357 kHz.

[0038] The magnetic sheet 100 according to an embodiment of the present invention can be manufactured to have a region varying the degree of fracturing by using a fracturing tool having a contact having a shape in which stress is concentrated in a specific portion. A shape of the contact may be triangular, rectangular, pentagonal, hexagonal, and so on, but not necessarily limited thereto. however, it is applicable as long as stress can be concentrated at a specific portion within the contact. The pitch, depth, and size of the contacts may be adjusted to adjust the degree of fracturing.

[0039] The magnetic sheet 100 according to an embodiment of the present disclosure changes magnetic characteristics (e.g., magnetic permeability, core loss, etc.) of each region due to structural factors such as shape and density of cracks formed by fracturing.

[0040] FIG. 4 is a diagram for explaining heights and inclinations of cracks formed in a magnetic sheet for a telecommunications module according to an embodiment of the present invention.

[0041] Referring to FIG. 4, cracks formed by fracturing a magnetic sheet 100 for a communication module according to an embodiment of the present disclosure may have a three-dimensional structure protruding from one surface St of the magnetic sheet 100. The crack may have a three-dimensional structure in which a height from one surface St of the magnetic sheet 100 decreases from one point to the outside. In this case, the height at one point, which is the maximum height of the crack, may be defined as the height h of the crack.

[0042] In addition, the crack may be formed to have an inclination α from one surface St of the magnetic sheet 100 with a height from one surface St of the magnetic sheet 100 decreasing toward the outside from one point.

[0043] The crack may have a positive three-dimensional structure on one surface St of the magnetic sheet 100 and a negative three-dimensional structure on the other surface Sb of the magnetic sheet 100. That is, the crack may be formed in a concave structure from the other surface Sb of the magnetic sheet 100 while protruding from the one surface St of the magnetic sheet 100.

[0044] Meanwhile, according to an embodiment of the present disclosure, a height h of a crack formed by fracturing the magnetic sheet 100 from one surface of the magnetic sheet 100 may be different from each other in the first and second regions 110, 120.

[0045] In addition, according to an embodiment of the present invention, the warp (α) of cracks formed by fracturing the magnetic sheet 100 from one surface of the magnetic sheet 100 may be different from each other in the first and second regions 110, 120.

[0046] That is, the first and second regions 110, 120 may have different degrees of fracturing, such that the height h and/or the inclination α of cracks formed by fracturing the magnetic sheet 100 may be different from each other. Accordingly, the magnetic characteristics in the first and second regions 110, 120 may be different from each other, and transmission efficiency at each operating frequency may be optimized.

[0047] FIG. 5 is a diagram for explaining the degree of formation of cracks formed in a magnetic sheet for a telecommunications module according to an embodiment of the present invention.

[0048] Referring to FIG. 5, cracks formed by fracturing the magnetic sheet 100 for a communication module according to an embodiment of the present disclosure may be formed to radiate about one point.

[0049] In this case, when a virtual circle c having a specific size is drawn on a crack formed by fracturing the magnetic sheet 100 as illustrated in FIG. 5, an average number of contacts between the crack and the virtual circle may be different from each other in the first and second regions 110, 120. For example, in FIG. 5, the number of contacts of the virtual circle c and the crack is eleven.

[0050] That is, the first and second regions 110, 120 may have different degrees of fracturing from each other, and when a virtual circle c of a specific size is drawn on a crack formed by fracturing the magnetic sheet 100, the average number of contacts between the crack and the virtual circle may be different from each other. Accordingly, the magnetic characteristics in the first and second regions 110, 120 may be different from each other, and transmission efficiency at each operating frequency may be optimized.

[0051] Table 1 below shows an example where wireless charging (wpc), near field communication (NFC), electronic payment (MST), cracks formed by fracturing the magnetic sheet 100 according to respective operating frequencies of PMA, tilt (a), and average number of contacts between the cracks and the virtual circle are different from each other when drawing the magnetic sheet 100 according to respective operating frequencies of PMA.

Operating Frequency	Crack Diameter	Crack Height (h)	Crack warp (a)	Average number of contacts
MST70kHz	400 um ± 100 um	20 um or less	7 ° or less	16 or more
WPC110kHz	400 um ± 100 um	20um~30um	3 ° -10 °	15 or more
WPC205kHz	400 um ± 100 um	20um~30um	3 ° -10 °	15 or more
PMA275kHz	400 um ± 100 um	20um~30um	3 ° -10 °	15 or more
PMA357kHz	400 um ± 100 um	20um~30um	3 ° -10 °	15 or more
NFC13.56MHz	400 um ± 100 um	41 um or greater	At least 10 °	14 or fewer

[0053] As described above, by making the degree of fracturing each of two or more regions of the magnetic sheet 100 different according to an embodiment of the present disclosure, even if the magnetic sheet 100 is made of the same type of magnetic material, the magnetic characteristics (e.g., magnetic permeability, core loss rate, etc.) of each region can be varied. Accordingly, it is possible to simultaneously apply as a shield to wireless charging (wpc), near field communication (NFC), etc. having different operating frequencies, and to optimize transmission efficiency at each operating frequency. Further, since the magnetic sheet 100 formed of the same type of magnetic material is simultaneously applicable to a shield for wireless charging (wpc), a shield for near field communication (NFC), and so on, space utilization can be maximized and manufacturing process can be simplified.

[0054] The invention is not to be limited by the embodiments described above and the accompanying drawings, but is intended to be limited in the appended claims. Accordingly, various

forms of substitution, modification, and modification will be possible by those skilled in the art within the scope of not departing from the technical concept of the present invention set forth in the claims, and it will also be said to fall within the scope of the present invention.

REFERENCE SIGNS LIST

[0055] 10: Wireless power transmission device 11: transmitter coil 20: wireless power reception device 21: receiver coil 22: battery 100: magnetic sheet 110: first region 120: second region 130: third region



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(73) 특허권자

삼성전기주식회사

경기도 수원시 영통구 매영로 150 (매탄동)

(72) 발명자

이승민

경기도 수원시 영통구 매영로 150 (매탄동)

조중영

경기도 수원시 영통구 매영로 150 (매탄동)

(뒷면에 계속)

(74) 대리인

특허법인씨엔에스

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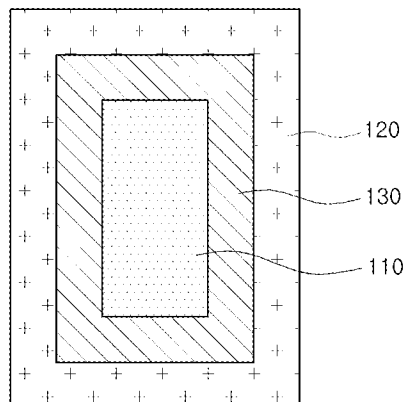
(54) 발명의 명칭 통신 모듈용 자성 시트

(57) 요약

본 발명은 자성 재료로 형성된 통신 모듈용 자성 시트에 있어서, 상기 자성 시트는 파쇄되어 크랙이 형성되고, 상기 자성 시트는 제 1 영역 및 상기 제 1 영역과 인접한 제 2 영역을 포함하며, 상기 제 1 및 제 2 영역은 파쇄되는 정도가 상이한 통신 모듈용 자성 시트에 관한 것이다.

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(72) 발명자

서정욱

경기도 수원시 영통구 매영로 150 (매탄동)

박두호

경기도 수원시 영통구 매영로 150 (매탄동)

형성시

청구항의

청구항 1

자성 재료로 형성된 통신 모듈용 자성 시트에 있어서,

상기 자성 시트는 금속 재질로 이루어지되 파쇄되어 형성된 크랙을 포함하며,

상기 자성 시트는 제 1 영역 및 상기 제 1 영역과 인접한 제 2 영역을 포함하며, 상기 제 1 및 제 2 영역은 파쇄되는 정도가 상이하여 투자율이 서로 다른 통신 모듈용 자성 시트.

청구항 2

삭제

청구항 3

삭제

청구항 4

제 1항에 있어서,

상기 제 1 영역은 무선 충전(WPC)용 차폐부이고, 상기 제 2 영역은 근거리 통신(NFC)용 차폐부인 통신 모듈용 자성 시트.

청구항 5

제 1항에 있어서,

상기 자성 시트는 제 1 영역 또는 제 2 영역에 인접하며, 파쇄되는 정도가 상이한 제 3 영역을 더 포함하며, 상기 제 3 영역은 전자 결재(MST)용 차폐부인 통신 모듈용 자성 시트.

청구항 6

제 1항에 있어서,

상기 제 2 영역은 상기 제 1 영역의 외곽에 형성되는 통신 모듈용 자성 시트.

청구항 7

제 1항에 있어서,

상기 자성 시트는 금속 리본으로 이루어진 통신 모듈용 자성 시트.

청구항 8

제 1항에 있어서,

상기 자성 시트가 파쇄되어 형성되는 크랙의 상기 자성 시트의 일면으로부터의 높이(h)가 상기 제 1 및 제 2 영역에서 서로 상이한 통신 모듈용 자성 시트.

청구항 9

제 1항에 있어서,

상기 자성 시트가 파쇄되어 형성되는 크랙의 상기 자성 시트의 일면으로부터의 경사(a)가 상기 제 1 및 제 2 영역에서 서로 상이한 통신 모듈용 자성 시트.

청구항 10

제 1항에 있어서,

상기 자성 시트가 파쇄되어 형성되는 크랙에 특정 크기의 가상의 원을 그렸을 때, 상기 크랙과 가상의 원과의 접점의 평균 개수가 상기 제 1 및 제 2 영역에서 서로 상이한 통신 모듈용 자성 시트.

청구항 11

자성 재료로 형성된 통신 모듈용 자성 시트에 있어서,

상기 자성 시트는 금속 재질로 이루어지며, 무선 충전(WPC)용 차폐부와, 상기 무선 충전(WPC)용 차폐부와 인접한 근거리 통신(NFC)용 차폐부를 포함하여 형성되고,

상기 무선 충전(WPC)용 차폐부 및 근거리 통신(NFC)용 차폐부는 상기 자성 시트가 파쇄되는 정도가 서로 상이하여 투자율이 서로 다른 통신 모듈용 자성 시트.

청구항 12

삭제

청구항 13

제 11항에 있어서,

상기 자성 시트는 파쇄되는 정도가 상이한 전자 결제(MST)용 차폐부를 더 포함하여 형성되는 통신 모듈용 자성 시트.

청구항 14

제 11항에 있어서,

상기 근거리 통신(NFC)용 차폐부는 상기 무선 충전(WPC)용 차폐부의 외곽에 형성되는 통신 모듈용 자성 시트.

청구항 15

제 11항에 있어서,

상기 자성 시트는 파쇄되어 크랙이 형성되며, 상기 크랙의 자성 시트의 일면으로부터의 높이 또는 경사가 상기 무선 충전(WPC)용 차폐부 및 근거리 통신(NFC)용 차폐부에서 서로 상이한 통신 모듈용 자성 시트.

청구항 16

제 11항에 있어서,

상기 자성 시트는 파쇄되어 크랙이 형성되며, 상기 크랙에 특정 크기의 가상의 원을 그렸을 때, 상기 크랙과 가상의 원과의 접점의 평균 개수가 상기 무선 충전(WPC)용 차폐부 및 근거리 통신(NFC)용 차폐부에서 서로 상이한 통신 모듈용 자성 시트.

발명의 설명

기술 분야

[0001] 본 발명은 통신 모듈용 자성 시트에 관한 것이다.

배경 기술

[0002] 최근 모바일 휴대용 장치에 무선 충전(WPC) 기능, 근거리 통신(NFC) 기능, 전자 결제(MST) 기능 등이 채용되고 있다.

[0003] 무선 충전(WPC), 근거리 통신(NFC), 전자 결제(MST) 기술은 동작 주파수, 데이터 전송율, 전송하는 전력량 등에서 차이가 있다.

[0004] 한편, 전자기기의 소형화 및 경량화로 인해 무선 충전(WPC) 기능, 근거리 통신(NFC) 기능, 전자 결제(MST) 기능을 수행 시 공간 활용이 중요해지고 있다. 그러나, 무선 충전(WPC), 근거리 통신(NFC), 전자 결제(MST) 기술은 각각 동작 주파수가 다르고, 요구되는 차폐부의 투자율이 다르기 때문에 이중의 자성 재료로 형성된 각각의 자성 시트를 사용해야 하는 어려움이 있었다.

선행기술문헌

특허문헌

[0005] (특허문헌 0001) 대한민국 공개특허공보 제2013-0060995호

발명의 내용

해결하려는 과제

[0006] 본 발명은 동종의 자성 재료로 형성된 자성 시트를 무선 충전(WPC)용 차폐부, 근거리 통신(NFC)용 차폐부 등에 동시에 적용 가능하도록 하여 공간 활용을 극대화하고, 제조 공정을 단순화한 통신 모듈용 자성 시트에 관한 것이다.

과제의 해결 수단

[0007] 본 발명의 일 실시형태는 동종의 자성 재료로 형성된 통신 모듈용 자성 시트에 파쇄되는 정도를 달리한 2 이상의 영역을 형성한다.

발명의 효과

[0008] 본 발명에 따르면, 동종의 자성 재료로 형성된 자성 시트를 무선 충전(WPC)용 차폐부, 근거리 통신(NFC)용 차폐부 등에 동시에 적용 가능하도록 하여 공간 활용을 극대화하고, 제조 공정을 단순화할 수 있다.

[0009] 또한, 각 동작 주파수에서의 전송 효율을 최적화하여 통신 효율을 향상시킬 수 있다.

도면의 간단한 설명

- [0010] 도 1은 일반적인 무선 충전(WPC) 시스템의 내부 구성을 간략하게 도시한 단면도이다.
- 도 2는 본 발명의 일 실시형태에 따른 통신 모듈용 자성 시트를 개략적으로 나타낸 평면도이다.
- 도 3은 본 발명의 다른 실시형태에 따른 통신 모듈용 자성 시트를 개략적으로 나타낸 평면도이다.
- 도 4는 본 발명의 일 실시형태에 따른 통신 모듈용 자성 시트에 형성되는 크랙의 높이 및 경사를 설명하는 도면이다.
- 도 5는 본 발명의 일 실시형태에 따른 통신 모듈용 자성 시트에 형성되는 크랙의 형성 정도를 설명하는 도면이다.

발명을 실시하기 위한 구체적인 내용

- [0011] 이하, 구체적인 실시형태 및 첨부된 도면을 참조하여 본 발명의 실시형태를 설명한다. 그러나, 본 발명의 실시형태는 여러 가지 다른 형태로 변형될 수 있으며, 본 발명의 범위가 이하 설명하는 실시형태로 한정되는 것은 아니다. 또한, 본 발명의 실시형태는 당업계에서 평균적인 지식을 가진 자에게 본 발명을 더욱 완전하게 설명하기 위해서 제공되는 것이다. 따라서, 도면에서의 요소들의 형상 및 크기 등은 보다 명확한 설명을 위해 과장될 수 있으며, 도면상의 동일한 부호로 표시되는 요소는 동일한 요소이다.
- [0012] 그리고 도면에서 본 발명을 명확하게 설명하기 위해서 설명과 관계없는 부분은 생략하고, 여러 층 및 영역을 명확하게 표현하기 위하여 두께를 확대하여 나타내었으며, 동일한 사상의 범위 내의 기능이 동일한 구성요소는 동일한 참조부호를 사용하여 설명한다.
- [0013] 명세서 전체에서, 어떤 부분이 어떤 구성요소를 "포함"한다고 할 때, 이는 특별히 반대되는 기재가 없는 한 다른 구성요소를 제외하는 것이 아니라 다른 구성요소를 더 포함할 수 있는 것을 의미한다.

[0014] 통신 모듈용 자성 시트

- [0015] 도 1은 일반적인 무선 충전(WPC) 시스템의 내부 구성을 간략하게 도시한 단면도이다.
- [0016] 도 1을 참조하면, 일반적인 무선 충전(WPC) 시스템은 무선전력 전송장치(10)와 무선전력 수신장치(20)로 구성될 수 있다.
- [0017] 상기 무선전력 전송장치(10)는 주변에 자기장을 발생시키는 장치이고, 상기 무선전력 수신장치(20)는 이를 통해 자기 유도 방식으로 전원 충전이 이루어지는 장치로서, 상기 무선전력 수신장치(20)는 휴대폰, 노트북, 태블릿 PC 등 다양한 형태의 전자기기로 구현될 수 있다.
- [0018] 상기 무선전력 전송장치(10)의 내부를 보면, 기판(12) 상에 송신부 코일(11)이 형성되어 있어 상기 무선전력 전송장치(10)로 교류전압이 인가되면 주위에 자기장이 형성된다. 이에 따라, 상기 무선전력 수신장치(20)에 내장된 수신부 코일(21)에는 상기 송신부 코일(11)로부터 유도된 기전력이 발생되어 배터리(22)가 충전될 수 있다.
- [0019] 전자기적으로 결합하는 상기 송신부 코일(11)과 수신부 코일(21)은 구리 등의 금속 와이어를 권회한 것으로, 그 권회 형상은 원형, 타원형, 사각형, 마름모형 등이 될 수 있으며, 전체적인 크기나 권회 횟수 등은 요구되는 특성에 따라 적절하게 제어하여 설정할 수 있다.
- [0020] 상기 수신부 코일(21)과 배터리(22) 사이에는 무선 충전(WPC)용 차폐부인 자성 시트(100)가 배치될 수 있다. 상기 자성 시트(100)는 상기 수신부 코일(21)과 배터리(22) 사이에 위치하여 수신부 코일(21)에서 발생한 자기장

이 배터리(22)로 도달하는 것을 차단해주는 역할을 한다.

[0021] 도 2에서는 무선 충전(WPC) 시스템을 설명하였으나, 근거리 통신(NFC), 전자 결제(MST) 시스템 등도 이와 유사하게 전송 장치와 수신 장치로 구성되며, 수신 장치 측에 수신부 코일과 배터리 사이에 자성 시트가 배치될 수 있다.

[0022] 한편, 공간 활용을 위해 무선 충전(WPC)용 코일과 근거리 통신(NFC)용 코일이 한 개의 기판 상에 이웃하게 실장되거나, 무선 충전(WPC)용 코일과 근거리 통신(NFC)용 코일을 동시에 사용하는 추세이다. 다만, 이에 반드시 제한되는 것은 아니다.

[0023] 그러나, 무선 충전(WPC), 근거리 통신(NFC), 전자 결제(MST) 기술은 각각 동작 주파수가 다르고, 전자기와 차폐부의 요구되는 투자율이 다르기 때문에 이들의 자성 재료로 형성된 각각의 자성 시트를 사용해야하는 어려움이 있었다. 예를 들어, 일반적으로 근거리 통신(NFC)의 경우 페라이트 자성 시트를 차폐부로 사용하고, 무선 충전(WPC), 전자 결제(MST)의 경우 금속 리본 자성 시트를 차폐부로 사용하였다.

[0024] 이에 따라, 각각의 자성 시트를 별도로 사용하기 때문에 공간을 많이 차지할 뿐만 아니라, 이종 재료의 자성 시트를 사용하게 되면 소결 작업이 복잡해지고 공정 수가 증가하는 문제가 있었다.

[0025] 이에 본 발명의 일 실시형태는 동종의 자성 재료로 형성된 통신 모듈용 자성 시트에 파쇄되는 정도를 달리한 2 이상의 영역을 형성하였다. 이에 따라, 동종의 자성 재료로 형성된 자성 시트를 무선 충전(WPC)용 차폐부, 근거리 통신(NFC)용 차폐부 등에 동시에 적용 가능하도록 하여 공간 활용을 극대화하고, 제조 공정을 단순화할 수 있도록 하였다. 나아가, 무선 충전(WPC), 근거리 통신(NFC) 등의 각 동작 주파수에서의 전송 효율을 최적화하여 통신 효율을 향상시켰다.

[0026] 도 2는 본 발명의 일 실시형태에 따른 통신 모듈용 자성 시트를 개략적으로 나타낸 평면도이다.

[0027] 도 2를 참조하면, 본 발명의 일 실시형태에 따른 통신 모듈용 자성 시트(100)는 제 1 영역(110) 및 상기 제 1 영역(110)과 인접한 제 2 영역(120)을 포함한다. 본 발명의 일 실시형태에 따른 자성 시트(100)는 파쇄되어 크랙이 형성되는데, 상기 제 1 및 제 2 영역(110, 120)은 파쇄되는 정도가 서로 상이하다.

[0028] 상기 자성 시트(100)는 동종의 자성 재료로 형성되며, 예를 들어, 페라이트 소결시트, 비정질 합금 또는 나노 결정립 합금으로 이루어진 박판의 금속 리본 등일 수 있다.

[0029] 이때, 상기 자성 시트(100)는 동종의 자성 재료로 이루어지지만, 제 1 및 제 2 영역(110, 120)은 파쇄되는 정도가 서로 상이하기 때문에 상기 제 1 영역(110)과 제 2 영역(120)은 투자율이 상이하다.

[0030] 한편, 상기 자성 시트(100)가 금속 리본일 경우 상기 제 1 영역(110)과 제 2 영역(120)은 손실(core loss)을 역시 상이할 수 있다.

[0031] 이에 따라, 본 발명의 일 실시형태에 따른 자성 시트(100)는 동작 주파수가 다른 무선 충전(WPC), 근거리 통신(NFC) 등에 차폐부로서 동시에 적용이 가능하며, 각 동작 주파수에서의 전송 효율을 최적화할 수 있다.

[0032] 상기 본 발명의 일 실시형태에 따른 자성 시트(100)의 제 1 영역(110)은 무선 충전(WPC)용 차폐부이고, 제 2 영역(120)은 근거리 통신(NFC)용 차폐부일 수 있다. 한편, 상기 제 2 영역(120)은 상기 제 1 영역(110)의 외곽에

형성될 수 있다.

- [0033] 도 3은 본 발명의 다른 실시형태에 따른 통신 모듈용 자성 시트를 개략적으로 나타낸 평면도이다.
- [0034] 도 3을 참조하면, 본 발명의 다른 실시형태에 따른 통신 모듈용 자성 시트(100)는 파쇄되는 정도가 상이한 상거 제 1 영역(110) 및 제 2 영역(120)을 포함하며, 제 1 영역(110) 또는 제 2 영역(120)에 인접하며, 파쇄되는 정도가 상이한 제 3 영역(130)을 더 포함한다.
- [0035] 도 3에 도시된 실시형태에 따르면, 제 1 영역(110)의 외곽에 제 3 영역(130)이 형성되고, 상기 제 3 영역(130)의 외곽에 제 2 영역(120)이 형성된다. 이때, 본 발명의 다른 실시형태에 따른 자성 시트(100)의 제 1 영역(110)은 무선 충전(WPC)용 차폐부이고, 제 2 영역(120)은 근거리 통신(NFC)용 차폐부이며, 제 3 영역(130)은 전자 결제(MST)용 차폐부일 수 있다.
- [0036] 다만, 이에 반드시 제한되는 것은 아니며, 무선 충전(WPC), 근거리 통신(NFC), 전자 결제(MST) 등의 각 동작 주파수에서의 전송 효율을 최적화할 수 있도록 각 영역의 파쇄 정도를 달리한 구조라면 적용 가능하다. 또한, 도 2 및 도 3은 자성 시트를 2 또는 3 영역으로 구분하였으나, 이에 반드시 제한되는 것은 아니며, 그 이상의 영역으로 구분할 수 있다.
- [0037] 예를 들어, 무선 충전(WPC)의 동작 주파수는 110kHz~205kHz, 근거리 통신(NFC)의 동작 주파수는 13.56MHz, 전자 결제(MST)의 동작 주파수는 70kHz, PMA의 동작 주파수는 275kHz~357kHz일 수 있다.
- [0038] 본 발명의 일 실시형태에 따른 자성 시트(100)는 특정 부분에서 응력이 집중되는 형태의 접점을 갖는 파쇄 도구를 사용하여 파쇄되는 정도를 달리한 영역을 갖도록 제조할 수 있다. 상기 접점의 형태는 삼각형, 사각형, 오각형, 육각형 등일 수 있으며, 다만, 이에 반드시 제한되는 것은 아니고, 접점 내 특정 부분에서 응력이 집중되어 질 수 있는 형태라면 적용 가능하다. 접점의 간격, 깊이, 크기를 조절하여 파쇄되는 정도 조절할 수 있다.
- [0039] 본 발명의 일 실시형태에 따른 자성 시트(100)는 파쇄되어 형성된 크랙의 형상, 밀도 등의 구조적 요인에 의해 각 영역의 자성 특성(예를 들어, 투자율, 손실(core loss) 등)이 변하게 된다.
- [0040] 도 4는 본 발명의 일 실시형태에 따른 통신 모듈용 자성 시트에 형성되는 크랙의 높이 및 경사를 설명하는 도면이다.
- [0041] 도 4를 참조하면, 본 발명의 일 실시형태에 따른 통신 모듈용 자성 시트(100)가 파쇄되어 형성되는 크랙은 상기 자성체 시트(100)의 일면(St)으로부터 돌출된 입체구조를 가질 수 있다. 상기 크랙은 일 점으로부터 외곽으로 갈수록 상기 자성체 시트(100)의 일면(St)으로부터의 높이가 낮아지는 입체구조를 가질 수 있다. 이때, 상기 크랙의 최대 높이인 일 점에서의 높이를 크랙의 높이(h)로 규정할 수 있다.
- [0042] 또한, 상기 크랙은 일 점으로부터 외곽으로 갈수록 상기 자성체 시트(100)의 일면(St)으로부터의 높이가 낮아지면서, 상기 자성체 시트(100)의 일면(St)으로부터 경사(a)를 갖도록 형성될 수 있다.
- [0043] 상기 크랙은 상기 자성체 시트(100)의 일면(St)에서 양각의 입체구조를 갖고, 상기 자성체 시트(100)의 타면(Sb)에서 음각의 입체구조를 가질 수 있다. 즉, 상기 크랙은 자성체 시트(100)의 일 면(St)으로부터 돌출된 구조이면서, 자성체 시트(100)의 타면(Sb)으로부터는 오목한 구조로 형성될 수 있다.

- [0044] 한편, 본 발명의 일 실시형태에 따르면, 상기 자성 시트(100)가 파쇄되어 형성되는 크랙의 상기 자성 시트(100)의 일면으로부터의 높이(h)가 상기 제 1 및 제 2 영역(110, 120)에서 서로 상이할 수 있다.
- [0045] 또한, 본 발명의 일 실시형태에 따르면, 상기 자성 시트(100)가 파쇄되어 형성되는 크랙의 상기 자성 시트(100)의 일면으로부터의 경사(a)가 상기 제 1 및 제 2 영역(110, 120)에서 서로 상이할 수 있다.
- [0046] 즉, 상기 제 1 및 제 2 영역(110, 120)은 파쇄되는 정도가 서로 상이하여 자성 시트(100)가 파쇄되어 형성되는 크랙의 높이(h) 및/또는 경사(a)가 서로 상이하게 형성될 수 있다. 이에 따라, 상기 제 1 및 제 2 영역(110, 120)에서의 자성 특성이 다르게 나타나고, 각 동작 주파수에서의 전송 효율을 최적화할 수 있다.
- [0047] 도 5는 본 발명의 일 실시형태에 따른 통신 모듈용 자성 시트에 형성되는 크랙의 형성 정도를 설명하는 도면이다.
- [0048] 도 5를 참조하면, 본 발명의 일 실시형태에 따른 통신 모듈용 자성 시트(100)가 파쇄되어 형성되는 크랙은 일 점을 중심으로 방사되는 형태로 형성될 수 있다.
- [0049] 이때, 도 5에 도시된 바와 같이 상기 자성 시트(100)가 파쇄되어 형성되는 크랙에 특정 크기의 가상의 원(c)을 그렸을 때, 상기 크랙과 가상의 원과의 접점의 평균 개수가 상기 제 1 및 제 2 영역(110, 120)에서 서로 상이할 수 있다. 예를 들어, 도 5에서는 가상의 원(c)과 크랙의 접점의 개수가 11개이다.
- [0050] 즉, 상기 제 1 및 제 2 영역(110, 120)은 파쇄되는 정도가 서로 상이하여, 자성 시트(100)가 파쇄되어 형성되는 크랙에 특정 크기의 가상의 원(c)을 그렸을 때 상기 크랙과 가상의 원과의 접점의 평균 개수가 서로 상이하게 형성될 수 있다. 이에 따라, 상기 제 1 및 제 2 영역(110, 120)에서의 자성 특성이 다르게 나타나고, 각 동작 주파수에서의 전송 효율을 최적화할 수 있다.
- [0051] 하기 표 1은 무선 충전(WPC), 근거리 통신(NFC), 전자 결제(MST), PMA의 각 동작 주파수에 따른 자성 시트(100)가 파쇄되어 형성되는 크랙의 높이(h), 경사(a), 약 210 μ m의 가상의 원(c)을 그렸을 때 상기 크랙과 가상의 원과의 접점의 평균 개수를 달리한 예시를 나타낸 것이다.

표 1

[0052]	동작 주파수	크랙 지름	크랙 높이(h)	크랙 경사(a)	접점의 평균 개수
	MST	400 μ m $\pm$ 100 μ m	20 μ m 이하	7° 이하	16개 이상
	WPC	400 μ m $\pm$ 100 μ m	20 μ m~30 μ m	3° ~ 10°	15개 이상
	WPC	400 μ m $\pm$ 100 μ m	20 μ m~30 μ m	3° ~ 10°	15개 이상
	PMA	400 μ m $\pm$ 100 μ m	20 μ m~30 μ m	3° ~ 10°	15개 이상
	PMA	400 μ m $\pm$ 100 μ m	20 μ m~30 μ m	3° ~ 10°	15개 이상
	NFC	400 μ m $\pm$ 100 μ m	41 μ m 이상	10° 이상	14개 이하

- [0053] 이와 같이, 본 발명의 일 실시형태에 따라 자성 시트(100)의 2 이상의 각 영역의 파쇄되는 정도를 상이하게 함으로써, 상기 자성 시트(100)가 동종의 자성 재료로 이루어지더라도 각 영역의 자성 특성(예를 들어, 투자율, 손실(core loss)을 등)을 달리할 수 있다. 이에 따라, 동작 주파수가 다른 무선 충전(WPC), 근거리 통신(NFC) 등에 차폐부로서 동시에 적용이 가능하며, 각 동작 주파수에서의 전송 효율을 최적화할 수 있다. 또한, 동종의 자성 재료로 형성된 자성 시트(100)를 무선 충전(WPC)용 차폐부, 근거리 통신(NFC)용 차폐부 등에 동시에 적용 가능하기 때문에 공간 활용을 극대화할 수 있고, 제조 공정을 단순화할 수 있다.

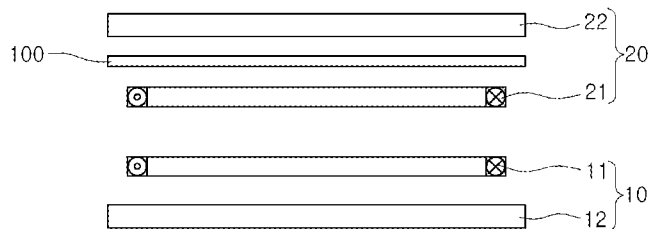
[0054] 본 발명은 상술한 실시 형태 및 첨부된 도면에 의해 한정되는 것이 아니며, 첨부된 청구범위에 한정하고자 한다. 따라서, 청구범위에 기재된 본 발명의 기술적 사상을 벗어나지 않는 범위 내에서 당 기술분야의 통상의 지식을 가진 자에 의해 다양한 형태의 치환, 변형 및 변경이 가능할 것이며, 이 또한 본 발명의 범위에 속한다고 할 것이다.

부호의 설명

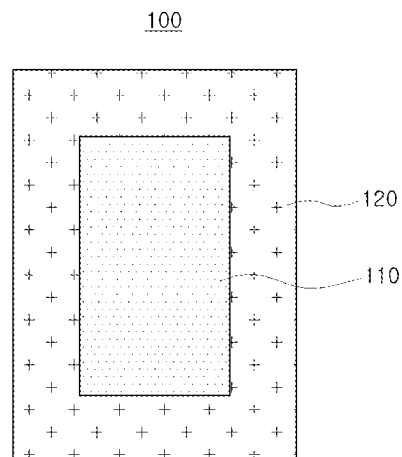
[0055] 10 : 무선전력 전송장치
11 : 송신부 코일
20 : 무선전력 수신장치
21 : 수신부 코일
22 : 배터리
100 : 자성 시트
110 : 제 1 영역
120 : 제 2 영역
130 : 제 3 영역

도면

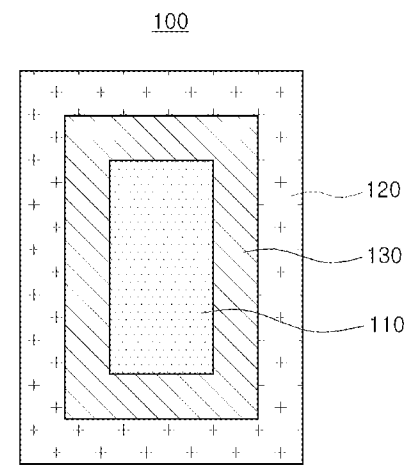
도면1



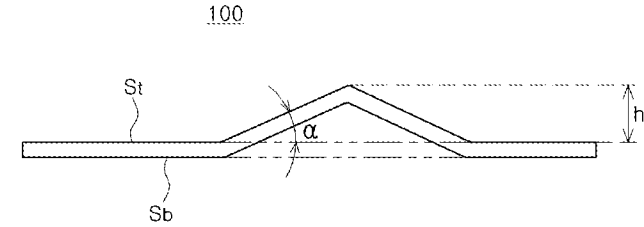
도면2



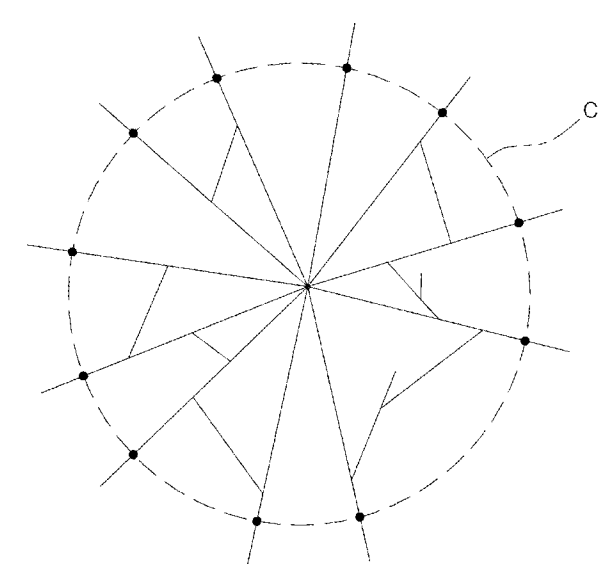
도면3



도면4



도면5



Wireless communication double antenna for portable electronic appliance

List of publications

Publication date

Application number 2015KR-0006341 Date 2015-01-13 Register

KR10-1640023 B1 Patent specification 2016-07-18

English Title

Wireless communication double antenna for portable electronic appliance

Other Title 휴대 단말기용 무선통신 이중 안테나

English Abstract (Native or MT)

The present invention relates to a wireless communication dual antenna for a mobile terminal. The antenna is based on a base film (10) and has a start terminal (21), a common terminal (23), and an end terminal outside while an external loop pattern (31) and an internal loop pattern (33) are connected by a connection pattern (32). The external loop pattern (31) from the start terminal (21) to the common terminal (23) is for first mode wireless communication (40), and together with the external loop pattern (31) from the start terminal (21) to the end terminal (24) through the connection pattern (32), the internal loop pattern (33) is for second mode wireless communication (50). Especially, as the second mode wireless communication (50) is realized by from the external loop pattern (31) to the internal loop pattern (330), the present invention can guarantee improved non-contact magnetic induction combination force.

Other Abstracts

본 발명은 베이스필름(10)을 기본으로 하면서 외부에 스타트단자(21) 공통단자(23) 및 엔드단자(24)만을 구비시키고, 외곽 루프패턴(31)과 내곽 루프패턴(33)이 연결패턴(32)에 의해 연결되도록 한 상태에서, 스타트단자(21)로부터 공통단자(23)에 이르는 외곽 루프패턴(31)은 제 1 모드 무선통신(40)을 구현케 하고, 스타트단자(21)로부터 연결패턴(32)을 지나 엔드단자(24)에 이르는 외곽 루프패턴(31)과 더불어 내곽 루프패턴(33)은 제 2 모드 무선통신(50)을 구현케 하여, 특히 제 2 모드 무선통신(50)이 외곽 루프패턴(31)을 비롯한 내곽 루프패턴(33)에 이르기까지 함께

확장 구현되어 배가된 비접촉 자기유도 결합력을 보장받을 수 있도록 한 휴대 단말기용 무선통신
이중 안테나에 관한 것이다.

Application Language KOREAN (KOR)

Inventor(s) PARK, JUNG-IL

PARK, JONG-JIN

Inventor(s) 박정일

박종진

Applicant/Assignee

IMTECH

Assignee 주식회사 아이엠텍

Reg. Nb: 120010259405

Patent Assignee History IMTECH INC.

Representative WON, EUN SUP

Reg. Nb: 919980004162

Representative Address WON, EUN SUP , 919980004162

Representative 원은섭

Reg. Nb: 919980004162

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IPC codes history

H01Q-007/00* H01Q-001/24

CPC codes

H01Q-001/24 H01Q-001/22/16 H01Q-001/24/3* H01Q-007/00 H04M-001/02/6 H02J-050/12 H02J-050/005

CPC codes history

H01Q-001/24 H01Q-001/22/16 H01Q-001/24/3* H01Q-007/00 H04M-001/02/6 H02J-050/12 H02J-050/005

Notes Number of Claims: 4

Cited Patents Search Report [Examiner]

-JP2012019302 (A) [JP2012019302] NEC TOKIN CORP; -KR20140090536 (A) [KR20140090536] DREAMTECH CO LTD;

Examiner citations

-JP2012019302 (A) [JP2012019302]; -KR1020140090536 (A) [KR1020140090536];

Applicant citations

-KR20130113222 (A) [KR20130113222] LG ELECTRONICS INC; -KR20130123310 (A) [KR20130123310] SAMSUNG ELECTRONICS CO LTD; -KR20130027403 (A) [KR20130027403] SAMSUNG ELECTRONICS CO LTD;

Description

TECHNICAL FIELD

[0001] The present invention relates to a wireless communication dual antenna for a portable terminal, More particularly, to a wireless communication dual antenna mobile terminal for a mobile terminal, in which a first mode wireless communication is implemented by an outer loop pattern extending from a start terminal to a common terminal, and a second mode wireless communication is extended by an inner loop pattern as well as an outer loop pattern extending from the start terminal to an end terminal through a connection pattern.

BACKGROUND ART

[0002] In general, the mobile terminal may include, for example, a smart phone and various applications (application programs) while viewing a window for displaying a screen as an intelligent terminal to which computer assistance functions such as Internet communication and information retrieval are added to the mobile phone.

[0003] Publication No. 2013-0113222 (antenna and mobile terminal equipped with the same) can be introduced as prior art document 1.

[0004] FIG. 1A is a block diagram of a mobile terminal associated with prior art document 1.

[0005] The mobile terminal 100 may include a wireless communication unit 110, an Audio/Video (a/V) input unit 120, a user input unit 130, a sensing unit 140, an output unit 150, a memory 160, an interface unit 170, a control unit 180, a power supply unit 190, and the like, as illustrated in FIG. 1A.

[0006] The wireless communication unit 110 may include a broadcast reception module 111, a mobile communication module 112, a wireless Internet module 113, a near field communication module 114, a location information module 115, and so on, an audio/video (a/V) input unit 120 is for inputting an audio signal or a video signal, A camera 121, a microphone 122, and the like may be included, and the user input unit 130 may be configured by a button 136, a touch sensor (static pressure/static) 137 disposed on a front surface, a rear surface, or a side surface of the mobile terminal 100.

[0007] The sensing unit 140 generates a sensing signal for controlling an operation of the mobile terminal 100 by sensing a current state of the mobile terminal 100 such as an open/close state of the mobile terminal 100, a position of the mobile terminal 100, presence/absence of a user contact, an orientation of the mobile terminal, acceleration/deceleration of the mobile terminal, and so on, The output 150 may include a proximity sensor 141, and the output 150 may be for generating output related to visual, audio, tactile, or the like, including a display unit 151, an acoustic output module 152, an alarm unit 153, a haptic module 154, and the like.

[0008] The memory unit 160 may store a program for processing and controlling the control unit 180, or may perform a function for temporary storage of input/output data (e.g., phone book unit, message, audio, still image, moving image, etc.).

[0009] The interface unit 170 serves as a passage with all external devices connected to the mobile terminal 100. The interface unit 170 may receive data from the external device, receive power and transmit the received data to each component in the mobile terminal 100, or transmit the data in the mobile terminal 100 to the external device. For example, a wired/wireless headset port, an external charger port, a wired/wireless data port, a memory card port, a port connecting a device provided with an identification module, an audio input/output (I/o) port, a video input/output (I/o) port, an earphone port, and the like may be included in the interface unit 170.

[0010] A controller 180 typically controls the overall operation of the mobile terminal. Related controls and processes are performed, for example, for voice calls, data communications, video calls, and the like. The control unit 180 may include a multimedia module 181 for multi-media playback.

[0011] The power supply 190 receives external power and internal power under control of the control unit 180, and supplies power necessary for operation of the respective components.

[0012] The power supply 190 may include, for example, a battery, a connection port, a power supply controller, and a charge monitoring unit.

[0013] FIG. 1B is a rear perspective view of a mobile terminal according to prior art document 1.

[0014] Referring to FIG. 1B, the rear face of the terminal body, i.e., the rear case 102, may be further equipped with a camera 121'. Adjacent to camera 121', flash 123 and mirror 124 may be further disposed. The flash 123 shines light toward the subject when photographing the subject with the camera 121'.

[0015] FIG. 1C is a top view illustrating attachment of an antenna 200 according to the prior art document to a rear cover 103 of a mobile terminal 100.

[0016] Referring to figs. 1A-1C, shown are front case 101, rear case 102, rear cover (or battery cover) 103, camera 121', interface 170, microphone 122, sound output 152', battery 191, battery mount 104, USIM card mount 105, memory card mount 106.

[0017] A space may be provided on a surface of the rear case 102 to mount external components such as the battery mounting unit 104, the USIM card mounting unit 105, and the memory card mounting unit 106. The exterior parts mounted on the surface of the rear case (102) are generally intended to enable the functions of the mobile terminal (100) to be diversified and expand the functions of the mobile terminal (100) to meet diversified consumer needs.

[0018] The antenna 200 has increased need for wireless communication with external devices and servers while diversifying functions of the mobile terminal 100. For example, an antenna (200) for receiving broadcast information such as Electronic Program Guide (EPG) of Digital Multimedia Broadcasting (DMB) or Electronic Service Guide (ESG) of Digital Video Broadcast-Handheld (DVB-H), Wibro, HSDPA, GSM, CDMA, WCDMA, an antenna (200) for wireless Internet such as LTE, etc., an antenna (200) for wireless Internet such as Bluetooth, Radio Frequency Identification (RFID), an antenna 200 for infrared data association (IrDA), Ultra Wideband (uwb), ZigBee near field communication, and the like is needed.

[0019] Such an antenna (200) is preferably formed in a large area for reception of radio waves and is preferably located on the surface side of the mobile terminal (100) so as not to be affected by other electronic components. Accordingly, as illustrated in FIG. 1C, the antenna 200 is disposed on the rear cover 103, which generally does not mount an electronic component and can secure a large area.

[0020] The antenna 200 of prior art document 1 mainly constitutes a flexible substrate 210, two kinds of patterns, and a magnetic sheet 230 as shown in FIG. 1 (c).

[0021] The pattern is divided into two kinds of high-frequency patterns 220 and low-frequency patterns 225. That is, the high-frequency pattern 220 is suitable for wireless communication, and the low-frequency pattern 225 is mainly suitable for wireless charging of the battery.

[0022] Radiocharger techniques used in mobile terminals (100) utilize electromagnetic induction principles.

[0023] Electromagnetic induction causes a current to flow to form a magnetic field, and when the mobile terminal 100 is placed thereon, a current flows through a low-frequency pattern mounted on the mobile terminal 100, i.e., a wireless charging coil 225, to charge.

[0024] The frequency may vary depending on the amount of power transmitted, but generally, the power used in small household appliances such as mobile terminal 100 may use a relatively low frequency to hundreds of kHz or less.

[0025] The wireless communication requires an antenna to perform functions such as Near Field Communication (NFC), Radio Frequency Identification (RFID), etc., in addition to transmission of radio waves for telephone calls, as a function of the mobile terminal 100 diversified. In particular, the frequencies used according to the wireless communication technology are different, and a relatively high frequency is used as compared to the frequencies used for wireless charging to transmit a large amount of data.

[0026] An example of a communication scheme in which the wireless communication antenna 200 of prior art document 1 is used includes Near Field Communication (NFC). Near field wireless communication is a contactless wireless communication module that utilizes about a 13.56 MHz frequency band as a kind of electronic tag (RFID).

[0027] A technology for transmitting data between terminals (100) at a close distance of approximately 10 to 40 cm is disclosed, which is a next-generation short-range communication technology having relatively excellent security and low cost because of a short communication distance. Both data reading and writing can be used, setting is not necessary for a device period like Bluetooth, and a near field communication function is added to the mobile terminal 100 in recent years.

[0028] However, since the mobile terminal 100 according to prior art document 1 is disposed in a state in which the high-frequency pattern 220 and the low-frequency pattern 200 are physically completely isolated from each other, the overall area thereof is relatively large. In particular, the high-frequency pattern 220 has a relatively greater patterning length than the low-frequency pattern 220 so as to increase the efficiency of electromagnetic induction at a distance of 10-40 cm, and it has a problem that the high-frequency pattern 220 does not have to be wound larger while being spaced apart from

the low-frequency pattern 200, and thus it is possible to occupy a wide and large occupation space.

[0029] FIG. 2 (a) is an exemplary diagram showing an on-plane arrangement of an NFC antenna and a wpt resonator in a resonance type wireless power receiving system to which prior art document 2 (Publication No. 2013-0123310; resonance stage arrangement in a resonance type wireless power receiving system) is applied, and FIG. 2 (b) shows an arrangement of an NFC antenna and a wpt resonator on a portable terminal.

[0030] Referring to Figs. 2A and 2B, looking first at mechanical mounting states of NFC antenna 10 and WPT resonator 20 in a wireless power receiving system to which Prior Art Document 2 is applied, for example, a portable terminal, planarly a looped antenna structure is installed so that NFC antenna 10 is located inside WPT resonator 20 having a looped antenna structure.

[0031] In addition, NFC antenna 10 can be installed on the rear surface of main body 1 of the portable terminal (at a battery portion that can be detachably installed), and wpt antenna 20 can be installed on the rear surface cover 2 of the portable terminal.

[0032] In this case, isolation distances (isolation d, isolation h) may occur between the NFC antenna 10 and the WPT resonator 20. This separation distance mechanically determines isolation characteristics of both frequencies (@13.56MHz, 6.78 MHz) of NFC antenna (10) and WPT resonator (20).

[0033] FIG. 2C is a circuit diagram of a resonant stage device in a resonant type wireless power receiving system according to one embodiment of prior art document 2, and numeral 20 is a high impedance circuit.

[0034] Referring to Fig. 2c, a resonant stage device according to the features of prior art document 2 may connect shunt capacitors 40 to WPT resonator 20 to prevent harmonics emitted from WPT Power Amplifier (PA) (not shown) from radiating outwards.

[0035] Meanwhile, in the resonant type wireless power receiving system according to prior art document 2, the resonant end device also has the disadvantage that because the NFC antenna 10 and the WPT resonator 20 are disposed in a state in which the NFC antenna 10 and the WPT resonator 20 are physically completely isolated from each other, the overall area cannot be relatively large, and the occupation space cannot be widely occupied.

[0036] FIG. 3 is a circuit diagram of a wireless power transfer control device 100 when using a power supply frequency band of 6.78 MHz according to an embodiment of prior art document 3 (published patent publication 2013-0027403).

[0037] Referring to FIG. 3, the wireless power transmission control apparatus 100 uses the 13.56 MHz band as the communication frequency band and uses the power supply frequency band different from the communication frequency band, so that regulation is

not affected even if the strength of the power supply signal and the communication signal is increased.

[0038] Further, when the 13.56 MHz band is used as the communication frequency band and the power supply frequency band is used different from the communication frequency band according to the prior art document 3 embodiment, the specific circuit configuration of the wireless power transmission control apparatus 100 may be configured differently.

[0039] For example, a separate configuration may be provided external to Power IC 120 for wireless power transfer control signal transmission and reception with NFC IC 140 as FIG. 3.

[0040] More specifically, referring to FIG. 3, a circuit of the wireless power transfer control apparatus 100 may include a WPT coil 410, an NFC coil 440, a Power IC 420, a General Purpose Input/Output (GPIO) Expander 422, an Analog Digital Converter (ADC) 424, and an NFC IC 430.

[0041] The WPT coil 410 may be connected with the power IC 420, resonates in a frequency band of 6.78 MHz, and receives power from the power supply TX and provides the power to the power IC 420. The power IC 420 generates various signals necessary for wireless power reception and operates in accordance with a wireless power transfer control signal according to a message received from the power supply TX. The Power IC (420) activates the overall operation of the wireless power transfer control device (100) by using a voltage according to the power received by the WPT coil (410). Further, while being supplied with power, current and voltage obtained by the supplied power are measured and regulated, and a constant voltage VDC_{out} is output.

[0042] GPIO Expander 422 is an input/output module that allows a signal output by power IC 420 to be input to NFC IC 430 between power IC 420 and NFC IC 430, and allows a signal output by NFC IC 430 to be input to power IC 420. ADC 424 converts an analog signal into a digital signal with respect to a signal transmitted and received by power IC 420 and NFC IC 430, and converts the digital signal into an analog signal to adjust signal transmission and reception between power IC 420 and NFC IC 430.

[0043] NFC IC 430 operates in accordance with the power provided by Power IC 420 and performs NFC communication with power supply TX via NFC coil 440. Here, the NFC coil 440 may be configured as an NFC coil (Coil) capable of radio wave radiation and radio wave reception in the 13.56 MHz band.

[0044] NFC IC 430 analyzes the signal received from power supply TX via NFC antenna 440 and transfers a wireless power transfer control signal to Power IC 420 using NFC IC input/output 431 according to the received signal. In this case, the NFC IC input/output unit 431 may include an SDA terminal and an SDC terminal. The SDA terminal receives or outputs data for wireless power transfer control, and the SDC terminal outputs a clock. In addition, according to the embodiment of the prior art document 3, the wireless power

transfer control signal is a control signal necessary for wireless power transfer, and can adjust voltage, current, temperature, and the like.

[0045] Meanwhile, in the embodiment of prior art document 3 described above, a power supply frequency band is used at 6.78 MHz and a 13.56 MHz band is used as a communication frequency band, but the power supply frequency band may be used at 100 to 200 kHz.

[0046] Meanwhile, the wireless power transfer control apparatus according to prior art document 3 also knows a limitation that because the WPT coil 410 and the NFC coil 440 are disposed in a state where the WPT coil 410 and the NFC coil 440 are physically completely isolated from each other, the overall area can be relatively large and occupied space can also be widely occupied.

CITATION LIST

PATENT LITERATURE

[0047] Prior Art Document 1-Publication No. 10-2013-0113222 (Antenna and Mobile Terminal equipped with the Same)

Prior Art Document 2-Publication No. 2013-0123310 (Resonant Stage Device in Resonant Type Wireless Power Receiving System)

Prior Art Document 3-Laid-open Patent No. 2013-0027403 (Wireless Power Transfer Control Device)

SUMMARY OF INVENTION

TECH PROBLEM

[0048] An object of the present invention is to provide a wireless communication dual antenna for a mobile terminal, in which a first mode wireless communication is implemented by an outer loop pattern extending from a start terminal to a common terminal, and a second mode wireless communication is implemented by an inner loop pattern as well as an outer loop pattern extending from the start terminal to an end terminal through a connection pattern.

[0049] An object of the present invention is to provide a wireless communication dual antenna for a mobile terminal in which a second mode wireless communication is expanded together up to an inner loop pattern including an outer loop pattern to ensure a doubled non-contact magnetic induction coupling force.

[0050] An object of the present invention is to provide a wireless communication dual antenna for a mobile terminal, which makes it possible to reduce the overall occupied space by reducing the lengths and sizes of the inner loop patterns and the outer loop patterns, by utilizing the extension and utilization of not only the inner loop patterns but

also the outer loop patterns but also the outer loop patterns, by making it possible to reduce the overall occupied space.

TECH SOLUTION

[0051] In order to achieve the above object, the present invention provides a process comprising:

[0052] A flexible base film having a flexible base film, an outer loop pattern wound inward from an edge of the base film starting from an external start terminal, a connection pattern extending inward from the outer loop pattern to the inside of the base film, an inner loop pattern starting from the connection pattern and wound toward a center of the base film and then connected to an outer end terminal, and a common terminal joined to the connection pattern and drawn out to the outside,

[0053] Wherein the outer loop pattern extending from the start terminal to the common terminal implements first mode wireless communication,

[0054] Wherein the outer loop pattern extending from the start terminal to the end terminal as well as the inner loop pattern extending from the start terminal to the end terminal are configured to expand and implement second mode wireless communication.

ADVANTAGEOUS EFFECTS

[0055] According to the present invention, it is possible to implement the first mode wireless communication by an outer loop pattern extending from the start terminal to the common terminal, and to expand and implement the second mode wireless communication by an inner loop pattern in addition to the outer loop pattern extending from the start terminal to the end terminal through the connection pattern.

[0056] According to the present invention, the second-mode wireless communication is expanded together up to an inner loop pattern including an outer loop pattern, so that a doubled non-contact magnetic induction coupling force can be ensured.

[0057] According to the present invention, it is possible to ensure that the wireless communication efficiency is multiplied by not only the inner loop pattern but also the outer loop pattern by using the second mode wireless communication, and furthermore, to reduce the length and size of the inner loop pattern and the outer loop pattern, thereby reducing the overall occupied space.

DESCRIPTION OF DRAWINGS

[0058] Fig. 1A is a block schematic diagram of a mobile terminal in connection with prior art document 1. FIG. 1B is a rear perspective view of a mobile terminal according to prior art document 1. FIG. 1C is a plan view showing the antenna according to prior art document 1 attached to the rear cover of the mobile terminal. FIG. 2A is an exemplary

diagram illustrating an on-plane arrangement of an NFC antenna and a WPT resonator in a resonant type wireless power receiving system to which prior art document 2 is applied. FIG. 2B is a structure diagram showing an arrangement structure of NFC antenna and WPT resonator of prior art document 2 on a portable terminal. FIG. 2C is a circuit diagram of a resonant stage device in a resonant type wireless power receiving system according to one embodiment of prior art document 2. FIG. 3 is a circuit diagram of a wireless power transmission control apparatus when using a power supply frequency band of 6.78 MHz according to an embodiment of prior art document 3. FIG. 4 is a plan view showing a radio communication dual antenna for a general mobile terminal derivable from prior documents in contrast to the present disclosure. FIG. 5A is a plan view showing a radio communication dual antenna for a mobile terminal according to the present invention. FIG. 5 (b) is an equivalent circuit diagram showing a radio communication dual antenna for a mobile terminal according to the present invention. FIG. 6A is a plan view showing a radio communication dual antenna for a mobile terminal according to an embodiment of the present invention. FIG. 6B is an equivalent circuit diagram showing a radio communication dual antenna for a mobile terminal according to an embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0059] Hereinafter, a preferred embodiment of a radio communication dual antenna for a mobile terminal according to the present invention will be described with reference to the drawings, wherein a plurality of the embodiments may exist, and objects, features, and advantages of the present invention can be better understood through such embodiments.

[0060] FIG. 4 is a top view illustrating a general radio communication dual antenna for a mobile terminal derivable from prior documents to the present disclosure.

[0061] A general wireless communication dual antenna for a mobile terminal, as shown in FIG. 4, is based on a flexible base film 100, and is independently provided with outer loop patterns 320 which are respectively connected to outer first start terminals 111 and first end terminals 112 and wound around edges of the base film 100. Further, an inner loop pattern 330 wound around a center of the base film 100 connected to the outer second start terminal 121 and the second end terminal 122, respectively, and spaced apart from the outer loop pattern 320.

[0062] In this case, the outer loop pattern 320 may utilize NFC and RFID for transmitting data between external terminals as the first mode radio communication (400) by non-contact magnetic induction coupling power in a frequency band of 13.56 MHz at a distance close to approximately 10 cm. The inner loop pattern 330 may utilize, as the second mode wireless communication 500, a WPT that enables charging of a battery with non-contact magnetic induction coupling force implemented in a band of 100 to 200 kHz by flowing a current according to an electromagnetic induction principle, i.e., an induction field principle, to form a magnetic field, and when the mobile terminal is placed thereon.

[0063] However, in a general wireless communication dual antenna for mobile terminals, an outer loop pattern (320) is independently provided on an outer periphery of a base film (100) by a first start terminal (111) and a first end terminal (112). Furthermore, the inner loop pattern 330 is independently provided at the center of the base film 100 by the second start terminal 121 and the second end terminal 122, so that the efficiency of the first mode wireless communication 400 and the second mode wireless communication 500 to non-contact magnetic induction coupling force cannot be maximized depending on the communication environment.

[0064] Particularly, the number of times that the inner loop pattern 330 utilized for the second mode wireless communication 500 of the WPT enabling battery charging of the mobile terminal is independently patterned and wound in a limited area of the base film 100 inside the outer loop pattern 320 is small, and the total length is not only short. That is, because inductance is small, charging efficiency of the battery may not be maximized.

[0065] FIG. 5A is a top view showing a radio communication dual antenna for a mobile terminal according to the present invention, and FIG. 5B is an equivalent circuit view showing a radio communication dual antenna for a mobile terminal according to the present invention.

[0066] A wireless communication dual antenna for a mobile terminal according to the present invention includes a flexible base film 10 as shown in Figs. 5A and 5B, an outer loop pattern 31 starting from an outer start terminal 21 and wound inward at an edge of the base film 10, a connection pattern 32 extending from the outer loop pattern 31 to the inside of the base film 10, an inner loop pattern 33 starting from the connection pattern 32 and wound toward the center of the base film 10 and then connected to an outer end terminal 24, and a common terminal 23 joined to the connection pattern 32 and drawn out to the outside.

[0067] That is, an outer loop pattern (31) extending from the start terminal (21) to the common terminal (23) implements a first mode radio communication (40) in a state where the outer loop pattern (31) and the inner loop pattern (33) are connected to each other by a connection pattern (32). As well as the outer loop pattern 31 extending from the start terminal 21 to the end terminal 24, the inner loop pattern 33 realizes the second mode wireless communication 50, and particularly, the second mode wireless communication 50 is extended together to the inner loop pattern 33 including the outer loop pattern 31.

[0068] A radio communication dual antenna for a mobile terminal according to the present invention independently forms a first mode radio communication 40 and a second mode radio communication 50 wound (patterned) on a base film 10; A common terminal 23 is tightened to the connection pattern 32 in a state in which the common terminal 23 is entirely continued from the start terminal 21 to the end terminal 24 as a center of the connection pattern 32. In particular, it is possible to maximize wireless communication efficiency by allowing the second mode wireless communication 50 to be expanded together to reach the inner loop pattern 33 including the outer loop pattern 31.

[0069] In this case, the second mode wireless communication 50 may be expanded together with the outer loop pattern 31 and the inner loop pattern 33 to ensure doubled non-contact magnetic induction coupling power.

[0070] In view of this feature, the first mode radio communication 40 is Near Field Communication (NFC) or Radio Frequency Identification (RFID), The second mode radio 50 may be characterized by being a magnetic secure transfer (MST) or a wireless power transfer (WPT), On the other hand, the first mode radio 40 may be a magnetic secure transfer (MST) or a wireless power transfer (WPT), and the second mode radio 50 may be a near field communication (NFC) or a radio frequency identification (RFID).

[0071] The first mode radio 40 is NFC or RFID and the second mode radio 50 is an MST or WPT, or vice versa, which implementation may allow a user to be made by selection depending on the communication environment.

[0072] Specifically, NFC, RFID and MST enable external terminal period data to be transmitted in a frequency band of 13.56 to 15 MHz at a close distance of approximately 10 to 40 cm as known already, The WPT is capable of forming a magnetic field by flowing a current according to the electromagnetic induction principle, i.e., the induction field principle, and placing the mobile terminal thereon to enable charging of the battery in the 100 to 200 kHz band.

[0073] On the other hand, the first mode radio communication 40 can be implemented with an L1 value which is the non-contact magnetic induction coupling force of the outer loop pattern 31 itself between the start terminal 21 and the common terminal 23 as illustrated in FIG. 5B, The second mode radio communication 50 makes it possible to ensure doubling of radio communication efficiency with extended non-contact magnetic induction coupling force incorporating L1 values of outer loop patterns 31 as well as L2 values by inner loop patterns 33 between start terminals 21 and end terminals 24 as shown in FIG. 5 (b).

[0074] According to the present disclosure, since the second mode wireless communication 50 is extended and utilized not only to the inner loop pattern 33 but also to the outer loop pattern 31, it is possible to reduce the lengths and sizes of the inner loop pattern 33 and the outer loop pattern 31, thereby greatly reducing the overall occupied space.

[0075] FIG. 6A is a top view showing a radio communication dual antenna for a mobile terminal according to an embodiment of the present invention, and FIG. 6B is an equivalent circuit view showing a radio communication dual antenna for a mobile terminal according to an embodiment of the present invention.

[0076] A wireless communication dual antenna for a mobile terminal according to the present invention includes a flexible base film 10 as shown in figs. 6 a and 6 b, an outer loop pattern 31 starting from an external start terminal 21 and wound inward at an edge of the base film 10, a connection pattern 32 extending from the outer loop pattern 31 to

the inside of the base film 10, an inner loop pattern 33 starting from the connection pattern 32 and wound toward the center of the base film 10 and connected to the outer end terminal 24, and a common terminal 23 joined to the connection pattern 32 and drawn out to the outside, and further comprising an auxiliary terminal 22 joined to the start terminal 21 and disposed between the common terminal 23 and the end terminal 24.

[0077] In addition, the second mode wireless communication 50 can be expanded by the inner loop pattern 33 as well as the outer loop pattern 31 extending from the auxiliary terminal 22 including the start terminal 21 to the end terminal 24 through the connection pattern 32.

[0078] As shown in FIG. 6 (a), a radio communication dual antenna for a mobile terminal according to the present invention includes a first mode radio 40 and a second mode radio 50 wound (patterned) on a base film 10, respectively. A common terminal 23 is tightened to the connection pattern 32 in a state in which the common terminal 23 is not formed independently but is entirely continued from the start terminal 21 to the end terminal 24 as a center of the connection pattern 32. In particular, it is possible to maximize wireless communication efficiency by allowing the second mode wireless communication 50 to be expanded together to reach the inner loop pattern 33 including the outer loop pattern 31.

[0079] In this case, the second mode wireless communication 50 may be expanded together with the outer loop pattern 31 and the inner loop pattern 33 to ensure doubled non-contact magnetic induction coupling power.

[0080] In view of this feature, the first mode radio 40 may be characterized as NFC or RFID, and the second mode radio 50 may be characterized as MST or WPT, and on the other hand, the first mode radio 40 may be characterized as MST or WPT, and the second mode radio 50 may be characterized as NFC or RFID.

[0081] The first mode radio 40 is NFC or RFID and the second mode radio 50 is an MST or WPT, or vice versa, which implementation may allow a user to be made by selection depending on the communication environment.

[0082] Specifically, NFC, RFID and MST enable external terminal period data to be transmitted in a frequency band of 13.56 to 15 MHz at a close distance of approximately 10 to 40 cm as known already, The WPT is capable of forming a magnetic field by flowing a current according to the electromagnetic induction principle, i.e., the induction field principle, and placing the mobile terminal thereon to enable charging of the battery in the 100 to 200 kHz band.

[0083] On the other hand, the first mode wireless communication 40 can be implemented as an L1 value which is a non-contact magnetic induction coupling force of the outer loop pattern 31 itself between the start terminal 21, the auxiliary terminal 22, and the common terminal 23 as shown in FIG. 6 (b), The second mode wireless communication 50 can ensure doubling of wireless communication efficiency with an extended non-contact magnetic induction coupling force incorporating an L2 value by the inner loop pattern 33

between the start terminal 21, the auxiliary terminal 22, and the end terminal 24 as well as an L1 value of the outer loop pattern 31 as illustrated in FIG. 6 (b).

[0084] According to the present disclosure, since the second mode wireless communication 50 is extended and utilized not only to the inner loop pattern 33 but also to the outer loop pattern 31, it is possible to reduce the lengths and sizes of the inner loop pattern 33 and the outer loop pattern 31, thereby greatly reducing the overall occupied space.

[0085] At this time, when the wireless communication dual antenna for a mobile terminal of the present invention is connected to the main circuit board in the mobile terminal, the auxiliary terminal 22 is considered to be easily and interchangeably connected without specifically changing the design for connecting four existing terminals.

[0086] On the other hand, the base film 10 may be a polyimide film, a pet film, or a PVC film, and of course, the pattern lines of the common terminal 23 joined to the connection pattern 32 and the pattern lines connected to the end terminals 24 may be patterned separately on the upper surface, lower surface, or both surfaces of the base film 10 through Via Hall, or the like so as not to cross each other.

INDUSTRIAL APPLICABILITY

[0087] The present invention can be used in the industry of mobile terminals such as tablet PC or smart phone.

REFERENCE SIGNS LIST

[0088] 10: base film 21: start terminal 22: auxiliary terminal 23: common terminal 24: end terminal 31: Outer loop pattern 32: connection pattern 33: inner loop pattern 40: first mode wireless communication 50: second mode wireless communication



(19) 대한민국특허청(KR)
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(73) 특허권자
주식회사 아이애크
경기도 파주시 월롱면 엘지로 274-43
(72) 발명자
박정일
경기도 성남시 분당구 궁내로40번길 36 (궁내동)
박종진
전라북도 전주시 완산구 신촌2길 20 4동 302호
(중화산동2가, 한신코아아파트)
(74) 대리인
원은섭

전체 청구항 수 : 총 4 항

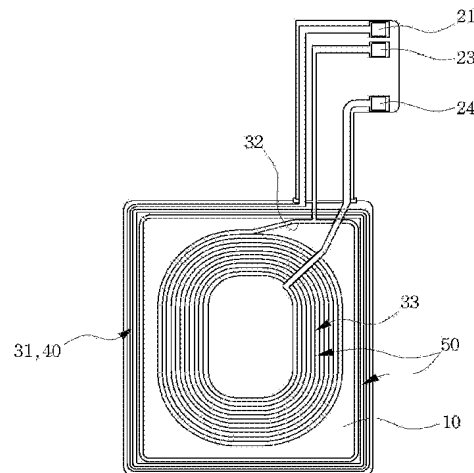
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(54) 발명의 명칭 휴대 단말기용 무선통신 이중 안테나

(57) 요약

본 발명은 베이스필름(10)을 기본으로 하면서 외부에 스타트단자(21) 공통단자(23) 및 엔드단자(24)만을 구비시키고, 외곽 루프패턴(31)과 내곽 루프패턴(33)이 연결패턴(32)에 의해 연결되도록 한 상태에서, 스타트단자(21)로부터 공통단자(23)에 이르는 외곽 루프패턴(31)은 제 1 모드 무선통신(40)을 구현케 하고, 스타트단자(21)로부터 연결패턴(32)을 지나 엔드단자(24)에 이르는 외곽 루프패턴(31)과 더불어 내곽 루프패턴(33)은 제 2 모드 무선통신(50)을 구현케 하여, 특히 제 2 모드 무선통신(50)이 외곽 루프패턴(31)을 비롯한 내곽 루프패턴(33)에 이르기까지 함께 확장 구현되어 배가된 비접촉 자기유도 결합력을 보장받을 수 있도록 한 휴대 단말기용 무선통신 이중 안테나에 관한 것이다.

도 5a



명세서

청구범위

청구항 1

플렉시블한 베이스필름(10)과, 외부의 스타트단자(21)로부터 시작하여 상기 베이스필름(10)의 가장자리에서 안쪽으로 권회되는 외곽 루프패턴(31)과, 상기 외곽 루프패턴(31)으로부터 상기 베이스필름(10)의 안쪽으로 이어지는 연결패턴(32)과, 상기 연결패턴(32)으로부터 시작하여 상기 베이스필름(10)의 중심을 향하여 권회된 후 외부의 엔드단자(24)에 연결되는 내곽 루프패턴(33)과, 상기 연결패턴(32)에 조인되어 외부로 인출되는 공통단자(23)를 포함하고,

상기 스타트단자(21)로부터 상기 공통단자(23)에 이르는 상기 외곽 루프패턴(31)은 제 1 모드 무선통신(40)을 구현하고,

상기 스타트단자(21)로부터 상기 연결패턴(32)을 지나 상기 엔드단자(24)에 이르는 상기 외곽 루프패턴(31)과 더불어 내곽 루프패턴(33)은 제 2 모드 무선통신(50)을 확장 구현하고,

상기 스타트단자(21) 및 엔드단자(24) 사이에 상기 공통단자(23)가 배치되고,

상기 스타트단자(21)에 조인되어 상기 공통단자(23) 및 엔드단자(24) 사이에 배치되는 보조단자(22)를 더 포함하고,

상기 제 2 모드 무선통신(50)은 상기 스타트단자(21)를 비롯한 상기 보조단자(22)로부터 상기 연결패턴(32)을 지나 상기 엔드단자(24)에 이르는 상기 외곽 루프패턴(31)과 더불어 내곽 루프패턴(33)에 의해 확장 구현되는 것을 특징으로 하는 휴대 단말기용 무선통신 이중 안테나.

청구항 2

삭제

청구항 3

제 1 항에 있어서,

상기 제 2 모드 무선통신(50)은 상기 외곽 루프패턴(31) 및 내곽 루프패턴(33)과 함께 확장 구현되어 배가된 비접촉 자기유도 결합력(Non-Contact Magnetic Inductive Coupling Power)을 보장받는 것을 특징으로 하는 휴대 단말기용 무선통신 이중 안테나.

청구항 4

제 3 항에 있어서,

상기 제 1 모드 무선통신(40)은 NFC(Near Field Communication) 또는 RFID(Radio Frequency Identification)이고,

상기 제 2 모드 무선통신(50)은 MST(Magnetic Secure Transmission) 또는 WPT(Wireless Power Transfer)인 것을 특징으로 하는 휴대 단말기용 무선통신 이중 안테나.

청구항 5

제 3 항에 있어서,

상기 제 1 모드 무선통신(40)은 MST(Magnetic Secure Transmission) 또는 WPT(Wireless Power Transfer)이고,

상기 제 2 모드 무선통신(50)은 NFC(Near Field Communication) 또는 RFID(Radio Frequency Identification)인 것을 특징으로 하는 휴대 단말기용 무선통신 이중 안테나.

발명의 설명

기술분야

[0001] 본 발명은 휴대 단말기용 무선통신 이종 안테나에 관한 것으로, 더욱 상세하게는 스타트단자로부터 공통단자에 이르는 외곽 루프패턴에 의해 제 1 모드 무선통신을 구현케 하고 스타트단자로부터 연결패턴을 지나 엔드단자에 이르는 외곽 루프패턴과 더불어 내곽 루프패턴에 의해 제 2 모드 무선통신을 확장 구현케 한 휴대 단말기용 무선통신 이종 안테나 휴대 단말기용 무선통신 이종 안테나에 관한 것이다.

배경기술

[0002] 일반적으로 휴대 단말기는 휴대전화에 인터넷 통신과 정보검색 등 컴퓨터 지원 기능을 추가한 지능형 단말기로서 화면을 디스플레이하는 윈도우를 보면서 인터넷 및 다양한 애플리케이션(응용프로그램)을 활용할 수 있도록 하는 스마트 폰 등을 한 예로 들 수 있다.

[0003] 선행기술문헌 1로서 공개특허 제2013-0113222호(안테나 및 이를 구비한 이동 단말기)를 소개할 수 있다.

[0004] 도 1a는 선행기술문헌 1과 관련된 이동 단말기의 블록 구성도(block diagram)이다.

[0005] 이동 단말기(100)는 도 1a에 도시된 바와 같이 무선 통신부(110), A/V(Audio/Video) 입력부(120), 사용자 입력부(130), 센싱부(140), 출력부(150), 메모리(160), 인터페이스부(170), 제어부(180) 및 전원 공급부(190) 등을 포함할 수 있다.

[0006] 무선 통신부(110)는 방송 수신 모듈(111), 이동통신 모듈(112), 무선 인터넷 모듈(113), 근거리 통신 모듈(114) 및 위치정보 모듈(115) 등을 포함할 수 있고, A/V(Audio/Video) 입력부(120)는 오디오 신호 또는 비디오 신호 입력을 위한 것으로, 카메라(121)와 마이크(122) 등이 포함될 수 있으며, 사용자 입력부(130)는 이동 단말기(100)의 전·후면 또는 측면에 위치하는 버튼(136), 터치 센서(정압/정전)(137)로 구성될 수 있다.

[0007] 센싱부(140)는 이동 단말기(100)의 개폐 상태, 이동 단말기(100)의 위치, 사용자 접촉 유무, 이동 단말기의 방위, 이동 단말기의 가속/감속 등과 같이 이동 단말기(100)의 현 상태를 감지하여 이동 단말기(100)의 동작을 제어하기 위한 센싱 신호를 발생시키고, 근접 센서(141)를 포함할 수 있으며, 출력부(150)는 시각, 청각 또는 촉각 등과 관련된 출력을 발생시키기 위한 것으로, 이에는 디스플레이부(151), 음향 출력 모듈(152), 알람부(153) 및 햅틱 모듈(154) 등이 포함될 수 있다.

[0008] 메모리부(160)는 제어부(180)의 처리 및 제어를 위한 프로그램이 저장될 수도 있고, 입/출력되는 데이터들(예를 들어, 전화번호부, 메시지, 오디오, 정지영상, 동영상 등)의 임시 저장을 위한 기능을 수행할 수도 있다.

[0009] 인터페이스부(170)는 이동 단말기(100)에 연결되는 모든 외부기기와의 통로 역할을 한다. 인터페이스부(170)는 외부 기기로부터 데이터를 전송받거나, 전원을 공급받아 이동 단말기(100) 내부의 각 구성 요소에 전달하거나, 이동 단말기(100) 내부의 데이터가 외부 기기로 전송되도록 한다. 예를 들어, 유/무선 헤드셋 포트, 외부 충전기 포트, 유/무선 데이터 포트, 메모리 카드(memory card) 포트, 식별 모듈이 구비된 장치를 연결하는 포트, 오디오 I/O(Input/Output) 포트, 비디오 I/O(Input/Output) 포트, 이어폰 포트 등이 인터페이스부(170)에 포함될 수 있다.

[0010] 제어부(controller)(180)는 통상적으로 이동 단말기의 전반적인 동작을 제어한다. 예를 들어 음성 통화, 데이터 통신, 화상 통화 등을 위한 관련된 제어 및 처리를 수행한다. 제어부(180)는 멀티 미디어 재생을 위한 멀티미디어 모듈(181)을 구비할 수도 있다.

[0011] 전원 공급부(190)는 제어부(180)의 제어에 의해 외부의 전원, 내부의 전원을 인가받아 각 구성요소들의 동작에 필요한 전원을 공급한다.

[0012] 전원 공급부(190)는 예를 들어 배터리, 연결포트, 전원공급제어부 및 충전모니터링부를 포함할 수 있다.

[0013] 도 1b는 선행기술문헌 1에 따른 이동 단말기의 후면 사시도이다.

[0014] 도 1b를 참조하면, 단말기 바디의 후면 즉, 리어 케이스(102)에는 카메라(121')가 추가로 장착될 수 있다. 카메라(121')에 인접하게는 플래쉬(123)와 거울(124)이 추가로 배치될 수 있다. 플래쉬(123)는 카메라(121')로 피사

체를 촬영하는 경우에 피사체를 향해 빛을 비추게 된다.

- [0015] 도 1c는 선행기술문헌에 따른 안테나(200)가 이동 단말기(100)의 후면커버(103)에 부착된 것을 도시한 평면도이다.
- [0016] 도 1a 내지 도 1c를 참조하면, 프론트 케이스(101), 리어 케이스(102), 후면커버(또는 배터리 커버)(103), 카메라(121'), 인터페이스(170), 마이크(122), 음향출력부(152'), 배터리(191), 배터리 장착부(104), USIM카드 장착부(105), 메모리카드 장착부(106)가 도시되어 있다.
- [0017] 리어 케이스(102) 표면에는 배터리 장착부(104), USIM카드 장착부(105) 및 메모리카드 장착부(106)와 같은 외장 부품이 실장될 수 있는 공간을 구비할 수 있다. 일반적으로 리어 케이스(102)의 표면에 실장되는 외장부품은 이동 단말기(100)의 기능이 다양화되고 다양해진 소비자의 요구를 충족시키기 위해 이동 단말기(100)의 기능을 확장할 수 있도록 하기 위함이다.
- [0018] 안테나(200)는 이동 단말기(100)의 기능이 다양화되면서 외부 장치 및 서버와 무선 통신을 할 필요성이 높아졌다. 예를 들면, DMB(Digital Multimedia Broadcasting)의 EPG(Electronic Program Guide) 또는 DVB-H(Digital Video Broadcast-Handheld)의 ESG(Electronic Service Guide) 등의 방송정보를 수신하기 위한 안테나(200), Wibro, HSDPA, GSM, CDMA, WCDMA, LTE 등 무선인터넷을 위한 안테나(200), 근거리 통신(short range communication) 기술로 블루투스(Bluetooth), RFID(Radio Frequency Identification), 적외선 통신(IrDA, infrared Data Association), UWB(Ultra Wideband), ZigBee 근거리 무선통신을 위한 안테나(200) 등이 필요하다.
- [0019] 이러한 안테나(200)는 전파의 수신을 위해 넓은 면적에 형성하는 것이 바람직하고 다른 전자부품들의 영향을 받지 않기 위해 이동 단말기(100)의 표면쪽에 위치함이 바람직하다. 따라서, 도 1c에 도시된 바와 같이 일반적으로 전자부품이 실장 되지 않아 넓은 면적을 확보할 수 있는 후면커버(103)에 상기 안테나(200)를 배치한다.
- [0020] 선행기술문헌 1의 안테나(200)는 도 1c에 도시된 바와 같이 연성기관(210), 2가지 종류의 패턴, 자성시트(230)를 주요구성으로 한다.
- [0021] 패턴은 크게 2가지 종류로 고주파용 패턴(220)과 저주파용 패턴(225)으로 구분된다. 즉, 서로 다른 주파수 대역을 이용하는 것을 특징으로 하며, 고주파용 패턴(220)은 무선통신에 적합하고, 저주파용 패턴(225)은 주로 배터리의 무선충전에 적합하다.
- [0022] 이동 단말기(100)에 이용되는 무선충전기술은 전자기 유도 원리를 이용한다.
- [0023] 전자기 유도는 전류를 흘려 자기장을 형성하고, 그 위에 이동 단말기(100)를 놓으면 이동 단말기(100)에 장착된 저주파용 패턴, 즉 무선 충전용 코일(225)에 전류가 흘러 충전이 된다.
- [0024] 전송하는 전력량에 따라 주파수가 달라질 수 있으나, 일반적으로 이동 단말기(100)와 같은 소형 가전제품에 이용되는 전력은 수백 mW이하로 비교적 낮은 주파수를 이용한다.
- [0025] 무선통신은 이동 단말기(100)의 기능이 다양화되면서, 전화통화를 위한 전파의 전송 이외에 NFC(Near Field Communication), RFID(Radio Frequency Identification) 등의 기능을 위해서도 안테나가 필요하다. 특히 무선통신 기술에 따라 이용하는 주파수는 다르며, 많은 양의 데이터를 전송하기 위해 무선 충전에 이용되는 주파수에 비해 상대적으로 고주파를 이용한다.
- [0026] 선행기술문헌 1의 무선 통신용 안테나(200)가 이용되는 통신 방식의 예로 근거리 무선통신(NFC: Near Field Communication)을 들 수 있다. 근거리 무선통신은 전자태그(RFID)의 일종으로 약 13.56MHz주파수 대역을 이용하는 비접촉식 무선통신 모듈이다.
- [0027] 대략 10~40cm의 가까운 거리에서 단말기(100) 간의 데이터를 전송하는 기술로서, 통신거리가 짧기 때문에 상대적으로 보안이 우수하고 가격이 저렴해 주목받는 차세대 근거리 통신기술이다. 데이터 읽기와 쓰기를 모두 이용할 수 있으며, 블루투스처럼 기기간에 설정이 필요 없어 최근 이동 단말기(100)에 근거리 무선통신 기능을 부가하고 있다.
- [0028] 그런데, 선행기술문헌 1에 따른 이동 단말기(100)는 고주파용 패턴(220)과 저주파용 패턴(200)이 서로 물리적으로 완전 격리된 상태로 배치되므로 인하여 전체 면적이 상대적으로 커질 수밖에 없고, 특히 고주파용 패턴(220)은 10~40cm의 거리에서 전자기 유도작용의 효율을 높일 수 있도록 저주파용 패턴(220)보다 상대적으로 패턴 길이가 커야만 하는데 저주파용 패턴(200)과의 이격된 상태에서 더 크게 권회되어야만 하여 점유공간을 넓고

크게 차지할 수밖에 없는 문제점을 안고 있다.

- [0029] 도 2a는 선행기술문헌 2(공개특허 제2013-0123310호; 공진 방식 무선 전력 수신 시스템에서 공진단 장치)가 적용되는 공진 방식 무선 전력 수신 시스템에서 NFC 안테나 및 WPT 공진기의 평면상 배치 구조를 나타낸 예시도이며, 도 2b는 NFC 안테나 및 WPT 공진기의 휴대용 단말기 상에서의 배치 구조를 나타낸다.
- [0030] 도 2a 및 도 2b를 참조하여, 먼저 선행기술문헌 2가 적용되는 무선 전력 수신 시스템, 예를 들어 휴대용 단말기에서 NFC 안테나(10) 및 WPT 공진기(20)의 기구적인 실장 상태를 살펴보면, 평면적으로 루프형 안테나 구조를 NFC 안테나(10)는 마찬가지로 루프형 안테나 구조를 가지는 WPT 공진기(20)의 내측에 위치하도록 설치된다.
- [0031] 또한, NFC 안테나(10)는 휴대용 단말기의 본체(1) 뒷면에서 (착탈 가능하게 설치될 수 있는 배터리 부위에) 설치될 수 있으며, WPT 안테나(20)는 휴대용 단말기의 뒷면 커버(2)에 설치될 수 있다.
- [0032] 이때, NFC 안테나(10)와 WPT 공진기(20) 사이에는 아이솔레이션 특성확보를 위해 적절히 설계된 이격 거리(Isolation d, Isolation h)가 발생한다. 이와 같은 이격 거리에 의해 NFC 안테나(10)와 WPT 공진기(20) 두 주파수(@13.56MHz, 6.78MHz)의 아이솔레이션 특성이 기구적으로 결정된다.
- [0033] 도 2c는 선행기술문헌 2의 일 실시예에 따른 공진 방식 무선 전력 수신 시스템에서 공진단 장치의 회로도이고, 부호 20은 고임피던스 회로이다.
- [0034] 도 2c를 참조하여, 선행기술문헌 2의 특징에 따른 공진단 장치는 WPT 전력용 증폭기(Power Amplifier: PA)(미도시)에서 방출되는 체배 성분(harmonics)이 외부로 방사되지 않도록 하기 위하여 WPT 공진기(20)에 션트 캐패시터(shunt capacitor)(40)를 연결할 수 있다.
- [0035] 그런데, 선행기술문헌 2에 따른 공진 방식 무선 전력 수신 시스템에서 공진단 장치 역시 NFC 안테나(10)와 WPT 공진기(20)가 서로 물리적으로 완전 격리된 상태로 배치되므로 인하여 전체 면적이 상대적으로 커질 수밖에 없으며 점유공간 또한 넓고 크게 차지할 수밖에 없는 단점을 지니고 있다.
- [0036] 도 3은 선행기술문헌 3(공개특허 제2013-0027403호)의 실시예에 따라 전력 공급 주파수 대역을 6.78MHz를 이용하는 경우 무선 전력전송 제어 장치(100)의 회로도이다.
- [0037] 도 3을 참조하면, 무선 전력 전송 제어 장치(100)는 13.56MHz 대역을 통신 주파수 대역으로 이용하고, 전력 공급 주파수 대역을 통신 주파수 대역과 다른 6.78MHz 대역을 이용함으로써, 전력 공급 신호와 통신 신호의 세기를 높더라도 규제에 영향을 받지 않게 된다.
- [0038] 또한, 선행기술문헌 3의 실시예에 따라 13.56MHz 대역을 통신 주파수 대역으로 이용하고, 전력 공급 주파수 대역을 통신 주파수 대역과 다른 6.78MHz 대역을 이용하는 경우 무선 전력 전송 제어 장치(100)의 구체적인 회로의 구성은 다르게 구성될 수 있다.
- [0039] 예를 들면, 도 3과 같이 Power IC(120) 외부에 NFC IC(140)와의 무선 전력 전송제어 신호 송수신을 위한 별도의 구성이 구비될 수 있다.
- [0040] 더욱 구체적으로, 도 3을 참조하면 무선 전력 전송 제어 장치(100)의 회로는 WPT 코일(410), NFC 코일(440), Power IC(420), GPIO(General Purpose Input/Output) Expander(422), ADC(Analog Digital Converter)(424), NFC IC(430)를 포함하여 구성될 수 있다.
- [0041] WPT 코일(410)은 POWER IC(420)와 연결될 수 있으며, 6.78MHz의 주파수 대역에서 공진하여, 전력 공급 장치(TX)로부터 전력을 공급받아 POWER IC(420)로 제공한다. Power IC(420)는 무선 전력 수신에 필요한 각종 신호를 생성하고, 전력 공급 장치(TX)로부터 수신된 메시지에 따른 무선 전력 전송 제어 신호에 따라 동작한다. 그리고, Power IC(420)는 WPT 코일(410)을 수신한 전력에 따른 전압을 이용하여 무선 전력 전송 제어 장치(100)의 전반적인 동작을 활성화시킨다. 또한, 전력을 공급받는 동안, 공급되는 전력에 의해 얻어지는 전류 및 전압을 측정 및 조절하고, 일정 전압(VDC_out)을 출력한다.
- [0042] GPIO Expander(422)는 입출력 모듈로서, POWER IC(420)와 NFC IC(430)사이에서 POWER IC(420)에 의해 출력되는 신호를 NFC IC(430)로 입력되도록 하고, NFC IC(430)에 의해 출력되는 신호를 POWER IC(420)에 입력되도록 한다. ADC(424)는 POWER IC(420)와 NFC IC(430)가 주고 받는 신호에 대해 아날로그 신호를 디지털 신호로 변환하

고, 디지털 신호를 아날로그 신호로 변환하여 POWER IC(420)와 NFC IC(430)간에 신호 송수신을 조절한다.

- [0043] NFC IC(430)는 Power IC(420)에 의해 제공되는 전력에 따라 동작하며, NFC 코일(440)을 통해 전력 공급 장치(TX)와 NFC 통신을 수행한다. 이때 NFC 코일(440)은 13.56MHz 대역에서 전파 방사 및 전파 수신이 가능한 NFC 코일(Coil)로 구성될 수 있다.
- [0044] NFC IC(430)는 NFC 안테나(440)를 통해 전력 공급 장치(TX)로부터 수신된 신호를 분석하고, 수신된 신호에 따라 무선 전력 전송 제어 신호를 NFC IC 입출력부(431)를 이용하여 Power IC(420)로 전달한다. 이때 NFC IC 입출력부(431)는 SDA 단자와 SDC 단자를 포함할 수 있다. SDA 단자는 무선 전력 전송 제어를 위한 데이터를 입력받거나 출력하고, SDC 단자는 클럭을 출력한다. 또한 선행기술문헌 3의 실시예에 따르면 무선전력 전송 제어 신호는 무선 전력 전송에 필요한 제어 신호로서, 전압, 전류, 온도 등의 조절이 가능하다.
- [0045] 한편, 상기한 선행기술문헌 3의 실시예에서는 전력 공급 주파수 대역을 6.78MHz를 이용하고, 13.56MHz 대역을 통신 주파수 대역으로 이용하는 경우를 예를 들었지만, 전력 공급 주파수 대역을 100~200kHz로 이용할 수도 있다.
- [0046] 그런데, 선행기술문헌 3에 따른 무선 전력전송 제어 장치 역시 WPT 코일(410)과 NFC 코일(440)이 서로 물리적으로 완전 격리된 상태로 배치되므로 인하여 전체 면적이 상대적으로 커질 수밖에 없으며 점유공간 또한 넓고 크게 차지할 수밖에 없는 한계를 안고 있다.

선행기술문헌

특허문헌

- [0047] (특허문헌 0001) 선행기술문헌 1 - 공개특허 10-2013-0113222(안테나 및 이를 구비한 이동 단말기)
- (특허문헌 0002) 선행기술문헌 2 - 공개특허 제2013-0123310호(공진 방식 무선 전력 수신 시스템에서 공진단 장치)
- (특허문헌 0003) 선행기술문헌 3 - 공개특허 제2013-0027403호(무선 전력전송 제어 장치)

발명의 내용

해결하려는 과제

- [0048] 본 발명의 목적은 스타트단자로부터 공통단자에 이르는 외곽 루프패턴에 의해 제 1 모드 무선통신을 구현케 하고, 스타트단자로부터 연결패턴을 지나 엔드단자에 이르는 외곽 루프패턴과 더불어 내곽 루프패턴에 의해 제 2 모드 무선통신을 확장 구현케 한 휴대 단말기용 무선통신 이중 안테나를 제공함에 있다.
- [0049] 본 발명의 목적은 제 2 모드 무선통신이 외곽 루프패턴을 비롯한 내곽 루프패턴에 이르기까지 함께 확장 구현되어 배가된 비접촉 자기유도 결합력을 보장받을 수 있도록 한 휴대 단말기용 무선통신 이중 안테나를 제공함에 있다.
- [0050] 본 발명의 목적은 제 2 모드 무선통신으로 내곽 루프패턴뿐만 아니라 외곽 루프패턴까지 확장 활용토록 하여 무선통신 효율의 배가된 보장은 물론이거니와 더 나아가 내곽 루프패턴 및 외곽 루프패턴의 길이 및 크기의 축소까지 가능케 하여 전체 점유공간을 더불어 줄일 수 있도록 한 휴대 단말기용 무선통신 이중 안테나를 제공함에 있다.

과제의 해결 수단

- [0051] 상기 목적을 달성하기 위한 본 발명은,
- [0052] 플렉시블한 베이스필름과, 외부의 스타트단자로부터 시작하여 상기 베이스필름의 가장자리에서 안쪽으로 권회되는 외곽 루프패턴과, 상기 외곽 루프패턴으로부터 상기 베이스필름의 안쪽으로 이어지는 연결패턴과, 상기 연결패턴으로부터 시작하여 상기 베이스필름의 중심을 향하여 권회된 후 외부의 엔드단자에 연결되는 내곽 루프패턴

과, 상기 연결패턴에 조인되어 외부로 인출되는 공통단자를 포함하고,

[0053] 상기 스타트단자로부터 상기 공통단자에 이르는 상기 외곽 루프패턴은 제 1 모드 무선통신을 구현하고,

[0054] 상기 스타트단자로부터 상기 연결패턴을 지나 상기 엔드단자에 이르는 상기 외곽 루프패턴과 더불어 내곽 루프패턴은 제 2 모드 무선통신을 확장 구현하는 것을 그 기술적 구성상의 기본 특징으로 한다.

발명의 효과

[0055] 본 발명에 따라 스타트단자로부터 공통단자에 이르는 외곽 루프패턴에 의해 제 1 모드 무선통신을 구현케 할 수 있고, 스타트단자로부터 연결패턴을 지나 엔드단자에 이르는 외곽 루프패턴과 더불어 내곽 루프패턴에 의해 제 2 모드 무선통신을 확장 구현케 할 수 있는 효과가 있다.

[0056] 본 발명은 제 2 모드 무선통신이 외곽 루프패턴을 비롯한 내곽 루프패턴에 이르기까지 함께 확장 구현되어 배가된 비접촉 자기유도 결합력을 보장받을 수 있도록 하는 효과가 있다.

[0057] 본 발명은 제 2 모드 무선통신으로 내곽 루프패턴뿐만 아니라 외곽 루프패턴까지 확장 활용토록 하여 무선통신 효율의 배가된 보장은 물론이거니와 더 나아가 내곽 루프패턴 및 외곽 루프패턴의 길이 및 크기의 축소까지 가능케 하여 전체 점유공간을 더불어 줄일 수 있도록 할 수는 효과가 있다.

도면의 간단한 설명

[0058] 도 1a는 선행기술문헌 1과 관련된 이동 단말기의 블록 구성도.

도 1b는 선행기술문헌1에 따른 이동 단말기의 후면 사시도.

도 1c는 선행기술문헌 1에 따른 안테나가 이동 단말기의 후면커버에 부착된 것을 도시한 평면도.

도 2a는 선행기술문헌 2가 적용되는 공진 방식 무선 전력 수신 시스템에서 NFC 안테나 및 WPT 공진기의 평면상 배치 구조를 나타낸 예시도.

도 2b는 선행기술문헌 2의 NFC 안테나 및 WPT 공진기의 휴대용 단말기 상에서의 배치 구조를 나타내는 구조도.

도 2c는 선행기술문헌 2의 일 실시예에 따른 공진 방식 무선 전력 수신 시스템에서 공진단 장치의 회로도.

도 3은 선행기술문헌 3의 실시예에 따라 전력 공급 주파수 대역을 6.78MHz를 이용하는 경우 무선 전력전송 제어 장치의 회로도.

도 4는 선행문헌들에서 도출해 낼 수 있는 일반적인 휴대 단말기용 무선통신 이중 안테나를 본 발명에 대비되도록 나타낸 평면도.

도 5a는 본 발명에 따른 휴대 단말기용 무선통신 이중 안테나를 나타내는 평면도.

도 5b는 본 발명에 따른 휴대 단말기용 무선통신 이중 안테나를 나타내는 등가 회로도.

도 6a는 본 발명의 실시예에 따른 휴대 단말기용 무선통신 이중 안테나를 나타내는 평면도.

도 6b는 본 발명의 실시예에 따른 휴대 단말기용 무선통신 이중 안테나를 나타내는 등가 회로도.

발명을 실시하기 위한 구체적인 내용

[0059] 이하, 본 발명에 따른 휴대 단말기용 무선통신 이중 안테나의 바람직한 실시예를 도면을 참조하여 설명하기로 하고, 그 실시예로는 다수 개가 존재할 수 있으며, 이러한 실시예를 통하여 본 발명의 목적, 특징 및 이점들을 더욱 잘 이해할 수 있게 된다.

[0060] 도 4는 선행문헌들에서 도출해 낼 수 있는 일반적인 휴대 단말기용 무선통신 이중 안테나를 본 발명에 대비되도록 나타낸 평면도이다.

[0061] 도 4에 도시된 바와 같이 일반적인 휴대 단말기용 무선통신 이중 안테나는 플렉시블한 베이스필름(100)을 기본으로 하면서, 외부의 제 1 스타트단자(111) 및 제 1 엔드단자(112)에 각각 연결되어 베이스필름(100)의 가장자

리에 권회되는 외곽 루프패턴(320)을 독립적으로 구비하고, 나아가 외부의 제 2 스타트단자(121) 및 제 2 엔드단자(122)에 각각 연결되어 외곽 루프패턴(320)으로부터 이격되는 베이스필름(100)의 중앙에 권회되는 내곽 루프패턴(330)을 독립적으로 구비한 구조로 이루어진다.

[0062] 이때, 외곽 루프패턴(320)은 대략 10~40cm의 가까운 거리에서 13.56MHz 주파수 대역의 비접촉 자기유도 결합력(Non-Contact Magnetic Inductive Coupling Power)으로 외부의 단말기 상호간 데이터를 전송기 위한 NFC 및 RFID를 제 1 모드 무선통신(400)으로 활용토록 할 수 있고, 내곽 루프패턴(330)은 전자기 유도원리, 즉 유도자기에 원리에 따라 전류를 흘려 자기장을 형성하고 그 위에 휴대 단말기를 놓으면 100~200kHz 대역에서 구현되는 비접촉 자기유도 결합력으로 배터리의 충전을 가능케 하는 WPT를 제 2 모드 무선통신(500)으로 활용케 할 수 있다.

[0063] 그런데, 일반적인 휴대 단말기용 무선통신 이중 안테나는 외곽 루프패턴(320)이 제 1 스타트단자(111) 및 제 1 엔드단자(112)에 의해 베이스필름(100)의 외곽에 독립적으로 구비되고, 나아가 내곽 루프패턴(330)이 제 2 스타트단자(121) 및 제 2 엔드단자(122)에 의해 베이스필름(100)의 중심에 독립적으로 구비되어, 제 1 모드 무선통신(400) 및 제 2 모드 무선통신(500)의 비접촉 자기유도 결합력에 대한 효율을 통신환경에 따라 극대화시킬 수 없는 한계를 안고 있다.

[0064] 특히, 휴대 단말기의 배터리 충전을 가능케 하는 WPT의 제 2 모드 무선통신(500)으로 활용되는 내곽 루프패턴(330)이 외곽 루프패턴(320) 안쪽의 베이스필름(100)의 제한된 영역에 독립적으로 패터닝되어 권회되는 횟수가 적을 뿐만 아니라 전체 길이 역시 짧을 수밖에 없어, 즉 인덕턴스가 작아 배터리의 충전효율을 극대화시키지 못하는 문제점을 낳고 있는 것이다.

[0065] 도 5a는 본 발명에 따른 휴대 단말기용 무선통신 이중 안테나를 나타내는 평면도이고, 도 5b는 본 발명에 따른 휴대 단말기용 무선통신 이중 안테나를 나타내는 등가 회로도이다.

[0066] 본 발명에 따른 휴대 단말기용 무선통신 이중 안테나는 도 5a 및 도 5b에 도시된 바와 같이 플렉시블한 베이스필름(10)과, 외부의 스타트단자(21)로부터 시작하여 베이스필름(10)의 가장자리에서 안쪽으로 권회되는 외곽 루프패턴(31)과, 외곽 루프패턴(31)으로부터 베이스필름(10)의 안쪽으로 이어지는 연결패턴(32)과, 연결패턴(32)으로부터 시작하여 베이스필름(10)의 중심을 향하여 권회된 후 외부의 엔드단자(24)에 연결되는 내곽 루프패턴(33)과, 연결패턴(32)에 조인되어 외부로 인출되는 공통단자(23)를 포함한다.

[0067] 즉, 베이스필름(10)을 기본으로 하면서 외부에 스타트단자(21), 공통단자(23) 및 엔드단자(24)만을 구비시키고, 외곽 루프패턴(31)과 내곽 루프패턴(33)이 연결패턴(32)에 의해 연결되도록 한 상태에서, 스타트단자(21)로부터 공통단자(23)에 이르는 외곽 루프패턴(31)은 제 1 모드 무선통신(40)을 구현케 하고, 스타트단자(21)로부터 연결패턴(32)을 지나 엔드단자(24)에 이르는 외곽 루프패턴(31)과 더불어 내곽 루프패턴(33)은 제 2 모드 무선통신(50)을 구현케 하여, 특히 제 2 모드 무선통신(50)이 외곽 루프패턴(31)을 비롯한 내곽 루프패턴(33)에 이르기까지 함께 확장 구현되도록 한 것이다.

[0068] 본 발명에 따른 휴대 단말기용 무선통신 이중 안테나는 베이스필름(10)에 권회되는(패터닝되는) 제 1 모드 무선통신(40) 및 제 2 모드 무선통신(50)을 각각 독립적으로 형성시키지 아니하고 연결패턴(32)을 중심으로 스타트단자(21)에서부터 엔드단자(24)에 이르기까지 전체적으로 이어지도록 한 상태에서 연결패턴(32)에 공통단자(23)를 조인한 것으로, 특히 제 2 모드 무선통신(50)이 외곽 루프패턴(31)을 비롯한 내곽 루프패턴(33)에 이르기까지 함께 확장 구현되도록 하여 무선통신 효율의 극대화를 이룰 수 있도록 한 것이다.

[0069] 이때, 제 2 모드 무선통신(50)은 외곽 루프패턴(31) 및 내곽 루프패턴(33)과 함께 확장 구현되어 배가된 비접촉 자기유도 결합력(Non-Contact Magnetic Inductive Coupling Power)을 보장받을 수 있게 되는 것이다.

[0070] 이러한 특징을 살려, 제 1 모드 무선통신(40)은 NFC(Near Field Communication) 또는 RFID(Radio Frequency Identification)이고, 제 2 모드 무선통신(50)은 MST(Magnetic Secure Transmission) 또는 WPT(Wireless Power Transfer)인 것을 특징으로 할 수 있으며, 다른 한편으로 제 1 모드 무선통신(40)은 MST(Magnetic Secure Transmission) 또는 WPT(Wireless Power Transfer)이고, 제 2 모드 무선통신(50)은 NFC(Near Field Communication) 또는 RFID(Radio Frequency Identification)인 것을 특징으로 할 수 있다.

[0071] 제 1 모드 무선통신(40)이 NFC 또는 RFID이고 제 2 모드 무선통신(50)이 MST 또는 WPT이거나, 그 반대의 경우로 구현케 할 수 있는데, 이러한 구현은 통신환경에 따라 사용자가 선택에 의해 이루어질 수 있도록 할 수 있음은

물론이다.

- [0072] 구체적으로, NFC, RFID 및 MST는 이미 공지된 것으로서 대략 10~40cm의 가까운 거리에서 13.56~15MHz 주파수 대역으로 외부의 단말기간 데이터를 전송할 수 있도록 하고, WPT는 전자기 유도원리, 즉 유도자기 원리에 따라 전류를 흘려 자기장을 형성하고 그 위에 휴대 단말기를 놓아 100~200kHz 대역에서 배터리의 충전을 가능케 하는 것이다.
- [0073] 한편, 제 1 모드 무선통신(40)은 도 5b에 도시된 바와 같이 스타트단자(21) 및 공동단자(23) 사이의 외곽 루프패턴(31) 자체의 비접촉 자기유도 결합력인 L1값으로 구현될 수 있도록 하는 반면, 제 2 모드 무선통신(50)은 도 5b에 도시된 바와 같이 스타트단자(21) 및 엔드단자(24) 사이의 내곽 루프패턴(33)에 의한 L2값뿐만 아니라 외곽 루프패턴(31)의 L1값을 합쳐한 확장된 비접촉 자기유도 결합력으로 무선통신 효율의 배가를 보장할 수 있도록 한다.
- [0074] 이와 같이, 본 발명에서는 제 2 모드 무선통신(50)을 내곽 루프패턴(33)뿐만 아니라 외곽 루프패턴(31)까지 확장 활용토록 하여 무선통신 효율의 배가된 보장은 물론이거니와 더 나아가 내곽 루프패턴(33) 및 외곽 루프패턴(31)의 길이 및 크기의 축소까지 가능케 하여 전체 점유공간을 크게 줄일 수 있도록 할 수 있다.
- [0075] 도 6a는 본 발명의 실시예에 따른 휴대 단말기용 무선통신 이중 안테나를 나타내는 평면도이고, 도 6b는 본 발명의 실시예에 따른 휴대 단말기용 무선통신 이중 안테나를 나타내는 등가 회로도이다.
- [0076] 본 발명에 따른 휴대 단말기용 무선통신 이중 안테나는 도 6a 및 도 6b에 도시된 바와 같이 플렉시블한 베이스필름(10)과, 외부의 스타트단자(21)로부터 시작하여 베이스필름(10)의 가장자리에서 안쪽으로 권회되는 외곽 루프패턴(31)과, 외곽 루프패턴(31)으로부터 베이스필름(10)의 안쪽으로 이어지는 연결패턴(32)과, 연결패턴(32)으로부터 시작하여 베이스필름(10)의 중심을 향하여 권회된 후 외부의 엔드단자(24)에 연결되는 내곽 루프패턴(33)과, 연결패턴(32)에 조인되어 외부로 인출되는 공동단자(23)를 포함하며, 스타트단자(21)에 조인되어 공동단자(23) 및 엔드단자(24) 사이에 배치되는 보조단자(22)를 더 포함할 수 있다.
- [0077] 그리고, 제 2 모드 무선통신(50)은 스타트단자(21)를 비롯한 보조단자(22)로부터 연결패턴(32)을 지나 엔드단자(24)에 이르는 외곽 루프패턴(31)과 더불어 내곽 루프패턴(33)에 의해 확장 구현되도록 한다.
- [0078] 도 6a에 도시된 바와 같이 본 발명에 따른 휴대 단말기용 무선통신 이중 안테나는 베이스필름(10)에 권회되는 (패터닝되는) 제 1 모드 무선통신(40) 및 제 2 모드 무선통신(50)을 각각 독립적으로 형성시키지 아니하고 연결패턴(32)을 중심으로 스타트단자(21)에서부터 엔드단자(24)에 이르기까지 전체적으로 이어지도록 한 상태에서 연결패턴(32)에 공동단자(23)를 조인한 것으로, 특히 제 2 모드 무선통신(50)이 외곽 루프패턴(31)을 비롯한 내곽 루프패턴(33)에 이르기까지 함께 확장 구현되도록 하여 무선통신 효율의 극대화를 이룰 수 있도록 한 것이다.
- [0079] 이때, 제 2 모드 무선통신(50)은 외곽 루프패턴(31) 및 내곽 루프패턴(33)과 함께 확장 구현되어 배가된 비접촉 자기유도 결합력(Non-Contact Magnetic Inductive Coupling Power)을 보장받을 수 있게 되는 것이다.
- [0080] 이러한 특징을 살려, 제 1 모드 무선통신(40)은 NFC 또는 RFID이고, 제 2 모드 무선통신(50)은 MST 또는 WPT인 것을 특징으로 할 수 있으며, 다른 한편으로 제 1 모드 무선통신(40)은 MST 또는 WPT이고, 제 2 모드 무선통신(50)은 NFC 또는 RFID인 것을 특징으로 할 수 있다.
- [0081] 제 1 모드 무선통신(40)이 NFC 또는 RFID이고 제 2 모드 무선통신(50)이 MST 또는 WPT이거나, 그 반대의 경우로 구현케 할 수 있는데, 이러한 구현은 통신환경에 따라 사용자가 선택에 의해 이루어질 수 있도록 할 수 있음은 물론이다.
- [0082] 구체적으로, NFC, RFID 및 MST는 이미 공지된 것으로서 대략 10~40cm의 가까운 거리에서 13.56~15MHz 주파수 대역으로 외부의 단말기간 데이터를 전송할 수 있도록 하고, WPT는 전자기 유도원리, 즉 유도자기 원리에 따라 전류를 흘려 자기장을 형성하고 그 위에 휴대 단말기를 놓아 100~200kHz 대역에서 배터리의 충전을 가능케 하는 것이다.
- [0083] 한편, 제 1 모드 무선통신(40)은 도 6b에 도시된 바와 같이 스타트단자(21), 보조단자(22) 및 공동단자(23) 사이의 외곽 루프패턴(31) 자체의 비접촉 자기유도 결합력인 L1값으로 구현될 수 있도록 하는 반면, 제 2 모드 무선통신(50)은 도 6b에 도시된 바와 같이 스타트단자(21), 보조단자(22) 및 엔드단자(24) 사이의 내곽 루프패턴

(33)에 의한 L2값뿐만 아니라 외곽 루프패턴(31)의 L1값을 합쳐한 확장된 비접촉 자기유도 결합력으로 무선통신 효율의 배가를 보장할 수 있도록 한다.

[0084] 이와 같이, 본 발명에서는 제 2 모드 무선통신(50)을 내곽 루프패턴(33)뿐만 아니라 외곽 루프패턴(31)까지 확장 활용토록 하여 무선통신 효율의 배가된 보장은 물론이거니와 더 나아가 내곽 루프패턴(33) 및 외곽 루프패턴(31)의 길이 및 크기의 축소까지 가능케 하여 전체 점유공간을 크게 줄일 수 있도록 할 수 있다.

[0085] 이때, 보조단자(22)는 휴대 단말기 내의 메인 회로기판에 본 발명인 휴대 단말기용 무선통신 이중 안테나가 접속될 경우 기존 네 개의 단자를 접속시키기 위한 설계를 특별히 바꾸지 않더라도 용이하게 호환성 있게 연결시킬 수 있도록 고려한 것이다.

[0086] 다른 한편으로, 베이스필름(10)은 폴리이미드필름, PET필름 또는 PVC필름일 수 있고, 연결패턴(32)에 조인된 공통단자(23)의 패턴라인 그리고 엔드단자(24)에 연결된 패턴라인 등은 상호간 크로스(Cross)되지 않도록 비아홀(Via Hall) 등을 통해 베이스필름(10)의 상면, 하면 또는 양면에 나누어 패터닝시킬 수 있음은 물론이다.

산업상 이용가능성

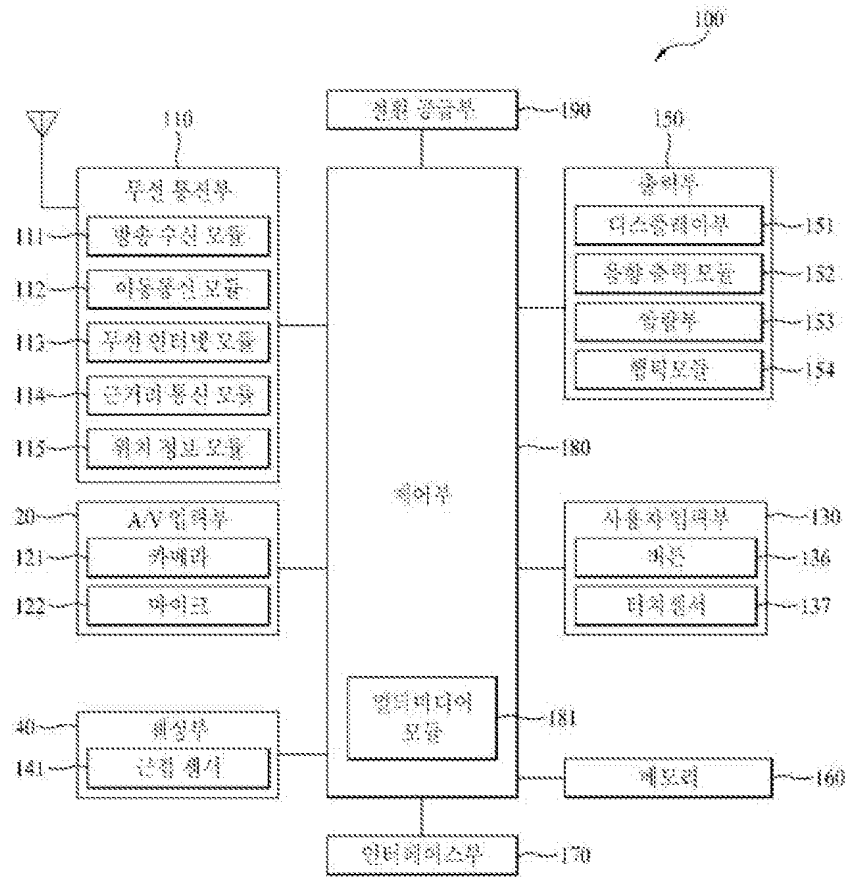
[0087] 본 발명은 테블릿 PC나 스마트 폰 등과 같은 휴대 단말기 산업분야에 이용될 수 있다.

부호의 설명

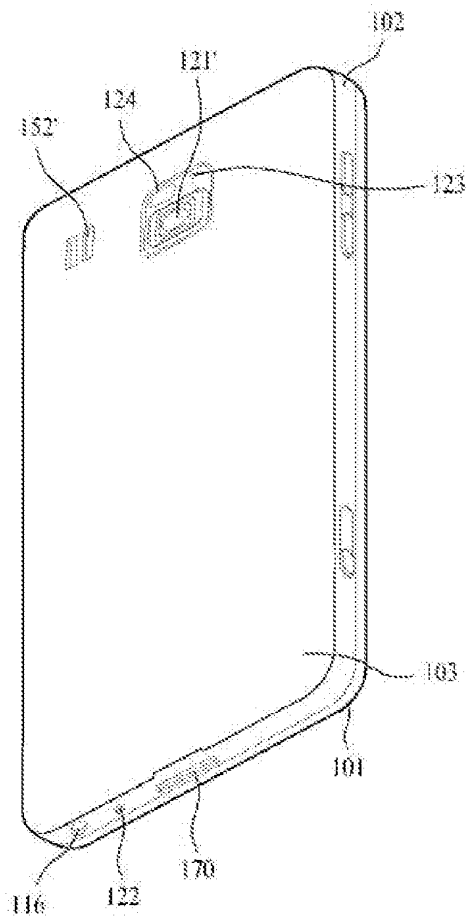
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	24 : 엔드단자	31 : 외곽 루프패턴
	32 : 연결패턴	33 : 내곽 루프패턴
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도면

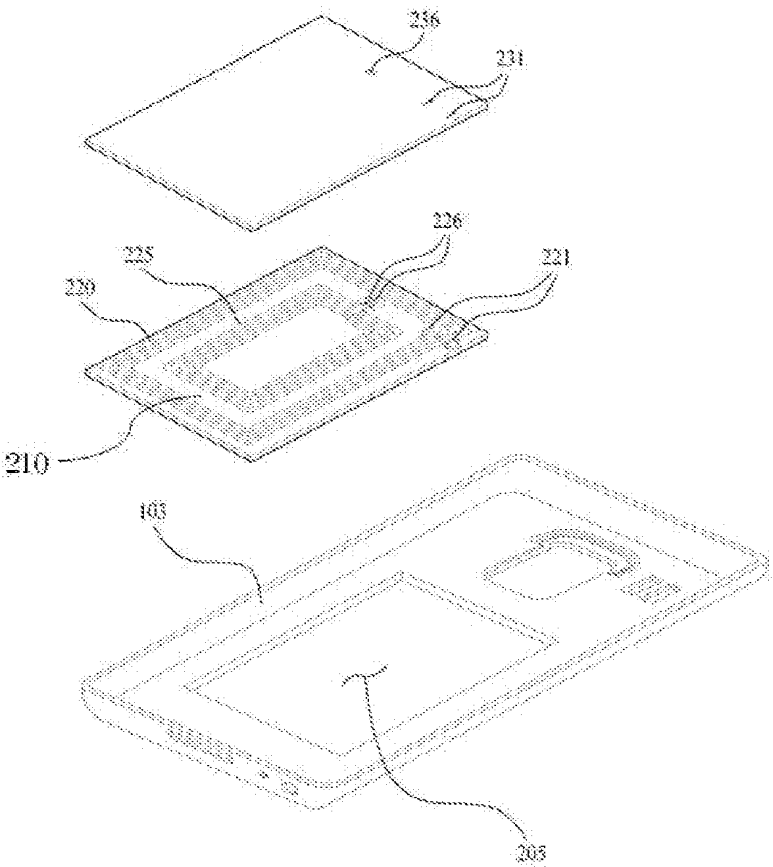
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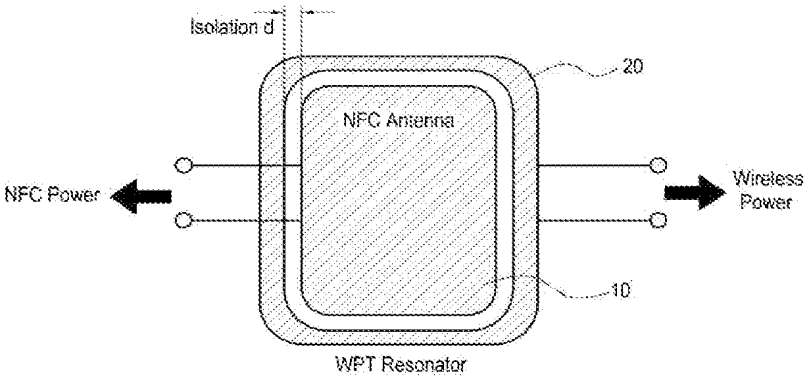
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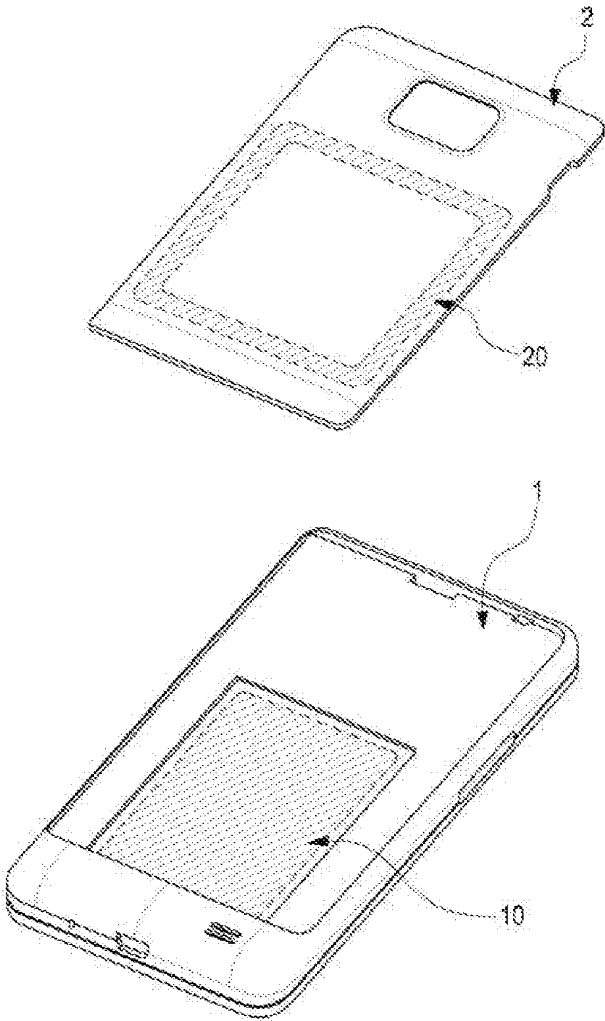
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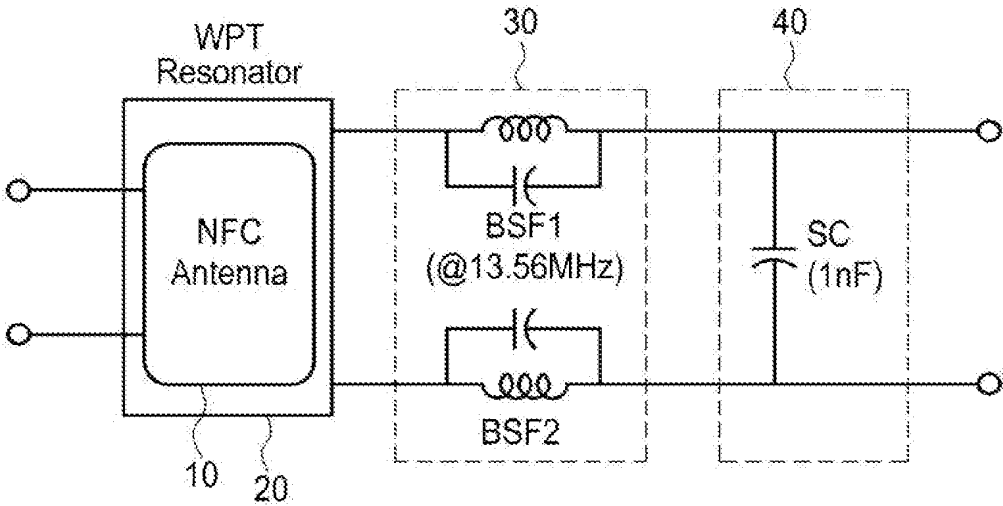
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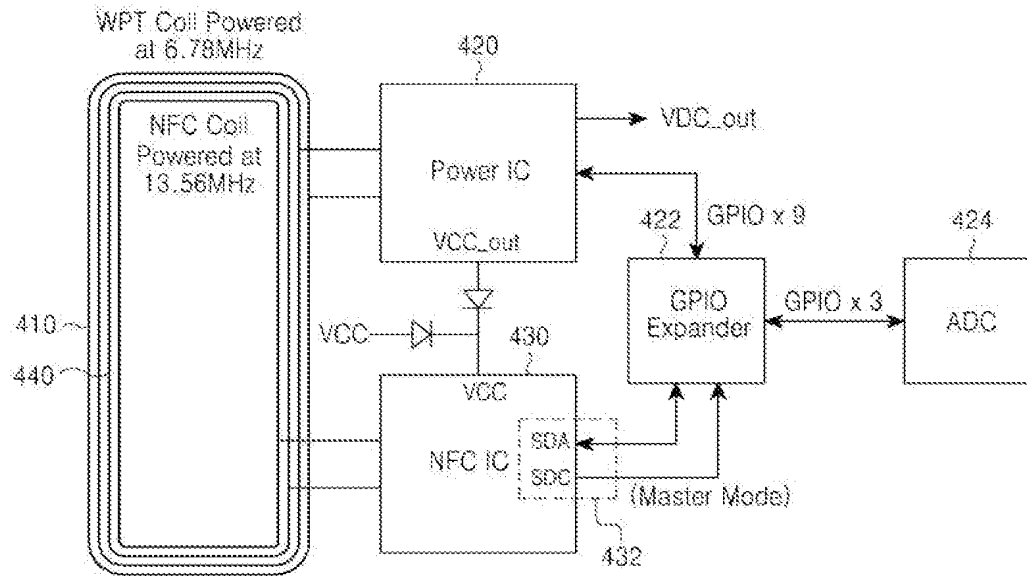
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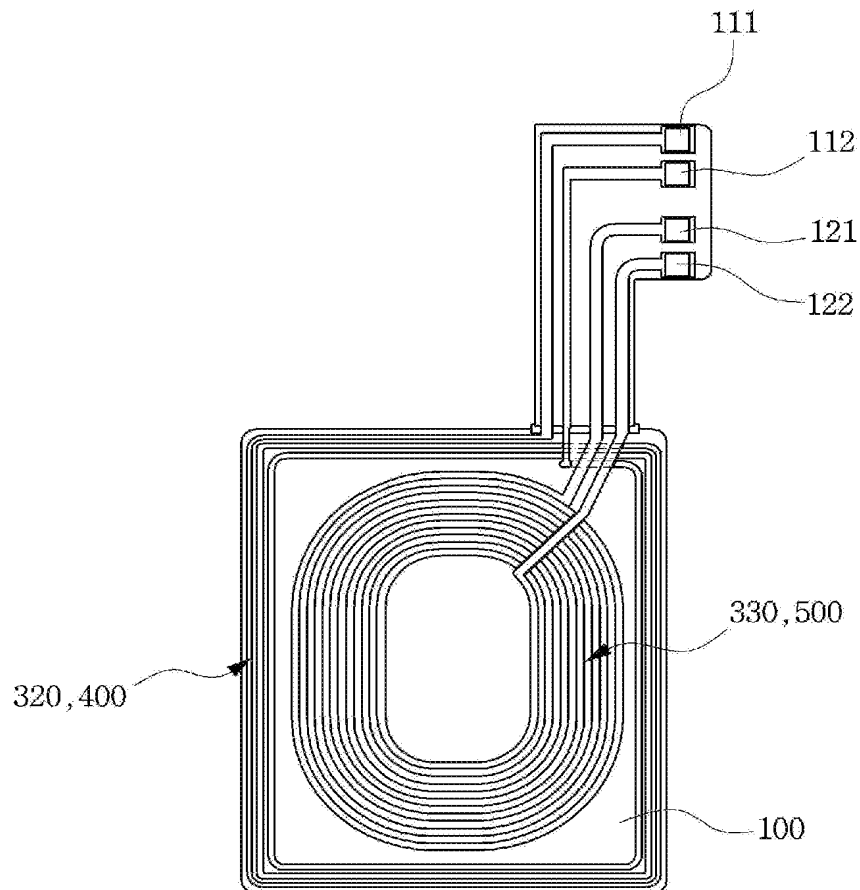
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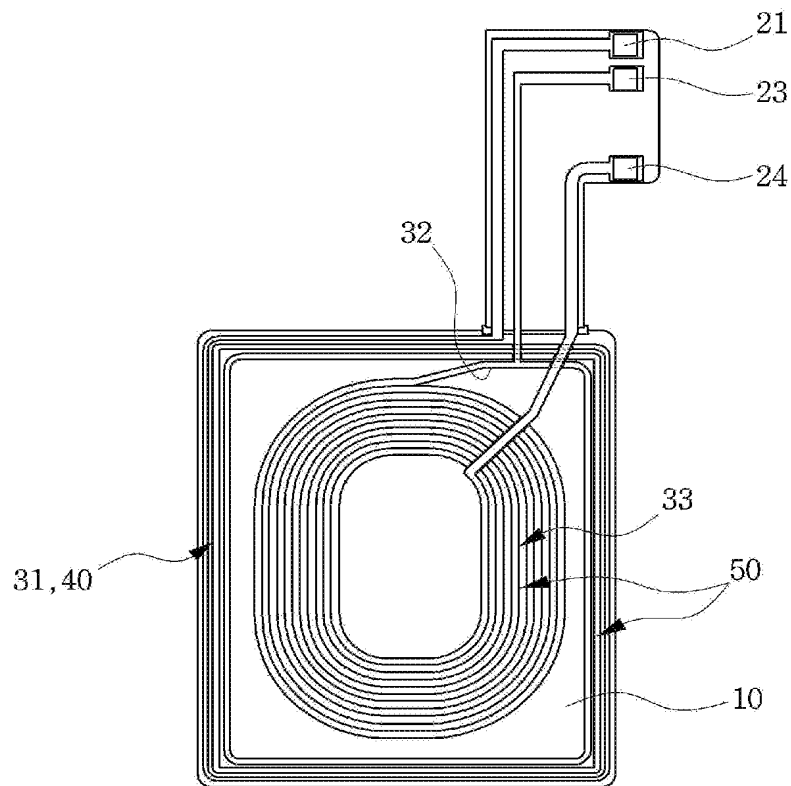
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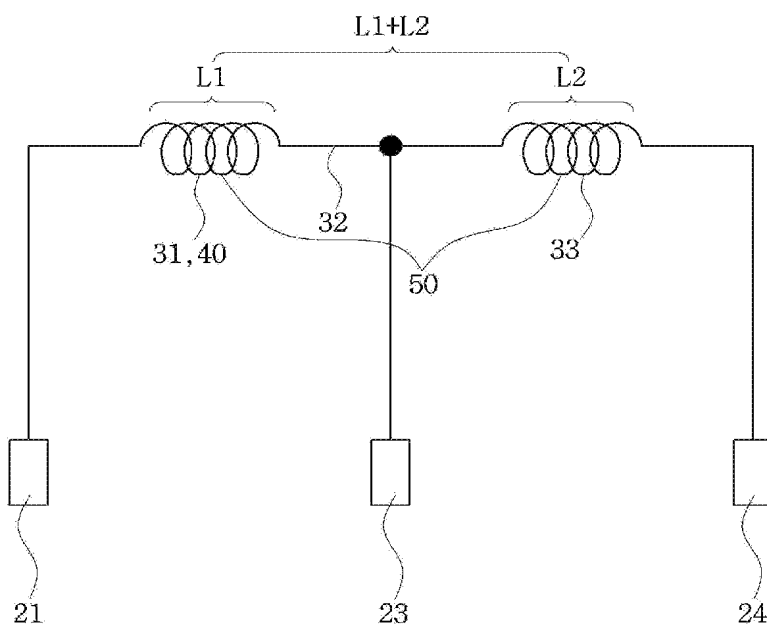
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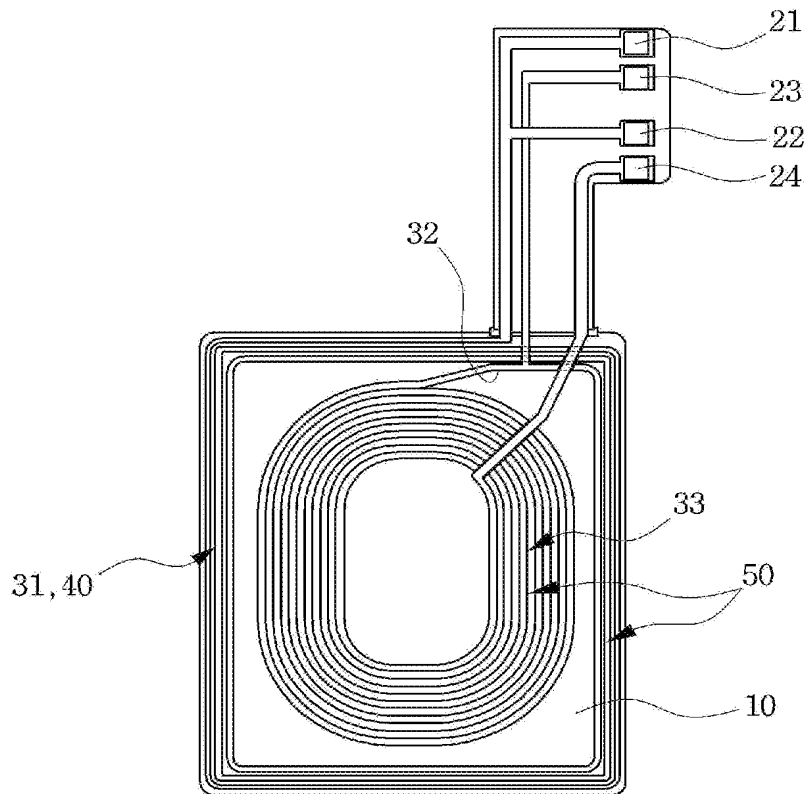
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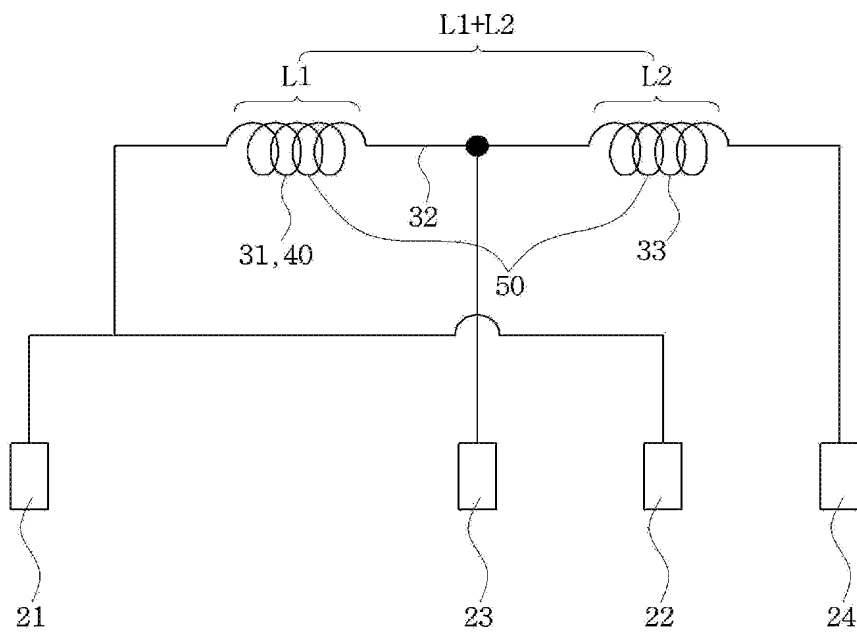
도 5b



도면6a



도면6b



Coil device for wireless charging or near-field induction of near field communication (nfc)

List of publications

Publication date

Application number 2013CN-U022915 Date 2013-01-16 Register

CN203103042 U Registered utility model 2013-07-31

English Title

Coil device for wireless charging or near-field induction of near field communication (nfc)

Other Title 用于无线充电或nfc近场感应的线圈装置

English Abstract (Native or MT)

The utility model provides a coil device for wireless charging or near-field induction of a near field communication (NFC). The coil device for wireless charging or near-field induction of the NFC comprises a soft substrate, a first coil and a second coil, wherein the soft substrate is panel-shaped, the first coil is fixedly arranged on the soft substrate, a hollow containing portion is formed in the middle of the first coil, the first coil is provided with two outgoing-line ends, the second coil is fixedly arranged on the soft substrate, the second coil is arranged inside the containing portion of the first coil, and the second coil is provided with two outgoing-line ends. The soft substrate is used with the help of the coil device for wireless charging or near-field induction of the NFC, therefore the defect that an existing substrate is easily bent by external force to cause breakage in the process of manufacture or carrying or use due to the fact that the existing substrate is a hard substrate can be overcome, and the purposes that the yield of products is improved, manufacturing cost is reduced, and using convenience is improved can be achieved. In addition, due to the fact that the soft substrate has magnetism, the purposes that stability of the induced current is improved, and electromagnetic interference is reduced can be achieved.

Other Abstracts

本实用新型提供一种用于无线充电或NFC近场感应的线圈装置，其包含：一软性基板，该软性基板为平板状；一第一线圈，该第一线圈固设于该软性基板上，又该第一线圈中间形成有一中空的内容置部，另该第一线圈具有两个出线端；一第二线圈，该第二线圈固设于该软性基板，又该第二线圈位于该第一线圈的内容置部内，另该第二线圈具有两个出线端；借助该线圈装置使用软性基板

，而可避免现有基板因系为硬性基板，而易于制造、搬运或使用等过程中受外力弯折而破裂的缺失，进而使本实用新型可达到提高产品良率、降低制造成本及增进使用便利性的功效；此外，又借助该软性基板进一步具有磁性，可兼具提升感应电流稳定度或降低电磁干扰的功效。

Application Language CHINESE (CHI)

Inventor(s) XIE MINGYAN

YANG XIANGZHONG

LU YUNHUANG

Inventor(s) 谢明彦

杨祥忠

卢云煌

Applicant/Assignee

TAI TECHNOLOGY ADVANCED ELECTRONICS

owned by TAI ADVANCED TECHNOLOGY

Assignee 西北台庆科技股份有限公司

Patent Assignee History TAI-TECH ADVANCED ELECTRONICS CO LTD

Representative WU HUAQUAN; BEIJING HC-IP AGENCY CO. LTD. (GENERAL PARTNERSHIP)

Representative 吴怀权; 北京汇智英财专利代理事务所(普通合伙) 11301

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Description

TECHNICAL FIELD

[0002] The utility model relates to a coil assembly for wireless charging or NFC near field response indicates especially one kind and can avoid the base plate easily to receive external force to buckle and cracked shortcoming, and then can improve product yield and reduce manufacturing cost's coil assembly.

BACKGROUND ART

[0004] In the Field of technology using induction coils, wireless charging and NFC (Near Field Communication) are two hottest application items, wherein the former is to approach a mobile phone and a wireless charging device to a certain distance, so that coil modules in the mobile phone and the wireless charging device can form a primary side and a secondary side of a transformer, respectively, so that the coil module in the mobile phone can generate current according to the electromagnetic induction principle, and further charge the mobile phone, and the latter is to utilize the way that the coil modules arranged in the two NFC devices can generate electrical signals such as current according to the electromagnetic induction when approaching, so as to achieve the purpose of reading, writing or exchanging data, and the common point of the two devices is that the coil modules must be arranged, please refer to fig. 1, wherein the coil module 1 is generally composed of a substrate 10 and a coil 2 wound on the substrate 10, the coil 2 can be fixed to the substrate 10 by bonding, and the coil 2 has two wire outlets 21, the two wire outlets 21 can be electrically connected to a power module or an NFC chip on a circuit board of an electronic device, such as a mobile phone, so that the coil module 1 can achieve the purpose of wireless charging or signal induction transmission according to the aforementioned operation principle.

[0005] As shown in fig. 1, although the coil module 1 can achieve the purpose of wireless charging or signal induction transmission, the substrate 10 is usually a rigid substrate, and therefore, the substrate is easily bent and broken by an external force during the manufacturing, carrying, or using processes, and the like, thereby causing a reduction in product yield, an increase in manufacturing cost, and inconvenience in use, and at the same time, once the substrate 10 is broken, the magnetic coupling characteristic (for a wireless charging coil) or the magnetic shielding characteristic (for an NFC coil) of the coil 2 is further reduced and deteriorated, thereby easily causing a loss such as poor stability of a charging induced current or an electromagnetic interference problem; in

addition, the wirelessly charged coil module 1 or the NFC near-field inductive coil module 1 is usually disposed independently and separately, so if the electronic device needs to have these two functions at the same time, two independent coil modules 1 must be disposed, which results in an increase in volume and cost, and thus there is a need for improvement.

[0006] Therefore, how to eliminate the above-mentioned disadvantages is the difficulty that the inventors of the present invention want to solve.

DISCLOSURE

[0007] SUMMARY OF THE UTILITY MODEL

[0008] In view of the existing coil module, because the substrate is a hard substrate, it is easy to bend and break by external force, resulting in reduced product yield and increased manufacturing cost, the utility model aims to provide a coil device for wireless charging or NFC near field induction, which uses a soft substrate with the help of the coil device, and can avoid the defect that the existing substrate is easy to bend and break by external force in the manufacturing, carrying or using process because of the hard substrate, thereby achieving the effects of improving product yield, reducing manufacturing cost and improving use convenience; in addition, the soft substrate is further provided with magnetism, so that the magnetic coupling characteristic of the first coil or the magnetic shielding characteristic of the second coil can be respectively improved, and the effect of improving the stability of induced current or reducing electromagnetic interference can be achieved.

[0009] To achieve the above object, the present invention provides a coil device for wireless charging or NFC near field induction, which comprises:

[0010] a flexible substrate, which is flat;

[0011] a first coil fixed on the flexible substrate, wherein a hollow accommodating part is formed in the middle of the first coil, and the first coil is provided with two wire outlet ends;

[0012] and the second coil is fixedly arranged on the flexible substrate, is positioned in the accommodating part of the first coil and is provided with two wire outlet ends.

[0013] In one embodiment of the present invention, the flexible substrate is a magnetic flexible substrate.

[0014] The utility model discloses an embodiment, this first coil is wireless charging coil.

[0015] The utility model discloses an embodiment, this second coil is NFC near field induction coil.

[0016] In an embodiment of the present invention, the first coil is adhered to the flexible substrate.

[0017] In an embodiment of the present invention, the second coil is adhered to the flexible substrate. By using the soft substrate, the coil device can avoid the defect that the existing substrate is easy to be broken by bending due to external force in the manufacturing, carrying or using process and the like because of the hard substrate, thereby achieving the effects of improving the product yield, reducing the manufacturing cost and improving the use convenience; in addition, the soft substrate is further provided with magnetism, so that the magnetic coupling characteristic of the first coil or the magnetic shielding characteristic of the second coil can be respectively improved, and the effect of improving the stability of induced current or reducing electromagnetic interference can be achieved.

[0018] The utility model discloses compare in prior art's advantage and include at least:

[0019] 1. the flexible substrate can avoid cracking, improve product yield and reduce manufacturing cost.

[0020] 2. The coil has better magnetic coupling characteristic or magnetic shielding characteristic.

DRAWINGS DESCRIPTION

[0022] Fig. 1 is a schematic diagram of a conventional coil module.

[0023] Fig. 2 is an exploded view of the present invention.

[0024] Fig. 3 is a schematic view of the assembly of the present invention.

[0025] Fig. 4 is a schematic diagram of the present invention, in which the first coil and the second coil are respectively connected to the power module and the NFC chip of the circuit board of the electronic device.

[0026] Fig. 5 is a schematic view of the present invention, which can be bent to prevent force rupture.

[0027] [description of main element symbols]

[0028] 1 coil module 10 substrate 2 coil 21 outlet terminal

[0029] 3 flexible substrate 4 first coil 41 outlet 42 holding part

[0030] 5 second coil 51 outlet terminal 6 circuit board 61 power supply module

[0031] 62 NFC wafer.

INVENTION MODE

[0032] Detailed Description

[0033] In order to make the other features and advantages of the present invention and the achieved efficacy thereof more apparent, the present invention is described in detail with reference to the accompanying drawings as follows:

[0034] referring to fig. 2 and 3, the present invention provides a coil device for wireless charging or NFC near field induction, including:

[0035] a flexible substrate 3, wherein the flexible substrate 3 is a flat plate, and more preferably, the flexible substrate 3 can be a magnetic flexible substrate;

[0036] a first coil 4, the first coil 4 is fixedly disposed on the flexible substrate 3, the first coil 4 is more specifically adhered to the flexible substrate 3, a hollow accommodating portion 42 is formed in the middle of the first coil 4, the first coil 4 has two wire-out ends 41, in this embodiment, the first coil 4 is a wireless charging coil;

[0037] a second coil 5, the second coil 5 being fixedly disposed on the flexible substrate 3, the second coil 5 being more specifically adhered to the flexible substrate 3, the second coil 5 being disposed in the accommodating portion 42 of the first coil 4, the second coil 5 having two wire-out terminals 51, in this embodiment, the second coil 5 is an NFC near-field induction coil;

[0038] referring to fig. 3 and 4, the first coil 4 and the second coil 5 are respectively fixed on the flexible substrate 3, and the first coil 4 and the second coil 5 respectively have two wire outlets 41 and 51, so that the two wire outlets 41 of the first coil 4 can be electrically connected to a power module 61 of an external electronic device, such as a circuit board 6 of a mobile phone, wherein the power module 61 can be a storage battery, and when the first coil 4 generates an induced current, the power module 51 can be charged; and two leading-out terminals 51 of the second coil 5 can also be electrically connected with the NFC chip 62 of the circuit board 6, so that the NFC chip 62 can read, write or exchange data with another electronic device having an NFC function in a manner that the second coil 5 generates electrical signals such as induced current, thereby achieving the purpose of simultaneously wirelessly charging and inductively transmitting signals.

[0039] Referring to fig. 5, by using the flexible substrate 3 of the coil device of the present invention, the defect that the conventional substrate 10 is easily broken by bending due to external force during the manufacturing, transporting or using processes due to the rigid substrate can be avoided, so that the present invention can achieve the effects of improving the yield of products, reducing the manufacturing cost and improving the convenience of use; meanwhile, the soft substrate 3 is further a magnetic soft substrate, so that the magnetic coupling characteristic of the wireless charging coil or the magnetic shielding characteristic of the NFC coil can be avoided to reduce the deterioration under the condition of difficult fracture, and the utility model can improve

the inductance value and the magnetic coupling characteristic of the first coil 4, and can maintain the magnetic shielding characteristic of the second coil 5, thereby the utility model can have the efficacy of improving the stability of the charging induced current and reducing the electromagnetic interference; in addition, borrow again the utility model discloses a be equipped with first coil 4 and second coil 5 on the soft base plate 3 respectively, and can make wireless charging coil and NFC near field induction coil on same piece of base plate, and then make the utility model discloses can have the efficiency of saving volume and better reduction in manufacturing cost concurrently.

[0040] In order to make the utility model show its progress and practicability, a comparative analysis with the prior art is as follows:

[0041] prior art

[0042] 1. The substrate is a hard substrate, and is easily broken by bending due to external force, resulting in a decrease in product yield and an increase in manufacturing cost.

[0043] 2. The magnetic coupling characteristic or the magnetic shielding characteristic of the coil is poor.

[0044] The utility model has the advantages of

[0045] 1. The flexible substrate can avoid cracking, improve product yield and reduce manufacturing cost.

[0046] 2. The coil has better magnetic coupling characteristic or magnetic shielding characteristic.

[0047] The above description is only a preferred embodiment of the present invention, and the scope of the present invention should not be limited thereby; therefore, all the equivalent changes and modifications made according to the claims and the contents of the creation specification of the present invention should still fall within the scope covered by the present invention.



(12) 实用新型专利

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(73) 专利权人 西北台庆科技股份有限公司

地址 中国台湾桃园县杨梅市幼狮工业区幼
四路 1 之 1 号

(72) 发明人 谢明谚 杨祥忠 卢云煌

(74) 专利代理机构 北京汇智英财专利代理事务
所(普通合伙) 11301

代理人 吴怀权

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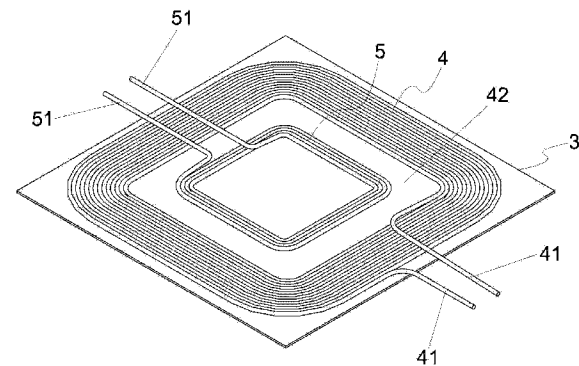
权利要求书1页 说明书3页 附图4页

(54) 实用新型名称

用于无线充电或 NFC 近场感应的线圈装置

(57) 摘要

本实用新型提供一种用于无线充电或 NFC 近场感应的线圈装置,其包含:一软性基板,该软性基板为平板状;一第一线圈,该第一线圈固设于该软性基板上,又该第一线圈中间形成有一中空
的容置部,另该第一线圈具有两个出线端;一第二线圈,该第二线圈固设于该软性基板,又该第二线圈位于该第一线圈的容置部内,另该第二线圈具有两个出线端;借助该线圈装置使用软性基板,而可避免现有基板因系为硬性基板,而容易于制造、搬运或使用等过程中受外力弯折而破裂的缺失,进而使本实用新型可达到提高产品良率、降低制造成本及增进使用便利性的功效;此外,又借助该软性基板进一步具有磁性,可兼具提升感应电流稳定度或降低电磁干扰的功效。



1. 一种用于无线充电或 NFC 近场感应的线圈装置,其特征在于,包含:
一个软性基板,该软性基板为平板状;
一个第一线圈,该第一线圈固设于该软性基板上,又该第一线圈中间形成有一个中空的容置部,另该第一线圈具有两个出线端;
一个第二线圈,该第二线圈固设于该软性基板,又该第二线圈位于该第一线圈的容置部内,另该第二线圈具有两个出线端。
2. 如权利要求 1 所述的用于无线充电或 NFC 近场感应的线圈装置,其特征在于,该软性基板为磁性软性基板。
3. 如权利要求 1 或 2 所述的用于无线充电或 NFC 近场感应的线圈装置,其特征在于,该第一线圈为无线充电线圈。
4. 如权利要求 1 或 2 所述的用于无线充电或 NFC 近场感应的线圈装置,其特征在于,该第二线圈为 NFC 近场感应线圈。
5. 如权利要求 1 或 2 所述的用于无线充电或 NFC 近场感应的线圈装置,其特征在于,该第一线圈与该软性基板相粘固。
6. 如权利要求 1 或 2 所述的用于无线充电或 NFC 近场感应的线圈装置,其特征在于,该第二线圈与该软性基板相粘固。

用于无线充电或 NFC 近场感应的线圈装置

技术领域

[0001] 本实用新型为一种用于无线充电或 NFC 近场感应的线圈装置,尤指一种可避免基板易受外力弯折而破裂的缺点,进而可提高产品良率与降低制造成本的线圈装置。

背景技术

[0002] 目前在运用感应线圈的技术领域中,无线充电与 NFC (Near Field Communication, 近场感应装置) 可说是最热门的两种应用项目,其中前者是将手机与无线充电装置靠近至一定距离,而使该手机及无线充电装置内的线圈模组可分别形成如同变压器的一次侧与二次侧,使手机内的线圈模组可因电磁感应原理产生电流,进而可对手机充电,后者则是利用两个 NFC 装置内所设置的线圈模组在靠近时可因电磁感应产生电流等电气信号的方式,而可达到读取、写入或交换资料的目的,两者的共通点为皆必须设置有线圈模组,请参阅图 1 所示,其中该线圈模组 1 通常由一基板 10 与一绕设于该基板 10 上的线圈 2 所构成,该线圈 2 可以粘固的方式与该基板 10 相结合固定,又该线圈 2 具有两个出线端 21,该两个出线端 21 即可与电子装置如手机的电路板上的电源模组或 NFC 晶片电性连接,进而使该线圈模组 1 可依前述动作原理达到无线充电或感应传输信号的目的。

[0003] 请参阅图 1 所示,该线圈模组 1,虽可达到无线充电或感应传输信号的目的,但该基板 10 通常为硬性基板,因此容易在制造、搬运或使用等过程中受外力弯折而破裂,进而造成产品良率降低、制造成本增加与使用上的不便,同时,该基板 10 一旦破裂,将会进一步造成线圈 2 的磁耦合特性(对无线充电线圈而言)或磁遮蔽特性(对 NFC 线圈而言)降低劣化,进而容易造成充电的感应电流稳定度较差或电磁干扰问题等缺失;此外,无线充电的线圈模组 1 或 NFC 近场感应的线圈模组 1 通常皆为独立分别设置,故电子装置若需同时具备这两种功能,则须配置两个独立的线圈模组 1,如此将导致体积变大与成本增加,因而实有改进的必要。

[0004] 是故,如何将上述等缺失加以摒除,即为本实用新型的发明人所欲解决的技术困难点的所在。

实用新型内容

[0005] 有鉴于现有的线圈模组,因基板为硬式基板,容易受外力弯折而破裂,造成产品良率降低与制造成本增加,因此本实用新型的目的在于提供一种用于无线充电或 NFC 近场感应的线圈装置,借助该线圈装置使用软性基板,而可避免现有基板因为硬性基板,而容易于制造、搬运或使用等过程中受外力弯折而破裂的缺点,进而使本实用新型可达到提高产品良率、降低制造成本及增进使用便利性的功效;此外,又借助该软性基板进一步具有磁性,而可分别提升该第一线圈的磁耦合特性或第二线圈的磁遮蔽特性,进而可兼具提升感应电流稳定度或降低电磁干扰的功效。

[0006] 为达成以上的目的,本实用新型提供一种用于无线充电或 NFC 近场感应的线圈装置,其包含:

- [0007] 一软性基板,该软性基板为平板状;
- [0008] 一第一线圈,该第一线圈固设于该软性基板上,又该第一线圈中间形成有一中空的容置部,另该第一线圈具有两个出线端;
- [0009] 一第二线圈,该第二线圈固设于该软性基板,又该第二线圈位于该第一线圈的容置部内,另该第二线圈具有两个出线端。
- [0010] 本实用新型的一个实施例,该软性基板为磁性软性基板。
- [0011] 本实用新型的一个实施例,该第一线圈为无线充电线圈。
- [0012] 本实用新型的一个实施例,该第二线圈为 NFC 近场感应线圈。
- [0013] 本实用新型的一个实施例,该第一线圈与该软性基板相粘固。
- [0014] 本实用新型的一个实施例,该第二线圈与该软性基板相粘固。借助该线圈装置使用软性基板,而可避免现有基板因为硬性基板,而易于制造、搬运或使用等过程中受外力弯折而破裂的缺失,进而使本实用新型可达到提高产品良率、降低制造成本及增进使用便利性的功效;此外,又借助该软性基板进一步具有磁性,而可分别提升该第一线圈的磁耦合特性或第二线圈的磁遮蔽特性,进而可兼具提升感应电流稳定度或降低电磁干扰的功效。
- [0015] 本实用新型相较于现有技术的优点至少包括:
- [0016] 1、软性基板可避免破裂,可提升产品良率并降低制造成本。
- [0017] 2、线圈具较佳的磁耦合特性或磁遮蔽特性。

附图说明

- [0018] 图 1 为现有线圈模组的示意图。
- [0019] 图 2 为本实用新型的分解示意图。
- [0020] 图 3 为本实用新型的组合示意图。
- [0021] 图 4 为本实用新型其第一线圈及第二线圈分别与电子装置其电路板的电源模组及 NFC 晶片连接的示意图。
- [0022] 图 5 为本实用新型可弯折以防止受力破裂的示意图。
- [0023] 【主要元件符号说明】
- [0024] 1 线圈模组 10 基板 2 线圈 21 出线端
- [0025] 3 软性基板 4 第一线圈 41 出线端 42 容置部
- [0026] 5 第二线圈 51 出线端 6 电路板 61 电源模组
- [0027] 62 NFC 晶片。

具体实施方式

- [0028] 为使本实用新型的其他特征内容与优点及其所达成的功效能够更为显现,兹将本实用新型配合附图,详细说明如下:
- [0029] 请参阅图 2、图 3 所示,本实用新型提供一种用于无线充电或 NFC 近场感应的线圈装置,其包含:
- [0030] 一软性基板 3,该软性基板 3 为平板状,更佳地,该软性基板 3 可为磁性软性基板;
- [0031] 一第一线圈 4,该第一线圈 4 固设于该软性基板 3 上,该第一线圈 4 更具体地可与该软性基板 3 相粘固,又该第一线圈 4 中间形成有一中空的容置部 42,另该第一线圈 4 具有

两个出线端 41, 在本实施例中, 该第一线圈 4 为无线充电线圈;

[0032] 一第二线圈 5, 该第二线圈 5 固设于该软性基板 3, 该第二线圈 5 更具体地可与该软性基板 3 相粘固, 又该第二线圈 5 位于该第一线圈 4 的容置部 42 内, 另该第二线圈 5 具有两个出线端 51, 在本实施例中, 该第二线圈 5 为 NFC 近场感应线圈;

[0033] 请再参阅图 3、图 4 所示, 借助该第一线圈 4 与第二线圈 5 分别固设于该软性基板 3 上, 且该第一线圈 4 与第二线圈 5 分别具有两个出线端 41、51, 而使该第一线圈 4 其两个出线端 41 可与外部的电子装置如手机其电路板 6 的电源模组 61 电性连接, 其中该电源模组 61 可为蓄电池, 当该第一线圈 4 产生感应电流时, 即可对该电源模组 51 充电; 又该第二线圈 5 其两个出线端 51 也可与该电路板 6 的 NFC 晶片 62 电性连接, 使该 NFC 晶片 62 可通过第二线圈 5 产生感应电流等电气信号的方式, 与另一个具 NFC 功能的电子装置进行资料的读取、写入或交换, 进而使本实用新型可达到同时用于无线充电与感应传输信号的目的。

[0034] 请再参阅图 5 所示, 借助本实用新型的线圈装置使用软性基板 3, 而可避免现有基板 10 因为硬性基板, 而易于制造、搬运或使用等过程中受外力弯折而破裂的缺失, 进而使本实用新型可达到提高产品良率、降低制造成本及增进使用便利性的功效; 同时, 又借助该软性基板 3 进一步为磁性软性基板, 故在不易破裂的情况下即可避免无线充电线圈的磁耦合特性或 NFC 线圈的磁遮蔽特性降低劣化, 而使本实用新型可提升该第一线圈 4 的感值与磁耦合特性, 并可维持该第二线圈 5 的磁遮蔽特性, 进而使本实用新型可兼具提升充电的感应电流稳定度与降低电磁干扰的功效; 另, 再借助本实用新型的软性基板 3 上分别设有第一线圈 4 与第二线圈 5, 而可将无线充电线圈与 NFC 近场感应线圈制作于同一块基板上, 进而使本实用新型可兼具节省体积及更佳降低制造成本的功效。

[0035] 为使本实用新型更加显现出其进步性与实用性, 兹与现有作一比较分析如下:

[0036] 现有技术:

[0037] 1、基板为硬式基板, 容易受外力弯折而破裂, 造成产品良率降低与制造成本增加。

[0038] 2、线圈的磁耦合特性或磁遮蔽特性较差。

[0039] 本实用新型优点:

[0040] 1、软性基板可避免破裂, 可提升产品良率并降低制造成本。

[0041] 2、线圈具较佳的磁耦合特性或磁遮蔽特性。

[0042] 以上所述的内容, 仅为本实用新型的较佳实施例而已, 当不能以此限定本实用新型实施范围; 故, 凡依本实用新型申请专利范围及创作说明书内容所作的简单的等效变化与修饰, 皆应仍属本实用新型专利涵盖的范围内。

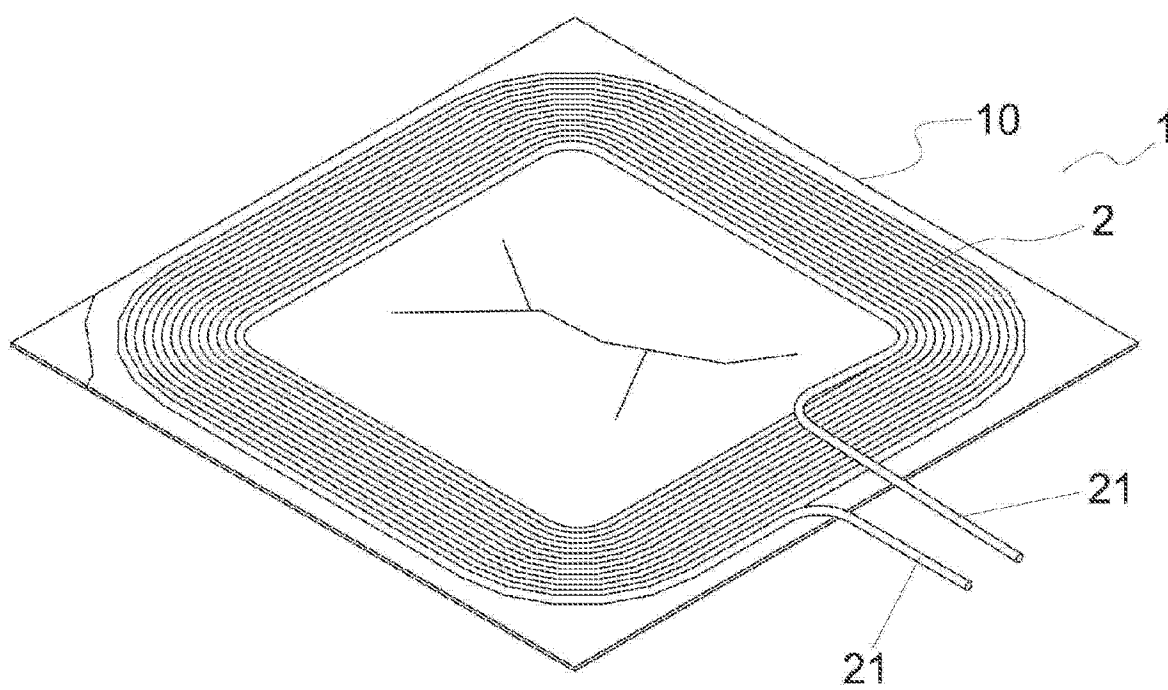


图 1

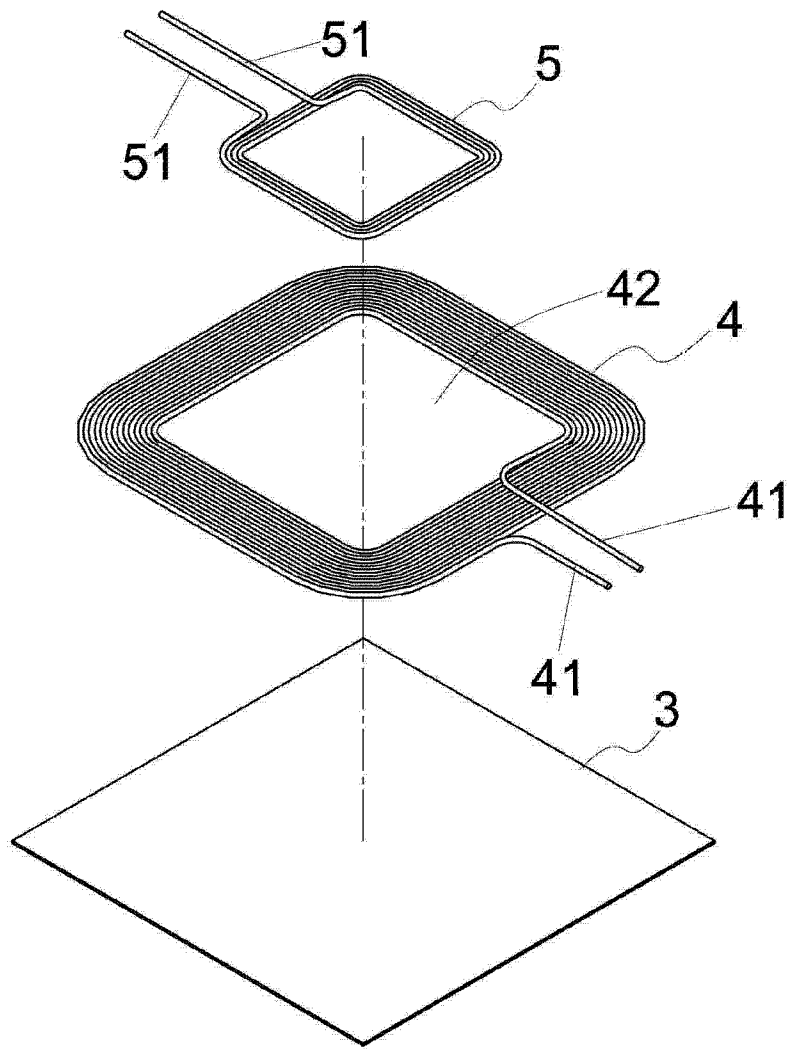


图 2

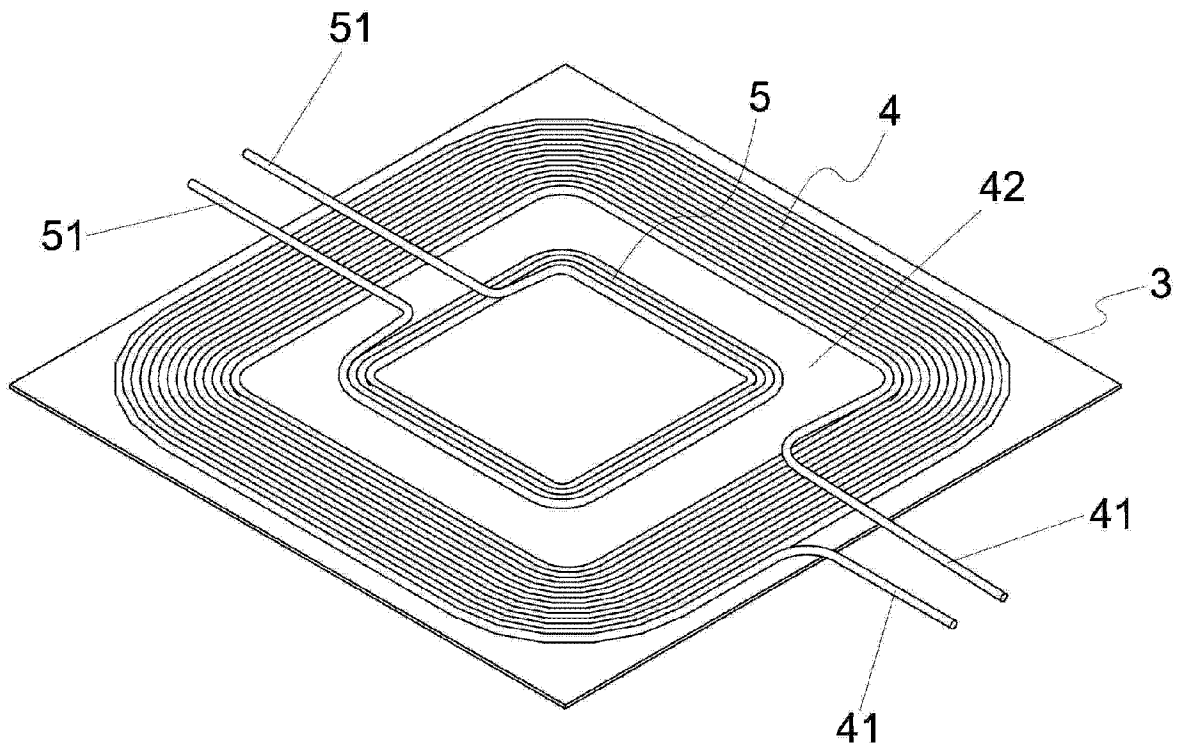


图 3

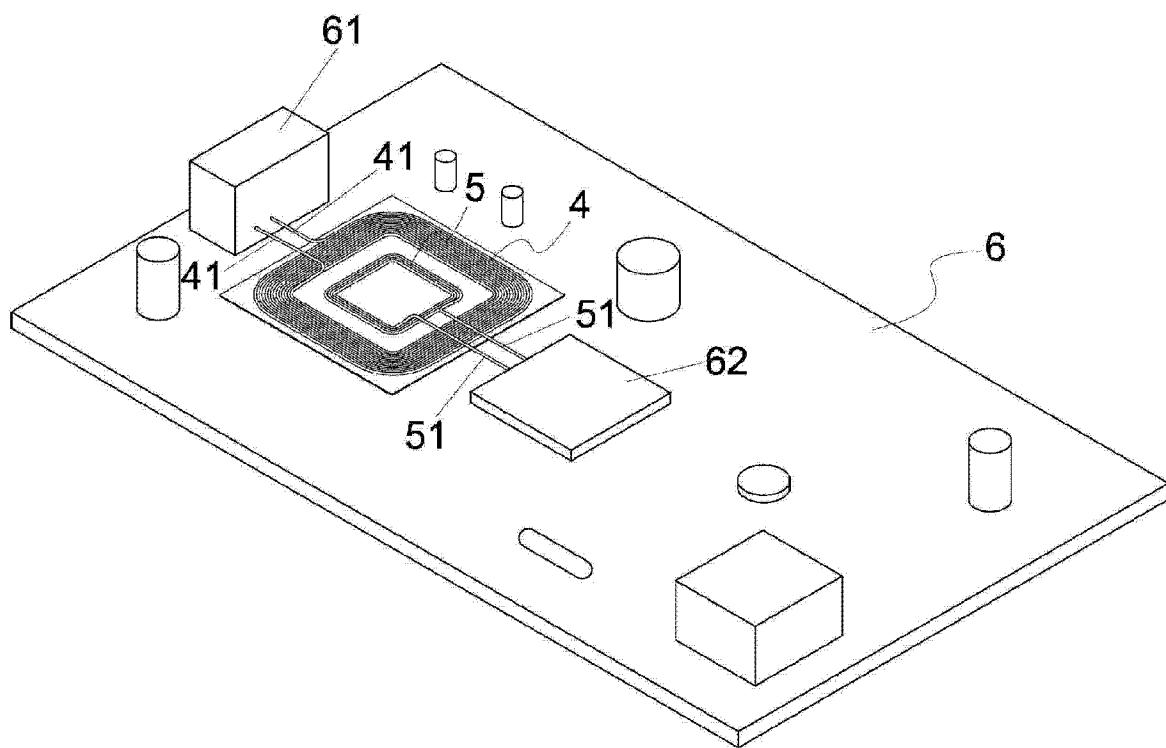


图 4

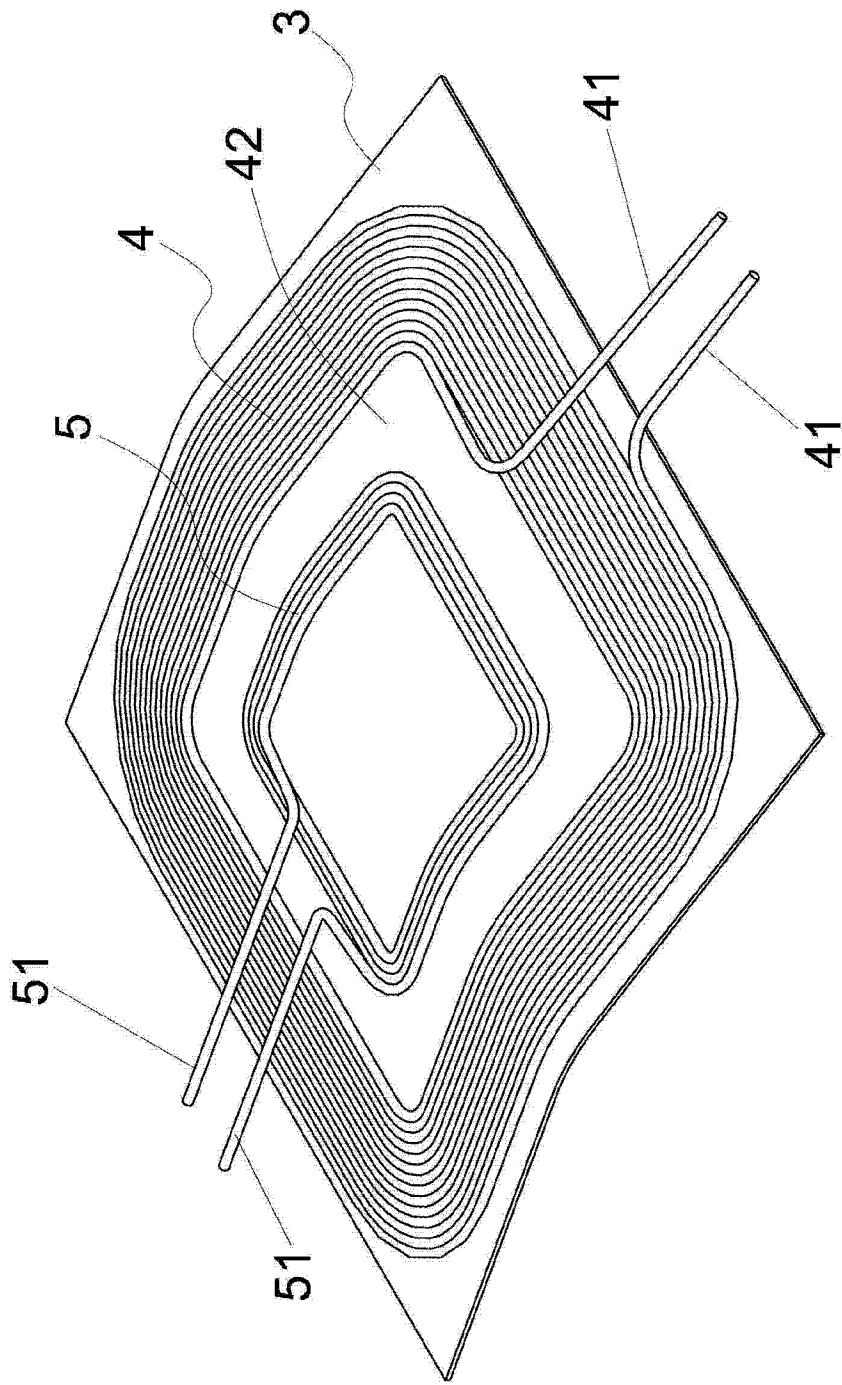


图 5

Electronic device capable of being wirelessly charged
List of publications
Publication date



-  Application number 2011KR-0077134 Date 2011-08-02 [Register](#)
 - [KR10-1811611 B1 Patent specification](#)2017-12-26 

English Title

Electronic device capable of being wirelessly charged

Other Title

무선 충전 가능한 전자 기기

English Abstract (Native or MT)

PURPOSE: A wireless chargeable electronic device is provided to increase magnetic flux density by reducing the shape and structure of a magnetic shielding member.

CONSTITUTION: A planar coil(2911a) is formed by winding a coil clockwise or counterclockwise. One end of a coil is arranged in the other end of the coil. One end of the coil is protrusively arranged along the lower side of the planar coil. A shielding member(2917) is contacted with the planar coil. A closed line is formed by one end and the other end of the coil.

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Other Abstracts

본 명세서는 무선 전력 송수신 및 근거리 통신이 가능한 전자 기기를 제시한다. 상기 전자 기기는 권선이 시계 또는 반시계 방향으로 감겨 형성되는 평면형 코일과, 누설 자기장을 차단하기 위해 상기 평면형 코일과 접촉되는 차폐 부재를 포함할 수 있다. 상기 권선의 일단은 상기 권선의 타단과 나란하게끔 상기 평면의 내측으로부터 외측 방향으로 상기 평면형 코일의 하부면을 따라 돌출 배치되고, 상기 권선의 일 지점은 단선(單線)으로 연장되어 상기 권선의 타단과 나란하게끔 배치될 수 있다. 그리고, 상기 권선의 일단 및 타단에 의해 형성되는 폐 선로는 전력의 무선 송수신을 위한 안테나로 이용되고, 상기 권선의 일단과 상기 연장된 단선에 의해 형성되는 폐 선로는 근거리 무선 통신을 위한 안테나로 이용될 수 있다.

**Application
Language**

KOREAN (KOR)

Inventor(s)

CHU, Inchang
SEO, Jeongkyo
PARK, Jinmoo

Inventor(s) 추인창
 서정교
 박진무

Applicant/Assignee LG ELECTRONICS

Assignee 엘지전자 주식회사
 Reg. Nb: 120020128403

Applicant/Assignee Address LG ELECTRONICS INC. , 120020128403

LG ELECTRONICS INC. , 120020128403

Patent Assignee History LG ELECTRONICS INC.
 LG ELECTRONICS INC.

Representative PARK, JANG WON
 Reg. Nb: 919980002023

Representative Address PARK, JANG WON , 919980002023

PARK, JANG WON , 919980002023

Representative 박장원
 Reg. Nb: 919980002023

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Notes Number of Claims: 10
 Number of Pages: 32

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 -JP2011125211 (A) [JP2011125211];

Description

TECHNICAL FIELD

[0001] The present specification relates to wireless power transfer.

BACKGROUND ART

[0002] Near Field Communication (NFC) is a non-contact near field communication technology capable of transmitting data at low power in the near field by applying RFID technology using a frequency of a 13.56 MHz band. NFC has been standardized around ECMA international and is participating in standardization and product compatibilization of noea, sonii, phillips, and the like.

[0003] This NFC technology can transfer data at low power (class 424 kbps) at distances within 10 cm.

[0004] When NFC is used, two or more terminals are brought close to each other without user artificial operation, it is possible to transmit and receive basic information such as phone numbers and data such as MP3 files or photos. In addition, NFC may be used to replace credit cards or traffic cards. Recently, manufacturers and communicators have movements to embed such NFC in a mobile terminal to transmit and receive various data, or to implement an electronic wallet.

[0005] Meanwhile, a mobile terminal traditionally charges an internal battery through a wire.

[0006] However, recently, methods of wirelessly supplying electrical energy without contact have been proposed.

[0007] Although there are several methods for wirelessly supplying or receiving electrical energy, there are typically inductive coupling based on electromagnetic induction phenomenon and electromagnetic resonance coupling based on electromagnetic resonance phenomenon due to wireless power signals of specific frequencies.

[0008] A transceiver is required in order to transmit and receive power in the inductive coupling method and the resonant coupling method, and mounting the power transceiver in a small electronic device such as a mobile terminal is highly subject to spatial constraints.

[0009] Furthermore, many spatially constraints follow the fact that the aforementioned transmission unit/reception unit for NFC is embedded in the mobile terminal, and the transmission/reception unit for transmitting/receiving the electric power.

[0010] However, it is very difficult to additionally mount the transceiver for NFC and the power transceiver into the mobile terminal, even when a recent mobile terminal includes

a battery, a display, and a driving circuit and the thickness thereof is manufactured within 1 cm.

SUMMARY OF INVENTION

TECH PROBLEM

[0011] According to an embodiment disclosed herein, a coil for wireless power transmission and reception and a coil for near field communication (NFC) may be miniaturized.

[0012] The shape and structure of the coil and the magnetic shielding member included in the electronic device disclosed herein can be more miniaturized and can greatly increase magnetic flux density. In addition, the shape and structure of the coils and magnetic shielding members included in the electronic devices disclosed herein may increase shielding of leakage magnetic flux more.

TECH SOLUTION

[0013] In order to achieve the aforementioned object, the present specification presents an electronic device capable of wireless power transmission and reception and near field communication. The electronic device may include a planar coil formed by winding windings in a clockwise or counterclockwise direction, and a shielding member in contact with the planar coil to shield a leakage magnetic field. One end of the winding may be protruded along a lower surface of the planar coil in an outward direction from an inner side of the plane so as to be parallel with the other end of the winding, and one point of the winding may extend in a single wire and be disposed so as to be parallel with the other end of the winding. In addition, a closed line formed by one end and the other end of the winding may be used as an antenna for wireless transmission and reception of power, and a closed line formed by one end of the winding and the extended disconnection may be used as an antenna for short-range wireless communication.

[0014] A groove may be formed on an upper surface of the shielding member to accommodate a protrusion of one end of the winding so that the planar coil is in full close contact.

[0015] A step corresponding to an area of the planar coil may be formed on an upper surface of the shielding member.

[0016] The winding may be formed by winding a center portion of the coil to form an empty space. An upper surface of the shielding member may have a protruding surface having an area corresponding to the void space to prevent the planar coil from coming off.

[0017] On the other hand, the present specification further provides an electronic device capable of wireless power transmission and reception and near field communication, the

electronic device further comprising: a planar coil configured to allow an induced current to flow through a change in an external magnetic field; and an outer peripheral surface or an inner peripheral surface of the planar coil, A near-field communication strip antenna spaced apart from an outer peripheral surface or an inner peripheral surface of the coil so as not to contact an outer peripheral surface or an inner peripheral surface of the coil, and a shielding member contacting the planar coil and the near-field communication antenna. Wherein a winding is wound in a clockwise or counterclockwise direction so that a center portion of the planar coil forms a void space, and one end of the winding is protruded along a lower surface of the planar coil in a direction from an inner side of the plane to an outer side of the plane so as to be parallel with the other end of the winding. In addition, a groove may be formed on an upper surface of the shielding member to accommodate a protrusion of one end of the winding so that the planar coil is in full close contact.

[0018] A groove for receiving the planar coil and a groove for receiving the near-field communication antenna are respectively formed on an upper surface of the shielding member. The planar coil and the near-field communication antenna may be electrically isolated by a protrusion between the groove for receiving the planar coil and the groove for receiving the near-field communication antenna.

[0019] An upper surface of the shielding member may have a protruding surface having an area corresponding to the void space to prevent the planar coil from coming off.

[0020] The near-field communication strip antenna may have a winding formed along an outer peripheral surface or an inner peripheral surface of the planar coil, and one end and the other end of the winding may be disposed parallel to the one end and the other end of the planar coil, respectively.

ADVANTAGEOUS EFFECTS

[0021] According to an embodiment disclosed herein, a coil for wireless power transmission and reception and reception and a coil for near field communication (NFC) may be miniaturized.

[0022] The shape and structure of the coil and the magnetic shielding member included in the electronic device disclosed herein can be more miniaturized and can greatly increase magnetic flux density. In addition, the shape and structure of the coils and magnetic shielding members included in the electronic devices disclosed herein may increase shielding of leakage magnetic flux more.

DESCRIPTION OF DRAWINGS

[0023] FIG. 1 is an example diagram conceptually illustrating a wireless power transmitter and an electronic device according to embodiments of the present disclosure. Figs. 2A and 2B are block diagrams illustrating, by way of example, configurations of a wireless power transmitter 100 and an electronic device 200 that can be employed in embodiments disclosed herein. FIG. 3 illustrates the concept of wirelessly transferring

power from a wireless power transmitter to an electronic device according to an inductive coupling scheme. FIG. 4 is a block diagram illustrating, by way of example, a portion of a configuration of a wireless power transmitter 100 and an electronic device 200 of an electromagnetic induction scheme that can be employed in the embodiments disclosed herein. FIG. 5 is a block diagram of a wireless power transfer configured to have one or more transmit coils that receive power according to an inductive coupling scheme available in embodiments disclosed herein. FIG. 6 is a block diagram illustrating a wireless power transmitter further including an additional configuration in addition to the configuration illustrated in FIG. 2A. FIG. 7 illustrates a configuration in a case where the electronic device 200 is implemented in a mobile terminal form according to embodiments disclosed herein. FIG. 8 presents an example in which the mobile terminal shown in FIG. 7 is charged in an electromagnetic induction manner by the wireless power transmitter 100. FIG. 9 presents an example of combining a coil for wireless power transmission and reception and a coil for near field communication according to a first embodiment of the present invention. FIG. 10 is an example diagram showing phenomenon of eddy currents caused by an electromagnetic induction method. Figure 11 shows the effect of eddy currents on wireless power transfer. Figs. 12 and 13 show examples of combining a coil for wireless power transmission and reception and a coil for near field communication according to a second embodiment of the present invention. Figs. 14 and 15 show examples of combining a coil for wireless power transmission and reception and a coil for near field communication according to a third embodiment of the present invention. Figs. 16 and 17 show examples of combining a coil for wireless power transmission and reception and a coil for near field communication according to a fourth embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0024] It should be noted that the technical terminology used herein is used merely to describe particular embodiments, and is not intended to be limiting of the present disclosure. Further, technical terms used in the present specification should be interpreted as a meaning commonly understood by those skilled in the art, and should not be interpreted as an excessively inclusive sense, or as an excessively reduced sense, unless specifically defined as other meanings in the present specification. Further, when the technical term used in the present specification is an erroneous technical term that does not accurately express the spirit of the present invention, it should be understood that the technical term that those skilled in the art can correctly understand should be substituted and understood. Further, the general terms used in the present invention should be interpreted as previously defined, or according to the context before and after, and should not be interpreted in an unduly reduced sense.

[0025] Also, as used herein, the singular forms "a," an, "and" the "include plural expressions unless the context clearly dictates otherwise. In this application, terms "consisting of" or "comprises" or the like should not necessarily be construed to include all of the various components described in the specification, or several steps, of which some components or some steps may not be included, or may further include additional components or steps.

[0026] In addition, the suffixes "module" and "part" for components used herein are conceived or concomitant only for ease of construction of the specification and do not have a distinctive meaning or role of each other by themselves.

[0027] In addition, terms including ordinal numbers, such as the first, second, etc. used herein, may be used to describe various components, but the components should not be limited by the terms. The terms are used only for the purpose of distinguishing one element from another element. For example, a first component may be referred to as a second component, and similarly a second component may be referred to as a first component, without departing from the scope of the present invention.

[0028] Hereinafter, preferred embodiments according to the present disclosure will be described in detail with reference to the accompanying drawings, in which the same or similar elements will be given the same reference numerals regardless of the reference numerals, and redundant explanation thereof will be omitted for the sake of brevity.

[0029] Further, in explaining the present disclosure, when it is judged that specific description of the related art can obscure the subject matter of the present disclosure, the detailed description will not be omitted. It should also be noted that the accompanying drawings are only for the purpose of readily understanding the spirit of the present invention, and that the spirit of the present invention should not be construed as being limited by the accompanying drawings.

[0030] FIG. 1 is an example diagram conceptually illustrating a wireless power transmitter and an electronic device according to embodiments of the present disclosure.

[0031] As can be seen with reference to FIG. 1, the wireless power transmitter 100 may be a power transfer device that transfers power wirelessly required by the electronic device 200.

[0032] Further, the wireless power transmitter 100 may be a wireless charging device that charges a battery of the electronic device 200 by wirelessly transferring power. When the wireless power transfer 100 is a wireless charging device, the wireless power transfer 100 will be described below with reference to Fig. 6.

[0033] In addition, the wireless power transmitter 100 may be implemented as various types of devices that deliver power to the electronic device 200 requiring power in an untouched state.

[0034] The electronic device 200 is a device capable of wirelessly receiving power from the wireless power transmitter 100 and operating. Further, the electronic device 200 may charge a battery using the received wireless power.

[0035] On the other hand, an electronic device for wirelessly receiving power described in the present specification is all portable electronic devices, including input/output devices such as keyboard, mouse, video or audio auxiliary output devices, Smart phones,

Personal Digital Assistants (PDAs), Portable Multimedia Players (pmp), tablets, multimedia appliances, and the like.

[0036] The electronic device 200 may be a mobile communication terminal (e.g., a mobile phone, a cellular phone, a tablet) or a multimedia device, as will be described below. When the electronic device is a mobile terminal, the electronic device will be described below with reference to Fig. 7.

[0037] Meanwhile, the wireless power transmitter 100 may wirelessly transfer power to the electronic device 200 without contact with each other using one or more wireless power transfer methods. That is, the wireless power transmitter 100 may transmit power by using one or more of an inductive coupling method based on an electromagnetic induction phenomenon due to the wireless power signal and an electromagnetic resonance coupling method based on an electromagnetic resonance phenomenon due to a wireless power signal of a specific frequency.

[0038] Wireless power transmission by the inductive coupling method is technology for wirelessly transmitting power using a primary coil and a secondary coil, and refers to transmitting power by inducing current to the other coil through a magnetic field that changes in one coil due to electromagnetic induction phenomenon.

[0039] Wireless power transmission by the resonant coupling method refers to the generation of resonance in the electronic device (200) according to a wireless power signal transmitted by the wireless power transmission device (100), and the transmission of power from the wireless power transmission device (100) to the electronic device (200) according to the resonance phenomenon.

[0040] Hereinafter, embodiments of the wireless power transmitter 100 and the electronic device 200 disclosed herein will be described in detail. In the addition of reference numerals to constituent elements of each of the following figures, the same numerals are used as possible, even though the same constituent elements are indicated on other figures.

[0041] FIG. 2 is a block diagram illustrating, by way of example, a configuration of a wireless power transmitter 100 and an electronic device 200 that can be employed in the embodiments disclosed herein.

[0042] Referring to FIG. 2A, the wireless power transmitter 100 is configured to include a Power Transmission Unit 110. The power delivery unit 110 may be configured to include a power conversion unit 111 and a power transmission control unit 112.

[0043] The power conversion unit 111 converts power supplied from the transmitting side power supply unit 190 into a wireless power signal and transmits the wireless power signal to the electronic device 200. The wireless power signal delivered by the power converter 111 is formed in the form of a magnetic field or electro-magnetic field having

oscillation characteristics. To achieve this, the power converter 111 may be configured to include a coil for generating the wireless power signal.

[0044] The power conversion unit 111 may include components for forming different types of wireless power signals according to respective power transfer schemes. For example, the power conversion unit 111 may be configured to include a primary coil forming a magnetic field that changes to induce a current in a secondary coil of the electronic device 200 according to an inductive coupling method. Further, the power conversion unit 111 may be configured to include a coil (or antenna) that forms an electromagnetic field having a specific resonant frequency in order to generate a resonance phenomenon in the electronic device 200 according to a resonant coupling method.

[0045] Further, the power conversion unit 111 may transmit power by using one or more methods of the inductive coupling method and the resonant coupling method described above.

[0046] Among the components included in the power conversion unit 111, those following the inductively coupled method will be described below with reference to figs. 4 and 5. Those following resonant coupling schemes are not very closely related to the key content of the present invention, and should not be described in detail.

[0047] Meanwhile, the power converter 111 may be configured to further include a circuit capable of adjusting characteristics of frequency, applied voltage, current, and so on used to form the wireless power signal.

[0048] The power transmission control unit 112 controls each component included in the power transmission unit 110. The power transmission control unit 112 may be implemented to be integrated with another control unit (not shown) that controls the wireless power supply apparatus 100.

[0049] Meanwhile, a region where the wireless power signal arrives may be divided into two regions. First, the active area refers to an area where a wireless power signal transferring power to the electronic device 200 passes. Next, the semi-active area refers to the area of interest in which the wireless power transfer 100 can sense the presence of the electronic device 200. Here, the power transmission control unit 112 may sense whether the electronic device 200 is placed in or removed from the active area or the sensing area. Specifically, the power transmission control unit 112 may detect whether the electronic device 200 is disposed in the active area or the sensing area by using a wireless power signal formed in the power conversion unit 111, or by separately provided sensors. For example, the power transmission control unit 112 may detect the presence of the electronic device 200 by monitoring whether the wireless power signal is influenced by the electronic device 200 present in the sensing area and a characteristic of power for forming the wireless power signal of the power conversion unit 111 changes. However, the active region and the sensing region may be different according to wireless power transfer methods such as inductive coupling methods and resonant coupling methods.

[0050] The power transmission control unit 112 may determine whether to start wireless power transfer or perform a process of identifying the electronic device 200 according to a result of detecting the presence of the electronic device 200.

[0051] Further, the power transmission control unit 112 may determine one or more characteristics of frequency, voltage, and current of the power conversion unit 111 to form the wireless power signal. The determination of the characteristic may be made by the condition of the wireless power transfer device 100 side or by the condition of the electronic device 200 side.

[0052] The power transmission control unit 112 may receive a power control message from the electronic device 200. The power transmission control unit 112 may determine one or more characteristics of frequency, voltage, and current of the power conversion unit 111 based on the received power control message, and may perform another control operation based on the power control message.

[0053] For example, the power transmission control unit 112 may determine one or more characteristics of frequency, current and voltage used to form the wireless power signal according to a power control message including one or more of rectified power amount information, state of charge information and identification information of the electronic device 200.

[0054] In addition, as another control operation using the power control message, the wireless power transmitter 100 may perform a general control operation related to wireless power transfer based on the power control message. For example, the wireless power transmitter 100 may receive information to output audibly or visually associated with the electronic device 200 through the power control message, receive information necessary for authentication of a device, and so on.

[0055] In order to receive the power control message, the power transmission control unit 112 may use at least one of a method of receiving through the wireless power signal and a method of receiving other user data.

[0056] In order to receive the power control message, the wireless power transmitter 100 may be configured to further include a power communication modulation/demodulation unit 113 electrically connected to the power converter 111. The demodulation unit 113 may be used to demodulate the wireless power signal modulated by the electronic device 200 and receive the power control message.

[0057] In addition, the power transmission control unit 112 may obtain the power control message by receiving user data including the power control message by a communication means (not shown) included in the wireless power transfer apparatus 100.

[0058] Meanwhile, referring to FIG. 2B, the electronic device 200 is configured to include a power supply 290. The power supply unit 290 supplies power necessary for

operation of the electronic device 200. The power supply 290 may be configured to include a power receiving unit 291 and a power receiving control unit 292.

[0059] The power receiver (291) receives wirelessly transferred power from the wireless power transmitter (100).

[0060] The power receiving unit 291 may include components necessary to receive the wireless power signal according to a wireless power transfer scheme. Further, the power receiving unit 291 may receive power according to one or more wireless power transfer schemes, and in this case, the power receiving unit 291 may include constituent elements necessary for each scheme together.

[0061] First, the power receiving unit 291 may be configured to include a coil for receiving a wireless power signal transmitted in a form of a magnetic field or an electromagnetic field having vibrating characteristics.

[0062] For example, as a component according to the inductive coupling method, the power receiving unit 291 may include a secondary coil in which a current is induced by a varying magnetic field. Further, the power receiving unit 291 may include a coil and a resonance circuit in which resonance phenomenon is generated by an electromagnetic field having a specific resonance frequency as a component according to the resonance coupling method.

[0063] However, when the power receiving unit 291 receives power according to one or more wireless power transfer schemes, the power receiving unit 291 may be implemented to receive the power using one coil, or may be implemented to receive the power using a coil formed differently according to each power transfer scheme.

[0064] Among the components included in the power receiving unit 291, those following the method of inductive coupling will be described below with reference to Fig. 4.

[0065] Meanwhile, the power receiving unit 291 may further include a rectifier circuit and a regulator to convert the wireless power signal to direct current. Further, the power receiving unit 291 may further include a circuit for preventing overvoltage or overcurrent from occurring according to the received power signal.

[0066] The power receiving control unit 292 controls each of the components included in the power supply unit 290.

[0067] Specifically, the power receiving control unit 292 may transmit a power control message to the wireless power transmitter 100. The power control message may instruct the wireless power transmitter 100 to initiate or terminate transmission of a wireless power signal. Further, the power control message may instruct the wireless power transmitter 100 to adjust characteristics of the wireless power signal.

[0068] In order to transmit the power control message, the power reception control unit 292 may use at least one of a method of transmitting through the wireless power signal and a method of transmitting through other user data.

[0069] In order to transmit the power control message, the electronic device 200 may be configured to further include a Power Communications Modulation/Demodulation Unit 293 electrically connected to the Power Receiver 291. As in the case of the wireless power transmitter 100 described above, the demodulation unit 293 may be used to transmit the power control message through the wireless power signal. The demodulation and demodulation unit 293 may be used as a means for adjusting current and/or voltage flowing through the power conversion unit 111 of the wireless power transmission device 100. Hereinafter, a method is described in which the demodulation and demodulation units 113 and 293 on the wireless power transmitter 100 side and the electronic device 200 side are used to transmit and receive a power control message via a wireless power signal.

[0070] The wireless power signal formed by the power converter (111) is received by the power receiver (291). In this case, the power reception control unit 292 controls the demodulation unit 293 on the side of the electronic device 200 to modulate the wireless power signal. For example, the power reception control unit 292 may perform the modulation process so that the amount of power received from the wireless power signal changes accordingly by changing the reactance of the demodulation unit 293 connected with the power reception unit 291. A change in the amount of power received from the wireless power signal results in a change in the current and/or voltage of the power converter (111) to form the wireless power signal. In an example, the demodulation unit 113 on the side of the wireless power transmitter 100 detects a change in current and/or voltage of the power converter 111 to perform a demodulation process.

[0071] That is, the power reception control unit 292 generates a packet including a power control message intended to be delivered to the wireless power transmitter 100 and modulates the wireless power signal to include the packet. The power transmission control unit 112 may decode the packet based on a result of performing a demodulation process of the demodulation unit 113, thereby obtaining the power control message included in the packet.

[0072] In addition, the power receiving control unit 292 may transmit the power control message to the wireless power transmitter 100 by transmitting user data including the power control message by a communication means (not illustrated) included in the electronic device 200.

[0073] Besides, the power supply unit 290 may be configured to further include a charging unit 298 and a battery 299.

[0074] The electronic device 200 receiving power for operation from the power supply 290 may operate according to the power delivered from the wireless power transmitter 100, or may operate according to the power charged to the battery 299 after charging the

battery 299 using the delivered power. In this case, the power reception control unit 292 may control the charging unit 298 to perform charging using the delivered power.

[0075] Hereinafter, a wireless power transmitter and an electronic device applicable to embodiments disclosed herein are described. First, referring to figs. 3 to 5, a method for transferring power by the wireless power transmitter to the electronic device according to an inductive coupling method is disclosed.

[0076] FIG. 3 illustrates the concept of wirelessly transferring power from a wireless power transmitter to an electronic device according to an inductive coupling scheme.

[0077] When the power transfer of the wireless power transmitter 100 follows the inductive coupling method, when the strength of the current flowing through the primary coil in the power transfer unit 110 changes, the magnetic field passing through the primary coil changes due to the current. The magnetic field thus changed generates an inductive electromotive force on a secondary coil side in the electronic device 200.

[0078] According to this way, the power converter (111) of the wireless power transmitter (100) is configured to include a transmit coil (1111 a) acting as a primary coil in magnetic induction. Further, the power receiving unit (291) of the electronic device (200) is configured to include a receiving coil (2911 a) acting as a secondary coil in magnetic induction.

[0079] First, the wireless power transmitter (100) and the electronic device (200) are arranged such that the transmission coil (1111 a) on the wireless power transmitter (100) side and the reception coil on the electronic device (200) side are close to each other. Then, when the power transmission control unit (112) controls the current of the transmission coil (1111 a) to change, the power reception unit (291) controls power to be supplied to the electronic device (200) using electromotive force induced in the reception coil (2911 a).

[0080] Efficiency of wireless power transfer by the inductive coupling scheme is less influenced by frequency characteristics, but is influenced by alignment and distance between the wireless power transfer device (100) including each coil and the electronic device (200).

[0081] Meanwhile, for wireless power transfer by inductive coupling, the wireless power transmitter 100 may be configured to include an interface surface (not illustrated) in a flat surface form. One or more electronic devices may be placed on the top of the interface surface, and the transmitting coil (1111 a) may be mounted on the bottom of the interface surface. In this case, the vertical spacing between the transmitting coil (1111 a) mounted at the lower part of the interface surface and the receiving coil (2911 a) of the electronic device (200) located at the upper part of the interface surface is formed small enough so that the distance between the coils can be efficiently performed.

[0082] Further, an arrangement indication unit (not illustrated) may be formed on an upper portion of the interface surface to indicate a position where the electronic device 200 is to be placed. The arrangement instructing unit instructs a position of the electronic device (200) in which arrangement between a transmitting coil (1111 a) mounted on a lower portion of the interface surface and the receiving coil (2911 a) can be suitably performed. The arrangement indication portion may be simple marks or formed in the form of a protruding structure for guiding the position of the electronic device 200. Alternatively, the arrangement indication unit may be formed in a form of a magnetic body such as a magnet mounted on a lower portion of the interface surface, and guide the coils to form a suitable arrangement by mutual attraction with a magnetic body of another pole mounted inside the electronic device 200.

[0083] Meanwhile, the wireless power transmitter 100 may be formed to include one or more transmission coils. The wireless power transmitter 100 may selectively use a portion of coils suitably arranged with a receiving coil 2911 a of the electronic device 200 among the one or more transmitting coils to increase power transmission efficiency. The wireless power transfer 100 including the one or more transmitting coils will be described below with reference to FIG. 5.

[0084] Hereinafter, a configuration of an inductively coupled wireless power transmitter and an electronic device applicable to embodiments disclosed in the present specification will be described in detail.

[0085] FIG. 4 is a block diagram illustrating, by way of example, a portion of a configuration of a wireless power transmitter 100 and an electronic device 200 of an electromagnetic induction scheme that can be employed in the embodiments disclosed herein. The configuration of the power transmission unit 110 included in the wireless power transmission apparatus 100 will be described with reference to FIG. 4A, and the configuration of the power supply unit 290 included in the electronic device 200 will be described with reference to FIG. 4B.

[0086] Referring to FIG. 4A, the power converter 111 of the wireless power transmitter 100 may be configured to include a transmit coil 1111 a and an inverter 1112.

[0087] As described above, the transmission coil 1111 a forms a magnetic field corresponding to a wireless power signal according to a change in current. The transmitting coil (1111 a) can be implemented in a flat spiral type or a cylindrical solenoid type.

[0088] The inverter 1112 converts a DC input obtained from the power supply unit 190 into an AC waveform. The alternating current modified by the inverter 1112 drives a resonant circuit including the transmitting coil 1111 a and a capacitor (not illustrated), such that a magnetic field is formed in the transmitting coil 1111 a.

[0089] Besides, the power conversion unit 111 may be configured to further include a positioning unit 1114.

[0090] The positioning unit 1114 may move or rotate the transmission coil 1111 a in order to increase efficiency of wireless power transfer by the inductive coupling method. This is because, as described above, power transfer by inductive coupling scheme is subject to alignment and distance between the wireless power transfer 100 and the electronics 200, including primary and secondary coils. In particular, the positioning unit (1114) may be used when the electronic device (200) is not present in an active area of the wireless power transmitter (100).

[0091] Therefore, the positioning unit (1114) moves the transmitting coil (1111 a) such that a center-to-center distance between the transmitting coil (1111 a) of the wireless power transfer device (100) and the receiving coil (2911 a) of the electronic device (200) is within a certain range. And a driving unit (not shown) configured to rotate the transmitting coil 1111 a so that centers of the transmitting coil 1111 a and the receiving coil 2911 a overlap each other.

[0092] To this end, the wireless power transmitter 100 may further include a position detection unit (not illustrated) including a sensor configured to detect a position of the electronic device 200, and the power transmission control unit 112 may control the position determination unit 1114 based on position information of the electronic device 200 received from the position detection sensor.

[0093] To this end, the power transmission control unit 112 may receive control information on the arrangement or distance from the electronic device 200 through the demodulation unit 113, and control the position determination unit 1114 based on the received control information on the arrangement or distance received.

[0094] If the power conversion unit 111 is configured to include a plurality of transmission coils, the positioning unit 1114 may determine which of the plurality of transmission coils is to be used for power transfer. A configuration of the wireless power transmitter 100 including the plurality of transmission coils will be described below with reference to FIG. 5.

[0095] Meanwhile, the power conversion unit 111 may be configured to further include a power sensing unit 1115. A power sensing unit (1115) on the wireless power transmission device (100) side monitors a current or a voltage flowing through the transmission coil (1111 a). The power sensing unit 1115 is configured to check whether the wireless power transmitter 100 operates normally, and may detect a voltage or a current of the externally supplied power and check whether the detected voltage or the current exceeds a threshold value. Although not illustrated, the power sensing unit 1115 may include a resistor to detect voltage or current of externally supplied power, and a comparator to compare a voltage value or current value of the detected power with a threshold value and output a comparison result. Based on the confirmation result of the power sensing unit 1115, the power transmission control unit 112 may control the switching unit (not illustrated) to cut off the power applied to the transmission coil 1111 a.

[0096] Referring to Fig. 4B, the power supply 290 of the electronic device 200 may be configured to include a receiving coil (Rx coil) 2911 a and a rectifier circuit 2913.

[0097] A current is induced in the receiving coil (2911 a) by changing a magnetic field formed from the transmitting coil (1111 a). As in the case of the transmitting coil 1111 a, an implementation of the receiving coil 2911 a may be in the form of a flat spiral or a cylindrical solenoid.

[0098] Further, series/parallel capacitors may be configured to be connected with the receiving coil (2911 a) for increasing the reception efficiency of wireless power or for resonant detection.

[0099] The receiving coil 2911 a may be a single coil or a plurality of coils.

[0100] The rectification circuit 2913 performs full-wave rectification on the current in order to convert alternating current to direct current. The rectifier circuit 2913 may be implemented as a full bridge rectifier circuit including four diodes, or a circuit using active components, for example.

[0101] In addition, the rectification circuit 2913 may further include a regulator that brings the rectified current into a flatter and stable direct current. Further, the output power of the rectifier circuit 2913 is supplied to the respective components of the power supply unit 290. Further, the rectifier circuit 2913 may further include a dc-dc converter configured to convert the output direct current power into an appropriate voltage to match the power required for each component of the power supply unit 290 (e.g., a circuit such as the charging unit 298).

[0102] The demodulation and demodulation unit 293 may be connected to the power receiving unit 291, and may be configured as a resistive element whose resistance changes with respect to the DC current, or may be configured as a capacitive element whose reactance changes with respect to the AC current. The power reception control unit 292 may modulate the wireless power signal received by the power reception unit 291 by changing the resistance or reactance of the modulation and demodulation unit 293.

[0103] Meanwhile, the power supply unit 290 may be configured to further include a power sensing unit 2914. A power sensing unit (2914) on the electronic device (200) monitors the voltage and/or current of the rectified power source by the rectifier circuit (2913), and when the voltage and/or current of the rectified power source exceeds a threshold as a result of the monitoring, the power reception control unit (292) transmits a power control message to the wireless power transmitter (100) to deliver proper power.

[0104] FIG. 5 is a block diagram of a wireless power transfer configured to have one or more transmit coils that receive power according to an inductive coupling scheme available in embodiments disclosed herein.

[0105] Referring to FIG. 5, a power conversion 111 of a wireless power transfer 100 according to embodiments disclosed herein may be comprised of one or more transfer coils 1111 a-1 to 1111a-n. The one or more transmission coils (1111 a-1 to 1111a-n) may be an array of partly overlapping primary coils. An active area may be determined by some of the one or more transmitting coils.

[0106] The one or more transmitting coils (1111 a-1 to 1111 a-n) may be mounted on the bottom of the interface surface. Further, the power conversion unit 111 may further include a multiplexer 1113 to establish and disconnect connection of some of the one or more transmission coils 1111 a-1 to 1111a-n.

[0107] When a position of an electronic device (200) placed on top of the interface surface is sensed, The power transmission control unit (112) may control the multiplexer (1113) such that coils which may be placed in inductive coupling relationship with a receiving coil (2911 a) of the electronic device (200) among the one or more transmission coils (1111 a-1 to 1111 a-n) may be connected in consideration of the sensed position of the electronic device (200).

[0108] To this end, the power transmission control unit 112 may obtain location information of the electronic device 200. For example, the power transmission control unit 112 may obtain the location of the electronic device 200 on the surface of the interface by the location sensing unit (not illustrated) provided in the wireless power transfer apparatus 100. In another example, the power transmission control unit (112) receives a power control message indicating strength of a wireless power signal from an object on the interface surface or a power control message indicating identification information of the object using the one or more transfer coils (1111 a-1 to 1111a-n) respectively, And obtain location information of the electronic device (200) by determining which coil is in proximity to the location of the one or more transmitting coils based on the received result.

[0109] Meanwhile, the active region may refer to a portion of the interface surface that allows a high-efficiency magnetic field to pass through when the wireless power transmitter 100 wirelessly transfers power to the electronic device 200. In an example, a single transmission coil for generating a magnetic field passing through the active region or a combination of one or more transmission coils may be referred to as a primary cell. Accordingly, the power transmission control unit 112 may determine an active area based on the sensed position of the electronic device 200, and may control the multiplexer 1113 to establish a connection of a main cell corresponding to the active area so that a receiving coil 2911 a of the electronic device 200 and coils belonging to the main cell may be placed in an inductively coupled relationship.

[0110] Further, the power converter 111 may additionally include an impedance matching unit (not illustrated) that adjusts impedance to form a resonant circuit with connected coils.

[0111] Meanwhile, an example of the wireless power transmitter implemented in the form of a wireless charger is described below.

[0112] FIG. 6 is a block diagram illustrating a wireless power transmitter further including an additional configuration in addition to the configuration illustrated in FIG. 2A.

[0113] As can be seen with reference to Fig. 6, the wireless power transmitter 100 may further include a sensor unit 120, a communication unit 130, an output unit 140, a memory 150 and a control unit 180 in addition to the power transmitter 110 and the power supply unit 190 supporting at least one of the inductive coupling method and the resonant coupling method described above.

[0114] The control unit 180 controls the power conversion unit 110, the sensor unit 120, the communication unit 130, the output unit 140, the memory 150, and the power supply unit 190.

[0115] The control unit 180 may be implemented as a separate module from the power transmission control unit 112 in the power conversion unit 110 described with reference to Fig. 2, or may be implemented as a single module.

[0116] The sensor unit 120 may be configured to include a sensor for sensing a position of the electronic device 200. The position information sensed by the sensor unit 120 may be used to enable the power conversion unit 110 to efficiently transmit power.

[0117] For example, in the case of wireless power transfer by inductive coupling, the sensor unit 120 may operate as a position detection unit, and the position information sensed by the sensor unit 120 may be used to move or rotate the transmission coil 1111 a in the power conversion unit 110.

[0118] In addition, for example, a wireless power transmitter 100 comprising one or more transmitting coils described above may determine coils of the one or more transmitting coils that may be placed in inductive or resonant coupling relationship with a receiving coil of the electronic device 200 based on positional information of the electronic device 200.

[0119] Meanwhile, the sensor unit 120 may be configured to monitor whether or not the electronic device 200 approaches a chargeable region. The function of detecting whether or not the sensor unit 120 approaches may be performed separately from or combined with the function of detecting whether or not the power transmission controller 112 in the power delivery unit 110 approaches or not the electronic device 200.

[0120] The communication unit (130) performs wired and wireless data communication with the electronic device (200). Wherein the communication unit (130) is configured to receive BluetoothTM, zigbee, Ultra Wide Band (uwb), Wireless USB, Near Field Communication (NFC), and Wireless LAN.

[0121] The communication unit (130) establishes a connection with the electronic device (200) to perform data communication with the electronic device (200). Connection information may be required in order for the communication unit 130 to establish a connection with the electronic device 200. The connection information for establishing the connection may be information necessary for authentication or authorization. The connection information may correspond to a physical (or hardware) address, a logical (or on a network) address, a password, or a cryptographic key of the communication unit 130.

[0122] The control unit 180 may receive the connection information necessary to establish a connection with the electronic device 200 through a power control message included in the wireless power signal modulated by the electronic device 200. The control unit 180 may establish a connection for data communication with the electronic device 200 based on the received connection information.

[0123] For example, the communication unit 130 may include Bluetooth™ when performing communication in a manner, the connection information includes Bluetooth™ address. In this case, the control unit 180 may be configured to control the Bluetooth™ and control the communication unit 130 to obtain an address and perform device pairing with the electronic device 200. Thereafter, the control unit 180 may establish a connection for transmitting and receiving user data to and from the electronic device 200.

[0124] For example, when the communication unit 130 performs communication in a wireless LAN method, the connection information may correspond to a service set identifier (SSID), authentication information of wired equivalent privacy (WEP) or Wi-Fi protected access (WPA), an address of a device, and so on. In this case, the control unit 180 may acquire the connection information through a power control message and control the communication unit 130 to authenticate or perform access with the electronic device 200. Thereafter, the control unit 180 may establish a connection for transmitting and receiving user data to and from the electronic device 200.

[0125] To this end, the control unit 180 may determine whether a connection is established with the electronic device 200, and request the electronic device 200 to transmit the connection information when the connection is not established and connection information is needed for establishing the connection as a result of the determination. The control unit 180 may request to transmit the connection information through a wireless power signal. For example, the control unit 180 may control the power conversion unit 111 to form a wireless power signal by applying a specific frequency, amplitude, voltage or current to the power conversion unit 111 to request the electronic device 200 to transmit the connection information. The electronic device (200) may sense a wireless power signal requesting transmission of the connection information and transmit the connection information by modulating the wireless power signal to include the connection information.

[0126] Meanwhile, the communication unit 130 may be in a standby state or disabled in order to save power. When the electronic device 200 is detected using the power delivery unit 110, the control unit 180 may determine whether the communication unit 130 is activated. When the communication unit 130 is not activated as a result of the determination, the control unit 180 may control the communication unit 130 to be activated.

[0127] The output unit (140) includes at least one of a display unit (141) and a sound output unit (142). Wherein the display portion (141) includes a liquid crystal display (LCD), a thin film transistor-liquid crystal display (TFT LCD), an organic light-emitting diode (OLED), a flexible display, a three-dimensional display. The display unit 141 may display the state of charge according to the control of the control unit 180.

[0128] It will be readily apparent to those skilled in the art that the configuration of the wireless power transmitter according to the above-described embodiments may also be applied to devices such as docking stations, terminal cradle devices, other electronic devices, and so on, except when applicable to wireless chargers only.

[0129] FIG. 7 illustrates a configuration in a case where the electronic device 200 is implemented in a mobile terminal form according to embodiments disclosed herein.

[0130] The mobile communication terminal 200 includes a power supply 290 illustrated in Fig. 2, Fig. 4 or Fig. 5.

[0131] Further, the terminal 200 may additionally include a wireless communication unit 210, an audio/video (a/V) input unit 220, a user input unit 230, a sensing unit 240, an output unit 250, a memory 260, an interface unit 270, and a control unit 280. The components shown in FIG. 7 are not required, so a terminal having more or fewer components may be implemented.

[0132] Hereinbelow, the elements will be described in order.

[0133] The wireless communication unit 210 may include one or more modules that enable wireless communication between the terminal 200 and a wireless communication system, between the terminal 200 and a network in which the terminal 200 is located, or between the terminal 200 and the wireless power transmitter 100. For example, the wireless communication unit 210 may include a broadcast receiving module 211, a mobile communication module 212, a wireless Internet module 213, a near field communication module 214, a location information module 215, and so on.

[0134] A broadcast reception module (211) receives broadcast signals and/or broadcast-related information from an external broadcast center through a broadcast channel.

[0135] The broadcast channel may include a satellite channel and a terrestrial channel. The broadcast center may mean a server generating and transmitting broadcast signals and/or broadcast-related information, or a server receiving pre-generated broadcast

signals and/or broadcast-related information and transmitting the pre-generated broadcast signals and/or broadcast-related information to a terminal. The broadcast signal may not only include a TV broadcast signal, a radio broadcast signal, and a data broadcast signal, but may also include a broadcast signal having a form in which the data broadcast signal is combined with the TV broadcast signal or the radio broadcast signal.

[0136] The broadcast-related information may refer to information relating to a broadcast channel, a broadcast program, or a broadcast service provider. The broadcast-related information can also be provided through a mobile communication network. In this case, it can be received by the mobile communication module 212.

[0137] The broadcast-related information may exist in various forms. For example, Electronic Program Guide (EPG) from Digital Multimedia Broadcasting (DMB) or Electronic Service Guide (ESG) from Digital Video Broadcast-Handheld (DVB-H), etc.

[0138] The broadcast receiving module (211) includes, for example, Digital Multimedia Broadcasting-Terrestrial (DMB-T), Digital Multimedia Broadcasting-Satellite (DMB-S), Media Forward Link Only (MediaFLO), Digital broadcast systems such as Digital Video Broadcast-Handheld (DVB-H), Integrated Services Digital Broadcast-Terrestrial (ISDB-T) may be used to receive digital broadcast signals. Of course, the broadcast receiving module 211 may be configured to be suitable for not only the digital broadcast system described above, but also other broadcast systems.

[0139] The broadcast signal and/or broadcast-related information received through the broadcast reception module 211 may be stored in the memory 260.

[0140] The mobile communication module (212) transmits and receives radio signals to and from at least one of a base station, an external terminal, and a server on the mobile communication network. The wireless signal may include various types of data according to voice call signal, video call signal, or text/multimedia message transmission/reception.

[0141] Wireless Internet module 213 refers to a module for wireless Internet connection, which may be embedded or external to terminal 200. The wireless Internet technology may include Wireless LAN (WLAN) (Wi-Fi), Wireless broadband (Wibro), World Interoperability for Microwave Access (Wimax), High Speed Downlink Packet Access (HSDPA), and the like.

[0142] Near-field communication module 214 refers to a module for near-field communication. Bluetooth, Radio Frequency Identification (RFID), infrared Data Association (IrDA), Ultra Wideband (uwb), ZigBee, and the like may be used as a wireless short range communication technology. Meanwhile, wired near-field communication may include USB (Universal Serial Bus), IEEE 1394, Thunderbolt, Intellectual Thunderbolt, and so on.

[0143] The wireless Internet module 213 or the near field communication module 214 may establish a data communication connection with the wireless power transmitter 100.

[0144] Through the established data communication, the wireless Internet module (213) or the near field communication module (214) may transmit an audio signal to the wireless power transmitter (100) via the near field communication module when there is an audio signal to output during wireless power transfer. In addition, through the established data communication, the wireless Internet module 213 or the near field communication module 214 may send the information to the wireless power transmitter 100 when there is information to be displayed. Alternatively, through the established data communication, the wireless Internet module 213 or the near field communication module 214 may receive an audio signal that is input through a microphone embedded in the wireless power transfer 100. In addition, the wireless internet module (213) or the near field communication module (214) may transmit identification information of the mobile terminal (200) to the wireless power transmitter (100) via the established data communication (e.g., phone number, or device name).

[0145] The location information module 215 may be a module for obtaining a location of a terminal, for example, a global positioning system (GPS) module.

[0146] Referring to FIG. 7, Audio/Video (a/V) input 220 is for audio or video signal input, which may include a camera 221, a microphone 222, and the like. A camera (221) processes an image frame such as a still image or a moving image obtained by an image sensor in an image call mode or a photographing mode. The processed image frame may be displayed on a display unit (251).

[0147] The image frame processed in the camera (221) may be stored in the memory (260) or transmitted to the outside through the wireless communication unit (210). Two or more cameras 221 may be provided depending on the environment of use.

[0148] Microphone 222 receives an external acoustic signal by a microphone (Microphone) in a call mode or recording mode, voice recognition mode, and the like, and processes the received acoustic signal into electrical voice data. The processed voice data can be converted into a form transmittable to a mobile communication base station through the mobile communication module 212 when in a call mode, and output the converted voice data. Various noise cancellation algorithms may be implemented in the microphone 222 to cancel noise generated in a process of receiving an external acoustic signal.

[0149] The user input unit (230) generates input data for the user to control the operation of the terminal. The user input 230 may be configured with a key pad dome switch, a touch pad (static pressure/static), a jog wheel, a jog switch, or the like.

[0150] The sensing unit 240 may include a proximity sensor 241, a pressure sensor 242, a motion sensor 243, and so on. The proximity sensor 241 can detect the presence or absence of an object approaching the mobile terminal 200, an object existing in the vicinity of the mobile terminal 200, and the like without mechanical contact. The proximity sensor 241 may detect a proximity object using a change in alternating magnetic field or a change in static magnetic field, or using a rate of change in

capacitance, and so on. Two or more proximity sensors 241 may be provided according to a configuration aspect.

[0151] The pressure sensor 242 may detect whether pressure is applied to the mobile terminal 200, a magnitude of the pressure, and so on. The pressure sensor 242 may be installed at a location where the mobile terminal 200 needs to detect pressure depending on the use environment. If the pressure sensor 242 is installed on the display unit 251, a touch input through the display unit 251 and a pressure touch input to which a pressure greater than that of the touch input is applied may be identified according to a signal output from the pressure sensor 242. Further, according to the signal output from the pressure sensor 242, the magnitude of the pressure applied to the display unit 251 when the pressure touch is input can also be seen.

[0152] The motion sensor 243 senses a position, movement, etc., of the mobile terminal 200 by using an acceleration sensor, a gyro sensor, etc. The acceleration sensor that can be used in the motion sensor 243 is an element that transforms it into an electrical signal about changes in acceleration in either direction. The acceleration sensor is usually constructed by mounting two axes or three axes on one package, and depending on the use environment, only one axis of Z axis may be required. Therefore, when an acceleration sensor in the X-axis or Y-axis direction is to be used instead of in the Z-axis direction for any reason, a separate piece substrate may be used to stand and mount the acceleration sensor on the main substrate. Further, the gyro sensor is a sensor for measuring an angular velocity of the mobile terminal 200 moving in rotation, and may sense a rotated angle with respect to each reference direction. For example, the gyro sensor may sense respective rotation angles, i.e. azimuth, pitch and roll, with reference to axes in three directions.

[0153] The output unit 250 is for generating output related to visual, audio, tactile, etc., which may include a display unit 251, an acoustic output module 252, an alarm unit 253, a haptic module 254, etc.

[0154] The display unit 251 displays (outputs) information processed by the terminal 200. For example, when the terminal is in call mode, a UI (User Interface) or GUI (Graphic User Interface) related to the call is displayed. When the terminal (200) is in the video call mode or the photographing mode, the photographed and/or received video or UI, GUI is displayed.

[0155] The display portion (251) includes a liquid crystal display (LCD), a thin film transistor liquid crystal display (TFT LCD), an organic light-emitting diode (OLED), a flexible display, a three-dimensional display.

[0156] Some of these displays may be configured to be transparent or light transmissive so that they can be viewed externally therethrough. This may be referred to as a transparent display, representative examples of which are TOLEDs (Transparent OLEDs), etc. The rear structure of the display portion 251 may also be configured as a light transmissive structure. Due to such a structure, a user may see an object positioned

behind the terminal body through an area occupied by the display unit 251 of the terminal body.

[0157] Two or more display units 251 may be present according to an implementation of the terminal 200. For example, a plurality of display units may be spaced apart from or integrally arranged on one surface of the terminal 200, and may also be arranged on different surfaces of the terminal 200.

[0158] When the display unit 251 and a sensor for sensing a touch operation (hereinafter, referred to as a 'touch sensor') form a mutually layer structure (hereinafter, referred to as a 'touch screen'), the display unit 251 may also be used as an input device in addition to an output device. The touch sensor may have the form of, for example, a touch film, a touch sheet, a touch pad, or the like.

[0159] The touch sensor may be configured to convert a change in pressure applied to a specific portion of the display unit 251 or capacitance generated in a specific portion of the display unit 251 into an electric input signal. The touch sensor may be configured to detect not only the location and area being touched, but also the pressure at the time of the touch.

[0160] If there is a touch input to the touch sensor, the corresponding signal (s) are sent to the touch controller. The touch controller processes the signal (s) and then sends the corresponding data to controller 280. Accordingly, the control unit 280 may know which region of the display unit 251 is touched.

[0161] A proximity sensor 241 may be disposed in an inner region of the terminal surrounded by the touch screen or in the vicinity of the touch screen. The proximity sensor refers to a sensor that detects the presence or absence of an object approaching a predetermined detection surface or an object present in the vicinity thereof without mechanical contact using the force of an electromagnetic field or infrared rays. The proximity sensor has a longer lifetime than the contact-type sensor, and its utilization is also high.

[0162] Examples of the proximity sensor include transmission type photoelectric sensors, direct reflection type photoelectric sensors, mirror type photoelectric sensors, high frequency oscillation type proximity sensors, capacitance type proximity sensors, magnetic type proximity sensors, infrared proximity sensors, and the like. And detect the proximity of the pointer by a change in electric field according to the proximity of the pointer when the touchscreen is electrostatic. In this case, the touch screen (touch sensor) may be classified as proximity sensors.

[0163] Hereinafter, for convenience of explanation, an action in which a pointer is brought into proximity without being contacted on the touchscreen so that it is recognized that the pointer is located on the touchscreen is referred to as a "proximity touch", and an action in which the pointer is actually contacted on the touchscreen is referred to as a "contact touch". The position where the pointer becomes a proximity touch with a pointer

on the touchscreen refers to a position where the pointer vertically corresponds to the touchscreen when the pointer becomes the proximity touch.

[0164] The proximity sensor senses proximity touch and proximity touch patterns (e.g., proximity touch distance, proximity touch direction, proximity touch speed, proximity touch time, proximity touch location, proximity touch movement state, etc.). Information corresponding to the sensed proximity touch operation and proximity touch pattern may be output on a touch screen.

[0165] The sound output module 252 may output audio data received from the wireless communication unit 210 or stored in the memory 260 in a call signal reception, a call mode or recording mode, a voice recognition mode, a broadcast reception mode, or the like. Sound output module 252 also outputs sound signals associated with functions performed at terminal 200 (e.g., call signal reception sound, message reception sound, etc.). Such sound output module 252 may include a receiver, speaker, Buzzer, and the like.

[0166] The alarm unit 253 outputs a signal for notifying the occurrence of an event of the terminal 200. Examples of events generated in the terminal include a call signal reception, a message reception, a key signal input, a touch input, and the like. Alarm unit 253 may output a signal for alerting the occurrence of an event in other forms than a video signal or an audio signal, for example, vibration. The video signal or audio signal may also be output via a display unit (251) or a speech output module (252), so that they (251, 252) may be classified as part of an alarm unit (253).

[0167] Haptic module 254 generates a variety of tactile effects that may be felt by a user. A representative example of a tactile effect that the haptic module 254 generates is vibration. The intensity and pattern of vibrations generated by the haptic module 254 are controllable. For example, different vibrations may be synthesized and output, or sequentially output.

[0168] In addition to vibration, the haptic module 254 may generate various tactile effects such as effects caused by stimulation of a pin array vertically moving with respect to a contact skin surface, an injection force or suction force of air through an injection port or a suction port, grazing on a skin surface, contact of an electrode, electrostatic force, and the like, and effects caused by heat absorption or heat sensitive reproduction using an element capable of generating heat.

[0169] The haptic module 254 may not only transmit the tactile effect through direct contact, but may also implement a user to feel the tactile effect through a near sensation such as a finger or arm. Two or more haptic modules 254 may be provided according to a configuration aspect of the terminal 200.

[0170] The memory 260 may store a program for operation of the control unit 280, and may temporarily store input/output data (e.g., phonebook, message, still image, moving

image, etc.). The memory 260 may store data regarding vibrations and sounds of various patterns output upon touch input on the touchscreen.

[0171] Further, the memory 260 may store a setting program related to wireless power transfer or wireless charging. The setting program may be executed by the control unit 280.

[0172] Further, the memory 260 may store an application related to wireless power transfer (or wireless charging) downloaded from an application providing server (e.g., an app store). The application related to wireless power transfer is a program for controlling wireless power transfer, and the electronic device 200 may wirelessly receive power from the wireless power transmitter 100 through the program or establish a connection for data communication with the wireless power transmitter 100.

[0173] Memory 260 may be of the flash memory type, hard disk type, multimedia card micro type, card type memory (e.g. SD or xD memory, etc.), Random Access Memory (ram), Static Random Access Memory (SRAM), Read-Only Memory (Rom), Electrically Erasable Programmable Read-Only Memory (EEPROM), Programmable Read-Only Memory (prom), magnetic memory, magnetic disk, and optical disk. The terminal 200 may operate in connection with web storage that performs the storage function of the memory 260 on the Internet.

[0174] The interface unit 270 serves as a passage with all external devices connected to the terminal 200. The interface unit 270 may receive data from the external device, receive power and transmit the received data to each component in the terminal 200, or transmit the data in the terminal 200 to the external device. For example, a wired/wireless headset port, an external charger port, a wired/wireless data port, a memory card port, a port connecting a device provided with an identification module, an audio input/output (I/o) port, a video input/output (I/o) port, an earphone port, and the like may be included in the interface unit 270.

[0175] The identification module is a chip storing various pieces of information for authenticating usage rights of the terminal 200, and may include a User Identify Module (UIM), Subscriber Identity Module (SIM), Universal Subscriber Identity Module (USIM), and so on. A device equipped with an identification module (hereinafter, the 'identification device') can be manufactured in a smart card format. Accordingly, the identification device can be connected with the terminal 200 via a port.

[0176] The interface unit may be a passage through which power from the cradle is supplied to the terminal 200 when the terminal 200 is connected to an external cradle, or may be a passage through which various command signals input from the cradle by a user are transmitted to the terminal. Various command signals input from the cradle or the power supply may be operated as signals to recognize that the terminal is correctly mounted in the cradle.

[0177] The controller 280 typically controls the overall operation of the terminal. Related controls and processes are performed, for example, for voice calls, data communications, video calls, etc. The control unit 280 may include a multimedia module 281 for multimedia playback. The multimedia module 281 may be implemented within the controller 280, or may be implemented separately from the controller 280. Further, the control unit 180 may be implemented as a separate module from the power receiving control unit 292 in the power supply unit 290 described with reference to Fig. 2, or may be implemented as a single module.

[0178] The control unit 280 may perform pattern recognition processing to recognize a handwriting input or a picture drawing input performed on the touchscreen as characters and images, respectively.

[0179] Meanwhile, the wireless Internet module 213 or the near field communication module 214 may be standby or disabled to save power. The control unit 280 may determine whether the wireless Internet module 213 or the near field communication module 214 is activated after the wireless power signal is received by the power reception unit 291. The control unit 280 may control the wireless Internet module 213 or the near field communication module 214 to activate when the wireless Internet module 213 or the near field communication module 214 is not activated as a result of the determination.

[0180] The control unit 280 performs wire charging or wireless charging according to a user input or an internal input. Here, the internal input is a signal indicating that the induced current generated in the secondary coil inside the terminal has been sensed.

[0181] As described above, the power receiving control unit 292 within the power supply 290 may be included in and implemented in the control unit 280, and operation by the power receiving control unit 292 may be understood to be performed by the control unit 280.

[0182] The power supply 290 receives external power and internal power under control of the control unit 280, and supplies power necessary for operation of the respective components.

[0183] The power supply unit 290 may include a battery 299 configured to supply power to each component of the terminal 200, and may include a charging unit 298 configured to charge the battery 299 wired or wireless.

[0184] Although the present specification discloses a mobile terminal as an apparatus for wirelessly receiving power as an example, it will be readily apparent to those skilled in the art that the configuration according to the embodiments described herein may also be applied to a fixed terminal such as a digital TV, a desktop computer, and the like, except when applicable to the mobile terminal only.

[0185] FIG. 8 presents an example in which the mobile terminal shown in FIG. 7 is charged in an electromagnetic induction manner by the wireless power transmitter 100.

[0186] As shown in FIG. 8, the magnetic field induced by the coil 1111 a in the wireless power transmitter 100 can be transferred to the coil 2911 a of the mobile terminal 200, which can convert it into power to charge the battery 229 of the mobile terminal 200.

[0187] FIG. 9 presents an example of combining a coil for wireless power transmission and reception and a coil for near field communication according to a first embodiment of the present invention.

[0188] As can be seen with reference to FIG. 9, a first embodiment of the present disclosure shows an example in which the coil for wireless power transmission and reception is formed into one coil in order to miniaturize a coil for near field communication (NFC).

[0189] As can be seen with reference to FIG. 9, a coil 2911 a, magnetic shielding member 2917 is shown.

[0190] The coil is planar and formed by winding in a clockwise or counterclockwise direction. One end (b) of the winding may be protruded along a lower surface or an upper surface of the planar coil in a direction from the inside to the outside of the plane so as to be parallel with the other end (a) of the winding. That is, one end b of the winding is protruded along an upper surface or a lower surface of the planar coil in a direction from the inside to the outside of the planar coil so as to be parallel with the other end a of the winding. That is, the flat type coil may be disposed above an upper surface or below a lower surface of the flat type coil in order to draw one end of the winding wound inside back toward the outside.

[0191] Further, one point of the winding may extend as a single wire and be disposed parallel to the other end of the winding.

[0192] One end (b) and the other end (a) of the winding are used as antennas for wireless transmission and reception of power, and the one end (b) of the winding and the extended disconnection (c) are used as antennas for near field communication. The length of the extended disconnection may be adjusted in length according to the near field communication scheme to be used. That is, by changing a point where the winding extends in the coil, the length of the extended disconnection may be adjusted.

[0193] By using one coil, it is possible to operate as an antenna for wireless transmission and reception of power and an antenna for near field communication, it is possible to miniaturize it.

[0194] Meanwhile, the magnetic shielding member (2917) is in contact with the planar coil to block leakage current.

[0195] In this case, the magnetic shielding member (2917) has a thickness of approximately 0.8 mm, and a winding thickness of the planar coil has a thickness of approximately 0.3 mm. Therefore, the total thickness of the planar coil is on the order of

0.6 mm inclusive to the projection of the windings. Accordingly, the total thickness of the coil 2911 a and the magnetic shielding member 2917 may be about 1.4 mm, for example.

[0196] However, such thickness needs to be additionally miniaturized in view of the total thickness of the mobile terminal being fabricated within 10 mm.

[0197] Accordingly, there may be an attempt to reduce the thickness of the magnetic shielding member 2917, but such an attempt may increase leakage current as seen with reference to figs. 10 and 11.

[0198] FIG. 10 is an example diagram showing the phenomenon of eddy currents caused by the electromagnetic induction scheme, and FIG. 11 shows the influence of eddy currents on wireless power transfer.

[0199] As can be seen with reference to FIG. 10, when the magnetic field is close to the conductor, an induced current caused by a change in the magnetic field is generated inside the conductor, which is referred to as an eddy current.

[0200] Such eddy currents cause abnormal signal flow with respect to normal signal flow or cause signal degradation, as unintended current flow.

[0201] In particular, as can be seen with reference to FIG. 11, if the thickness of the magnetic shield member 2917 is not sufficient, or performance, the magnetic field leaks unobstructed by the magnetic shield member 2917, resulting in eddy currents up to a proximate conductive material 1915, such as a circuit board.

[0202] Therefore, reducing the thickness of the magnetic shielding member for miniaturization may cause disadvantages of greatly increasing leakage magnetic field and a disadvantage of greatly deteriorating efficiency. In addition, eddy currents can cause disadvantages caused by large eddy currents.

[0203] Accordingly, approaches for miniaturizing a coil for wireless power transmission and reception and a coil for near field communication (NFC) to such an extent that the coil for wireless power transmission and reception can be mounted in a miniaturized electronic device without reducing the thickness of the magnetic shielding member will be described with reference to Figs. 12 to 17.

[0204] Figs. 12 and 13 show examples of combining a coil for wireless power transmission and reception and a coil for near field communication according to a second embodiment of the present invention.

[0205] As can be seen with reference to figs. 12 and 13, coil (2911 a) is adhered with magnetic shielding member (2917) by adhesive member (2917).

[0206] The coil 2911 a is planar, and is formed by winding wound in a clockwise or counterclockwise direction.

[0207] The planar coil (2911 a) is formed by winding windings wound clockwise or counterclockwise. The planar coil 2911 a may be circular, elliptical or rectangular. The winding of the windings is such that an empty area is formed inside the planar coil (2911 a). In this case, the void area of the interior may be circular, elliptical, or rectangular, as described above.

[0208] One end (b) of the winding may be protruded along a lower surface of the planar coil 2911 a in a direction from the inside of the plane to the outside so as to be parallel with the other end (a) of the winding. That is, one end (b) of the winding is protruded along a lower surface of the planar coil 2911 a in a direction from the inside to the outside of the planar coil 2911 a so as to be parallel with the other end (a) of the winding. That is, in order to draw one end of the winding wound inside back toward the outside, the flat type coil may be disposed below a lower surface of the flat type coil.

[0209] Further, one point of the winding may extend as a single wire and be disposed parallel to the other end b of the winding.

[0210] One end (b) and the other end (a) of the winding are used as antennas for wireless transmission and reception of power, and the one end (b) of the winding and the extended disconnection (c) are used as antennas for near field communication. The length of the extended disconnection may be adjusted in length according to the near field communication scheme to be used. That is, by changing a point where the winding extends in the coil, the length of the extended disconnection may be adjusted.

[0211] In addition, a groove is formed on an upper surface of the shielding member 2917 to accommodate a protrusion of one end of the winding so that the planar coil is in full close contact. Along the groove, one end (b) and the other end (a) of the winding may be guided to the outside of the magnetic shielding member 2917, and one end and the other end of the winding guided to the outside may be connected to the inverter 1112 or the rectifier circuit 2913 described with reference to FIG. 4.

[0212] The depth of the groove may be greater than the thickness of the winding, e.g., 0.3 mm. Further, a width of the groove may be formed to be greater than a certain distance apart from each other while the one end and the other end of the winding are spaced apart from each other by the certain distance apart from each other. Alternatively, the width of the groove may be formed to correspond to the thickness of the winding to accommodate only one end of the winding. In this case, since the other end of the winding is spaced apart from the one end of the winding by a certain distance, the other end of the winding may not be guided by the groove, but may contact the upper surface of the magnetic shielding member 2917.

[0213] The shielding member 2917 having such a shape may be injected by a mold, and thus may be mass-produced at a lower cost.

[0214] As such, in a second embodiment, assuming that the thickness of the magnetic shielding member 2917 is on the order of about 0.8 mm and the winding thickness of the

planar coil is on the order of about 0.3 mm, Since a portion where one end of the winding protrudes is received by the groove of the magnetic shielding member 2917, the total thickness of the coil 2911 a and the magnetic shielding member 2917 can be reduced by, for example, 1.1 mm.

[0215] Figs. 14 and 15 show examples of combining a coil for wireless power transmission and reception and a coil for near field communication according to a third embodiment of the present invention.

[0216] A first coil (2911 a-1) for wireless power transmission and reception is planar and formed by winding wound in a clockwise or counterclockwise direction. In the first coil, an induced current may flow through a change in an external magnetic field. A central portion of the first coil (2911 a-1) is formed by winding the winding in a clockwise or counterclockwise direction to form a void space, and one end of the winding is protruded along a lower surface of the planar coil in a direction from the inside of the plane to the outside of the plane so as to be parallel with the other end of the winding. The planar coil 2911 a may be circular, elliptical or rectangular. In this case, the void area of the interior may be circular, elliptical, or rectangular, as described above.

[0217] A second coil (2911 a-2) for near-field communication is formed along an outer peripheral surface of the planar coil and spaced apart from each other so as not to come into contact with the outer peripheral surface of the coil. The winding causes the second coil (2911 a-2) to have a strip-shaped antenna shape.

[0218] Meanwhile, as can be seen with reference to figs. 14 and 15, a groove for receiving the first coil and a groove for receiving the second coil may be formed on an upper surface of the shielding member 2917, respectively. That is, a stepped portion may be formed on an upper surface of the shielding member 2917 to accommodate the first coil and the second coil. In other words, a groove corresponding to the area of the first coil and a groove corresponding to the area of the second coil may be additionally formed on the upper surface of the shielding member 2917.

[0219] The stepped portion as described above may exhibit an effect of shielding the side surface of the first coil 2911 a, i.e., a side shield effect. Accordingly, not only does the magnetic flux density of the first coil increase, but also can greatly reduce the leakage magnetic field. On the other hand, the first coil and the second coil 2911 a-2 may be electrically isolated by a protrusion between the groove for receiving the first coil 2911 a-1 and the groove for receiving the second coil 2911 a-2.

[0220] Meanwhile, the area of the stepped portion (i.e., groove) formed on the upper surface of the shielding member 2917 to accommodate the first coil may correspond to the actual area of the first coil 2911 a-1 except for the void space at the center of the first coil 2911 a-1. That is, the upper surface of the magnetic shielding member 2917 has a groove formed only in a portion corresponding to the thread area of the first coil 2911 a-1 except for the void space. Accordingly, a center portion of the magnetic shielding member 2917 corresponding to the void space may have a protruding surface higher than

a height of the groove, and the protruding surface may prevent the coil from escaping and increase magnetic flux density.

[0221] The shielding member 2917 having such a shape may be injected by a mold, and thus may be mass-produced at a lower cost.

[0222] Figs. 16 and 17 show examples of combining a coil for wireless power transmission and reception and a coil for near field communication according to a fourth embodiment of the present invention.

[0223] A second coil (2911 a-2) for near-field communication is formed along an inner peripheral surface of the planar coil and spaced apart from each other so as not to come into contact with the inner peripheral surface of the coil. The winding causes the second coil (2911 a-2) to have a strip-shaped antenna shape.

[0224] In addition, the description of the configuration illustrated in figs. 16 and 17 is similar to the description of the configuration illustrated in figs. 14 and 15, and thus the foregoing will not be redundantly described, but will be accorded with the description provided above.

[0225] The protection scope of the present invention described above is not limited to the embodiments disclosed herein, but the present invention can be modified, altered, or improved in various forms within the spirit of the present invention and scope set forth in the claims.



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(73) 특허권자

엘지전자 주식회사

서울특별시 영등포구 여의대로 128 (여의도동)

(72) 발명자

추인창

서울특별시 서초구 양재대로11길 19, LG서초센터 (양재동)

서정교

서울특별시 서초구 양재대로11길 19, LG서초센터 (양재동)

박진무

서울특별시 서초구 양재대로11길 19, LG서초센터 (양재동)

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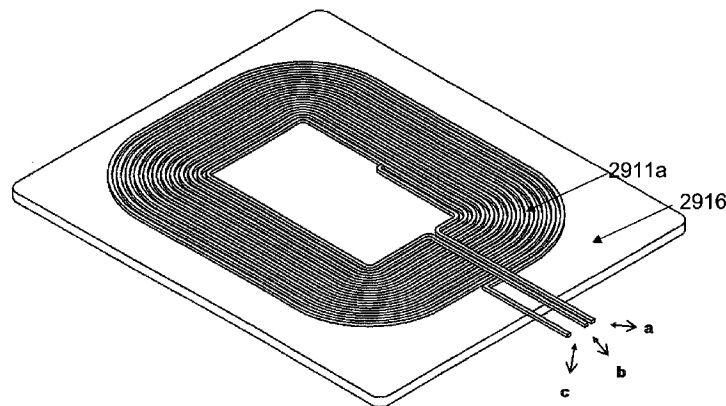
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(54) 발명의 명칭 무선 충전 가능한 전자 기기

(57) 요약

본 명세서는 무선 전력 송수신 및 근거리 통신이 가능한 전자 기기를 제시한다. 상기 전자 기기는 권선이 시계 또는 반시계 방향으로 감겨 형성되는 평면형 코일과, 누설 자기장을 차단하기 위해 상기 평면형 코일과 접촉되는 차폐 부재를 포함할 수 있다. 상기 권선의 일단은 상기 권선의 타단과 나란하게끔 상기 평면의 내측으로부터 외측 방향으로 상기 평면형 코일의 하부면을 따라 돌출 배치되고, 상기 권선의 일 지점은 단선(單線)으로 연장되어 상기 권선의 타단과 나란하게끔 배치될 수 있다. 그리고, 상기 권선의 일단 및 타단에 의해 형성되는 패 선로는 전력의 무선 송수신을 위한 안테나로 이용되고, 상기 권선의 일단과 상기 연장된 단선에 의해 형성되는 패 선로는 근거리 무선 통신을 위한 안테나로 이용될 수 있다.

도면 - 도9



평면형

평면형

청구항 1

무선 전력 송수신 및 근거리 통신이 가능한 전자 기기로서,

권선이 시계 또는 반시계 방향으로 감겨 형성되는 평면형 코일과,

여기서 상기 권선의 일단은 상기 권선의 타단과 나란하게끔 상기 평면의 내측으로부터 외측 방향으로 상기 평면형 코일의 하부면을 따라 돌출 배치되어, 상기 권선의 일단 및 상기 권선의 타단은 상기 하부면에서 상기 내측으로부터 상기 외측 방향으로 연장되고, 상기 권선의 일 지점은 상기 평면의 외측에서 단선(單線)으로 연장되어 상기 권선의 타단과 나란하게끔 배치되고;

누설 자기장을 차단하기 위해 상기 평면형 코일과 접촉되는 차폐 부재를 포함하고,

여기서 상기 권선의 일단 및 타단에 의해 형성되는 한 개의 상기 평면형 코일 내의 패 선로는 전력의 무선 송수신을 위한 안테나로 이용되고, 상기 권선의 일단과 상기 연장된 단선에 의해 형성되는 상기 한 개의 상기 평면형 코일 내의 다른 패 선로는 근거리 무선 통신을 위한 안테나로 이용되고,

상기 차폐 부재의 상면에는 상기 평면형 코일이 완전히 밀착 접촉되도록 상기 내측으로부터 상기 외측 방향으로 연장된 상기 권선의 일단 및 상기 권선의 타단의 돌출을 수용하기 위한 홈이 형성되어 있고,

상기 연장된 단선은 상기 홈에 수용되지 않고, 상기 차폐 부재의 상면에 접촉되는 것을 특징으로 하는 전자 기기.

청구항 2

제1항에 있어서,

상기 근거리 무선 통신의 방식에 따라서 상기 평면형 코일에서 상기 단선이 연장되는 지점이 변경됨으로써, 상기 연장된 단선의 길이가 조절되는 것을 특징으로 하는 전자 기기.

청구항 3

제1항에 있어서,

상기 차폐 부재의 상면에는 상기 평면형 코일의 면적에 대응하는 단차가 형성되어 있는 것을 특징으로 하는 전자 기기.

청구항 4

제1항에 있어서,

상기 권선은 상기 코일의 중심부가 빈공간을 형성하도록 감겨 있는 것을 특징으로 하는 전자 기기.

청구항 5

제4항에 있어서,

상기 차폐 부재의 상면은 상기 평면형 코일이 이탈되는 것을 방지하기 위해 상기 빈공간에 대응하는 면적의 돌출면을 갖는 것을 특징으로 하는 전자 기기

청구항 6

삭제

청구항 7

삭제

청구항 8

삭제

청구항 9

삭제

청구항 10

삭제

발명의 설명**기술 분야**

[0001] 본 명세서는 무선 전력 전송에 관한 것이다.

배경 기술

[0002] NFC(Near Field Communication; 근거리 무선 통신)란, 13.56MHz 대역의 주파수를 사용하는 RFID 기술을 응용해 근거리에서 낮은 전력으로 데이터를 전송할 수 있는 비접촉식 근거리 무선통신 기술이다. NFC는 ECMA international을 중심으로 표준화되었으며 노키아, 소니, 필립스 등이 표준화 및 제품 상용화에 참여하고 있다.

[0003] 이러한, NFC 기술은 10cm 이내의 거리에서 낮은 전력으로 데이터를 전송(424kbps급)할 수 있다.

[0004] NFC를 이용하면, 사용자의 인위적인 조작 없이도 두 개 이상의 단말기를 근접시키면 전화번호와 같은 기본적인 정보는 물론 MP3 파일이나 사진 등의 데이터를 주고받을 수 있다. 또한, NFC를 이용하면 신용 카드나 교통 카드를 대체할 수도 있다. 최근에는 제조 업체 및 통신사들은 이와 같은 NFC를 이동 단말기에 내장하여, 다양한 데이터를 송수신하게 하거나, 혹은 전자 지갑을 구현하려는 움직임이 있다.

[0005] 한편, 이동 단말기는 전통적으로 유선을 통해 내부 배터리를 충전하고 있다.

[0006] 그러나, 최근에는 접촉 없이 무선으로 전기 에너지를 공급하는 방법이 제시되고 있다.

[0007] 상기 무선으로 전기 에너지를 공급하거나, 공급받기 위한 여러 방법이 있으나, 대표적으로 전자기 유도 현상에 기초한 유도 결합(Inductive Coupling) 방식과 특정한 주파수의 무선 전력 신호에 의한 전자기적 공진 현상에 기초한 공진 결합(Electromagnetic Resonance Coupling) 방식이 있다.

[0008] 상기 유도 결합 방식과 상기 공진 결합 방식에서 전력을 송수신하기 위해서는 송수신부가 필요한데, 이동 단말기와 같은 소형의 전자 기기에서 상기 전력 송수신부를 탑재하는 것은 공간적 제약이 많이 따른다.

[0009] 더구나, 전송한 NFC를 위한 송신부/수신부를 이동 단말기에 내장함과 아울러, 상기 전력을 송수신하기 위한 송수신부를 추가적으로 내장하는 것을 공간상 많은 제약이 따른다.

[0010] 그러나, 최근 이동 단말기는 배터리와, 디스플레이, 구동 회로를 포함하고 서도, 그 두께가 1cm 내로 제조되는 실정을 감안하면, 상기 NFC를 위한 송수신부 및 상기 전력 송수신부를 추가적으로 상기 이동 단말기 내에 탑재하는 것은 매우 어렵다.

발명의 내용**해결하려는 과제**

[0011] 본 명세서에서 개시된 실시예에 의하면, 무선 전력송수신을 위한 코일과 근거리 통신 예컨대 NFC(Near Field Communication)을 위한 코일을 소형화할 수 있다.

[0012] 본 명세서에 개시된 전자 기기 내에 포함되는 코일 및 자기 차폐 부재의 형상 및 구조는 보다 소형화가 가능함과 아울러, 자속 밀도를 크게 증가시킬 수 있다. 또한, 본 명세서에 개시된 전자 기기 내에 포함되는 코일 및 자기 차폐 부재의 형상 및 구조는 누설 자속의 차폐를 보다 크게 증가시킬 수 있다.

과제의 해결 수단

- [0013] 전술한 목적을 달성하기 위하여, 본 명세서는 무선 전력 송수신 및 근거리 통신이 가능한 전자 기기를 제시한다. 상기 전자 기기는 권선이 시계 또는 반시계 방향으로 감겨 형성되는 평면형 코일과, 누설 자기장을 차단하기 위해 상기 평면형 코일과 접촉되는 차폐 부재를 포함할 수 있다. 상기 권선의 일단은 상기 권선의 타단과 나란하게끔 상기 평면의 내측으로부터 외측 방향으로 상기 평면형 코일의 하부면을 따라 돌출 배치되고, 상기 권선의 일 지점은 단선(單線)으로 연장되어 상기 권선의 타단과 나란하게끔 배치될 수 있다. 그리고, 상기 권선의 일단 및 타단에 의해 형성되는 패 선로는 전력의 무선 송수신을 위한 안테나로 이용되고, 상기 권선의 일단과 상기 연장된 단선에 의해 형성되는 패 선로는 근거리 무선 통신을 위한 안테나로 이용될 수 있다.
- [0014] 상기 차폐 부재의 상면에는 상기 평면형 코일이 완전히 밀착 접촉되도록 상기 권선 일단의 돌출을 수용하기 위한 홈이 형성될 수 있다.
- [0015] 상기 차폐 부재의 상면에는 상기 평면형 코일의 면적에 대응하는 단차가 형성될 수 있다.
- [0016] 상기 권선은 상기 코일의 중심부가 빈공간을 형성하도록 감겨 형성될 수 있다. 상기 차폐 부재의 상면은 상기 평면형 코일이 이탈되는 것을 방지하기 위해 상기 빈공간에 대응하는 면적의 돌출면을 가질 수 있다.
- [0017] 한편, 본 명세서는 추가적으로 무선 전력 송수신 및 근거리 통신이 가능한 전자 기기를 또한 제공한다. 상기 전자 기기는 외부 자기장 변화에 의하여 유도 전류가 흐르도록 구성된 평면형 코일과, 상기 평면형 코일의 외주면 또는 내주면을 따라 형성되고, 상기 코일의 외주면 또는 내주면과 접촉되지 않도록 이격되어 형성된 근거리 통신용 스트립(strip) 안테나와, 상기 평면형 코일 및 상기 근거리 통신용 안테나와 접촉되는 차폐 부재를 포함할 수 있다. 상기 평면형 코일의 중심부가 빈공간을 형성하도록 권선이 시계 또는 반시계 방향으로 감겨 형성되고, 상기 권선의 일단은 상기 권선의 타단과 나란하게끔 상기 평면의 내측으로부터 외측 방향으로 상기 평면형 코일의 하부면을 따라 돌출 배치될 수 있다. 그리고, 상기 차폐 부재의 상면에는 상기 평면형 코일이 완전히 밀착 접촉되도록 상기 권선 일단의 돌출을 수용하기 위한 홈이 형성될 수 있다.
- [0018] 상기 차폐 부재의 상면에는 상기 평면형 코일을 수용하기 위한 홈과, 상기 근거리 통신용 안테나를 수용하기 위한 홈이 각각 형성될 수 있다. 상기 평면형 코일을 수용하기 위한 홈과 상기 근거리 통신용 안테나를 수용하기 위한 홈 사이의 돌출부에 의해 상기 평면형 코일과 상기 근거리 통신용 안테나는 전기적으로 고립될 수 있다.
- [0019] 상기 차폐 부재의 상면은 상기 평면형 코일이 이탈되는 것을 방지하기 위해 상기 빈공간에 대응하는 면적의 돌출면을 가질 수 있다.
- [0020] 상기 근거리 통신용 스트립 안테나는 권선이 상기 평면형 코일의 외주면 또는 내주면을 따라 형성되고, 상기 권선의 일단과 타단은 상기 평면형 코일의 일단 및 타단과 각각 나란하게끔 배치될 수 있다.

발명의 효과

- [0021] 본 명세서에서 개시된 실시예에 의하면, 무선 전력송수신을 위한 코일과 근거리 통신 예컨대 NFC(Near Field Communication)을 위한 코일을 소형화할 수 있다.
- [0022] 본 명세서에 개시된 전자 기기 내에 포함되는 코일 및 자기 차폐 부재의 형상 및 구조는 보다 소형화가 가능함과 아울러, 자속 밀도를 크게 증가시킬 수 있다. 또한, 본 명세서에 개시된 전자 기기 내에 포함되는 코일 및 자기 차폐 부재의 형상 및 구조는 누설 자속의 차폐를 보다 크게 증가시킬 수 있다.

도면의 간단한 설명

- [0023] 도 1은 본 발명의 실시 예들에 따른 무선 전력 전송장치 및 전자 기기를 개념적으로 나타낸 예시도이다.
- 도 2의 (a) 및 (b)는 각각 본 명세서에 개시된 실시 예들에서 채용 가능한 무선 전력 전송장치(100) 및 전자 기기(200)의 구성을 예시적으로 나타낸 블록도이다.
- 도 3은 유도 결합 방식에 따라 무선 전력 전송장치로부터 전자 기기에 무선으로 전력이 전달되는 개념을 도시한다.
- 도 4는 본 명세서에 개시된 실시 예들에서 채용 가능한 전자기 유도 방식의 무선 전력 전송장치(100) 및 전자 기기(200)의 구성의 일부를 예시적으로 나타낸 블록도이다.
- 도 5는 본 명세서에 개시된 실시 예들에서 채용 가능한 유도 결합 방식에 따라 전력을 수신하는 하나 이상의 전송 코일들을 가지도록 구성된 무선 전력 전송장치의 블록도이다.

도 6은 도 2의 (a)에 도시된 구성 외에 추가적인 구성을 더 포함하는 무선 전력 전송장치를 나타낸 블록도이다.

도 7은 본 명세서에 개시된 실시 예들에 따른 전자 기기(200)가 이동 단말기 형태로 구현된 경우의 구성을 나타낸다.

도 8은 도 7에 도시된 이동 단말기가 무선 전력 전송장치(100)에 의해 전자기 유도 방식으로 충전되는 예를 나타낸다.

도 9는 본 발명의 제1 실시예에 따라 무선 전력 송수신을 위한 코일과 근거리 통신용 코일을 결합한 예를 나타낸다.

도 10은 전자기 유도 방식에 의해 초래되는 와전류(eddy current)의 현상을 나타낸 예시도이다.

도 11은 와전류가 무선 전력 전송에 미치는 영향을 나타낸다.

도 12 및 도 13은 본 발명의 제2 실시예에 따라 무선 전력 송수신을 위한 코일과 근거리 통신용 코일을 결합한 예를 나타낸다.

도 14 및 도 15는 본 발명의 제3 실시예에 따라 무선 전력 송수신을 위한 코일과 근거리 통신용 코일을 결합한 예를 나타낸다.

도 16 및 도 17은 본 발명의 제4 실시예에 따라 무선 전력 송수신을 위한 코일과 근거리 통신용 코일을 결합한 예를 나타낸다.

발명을 실시하기 위한 구체적인 내용

- [0024] 본 명세서에서 사용되는 기술적 용어는 단지 특정한 실시 예를 설명하기 위해 사용된 것으로, 본 발명을 한정하려는 의도가 아님을 유의해야 한다. 또한, 본 명세서에서 사용되는 기술적 용어는 본 명세서에서 특별히 다른 의미로 정의되지 않는 한, 본 발명이 속하는 기술 분야에서 통상의 지식을 가진 자에 의해 일반적으로 이해되는 의미로 해석되어야 하며, 과도하게 포괄적인 의미로 해석되거나, 과도하게 축소된 의미로 해석되지 않아야 한다. 또한, 본 명세서에서 사용되는 기술적인 용어가 본 발명의 사상을 정확하게 표현하지 못하는 잘못된 기술적 용어일 때에는, 당업자가 올바르게 이해할 수 있는 기술적 용어로 대체되어 이해되어야 할 것이다. 또한, 본 발명에서 사용되는 일반적인 용어는 사전에 정의되어 있는 바에 따라, 또는 전후 문맥상에 따라 해석되어야 하며, 과도하게 축소된 의미로 해석되지 않아야 한다.
- [0025] 또한, 본 명세서에서 사용되는 단수의 표현은 문맥상 명백하게 다르게 뜻하지 않는 한, 복수의 표현을 포함한다. 본 출원에서, "구성된다" 또는 "포함한다" 등의 용어는 명세서 상에 기재된 여러 구성 요소들, 또는 여러 단계들을 반드시 모두 포함하는 것으로 해석되지 않아야 하며, 그 중 일부 구성 요소들 또는 일부 단계들은 포함되지 않을 수도 있고, 또는 추가적인 구성 요소 또는 단계들을 더 포함할 수 있는 것으로 해석되어야 한다.
- [0026] 또한, 또한, 본 명세서에서 사용되는 구성요소에 대한 접미사 "모듈" 및 "부"는 명세서 작성의 용이함만이 고려되어 부여되거나 혼용되는 것으로서, 그 자체로 서로 구별되는 의미 또는 역할을 갖는 것은 아니다.
- [0027] 또한, 본 명세서에서 사용되는 제1, 제2 등과 같이 서수를 포함하는 용어는 다양한 구성 요소들을 설명하는데 사용될 수 있지만, 상기 구성 요소들은 상기 용어들에 의해 한정되어서는 안 된다. 상기 용어들은 하나의 구성 요소를 다른 구성요소로부터 구별하는 목적으로만 사용된다. 예를 들어, 본 발명의 권리 범위를 벗어나지 않으면서 제1 구성요소는 제2 구성 요소로 명명될 수 있고, 유사하게 제2 구성 요소도 제1 구성 요소로 명명될 수 있다.
- [0028] 이하, 첨부된 도면을 참조하여 본 발명에 따른 바람직한 실시 예를 상세히 설명하되, 도면 부호에 관계없이 동일하거나 유사한 구성 요소는 동일한 참조 번호를 부여하고 이에 대한 중복되는 설명은 생략하기로 한다.
- [0029] 또한, 본 발명을 설명함에 있어서 관련된 공지 기술에 대한 구체적인 설명이 본 발명의 요지를 흐릴 수 있다고 판단되는 경우 그 상세한 설명을 생략한다. 또한, 첨부된 도면은 본 발명의 사상을 쉽게 이해할 수 있도록 하기 위한 것일 뿐, 첨부된 도면에 의해 본 발명의 사상이 제한되는 것으로 해석되어서는 아니 됨을 유의해야 한다.
- [0030] 도 1은 본 발명의 실시 예들에 따른 무선 전력 전송장치 및 전자 기기를 개념적으로 나타낸 예시도이다.

- [0031] 도 1을 참조하여 알 수 있는 바와 같이, 상기 무선 전력 전송장치(100)는 상기 전자 기기(200)가 필요로 하는 무선으로 전력을 전달하는 전력 전달 장치일 수 있다.
- [0032] 또한, 상기 무선 전력 전송장치(100)는 무선으로 전력을 전달함으로써 상기 전자 기기(200)의 배터리를 충전하는 무선 충전 장치일 수 있다. 상기 무선 전력 전송장치(100)가 무선 충전 장치일 경우에는 도 6를 참조하여 후술하기로 한다.
- [0033] 그 밖에도, 상기 무선 전력 전송장치(100)는 접촉되지 않은 상태에서 전원이 필요한 전자 기기(200)에게 전력을 전달하는 여러 가지 형태의 장치로 구현될 수 있다.
- [0034] 상기 전자 기기(200)는 상기 무선 전력 전송장치(100)로부터 무선으로 전력을 수신하여 동작이 가능한 기기이다. 또한, 상기 전자 기기(200)는 상기 수신된 무선 전력을 이용하여 배터리를 충전할 수 있다.
- [0035] 한편, 본 명세서에서 설명되는 무선으로 전력을 수신하는 전자 기기는 휴대가 가능한 모든 전자 기기, 예컨대 키보드, 마우스, 영상 또는 음성의 보조 출력장치 등의 입력장치들을 비롯하여, 휴대폰, 셀룰러폰, 스마트 폰(smart phone), PDA(Personal Digital Assistants), PMP(Portable Multimedia Player)와, 태블릿, 혹은 멀티미디어 기기 등을 포괄하는 의미로 해석되어야 한다.
- [0036] 상기 전자 기기(200)는, 후술하는 바와 같이, 이동 통신 단말기(예컨대 휴대폰, 셀룰러폰, 태블릿) 또는 멀티미디어 기기일 수 있다. 상기 전자 기기가 이동단말기일 경우에는 도 7을 참조하여 후술하기로 한다.
- [0037] 한편, 상기 무선 전력 전송장치(100)는 하나 이상의 무선 전력 전달 방법을 이용하여 상기 전자 기기(200)로 상호간 접촉이 없이 무선으로 전력을 전달할 수 있다. 즉, 상기 무선 전력 전송장치(100)는 상기 무선 전력 신호에 의한 전자기 유도 현상에 기초한 유도 결합(Inductive Coupling) 방식과 특정한 주파수의 무선 전력 신호에 의한 전자기적 공진 현상에 기초한 공진 결합(Electromagnetic Resonance Coupling) 방식 중 하나 이상을 이용하여 전력을 전달할 수 있다.
- [0038] 상기 유도 결합 방식에 의한 무선 전력 송신은 1차 코일 및 2차 코일을 이용하여 전력을 무선으로 전송하는 기술로, 전자기 유도 현상에 의하여 하나의 코일에서 변화하는 자기장 통해 다른 코일 쪽에 전류가 유도됨으로써 전력이 전달되는 것을 말한다.
- [0039] 상기 공진 결합 방식에 의한 무선 전력 송신은 상기 무선 전력 전송장치(100)에서 전송한 무선 전력 신호에 의하여 상기 전자 기기(200)에서 공진이 발생하고, 상기 공진 현상에 의하여 상기 무선 전력 전송장치(100)로부터 상기 전자 기기(200)로 전력이 전달되는 것을 말한다.
- [0040] 이하에서는 본 명세서에 개시된 무선 전력 전송장치(100) 및 전자 기기(200)에 관한 실시 예들을 구체적으로 설명한다. 하기의 각 도면의 구성 요소들에 참조 부호를 부가함에 있어서, 동일한 구성 요소들에 한해서는 비록 다른 도면상에 표시되더라도 가능한 한 동일한 부호를 사용한다.
- [0041] 도 2는 본 명세서에 개시된 실시 예들에서 채용 가능한 무선 전력 전송장치(100) 및 전자 기기(200)의 구성을 예시적으로 나타낸 블록도이다.
- [0042] 도 2의 (a)를 참조하면, 상기 무선 전력 전송장치(100)는 전력 전달부(Power Transmission Unit)(110)를 포함하도록 구성된다. 상기 전력 전달부(110)는 전력 변환부(Power Conversion Unit)(111) 및 전력 송신 제어부(Power Transmission Control Unit)(112)를 포함하여 구성될 수 있다.
- [0043] 상기 전력 변환부(111)는 송신측 전원 공급부(190)로부터 공급된 전력을 무선 전력 신호(wireless power signal)로 변환하여 상기 전자 기기(200)로 전달한다. 상기 전력 변환부(111)에 의하여 전달되는 무선 전력 신호는 진동(oscillation)하는 특성을 가진 자기장(magnetic field) 또는 전자기장(electro-magnetic field)의 형태로 형성된다. 이를 위하여 상기 전력 변환부(111)는 상기 무선 전력 신호가 발생하는 코일을 포함하도록 구성될 수 있다.
- [0044] 상기 전력 변환부(111)는 각 전력 전달 방식에 따라 다른 형태의 무선 전력 신호를 형성하기 위한 구성 요소를 포함할 수 있다. 예를 들어, 상기 전력 변환부(111)는 유도 결합 방식에 따라 상기 전자 기기(200)의 2차 코일에 전류를 유도시키기 위하여 변화하는 자기장을 형성시키는 1차 코일을 포함하도록 구성될 수 있다. 또한, 상

기 전력 변환부(111)는 공진 결합 방식에 따라 상기 전자 기기(200)에 공진 현상을 발생시키기 위하여 특정 공진 주파수를 가진 전자기장을 형성시키는 코일(또는 안테나)를 포함하도록 구성될 수 있다.

[0045] 또한, 상기 전력 변환부(111)는 전송된 유도 결합 방식과 공진 결합 방식 중 하나 이상의 방법을 이용하여 전력을 전달할 수 있다.

[0046] 상기 전력 변환부(111)에 포함되는 구성 요소들 중 유도 결합 방식을 따르는 것들에 대하여는 도 4 및 도 5를 참조하여 후술된다. 공진 결합 방식을 따르는 것들에 대하여는 본 발명의 핵심 내용과 아주 밀접한 관련이 없는 바, 상세하게 설명하지 않기로 한다.

[0047] 한편, 상기 전력 변환부(111)는 상기 무선 전력 신호를 형성시키기 위해 사용되는 주파수, 인가되는 전압, 전류 등의 특성을 조절할 수 있는 회로를 더 포함하도록 구성될 수 있다.

[0048] 상기 전력 송신 제어부(112)는 상기 전력 전달부(110)에 포함되는 각 구성요소를 제어한다. 상기 전력 송신 제어부(112)는 상기 무선 전력 공급 장치(100)를 제어하는 다른 제어부(미도시)와 통합되도록 구현될 수 있다.

[0049] 한편, 상기 무선 전력 신호가 도달할 수 있는 영역은 두 가지로 구분될 수 있다. 먼저, 활동 영역(active area)은 상기 전자 기기(200)로 전력을 전달하는 무선 전력 신호가 통과하는 영역을 말한다. 다음으로, 감지 영역(semi-active area)은 상기 무선 전력 전송장치(100)가 상기 전자 기기(200)의 존재를 감지할 수 있는 관심 영역을 말한다. 여기서, 상기 전력 송신 제어부(112)는 상기 전자 기기(200)가 상기 활동 영역 또는 감지 영역에 배치(placement)되거나 제거(removal)되었는지 여부에 대하여 감지할 수 있다. 구체적으로, 상기 전력 송신 제어부(112)는 상기 전력 변환부(111)에서 형성되는 무선 전력 신호를 이용하거나, 별도로 구비된 센서에 의하여 상기 전자 기기(200)가 상기 활동 영역 또는 감지 영역에 배치되었는지 여부를 검출할 수 있다. 예컨대, 상기 전력 송신 제어부(112)는 상기 감지 영역에 존재하는 상기 전자 기기(200)로 인하여 상기 무선 전력 신호가 영향을 받아, 상기 전력 변환부(111)의 상기 무선 전력 신호를 형성하기 위한 전력의 특성이 변화하는지 여부를 모니터링함으로써 상기 전자 기기(200)의 존재를 검출할 수 있다. 다만, 상기 활동 영역 및 감지 영역은 유도 결합 방식 및 공진 결합 방식 등의 무선 전력 전달방식에 따라 다를 수 있다.

[0050] 상기 전력 송신 제어부(112)는 상기 전자 기기(200)의 존재를 검출한 결과에 따라 상기 전자 기기(200)를 식별하는 과정을 수행하거나, 무선 전력 전송을 시작할 것인지 여부를 결정할 수 있다.

[0051] 또한, 상기 전력 송신 제어부(112)는 상기 무선 전력 신호를 형성하기 위한 상기 전력 변환부(111)의 주파수, 전압, 전류 중 하나 이상의 특성을 결정할 수 있다. 상기 특성의 결정은 상기 무선 전력 전송장치(100) 측의 조건에 의하여 또는 상기 전자 기기(200) 측의 조건에 의하여 이루어질 수 있다.

[0052] 상기 전력 송신 제어부(112)는 상기 전자 기기(200)로부터 전력 제어 메시지를 수신할 수 있다. 상기 전력 송신 제어부(112)는 상기 수신된 전력 제어 메시지를 기초로 상기 전력 변환부(111)의 주파수, 전압, 전류 중 하나 이상의 특성을 결정할 수 있으며, 그 밖에 상기 전력 제어 메시지를 기초로 다른 제어 동작을 수행할 수 있다.

[0053] 예를 들어, 상기 전력 송신 제어부(112)는 상기 전자 기기(200)의 정류된 전력량 정보, 충전 상태 정보 및 식별 정보 중 하나 이상을 포함하는 전력 제어 메시지에 따라 상기 무선 전력 신호를 형성시키기 위해 사용되는 주파수, 전류, 전압 중 하나 이상의 특성을 결정할 수 있다.

[0054] 또한, 상기 전력 제어 메시지를 이용하는 그 밖의 다른 제어 동작으로서, 상기 무선 전력 전송장치(100)는 무선 전력 전달과 관련된 일반적인 제어 동작을 상기 전력 제어 메시지를 기초로 수행할 수 있다. 예를 들어, 상기 무선 전력 전송장치(100)는 상기 전력 제어 메시지를 통하여 상기 전자 기기(200)와 관련된 청각적 또는 시각적으로 출력할 정보를 수신하거나, 기기간의 인증 등에 필요한 정보를 수신할 수도 있다.

[0055] 이와 같은 상기 전력 제어 메시지를 수신하기 위하여, 상기 전력 송신 제어부(112)는 상기 무선 전력 신호를 통하여 수신하는 방법 및 그 외의 사용자 데이터를 수신하는 방법 중 적어도 하나를 이용할 수 있다.

[0056] 상기 전력 제어 메시지를 수신하기 위하여, 상기 무선 전력 전송장치(100)는 상기 전력 변환부(111)와 전기적으로 연결된 변복조부(Power Communications Modulation/Demodulation Unit)(113)를 더 포함하도록 구성될 수 있다. 상기 변복조부(113)는 상기 전자 기기(200)에 의하여 변조된 무선 전력 신호를 복조하여 상기 전력 제어 메시지를 수신하기 위하여 사용될 수 있다.

- [0057] 그 밖에, 상기 전력 송신 제어부(112)는 상기 무선 전력 전송장치(100)에 포함되어 있는 통신 수단(미도시)에 의하여 전력 제어 메시지가 포함되어 있는 사용자 데이터를 수신함으로써 전력 제어 메시지를 획득할 수도 있다.
- [0058] 한편, 도 2의 (b)를 참조하면, 상기 전자 기기는(200)는 전원 공급부(290)를 포함하도록 구성된다. 상기 전원 공급부(290)는 상기 전자 기기(200)의 작동에 필요한 전력을 공급한다. 상기 전원 공급부(290)는 전력 수신부(291) 및 전력 수신 제어부(292)를 포함하여 구성될 수 있다.
- [0059] 상기 전력 수신부(291)는 상기 무선 전력 전송장치(100)로부터 무선으로 전달되는 전력을 수신한다.
- [0060] 상기 전력 수신부(291)는 무선 전력 전달 방식에 따라 상기 무선 전력 신호를 수신하기 위해 필요한 구성 요소를 포함할 수 있다. 또한, 상기 전력 수신부(291)는 하나 이상의 무선 전력 전달 방식에 따라 전력을 수신할 수 있으며, 이 경우 상기 전력 수신부(291)는 각 방식에 따라 필요한 서로 구성 요소들을 함께 포함할 수 있다.
- [0061] 먼저, 상기 전력 수신부(291)는 진동하는 특성을 가진 자기장 또는 전자기장의 형태로 전달되는 무선 전력 신호를 수신하기 위한 코일을 포함하도록 구성될 수 있다.
- [0062] 예컨대, 유도 결합 방식에 따른 구성 요소로서, 상기 전력 수신부(291)는 변화되는 자기장에 의하여 전류가 유도되는 2차 코일을 포함할 수 있다. 또한, 상기 전력 수신부(291)는 공진 결합 방식에 따른 구성 요소로서 특정 공진 주파수를 가진 전자기장에 의하여 공진 현상이 발생하는 코일 및 공진 회로를 포함할 수 있다.
- [0063] 다만, 상기 전력 수신부(291)가 하나 이상의 무선 전력 전달 방식에 따라 전력을 수신하는 경우, 상기 전력 수신부(291)는 하나의 코일을 이용하여 수신하도록 구현되거나, 또는 각 전력 전달 방식에 따라 다르게 형성된 코일을 이용하여 수신하도록 구현될 수 있다.
- [0064] 상기 전력 수신부(291)에 포함되는 구성 요소들 중 유도 결합 방식을 따르는 것들에 대하여는 도 4를 참조하여 후술된다.
- [0065] 한편, 상기 전력 수신부(291)는 상기 무선 전력 신호를 직류로 변환하기 위한 정류 회로(rectifier) 및 평활 회로(regulator)를 더 포함할 수 있다. 또한, 상기 전력 수신부(291)는 수신된 전력 신호에 의하여 과전압 또는 과전류가 발생하지 않도록 방지하는 회로를 더 포함할 수 있다.
- [0066] 상기 전력 수신 제어부(292)는 상기 전원 공급부(290)에 포함되는 각 구성요소를 제어한다.
- [0067] 구체적으로, 상기 전력 수신 제어부(292)는 상기 무선 전력 전송장치(100)로 전력 제어 메시지를 전달할 수 있다. 상기 전력 제어 메시지는 상기 무선 전력 전송장치(100)에게 무선 전력 신호의 전달을 개시하거나 종료하도록 지시하는 것일 수 있다. 또한 상기 전력 제어 메시지는 상기 무선 전력 전송장치(100)에게 상기 무선 전력 신호의 특성을 조절하도록 지시하는 것일 수 있다.
- [0068] 이와 같은 상기 전력 제어 메시지를 전송하기 위하여, 상기 전력 수신 제어부(292)는 상기 무선 전력 신호를 통하여 전송하는 방법 및 그 외의 사용자 데이터를 통하여 전송하는 방법 중 적어도 하나를 이용할 수 있다.
- [0069] 상기 전력 제어 메시지를 전송하기 위하여, 상기 전자 기기(200)는 상기 전력 수신부(291)와 전기적으로 연결된 변복조부(Power Communications Modulation/Demodulation Unit)(293)를 더 포함하도록 구성될 수 있다. 상기 변복조부(293)는, 전송된 상기 무선 전력 전송장치(100)의 경우와 마찬가지로, 상기 무선 전력 신호를 통하여 상기 전력 제어 메시지를 전송하기 위하여 사용될 수 있다. 상기 변복조부(293)는 상기 무선 전력 송신장치(100)의 전력 변환부(111)를 흐르는 전류 및/또는 전압을 조절하는 수단으로 사용될 수 있다. 이하, 상기 무선 전력 전송장치(100) 측과 상기 전자 기기(200) 측의 각각의 변복조부(113 및 293)가 무선 전력 신호를 통한 전력 제어 메시지의 송수신을 위하여 사용되는 방법에 대하여 설명된다.
- [0070] 상기 전력 변환부(111)에 의하여 형성된 무선 전력 신호는 상기 전력 수신부(291)에 의하여 수신된다. 이때, 상기 전력 수신 제어부(292)는 상기 무선 전력 신호를 변조(modulation)하도록 상기 전자 기기(200) 측의 변복조부(293)를 제어한다. 예컨대, 상기 전력 수신 제어부(292)는 상기 전력 수신부(291)과 연결된 변복조부(293)의 리액턴스(reactance)를 변경시킴으로써 상기 무선 전력 신호로부터 수신하는 전력량이 그에 따라 변화도록 변조

과정을 수행할 수 있다. 상기 무선 전력 신호로부터 수신되는 전력량의 변경은 상기 무선 전력 신호를 형성시키는 상기 전력 변환부(111)의 전류 및/또는 전압의 변경을 가져온다. 이 때, 상기 무선 전력 전송장치(100) 측의 변복조부(113)는 상기 전력 변환부(111)의 전류 및/또는 전압의 변경을 감지하여 복조(demodulation) 과정을 수행한다.

[0071] 즉, 상기 전력 수신 제어부(292)는 상기 무선 전력 전송장치(100)에게 전달하고자 하는 전력 제어 메시지를 포함하는 패킷(packet)을 생성하여 상기 패킷이 포함되도록 상기 무선 전력 신호를 변조하고, 상기 전력 송신 제어부(112)는 상기 변복조부(113)의 복조 과정 수행 결과를 기초로 상기 패킷을 디코드함으로써, 상기 패킷에 포함되어 있는 상기 전력 제어 메시지를 획득할 수 있다.

[0072] 그 밖에, 상기 전력 수신 제어부(292)는 상기 전자 기기(200)에 포함되어 있는 통신 수단(미도시)에 의하여 전력 제어 메시지가 포함되어 있는 사용자 데이터를 전송함으로써 전력 제어 메시지를 상기 무선 전력 전송장치(100)로 전송할 수도 있다.

[0073] 그 밖에, 상기 전원 공급부(290)는 충전부(298) 및 배터리(299)를 더 포함하도록 구성될 수 있다.

[0074] 상기 전원 공급부(290)로부터 동작을 위한 전원을 공급받는 상기 전자 기기(200)는 상기 무선 전력 전송장치(100)로부터 전달된 전력에 의하여 동작하거나, 또는 상기 전달된 전력을 이용하여 상기 배터리(299)를 충전한 후 상기 배터리(299)에 충전된 전력에 의하여 동작할 수 있다. 이때, 상기 전력 수신 제어부(292)는 상기 전달된 전력을 이용하여 충전을 수행하도록 상기 충전부(298)를 제어할 수 있다.

[0075] 이하에서, 본 명세서에 개시된 실시 예들에 적용 가능한 무선 전력 전송장치 및 전자 기기에 대하여 설명된다. 먼저, 도 3 내지 도 5를 참조하여 상기 무선 전력 전송장치가 상기 전자 기기로 유도 결합 방식에 따라 전력을 전달하는 방법이 개시된다.

[0076] 도 3은 유도 결합 방식에 따라 무선 전력 전송장치로부터 전자 기기에 무선으로 전력이 전달되는 개념을 도시한다.

[0077] 무선 전력 전송장치(100)의 전력 전달이 유도 결합 방식을 따르는 경우, 상기 전력 전달부(110) 내의 1차 코일(primary coil)에 흐르는 전류의 세기가 변화되면, 그 전류에 의해 1차 코일을 통과하는 자기장이 변화한다. 이와 같이 변화된 자기장은 상기 전자 기기(200) 내의 2차 코일(secondary coil) 측에 유도 기전력을 발생시킨다.

[0078] 이 방식에 따르면, 상기 무선 전력 전송장치(100)의 상기 전력 변환부(111)는 자기 유도에서의 1차 코일로 동작하는 전송 코일(Tx coil)(1111a)을 포함하도록 구성된다. 또한 상기 전자 기기(200)의 상기 전력 수신부(291)는 자기 유도에서의 2차 코일로 동작하는 수신 코일(Rx coil)(2911a)을 포함하도록 구성된다.

[0079] 먼저, 상기 무선 전력 전송장치(100) 측의 상기 전송 코일(1111a)과 상기 전자 기기(200) 측의 수신 코일이 근접하도록 상기 무선 전력 전송장치(100) 및 상기 전자 기기(200)를 배치한다. 그 후 상기 전력 송신 제어부(112)가 상기 전송 코일(1111a)의 전류가 변화되도록 제어하면, 상기 전력 수신부(291)는 상기 수신 코일(2911a)에 유도된 기전력을 이용하여 상기 전자 기기(200)에 전원을 공급하도록 제어한다.

[0080] 상기 유도 결합 방식에 의한 무선 전력 전달의 효율은, 주파수 특성에 따른 영향은 적으나, 각 코일을 포함하는 상기 무선 전력 전송장치(100) 및 상기 전자 기기(200) 사이의 배열(alignment) 및 거리(distance)의 영향을 받게 된다.

[0081] 한편, 유도 결합 방식에 의한 무선 전력 전달을 위하여 상기 무선 전력 전송장치(100)는 평평한 표면(flat surface) 형태의 인터페이스 표면(interface surface)(미도시)을 포함하도록 구성될 수 있다. 상기 인터페이스 표면의 상부에는 하나 이상의 전자 기기가 놓일 수 있으며, 상기 인터페이스 표면의 하부에는 상기 전송 코일(1111a)이 장착될 수 있다. 그 경우, 상기 인터페이스 표면의 하부에는 장착된 상기 전송 코일(1111a)과 상기 인터페이스 표면의 상부에 위치한 전자기기(200)의 수신 코일(2911a) 사이의 수직 공간(vertical spacing)이 작게 형성됨으로써 상기 코일들 간의 거리는 유도 결합 방식에 의한 무선 전력 전달이 효율적으로 이루어질 수 있도록 충분히 작게 된다.

- [0082] 또한, 상기 인터페이스 표면의 상부에는 상기 전자 기기(200)가 놓일 위치를 지시하는 배열 지시부(미도시)가 형성될 수 있다. 상기 배열 지시부는 상기 인터페이스 표면의 하부에 장착된 전송 코일(1111a)과 상기 수신 코일(2911a) 사이의 배열이 적합하게 이루어질 수 있는 상기 전자 기기(200)의 위치를 지시한다. 상기 배열 지시부는 단순한 표시(marks)이거나, 상기 전자 기기(200)의 위치를 가이드하는 돌출 구조의 형태로 형성될 수 있다. 또는 상기 배열 지시부는 상기 인터페이스 표면의 하부에 장착되는 자석과 같은 자성체의 형태로 형성되어, 상기 전자 기기(200) 내부에 장착된 다른 극의 자성체와의 상호간 인력에 의하여 상기 코일들이 적합한 배열을 이루도록 가이드할 수도 있다.
- [0083] 한편, 상기 무선 전력 전송장치(100)는 하나 이상의 전송 코일을 포함하도록 형성될 수 있다. 상기 무선 전력 전송장치(100)는 상기 하나 이상의 전송 코일 중에서 상기 전자 기기(200)의 수신 코일(2911a)과 적합하게 배열된 일부의 코일을 선택적으로 이용하여 전력 전송 효율을 높일 수 있다. 상기 하나 이상의 전송 코일을 포함하는 무선 전력 전송장치(100)에 관하여 도 5를 참조하여 후술된다.
- [0084] 이하에서는, 본 명세서에 개시된 실시 예들에 적용 가능한 유도 결합 방식의 무선 전력 전송장치 및 전자 기기의 구성에 대하여 구체적으로 설명된다.
- [0085] 도 4는 본 명세서에 개시된 실시 예들에서 채용 가능한 전자기 유도 방식의 무선 전력 전송장치(100) 및 전자 기기(200)의 구성의 일부를 예시적으로 나타낸 블록도이다. 도 4의 (a)를 참조하여 상기 무선 전력 전송장치(100)에 포함된 상기 전력 전달부(110)의 구성에 대하여 설명하고, 도 4의 (b)를 참조하여 상기 전자 기기(200)에 포함된 상기 전원 공급부(290)의 구성에 대하여 설명한다.
- [0086] 도 4의 (a)를 참조하면, 상기 무선 전력 전송장치(100)의 상기 전력 변환부(111)는 전송 코일(Tx coil)(1111a) 및 인버터(1112)를 포함하도록 구성될 수 있다.
- [0087] 상기 전송 코일(1111a)은, 전술된 바와 같이, 전류의 변화에 따라 무선 전력 신호에 해당하는 자기장을 형성한다. 상기 전송 코일(1111a)은 평판 나선형태(Planar Spiral type) 또는 원통형 솔레노이드 형태(Cylindrical Solenoid type)로 구현될 수 있다.
- [0088] 상기 인버터(1112)는 상기 전원 공급부(190)로부터 얻은 직류 입력(DC input)을 교류 파형(AC waveform)으로 변형시킨다. 상기 인버터(1112)에 의해 변형된 교류 전류는 상기 전송 코일(1111a) 및 커패시터(capacitor)(미도시)를 포함하는 진동 회로(resonant circuit)를 구동시킴으로써 자기장이 상기 전송 코일(1111a)에서 형성된다.
- [0089] 그 밖에, 상기 전력 변환부(111)는 위치 결정부(Positioning Unit)(1114)를 더 포함하도록 구성될 수 있다.
- [0090] 상기 위치 결정부(1114)는 상기 유도 결합 방식에 의한 무선 전력 전달의 효율을 높이기 위하여 상기 전송 코일(1111a)을 이동 또는 회전시킬 수 있다. 이는, 전술된 바와 같이, 유도 결합 방식에 의한 전력 전달은 1차 및 2차 코일을 포함하는 상기 무선 전력 전송장치(100) 및 상기 전자 기기(200) 사이의 배열(alignment) 및 거리(distance)의 영향을 받기 때문이다. 특히, 상기 위치 결정부(1114)는 상기 전자 기기(200)가 상기 무선 전력 전송장치(100)의 활동 영역 내에 존재하지 않는 경우에 사용될 수 있다.
- [0091] 따라서, 상기 위치 결정부(1114)는 상기 무선 전력 전송장치(100)의 상기 전송 코일(1111a)과 및 상기 전자 기기(200)의 상기 수신 코일(2911a)의 중심간 거리(distance)가 일정 범위 이내가 되도록 상기 전송 코일(1111a)을 이동시키거나, 상기 전송 코일(1111a)과 상기 수신 코일(2911a)의 중심이 중첩되도록 상기 전송 코일(1111a)을 회전시키는 구동부(미도시)를 포함하도록 구성될 수 있다.
- [0092] 이를 위하여, 상기 무선 전력 전송장치(100)는 상기 전자 기기(200)의 위치를 감지하는 센서로 이루어진 위치 감지부(detection unit)(미도시)를 더 구비할 수 있고, 상기 전력 송신 제어부(112)는 상기 위치 감지 센서로부터 수신한 상기 전자 기기(200)의 위치 정보를 기초로 상기 위치 결정부(1114)를 제어할 수 있다.
- [0093] 또한, 이를 위하여 상기 전력 송신 제어부(112)는 상기 변복조부(113)를 통하여 상기 전자 기기(200)와의 배열 또는 거리에 대한 제어 정보를 수신하고, 상기 수신된 배열 또는 거리에 대한 제어 정보를 기초로 상기 위치 결

정부(1114)를 제어할 수 있다.

- [0094] 만약, 상기 전력 변환부(111)가 복수의 전송 코일을 포함하도록 구성되었다면, 상기 위치 결정부(1114)는 상기 복수의 전송 코일 중에서 어느 것이 전력 전달을 위하여 사용될 것인지 결정할 수 있다. 상기 복수의 전송 코일을 포함한 무선 전력 전송장치(100)의 구성에 대해서는 도 5를 참조하여 후술된다.
- [0095] 한편, 상기 전력 변환부(111)는 전력 센싱부(1115)를 더 포함하도록 구성될 수 있다. 상기 무선 전력 전송장치(100) 측의 전력 센싱부(1115)는 상기 전송 코일(1111a)에 흐르는 전류 또는 전압을 모니터링한다. 상기 전력 센싱부(1115)는 무선 전력 전송장치(100)의 정상동작 여부를 확인하기 위한 것으로, 외부로부터 공급되는 전원의 전압 또는 전류를 검출하고, 상기 검출된 전압 또는 전류가 임계값을 초과하는지를 확인할 수 있다. 상기 전력 센싱부(1115)는, 도시되지 않았으나, 외부로부터 공급되는 전원의 전압 또는 전류를 검출하기 위한 저항과 상기 검출된 전원의 전압값 또는 전류값과 임계값을 비교하여 그 비교 결과를 출력하는 비교기를 포함할 수 있다. 상기 전력 센싱부(1115)의 상기 확인 결과를 기초로, 상기 전력 송신 제어부(112)는 스위칭부(미도시)를 제어하여 상기 전송 코일(1111a)로 인가되는 전원을 차단할 수 있다.
- [0096] 도 4의 (b)를 참조하면, 상기 전자 기기(200)의 상기 전원 공급부(290)는 수신 코일(Rx 코일)(2911a) 및 정류 회로(2913)를 포함하도록 구성될 수 있다.
- [0097] 상기 전송 코일(1111a)로부터 형성된 자기장에 변화에 의하여 상기 수신 코일(2911a)에서 전류가 유도된다. 상기 수신 코일(2911a)의 구현 형태는, 상기 전송 코일(1111a)의 경우와 마찬가지로, 평판 나선 형태 또는 원통형 솔레노이드 형태일 수 있다.
- [0098] 또한, 무선 전력의 수신 효율을 높이거나 공진 감지(resonant detection)를 위해 직/병렬 커패시터들(series and parallel capacitors)이 상기 수신 코일(2911a)과 연결되도록 구성될 수 있다.
- [0099] 상기 수신 코일(2911a)은 단일 코일 또는 복수의 코일 형태일 수 있다.
- [0100] 상기 정류 회로(2913)는 교류를 직류로 변환시키기 위하여 전류에 대하여 전파 정류(full-wave rectification)를 수행한다. 상기 정류 회로(2913)는, 예컨대, 4개의 다이오드로 이루어진 브릿지(full bridge) 정류 회로, 또는 능동 소자(active components)를 이용한 회로로 구현될 수 있다.
- [0101] 그 밖에, 상기 정류 회로(2913)는 정류된 전류를 보다 평탄하고 안정적인 직류로 만들어 주는 평활 회로(regulator)를 더 포함할 수 있다. 또한, 상기 정류 회로(2913)의 출력 전원은 상기 전원 공급부(290)의 각 구성 요소들에게 공급된다. 또한, 상기 정류 회로(2913)은 출력되는 직류 전원을 상기 전원 공급부(290)의 각 구성 요소(예컨대, 충전부(298)와 같은 회로)에 필요한 전원에 맞추기 위하여 적절한 전압으로 변환하는 직류-직류 변환기(DC-DC converter)를 더 포함할 수 있다.
- [0102] 상기 변복조부(293)는 상기 전력 수신부(291)과 연결되고, 직류 전류에 대해서는 저항(resistance)이 변하는 저항성 소자로 구성될 수 있고, 교류 전류에 대해서는 리액턴스(reactance)가 변하는 용량성 소자로 구성될 수 있다. 상기 전력 수신 제어부(292)는 상기 변복조부(293)의 저항 또는 리액턴스를 변경시킴으로써 상기 전력 수신부(291)에 수신되는 무선 전력 신호를 변조할 수 있다.
- [0103] 한편, 상기 전원 공급부(290)는 전력 센싱부(2914)를 더 포함하도록 구성될 수 있다. 상기 전자 기기(200) 측의 전력 센싱부(2914)는 상기 정류 회로(2913)에 의하여 정류된 전원의 전압 및/또는 전류를 모니터링하고, 상기 모니터링 결과 상기 정류된 전원의 전압 및/또는 전류가 임계값을 초과하는 경우 상기 전력 수신 제어부(292)는 적절한 전력을 전달하도록 상기 무선 전력 전송장치(100)에게 전력 제어 메시지를 송신한다.
- [0104] 도 5는 본 명세서에 개시된 실시 예들에서 채용 가능한 유도 결합 방식에 따라 전력을 수신하는 하나 이상의 전송 코일들을 가지도록 구성된 무선 전력 전송장치의 블록도이다.
- [0105] 도 5를 참조하면, 본 명세서에 개시된 실시 예들을 따르는 무선 전력 전송장치(100)의 전력 변환부(111)는 하나 이상의 전송 코일들(1111a-1 내지 1111a-n)로 구성될 수 있다. 상기 하나 이상의 전송 코일들(1111a-1 내지 1111a-n)은 부분적으로 겹치는 1차 코일들의 배열(an array of partly overlapping primary coils)일 수 있다. 상기 하나 이상의 전송 코일들 중 일부에 의하여 활동 영역이 결정될 수 있다.
- [0106] 상기 하나 이상의 전송 코일들(1111a-1 내지 1111a-n)은 상기 인터페이스 표면의 하부에 장착될 수 있다. 또한, 상기 전력 변환부(111)는 상기 하나 이상의 전송 코일들(1111a-1 내지 1111a-n) 중 일부의 코일들의 연결을 수렴하고 해제하는 다중화기(Multiplexer)(1113)를 더 포함할 수 있다.

- [0107] 상기 인터페이스 표면의 상부에 놓인 전자 기기(200)의 위치가 감지되면, 상기 전력 송신 제어부(112)는 상기 전자 기기(200)의 감지된 위치를 고려하여 상기 하나 이상의 전송 코일들(111a-1 내지 111a-n) 중 상기 전자 기기(200)의 수신 코일(2911a)과 유도 결합 관계에 놓일 수 있는 코일들이 연결될 수 있도록 상기 다중화기(1113)를 제어할 수 있다.
- [0108] 이를 위하여 상기 전력 송신 제어부(112)가 상기 전자 기기(200)의 위치 정보를 획득할 수 있다. 예를 들어, 상기 전력 송신 제어부(112)는 상기 무선 전력 전송장치(100)에 구비된 상기 위치 감지부(미도시)에 의하여 상기 인터페이스 표면 상의 상기 전자 기기(200)의 위치를 획득할 수 있다. 또 다른 예를 들어, 상기 전력 송신 제어부(112)는 상기 하나 이상의 전송 코일들(111a-1 내지 111a-n)을 각각 이용하여 상기 인터페이스 표면 상의 물체로부터 무선 전력 신호의 강도를 나타내는 전력 제어 메시지 또는 상기 물체의 식별 정보를 나타내는 전력 제어 메시지를 수신하고, 상기 수신된 결과를 기초로 상기 하나 이상의 전송 코일들 중 어느 코일의 위치와 근접한지를 판단함으로써 상기 전자 기기(200)의 위치 정보를 획득할 수도 있다.
- [0109] 한편, 상기 활동 영역은 상기 인터페이스 표면의 일부로서, 상기 무선 전력 전송장치(100)가 상기 전자 기기(200)에 무선으로 전력을 전달할 때 높은 효율의 자기장이 통과할 수 있는 부분을 의미할 수 있다. 이 때, 상기 활동 영역을 통과하는 자기장을 형성시키는 단일 전송 코일 또는 하나 이상의 전송 코일들의 조합을 주요 셀(primary cell)로 지칭할 수 있다. 따라서, 상기 전력 송신 제어부(112)는 상기 전자 기기(200)의 감지된 위치를 기초로 활동 영역을 결정하고, 상기 활동 영역에 대응되는 주요 셀의 연결을 수립하여 상기 전자 기기(200)의 수신 코일(2911a)와 상기 주요 셀에 속한 코일들이 유도 결합 관계에 놓일 수 있도록 상기 다중화기(1113)를 제어할 수 있다.
- [0110] 또한, 상기 전력 변환부(111)는 연결된 코일들과 진동 회로(resonant circuit)를 형성하도록 임피던스를 조절하는 임피던스 매칭부(impedance matching unit)(미도시)를 더 포함할 수 있다.
- [0111] 한편, 이하에서는 무선 충전기의 형태로 구현된 상기 무선 전력 전송장치의 예가 설명된다.
- [0112] 도 6는 도 2의 (a)에 도시된 구성 외에 추가적인 구성을 더 포함하는 무선 전력 전송장치를 나타낸 블록도이다.
- [0113] 도 6을 참조하여 알 수 있는 바와 같이, 상기 무선 전력 전송장치(100)는 전송된 상기 유도 결합 방식 및 공진 결합 방식 중 하나 이상을 지원하는 전력 전달부(110) 및 전원 공급부(190)외에, 센서부(120), 통신부(130), 출력부(140), 메모리(150) 및 제어부(180)를 더 포함할 수 있다.
- [0114] 상기 제어부(180)는 상기 전력 변환부(110), 상기 센서부(120), 상기 통신부(130), 상기 출력부(140), 상기 메모리(150) 및 상기 전원 공급부(190)를 제어한다.
- [0115] 상기 제어부(180)는 도 2를 참조하여 설명된 상기 전력 변환부(110) 내의 전력 송신 제어부(112)와 별도의 모듈로 구현되거나 단일 모듈로 구현될 수 있다.
- [0116] 상기 센서부(120)는 상기 전자 기기(200)의 위치를 감지하는 센서를 포함하도록 구성될 수 있다. 상기 센서부(120)가 감지한 위치 정보는 상기 전력 변환부(110)가 효율적으로 전력을 전달할 수 있도록 사용될 수 있다.
- [0117] 예컨대, 유도 결합 방식에 의한 무선 전력 전달의 경우, 상기 센서부(120)는 위치 감지부(detection unit)로 동작할 수 있으며, 상기 센서부(120)가 감지한 위치 정보는 상기 전력 변환부(110) 내의 상기 전송 코일(111a)을 이동 또는 회전 시키기 위해 사용될 수 있다.
- [0118] 또한, 예를 들어, 전송된 하나 이상의 전송 코일을 포함하여 이루어진 무선 전력 전송장치(100)는 상기 전자 기기(200)의 위치 정보를 기초로 상기 하나 이상의 전송 코일들 중 상기 전자 기기(200)의 수신 코일과 유도 결합 관계 또는 공진 결합 관계에 놓일 수 있는 코일들을 결정할 수 있다.
- [0119] 한편, 상기 센서부(120)는 상기 전자 기기(200)가 충전이 가능한 영역으로 접근하는지 여부를 모니터링 하도록 구성될 수도 있다. 상기 센서부(120)의 접근 여부 감지 기능은 상기 전력 전달부(110) 내의 전력 송신 제어부(112)가 상기 전자 기기(200)의 접근 여부를 감지하는 기능과 별도로 또는 서로 결합되어 수행될 수 있다.
- [0120] 상기 통신부(130)는 상기 전자 기기(200)와 유무선 데이터 통신을 수행한다. 상기 통신부(130)는 BluetoothTM, 지그비(Zigbee), UWB(Ultra Wide Band), Wireless USB, NFC(Near Field Communication), Wireless LAN 중 어느 하나 이상을 위한 전자 부품을 포함할 수 있다.
- [0121] 상기 통신부(130)는 상기 전자 기기(200)와의 데이터 통신을 수행하기 위하여 상기 전자 기기(200)와 연결될 수

립한다. 상기 통신부(130)가 상기 전자 기기(200)와의 연결을 수립하기 위하여 접속 정보가 필요할 수 있다. 상기 연결을 수립하기 위한 접속 정보는 인증(authentication) 또는 허가(authorization)를 위해 필요한 정보일 수 있다. 상기 접속 정보는 상기 통신부(130)의 물리적(또는 하드웨어) 주소, 논리적(또는 네트워크 상의) 주소, 암호(password) 또는 암호학적인 키(cryptographic key)에 해당할 수 있다.

[0122] 상기 제어부(180)는 상기 전자 기기(200)와의 연결을 수립하기 위하여 필요한 상기 접속 정보를 상기 전자 기기(200)가 변조한 무선 전력 신호에 포함된 전력 제어 메시지를 통하여 수신할 수 있다. 상기 제어부(180)는 상기 수신된 접속 정보를 기초로 상기 전자 기기(200)와 데이터 통신을 위한 연결을 수립할 수 있다.

[0123] 예컨대, 상기 통신부(130)가 Bluetooth[™] 방식으로 통신을 수행하는 경우, 상기 접속 정보는 Bluetooth[™] 주소에 해당할 수 있다. 이 경우 상기 제어부(180)는 전력 제어 메시지를 통하여 상기 Bluetooth[™] 주소를 획득하고 상기 전자 기기(200)와 장치 페어링을 하도록 상기 통신부(130)를 제어할 수 있다. 이후 상기 제어부(180)는 상기 전자 기기(200)와 사용자 데이터를 송수신하기 위한 연결을 수립할 수 있다.

[0124] 예컨대, 상기 통신부(130)가 무선 랜 방식으로 통신을 수행하는 경우, 상기 접속 정보는 SSID(service set identifier), WEP(wired equivalent privacy) 또는 WPA(Wi-Fi protected access)의 인증 정보, 장치의 주소 등에 해당할 수 있다. 이 경우 상기 제어부(180)는 전력 제어 메시지를 통하여 상기 접속 정보를 획득하고 상기 전자 기기(200)와 인증 또는 접속을 수행하도록 상기 통신부(130)를 제어할 수 있다. 이후 상기 제어부(180)는 상기 전자 기기(200)와 사용자 데이터를 송수신하기 위한 연결을 수립할 수 있다.

[0125] 이를 위하여, 상기 제어부(180)는 상기 전자 기기(200)와 연결이 수립되어 있는지 여부를 판단하고, 상기 판단 결과 상기 연결이 수립되어 있지 않고 상기 연결 수립을 위하여 접속 정보가 필요한 경우에 상기 전자 기기(200)에게 상기 접속 정보를 전송할 것을 요청할 수 있다. 상기 제어부(180)는 무선 전력 신호를 통하여 상기 접속 정보를 전송할 것을 요청할 수 있다. 예컨대, 상기 제어부(180)는 상기 전력 변환부(111)에 특정한 주파수, 진폭, 전압 또는 전류를 인가하여 무선 전력 신호를 형성하도록 제어함으로써 상기 전자 기기(200)가 상기 접속 정보를 전송할 것을 요청할 수 있다. 상기 전자 기기(200)는 상기 접속 정보의 전송을 요청하는 무선 전력 신호를 감지하고, 상기 접속 정보를 포함하도록 상기 무선 전력 신호를 변조함으로써 상기 접속 정보를 전송할 수 있다.

[0126] 한편, 상기 통신부(130)는 전력을 절감하기 위하여 대기 상태(standby) 상태 또는 비활성화(disabled) 되어 있는 경우가 있다. 상기 제어부(180)는 상기 전력 전달부(110)를 이용하여 상기 전자 기기(200)를 검출된 경우, 상기 통신부(130)가 활성화되어 있는지 여부를 판단할 수 있다. 상기 제어부(180)는 상기 판단 결과 상기 통신부(130)가 활성화되지 않은 경우, 상기 통신부(130)를 활성화하도록 제어할 수 있다.

[0127] 상기 출력부(140)는 디스플레이부(141) 및 음향 출력부(142) 중 적어도 하나를 포함한다. 상기 디스플레이부(141)는 액정 디스플레이(liquid crystal display, LCD), 박막 트랜지스터 액정 디스플레이(thin film transistor-liquid crystal display, TFT LCD), 유기 발광 다이오드(organic light-emitting diode, OLED), 플렉시블 디스플레이(flexible display), 3차원 디스플레이(3D display) 중에서 적어도 하나를 포함할 수 있다. 상기 디스플레이부(141)는 상기 제어부(180)의 제어에 따라 충전 상태를 표시할 수 있다.

[0128] 이상 개시된 본 명세서에 기재된 실시 예에 따른 무선 전력 전송장치의 구성은 무선 충전기에만 적용 가능한 경우를 제외하면, 도킹 스테이션(docking station), 단말기 크래들 장치(cradle device), 기타 전자 장치 등과 같은 장치에도 적용될 수도 있음을 본 기술분야의 당업자라면 쉽게 알 수 있을 것이다.

[0129] 도 7은 본 명세서에 개시된 실시 예들에 따른 전자 기기(200)가 이동 단말기 형태로 구현된 경우의 구성을 나타낸다.

[0130] 상기 이동통신 단말기(200)는 도 2, 도 4 또는 도 5에 도시된 전원 공급부(290)를 포함한다.

[0131] 그리고, 상기 단말기(200)는 무선 통신부(210), A/V(Audio/Video) 입력부(220), 사용자 입력부(230), 센싱부(240), 출력부(250), 메모리(260), 인터페이스부(270), 제어부(280)를 더 포함할 수 있다. 도 7에 도시된 구성 요소들이 필수적인 것은 아니어서, 그보다 많은 구성요소들을 갖거나 그보다 적은 구성요소들을 갖는 단말기가 구현될 수도 있다.

[0132] 이하, 상기 구성요소들에 대해 차례로 살펴본다.

- [0133] 무선 통신부(210)는 단말기(200)와 무선 통신 시스템 사이, 단말기(200)와 단말기(200)가 위치한 네트워크 사이, 또는 단말기(200)와 상기 무선 전력 전송장치(100) 사이의 무선 통신을 가능하게 하는 하나 이상의 모듈을 포함할 수 있다. 예를 들어, 무선 통신부(210)는 방송 수신 모듈(211), 이동통신 모듈(212), 무선 인터넷 모듈(213), 근거리 통신 모듈(214) 및 위치정보 모듈(215) 등을 포함할 수 있다.
- [0134] 방송 수신 모듈(211)은 방송 채널을 통하여 외부의 방송 센터로부터 방송 신호 및/또는 방송 관련된 정보를 수신한다.
- [0135] 상기 방송 채널은 위성 채널 및 지상파 채널을 포함할 수 있다. 상기 방송 센터는, 방송 신호 및/또는 방송 관련 정보를 생성하여 송신하는 서버 또는 기 생성된 방송 신호 및/또는 방송 관련 정보를 제공받아 단말기에 송신하는 서버를 의미할 수 있다. 상기 방송 신호는, TV 방송 신호, 라디오 방송 신호, 데이터 방송 신호를 포함할 뿐만 아니라, TV 방송 신호 또는 라디오 방송 신호에 데이터 방송 신호가 결합한 형태의 방송 신호도 포함할 수 있다.
- [0136] 상기 방송 관련 정보는, 방송 채널, 방송 프로그램 또는 방송 서비스 제공자에 관련한 정보를 의미할 수 있다. 상기 방송 관련 정보는, 이동통신망을 통하여도 제공될 수 있다. 이러한 경우에는 상기 이동통신 모듈(212)에 의해 수신될 수 있다.
- [0137] 상기 방송 관련 정보는 다양한 형태로 존재할 수 있다. 예를 들어, DMB(Digital Multimedia Broadcasting)의 EPG(Electronic Program Guide) 또는 DVB-H(Digital Video Broadcast-Handheld)의 ESG(Electronic Service Guide) 등의 형태로 존재할 수 있다.
- [0138] 상기 방송 수신 모듈(211)은, 예를 들어, DMB-T(Digital Multimedia Broadcasting-Terrestrial), DMB-S(Digital Multimedia Broadcasting-Satellite), MediaFLO(Media Forward Link Only), DVB-H(Digital Video Broadcast-Handheld), ISDB-T(Integrated Services Digital Broadcast-Terrestrial) 등의 디지털 방송 시스템을 이용하여 디지털 방송 신호를 수신할 수 있다. 물론, 상기 방송 수신 모듈(211)은, 상술한 디지털 방송 시스템뿐만 아니라 다른 방송 시스템에 적합하도록 구성될 수도 있다.
- [0139] 방송 수신 모듈(211)을 통해 수신된 방송 신호 및/또는 방송 관련 정보는 메모리(260)에 저장될 수 있다.
- [0140] 이동통신 모듈(212)은, 이동 통신망 상에서 기지국, 외부의 단말, 서버 중 적어도 하나와 무선 신호를 송수신한다. 상기 무선 신호는, 음성 호 신호, 화상 통화 호 신호 또는 문자/멀티미디어 메시지 송수신에 따른 다양한 형태의 데이터를 포함할 수 있다.
- [0141] 무선 인터넷 모듈(213)은 무선 인터넷 접속을 위한 모듈을 말하는 것으로, 단말기(200)에 내장되거나 외장될 수 있다. 무선 인터넷 기술로는 WLAN(Wireless LAN)(Wi-Fi), Wibro(Wireless broadband), Wimax(World Interoperability for Microwave Access), HSDPA(High Speed Downlink Packet Access) 등이 이용될 수 있다.
- [0142] 근거리 통신 모듈(214)은 근거리 통신을 위한 모듈을 말한다. 무선의 근거리 통신(short range communication) 기술로 블루투스(Bluetooth), RFID(Radio Frequency Identification), 적외선 통신(IrDA, infrared Data Association), UWB(Ultra Wideband), ZigBee 등이 이용될 수 있다. 한편, 유선의 근거리 통신으로는 USB(Universal Serial Bus), IEEE 1394, 인텔사의 쉐더볼트 등이 이용될 수 있다.
- [0143] 상기 무선 인터넷 모듈(213) 또는 상기 근거리 통신 모듈(214)은 상기 무선 전력 전송장치(100)와 데이터 통신 연결을 수립할 수 있다.
- [0144] 상기 수립된 데이터 통신을 통해, 상기 무선 인터넷 모듈(213) 또는 상기 근거리 통신 모듈(214)은 무선으로 전력을 전달하는 중에, 출력할 오디오 신호가 있는 경우, 상기 오디오 신호를 상기 근거리 통신 모듈을 통해 상기 무선 전력 전송장치(100)로 전송할 수 있다. 또한, 상기 수립된 데이터 통신을 통해, 상기 무선 인터넷 모듈(213) 또는 상기 근거리 통신 모듈(214)은 디스플레이할 정보가 있는 경우, 상기 정보를 상기 무선 전력 전송장치(100)로 전송할 수 있다. 또는, 상기 수립된 데이터 통신을 통해, 상기 무선 인터넷 모듈(213) 또는 상기 근거리 통신 모듈(214)은 상기 무선 전력 전송장치(100)에 내장된 마이크를 통해 입력되는 오디오 신호를 수신할 수 있다. 또한, 상기 무선 인터넷 모듈(213) 또는 상기 근거리 통신 모듈(214)은 상기 이동 단말기(200)의 식별 정보(예컨대, 휴대폰인 경우 전화 번호, 또는 기기명)를 상기 수립된 데이터 통신을 통해 상기 무선 전력 전송장치(100)로 전송할 수 있다.
- [0145] 위치정보 모듈(215)은 단말의 위치를 획득하기 위한 모듈로서, 예로는 GPS(Global Position System) 모듈이 있

다.

- [0146] 도 7을 참조하면, A/V(Audio/Video) 입력부(220)는 오디오 신호 또는 비디오 신호 입력을 위한 것으로, 이에 카메라(221)와 마이크(222) 등이 포함될 수 있다. 카메라(221)는 화상 통화모드 또는 촬영 모드에서 이미지 센서에 의해 얻어지는 정지영상 또는 동영상 등의 화상 프레임을 처리한다. 처리된 화상 프레임은 디스플레이부(251)에 표시될 수 있다.
- [0147] 카메라(221)에서 처리된 화상 프레임은 메모리(260)에 저장되거나 무선 통신부(210)를 통하여 외부로 전송될 수 있다. 카메라(221)는 사용 환경에 따라 2개 이상이 구비될 수도 있다.
- [0148] 마이크(222)는 통화모드 또는 녹음모드, 음성인식 모드 등에서 마이크로폰(Microphone)에 의해 외부의 음향 신호를 입력받아 전기적인 음성 데이터로 처리한다. 처리된 음성 데이터는 통화 모드인 경우 이동통신 모듈(212)을 통하여 이동통신 기지국으로 송신 가능한 형태로 변환되어 출력될 수 있다. 마이크(222)에는 외부의 음향 신호를 입력받는 과정에서 발생하는 잡음(noise)을 제거하기 위한 다양한 잡음 제거 알고리즘이 구현될 수 있다.
- [0149] 사용자 입력부(230)는 사용자가 단말기의 동작 제어를 위한 입력 데이터를 발생시킨다. 사용자 입력부(230)는 키 패드(key pad) 돔 스위치 (dome switch), 터치 패드(정압/정전), 조그 휠, 조그 스위치 등으로 구성될 수 있다.
- [0150] 센싱부(240)는 근접센서(241), 압력센서(242), 및 모션 센서(243) 등을 포함할 수 있다. 상기 근접센서(241)는 이동 단말기(200)로 접근하는 물체나, 이동 단말기(200)의 근방에 존재하는 물체의 유무 등을 기계적 접촉이 없이 검출할 수 있도록 한다. 상기 근접센서(241)는, 교류자계의 변화나 정자계의 변화를 이용하거나, 혹은 정전 용량의 변화율 등을 이용하여 근접물체를 검출할 수 있다. 상기 근접센서(241)는 구성 태양에 따라 2개 이상이 구비될 수 있다.
- [0151] 상기 압력센서(242)는 이동 단말기(200)에 압력이 가해지는지 여부와, 그 압력의 크기 등을 검출할 수 있다. 상기 압력센서(242)는 사용 환경에 따라 이동 단말기(200)에서 압력의 검출이 필요한 부위에 설치될 수 있다. 만일, 압력센서(242)가 디스플레이부(251)에 설치되는 경우, 상기 압력센서(242)에서 출력되는 신호에 따라, 상기 디스플레이부(251)를 통한 터치 입력과, 터치 입력보다 더 큰 압력이 가해지는 압력터치 입력을 식별할 수 있다. 또한, 상기 압력센서(242)에서 출력되는 신호에 따라, 압력터치 입력시 상기 디스플레이부(251)에 가해지는 압력의 크기도 알 수 있다.
- [0152] 상기 모션 센서(243)는 가속도 센서, 자이로 센서 등을 이용하여 이동 단말기(200)의 위치나 움직임 등을 감지한다. 상기 모션 센서(243)에 사용될 수 있는 가속도 센서는 어느 한 방향의 가속도 변화에 대해서 이를 전기 신호로 바꾸어 주는 소자이다. 가속도 센서는 보통 2축이나 3축을 하나의 패키지에 실장하여 구성되며, 사용 환경에 따라서는 Z축 한 축만 필요한 경우도 있다. 따라서, 어떤 이유로 Z축 방향 대신 X축 또는 Y축 방향의 가속도 센서를 써야 할 경우에는 별도의 조각 기판을 사용하여 가속도 센서를 주 기판에 세워져 실장할 수도 있다. 또한, 상기 자이로 센서는 회전 운동을 하는 이동 단말기(200)의 각속도를 측정하는 센서로서, 각 기준 방향에 대한 회전된 각도를 감지할 수 있다. 예컨대, 상기 자이로 센서는 3개 방향의 축을 기준으로 한 각각의 회전 각도, 즉 방위각(azimuth), 피치(pitch) 및 롤(roll)을 감지할 수 있다.
- [0153] 출력부(250)는 시각, 청각 또는 촉각 등과 관련된 출력을 발생시키기 위한 것으로, 이에 디스플레이부(251), 음향 출력 모듈(252), 알람부(253), 및 햅틱 모듈(254) 등이 포함될 수 있다.
- [0154] 디스플레이부(251)는 단말기(200)에서 처리되는 정보를 표시(출력)한다. 예를 들어, 단말기 통화 모드인 경우 통화와 관련된 UI(User Interface) 또는 GUI(Graphic User Interface)를 표시한다. 단말기(200)가 화상 통화 모드 또는 촬영 모드인 경우에는 촬영 또는/및 수신된 영상 또는 UI, GUI를 표시한다.
- [0155] 디스플레이부(251)는 액정 디스플레이(liquid crystal display, LCD), 박막 트랜지스터 액정 디스플레이(thin film transistor-liquid crystal display, TFT LCD), 유기 발광 다이오드(organic light-emitting diode, OLED), 플렉시블 디스플레이(flexible display), 3차원 디스플레이(3D display) 중에서 적어도 하나를 포함할 수 있다.
- [0156] 이들 중 일부 디스플레이는 그를 통해 외부를 볼 수 있도록 투명형 또는 광투과형으로 구성될 수 있다. 이는 투명 디스플레이라 호칭될 수 있는데, 상기 투명 디스플레이의 대표적인 예로는 TOLED(Transparent OLED) 등이 있다. 디스플레이부(251)의 후방 구조 또한 광 투과형 구조로 구성될 수 있다. 이러한 구조에 의하여, 사용자는

단말기 바디의 디스플레이부(251)가 차지하는 영역을 통해 단말기 바디의 후방에 위치한 사물을 볼 수 있다.

- [0157] 단말기(200)의 구현 형태에 따라 디스플레이부(251)이 2개 이상 존재할 수 있다. 예를 들어, 단말기(200)에는 복수의 디스플레이부들이 하나의 면에 이격되거나 일체로 배치될 수 있고, 또한 서로 다른 면에 각각 배치될 수도 있다.
- [0158] 디스플레이부(251)와 터치 동작을 감지하는 센서(이하, '터치 센서'라 함)가 상호 레이어 구조를 이루는 경우(이하, '터치 스크린'이라 함)에, 디스플레이부(251)는 출력 장치 이외에 입력 장치로도 사용될 수 있다. 터치 센서는, 예를 들어, 터치 필름, 터치 시트, 터치 패드 등의 형태를 가질 수 있다.
- [0159] 터치 센서는 디스플레이부(251)의 특정 부위에 가해진 압력 또는 디스플레이부(251)의 특정 부위에 발생하는 정전 용량 등의 변화를 전기적인 입력신호로 변환하도록 구성될 수 있다. 터치 센서는 터치 되는 위치 및 면적뿐만 아니라, 터치 시의 압력까지도 검출할 수 있도록 구성될 수 있다.
- [0160] 터치 센서에 대한 터치 입력이 있는 경우, 그에 대응하는 신호(들)는 터치 제어기로 보내진다. 터치 제어기는 그 신호(들)를 처리한 다음 대응하는 데이터를 제어부(280)로 전송한다. 이로써, 제어부(280)는 디스플레이부(251)의 어느 영역이 터치 되었는지 여부 등을 알 수 있게 된다.
- [0161] 상기 터치스크린에 의해 감싸지는 단말의 내부 영역 또는 상기 터치 스크린의 근처에 근접 센서(241)가 배치될 수 있다. 상기 근접 센서는 소정의 검출면에 접근하는 물체, 혹은 근방에 존재하는 물체의 유무를 전자계의 힘 또는 적외선을 이용하여 기계적 접촉이 없이 검출하는 센서를 말한다. 근접 센서는 접촉식 센서보다는 그 수명이 길며 그 활용도 또한 높다.
- [0162] 상기 근접 센서의 예로는 투과형 광전 센서, 직접 반사형 광전 센서, 미러 반사형 광전 센서, 고주파 발진형 근접 센서, 정전용량형 근접 센서, 자기형 근접 센서, 적외선 근접 센서 등이 있다. 상기 터치스크린이 정전식인 경우에는 상기 포인터의 근접에 따른 전계의 변화로 상기 포인터의 근접을 검출하도록 구성된다. 이 경우 상기 터치스크린(터치 센서)은 근접 센서로 분류될 수도 있다.
- [0163] 이하에서는 설명의 편의를 위해, 상기 터치스크린 상에 포인터가 접촉되지 않으면서 근접되어 상기 포인터가 상기 터치스크린 상에 위치함이 인식되도록 하는 행위를 "근접 터치(proximity touch)"라고 칭하고, 상기 터치스크린 상에 포인터가 실제로 접촉되는 행위를 "접촉 터치(contact touch)"라고 칭한다. 상기 터치스크린 상에서 포인터로 근접 터치가 되는 위치라 함은, 상기 포인터가 근접 터치될 때 상기 포인터가 상기 터치스크린에 대해 수직으로 대응되는 위치를 의미한다.
- [0164] 상기 근접센서는, 근접 터치와, 근접 터치 패턴(예를 들어, 근접 터치 거리, 근접 터치 방향, 근접 터치 속도, 근접 터치 시간, 근접 터치 위치, 근접 터치 이동 상태 등)을 감지한다. 상기 감지된 근접 터치 동작 및 근접 터치 패턴에 상응하는 정보는 터치 스크린상에 출력될 수 있다.
- [0165] 음향 출력 모듈(252)은 호 신호 수신, 통화모드 또는 녹음 모드, 음성인식 모드, 방송수신 모드 등에서 무선 통신부(210)로부터 수신되거나 메모리(260)에 저장된 오디오 데이터를 출력할 수 있다. 음향 출력 모듈(252)은 단말기(200)에서 수행되는 기능(예를 들어, 호 신호 수신음, 메시지 수신음 등)과 관련된 음향 신호를 출력하기도 한다. 이러한 음향 출력 모듈(252)에는 리시버(Receiver), 스피커(speaker), 버저(Buzzer) 등이 포함될 수 있다.
- [0166] 알람부(253)는 단말기(200)의 이벤트 발생을 알리기 위한 신호를 출력한다. 단말에서 발생 되는 이벤트의 예로는 호 신호 수신, 메시지 수신, 키 신호 입력, 터치 입력 등이 있다. 알람부(253)는 비디오 신호나 오디오 신호 이외에 다른 형태, 예를 들어 진동으로 이벤트 발생을 알리기 위한 신호를 출력할 수도 있다. 상기 비디오 신호나 오디오 신호는 디스플레이부(251)나 음성 출력 모듈(252)을 통해서도 출력될 수 있어서, 그들(251, 252)은 알람부(253)의 일부로 분류될 수도 있다.
- [0167] 햅틱 모듈(haptic module)(254)은 사용자가 느낄 수 있는 다양한 촉각 효과를 발생시킨다. 햅틱 모듈(254)이 발생시키는 촉각 효과의 대표적인 예로는 진동이 있다. 햅틱 모듈(254)이 발생하는 진동의 세기와 패턴 등은 제어가능하다. 예를 들어, 서로 다른 진동을 합성하여 출력하거나 순차적으로 출력할 수도 있다.
- [0168] 햅틱 모듈(254)은, 진동 외에도, 접촉 피부면에 대해 수직 운동하는 핀 배열, 분사구나 흡입구를 통한 공기의 분사력이나 흡입력, 피부 표면에 대한 스침, 전극(electrode)의 접촉, 정전기력 등의 자극에 의한 효과와, 흡열이나 발열 가능한 소자를 이용한 냉온감 재현에 의한 효과 등 다양한 촉각 효과를 발생시킬 수 있다.

- [0169] 햅틱 모듈(254)은 직접적인 접촉을 통해 촉각 효과의 전달할 수 있을 뿐만 아니라, 사용자가 손가락이나 팔 등의 근 감각을 통해 촉각 효과를 느낄 수 있도록 구현할 수도 있다. 햅틱 모듈(254)은 단말기(200)의 구성 태양에 따라 2개 이상이 구비될 수 있다.
- [0170] 메모리(260)는 제어부(280)의 동작을 위한 프로그램을 저장할 수 있고, 입/출력되는 데이터들(예를 들어, 폰북, 메시지, 정지영상, 동영상 등)을 임시 저장할 수도 있다. 상기 메모리(260)는 상기 터치스크린 상의 터치 입력시 출력되는 다양한 패턴의 진동 및 음향에 관한 데이터를 저장할 수 있다.
- [0171] 또한, 상기 메모리(260)는 무선 전력 전송 또는 무선 충전과 관련된 설정 프로그램을 저장할 수 있다. 상기 설정 프로그램은 상기 제어부(280)에 의하여 실행될 수 있다.
- [0172] 또한, 상기 메모리(260)는 어플리케이션 제공 서버(예: 앱스토어)로부터 다운로드한 무선 전력 전송(또는 무선 충전)과 관련된 어플리케이션(application)을 저장할 수 있다. 상기 무선 전력 전송 관련 어플리케이션은 무선 전력 전송을 제어하기 위한 프로그램으로, 상기 전자 기기(200)는 해당 프로그램을 통해 상기 무선 전력 전송장치(100)로부터 무선으로 전력을 수신하거나 상기 무선 전력 전송장치(100)와 데이터 통신을 위한 연결을 수립할 수 있다.
- [0173] 메모리(260)는 플래시 메모리 타입(flash memory type), 하드디스크 타입(hard disk type), 멀티미디어 카드 마이크로 타입(multimedia card micro type), 카드 타입의 메모리(예를 들어 SD 또는 xD 메모리 등), 램(Random Access Memory, RAM), SRAM(Static Random Access Memory), 롬(Read-Only Memory, ROM), EEPROM(Electrically Erasable Programmable Read-Only Memory), PROM(Programmable Read-Only Memory), 자기 메모리, 자기 디스크, 광디스크 중 적어도 하나의 타입의 저장매체를 포함할 수 있다. 단말기(200)는 인터넷(Internet)상에서 상기 메모리(260)의 저장 기능을 수행하는 웹 스토리지(web storage)와 관련되어 동작할 수도 있다.
- [0174] 인터페이스부(270)는 단말기(200)에 연결되는 모든 외부기기와의 통로 역할을 한다. 인터페이스부(270)는 외부 기기로부터 데이터를 전송받거나, 전원을 공급받아 단말기(200) 내부의 각 구성 요소에 전달하거나, 단말기(200) 내부의 데이터가 외부 기기로 전송되도록 한다. 예를 들어, 유/무선 헤드셋 포트, 외부 충전기 포트, 유/무선 데이터 포트, 메모리 카드(memory card) 포트, 식별 모듈이 구비된 장치를 연결하는 포트, 오디오 I/O(Input/Output) 포트, 비디오 I/O(Input/Output) 포트, 이어폰 포트 등이 인터페이스부(270)에 포함될 수 있다.
- [0175] 식별 모듈은 단말기(200)의 사용 권한을 인증하기 위한 각종 정보를 저장한 칩으로서, 사용자 인증 모듈(User Identify Module, UIM), 가입자 인증 모듈(Subscriber Identity Module, SIM), 범용 사용자 인증 모듈(Universal Subscriber Identity Module, USIM) 등을 포함할 수 있다. 식별 모듈이 구비된 장치(이하 '식별 장치')는, 스마트 카드(smart card) 형식으로 제작될 수 있다. 따라서 식별 장치는 포트를 통하여 단말기(200)와 연결될 수 있다.
- [0176] 상기 인터페이스부는 단말기(200)가 외부 크래들(cradle)과 연결될 때 상기 크래들로부터의 전원이 상기 단말기(200)에 공급되는 통로가 되거나, 사용자에 의해 상기 크래들에서 입력되는 각종 명령 신호가 상기 단말로 전달되는 통로가 될 수 있다. 상기 크래들로부터 입력되는 각종 명령 신호 또는 상기 전원은 상기 단말기(200)가 상기 크래들에 정확히 장착되었음을 인지하기 위한 신호로 동작될 수도 있다.
- [0177] 제어부(controller, 280)는 통상적으로 단말의 전반적인 동작을 제어한다. 예를 들어 음성 통화, 데이터 통신, 화상 통화 등을 위한 관련된 제어 및 처리를 수행한다. 제어부(280)는 멀티 미디어 재생을 위한 멀티미디어 모듈(281)을 구비할 수도 있다. 멀티미디어 모듈(281)은 제어부(280) 내에 구현될 수도 있고, 제어부(280)와 별도로 구현될 수도 있다. 또한, 상기 제어부(180)는 도 2를 참조하여 설명된 상기 전원 공급부(290) 내의 전력 수신 제어부(292)와 별도의 모듈로 구현되거나 단일 모듈로 구현될 수 있다.
- [0178] 상기 제어부(280)는 상기 터치스크린 상에서 행해지는 필기 입력 또는 그림 그리기 입력을 각각 문자 및 이미지로 인식할 수 있는 패턴 인식 처리를 행할 수 있다.
- [0179] 한편, 상기 무선 인터넷 모듈(213) 또는 상기 근거리 통신 모듈(214)은 전력을 절감하기 위하여 대기 상태(standby) 상태 또는 비활성화(disabled) 되어 있는 경우가 있다. 상기 제어부(280)는 상기 전력 수신부(291)에 의하여 상기 무선 전력 신호가 수신된 후 상기 무선 인터넷 모듈(213) 또는 상기 근거리 통신 모듈(214)이 활성

화되어 있는지 여부를 판단할 수 있다. 상기 제어부(280)는 상기 판단 결과 상기 무선 인터넷 모듈(213) 또는 상기 근거리 통신 모듈(214)가 활성화되지 않은 경우, 상기 무선 인터넷 모듈(213) 또는 상기 근거리 통신 모듈(214)를 활성화하도록 제어할 수 있다.

- [0180] 상기 제어부(280)는 사용자 입력 또는 내부 입력에 따라 유선 충전 또는 무선 충전을 수행한다. 여기서, 내부 입력은 단말기 내부의 2차코일에서 생성되는 유도 전류가 감지되었음을 알리는 신호이다.
- [0181] 전술된 바와 같이, 상기 전원 공급부(290) 내의 전력 수신 제어부(292)는 상기 제어부(280)에 포함되어 구현될 수 있으며, 본 명세서에서 상기 전력 수신 제어부(292)에 의한 동작은 상기 제어부(280)가 수행하는 것으로 이해될 수 있다.
- [0182] 전원 공급부(290)는 제어부(280)의 제어에 의해 외부의 전원, 내부의 전원을 인가받아 각 구성요소들의 동작에 필요한 전원을 공급한다.
- [0183] 전원공급부(290)는 단말기(200)의 각 구성요소로 전원을 공급하는 배터리(299)를 구비하며, 상기 배터리(299)를 유선 또는 무선 충전하기 위한 충전부(298)를 포함할 수 있다.
- [0184] 본 명세서는 무선으로 전력을 수신하는 장치로서 이동 단말을 예로서 개시하고 있으나, 본 명세서에 기재된 실시 예에 따른 구성은 이동 단말에만 적용 가능한 경우를 제외하면, 디지털 TV, 데스크탑 컴퓨터 등과 같은 고정 단말기에도 적용될 수도 있음을 본 기술분야의 당업자라면 쉽게 알 수 있을 것이다.
- [0185] 도 8은 도 7에 도시된 이동 단말기가 무선 전력 전송장치(100)에 의해 전자기 유도 방식으로 충전되는 예를 나타낸다.
- [0186] 도 8에 도시된 바와 같이, 무선 전력 전송장치(100)에서 코일(1111a)에 의해 유도되는 자기장이 이동 단말기(200)의 코일(2911a)에 전달되고, 이를 전력으로 변환하여 이동 단말기(200)의 배터리(229)를 충전할 수 있게 된다.
- [0187] 도 9는 본 발명의 제1 실시예에 따라 무선 전력 송수신을 위한 코일과 근거리 통신용 코일을 결합한 예를 나타낸다.
- [0188] 도 9를 참조하여 알 수 있는 바와 같이, 본 발명의 제1 실시예는 무선 전력송수신을 위한 코일과 근거리 통신 예컨대 NFC(Near Field Communication)을 위한 코일을 소형화하기 위해서, 이를 하나의 코일로 형성한 예가 나타나 있다.
- [0189] 도 9를 참고하여 알 수 있는 바와 같이, 코일(2911a), 자기 차폐 부재(2917)이 나타나 있다.
- [0190] 상기 코일은 평면형으로서, 권선이 시계 또는 반시계 방향으로 감겨 형성된다. 상기 권선의 일단(b)은 상기 권선의 타단(a)과 나란하게끔 상기 평면의 내측으로부터 외측 방향으로 상기 평면형 코일의 하부면 또는 상부면을 따라 돌출 배치될 수 있다. 즉, 상기 권선의 일단(b)은 상기 권선의 타단(a)과 나란하게끔 상기 평면형 코일의 내측으로부터 외측 방향으로 상기 평면형 코일의 상부면 또는 하부면을 따라 돌출 배치된다. 즉, 내측에 감겨있는 권선의 일단을 다시 외부측으로 빼기 위해서, 상기 평면형 코일의 상부면 위로 또는 하부면 아래로 배치되게 된다.
- [0191] 그리고, 상기 권선의 일 지점은 단선(單線)으로 연장되어 상기 권선의 타단과 나란하게끔 배치될 수 있다.
- [0192] 상기 권선의 일단(b), 타단(a)은 전력의 무선 송수신을 위한 안테나로 이용되고, 상기 권선의 일단(b)과 상기 연장된 단선(c)은 근거리 무선 통신을 위한 안테나로 이용될 수 있다. 상기 연장된 단선의 길이는 이용하려는 근거리 무선 통신 방식에 따라서 그 길이가 조절될 수 있다. 즉, 상기 코일에서 상기 권선이 연장되는 지점이 변경됨으로써, 상기 연장된 단선의 길이를 조절할 수 있다.
- [0193] 이와 같이 한 개의 코일을 이용하여, 전력의 무선 송수신을 위한 안테나와 근거리 무선 통신을 위한 안테나로 동작하게끔 함으로써, 소형화할 수 있다.
- [0194] 한편, 상기 자기 차폐 부재(2917)은 상기 평면형 코일과 접촉되어, 누설 전류를 차단한다.

- [0195] 이때, 상기 자기 차폐 부재(2917)은 두께가 대략 0.8mm 정도이며, 상기 평면형 코일의 권선 두께는 대략 0.3mm 정도이다. 그러므로, 상기 평면형 코일의 전체 두께는 상기 권선의 돌출까지 포함하여 0.6mm 정도가 된다. 따라서, 상기 코일(2911a), 자기 차폐 부재(2917)의 총 두께는 예컨대 1.4mm 정도가 될 수 있다.
- [0196] 다만, 이와 같은 두께는 이동 단말기의 총 두께가 10mm 내로 제작되는 점을 감안하면, 추가적으로 소형화될 필요가 있다.
- [0197] 이에 상기 자기 차폐 부재(2917)의 두께를 줄이려는 시도가 있을 수 있으나, 이러한 시도는 도 10 및 도 11을 참고하여 알 수 있는 바와 같이 누설 전류를 증가시킬 수 있다.
- [0198] 도 10은 전자기 유도 방식에 의해 초래되는 와전류(eddy current)의 현상을 나타낸 예시도이고, 도 11은 와전류가 무선 전력 전송에 미치는 영향을 나타낸다.
- [0199] 도 10을 참조하여 알 수 있는 바와 같이, 자기장이 전도체와 근접하는 경우에는 전도체 내부에 자기장의 변화에 의한 유도 전류가 발생하게 되는데 이를 와전류 라고 한다.
- [0200] 이와 같은 와전류는 의도하지 않은 전류 흐름으로서, 정상적인 신호 흐름에 대해 비정상적인 신호 흐름을 유발하거나 혹은 신호 열화의 현상을 유발한다.
- [0201] 특히, 도 11을 참고하여 알 수 있는 바와 같이, 자기 차폐 부재(2917)의 두께가 충분하지 않거나, 성능을 다하지 못하는 경우, 자기장은 자기 차폐 부재(2917)에 의해서도 차단되지 않고 누설되어, 근접한 전도성 물질(1915), 예컨대 회로 보드에까지 와전류가 발생한다.
- [0202] 따라서, 소형화를 위해서 상기 자기 차폐 부재의 두께를 줄이는 것은, 누설 자기장이 크게 증가시키게 되는 단점과, 효율이 매우 저하되는 단점을 야기할 수 있다. 또한, 와전류가 크게 야기되는 단점을 야기할 수 있다.
- [0203] 따라서, 상기 자기 차폐 부재의 두께를 줄이지 않으면서, 소형의 전자 기기에 탑재할 수 있을 정도로 무선 전력 송수신을 위한 코일과 근거리 통신 예컨대 NFC(Near Field Communication)을 위한 코일을 소형화하는 방안들을 도 12 내지 도 17를 참조하여 설명하기로 한다.
- [0204] 도 12 및 도 13은 본 발명의 제2 실시예에 따라 무선 전력 송수신을 위한 코일과 근거리 통신용 코일을 결합한 예를 나타낸다.
- [0205] 도 12 및 도 13를 참고하여 알 수 있는 바와 같이, 코일(2911a)은 접착 부재(2917)에 의해 자기 차폐 부재(2917)와 접촉된다.
- [0206] 상기 코일(2911a)은 평면형으로서, 권선이 시계 또는 반시계 방향으로 감겨 형성되어 있다.
- [0207] 상기 평면형 코일(2911a)은 권선이 시계 또는 반시계 방향으로 감겨 형성된다. 상기 평면형 코일(2911a)은 원형, 타원형 또는 사각형일 수 있다. 상기 권선의 감김은 상기 평면형 코일(2911a)내부에는 빈 면적이 형성되도록 이루어진다. 이때, 상기 내부의 빈 면적은 전술한 바와 같이, 원형, 타원형, 또는 사각형일 수 있다.
- [0208] 상기 권선의 일단(b)은 상기 권선의 타단(a)과 나란하게끔 상기 평면의 내측으로부터 외측 방향으로 상기 평면형 코일(2911a)의 하부면을 따라 돌출 배치될 수 있다. 즉, 상기 권선의 일단(b)은 상기 권선의 타단(a)과 나란하게끔 상기 평면형 코일(2911a)의 내측으로부터 외측 방향으로 상기 평면형 코일(2911a)의 하부면을 따라 돌출 배치된다. 즉, 내측에 감겨있는 권선의 일단을 다시 외부측으로 빼기 위해서, 상기 평면형 코일의 하부면 아래로 배치되게 된다.
- [0209] 그리고, 상기 권선의 일 지점은 단선(單線)으로 연장되어 상기 권선의 타단(b)과 나란하게끔 배치될 수 있다.
- [0210] 상기 권선의 일단(b), 타단(a)은 전력의 무선 송수신을 위한 안테나로 이용되고, 상기 권선의 일단(b)과 상기 연장된 단선(c)은 근거리 무선 통신을 위한 안테나로 이용될 수 있다. 상기 연장된 단선의 길이는 이용하려는 근거리 무선 통신 방식에 따라서 그 길이가 조절될 수 있다. 즉, 상기 코일에서 상기 권선이 연장되는 지점이 변경됨으로써, 상기 연장된 단선의 길이를 조절할 수 있다.
- [0211] 그리고, 상기 차폐 부재(2917)의 상면에는 상기 평면형 코일이 완전히 밀착 접촉되도록 상기 권선 일단의 돌출을 수용하기 위한 홈이 형성된다. 상기 홈을 따라 상기 권선의 일단(b)과 상기 타단(a)은 상기 자기 차폐 부재(2917)의 외부로 안내되고, 상기 외부로 안내된 권선의 일단과 타단은 도 4를 참조하여 설명한 인버터(1112) 도

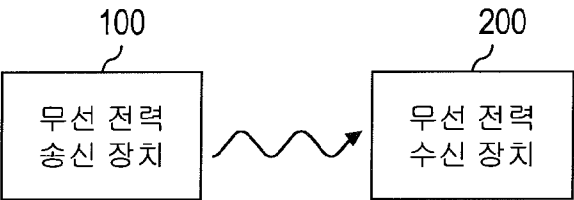
는 정류회로(2913)과 연결되게 된다.

- [0212] 상기 홈의 깊이는 상기 권선의 두께, 예컨대 0.3mm 보다 크게 형성될 수 있다. 아울러, 상기 홈의 폭은 상기 권선의 일단과 타단이 일정 거리로 서로 이격된 상태에서, 상기 일단과 타단이 모두 수용되도록 상기 이격된 거리보다 더 크게 형성될 수 있다. 대안적으로, 상기 홈의 폭은 상기 권선의 일단만을 수용하도록, 상기 권선의 두께에 대응되게 형성될 수 있다. 이 경우, 상기 권선의 타단은 상기 권선의 일단과 일정 거리만큼 이격되어 있으므로, 상기 홈에 의해 안내되지 않고, 상기 자기 차폐 부재(2917)의 상면에 접촉될 수 있다.
- [0213] 이와 같은 형상의 차폐 부재(2917)는 금형에 의하여 사출될 수 있어, 보다 저비용으로 대량 생산할 수 있다.
- [0214] 이와 같이, 제2 실시예에서, 상기 자기 차폐 부재(2917)의 두께가 대략 0.8mm 정도라고 하고, 상기 평면형 코일의 권선 두께는 대략 0.3mm 정도라고 하면, 상기 권선의 일단부가 돌출되는 부분은 상기 자기 차폐 부재(2917)의 홈에 의하여 수용되므로, 상기 코일(2911a), 자기 차폐 부재(2917)의 총 두께는 예컨대 1.1mm 정도로 줄어들 수 있게 된다.
- [0215] 도 14 및 도 15은 본 발명의 제3 실시예에 따라 무선 전력 송수신을 위한 코일과 근거리 통신용 코일을 결합한 예를 나타낸다.
- [0216] 무선 전력 송수신을 위한 제1 코일(2911a-1)은 평면형으로서, 권선이 시계 또는 반시계 방향으로 감겨 형성되어 있다. 상기 제1 코일은 외부 자기장 변화에 의하여 유도 전류가 흐를 수 있다. 상기 제1 코일(2911a-1)의 중심부는 빈공간을 형성하도록, 상기 권선이 시계 또는 반시계 방향으로 감겨 형성되고, 상기 권선의 일단은 상기 권선의 타단과 나란하게끔 상기 평면의 내측으로부터 외측 방향으로 상기 평면형 코일의 하부면을 따라 돌출 배치될 수 있다. 상기 평면형 코일(2911a)은 원형, 타원형 또는 사각형일 수 있다. 이때, 상기 내부의 빈 면적은 전술한 바와 같이, 원형, 타원형, 또는 사각형일 수 있다.
- [0217] 근거리 통신을 위한 제2 코일(2911a-2)은 권선이 상기 평면형 코일의 외주면을 따라 형성되되, 상기 코일의 외주면과 접촉되지 않도록 이격되어 형성된다. 상기 권선에 의해 상기 제2 코일(2911a-2)은 스트립 형태의 안테나 형상을 갖는다.
- [0218] 한편, 도 14 및 도 15를 참고하여 알 수 있는 바와 같이, 상기 차폐 부재(2917)의 상면에는 상기 제1 코일을 수용하기 위한 홈과, 제2 코일을 수용하기 위한 홈이 각기 형성될 수 있다. 즉, 상기 차폐 부재(2917)의 상면에는 상기 제1 코일 및 제2 코일을 수용하기 위해 단차질 수 있다. 다시 말해서, 상기 차폐 부재(2917)의 상면에는 상기 제1 코일의 면적에 대응하도록 홈과, 상기 제2 코일의 면적에 대응하는 홈이 추가적으로 형성될 수 있다.
- [0219] 이와 같이 상기 형성된 단차는 상기 제1 코일(2911a)의 측면을 차폐하는 효과, 즉 사이드 쉴드(shield) 효과를 나타낼 수 있다. 따라서, 상기 제1 코일의 자속 밀도가 증가하게 될 뿐만 아니라, 누설 자기장을 크게 감소시킬 수 있게 된다. 한편, 상기 제1 코일(2911a-1)을 수용하기 위한 홈과 상기 제2 코일(2911a-2)을 수용하기 위한 홈 사이의 돌출부에 의해 상기 제1 코일과 상기 제2 코일(2911a-2)은 전기적으로 고립될 수 있다.
- [0220] 한편, 상기 제1 코일을 수용하기 위해 상기 차폐 부재(2917)의 상면에 형성된 단차(즉, 홈)의 면적은 상기 제1 코일(2911a-1)의 중심부 빈공간을 제외한 상기 제1 코일(2911a-1)의 실 면적에 해당할 수 있다. 즉, 상기 자기 차폐 부재(2917)의 상면은 상기 빈공간을 제외한 상기 제1 코일(2911a-1)의 실 면적에 해당하는 부분에만 홈이 형성된다. 따라서, 상기 빈공간에 해당하는 상기 자기 차폐 부재(2917)의 중앙 부분은 상기 홈의 높이보다 높은 돌출면을 갖게 되고, 상기 돌출면은 상기 코일이 이탈되는 것을 방지함과 아울러, 자속 밀도를 증가시킬 수 있다.
- [0221] 이와 같은 형상의 차폐 부재(2917)는 금형에 의하여 사출될 수 있어, 보다 저비용으로 대량 생산할 수 있다.
- [0222] 도 16 및 도 17은 본 발명의 제4 실시예에 따라 무선 전력 송수신을 위한 코일과 근거리 통신용 코일을 결합한 예를 나타낸다.
- [0223] 근거리 통신을 위한 제2 코일(2911a-2)은 권선이 상기 평면형 코일의 내주면을 따라 형성되되, 상기 코일의 내주면과 접촉되지 않도록 이격되어 형성된다. 상기 권선에 의해 상기 제2 코일(2911a-2)은 스트립 형태의 안테나 형상을 갖는다.
- [0224] 그 밖에, 도 16 및 도 17에 도시된 구성에 대한 설명은 도 14 및 도 15의 구성에 대한 설명과 유사하므로, 중복하여 설명하지 않고, 전술한 내용을 준용하기로 한다.
- [0225] 이상에서 설명한 본 발명의 보호범위는 본 명세서에 개시된 실시 예들로 한정되지 아니하고, 본 발명은 본 발명

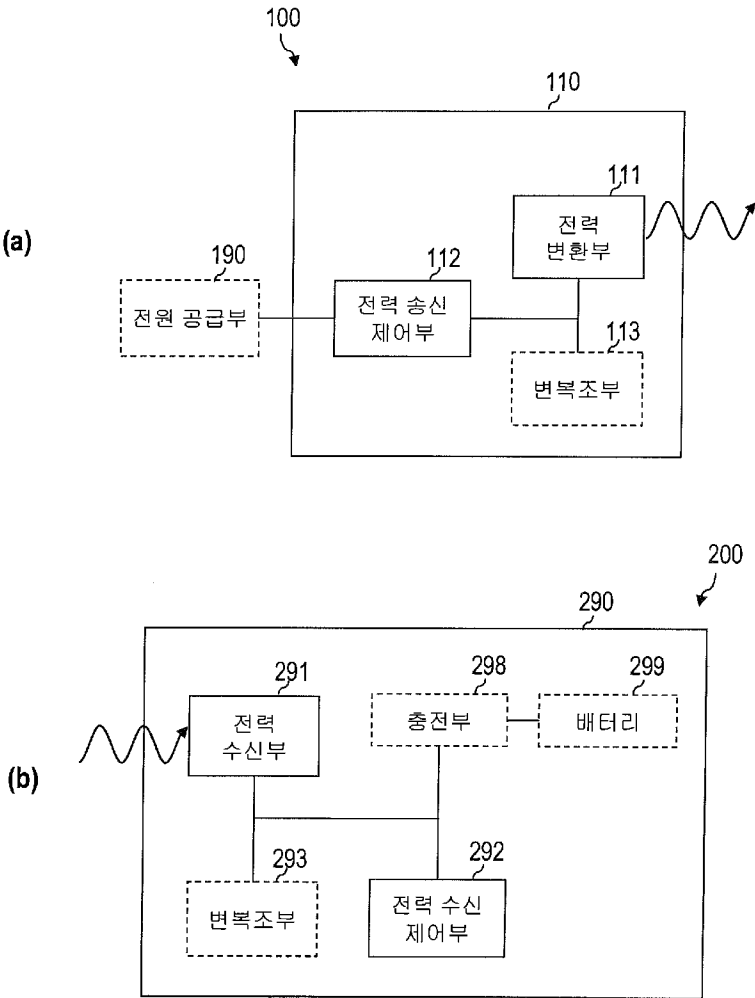
의 사상 및 특허청구범위에 기재된 범주 내에서 다양한 형태로 수정, 변경, 또는 개선될 수 있다.

도면

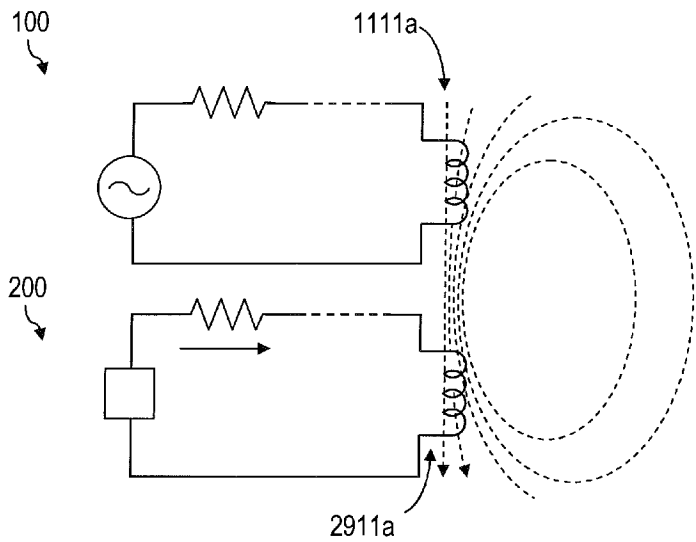
도면1



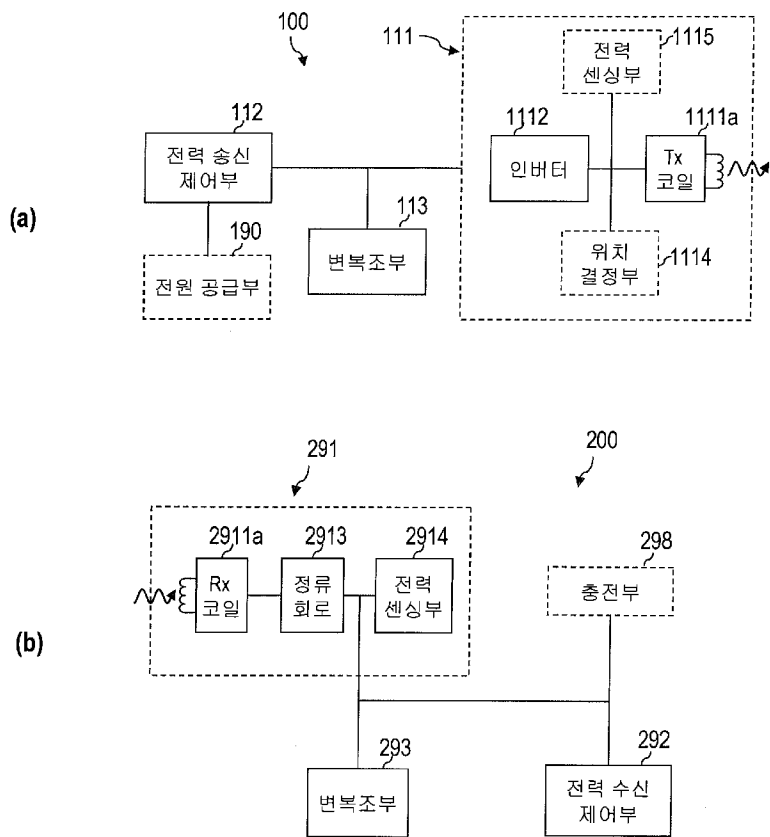
도면2



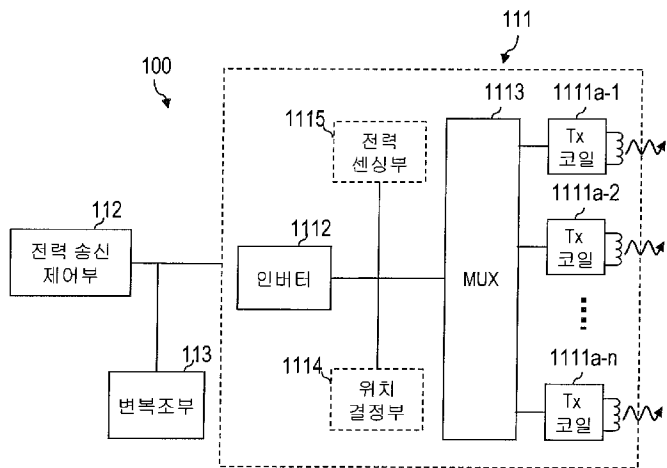
도면3



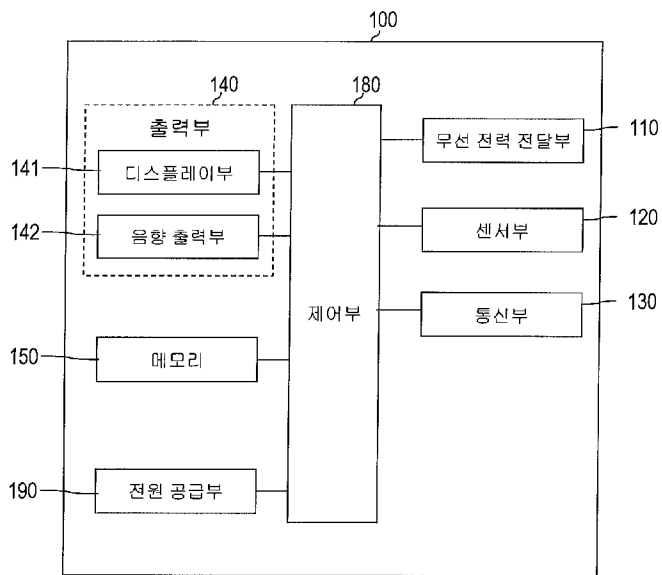
도면4



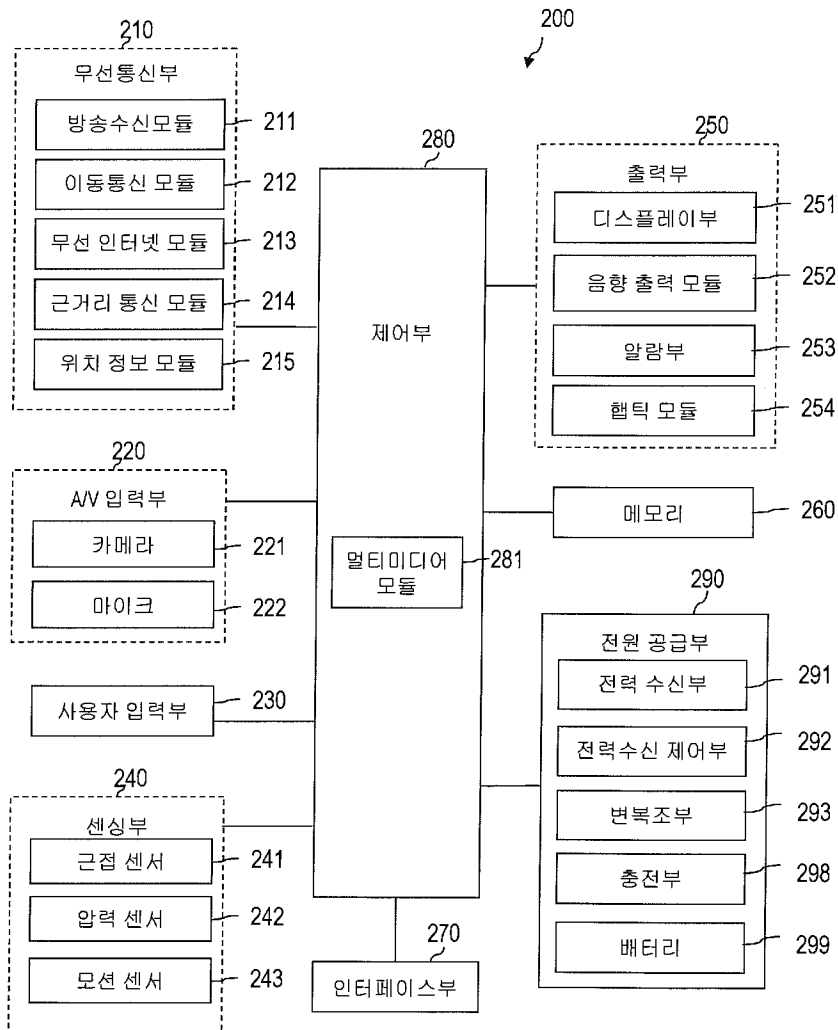
도면5



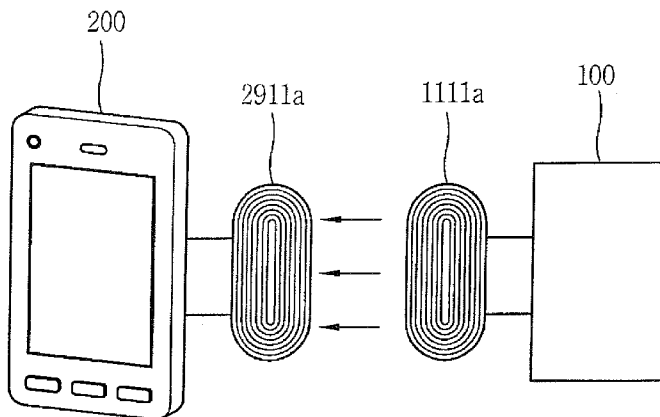
도면6



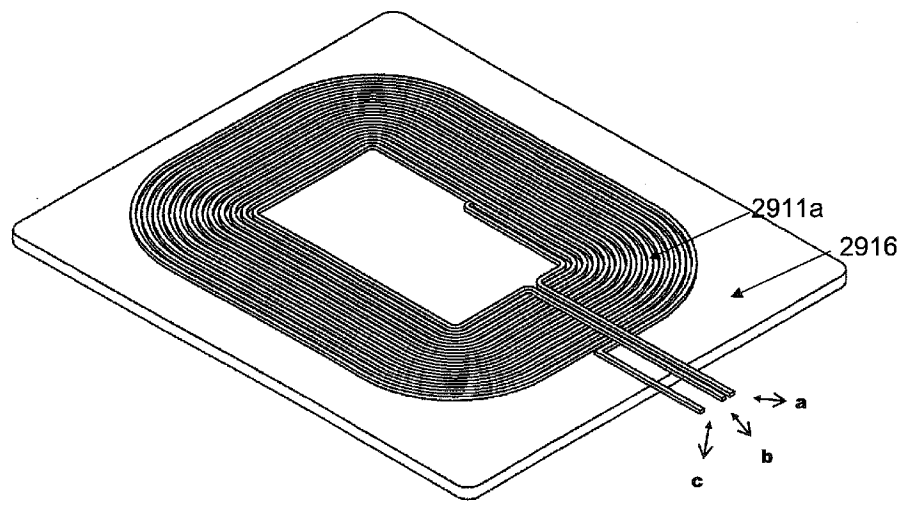
도면7



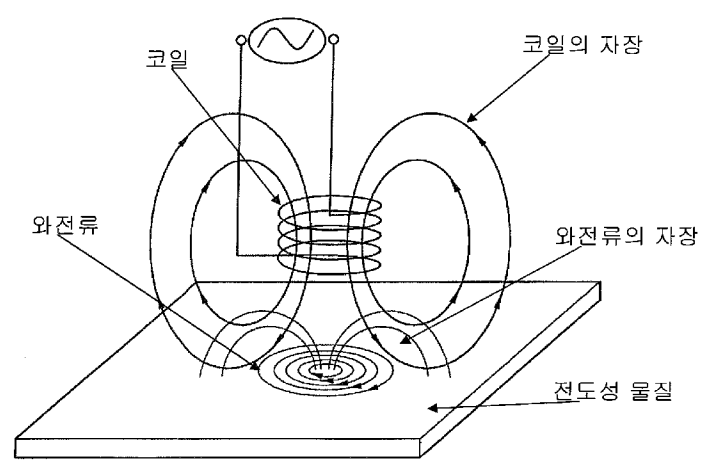
도면8



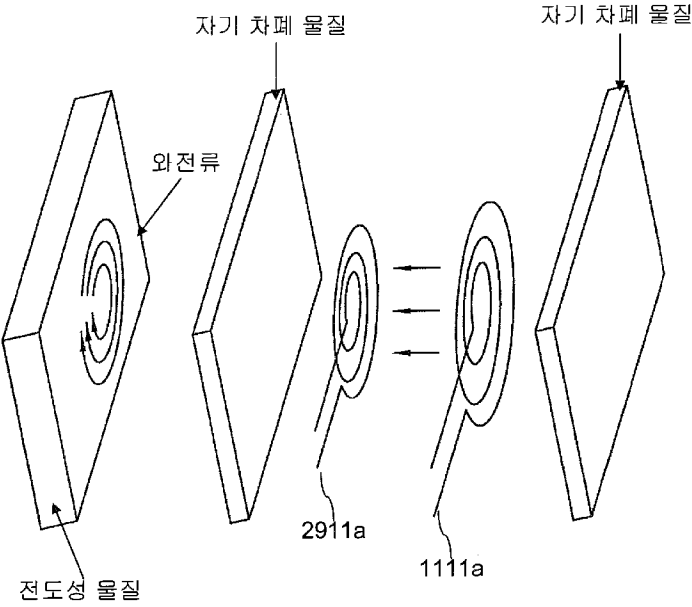
도면9



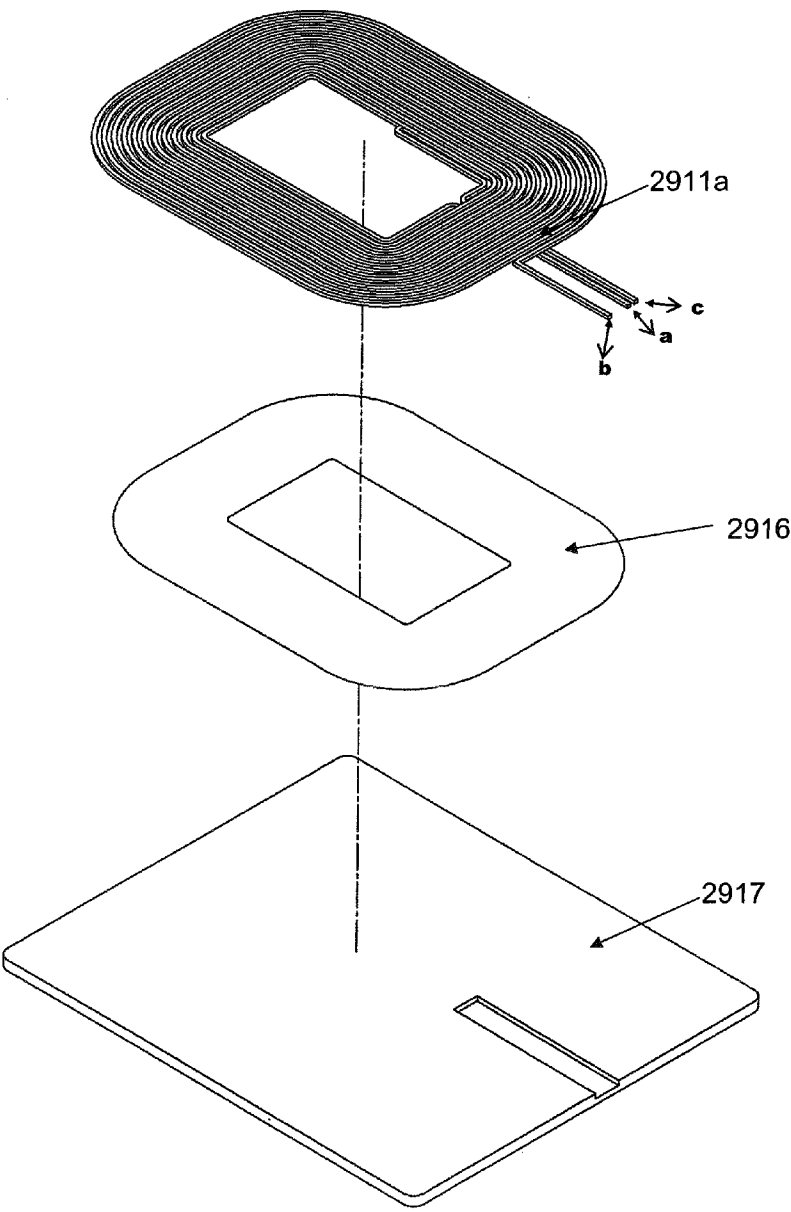
도면10



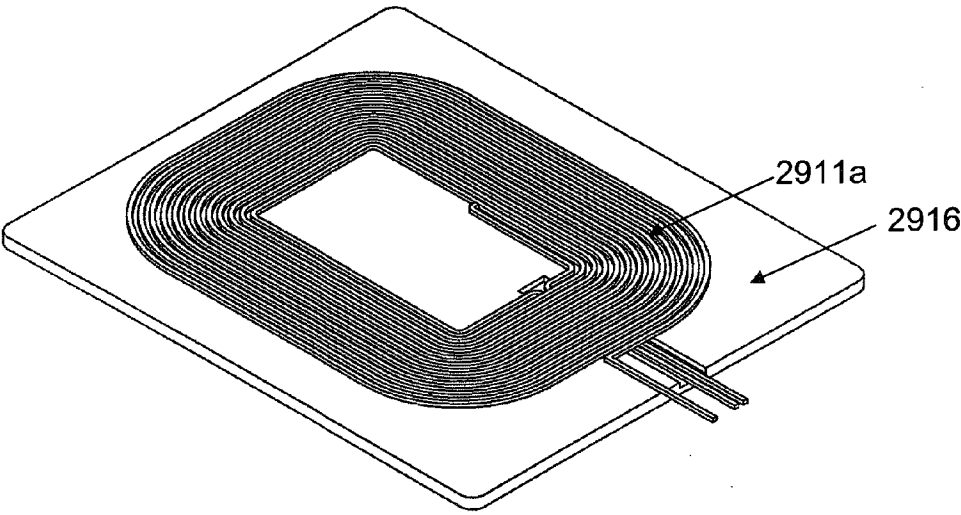
도면11



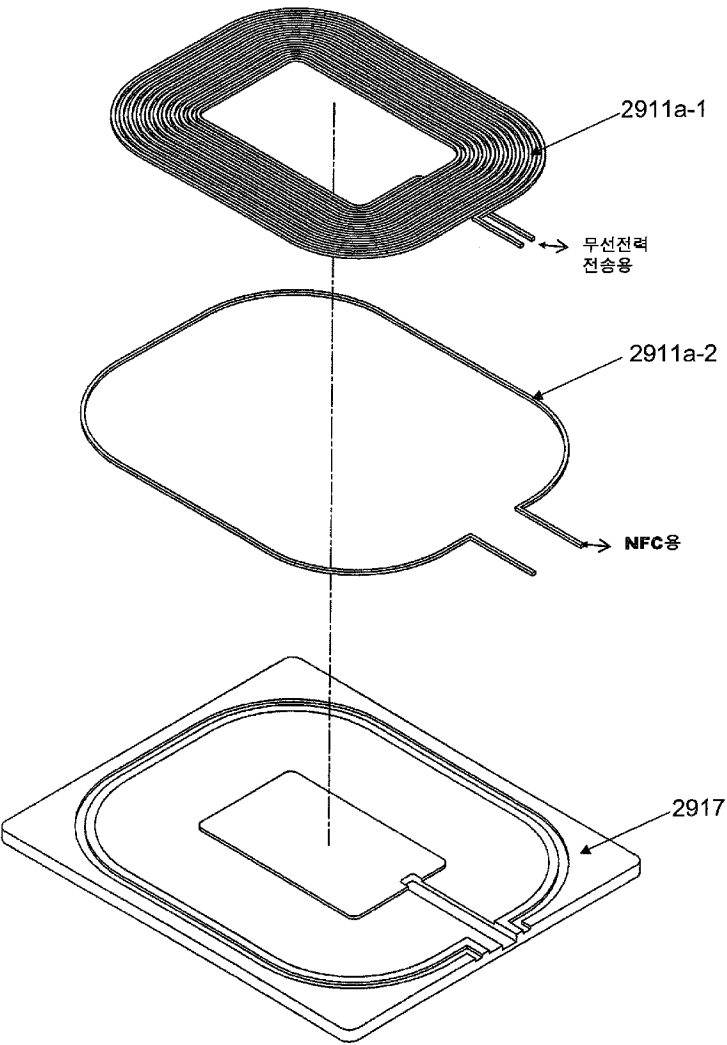
도면12



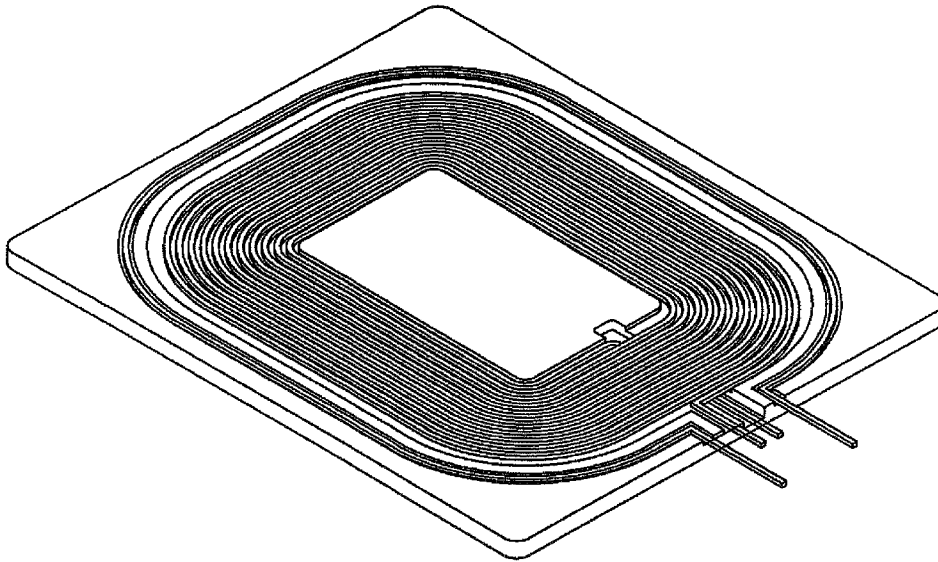
도면13



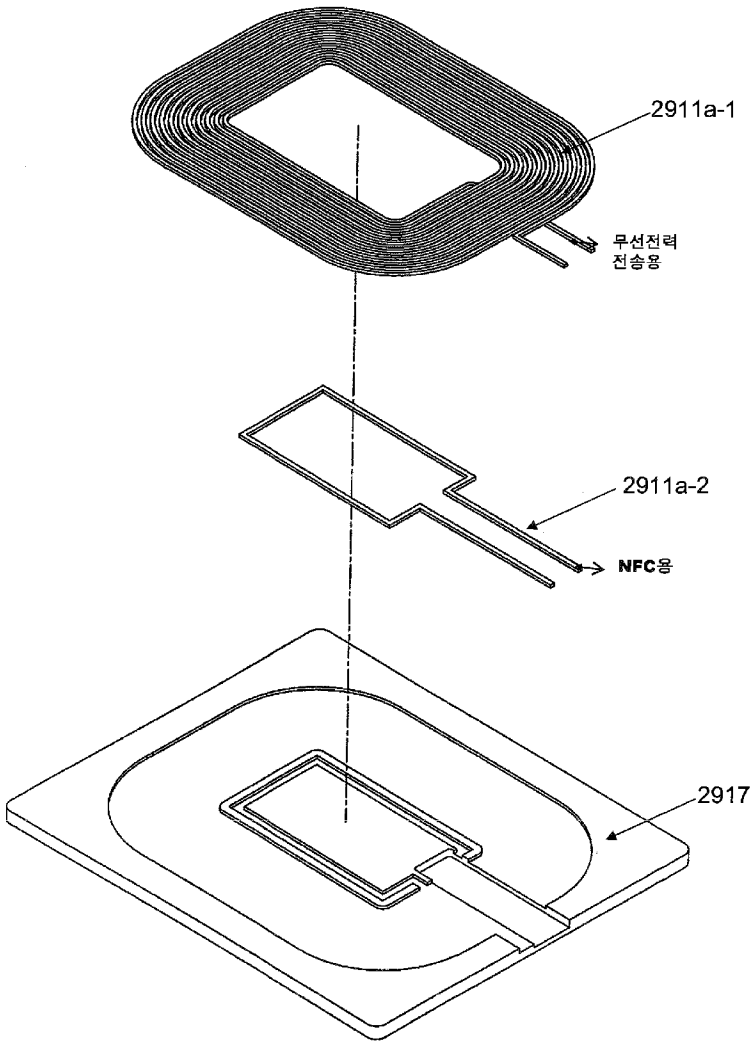
도면4



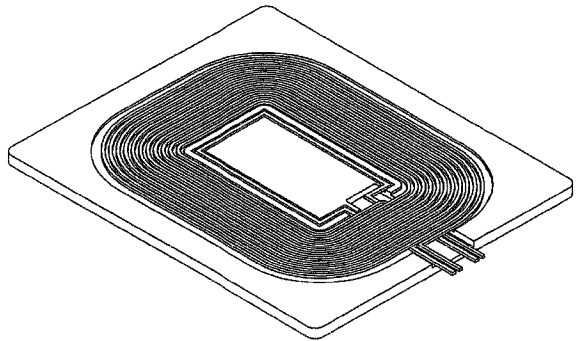
도면15



도면16



도면17



Mobile phone wireless charging coil structure
List of publications
Publication date



-  Application number 2018CN-U2150085 Date 2018-12-20 [Register](#)
 - [CN209015853 U Registered utility model](#) 2019-06-21 

English Title

Mobile phone wireless charging coil structure

Other Title

一种手机无线充电线圈结构

English Abstract (Native or MT)

The embodiment of the utility model discloses a wireless charging coil structure of a mobile phone, which comprises a circuit board, a first connecting part is formed on the circuit board, and a first golden finger is arranged on the first connecting part; a first charging coil body is printed on one surface of the circuit board, and a second charging coil body is printed on the other surface of the circuit board; the first golden finger is connected with the first charging coil body; the first charging coil body is provided with a first jumper wire part and a second jumper wire part. wherein the first charging coil body is communicated with the second charging coil body through the first jumper wire part, the first charging coil body is further communicated with the second charging coil body through the second jumper wire part, and the first charging coil body and the second charging coil body are connected in series to form a double-layer structure. According to the utility model, the wireless charging coil structure in the mobile phone is innovated, the NFC coil is effectively fused, and the utilization rate of the internal space of the mobile phone is improved.

Other Abstracts

本实用新型实施例公开了一种手机无线充电线圈结构，包括电路板，所述电路板上形成有第一连接部，所述第一连接部上设有第一金手指；所述电路板的一面印刷有第一充电线圈体，电路板的另外一面印刷有第二充电线圈体；所述第一金手指连接所述第一充电线圈体，所述第一充电线圈体上设有第一跳线部和第二跳线部，第一充电线圈体经过所述第一跳线部与第二充电线圈体连通，第一充电线圈体还经过所述第二跳线部与第二充电线圈体连通，所述第一充电线圈体和第二充电线圈体之间串联形成双层结构。本实用新型对手机内部的无线充电线圈结构进行创新，有效地融合NFC线圈，提高手机内部空间利用率。

Application Language

CHINESE (CHI)

Inventor(s)

PENG HONGWEI
DU XIAOYUN
DENG HAIXIANG
ZHU XUEHAI
OU QINGXIN
WANG JIAN

Inventor(s)
彭宏伟
杜小云
邓海祥
朱学海
欧庆欣
王建

Applicant/Assignee SHENZHEN CHUANGXINQI COMMUNICATION [CN]
owned by SHENZHEN HUAYIN COMMUNICATION

Assignee 深圳市创新奇通讯有限公司 [CN]

Applicant/Assignee Address SHENZHEN CHUANGXINQI COMMUNICATION CO LTD , CN

Patent Assignee History SHENZHEN CHUANGXINQI COMMUNICATION CO LTD [CN]

Representative WU YUAN; BEIJING ZHIGUAGUA PROPERTY AGENCY CO., LTD.
Reg. Nb: 11577; LÜ XUEWEN; BEIJING ZHIGUAGUA PROPERTY AGENCY CO., LTD.
Reg. Nb: 11577

Representative Address WU YUAN ; BEIJING ZHIGUAGUA PROPERTY AGENCY CO., LTD. , 11577
LÜ XUEWEN ; BEIJING ZHIGUAGUA PROPERTY AGENCY CO., LTD. , 11577

Representative 武媛 ; 北京知呱呱知识产权代理有限公司
Reg. Nb: 11577; 吕学文 ; 北京知呱呱知识产权代理有限公司
Reg. Nb: 11577

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Description

TECHNICAL FIELD

[0002] The embodiment of the utility model provides a relate to the cell-phone technical field that charges, concretely relates to cell-phone wireless charging coil structure.

BACKGROUND ART

[0004] The wireless charging technology of the mobile phone brings great convenience to our life. The resonance principle used in wireless charging is magnetic field resonance, only the magnetic field resonance is transmitted between wireless charging coils which resonate at the same frequency, other devices cannot accept wave bands, and the magnetic field used in the wireless charging technology is harmless to human bodies. The charging base and the mobile phone terminal are respectively provided with a built-in coil, when the charging base and the mobile phone terminal are close to each other, the transmitting coil generates a certain current in the mobile phone receiving coil through electromagnetic induction based on alternating current with a certain frequency, so that point energy is transferred from the transmitting end to the receiving end, and the mobile phone is supplied with power from the charging base.

[0005] At present, people have higher and higher requirements on the thickness of mobile phones, and generally, light and thin mobile phones are more favored by consumers. Due to the complexity of the internal structure of the mobile phone, how to reasonably arrange the internal structure of the mobile phone is sought by developers. At present, the NFC function and the wireless function of charging are very important to smart mobile phone always, and current cell-phone adopts single-layer structure on the overall arrangement of wireless charging coil usually, and the utilization efficiency of electric field is low to there is not the technical scheme that fuses wireless coil and the NFC coil that charges, the design of disconnect-type occupies the cell-phone inner space, influences the design effect of cell-phone.

DISCLOSURE

[0006] SUMMERY OF THE UTILITY MODEL

[0007] Therefore, the embodiment of the utility model provides a wireless charging coil structure of cell-phone innovates the inside wireless charging coil structure of cell-phone, fuses the NFC coil effectively, improves cell-phone inner space utilization.

[0008] In order to achieve the above object, the embodiments of the present invention provide the following technical solutions: a wireless charging coil structure of a mobile phone comprises a circuit board, wherein a first connecting part is formed on the circuit board, and a first golden finger is arranged on the first connecting part; one side of the circuit board is printed with a first charging coil body, and the other side of the circuit board is printed with a second charging coil body; the first golden finger is connected

with the first charging coil body, a first jumping wire portion and a second jumping wire portion are arranged on the first charging coil body, the first charging coil body passes through the first jumping wire portion and is communicated with the second charging coil body, the first charging coil body further passes through the second jumping wire portion and is communicated with the second charging coil body, and the first charging coil body and the second charging coil body are connected in series to form a double-layer structure.

[0009] As a preferred scheme of the wireless charging coil structure of the mobile phone, a second connecting part is formed on the circuit board, and a second golden finger is arranged on the second connecting part; one side of the circuit board is printed with a first NFC coil body, and the other side of the circuit board is printed with a second NFC coil body; the second gold finger is connected with the first NFC coil body.

[0010] As a preferred scheme of the wireless charging coil structure of the mobile phone, a third jumper part and a fourth jumper part are arranged on the first NFC coil body, the first NFC coil body is communicated with the second NFC coil body through the third jumper part, the first NFC coil body is also communicated with the second NFC coil body through the fourth jumper part, and the first NFC coil body and the second NFC coil body are connected in series to form a double-layer structure.

[0011] As a preferable scheme of the wireless charging coil structure of the mobile phone, the first NFC coil body is wound around the periphery of the first charging coil body, and the second NFC coil body is wound around the periphery of the second charging coil body.

[0012] As the preferred scheme of the wireless charging coil structure of the mobile phone, the second golden finger is provided with a first NFC positive terminal and a first NFC negative terminal, and the second golden finger is connected with the mobile phone mainboard through the first NFC positive terminal and the first NFC negative terminal.

[0013] As the preferred scheme of the wireless charging coil structure of the mobile phone, the first golden finger is provided with a first charging positive terminal and a first charging negative terminal, and the first golden finger is connected with the mobile phone mainboard through the first charging positive terminal and the first charging negative terminal.

[0014] As the preferred scheme of the wireless charging coil structure of the mobile phone, the circuit board is provided with heat dissipation holes.

[0015] As the preferred scheme of the wireless charging coil structure of the mobile phone, the circuit board is made of nanocrystalline materials, and the circuit board is covered with insulating ink and gum.

[0016] The utility model discloses an embodiment has following advantage: one side of the circuit board is printed with a first charging coil body, and the other side of the circuit

board is printed with a second charging coil body; the first golden finger is connected with the first charging coil body, a first wire jumping part and a second wire jumping part are arranged on the first charging coil body, the first charging coil body is communicated with the second charging coil body through the first wire jumping part, the first charging coil body is also communicated with the second charging coil body through the second wire jumping part, and the first charging coil body and the second charging coil body are connected in series to form a double-layer structure. This technical scheme innovates the inside wireless charging coil structure of cell-phone, fuses the NFC coil effectively, improves cell-phone inner space utilization, and the utilization efficiency of electric field is high, makes the design of cell-phone more frivolous. The mobile phone gets rid of the constraint of various charging interfaces, and is convenient to operate and charge.

DRAWINGS DESCRIPTION

[0018] In order to more clearly illustrate the embodiments of the present invention or the technical solutions in the prior art, the drawings used in the description of the embodiments or the prior art will be briefly described below. It should be apparent that the drawings in the following description are merely exemplary, and that other embodiments can be derived from the drawings provided by those of ordinary skill in the art without inventive effort.

[0019] The structure, ratio, size and the like shown in the present specification are only used for matching with the content disclosed in the specification, so as to be known and read by people familiar with the technology, and are not used for limiting the limit conditions which can be implemented by the present invention, so that the present invention has no technical essential significance, and any structure modification, ratio relationship change or size adjustment should still fall within the scope which can be covered by the technical content disclosed by the present invention without affecting the efficacy and the achievable purpose of the present invention.

[0020] Fig. 1 is a schematic front view of a wireless charging coil structure of a mobile phone provided in an embodiment of the present invention;

[0021] fig. 2 is a schematic reverse side view of a wireless charging coil structure of a mobile phone provided in an embodiment of the present invention;

[0022] fig. 3 is a schematic diagram of a circuit board of a wireless charging coil structure of a mobile phone according to an embodiment of the present invention;

[0023] in the figure: 1. a circuit board; 2. a first connection portion; 3. a first golden finger; 4. a first charging coil body; 5. a second charging coil body; 6. a first jumper section; 7. a second jumper portion; 8. a second connecting portion; 9. a second golden finger; 10. a first NFC coil body; 11. a second NFC coil body; 12. a third jumper portion; 13. a fourth jumper portion; 14. a first charging positive terminal; 15. a first charging negative terminal; 16. a first NFC positive terminal; 17. a first NFC negative terminal; 18. And (4) heat dissipation holes.

INVENTION MODE

[0024] Detailed Description

[0025] The present invention is described in terms of specific embodiments, and other advantages and benefits of the present invention will become apparent to those skilled in the art from the following disclosure. Based on the embodiments in the present invention, all other embodiments obtained by a person skilled in the art without creative work belong to the protection scope of the present invention.

[0026] In the present specification, the terms "upper", "lower", "left", "right", "middle", and the like are used for the sake of clarity only, and are not intended to limit the scope of the present invention, and changes or adjustments of the relative relationship thereof are also considered to be the scope of the present invention without substantial changes in the technical content.

[0027] Referring to fig. 1, 2 and 3, a wireless charging coil structure of a mobile phone is provided, which includes a circuit board 1, a first connecting portion 2 is formed on the circuit board 1, and a first gold finger 3 is arranged on the first connecting portion 2; one side of the circuit board 1 is printed with a first charging coil body 4, and the other side of the circuit board 1 is printed with a second charging coil body 5; the first golden finger 3 is connected with the first charging coil body 4, a first jumping wire part 6 and a second jumping wire part 7 are arranged on the first charging coil body 4, the first charging coil body 4 passes through the first jumping wire part 6 and is communicated with the second charging coil body 5, the first charging coil body 4 further passes through the second jumping wire part 7 and is communicated with the second charging coil body 5, and the first charging coil body 4 and the second charging coil body 5 are connected in series to form a double-layer structure.

[0028] In one embodiment of the wireless charging coil structure of the mobile phone, a second connection portion 8 is formed on the circuit board 1, and a second gold finger 9 is arranged on the second connection portion 8; a first NFC coil body 10 is printed on one surface of the circuit board 1, and a second NFC coil body 11 is printed on the other surface of the circuit board 1; the second gold finger 9 is connected to the first NFC coil body 10. In the technical scheme, NFC is an abbreviation of Near Field Communication, and is called a Near Field Communication technology in Chinese. NFC allows contactless point-to-point data transfer (within ten centimeters) between electronic devices to exchange data.

[0029] Specifically, a third jumper part 12 and a fourth jumper part 13 are arranged on the first NFC coil body 10, the first NFC coil body 10 is communicated with the second NFC coil body 11 through the third jumper part 12, the first NFC coil body 10 is also communicated with the second NFC coil body 11 through the fourth jumper part 13, and the first NFC coil body 10 and the second NFC coil body 11 are connected in series to form a double-layer structure. The first NFC coil body 10 is wound around the periphery of the first charging coil body 4, and the second NFC coil body 11 is wound around the

periphery of the second charging coil body 5. The first charging coil body 4, the second charging coil body 5, the first NFC coil body 10 and the second NFC coil body 11 are reasonably arranged on the same circuit board 1, and the internal space of the mobile phone is saved.

[0030] In an embodiment of the wireless charging coil structure of the mobile phone, the first gold finger 3 is provided with a first positive charging terminal 14 and a first negative charging terminal 15, and the first gold finger 3 is connected to a main board of the mobile phone through the first positive charging terminal 14 and the first negative charging terminal 15. The second golden finger 9 is provided with a first NFC positive terminal 16 and a first NFC negative terminal 17, and the second golden finger 9 is connected with a mobile phone mainboard through the first NFC positive terminal 16 and the first NFC negative terminal 17. The mobile phone mainboard that mentions in this technical scheme belongs to prior art, and this technical scheme does not relate to the improvement to the mobile phone mainboard, and the golden finger refers to the contact part of slot socket.

[0031] In an embodiment of the wireless charging coil structure of the mobile phone, the circuit board 1 is provided with heat dissipation holes 18. The heat dissipation holes 18 are beneficial to heat dissipation of the circuit board 1, prolong the service life of the coil structure and ensure normal performance. The circuit board 1 is made of a nanocrystalline material, the nanocrystalline material is one of the materials with the highest magnetic permeability at present, the saturation magnetic induction intensity is high, the iron loss is low, and the circuit board is a green, low-carbon and environment-friendly soft magnetic material. The formula components of the iron-based nanocrystalline material are Fe, Si, B, Cu and Nb. The nanocrystalline alloy is directly formed into an amorphous thin strip from molten steel by a rapid cooling speed technology, and then the amorphous is crystallized into a crystal structure with a nanoscale through vacuum or protective atmosphere heat treatment. The circuit board 1 is covered with insulating ink and gum. The insulating ink plays a role in protecting the circuit, and the gum enhances the stability of the circuit board 1.

[0032] In the embodiment of the present invention, one side of the circuit board 1 is printed with a first charging coil body 4, and the other side of the circuit board 1 is printed with a second charging coil body 5; the first golden finger 3 is connected with the first charging coil body 4, a first jumping wire part 6 and a second jumping wire part 7 are arranged on the first charging coil body 4, the first charging coil body 4 is communicated with the second charging coil body 5 through the first jumping wire part 6, the first charging coil body 4 is further communicated with the second charging coil body 5 through the second jumping wire part 7, and the first charging coil body 4 and the second charging coil body 5 are connected in series to form a double-layer structure. A second connecting part 8 is formed on the circuit board 1, and a second golden finger 9 is arranged on the second connecting part 8; one side of the circuit board 1 is printed with a first NFC coil body 10, and the other side of the circuit board 1 is printed with a second NFC coil body 11; the second gold finger 9 is connected to the first NFC coil body 10. The first NFC coil body 10 is provided with a third jumper part 12 and a fourth jumper

part 13, the first NFC coil body 10 is communicated with the second NFC coil body 11 through the third jumper part 12, the first NFC coil body 10 is also communicated with the second NFC coil body 11 through the fourth jumper part 13, and the first NFC coil body 10 and the second NFC coil body 11 are connected in series to form a double-layer structure. This technical scheme innovates the inside wireless charging coil structure of cell-phone, fuses the NFC coil effectively, improves cell-phone inner space utilization, and the utilization efficiency of electric field is high, makes the design of cell-phone more frivolous. The mobile phone gets rid of the constraint of various charging interfaces, and is convenient to operate and charge.

[0033] Although the invention has been described in detail with respect to the general description and the specific embodiments, it will be apparent to those skilled in the art that modifications and improvements can be made based on the invention. Therefore, such modifications and improvements are intended to be within the scope of the invention as claimed.



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(73)专利权人 深圳市创新奇通讯有限公司

地址 518000 广东省深圳市宝安区光明新
区玉塘街道田寮社区根玉路晔明模具
工业园厂房A二楼A区、三楼

(72)发明人 彭宏伟 杜小云 邓海祥 朱学海
欧庆欣 王建

(74)专利代理机构 北京知呱呱知识产权代理有
限公司 11577

代理人 武媛 吕学文

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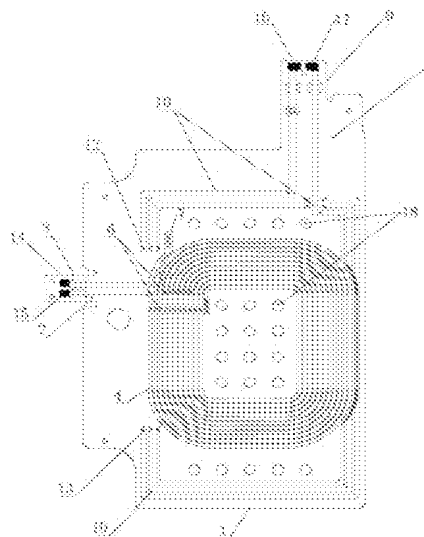
权利要求书1页 说明书4页 附图3页

(54)实用新型名称

一种手机无线充电线圈结构

(57)摘要

本实用新型实施例公开了一种手机无线充电线圈结构,包括电路板,所述电路板上形成有第一连接部,所述第一连接部上设有第一金手指;所述电路板的一面印刷有第一充电线圈体,电路板的另外一面印刷有第二充电线圈体;所述第一金手指连接所述第一充电线圈体,所述第一充电线圈体上设有第一跳线部和第二跳线部,第一充电线圈体经过所述第一跳线部与第二充电线圈体连通,第一充电线圈体还经过所述第二跳线部与第二充电线圈体连通,所述第一充电线圈体和第二充电线圈体之间串联形成双层结构。本实用新型对手机内部的无线充电线圈结构进行创新,有效地融合NFC线圈,提高手机内部空间利用率。



1. 一种手机无线充电线圈结构,其特征在于:包括电路板(1),所述电路板(1)上形成有第一连接部(2),所述第一连接部(2)上设有第一金手指(3);所述电路板(1)的一面印刷有第一充电线圈体(4),电路板(1)的另外一面印刷有第二充电线圈体(5);所述第一金手指(3)连接所述第一充电线圈体(4),所述第一充电线圈体(4)上设有第一跳线部(6)和第二跳线部(7),第一充电线圈体(4)经过所述第一跳线部(6)与第二充电线圈体(5)连通,第一充电线圈体(4)还经过所述第二跳线部(7)与第二充电线圈体(5)连通,所述第一充电线圈体(4)和第二充电线圈体(5)之间串联形成双层结构。

2. 根据权利要求1所述的一种手机无线充电线圈结构,其特征在于:所述电路板(1)上形成有第二连接部(8),所述第二连接部(8)上设有第二金手指(9);所述电路板(1)的一面印刷有第一NFC线圈体(10),电路板(1)的另外一面印刷有第二NFC线圈体(11);所述第二金手指(9)连接所述第一NFC线圈体(10)。

3. 根据权利要求2所述的一种手机无线充电线圈结构,其特征在于:所述第一NFC线圈体(10)上设有第三跳线部(12)和第四跳线部(13),第一NFC线圈体(10)经过所述第三跳线部(12)与第二NFC线圈体(11)连通,第一NFC线圈体(10)还经过所述第四跳线部(13)与第二NFC线圈体(11)连通,所述第一NFC线圈体(10)和第二NFC线圈体(11)之间串联形成双层结构。

4. 根据权利要求2所述的一种手机无线充电线圈结构,其特征在于:所述第一NFC线圈体(10)环绕在第一充电线圈体(4)的外围,所述第二NFC线圈体(11)环绕在第二充电线圈体(5)的外围。

5. 根据权利要求2所述的一种手机无线充电线圈结构,其特征在于:所述第二金手指(9)设有第一NFC正极端子(16)和第一NFC负极端子(17),第二金手指(9)通过所述第一NFC正极端子(16)和第一NFC负极端子(17)与手机主板连接。

6. 根据权利要求1所述的一种手机无线充电线圈结构,其特征在于:所述第一金手指(3)设有第一充电正极端子(14)和第一充电负极端子(15),第一金手指(3)通过所述第一充电正极端子(14)和第一充电负极端子(15)与手机主板连接。

7. 根据权利要求1所述的一种手机无线充电线圈结构,其特征在于:所述电路板(1)上设有散热孔(18)。

8. 根据权利要求1所述的一种手机无线充电线圈结构,其特征在于:所述电路板(1)采用纳米晶材质,电路板(1)上覆盖有绝缘油墨和背胶。

一种手机无线充电线圈结构

技术领域

[0001] 本实用新型实施例涉及手机充电技术领域,具体涉及一种手机无线充电线圈结构。

背景技术

[0002] 手机无线充电技术的出现,给我们的生活带来了极大的便利。无线充电使用的共振原理是磁场共振,只在以同一频率共振的无线充电线圈之间传输,而其他装置无法接受波段,无线充电技术使用的磁场本身就是对人体无害的。充电底座以及手机终端分别内置了线圈,当两者靠近,发射线圈基于一定频率的交流电通过电磁感应在手机接收线圈中产生一定的电流,从而将点能量从发射端转移到接收端,便开始从充电座向手机进行供电。

[0003] 现阶段,人们对手机的厚度要求越来越高,通常轻薄的手机更加受到消费者的青睐。由于手机内部结构复杂性,如何对手机内部结构进行合理的布局一致是研发者所追求的。目前,对于智能手机而言NFC功能和无线充电功能一直是很重要的,现有的手机在无线充电线圈的布局上通常是采用单层结构,电场的利用效率低,并且不存在将无线充电的线圈与NFC线圈进行融合的技术方案,分离式的设计占用手机内部空间,影响手机的设计效果。

实用新型内容

[0004] 为此,本实用新型实施例提供一种手机无线充电线圈结构,对手机内部的无线充电线圈结构进行创新,有效地融合NFC线圈,提高手机内部空间利用率。

[0005] 为了实现上述目的,本实用新型的实施方式提供如下技术方案:一种手机无线充电线圈结构,包括电路板,所述电路板上形成有第一连接部,所述第一连接部上设有第一金手指;所述电路板的一面印刷有第一充电线圈体,电路板的另外一面印刷有第二充电线圈体;所述第一金手指连接所述第一充电线圈体,所述第一充电线圈体上设有第一跳线部和第二跳线部,第一充电线圈体经过所述第一跳线部与第二充电线圈体连通,第一充电线圈体还经过所述第二跳线部与第二充电线圈体连通,所述第一充电线圈体和第二充电线圈体之间串联形成双层结构。

[0006] 作为手机无线充电线圈结构的优选方案,所述电路板上形成有第二连接部,所述第二连接部上设有第二金手指;所述电路板的一面印刷有第一NFC线圈体,电路板的另外一面印刷有第二NFC线圈体;所述第二金手指连接所述第一NFC线圈体。

[0007] 作为手机无线充电线圈结构的优选方案,所述第一NFC线圈体上设有第三跳线部和第四跳线部,第一NFC线圈体经过所述第三跳线部与第二NFC线圈体连通,第一NFC线圈体还经过所述第四跳线部与第二NFC线圈体连通,所述第一NFC线圈体和第二NFC线圈体之间串联形成双层结构。

[0008] 作为手机无线充电线圈结构的优选方案,所述第一NFC线圈体环绕在第一充电线圈体的外围,所述第二NFC线圈体环绕在第二充电线圈体的外围。

[0009] 作为手机无线充电线圈结构的优选方案,所述第二金手指设有第一 NFC正极端子和第一NFC负极端子,第二金手指通过所述第一NFC正极端子和第一NFC负极端子与手机主板连接。

[0010] 作为手机无线充电线圈结构的优选方案,所述第一金手指设有第一充电正极端子和第一充电负极端子,第一金手指通过所述第一充电正极端子和第一充电负极端子与手机主板连接。

[0011] 作为手机无线充电线圈结构的优选方案,所述电路板上设有散热孔。

[0012] 作为手机无线充电线圈结构的优选方案,所述电路板采用纳米晶材质,电路板上覆盖有绝缘油墨和背胶。

[0013] 本实用新型的实施方式具有如下优点:电路板的一面印刷有第一充电线圈体,电路板的另外一面印刷有第二充电线圈体;第一金手指连接第一充电线圈体,第一充电线圈体上设有第一跳线部和第二跳线部,第一充电线圈体经过第一跳线部与第二充电线圈体连通,第一充电线圈体还经过第二跳线部与第二充电线圈体连通,第一充电线圈体和第二充电线圈体之间串联形成双层结构。本技术方案对手机内部的无线充电线圈结构进行创新,有效地融合NFC线圈,提高手机内部空间利用率,电场的利用效率高,使手机的设计更加轻薄。使手机摆脱各种充电接口的束缚,操作方便,充电便捷。

附图说明

[0014] 为了更清楚地说明本实用新型的实施方式或现有技术中的技术方案,下面将对实施方式或现有技术描述中所需要使用的附图作简单地介绍。显而易见地,下面描述中的附图仅仅是示例性的,对于本领域普通技术人员来讲,在不付出创造性劳动的前提下,还可以根据提供的附图引伸获得其它的实施附图。

[0015] 本说明书所绘示的结构、比例、大小等,均仅用以配合说明书所揭示的内容,以供熟悉此技术的人士了解与阅读,并非用以限定本实用新型可实施的限定条件,故不具技术上的实质意义,任何结构的修饰、比例关系的改变或大小的调整,在不影响本实用新型所能产生的功效及所能达成的目的下,均应仍落在本实用新型所揭示的技术内容得能涵盖的范围内。

[0016] 图1为本实用新型实施例中提供的一种手机无线充电线圈结构正面示意图;

[0017] 图2为本实用新型实施例中提供的一种手机无线充电线圈结构反面示意图;

[0018] 图3为本实用新型实施例中提供的一种手机无线充电线圈结构电路板示意图;

[0019] 图中:1、电路板;2、第一连接部;3、第一金手指;4、第一充电线圈体;5、第二充电线圈体;6、第一跳线部;7、第二跳线部;8、第二连接部;9、第二金手指;10、第一NFC线圈体;11、第二NFC线圈体;12、第三跳线部;13、第四跳线部;14、第一充电正极端子;15、第一充电负极端子;16、第一NFC正极端子;17、第一NFC负极端子; 18、散热孔。

具体实施方式

[0020] 以下由特定的具体实施例说明本实用新型的实施方式,熟悉此技术的人士可由本说明书所揭露的内容轻易地了解本实用新型的其他优点及功效,显然,所描述的实施例是本实用新型一部分实施例,而不是全部的实施例。基于本实用新型中的实施例,本领域普通

技术人员在没有做出创造性劳动前提下所获得的所有其他实施例,都属于本实用新型保护的范围。

[0021] 本说明书中所引用的如“上”、“下”、“左”、“右”、“中间”等的用语,亦仅为便于叙述的明了,而非用以限定本实用新型可实施的范围,其相对关系的改变或调整,在无实质变更技术内容下,当亦视为本实用新型可实施的范畴。

[0022] 参见图1、图2和图3,提供一种手机无线充电线圈结构,包括电路板1,所述电路板1上形成有第一连接部2,所述第一连接部2上设有第一金手指3;所述电路板1的一面印刷有第一充电线圈体4,电路板1的另外一面印刷有第二充电线圈体5;所述第一金手指3连接所述第一充电线圈体4,所述第一充电线圈体4上设有第一跳线部6和第二跳线部7,第一充电线圈体4经过所述第一跳线部6与第二充电线圈体5连通,第一充电线圈体4还经过所述第二跳线部7与第二充电线圈体5连通,所述第一充电线圈体4和第二充电线圈体5之间串联形成双层结构。

[0023] 手机无线充电线圈结构的一个实施例中,所述电路板1上形成有第二连接部8,所述第二连接部8上设有第二金手指9;所述电路板1的一面印刷有第一NFC线圈体10,电路板1的另外一面印刷有第二NFC线圈体11;所述第二金手指9连接所述第一NFC线圈体10。本技术方案中的NFC是Near Field Communication缩写,中文全称近距离无线通讯技术。NFC允许电子设备之间进行非接触式点对点数据传输(在十厘米内)交换数据。

[0024] 具体的,所述第一NFC线圈体10上设有第三跳线部12和第四跳线部13,第一NFC线圈体10经过所述第三跳线部12与第二NFC线圈体11连通,第一NFC线圈体10还经过所述第四跳线部13与第二NFC线圈体11连通,所述第一NFC线圈体10和第二NFC线圈体11之间串联形成双层结构。所述第一NFC线圈体10环绕在第一充电线圈体4的外围,所述第二NFC线圈体11环绕在第二充电线圈体5的外围。在同一个电路板1上对第一充电线圈体4、第二充电线圈体5、第一NFC线圈体10和第二NFC线圈体11进行合理的布局,节约手机内部空间。

[0025] 手机无线充电线圈结构的一个实施例中,所述第一金手指3设有第一充电正极端子14和第一充电负极端子15,第一金手指3通过所述第一充电正极端子14和第一充电负极端子15与手机主板连接。所述第二金手指9设有第一NFC正极端子16和第一NFC负极端子17,第二金手指9通过所述第一NFC正极端子16和第一NFC负极端子17与手机主板连接。本技术方案中提到的手机主板属于现有技术,本技术方案不涉及对手机主板的改进,金手指指的是插槽插口的接触部分。

[0026] 手机无线充电线圈结构的一个实施例中,所述电路板1上设有散热孔18。散热孔18有利于电路板1的散热,延长线圈结构的使用寿命,保证正常的性能。所述电路板1采用纳米晶材质,纳米晶材料是目前导磁率最高的材料之一,高饱和磁感应强度,低铁损,是绿色低碳环保的软磁材料。铁基纳米晶材料配方成分为Fe, Si, B, Cu, Nb。先通过快速冷速技术,把纳米晶合金从熔融的钢水直接成型为非晶态的薄带,然后通过真空或保护气氛热处理,使非晶晶化成具有纳米级尺度的晶体结构。电路板1上覆盖有绝缘油墨和背胶。绝缘油墨起到保护线路的作用,背胶增强电路板1的稳定性。

[0027] 本实用新型的实施方式中,电路板1的一面印刷有第一充电线圈体4,电路板1的另外一面印刷有第二充电线圈体5;第一金手指3连接第一充电线圈体4,第一充电线圈体4上设有第一跳线部6和第二跳线部7,第一充电线圈体4经过第一跳线部6与第二充电线圈体5

连通,第一充电线圈体4还经过第二跳线部7与第二充电线圈体5连通,第一充电线圈体4和第二充电线圈体5之间串联形成双层结构。电路板1上形成有第二连接部8,第二连接部8上设有第二金手指9;电路板1的一面印刷有第一NFC线圈体10,电路板1的另外一面印刷有第二NFC线圈体11;第二金手指9连接第一NFC线圈体10。第一NFC线圈体10上设有第三跳线部12和第四跳线部13,第一NFC线圈体10经过第三跳线部12与第二NFC线圈体11连通,第一NFC线圈体10还经过第四跳线部13与第二NFC线圈体11连通,第一NFC线圈体10和第二NFC线圈体11之间串联形成双层结构。本技术方案对手机内部的无线充电线圈结构进行创新,有效地融合NFC线圈,提高手机内部空间利用率,电场的利用效率高,使手机的设计更加轻薄。使手机摆脱各种充电接口的束缚,操作方便,充电便捷。

[0028] 虽然,上文中已经用一般性说明及具体实施例对本实用新型作了详尽的描述,但在本实用新型基础上,可以对之作一些修改或改进,这对本领域技术人员而言是显而易见的。因此,在不偏离本实用新型精神的基础上所做的这些修改或改进,均属于本实用新型要求保护的范围。

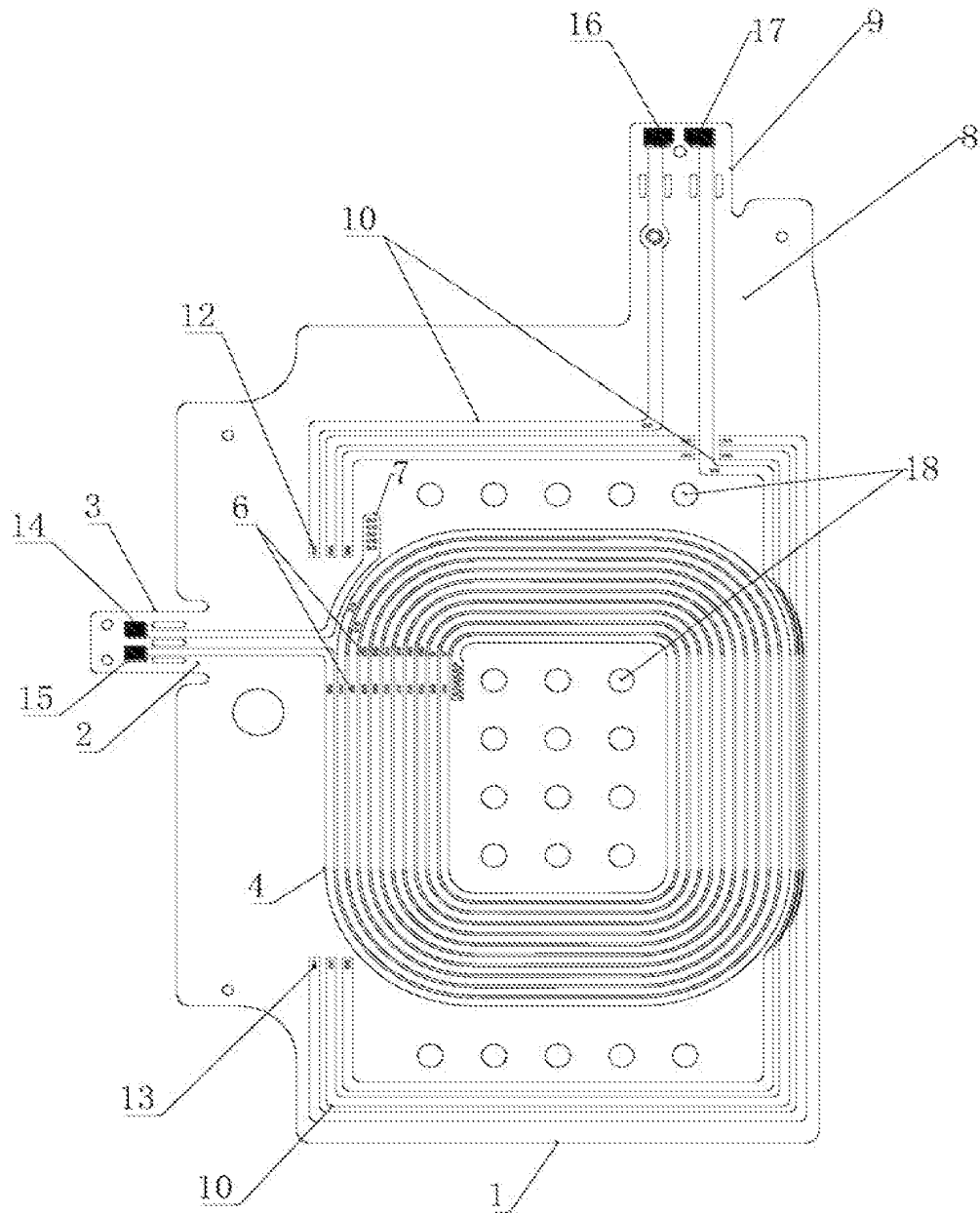


图1

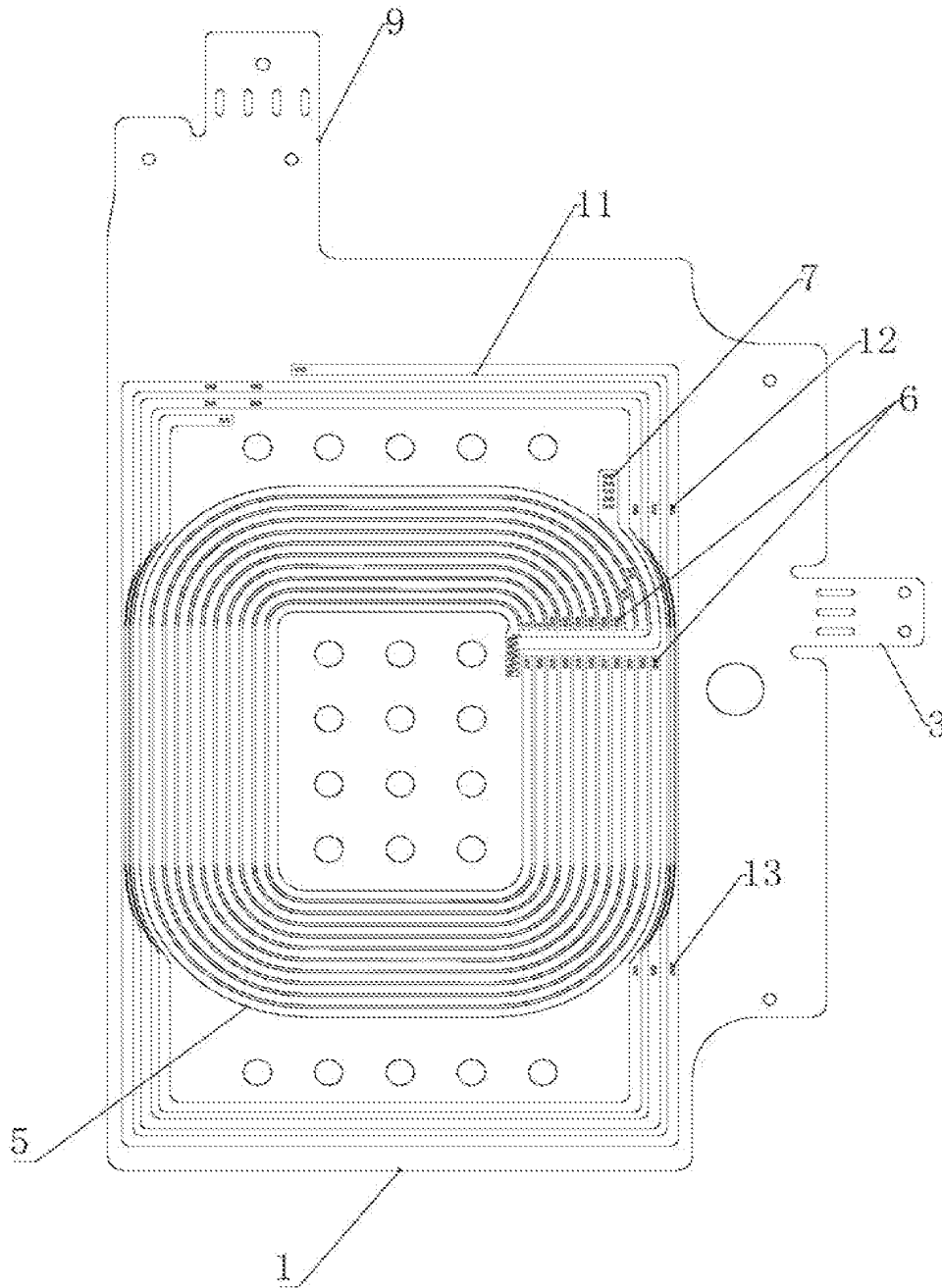


图2

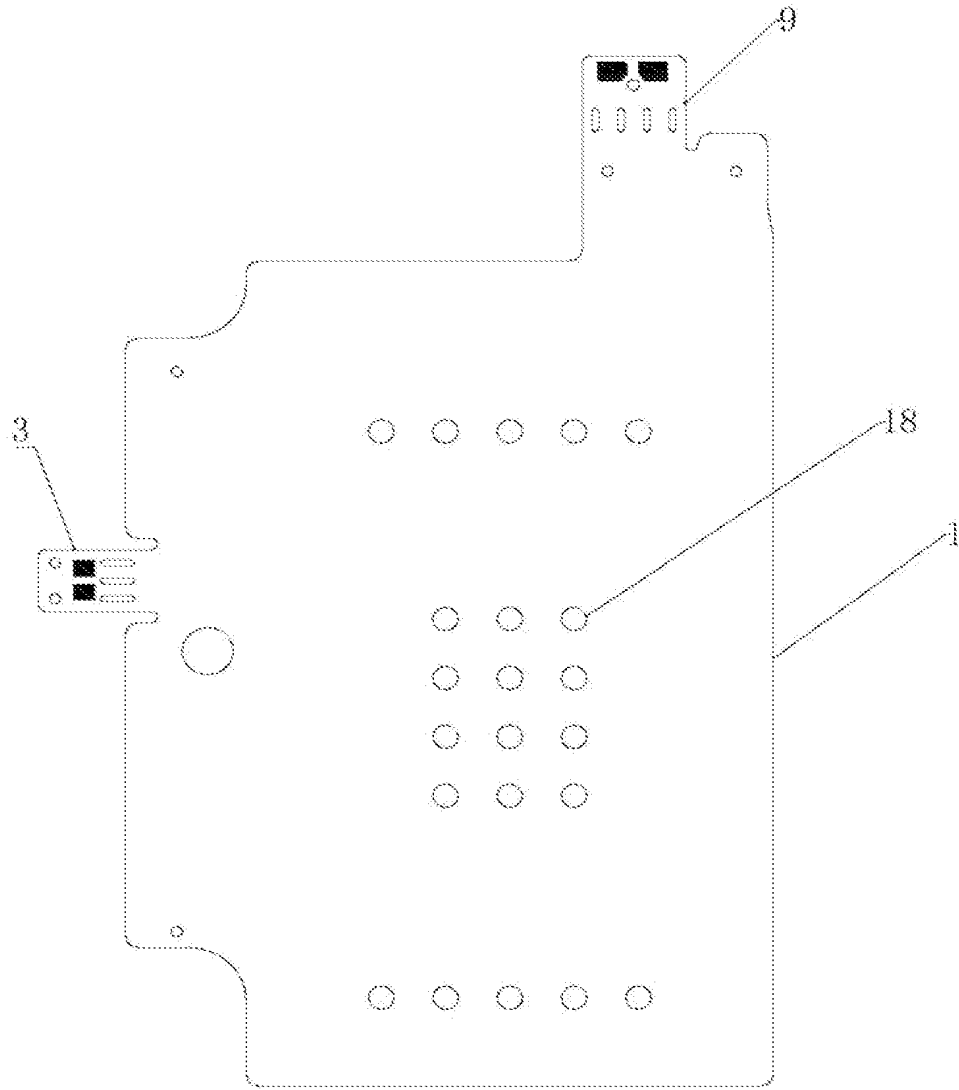


图3



(11)

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(71) Applicant: **NuCurrent, Inc.**
Chicago, IL 60661 (US)

(72) Inventors:
• **PERALTA, Alberto**
Chicago, IL Illinois 60661 (US)
• **SINGH, Vinit**
Austin, TX Texas 78704 (US)
• **RAJAGOPALAN, Ajit**
Chicago, IL Illinois 60661 (US)
• **LUZINSKI, Jason**
Chicago, IL Illinois 60608 (US)
• **BABCOCK, Jacob**
Chicago, IL Illinois 60642 (US)
• **FRYSZ, Christine, A.**
Orchard Park, NY New York 14127 (US)

(74) Representative: **Müller-Boré & Partner**
Patentanwälte PartG mbB
Friedenheimer Brücke 21
80639 München (DE)

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(54) **SINGLE LAYER MULTI MODE ANTENNA FOR WIRELESS POWER TRANSMISSION USING
MAGNETIC FIELD COUPLING**

(57) Various embodiments of a single structure multiple mode antenna are described. The antenna is preferably constructed of a single layer having a first inductor coil that is electrically connected in series with a second inductor coil. The antenna is constructed having a plurality of electrical connections positioned along the first and second inductor coils. A plurality of terminals facilitates connection of the electrical connections thereby providing numerous electrical connection configurations and enables the antenna to be selectively tuned to various frequencies and frequency bands.

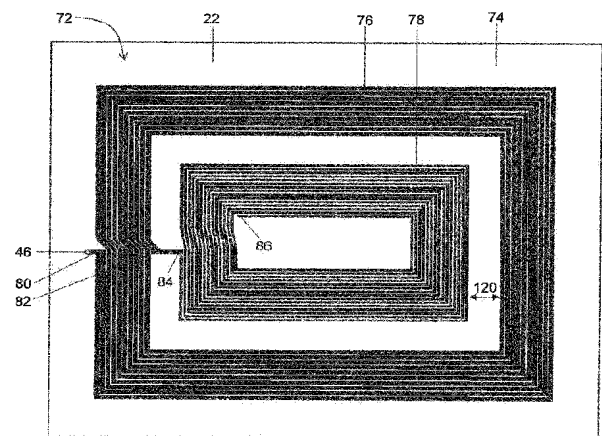


FIG. 3B

Description**TECHNICAL FIELD**

5 **[0001]** The present disclosure relates generally to the wireless transmission of electrical energy and data. More specifically, this application relates to an antenna that facilitates the wireless transmission of data and electrical energy at multiple operating frequency bands.

BACKGROUND

10 **[0002]** Wireless energy transfer is useful in cases where the interconnection of wires may be inconvenient, hazardous or impossible. In recent years, applications employing near-field wireless power and/or data transmission have gained prominence in areas such as consumer electronics, medical systems, military systems and industrial applications. Near-field communication enables the transfer of electrical energy and/or data wirelessly through magnetic field induction
15 between a transmitting antenna and a corresponding receiving antenna. Near-field communication interface and protocol modes are defined by ISO/IEC standard 18092.

[0003] However, near-field communication is often not optimal because prior art antennas that facilitate the wireless transfer of electrical power and/or data operate inefficiently. In such cases, the amount of electrical energy received by the corresponding antenna is generally significantly less than the amount of electrical energy initially transmitted. In
20 addition, data that is received may be incomplete or may become corrupted. In addition, near-field communication generally suffers from reduced wireless transfer distances, i.e., the transmission range, and physical antenna orientation issues. These inefficiencies of near field communication are largely due to the low quality factor of the prior art antennas in addition to the inefficient large size of prior art antennas. In general, prior art near field communication antennas have a relatively large size that hinders efficient operation and wireless transmission. Size and efficiency are often a tradeoff,
25 a problem which becomes more acute when multiple wireless operations are desired, i.e., multiple modes of operation. A solution to inefficient near-field communication is antenna integration.

[0004] Inductive solutions transfer power and/or data between two inductor coils that are placed in close proximity to each other. This technology, for example, facilitates the deployment of inductive charging "hot spots" that enables
30 wireless electrical charging of electronic devices by simply placing them near a charging "hot spot", such as on a surface of a table. However, for these systems to operate efficaciously, the respective transmitter and receiver antennas are required to not only be located in close proximity to each other but, in addition, must also be physically positioned in a specific orientation with respect to one another. Typically, these prior art antennas require that they are physically positioned in near perfect alignment such that the centers of the respective transmitting and receiving antennas are oriented in perfect opposition to each other in order to operate efficaciously. This general requirement for near perfect
35 physical alignment of the transmitting and receiving antennas typically leads to poor near field communication performance as it is challenging to achieve perfect alignment of the opposing transmitting and receiving antennas to ensure proper wireless power and/or data transfer.

[0005] As a result, use of these prior art antennas leads to near field communication that is generally not reliable and significantly reduced operating efficiency. As defined herein "inductive charging" is a wireless charging technique that
40 utilizes an alternating electromagnetic field to transfer electrical power between two antennas. "Resonant inductive coupling" is defined herein as the near field wireless transmission of electrical energy between two magnetically coupled coils that are part of two spaced apart resonant circuits that are tuned to resonate at the same frequency. "Magnetic resonance" is defined herein as the excitation of particles (as atomic nuclei or electrons) in a magnetic field by exposure to electromagnetic radiation of a specific frequency.

[0006] Various multimode wireless power solutions have been developed to address these antenna positioning and proximity limitations and concomitant of reliability & efficiency issues. In some cases, operating frequency bands have been reduced, for example, a frequency band that ranges from about 150 kHz to about 250 kHz to increase range from about 15 mm to about 20 mm has been achieved by resonating the receiving antenna at a frequency that is about the same as the frequency of the transmitting antenna, both of which are similar to the frequency at which power transfer
50 is taking place. However, such solutions have not sufficiently addressed the need to provide increased efficient wireless transfer with multiple mode operation capability through modification of the antenna structure.

[0007] Inductive and resonance interface standards have been developed to create global standards for wireless charging technologies. "Qi" is a wireless inductive power transfer standard/specification. Specifically, the Qi wireless inductive power transfer standard is an interface standard that was developed by the Wireless Power Consortium. The Qi interface standard is a protocol generally intended to facilitate transfer of low electrical power up to about 15W at
55 frequencies ranging from 100 kHz to about 200 kHz over distances ranging from about 2 mm to about 5 mm.

[0008] "Rezence" is a competing interface standard developed by the Alliance for Wireless Power (A4WP) for wireless electrical power transfer based on the principles of magnetic resonance. Specifically, the Rezence interface standard

currently supports electrical power transfer up to about 50W, at distances up to about 5 cm. Unlike the Qi interface standard, the Rezence interface standard utilizes an increased frequency of about 6.78 MHz +/- 15 kHz.

[0009] In addition, there exists a third standard developed by the Power Matters Alliance (PMA) that operates in the frequency range of about 100 kHz to about 350 kHz. Unlike prior art multi-band antennas, the multi-band single structure antenna of the present disclosure is capable of receiving and/or transmitting signals and/or electrical energy across all of these standards with one antenna.

[0010] Currently these standards are the preeminent standards for wireless power technology in consumer electronics. Although these standards are relatively new to the market, the surge in development of small portable wireless devices and the proliferation of wireless transmission solutions into other wireless applications increases the need for, and adoption of, these standards. The Qi interface standard, released in 2010, has already been widely adopted. The Qi interface standard is currently incorporated into more than 20 million products world-wide.

[0011] Antennas are a key building block in the construction of wireless power and/or data transmission systems. As wireless technologies have developed, antennas have advanced from a simple wire dipole to more complex structures. Multi-mode antennas have been designed to take advantage of different wireless interface standards. For example, Qi inductive wireless charging was first demonstrated in an Android smartphone more than four years ago. In 2015, the Samsung® Galaxy S6® supports two wireless charging standards, namely PMA and WPC's Qi. This solution, however, addresses inductive interface standards only. Given the differences in, for example, performance efficiencies, size, transfer range, and positioning freedom between inductive transmission versus resonance-based transmission, what is needed is a single antenna board that works with all types of wireless charging standards, for example, the PMA standard, WPC's Qi standard and A4WP's Rezence standard.

[0012] Furthermore, some wireless transmission applications will utilize a combination of standards-based and/or non-standards-based transfer protocols. The multi-band single structure antenna of the present disclosure is capable of receiving and/or transmitting signals and/or electrical energy across any combination of standards-based and/or non-standards-based transfer protocols with one antenna.

[0013] Prior art "multi mode" antennas, referred to as "Two-Structure Dual Mode" (TSDM) antennas, are typically constructed having two discrete antenna structures that are positioned on a substrate. The two discrete antenna structures that comprise a TSDM antenna operate independent of each other and require separate terminal connections to each of the respective independent antenna. FIG. 1 illustrates an example of such a prior art two-structure dual mode antenna 10 which comprises a first exterior inductor 12 and a second, separate interior inductor 14, each antenna having a positive and negative terminal connection respectively that are not electrically connected. However, such TSDM antennas have a relatively large footprint which comprises a significant amount of space and surface area. Such TSDM antennas are therefore, not ideally suited for incorporation with small electronic devices or positioned within small confined spaces.

[0014] Two-structure multi-mode (TSMM) antennas 10 are generally constructed such that both the separate exterior and interior inductors 12, 14 each have a specific inductance. Thus, the exterior inductor 12 is constructed having a specific number of exterior inductor turns and the interior inductor 14 is constructed having a specific number of interior inductor turns. In this structure, the two respective coils operate as independent antennas. Coil-based TSMM antennas fundamentally require a large amount of area to enable better performance. Specifically, antenna coupling between the exterior and interior antennas require that they be positioned a distance away from each other such that energy generated from one antenna is not absorbed by the other. Furthermore, in a traditional TSMM configuration, when the "interior" antenna is operating, the area extending from the outermost trace of the internal antenna to the outermost trace of the exterior antenna is not being utilized and, thus, is "wasted" space.

SUMMARY

[0015] The present disclosure provides various embodiments of an antenna that is capable of wirelessly receiving and/or transmitting electrical power and/or data between different locations. Specifically, the antenna of the present disclosure is designed to enable wireless reception or transmission of electrical power and/or data over multiple frequencies such as the specifications established by the Qi and Rezence interface standards, as previously mentioned. The multi-mode antenna of the present disclosure is of a single structure comprising at least two inductor coils that are electrically connected in series. In an embodiment, the single structure multi-mode antenna of the present disclosure may comprise a composite of at least one substrate on which at least one electrically conductive filar is disposed. Furthermore, at least one of the substrate layers that comprise the single structure antenna may be composed of a different material. Alternatively, the single structure antenna of the present disclosure may be constructed without a substrate.

[0016] The single structure antenna of the present disclosure preferably comprises at least two inductor coils that are electrically connected in series. Each of the inductors is preferably composed of an electrically conductive material such as a wire, which may include, but is not limited to, a conductive trace, a filar, a filament, a wire, or combinations thereof. It is noted that throughout this specification the terms, "wire", "trace", "filament" and "filar" may be used interchangeably.

As defined herein, the word "wire" is a length of electrically conductive material that may either be of a two dimensional conductive line or track that may extend along a surface or alternatively, a wire may be of a three dimensional conductive line or track that is contactable to a surface. A wire may comprise a trace, a filar, a filament or combinations thereof. These elements may be a single element or a multitude of elements such as a multifilar element or a multifilament element. Further, the multitude of wires, traces, filars, and filaments may be woven, twisted or coiled together such as in a cable form. The wire as defined herein may comprise a bare metallic surface or alternatively, may comprise a layer of electrically insulating material, such as a dielectric material that contacts and surrounds the metallic surface of the wire. A "trace" is an electrically conductive line or track that may extend along a surface of a substrate. The trace may be of a two dimensional line that may extend along a surface or alternatively, the trace may be of a three dimensional conductive line that is contactable to a surface. A "filar" is an electrically conductive line or track that extends along a surface of a substrate. A filar may be of a two dimensional line that may extend along a surface or alternatively, the filar may be a three dimensional conductive line that is contactable to a surface. A "filament" is an electrically conductive thread or threadlike structure that is contactable to a surface.

[0017] In a preferred embodiment, the at least two inductor coils are disposed on an external surface of one of the plurality of substrates. Alternatively, at least one of the plurality of inductor coils may be disposed on each of the substrates that comprise the antenna structure. At least one via may be provided that connects at least two of the conductive materials that comprise the inductors of the antenna. In a preferred embodiment, the at least one via may be provided to create an electrical shunt connection between the coils, or portions thereof. As defined herein the term "shunt" means an electrically conductive pathway that is created by electrically joining two points of a circuit such that an electrical current or an electrical voltage may pass therethrough.

[0018] The inductor coils are strategically positioned and electrically connected in series to facilitate the reception and/or transmission of wirelessly transferred electrical power or data through near field magnetic induction at either, both or all frequency ranges of about 100 kHz to about 200 kHz (Qi interface standard), 100kHz to about 350 kHz (PMA interface standard), 6.78 MHz (Rezence interface standard), or alternatively at a frequency being employed by the device in a proprietary recharging mode. In addition, the antenna of the present disclosure may be designed to receive or transmit over a wide range of frequencies on the order of about 1 kHz to about 1 GHz or greater in addition to the Qi and Rezence interfaces standards.

[0019] In addition to enabling dynamic adjustment of the antenna's operating frequency, the single structure of the present disclosure also enables dynamic adjustment of its self-resonance frequency. Such self resonant frequencies are typically utilized for radio frequency (RF) communication such as a cellular phone or radio. The single structure antenna of the present application is capable of self resonant frequencies that range from about 1 kHz to about 500 GHz. Furthermore, the single structure antenna of the present application is capable of dynamically adjusting the inductance exhibited by the antenna.

[0020] Such a dynamic adjustment of at least one of the operating frequency, resonance frequency and inductance of the antenna is preferably accomplished through modifying the various connections within the antenna. More specifically, the operating frequency, the self-resonance frequency and/or the inductance of the antenna can be changed by modifying the various "tapped" inductance coil electrical connections that are strategically positioned therewithin. Thus, by modifying the sequence of the electrical connections between the at least various portions of the electrically connected inductor coils that comprise the antenna, the operating frequency, resonance frequency and/or inductance can be dynamically adjusted to meet various application requirements. Moreover, by dynamically adjusting the electrical connections within the antenna of the present disclosure, the separation distance between adjacent antennas that facilitates data or electrical power transfer can also be adjusted to meet specific application requirements. As defined herein, the term "tapped" means an electrical connection between at least two points.

[0021] In a preferred embodiment, various materials may be incorporated within the structure of the antenna to shield the coils from magnetic field and/or electromagnetic interference and, thus, further enhance the antenna's electrical performance. Specifically, magnetic field shielding materials, such as a ferrite material, may be positioned about the antenna structure to either block or absorb magnetic fields that create undesirable proximity effects that increase electrical impedance within the antenna. As will be discussed in more detail, these proximity effects generally increase electrical impedance within the antenna which results in a degradation of the quality factor. In addition, the magnetic field shielding materials may be positioned about the antenna structure to increase inductance and/or act as a heat sink within the antenna structure to minimize over heating of the antenna. Furthermore, such materials may be utilized to modify the magnetic field profile of the antenna. Modification of the magnetic field(s) exhibited by the single structure antenna of the present disclosure may be desirable in applications such as wireless charging. For example, the profile and strength of the magnetic field exhibited by the antenna may be modified to facilitate and/or improve the efficiency of wireless power transfer between the antenna and an electric device such as a cellular phone. Thus, by modifying the profile and/or strength of the magnetic field about an electronic device being charged, minimizes undesirable interferences which may hinder or prevent transfer of data or an electrical charge therebetween.

[0022] Thus, the single structure antenna of the present disclosure is of an efficient design that is capable of operating

over multiple frequencies having an optimized inductance and quality factor that comprises at least two inductor coils that are electrically connected in series. The single structure antenna of the present disclosure enables the antenna to be tuned to a multitude of customizable frequencies and frequency bands to facilitate optimized wireless transfer of electrical energy and/or data.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

FIG. 1 illustrates an embodiment of a prior art four terminal two-structure dual mode antenna.
 FIG. 2 shows an embodiment of a three terminal single structure multiple mode antenna of the present disclosure comprising a switch circuit.
 FIG. 2A is an electrical schematic diagram of the three terminal single structure multiple mode antenna illustrated in FIG. 2.
 FIG. 3 illustrates an embodiment of a three terminal single structure multiple mode antenna of the present disclosure.
 FIG. 3A is an electrical schematic diagram of the three terminal embodiment of the antenna shown in FIG. 3.
 FIG. 3B is an embodiment of a first layer of a multi-layer single structure multiple mode antenna of the present disclosure.
 FIG. 3C is an embodiment of a second layer of a multi-layer single structure multiple mode antenna of the present disclosure.
 FIG. 3D illustrates a magnified view of a portion of an inductor coil having a plurality of shunted via connections.
 FIG. 3E is an embodiment of a three terminal single structure multiple mode antenna of the present disclosure in which the respective terminals are connected to a single filar.
 FIG. 3F is a magnified view showing an embodiment in which the filars of an inductor coil are electrically bypassing the terminal lines.
 FIG. 4 is an electrical schematic diagram of the four terminal antenna embodiment of the present disclosure shown in FIG. 4.
 FIG. 5 shows an embodiment of a single structure multiple mode antenna of the present disclosure comprising a conductive filar with a variable width.
 FIGS. 6A-6E illustrate cross-sectional views of different embodiments of the antenna of the present disclosure with different ferrite material shielding configurations.
 FIG. 7 is a flow diagram that illustrates an embodiment of a fabrication process of a single structure antenna of the present disclosure.
 FIG. 8A illustrates an embodiment of the magnetic field strengths generated by a single turn coil antenna.
 FIG. 8B illustrates an embodiment of the magnetic field strengths generated by a two turn coil antenna.
 FIG. 8C illustrates an embodiment of the magnetic field strengths generated by a three turn coil antenna.
 FIG. 9 shows an embodiment of a two coil antenna fabricated from a metal stamping process.
 FIG. 10 is a flow chart that illustrates an embodiment of a fabrication process of a single structure antenna of the present disclosure having a unitary body structure.
 FIG. 11 shows a theoretical embodiment of a single structure antenna of the present disclosure comprising $n+1$ number of terminals.
 FIGS. 12A-12C illustrate various embodiments of electrical switch configurations that provide different electrical connections between inductor coils.
 FIG. 13 is a flow chart that illustrates an embodiment of operating a single structure antenna of the present disclosure.

DETAILED DESCRIPTION

[0024] In the following description, numerous specific details are set forth by way of examples in order to provide a thorough understanding of the relevant teachings. However, it should be apparent to those skilled in the art that the present teachings may be practiced without such details. In other instances, well known methods, procedures, components, and/or circuitry have been described at a relatively high-level, without detail, in order to avoid unnecessarily obscuring aspects of the present teachings.

[0025] The antenna and communication system thereof of the present disclosure provides for improved induction communication, such as near field communication. More specifically, the antenna of the present disclosure is of a single structure design that enables coupled magnetic resonance. Coupled magnetic resonance is an alternative technology that when appropriately designed, can provide for increased wireless power transfer and communication efficiencies and is less dependent of physical orientation and positioning requirements of prior art antennas. As a result, the antenna of the present disclosure provides for improved wireless transfer efficiency and a better user experience.

[0026] The multi-band single structure antenna of the present disclosure also enables increased transmission range. As will be discussed in more detail, the structure of the antenna of the present disclosure enables tuning of the operating frequency. This enables the operator to quickly modify the receiving antenna's operating frequency to match the frequency of the transmitted signal or, alternatively, transmit a signal at an increased frequency using a frequency multiplier to match the increased operating frequency of a receiving antenna. Furthermore, the single structure antenna of the present disclosure may also comprise a selection circuit which may be capable of conditioning or modifying the received or transmitted signal. An example of which includes modifying the operating frequency of the antenna by a frequency multiplying factor to increase range.

[0027] In addition, the antenna of the present disclosure enables increased operating frequencies. Operating at a higher frequency range provides for smaller antenna form factors. For example, consider a generic transmitting and receiving antenna combination both operating at a frequency ($\square\square$) that are spaced a distance d apart and have a coupling factor, k . The transmitting antenna has a transmitting antenna inductance (L_{TX}) and the receiving antenna has a receiving antenna inductance (L_{RX}). In this scenario, the induced voltage at the receiving antenna is given by the formula:

$$V_{induced} \sim \omega k \sqrt{L_{TX} L_{RX}}$$

[0028] Based on the equation above, if the frequency of operation ($\square\square$) is increased, the respective transmitting and receiving antenna inductances required to produce a similar induced voltage is reduced, given a similar coupling factor, k . Thus, as a result, smaller inductors that require less space can be utilized for the respective antennas. For example, if the form factor, i.e., surface area of the coils is kept nearly identical having a similar coupling coefficient, a thinner receiver coil or transmitter coil may be possible by designing for a reduced receiving or transmitting inductance because of the increased operating frequency ($\square\square$).

[0029] In wearable electronics, where space is at a premium, operating at a higher frequency and tuning the respective inductors of the receiving antenna closer to the intended frequency of transmission provides the potential of increased performance, i.e., improved quality factor and increased induced voltages in a smaller form factor.

[0030] In contrast to the prior art TSM antenna, the single-structure multi-mode (SSMM) antenna of the present disclosure provides an efficient design that enables the reception and transmission of a multitude of a non-limiting range of frequencies which includes the frequency specification of the Qi and Rezence interface standards, in addition to many other wireless electrical power transfer standards. In addition, the single structure multi-mode antenna of the present disclosure enables multiple communication based standards such as, but not limited to, near field communication (NFC), radio frequency identification (RFID), multi-mode standard transponder (MST), in addition to a host of frequency standards that operate at frequencies greater than about 400 MHz. The physical mechanism of these multiple "power" transfer and/or "communications" modes may be purely magnetic, such as via magnetic fields, electromagnetic, such as via electromagnetic waves, electrical, such as via capacitive interactions or piezoelectric action. Piezoelectric power transfer and/or communication modes would generally require a unique piezoelectric material such as barium titanate, lead zirconate titanate, or potassium niobate that is able to transduce acoustic signals to electrical signals and vice versa.

[0031] Specifically, the single-structure multi-mode (SSMM) antenna of the present disclosure facilitates either or both the transmission and reception of wirelessly transmitted electrical power and/or data. The unique design and construction of the SSMM antenna of the present disclosure, provides an antenna having optimized electrical performance in a reduced form factor.

[0032] In addition, the single structure antenna of the present disclosure may also comprise a plurality of materials such as various ferrite materials to block magnetic fields from adjacent wire strands of the plurality of coils. Thus, these magnetic blocking materials shield adjacent wire strands from the adverse effects of magnetic fields on the propagation of electrical power and/or electric signals.

[0033] Specifically, the present disclosure provides an antenna having a single coil structure in which a multitude inductor coils are electrically connected in series. Such a construction provides for an antenna having a compact design that enables adjustment or tuning of the inductance within the antenna which results in the ability to tune multiple antenna frequencies.

[0034] Turning now to the drawings, FIGS. 2, 2A, 3, 3A, 3B, 3C, 3D, 3E, 4, 4A, 9 and 11 illustrate different embodiments and configurations of a single structure multi-mode antenna of the present disclosure. FIG. 2 illustrates an embodiment of a three-terminal antenna 20 of the present disclosure. As illustrated, the antenna 20 comprises a substrate 22 on which is positioned a first, outer coil 24 and a second, interior coil 26. More specifically, both the first and second coils 24, 26 are positioned on an external surface 28 of the substrate 22.

[0035] As shown, the first outer coil 24 comprises a first electrically conductive material 30 such as a trace or filar which is positioned in a curved orientation with respect to the surface 28 of the substrate 22. In a preferred embodiment, the trace or filar 30 is positioned in a spiral or serpentine orientation with respect to the surface 28 of the substrate 22

having " N_1 " number of turns. The second interior coil 26 comprises a second electrically conductive material 32 such as a trace or filar positioned in a curved orientation with respect to the surface 28 of the substrate 22. In a preferred embodiment, the second trace or filar 32 is positioned in a spiral or serpentine orientation with respect to the surface 28 of the substrate 22 having " N_2 " number of turns.

[0036] In a preferred embodiment as shown in FIG. 2, the second interior coil 26 is positioned within an inner perimeter formed by the first outer coil 24. As defined herein, a "turn" is a single complete circumferential revolution of the electrically conductive filar positioned on the surface of a substrate. As illustrated in the example antenna shown in FIG. 2, the first outer coil 24 comprises 3 turns (N_1) and the second interior coil 26 comprises 14 turns (N_2). In a preferred embodiment, the first outer coil 24 may comprise from about 1 to as many as 500 or more " N_1 " turns and the second interior coil 26 may comprise from about 1 to as many as 1,000 or more " N_2 " turns. In a preferred embodiment, the number of " N_2 " turns is greater than the number of " N_1 " turns. In addition, it is not necessary for the first and second coils 24, 26 to be constructed having a discrete number of turns, the coils 24, 26 may also be constructed having a partial turn or revolution such as a half or quarter of a complete turn.

[0037] In addition, the conductive filars 30 that form the first outer inductive coil 24 have a filar width that may range from about 0.01 mm to about 20 mm. In a preferred embodiment, the width of the outer inductor coil filars 30 is constant. However, the width of the first outer inductor conductive filars 30 may vary. The conductive filars 32 that form the second interior inductive coil 26 have a preferred width that ranges from about 0.01 mm to about 20 mm. The second conductive filar 32 may also be constructed having a constant or variable width. In a preferred embodiment, the first electrically conductive filars 30 that form the first outer inductor coil 24, have a width that is greater than the width of the second electrically conductive filars 32 that form the second interior inductor coil 26. However, it is contemplated that the width of the first conductive filars 30 may be about equal to or narrower than the width of the second electrically conductive filars 32 that form the second interior inductor coil 26.

[0038] In general, the first outer inductor coil 24 contributes to the reception and/or transmission of higher frequencies in the MHz range whereas, the second interior inductor coil 26 contributes to the reception and/or transmission of frequencies in the kHz range. The increased perimeter size and typically fewer number of filar turns that comprise the first outer inductor coil 24, generally create first coil inductances in the 4.2 μ H range, which, thus, provides reception and/or transmission in the MHz operating frequency range. In contrast, the increased number of filar turns and smaller coil diameter of the second interior inductor coil 26 generally create inductances in the 8.2 μ H range, which provides reception and/or transmission in the kHz operating frequency range. Furthermore, by electrically connecting at least the first and second inductor coils 24, 26 in series at different locations thereof, enables the single structure antenna of the present disclosure to operate at multiple frequencies while encompassing reduced surface area and a smaller foot print.

[0039] Specifically, the single structure antenna of the present disclosure comprises a plurality of terminal connections that are strategically positioned on the first and second inductor coils 24, 26, respectively. This unique antenna design provides for a variety of tunable inductances which, in turn, provides for a variety of selectively tunable operating frequencies. In a preferred embodiment, the single structure antenna can be designed so that it can operate at multiple frequencies and multiple frequency bands anywhere between about the 1 kHz range to about the 10 GHz range. The prior art two structure antenna 10 is not capable of operating at such multiple frequencies with such a reduced foot print size.

[0040] FIG. 2 illustrates an example of a three terminal single structure antenna 20 of the present disclosure. As shown in FIG. 2, the first outer coil 24 is electrically connected in series to the second interior coil 26. This electrical connection between the two coils 24, 26 combines the inductance contributions of both coils, and portions thereof, in a reduced foot print. FIG. 2A is an electrical schematic diagram of the antenna 20 shown in FIG. 2. As shown, the antenna 20 comprises three terminals, a first terminal 34 a second terminal 36, and a third terminal 35. As illustrated, the first terminal 34 is electrically connected to the first outer inductive coil 24, the second terminal 36 is electrically connected to the second interior inductive coil 26, and the third terminal 35 is electrically connected to a second end of the first outer coil 24. Alternatively, the antenna 20 may be constructed having the first terminal 34 electrically connected to the second inductive coil 26 and the second terminal 36 electrically connected to the first inductive coil 24.

[0041] In a preferred embodiment, the antenna 20 may be constructed with an electrical switch circuit 37 that enables selection of a desired inductance and operating frequency. More specifically, the electrical switch circuit 37 enables the detection and analysis of the electrical impedance of either or combination thereof of the first and second coils 24, 26. Therefore, based on the detection and analysis of the electrical impedance, an efficient selection of the antenna's operating frequency can be achieved based on an optimized or desired electrical impedance value. In addition, the selection of the terminal connections may be based on an optimized or desired inductance value at a desired operating frequency or frequencies.

[0042] As illustrated in FIG. 2A, the switch circuit 37 is electrically connected in series between the first and second coils 24, 26. In a preferred embodiment, the switch circuit 37 enables the selection of a connection between the first and second coils 24, 26, or alternatively, a selection of either of the first or second coils 24, 26 individually. The third terminal 35 is electrically connected at point 33 which is an electrical junction between the first and second coils 24, 26.

[0043] As previously mentioned, the electrical switch circuit 37 preferably comprises at least one capacitor C_1 having a first capacitance. The at least one capacitor C_1 is preferably electrically connected along the third terminal 35. In addition, the switch 37 may also comprise a second capacitor C_2 having a second capacitance. The second capacitor C_2 is preferably connected between point 33 and the second interior coil 26. Inclusion of the at least one capacitor C_1 enables the detection and analysis of the impedance of either or both coils 24, 26 at an operating frequency. In a preferred embodiment, the electrical impedance can be determined by the following equation: $X = 2\pi fL$, where X is the electrical impedance of the antenna, f is the operating frequency of the antenna and L is the inductance of the antenna.

[0044] In a preferred embodiment, the substrate 22 is of a flexible form, capable of bending and mechanical flexure. The substrate 22 is preferably composed of an electrically insulating material. Examples of such insulative materials may include but are not limited to, a paper, a polymeric material such as polyimide, acrylic or Kapton, fiberglass, polyester, polyether imide, polytetrafluoroethylene, polyethylene, polyetheretherketone (PEEK), polyethylene naphthalate, fluoropolymers, copolymers, a ceramic material such as alumina, composites thereof, or a combination thereof. In some situations (e.g. when the antenna is constructed using insulated wire such as magnet wire/litz wire or stamped metal), the substrate may be the shielding material.

[0045] In a preferred embodiment, at least one of the first, second and third terminals 34, 36, 35 of the antenna 20 are electrically connectable to an electronic device 38. The electrical device 38 may be used to modify and/or condition the electrical power, electrical voltage, electrical current or electronic data signal received or transmitted by the antenna 20. The electrical energy received by the antenna may be used to directly power the electronic device 38. Alternatively, the electrical device 38 may be used to transmit electrical power and/or a data signal thereof. The electronic device 38 may comprise, but is not limited to, a tuning or matching circuit (not shown), a rectifier (not shown), a voltage regulator (not shown), an electrical resistance load (not shown), an electrochemical cell (not shown) or combinations thereof.

[0046] FIG. 3 illustrates an additional embodiment of a three terminal single structure antenna 40 of the present disclosure. Similar to the antenna 20 embodiment illustrated in FIG. 2, the three terminal antenna 40 comprises a first outer coil 42 that is electrically connected in series to a second interior coil 44. The electrical connection between the two coils 42, 44 combines the inductance contributions of each of the coils 42, 44 in a reduced size and surface area. The addition of a third terminal further enables the antenna 40 to be tuned to a specific frequency or multiple frequency bands. Thus, by providing multiple connection points within and between the outer and interior inductor coils 42, 44 the inductance, and thus, the receiving or transmitting frequency bands can be instantaneously adjusted without the need to add or remove inductors. The three terminal antenna design enables the first and second coils 42, 44 to be strategically connected at different locations along either or both the first and second coil 42, 44. As a result, the inductance of the antenna 40 can be modified, i.e., increased or decreased, without increasing the size of the footprint of the antenna. The antenna 40 of the present disclosure efficiently utilizes space and substrate surface area to increase and/or decrease inductance therewithin and, thus, custom tune the operating frequency or frequency band of the antenna 40.

[0047] The antenna 40 as shown in FIG. 3 comprises three terminals, a first terminal 46, a second terminal 48, and a third terminal 50, each having three respective terminal connections 52, 54, and 56. Each of the terminals is electrically connected at different terminal connection points of the antenna 40. As shown, the first terminal 46 extends from a first end 58 of a first trace 60 of the first outer coil 42. The second terminal 48 extends from a first end 62 of a second trace 64 of the second inductor 44. The third terminal 50 extends from a second end 66 of the second trace 64 of the second coil 44. Thus, the three terminals 46, 48, and 50 provide different connection points between the first and second inductor coils 42, 44 and portions thereof. Connecting the various terminals in different combinations thus provides the antenna 40 of the present disclosure with different adjustable inductances which, in turn, modifies the operating frequency or operating mode of the antenna 40. For example, by electrically connecting the first terminal 46 to the second terminal 48, a first inductance may be produced that is generally suitable for operation at a first operating frequency. Electrically connecting the first terminal 46 to the third terminal 50 produces a second inductance that is generally suitable for operation at a second operating frequency. Electrically connecting the second terminal 48 to the third terminal 50 produces a third inductance that is generally suitable for operation at a third operating frequency. Each of the inductances that are capable of being generated by the antenna of the present disclosure is preferably different from each other. Furthermore, it is contemplated that the antenna may be able to instantaneously switch from one inductance value to another, thereby instantaneously changing the antenna's operating frequency.

[0048] FIG. 3A illustrates an electrical schematic diagram of the three terminal antenna 40 illustrated in FIG. 3. As shown, connecting the first terminal 46 and the third terminal 50 provides a connection to the first outer inductor coil 42 having " N_1 " number of turns. Connecting the second terminal 48 to the first terminal 46 provides a connection to the second interior inductor coil 44 having " N_2 " number of turns. Lastly, establishing a connection between the second and third terminals 48, 50 provides an electrical series connection to both the first outer inductor coil 42 and the second interior inductor coil 44 having " N_1 " + " N_2 " turns. More specifically, FIG. 3A illustrates an embodiment in which the first inductor coil 42 is electrically connected in series with the second inductor coil 44. As shown, the first terminal 46 is electrically connected to the first end 58 of the first outer inductor coil 42. The second terminal 48 is electrically connected to the first end 62 of the second inductor coil 44 at an electrical junction 68 distal of the first inductor coil first end 58. As

illustrated, the third terminal 50 is electrically connected to a second end 70 of the first inductor coil 42.

[0049] In a preferred embodiment, the three-terminal antenna design shown in FIGS. 3 and 3A enables the operation of the antenna in three different operation modes. As defined herein, an operation mode is an operating frequency band width. Such modes may include, but are not limited to the Qi, PMA and Rezence wireless standard frequencies. Table I shown below, details an example of the different terminal connection configurations and how they affect the operation mode of the antenna. More specifically, Table I illustrates various examples of how the operating frequency of the antenna may be changed by connecting various terminal connections together. It is noted that the operating frequencies detailed in Table I are examples and that the operating frequency bands may be custom tailored to meet specific requirements. Such customization can be achieved through designing each coil with a specific number of turns, a specific trace width, and terminal location points on each of the first and second coils.

Table I

Mode	Operating Frequency	Terminal Connections
1	100 - 250 kHz (Qi and/or PMA)	1 and 2
1	6.78 MHz (A4WP)	1 and 3
2	13.56 MHz (NFC/RFID/ Proprietary power and data)	1 and 3
2	100 - 250 kHz (Qi and/or PMA)	2 and 3
3	250 - 500 kHz (PMA and/or, proprietary power and data)	2 and 3

[0050] While FIGS. 3 and 3A illustrate a specific example of connecting three terminals to the respective ends of the first and second inductor coils 42, 44, it is further contemplated that these connections may be positioned at various electrically conductive points along the first and second conductive traces 60, 64 of the first and second inductor coils 42, 44. In addition, it is contemplated that additional terminal connections may be positioned along the first and second 42, 44 inductor coils of the antenna 40, to further provide customized inductances and, thus, provide customized operating frequencies of the antenna 40. In general, establishing an electrical connection with an inductor coil or multiple inductor coils having an increased number of turns increases the inductance that results in an antenna that more suitable to receive or transmit lower frequency signals. Likewise, establishing an electrical connection with an inductor coil or multiple inductor coils having a decreased number of turns decreases the inductance and therefore results in an antenna that is more suitable to receive or transmit higher frequency signals.

[0051] Similar to the two terminal antenna illustrated in FIGS. 2 and 2A, the three terminal antenna may be electrically connected to an electrical device 38. The electrical device 38 may be designed to condition or modify electrical power and/or an electrical signal, such as a digital data signal. Alternatively, the electrical device 38 may directly receive or transmit the electrical power and/or data signal. The electronic device 38 may comprise, but is not limited to, a tuning or matching circuit (not shown), a rectifier (not shown), a voltage regulator (not shown), an electrical resistance load (not shown), an electrochemical cell (not shown) or combinations thereof. In addition to modifying or conditioning a received electrical voltage, electrical current, or digital signal, the electronic device 38 may also be used to modify or condition an electrical voltage, electrical current, or digital signal that is being transmitted by the antenna 40.

[0052] FIGS. 3B and 3C illustrate an embodiment of a multiple layer three terminal antenna 72. In a preferred embodiment, the single structure antenna of the present disclosure may comprise a plurality of two or more substrate layers 22 that are positioned in a parallel orientation to each other. In addition, at least one electrically conductive trace is positioned along an exterior surface of the substrates that comprise the antenna 72. The filar or filars may be orientated such that at least one inductor coil is disposed along a top surface of one or more of the substrates. The substrates that comprise the antenna are preferably oriented in the same orientation such that the bottom surface of a first substrate is positioned above the top surface of a second substrate.

[0053] In addition, at least one via may be provided to establish an electrical connection between the various substrate layers. In a preferred embodiment, the at least one via provides an electrical connection between filars or portions of filars that comprise an inductor coil or coils at different substrate layers. As defined herein a "via" is an electrical connection between two or more substrate layers. A via may comprise a wire, an electrically filled through-bore or electrically conductive trace.

[0054] Specifically, FIGS. 3B and 3C illustrate the first and second layers, respectively of a two layer three terminal single structure antenna. FIG. 3B illustrates an embodiment of a first or lower layer 74 of the antenna 72 of the present disclosure. As shown, the first layer 74 comprises a first outer inductive coil 76 that is electrically connected in series to a second interior inductive coil 78.

[0055] In a preferred embodiment, as illustrated in FIG. 3B, the first terminal 46 is electrically connected in parallel to

two traces or filars, thereby creating a bifilar connection 80 that comprises the first inductor coil 76. It is noted that two or more adjacent electrically conductive traces or filars that comprise an inductive coil may be connected in parallel. In general, connecting two or more adjacent traces or filars reduces electrical resistance, particularly the equivalent series resistance (ESR) of the antenna and as a result, improves the quality factor of the antenna.

[0056] As shown in FIG. 3B, the first inductor coil 76 is electrically connected in series to the second interior inductor coil 78 that is positioned within an inner perimeter formed by the first inductor coil 76. As shown, a second end 82 of the first inductor coil 76, located at an inner most end of the coil 76 is electrically connected to a first end 84 of the second inductor coil 78. The first end 84 of the interior inductor coil 78 is disposed at the end of an outer most filar track of the second inductor coil 78. The second inductor coil 78 terminates at a second inductor coil second end 86 which is disposed at an inner most location of the second inductor coil 78.

[0057] FIG. 3C illustrates an embodiment of a second upper substrate layer 88 of the antenna 72 of the present disclosure. The second layer 88 is preferably positioned directly above the first lower substrate 74. The second layer 88 comprises a third outer inductor coil 90 that is electrically connected in series to a fourth interior inductor coil 92. In a preferred embodiment, the respective first and third coils 76, 90 and the second and fourth coils 78, 92 of the first and second layers 74, 88 may be positioned about their respective substrates in a parallel relationship. In addition, the respective first and third coils 76, 90 and the second and fourth coils 78, 92 of the first and second layers 74, 88 may be in a similar position about their respective substrate surfaces and may comprise the same number of turns with similar trace widths. Alternatively, the respective first and third coils 76, 90 and the second and fourth coils 78, 92 of the first and second layers 74, 88 may be positioned at different locations relative to their specific substrate surfaces and they may have differing number of turns with differing trace widths.

[0058] Similar to the first layer 74, the first terminal 46 of the second layer 74 is electrically connected in parallel to two adjacently positioned traces or filars, thereby creating a bifilar connection at a first end 94 of the third inductor coil 90. This bifilar connection comprises the electrical trace pattern of the third inductor coil 90, extending around the third coil 90 and ending at a second end 96 thereof. Furthermore, the third inductor coil 90 is electrically connected in series to the fourth interior inductor coil 92 positioned within the inner perimeter of the third inductor coil 90 at a third inductor coil second end 96 which is disposed at an interior location of the third inductor coil 90. The fourth inductor coil 92 is electrically connected to the third inductor coil 90 at a first end 98 of the interior inductor coil which is disposed at an outer most filar track of the fourth inductor coil 92. In addition, as illustrated in FIG. 3C, the second upper layer 88 also comprises the second and third terminal connections 48, 50. In a preferred embodiment, the second terminal 48 is electrically connected at a second end 100 of the fourth inductor coil 92 positioned at an inner most location of the fourth coil 92. In addition, the length of the second terminal 48 is electrically isolated from each of the filar tracks that comprise the third and fourth inductor coils 90, 92. The third terminal 50 is provided on the second upper layer 88. As shown, the third terminal 50 is electrically connected to the bifilar track 94 that is disposed at the inner most location of the third outer inductor coil 90.

[0059] Furthermore, a via 102 or a plurality of vias 102, are preferably positioned between two or more substrate layers 74, 88 that comprise the single structure antenna 72 of the present disclosure. More preferably, the at least one via 102 provides a shunted electrical connection between different locations between the respective first and third inductor coils 76, 90 or the second and fourth inductor coils 78, 92 to minimize electrical resistance which may adversely affect electrical performance and quality factor.

[0060] In a preferred embodiment, a plurality of shunted via connections are positioned between the upper and lower layers to electrically isolate portions of the second and third terminals 48, 50, thereby enabling the terminals to "overpass" the conductive traces of the respective coils. More specifically, to create an "overpass" a plurality of vias 102 may be positioned on respective left and right sides of a trace 104 of the terminal. The plurality of vias 102 positioned on the respective left and right sides of the terminal line 104 of the terminal thus form electrical paths underneath the terminal trace 104, thereby electrically isolating the terminal trace 104 by "bypassing" the portion of conductive traces on which the terminal lead 104 is positioned. In addition, the plurality of shunted vias 102 may also create an electrical path that bypasses at least a portion of the terminal lead 104. In this embodiment, each of the plurality of vias 102 are positioned in opposition to each other on respective left and right sides of the terminal lead 104.

[0061] FIG. 3D illustrates a magnified view of an example of a plurality of shunted via connections between a portion of the first inductor coil 76 that is disposed on the lower first substrate layer 74 and the third inductor coil 90 that is disposed on the upper second substrate layer 88. As shown, a plurality of via connections is shown between inductor coils that are disposed on the respective upper and lower substrate layers 74, 88. More specifically, as shown in the embodiment of FIG. 3D, there are four vias 102 positioned along each filar tracks besides each of the respective right and left sides of the terminal line 104. In a preferred embodiment, the via connections provide a shunted electrical connection that by passes under the terminal line 104. Thus by positioning a plurality of vias adjacent the respective sides of the terminal line 104, an electrical connection can be provided that bypasses the terminal line 104 of the terminal thereby keeping the terminal trace 104 electrically isolated from the conductive traces it passes through. Furthermore, by providing a plurality of vias 102 positioned along each of the filar tracks that comprise the inductor coil, various

electrical connections can be made which can further tailor the inductance and resulting operating frequency of the single structure antenna of the present disclosure. For example, various electrically isolated terminal connections can be positioned throughout the inductor coils thus establishing further customized inductances and operating frequencies.

[0062] FIG. 3E illustrates an alternative embodiment of a single structure antenna 106 in which respective first and second inductive coils 108, 110 comprise a single filar pattern. As shown the first, second and third terminals 46, 48, and 50 are respectively connected to a single filar that comprises the first and second inductor coils 108, 110. While it is preferred to connect the respective terminals to multiple filars, such as the first terminal connection shown in FIGS. 3B and 3C, to minimize electrical resistance, it may be necessary to provide an electrical connection to a single filar to achieve a desired inductance in a relatively small space and/or surface area. In general, having an electrical parallel connection to two or more adjacently positioned filars reduces electrical resistance which in turn increases the quality factor of the antenna.

[0063] FIG. 3F illustrates a magnified view of the terminal connections illustrated in FIG. 3E. As shown, the terminal traces of the second and third terminals 48, 50 are electrically isolated as they effectively bypass over the electrically conductive the filar tracks that comprise the inductor coil. Via connections 103 provided on both sides of the respective terminal lines 104 provide an electrical connection that bypasses the terminal lines thereby electrically isolating the terminal lines from the filar lines of that comprise the inductor coil. As shown, a plurality of vias 102A are positioned on the right side of the terminal lead 104 of the third terminal 50, vias 102B are positioned to the left and right of the terminal traces 104 of respective third terminal 50 and second terminal 48 and vias 102C are positioned to the left of the terminal trace of the first terminal 48.

[0064] In addition to the two and three terminal antennas illustrated in the present application, it is further contemplated that a single structure antenna may comprise four or more terminal connections. FIG. 4 illustrates an electrical circuit diagram of an embodiment of a four terminal antenna 112 of the present disclosure. As illustrated, the first terminal 46 is electrically connected to the first end 58 of the first outer inductor coil 42. The second terminal 48 is electrically connected to the first end of the second inductor coil 44. The third terminal 50 is electrically connected to the second end 70 of the first inductor coil 42. In addition, a fourth terminal 114 is electrically connected to a second point 116 along the electrically conductive track of the first inductor coil 42. The fourth terminal connection effectively shortens the length of the first inductor coil 42 and/or the number of turns between electrical connections thereby providing an additional terminal connection which can be selected to adjust the inductance and operating frequency of the antenna.

[0065] Table II shown below, details the inductance and resulting operating frequency of an exemplar three and four terminal connection antennas illustrated in FIGS. 2, 2A, 3, 3A, 4 and 4B. It is noted that the inductance may be increased or decreased by modifying the number of turns of at least one of the first and second inductor coils.

Table II

Antenna Config	Terminal Connection Config	N ₁	N ₂	Operating Frequency	Inductance (μ H)	Quality Factor
4 Terminal	1 and 2	3	0	6.78 MHz	0.84	> 110
4 Terminal	3 and 4	0	14	100-300 kHz	6.7	> 20
3 Terminal	1 and 2	3	14	6.78 MHz	0.84	> 110
3 Terminal	1 and 3	3	17	100-300 kHz	7.5	~17.5
3 Terminal	2 and 3	3	14	100-300 kHz	6.7	> 20

[0066] As the table above illustrates, by establishing different electrical connection points along the coils that comprise the antenna, provides for a wide range of inductances, operating frequencies and frequency bands. As shown above, by increasing or decreasing the total number of turns, i.e. by selectively connecting different locations of the electrically connected the first and second inductor coils, and portions thereof affects the resultant inductance of the antenna.

[0067] In a preferred embodiment, the electrical or electronic device 38 may be a selection circuit 118 electrically connected to the single structure antenna of the present disclosure. Specifically, the selection circuit 118 is electrically connected to at least two of the terminals that comprise the antenna. The selection circuit 118 actively monitors and measures the electrical impedance at the respective antenna terminals and combinations thereof. Thus, when the electrical impedance is measured to be at, above, or below a certain threshold electrical impedance or band of electrical impedances, the selection circuit 118 is capable of connecting or disconnecting the various terminals that comprise the antenna to achieve a desired frequency band. In a preferred embodiment, the selection circuit 118 comprises at least one capacitor having a capacitance C₃. The capacitance of the selection circuit is selected to activate a switching mechanism between antenna terminals by providing a high impedance path or a low impedance path, depending on the frequency of operation. In addition, the selection circuit 118 may also be able to actively connect and/or disconnect

various regions or specific locations along the inductance coils that comprise the single structure antenna. In an embodiment, the selection circuit 118 operates by selecting an inductor coil, portion of an inductor coil, or combinations thereof, having the lowest electrical impedance. Alternatively, the selection circuit 118 may be designed to actively switch between terminals at a specific electrical impedances or range of electrical impedances. For example, the selection circuit 118 may measure the electrical impedance at various terminal connections and determine that based on the value of the capacitance C_3 within the selection circuit 118 to connect terminals 1 and 3 instead of terminals 1 and 2 for example.

[0068] Consider, for example, a multi-mode antenna system wherein a first frequency mode is operating in the frequency range of $f_1 \pm \Delta f_1$, and a second frequency mode is operating at $f_2 \pm \Delta f_2$, wherein f_1 is the resonating frequency of the first outer inductor coil, Δf_1 is the bandwidth of the resonating frequency of the first outer inductor coil formed by the first terminal 46 and the third terminal 50 (FIG. 3E), f_2 is the resonating frequency of the second interior inductor coil, and Δf_2 is the bandwidth of the resonating frequency of the second interior inductor coil formed between the first and second terminals 46, 48 (FIG. 3E), provided the following conditions (A, B, and C) are true for the exemplar antenna.

Example conditions:

[0069]

A.

$$f_1 \geq 10f_2,$$

B.

$$\Delta f_2 \leq 0.5f_2$$

C.

$$\Delta f_1 \leq f_1/50$$

[0070] The selection circuit may be configured to select a desired antenna impedance Z_2 , at a desired antenna operating frequency f . For example, given the parameter equations as shown below, where C_3 is the capacitance value of the selection circuit 118 for a desired antenna operating frequency, f (e.g. $f = f_1 \pm \Delta f_1$ or $f = f_2 \pm \Delta f_2$) and in which the impedance of the antenna is multiplied by a constant such as 1, 2, or 5. Thus, the selection circuit 118 can be designed such that the terminal connections are made at a certain impedance threshold value at a specific frequency or frequency band which may be determined by a multiplier constant.

$$\frac{1}{2\pi f C_3} < \text{Constant} \times |Z_1 \text{ or } 2|$$

[0071] In general, the greater the difference in electrical impedance, the better discrimination in coil selection, thus the multiplier constant such be selected to create a discriminating electrical impedance that may be used to modify the operating frequency of the antenna. Thus, provided a capacitance value C_3 , the selection circuit may choose between the lower of the electrical resistance of the first inductor coil Z_1 and the electrical resistance of the second inductor coil

Z_2 . In the example, if $\frac{1}{2\pi f C_3}$ is lower than Z_2 , the selection circuit may actively choose the terminal connections for the first inductor coil. An exemplary situation is when the higher frequency range conforms to a single mode, the Rezence wireless charging standard operating at a frequency f_1 of about 6.78 MHz with a bandwidth of ± 15 kHz, while the lower frequency range conforms to two modes, i.e., the Qi standard operating between 100 kHz and 205 kHz and the PMA standard operating between 100 kHz and 350 kHz. In this case, if the first outer inductor coil is selected, then the antenna will actively receive or transmit in the Rezence mode at an operating frequency of about 6.78 MHz.

[0072] In addition to the number of turns and various lengths of the electrically conductive filars of the respective inductor coils that control the inductance and operating frequency of the antenna of the present disclosure, the quality

factor of the single structure multiple mode antenna of the present disclosure can be significantly affected by the length and position of a gap 120 of space disposed between adjacent first and second inductor coils such as the first and second inductor coils 76, 78 and/or the third and fourth inductor coils 90, 92.

[0073] As will be described herein, the single structure multiple mode antenna 20, 40, 72, 106, 112 of the present disclosure is preferably designed with a high quality factor (QF) to achieve efficient reception/transfer of electrical power and/or an electrical data signal. In general, the quality factor of the antenna is increased by reducing the intrinsic resistive losses within the antenna, particularly at high operating frequencies of at least 300 kHz.

[0074] The quality factor is the ratio of energy stored by a device to the energy lost by the device. Thus, the QF of an antenna is the rate of energy loss relative to the stored energy of the antenna. A source device carrying a time-varying current, such as an antenna, possesses energy which may be divided into three components: 1) resistive energy (W_{res}), 2) radiative energy (W_{rad}), and 3) reactive energy (W_{rea}). In the case of antennas, energy stored is reactive energy and energy lost is resistive and radiative energies, wherein the antenna quality factor is represented by the equation $Q = W_{rea} / (W_{res} + W_{rad})$.

[0075] In near field communications, radiative and resistive energies are released by the device, in this case the antenna, to the surrounding environment. When energy must be transferred between devices having limited power stores, e.g., battery powered devices having size constraints, excessive power loss may significantly reduce the devices' performance effectiveness. As such, near-field communication devices are designed to minimize both resistive and radiative energies while maximizing reactive energy. In other words, near-field communications benefit from maximizing Q.

[0076] By example, the efficiency of energy and/or data transfer between devices in an inductively coupled system is based on the quality factor of the antenna in the transmitter (Q_1), the quality factor of the antenna in the receiver (Q_2), and the coupling coefficient between the two antennas (κ). The efficiency of the energy transfer varies according to the following relationship: $\text{eff} \propto \kappa^2 Q_1 Q_2$. A higher quality factor indicates a lower rate of energy loss relative to the stored energy of the antenna. Conversely, a lower quality factor indicates a higher rate of energy loss relative to the stored energy of the antenna. The coupling coefficient (κ) expresses the degree of coupling that exists between two antennas.

[0077] Further, by example, the quality factor of an inductive antenna varies according to the following relationship:

$$Q = \frac{2\pi f L}{R}$$

where f is the frequency of operation, L is the inductance, and R is the total resistance (ohmic + radiative). As the quality factor is inversely proportional to the resistance, a higher resistance translates into a lower quality factor. Thus, the antenna of the present disclosure is designed to decrease the electrical resistance and, therefore, increase the quality factor.

[0078] Specifically, the single structure multiple mode antenna of the present disclosure is designed with a gap of space 120 positioned between adjacently positioned inductor coils such as the first and second inductor coils 24, 26. This gap 120 preferably reduces the proximity effect between adjacently positioned inner and outer coils, such as 76, 78 (FIG. 3B) and 90, 92 (FIG. 3C). As defined herein, "proximity effect" is the resultant increase in electrical resistance that occurs when two wires carrying alternating current, are positioned next to each other. More specifically, the proximity effect relates to the effect that one current carrying filament has on an adjacent current carrying filament when time-varying current is propagating through at least one of the conductive filaments. The magnetic field generated by one filament creates a field that opposes the current in the adjacent filament, thereby creating additional alternating current (AC) electrical resistance. This effect increases with frequency according to Faraday's law. In other words, when two electrically conductive wires are positioned next to each other, the magnetic field of one wire induces longitudinal eddy currents in the other adjacent wire. These eddy currents flow in long loops along the wire in the opposite direction as the main current. Thus, these eddy currents reinforce the main current on the side facing away from the first wire, and oppose the main current on the side facing the first wire. The net effect is a redistribution of the current in the cross section of the wire into a thin strip on the side facing away from the other wire. Since the current is concentrated into a smaller area of the wire, the resistance is increased.

[0079] The proximity effect has a significant effect on the quality factor of the antenna design. The applicants have discovered that the proximity effect can be greatly reduced by increasing the gap or distance 120 between the first outer and second interior inductor coils. However, increasing the gap 120 between these coils such that the proximity effect is negligible appreciably increases the foot print of the antenna which is not desired.

[0080] Therefore, a balance between the strength of the proximity effect and its effect on the quality factor and foot print size must be optimally achieved. In general, the applicants have discovered that by providing the gap 120 having a distance of about 0.2 mm reduces the magnetic field strength by about 50%, and designing the gap 120 with a distance of about 1 mm reduces the magnetic field strength by about 90%. It is contemplated that the gap 120 may range from

about 0.05 mm to about 10 mm.

[0081] Another important consideration is the operating frequency of the antenna. In general, AC electrical resistance increases with increasing magnetic field strength. This increase in AC electrical resistance is about proportional to the magnetic field strength. This is due to the generally increased proximity effect at increased operating frequencies. In general, the increase in proximity effect can be mathematically represented by the strength of the magnetic field H of an adjacent filar multiplied by the operating frequency.

[0082] For example, to obtain a similarly equal reduction of proximity effect for a first antenna operating at 6.78 MHz in comparison to a second antenna operating at 200 kHz, the magnetic field strength generated by the first antenna is required to be reduced by about a factor of 34 (6.78MHz/200kHz). Therefore, to obtain a similar reduction in AC electrical resistance due to the proximity effect, between the first antenna operating at 6.78 MHz and the second antenna operating at 200 kHz, would thus require a gap of about 0.2 mm between adjacent coil traces for the second antenna operating at 200 kHz, and a gap greater than 5 mm between adjacent coil traces for the first antenna operating at 6.78 MHz.

[0083] The applicants have thus discovered that designing the gap 120 having a dimension of 0.5 mm, or greater, between the first outer and second interior coils significantly reduces the proximity effect to a negligible amount for frequencies between about 100 to about 200 kHz. Furthermore, the applicants have discovered that designing the gap 120 having a distance of about 1 mm for frequencies between about 200 to about 400 kHz, or greater, is more preferred. In some cases, where the overall allowable surface area is large, for example, when the total number of turns of the first outer and second interior inductor coils is greater than 100 and the frequency is around 6.78 MHz to 13.56 MHz, this distance can be as great as 10 mm. In general, a gap distance 120 of about 10 mm effectively reduces the magnetic field strength and the proximity effect by about 99 percent.

[0084] Table III shown below, illustrates the effect of the gap size on the electrical resistance and resulting quality factor. Specifically, examples 1-4 are of a three terminal single structure multi-mode antenna having different gap sizes between the first outer and second interior coils. As illustrated in the table, increasing the size of the gap to about 1.8 mm, increases the quality factor by about 35% in comparison to a gap size of 0.2 mm of the antenna constructed in example 4. If a larger footprint is possible for the entire antenna structure, this gap size may be further increased greater than 5 mm which results in an increase in quality factor of about 42% in comparison to the example 4 antenna which constructed with a gap size of about 0.2 mm.

[0085] For example, a system with a coupling coefficient of about 0.05 for a system operating at 6.78 MHz, and using the same coil configuration for the respective receiving and transmitting antennas with a 1.8 mm gap will yield an antenna to antenna efficiency improvement of about 16%. In addition, using a gap size greater than 5 mm would yield an antenna to antenna efficiency improvement of about 18% given the equation below where K is the coupling coefficient between a transmitting and receiving antenna, Q_1 is the quality factor of the receiving antenna, and Q_2 is the quality factor of the transmitting antenna. As defined herein, "antenna to antenna efficiency" is the percentage of electrical energy received by a receiving antenna that was originally transmitted by a corresponding transmitting antenna.

$$Eff = \frac{\kappa^2 Q_1 Q_2}{(1 + \sqrt{1 + (\kappa^2 Q_1 Q_2)})^2}$$

Table III

Example	Gap Size	Freq. (MHz)	Inductance (μ H)	Resistance (ohms)	Quality Factor
1	>5.0mm	6.78	3.1	1.30	101.6
2	1.8mm	6.78	3.1	1.37	96.4
3	1.0mm	6.78	3.1	1.57	84.1
4	0.2mm	6.78	3.1	1.85	71.4

[0086] It is important to note that the magnetic field strength is directly proportional to the strength of the electrical current being propagated through an adjacent filar. For example, given the same operating frequency, the strength of the proximity effect generated from a filar with 1A of electrical current propagated therewithin is about 100 times greater than if the electrical current is at 10 mA.

[0087] FIG. 5 illustrates an embodiment of an inductor coil 121 which comprises a conductive filar 123 having a variable filar width. As shown, at least one of the inductor coils that comprise an antenna may be constructed having a filar width that ranges from about 5 mm to about 0.01mm, more preferably from 0.55 mm to about 0.2 mm. In the preferred

embodiment shown, the inductor coil is constructed having an outer filar width at a first coil end 122 that ranges from about 10 mm to about 1 mm that progressively becomes narrow as the filar extends towards the center of the inductor 121. In a preferred embodiment, the filar width at the second end 124 may range from about 5 mm to about 0.01 mm. Such thinning of the filar width is desirous to provide an additional number of turns within a smaller surface area, thereby leading to an inductance value that is higher than what would have been achieved with wider traces for all turns. Furthermore, increasing the number of turns reduces the cross-sectional area of the filament utilized by the current due to the net proximity effects of the multitude of filaments. Therefore it is possible that a wide trace may have regions through which the current density is significantly reduced. By designing the coil in a manner of reducing the trace widths, the area utilization is maximized. Utilization of cross-sectional area is reduced due to proximity effect with increased frequency and a greater number of traces.

[0088] Constructing a coil with variable trace widths can significantly increase the inductance of the antenna. For example, two antennas having the same coil outer dimension of 34.5 mm X 27 mm and an inner dimension of 15.4 mm X 7.9 mm were constructed. The first antenna was constructed with 13 turns at a constant trace width of about 0.55 mm and a constant gap with between traces of about 0.2 mm. In comparison, the second antenna coil was constructed with 13 turns and a constant gap width of about 0.2 mm between adjacent traces of the coil. However, the second antenna was also constructed having a variable trace width that ranged from 0.55 mm to about 0.2 mm in the interior of the coil. The inductance of the antenna of design 1 having a constant trace width was measured to be about 4.2 μ H. In contrast, the inductance of the antenna of design 2 with the variable trace width was measured to be about 8.2 μ H, about double the inductance of the antenna of the first design with the same overall dimensions.

[0089] In a preferred embodiment, the quality factor may also be increased by incorporating various materials or structures that prevent or block the magnetic fields that cause the proximity effect that thus results in increased electrical resistance of adjoining conductive filars and ultimately results in a decreased quality factor. One such shielding material are ferrite materials which have a high permeability that effectively shields inductor coils from magnetic fields generated from an adjacent inductor coil or coils. Thus, by shielding the inductive coil from the magnetic field generated from another coil, reduces the proximity effect and, thus, increases the quality factor of the antenna.

[0090] The shielding material preferably has the primary function of providing a low reluctance path to magnetic field lines thereby reducing the interaction of the magnetic fields with other metallic objects, especially objects (e.g. batteries, circuit boards) placed behind the coil assembly. A second function of the shielding material is preferably to boost the inductance of the coil and, simultaneously, to increase the coupling between the transmitter coil assembly and the receiver coil assembly. The latter directly affects the efficiency of power transfer. The third ancillary benefit is that it may also improve the Quality Factor of the coil antenna if the loss tangent of the magnetic material is sufficiently small. As defined herein, "reluctance" is the resistance to a magnetic flux.

[0091] FIGS. 6A, 6B, 6C, 6D, and 6E are cross-sectional views illustrating various embodiments in which an inductor coil having an electrically conductive trace 30, 32 of a single structure multi-mode antenna of the present disclosure may be constructed using materials that shield the conductive traces, i.e., wires of the coils 24, 26 from magnetic fields. Such shielding materials may include, but are not limited to, zinc comprising ferrite materials such as manganese-zinc, nickel-zinc, copper-zinc, magnesium-zinc, and combinations thereof. These and other ferrite material formulations may be incorporated within a polymeric material matrix so as to form a flexible ferrite substrate. Examples of such materials may include but are not limited to, FFSR and FFSX series ferrite materials manufactured by Kitagawa Industries America, Inc. of San Jose California and Flux Field Directional RFIC material, manufactured by 3M™ Corporation of Minneapolis MN.

[0092] As shown in the various embodiments, three different such materials, a first material 126, a second material 128 and a third material 132, each having a different permeability, loss tangent, and/or magnetic flux saturation density may be used in the construction of the single structure antenna of the present disclosure. In a preferred embodiment, the first material 126 may comprise at least one of the FFSX series of ferrite materials having a permeability of about 100 to about 120 across a frequency range of at least 100 kHz to 7 MHz. The second material 128 may comprise the RFIC ferrite material having a permeability of about 40 to about 60, and the third material 130 may also comprise a ferrite material or combinations thereof, as previously mentioned. In a preferred embodiment, the first 126, second 128, or third 130 materials may comprise a permeability greater than 40. More preferably, the first 126, second 128, or third 130 materials may comprise a permeability greater than 100. The magnetic flux saturation density (B_{sat}) is at least 380 mT.

[0093] FIG. 6A shows an embodiment in which the conductive segments 30, 32 are positioned directly on an exterior surface of the ferrite materials. As shown, the first and second ferrite materials 126, 128 serve as substrate layers on which the conductive traces 30, 32 are positioned. The third ferrite material 130 is preferably positioned within a central location between the coil winding. Note that each conductive segment 30, 32 could represent multiple traces of the coil turns. Specifically, as shown, first and second outer segments 131, 135 of the conductive traces 30, 32 are positioned directly on the surface of a first layer of the first ferrite material 126 and the third and fourth inner segments 137, 139 of the conductive trace 30, 32 are positioned directly on the surface of a second layer of the second ferrite material 128. The second layer of the second ferrite material 128 is positioned on top of the first layer of the first ferrite material 126.

A third layer of the third ferrite material 130 is positioned directly on the second layer of the second ferrite material 128. In a preferred embodiment, the first, second and third layers of the different ferrite materials 126, 128, and 130 are positioned such that magnetic fields 132 generated by the conductive trace 30, 32 are absorbed by the ferrite materials. Furthermore, the selection of the ferrite material may be based on the material used to construct the conductive lines as well as the amount of the current or voltage flowing therethrough.

[0094] In a preferred embodiment, the various shielding materials and structures could be used to create a hybrid shielding embodiment. In a hybrid shielding embodiment, the various shielding materials are strategically positioned to improve the performance of the multiple inductor coils which resonate at differing frequencies. Thus, the shielding materials are positioned to enhance the multi-mode operation of the antenna 10. For example, utilizing a ferrite material having an increased permeability of about 100 to 120, such as the FFSX series material may be used to optimally shield a coil resonating at 6.78 MHz without degrading the performance of the other coil resonating at a lower frequency range of 100 kHz to about 500 kHz. Likewise, utilization of a ferrite material having a lower permeability such as from about 40 to about 60, like the RFIC material, is preferred because it enhances operation of a coil resonating in the lower kHz frequency region without degrading performance of the higher MHz resonating coil.

[0095] In addition to the specific shielding material, the positioning of the shielding material is also important to the optimal operation of the multi-mode single structure antenna of the present disclosure. For example with reference to FIGS. 6A through 6E, it may be preferred to position the higher permeability ferrite material near the higher resonating coil, such as the relative location of the first material 126 as shown in FIGS. 6A-6E. Similarly, it may be beneficial to position the lower permeability material near the coil that is resonating in the kHz range such as the location of the second material 128. The third material 130 could be a material that has similar material properties as the second material 128 or, alternatively, the third material 130 could be a ferrite material that has a high magnetic saturation that preserves the magnetic performance of the other materials in the presence of a transmitting that comprise a magnet; it also acts as an attractor to help affixing to transmitting coils that comprise a magnet.

[0096] FIG. 6B illustrates a different embodiment of the construction of the antenna of the present disclosure in which the second ferrite material 128 is positioned within a cavity formed within the first material 126. In addition, the height of the second ferrite material layer 128 is greater than the height of the first layer of the first ferrite material 126.

[0097] FIG. 6C illustrates another alternative embodiment in which the second ferrite material 128 is positioned within a cavity of the first ferrite material 126. However, in contrast to the embodiments shown in FIGS. 6A and 6B, the height of the respective first and second ferrite material layers are about the same. FIG. 6D shows yet another embodiment in which the third ferrite material 130 may be positioned within a second cavity positioned within the second material layer 128. In addition, the second material 128 is positioned within the first cavity formed within the first layer of the first material 126. Lastly, FIG. 6E illustrates a fourth embodiment in which all three materials 126, 128 and 130 are positioned such that they are of about the same height. Specifically as shown, the third material 130 is positioned within the second cavity of the second material layer 128, the second material 128 is positioned within the first cavity of the first material layer 126 with all three material layers 126, 128, 130 being of about equal height. Therefore, the various layers of ferrite material may be positioned at different heights relative to each other such that magnetic fields 132 generated by adjacent conductive lines are optimally adsorbed by the ferrite materials.

[0098] In addition to utilizing three ferrite materials as previously discussed, it is contemplated that mixtures or compounds of various ferrite materials may be used to further custom tailor the desired permeability. Furthermore, the various layers may be composed of ferrite material mixtures and alloys. It is also noted that FIGS. 6A-6C represents specific embodiments in which ferrite materials may be positioned within the structure of the antenna of the present disclosure. It is contemplated that the various first, second, and third ferrite materials 126, 128, 130 can be interchangeably positioned throughout the structure of the antenna to custom tailor a desired response or create a specific magnetic field profile.

[0099] It will be appreciated that the multi-mode single structure antenna of the present application may be formed or made by any suitable techniques and with any suitable materials. For example, the antenna coils may comprise suitable metals or metal containing compounds and/or composites, conductive polymers, conductive inks, solders, wire, fiber, filaments, ribbon, layered metal combinations and combinations thereof be used as conductive materials. Suitable fabrication techniques may be used to place conductors on/in a substrate, including, but not limited to, printing techniques, photolithography techniques, chemical or laser etching techniques, laser cladding, laser cutting, physical or chemical vapor deposition, electrochemical deposition, molecular beam epitaxy, atomic layer deposition, stamping, chemical processing, and combinations thereof. It may also be suitable to fabricate the multi-mode single-structure antenna with wire-winding techniques leveraging magnet wires, coated wires, litz wires or other wires used by those skilled in the art. Electrical property enhancement, i.e., enhancement of electrical conductivity and substrate dielectric constant may also be used to achieve the desired properties for a specific application. For example, enhancement of electrical conductivity may be achieved through ion implantation, doping, furnace annealing, rapid thermal annealing, UV processing and combinations thereof.

[0100] FIG. 7 illustrates a flow chart illustrating an embodiment of a method of fabricating a single structure multi-mode antenna of the present disclosure. As shown in the flow chart, in a first step 200 a substrate 22 may be provided.

In a second step 202 the first coil 24 is formed. The first coil 24 may be formed on a surface 28 of a substrate 22 or alternatively, the first coil 24 may be formed without a substrate 22 using at least any of the fabrication techniques previously discussed. In a third step 204, the second coil 26 is formed such that is electrically connected to the first coil 24. Like the previous step 202, the second coil 26 may be formed on a surface 28 of the substrate 22 or alternatively, the second coil 26 may be formed without a substrate 22 using at least any of the fabrication techniques previously discussed. Alternatively, the first and second coils 24, 26 may be formed such that they are contactable to a surface 28 of a substrate 22. In this case, the first and second coils 24, 26 are removably contactable to the surface 28 of a substrate 22. For example, the substrate 22 may provide a temporary mechanical support for the antenna.

[0101] After the first and second coils 24, 26 have been formed, either with or without a substrate 22, at least one terminal is electrically connected to at least one of the first and second coils 24, 26 (step 206). In an optional fourth step 206, magnetic shielding materials may be incorporated within the structure of the antenna. In a fifth step 208, at least one terminal is electrically connected to at least one of the first and second coils 24, 26. In an optional sixth step 210, a selection circuit 118 may be electrically connected to at least one of the terminals or at least one of the first and second coils 24, 26. In addition, or in lieu of a selection circuit, an electrical switch 37 may be electrically connected to at least one of the first and second coils 24, 26 or at least one terminal.

[0102] FIGS. 8A-8C illustrate various embodiments of magnetic field intensity profiles as a function of the number of turns that comprise the coil of the antenna of the present disclosure. As illustrated, in general, modifying the number of turns of the inductor affects the shape and profile of the intensity of the magnetic field. This ability to modify the position and/or strength of the magnetic field strength that is generated by the antenna can be desirable in optimizing data and energy transfer. In a preferred embodiment the strength and profile of the magnetic field can be custom tailored to meet the dimensions of various electronic devices. For example, by modifying the number of coils and/or position of magnetic shielding materials that comprise the single structure antenna of the present disclosure, the intensity profile of the magnetic fields that is generated by the antenna can be modified. It is noted that all the magnetic intensity profiles 8A-8C were taken of single structure antennas having an outer coil width dimension of about 150 mm and an outer coil length dimension of about 90 mm. In addition, the profile magnetic field measurements were taken from about 8 mm away from the outer surface of the respective antennas. A relative intensity scale lies along the right side of each of the plots FIGS. 8A-8C. As indicated by the intensity scale, the strongest magnetic field intensity has a relative intensity of about 1 and is graphically represented having the darkest shade of black. The weakest magnetic field strength has a relative intensity of about 0.1 and is shown having the lightest shade of grey.

[0103] FIG. 8A illustrates an embodiment of a magnetic field intensity profile taken of a single structure antenna comprising one outer coil having one turn. The magnetic field intensity is greatest along the outer perimeter of the coil as illustrated by the darker shades of black which represent the strongest magnetic field intensity. While the strongest magnetic field intensities are along the outer perimeter, the weakest magnetic field intensity, represented by the lighter shade of grey, lies in the central area formed within the perimeter of the coil. Thus, this embodiment is optimally configured for wireless energy transfer along the outer perimeter of the antenna.

[0104] FIG. 8B illustrates an embodiment of a magnetic field intensity profile taken of a single structure antenna comprising a coil having two turns. As shown, the greatest magnetic field intensity lies more along an inner portion of the coil as compared to the field magnetic field intensity profile of a coil having one turn as shown in FIG. 8A. The weakest field intensities of the two turn coil, shown by the lighter shade of grey, lie along the outer perimeter of the second turn of the coil which is positioned towards the interior of the antenna. In comparison to the coil having one turn as illustrated in FIG. 8A, the magnetic field along the central area of the antenna comprising a coil having two turns has an overall increased magnetic field. Thus, as shown, adding an additional interior turn moves the greatest field intensities closer to the middle of the antenna.

[0105] FIG. 8C illustrates an embodiment of a magnetic field intensity profile taken of a single structure antenna comprising a coil having three turns, a first outer turn, a second inner turn and a third inner most turn. Similar to the antenna comprising a coil with two turn, the magnetic field intensity of the three turn coil antenna shown in FIG. 8C is the strongest, along the inner perimeter of the third innermost coil and central area of the antenna. Thus, the antenna comprising a coil having three turns has the strongest magnetic field in general in the central area of the antenna. In addition, the respective corner locations of the second inner turn of the coil also has increased magnetic field intensity. Therefore, such an antenna with a three turn coil is optimally designed to transfer electrical power and data in the central area of the antenna.

[0106] FIG. 9 illustrates a further embodiment of an antenna 140 of the present disclosure of a one piece construction having a unitary antenna body. As illustrated, the antenna 140 is preferably formed from one piece of wire or filament 142 that is formed into the shape of the unitary body antenna 140 extending from a first wire end 149 to a second wire end 153. In a preferred embodiment, the antenna 140 may be formed by a stamping process in which the electrically conductive material is formed together in a mold and die stamp forming process using a metal blank. In a preferred embodiment, the metal blank is positioned between the mold and die. The die is pressed against the metal blank within the mold thus forming the antenna body 140. In addition, the electrically conductive material that forms the unitary

antenna body may be a metal bar, wire, or filament that is stamped out of a sheet of metal. Alternatively, antenna 140 may be formed by a wound wire process whereby the unitary body of the antenna 140 is formed from a single wire that is curved or wound into the desired shape of the antenna 140 comprising a plurality of turns.

[0107] The antenna 140 is preferably formed of a continuous wire form having multiple electrical connection points 148, 150, 152 that are disposed along various portions of the wire 142 of the antenna 140. The plurality of electrical connection points 148, 150, 152 or electrical "taps" create multiple inductor coils having different inductances that comprise the antenna 140 of the present disclosure.

[0108] As illustrated in FIG. 9, a first electrical connection point 148 that is disposed at the first end 149 of the wire 142 of the antenna 140 serves as the common electrical connection. A second electrical connection point 150 is positioned along the third turn of the antenna 140 serves as the "low" inductance electrical connection. A third electrical connection point 152 is disposed at the second end 153 of the antenna 140 serves as the "high" inductance electrical connection of the antenna 140. In an embodiment, terminal leads 154, 156, 158, such as electrically conductive wires, may be attached to these electrical connection points to create antenna terminals. Thus, as shown, the first electrical connection point 148 may serve as the first terminal 34, the third electrical connection point 152 may serve as the second terminal 36 and the second electrical connection point 150 may serve as the third terminal 35. Furthermore, the various first, second and third electrical connection points 148, 150, 152 form the multiple inductor coils of the antenna 140. As illustrated, a first outer inductor coil portion 144 having N_1 number of turns is disposed between the first and second electrical connection points 148, 150 and a second inductor coil portion 146 having N_2 number of turns is disposed between the second and third electrical connection points 150, 152. Similar to the previous single structure antenna embodiments, the unitary body antenna 140 may comprises more than three terminal connections which can be electrically connected to generate a multitude of operating frequencies and/or inductances. In addition, a turn gap 161 may be positioned between adjacent turns of the first and second inductor coils portions 144, 146. Specifically, the turn gap 161 is a space disposed between adjacent wires 142 of the antenna 140. In a preferred embodiment, the turn gap 161 may extend from about 0.1 mm to about 50 mm.

[0109] Preferably, the unitary body antenna 140 illustrated in FIG. 9 is self-standing and does not require the support of a substrate. However, it is contemplated that such an antenna structure may be contactable to a substrate surface. Substrates may include, but are not limited to, a dielectric material and/or a magnetic field blocking material such as a ferrite material as previously discussed. In addition, such an antenna construct may be incorporated within an article of clothing, furniture, an electrical appliance or a vehicle.

[0110] FIG. 10 is a flow chart that illustrates an embodiment of method of fabricating the single structure multi-mode antenna 140 having a unitary antenna body. As shown in the flow chart, in a first step 212, a metal blank is provided. In a second step 214, a die and mold that are used to form the metal blank into the form of the antenna 140 are provided. In a third step 216, the die is used to form the blank metal into the form of the unitary body antenna 140. In a fourth step 218, at least one terminal is electrically connected to at least one of the first and second coil portions 144, 146. In an optional fifth step 220, a selection circuit 118 may be electrically connected to at least one of the terminals or at least one of the first and second coil portions 144, 146. In addition, or in lieu of a selection circuit 118, an electrical switch 37 may be electrically connected to at least one of the first and second coil portions 144, 146 or at least one terminal.

[0111] It is further contemplated that the various embodiments of the single structure antenna of the present disclosure may comprise a plurality of terminals greater than three. FIG. 11 illustrates a theoretical example in which a single structure antenna of the present disclosure may comprise a plurality of $n+1$ number of terminal connections. As shown, the antenna of the present disclosure may comprise three, four, five or more terminal connections which can be electrically connected to generate an infinite number of operating frequency bands and/or inductances.

[0112] FIG. 11 illustrates a theoretical example of a single structure antenna of the present disclosure that comprises an indefinite number of inductors, L_n in which each of the multitude of inductors may have a different inductance. Furthermore, as illustrated, the respective inductors, L_1 through L_n preferably comprise a terminal connection T_1 through $T_{(n+1)}$ or electrical "tap" that is electrically connected to at least a portion of the respective inductor coil. Therefore, it is possible to create a single structure antenna that may be selectively tuned to exhibit an unlimited number of frequencies and/or inductances such that the antenna of the present disclosure can be tuned to an exact frequency or frequencies.

[0113] FIGS. 12A-12C illustrate embodiments of electrical switch configurations 160 that may be used to electrically connect and/or disconnect the various terminals that may comprise the single structure antenna of the present disclosure. It is noted that FIGS. 12A-12C correlate to respective embodiments illustrated in FIGS. 8A-8C. As illustrated in FIGS. 12A-12C, the exemplar antenna comprises three inductors L_1 - L_3 having four terminal connections T_1 - T_4 . A multiple of electrical connection points 162A-162P are positioned at various locations along the antenna. In addition, the antenna comprises a multitude of electrical switches 164, 166, 168, 170, 172, 174, 176 and 178 that are positioned along the antenna and are designed to electrically connect and/or disconnect the various electrical connection points along the antenna. For example, electrical switch 164 is shown electrically connecting electrical connection points 162A and 162B, electrical switch 172 is shown electrically connecting electrical connection points 162M and 162N. Thus, by electrically connecting a certain combination of electrical connection points 162A-162P along the single structure antenna by at

least one of the various electrical switches 164-178 the antenna can be tuned to a desired operating frequency, frequencies and/or inductances that are suitable to wirelessly transfer or receive electrical energy and/or data signals as desired.

[0114] Furthermore, any of these multitude of switches may be turned electrically "on" or "off" as desired as the antenna operates. It is noted that electrically active, i.e., electrically connected, electrical connection points are illustrated as black filled circles whereas non-active electrical connection points, i.e., electrical connection points that are electrically disconnected, are shown as unfilled circles. It is further noted that a microprocessor (not shown) or circuit board (not shown) may be used to control the combination of switches that are turned "on" or "off". In addition, the electrical switch may comprise a multitude of different electrical switches. Examples of which may include, but are not limited to, an electrical toggle switch, a rocker switch, a push button switch, an inline switch, switched capacitor networks, and filter networks that utilize inductors and/or capacitors. As defined herein, an electrical switch is an electrical component that can either connect or disconnect an electrical current, voltage, signal or combinations thereof, along an electrical pathway. A switch can also divert an electrical current, voltage, signal or combinations thereof, from one electrical conductor to another. An electrical switch that is in an "on" position is defined as allowing an electrical signal or electrical current or voltage to pass therethrough and thus is electrically connected. An electrical switch that is in an "off" position is defined as prohibiting an electrical signal or electrical current or voltage to pass therethrough and thus is electrically disconnected.

[0115] FIG. 12A illustrates an embodiment in which the antenna of the present disclosure is configured with the first and fourth terminals T1, T4 electrically connected such that the antenna exhibits an inductance equal to the combination of the first, second and third inductors L_1 , L_2 and L_3 . Specifically, as illustrated, electrical switches 164, 166, 172 and 178 are closed and electrical connection points 162A, 162B, 162C, 162D, 162M, 162N, 162O and 162P are electrically closed thereby allowing electrical current to pass therethrough.

[0116] FIG. 12B shows an embodiment in which the antenna is configured with the first and second terminals T1, T2 electrically connected so that the antenna exhibits an inductance comprising the first inductor L_1 . Specifically, as illustrated, electrical switches 164, 166, and 170 are electrically closed and electrical connection points 162A, 162B, 162C, 162E, 162F, and 162H are electrically active. All other electrical switches and electrical connection points are illustrated to be electrically open.

[0117] FIG. 12C shows an embodiment of the antenna in which the first and third inductors L_1 , L_3 that comprise the antenna are electrically connected. As illustrated, an electrical switch connections bypass the second inductor L_2 within the antenna. A first bypass switch electrically connects the first inductor to a bypass portion of the antenna and a second bypass switch electrically connects the first inductor L_1 to the third inductor L_3 . Specifically, as illustrated, electrical switches 164, 168, 174 and 178 are electrically closed and electrical connection points 162A, 162B, 162C, 162E, 162F, 162G, 162I, 162K, 162L, 162N, 162O and 162P are electrically active.

[0118] FIG. 13 is a flow chart that illustrates an embodiment of operating the multi-mode single structure antenna of the present disclosure. As shown, in a first step 222, a multi-mode single structure antenna of the present disclosure is provided. In a second step 224, a connection between at least two terminals is selected. Thus, by connecting two of the at least three terminals enables an operator to select a desired receiving or transmitting antenna frequency. In addition, by connecting two of the at least three terminals enables an operator to select a desired inductance that is exhibited by the antenna. To tune the antenna to a different frequency or inductance, a second connection between two of the at least three terminals having a different electrical connection configuration of that of the first is made. The electrical connections between terminals may be made manually or alternatively, can be made automatically by a machine such as a computer or device comprising a processing unit. As previously mentioned, the electrical connections between terminals can be made via an electrical switch 37 and/or a selection circuit 118. Thus, it is contemplated that the single structure antenna of the present disclosure is capable of being tuned to a plurality of unlimited frequencies or inductances by connecting different terminals or electrical points positioned along at least the first and second coils 24, 26. It is appreciated that various modifications to the inventive concepts described herein may be apparent to those of ordinary skill in the art without departing from the spirit and scope of the present disclosure as defined by the appended claims.

[0119] In one or more embodiments of the present disclosure, a multi-mode single structure antenna includes a first conductive wire forming a first coil having N_1 number of turns with spaced apart first and second first coil ends, the first coil contactable to a substrate surface, wherein the first coil is capable of generating a first inductance. The antenna also includes a second conductive wire forming a second coil having N_2 number of turns with spaced apart first and second second coil ends, the second coil capable of generating a second inductance positioned within an inner perimeter formed by the first coil. The antenna further includes a first terminal electrically connected to the first end of the first coil, a second terminal electrically connected to the second end of the second coil and a third terminal electrically connected along either of the first or second coils. The antenna also includes wherein a tunable inductance is generatable by selecting a connection between two of the first, second and third terminals.

[0120] One or more embodiments include a gap disposed between the inner perimeter of the first coil and an outer perimeter of the second coil. One or more embodiments include wherein the gap is at least about 0.1 mm. One or more embodiments include wherein the first conductive wire comprises two or more filars electrically connected in parallel. One or more embodiments include wherein the second conductive wire comprises two or more filars electrically connected

in parallel. One or more embodiments include wherein the first terminal is electrically connected to the first end of the first coil, the first end of the first coil disposed at an end of the first wire of the first coil located at an outermost first coil perimeter, the third terminal is electrically connected to the first end of the second coil positioned at a second coil outer perimeter, and the second terminal is electrically connected to the second end of the second coil located along an interior perimeter of the second coil pattern.

[0121] One or more embodiments include wherein a selection circuit is electrically connected to at least one of the first, second, and third terminals. One or more embodiments include wherein the selection circuit comprises at least one component selected from the group consisting of a capacitor, a resistor, and an inductor. One or more embodiments include wherein N_1 is at least one and N_2 is at least two. One or more embodiments include wherein N_2 is greater than N_1 . One or more embodiments include wherein each terminal has a terminal lead portion that extends between a coil connection point and a terminal end, the coil connection point electrically connected to either of the first and second conductive wires of the first and second coils respectively, and wherein the terminal lead portion extends over at least a portion of either of the first and second conductive wires of the first and second coils respectively.

[0122] One or more embodiments include wherein a plurality of first vias are positioned adjacently along a right side of a length of the terminal lead portion and a plurality of second vias are positioned along a left side of the length of the terminal lead portion and opposed from the plurality of first vias so that each of the plurality of first vias opposes one of the plurality of second vias, wherein the respective opposing vias of the plurality of first and second vias are electrically connected to the same conductive wire of either of the first or second coils, thereby establishing a conductive electrical path therebetween that bypasses the terminal lead portion. One or more embodiments include wherein at least the first conductive wire or the second conductive wire has a variable wire width. One or more embodiments include the antenna having a quality factor greater than 10.

[0123] One or more embodiments include wherein an electrical signal selected from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof is receivable by at least the first and second coils. One or more embodiments include wherein an electrical signal selected from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof is transmittable by at least the first and second coils. One or more embodiments include wherein the substrate comprises material composed of an electrically insulative material selected from the group consisting of a polyimide, an acrylic, fiberglass, polyester, polyether imide, polytetrafluoroethylene, polyethylene, polyetheretherketone (PEEK), polyethylene naphthalate, fluoropolymers, copolymers, a ceramic material, a ferrite material, and combinations thereof.

[0124] One or more embodiments include wherein the antenna is capable of receiving or transmitting within a frequency band selected from the group consisting of about 100 kHz to about 250 kHz, about 250 kHz to about 500 kHz, 6.78 MHz, 13.56 MHz, and combinations thereof. One or more embodiments include wherein the antenna is capable of receiving or transmitting at frequencies of at least 100 kHz. One or more embodiments include wherein a tunable operating frequency is generatable by selecting a connection between two of the first, second, and third terminals.

[0125] One or more embodiments include an antenna, the antenna having: a first conductive wire forming a first coil having N_1 number of turns with spaced apart first and second first coil ends, the first coil contactable to a substrate surface, wherein the first coil is capable of generating a first inductance; a second conductive wire forming a second coil having N_2 number of turns with spaced apart first and second second coil ends, the second coil capable of generating a second inductance positioned within an inner perimeter formed by the first coil; a first terminal electrically connected to the first end of the first coil, a second terminal electrically connected to the second end of the second coil and a third terminal electrically connected along either of the first or second coils; and wherein a tunable inductance is generatable by selecting a connection between two of the first, second and third terminals.

[0126] In one or more embodiments, the antenna further having a gap disposed between the inner perimeter of the first coil and an outer perimeter of the second coil. The antenna wherein the gap is at least about 0.1 mm. The antenna wherein the first conductive wire comprises two or more filars electrically connected in parallel. The antenna wherein the second conductive wire comprises two or more filars electrically connected in parallel. The antenna wherein the first terminal is electrically connected to the first end of the first coil, the first end of the first coil disposed at an end of the first wire of the first coil located at an outermost first coil perimeter, the third terminal is electrically connected to the first end of the second coil positioned at a second coil outer perimeter, and the second terminal is electrically connected to the second end of the second coil located along an interior perimeter of the second coil pattern. The antenna wherein a selection circuit is electrically connected to at least one of the first, second, and third terminals. The antenna, wherein the selection circuit includes at least one component selected from the group consisting of a capacitor, a resistor, and an inductor. The antenna, wherein N_1 is at least one and N_2 is at least two. The antenna, wherein N_2 is greater than N_1 . The antenna, wherein each terminal has a terminal lead portion that extends between a coil connection point and a terminal end, the coil connection point electrically connected to either of the first and second conductive wires of the first and second coils respectively, and wherein the terminal lead portion extends over at least a portion of either of the first and second conductive wires of the first and second coils respectively. The antenna, wherein a plurality of first vias are positioned adjacently along a right side of a length of the terminal lead portion and a plurality of second vias are positioned

along a left side of the length of the terminal lead portion and opposed from the plurality of first vias so that each of the plurality of first vias opposes one of the plurality of second vias, wherein the respective opposing vias of the plurality of first and second vias are electrically connected to the same conductive wire of either of the first or second coils, thereby establishing a conductive electrical path therebetween that bypasses the terminal lead portion. The antenna, wherein at least the first conductive wire or the second conductive wire has a variable wire width. The antenna, the antenna having a quality factor greater than 10. The antenna, wherein an electrical signal selected from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof is receivable by at least the first and second coils. The antenna, wherein an electrical signal selected from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof is transmittable by at least the first and second coils. The antenna, wherein the substrate comprises material composed of an electrically insulative material selected from the group consisting of a polyimide, an acrylic, fiberglass, polyester, polyether imide, polytetrafluoroethylene, polyethylene, polyetheretherketone (PEEK), polyethylene naphthalate, fluropolymers, copolymers, a ceramic material, a ferrite material, and combinations thereof. The antenna, wherein the antenna is capable of receiving or transmitting within a frequency band selected from the group consisting of about 100 kHz to about 250 kHz, about 250 kHz to about 500 kHz, 6.78 MHz, 13.56 MHz, and combinations thereof. The antenna, wherein the antenna is capable of receiving or transmitting at frequencies of at least 100 kHz. The antenna, wherein a tunable operating frequency is generatable by selecting a connection between two of the first, second, and third terminals.

[0127] In one or more of the embodiments of the present disclosure, a single structure multi mode antenna includes a first conductive wire forming a first coil having N_1 number of turns with spaced apart first and second first coils ends, the first coil contactable to a substrate surface, wherein the first coil is capable of generating a first inductance. The antenna also includes a second conductive wire forming a second coil having N_2 number of turns with spaced apart first and second second coil ends, the second coil capable of generating a second inductance positioned within an inner perimeter formed by the first coil. The antenna further includes a first terminal electrically connected to the first end of the first coil, a second terminal electrically connected to the second end of the second coil and a third terminal electrically connected along either of the first or second coils. The antenna includes an electrical switch circuit having at least one capacitor that is electrically connected to either of the first, second or third terminals. The antenna also includes a tunable inductance or frequency that is generatable by selecting a connection between two of the first, second and third terminals by actuation of the electrical switch circuit.

[0128] One or more embodiments include a gap disposed between the inner perimeter of the first coil and an outer perimeter of the second coil. One or more embodiments include wherein the gap is at least about 0.1 mm. One or more embodiments include wherein the first conductive wire comprises two or more filars electrically connected in parallel. One or more embodiments include wherein the second conductive wire comprises two or more filars electrically connected in parallel. One or more embodiments include wherein the first terminal is electrically connected to the first end of the first coil, the first end of the first coil disposed at an end of the first wire of the first coil located at an outermost first coil perimeter, the third terminal is electrically connected to the first end of the second coil positioned at a second coil outer perimeter, and the second terminal is electrically connected to the second end of the second coil located along an interior perimeter of the second coil.

[0129] One or more embodiments include wherein a selection circuit is electrically connected to the first, second and third terminals, wherein the selection circuit electrically connects two of the first, second and third terminals to generate a tunable inductance. One or more embodiments include wherein the selection circuit comprises at least one electrical component selected from the group consisting of a resistor, a capacitor and an inductor. One or more embodiments include wherein N_1 is at least one and N_2 is at least two. One or more embodiments include wherein N_2 is greater than N_1 . One or more embodiments include wherein each terminal has a terminal lead portion that extends between a coil connection point and a terminal end, the coil connection point electrically connected to either of the first and second conductive wires of the first and second coils, respectively, and wherein the terminal lead portion extends over at least a portion of either of the first and second conductive wires of the first and second coils, respectively.

[0130] One or more embodiments include wherein a plurality of first vias are positioned adjacently along a right side of a length of the terminal lead portion and a plurality of second vias are positioned along a left side of the length of the terminal lead portion and opposed from the plurality of first vias so that each of the plurality of first vias opposes one of the plurality of second vias, wherein the respective opposing vias of the plurality of first and second vias are electrically connected to the same conductive wire of either of the first and second coils, thereby establishing a conductive electrical path therebetween that bypasses the terminal lead portion. One or more embodiments include wherein at least the first conductive wire and the second conductive wire has a variable wire width. One or more embodiments include the antenna having a quality factor greater than 10. One or more embodiments include wherein an electrical signal selected from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof is receivable by at least the first and second coils.

[0131] One or more embodiments include wherein an electrical signal selected from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof is transmittable by at least the first and

second coils. One or more embodiments include One or more embodiments include wherein the substrate comprises material composed of an electrically insulative material selected from the group consisting of a polyimide, an acrylic, fiberglass, polyester, polyether imide, polytetrafluoroethylene, polyethylene, polyetheretherketone (PEEK), polyethylene naphthalate, fluropolymers, copolymers, a ceramic material, a ferrite material, and combinations thereof. One or more
 5 embodiments include wherein the antenna is capable of receiving a frequency band selected from the group consisting of about 100 kHz to about 250 kHz, about 250 kHz to about 500 kHz, 6.78 MHz, 13.56 MHz, and combinations thereof. One or more embodiments include wherein the antenna is capable of receiving or transmitting frequencies of at least 100 kHz. One or more embodiments include wherein actuation of the electrical switch electrically connects two of the three terminal ends so that an antenna inductance is modified.

[0132] One or more embodiments include a single structure multi mode antenna having an internal switch circuit, comprising: a first conductive wire forming a first coil having N_1 number of turns with spaced apart first and second first coil ends contactable to a substrate surface, wherein the first coil is capable of generating a first inductance; a second conductive wire forming a second coil having N_2 number of turns with spaced apart first and second coil ends, the second coil capable of generating a second inductance positioned within an inner perimeter formed by the first coil; a first terminal electrically connected to the first end of the first coil, a second terminal electrically connected to the second end of the
 15 second coil and a third terminal electrically connected to an electrical switch circuit comprising at least one capacitor, wherein the electrical switch circuit is electrically connected along either of the first or second coils; and wherein actuation of the electrical switch electrically connects two of the three terminal ends so that an antenna operating frequency is modified. The antenna, wherein a gap is disposed between the inner perimeter of the first coil and an outer perimeter of the second coil. The antenna, wherein the gap is at least about 0.1 mm. The antenna, wherein the first conductive wire comprises two or more filars electrically connected in parallel. The antenna, wherein the second conductive wire comprises two or more filars electrically connected in parallel. The antenna, wherein the first terminal is electrically connected to the first end of the first coil, the first end of the first coil disposed at an end of the first wire of the first coil located at an outermost first coil perimeter, the third terminal is electrically connected to the first end of the second coil
 20 positioned at a second coil outer perimeter, and the second terminal is electrically connected to the second end of the second coil located along an interior perimeter of the second coil. The antenna, wherein a selection circuit is electrically connected to the first, second and third terminals, wherein the selection circuit electrically connects two of the first, second and third terminals to generate a tunable inductance. The antenna, wherein the selection circuit comprises at least one electrical component selected from the group consisting of a resistor, a capacitor and an inductor. The antenna, wherein N_1 is at least one and N_2 is at least two. The antenna, wherein N_2 is greater than N_1 . The antenna, wherein each terminal has a terminal lead portion that extends between a coil connection point and a terminal end, the coil connection point electrically connected to either of the first and second conductive wires of the first and second coils, respectively, and wherein the terminal lead portion extends over at least a portion of either of the first and second conductive wires of the first and second coils, respectively. The antenna, wherein a plurality of first vias are positioned
 30 adjacently along a right side of a length of the terminal lead portion and a plurality of second vias are positioned along a left side of the length of the terminal lead portion and opposed from the plurality of first vias so that each of the plurality of first vias opposes one of the plurality of second vias, wherein the respective opposing vias of the plurality of first and second vias are electrically connected to the same conductive wire of either of the first and second coils, thereby establishing a conductive electrical path therebetween that bypasses the terminal lead portion. The antenna, wherein at least the first conductive wire and the second conductive wire has a variable wire width. The antenna having a quality factor greater than The antenna, wherein an electrical signal selected from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof is receivable by at least the first and second coils. The antenna, wherein an electrical signal selected from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof is transmittable by at least the first and second coils. The antenna, wherein the
 45 substrate comprises material composed of an electrically insulative material selected from the group consisting of a polyimide, an acrylic, fiberglass, polyester, polyether imide, polytetrafluoroethylene, polyethylene, polyetheretherketone (PEEK), polyethylene naphthalate, fluropolymers, copolymers, a ceramic material, a ferrite material, and combinations thereof. The antenna, wherein the antenna is capable of receiving a frequency band selected from the group consisting of about 100 kHz to about 250 kHz, about 250 kHz to about 500 kHz, 6.78 MHz, 13.56 MHz, and combinations thereof. The antenna, wherein the antenna is capable of receiving or transmitting frequencies of at least 100 kHz. The antenna, wherein actuation of the electrical switch electrically connects two of the three terminal ends so that an antenna inductance is modified.

[0133] In at least one of the embodiments of the present disclosure, a single structure multi mode antenna includes a substrate composed of an electrically insulative material having opposed top and bottom surfaces. In addition, the
 55 antenna includes a first conductive wire forming a first coil having N_1 number of turns with spaced apart first and second first coils ends, the first coil disposed on the top substrate surface, wherein the first coil is capable of generating a first inductance. The antenna also includes a second conductive wire forming a second coil having N_2 number of turns with spaced apart first and second second coil ends, the second coil capable of generating a second inductance positioned

within an inner perimeter formed by the first coil, disposed on the top substrate surface, the second coil connected to the first coil in electrical series. The antenna further includes a third conductive wire forming a third coil having N_3 number of turns with spaced apart first and second third coils ends, the third coil disposed on the opposing bottom substrate of the surface, and wherein the third coil is capable of generating a third inductance. In addition, the antenna includes at least one first via that electrically connects the third coil to at least one of the first and second conductive wires. The antenna further includes a first terminal electrically connected to the first end of the first coil, a second terminal electrically connected to the second end of the second coil and a third terminal electrically connected along either of the first or second coils. The antenna also includes wherein a tunable inductance or frequency is generatable by selecting a connection between two of the first, second and third terminals.

[0134] One or more embodiments include wherein a first gap is disposed between the inner perimeter of the first coil and an outer perimeter of the second coil. One or more embodiments include wherein a length of the first gap is at least about 0.1 mm. One or more embodiments include wherein at least one of the first second and third conductive wires comprise two or more filars electrically connected in parallel. One or more embodiments include wherein a fourth conductive wire forming a fourth coil having N_4 number of turns, the fourth coil capable of exhibiting a fourth inductance is disposed within an inner perimeter of the third coil on the bottom substrate surface, wherein the third and fourth coils are connected in electrical series. One or more embodiments include wherein the first terminal is electrically connected to the first end of the first coil, the first end of the first coil disposed at an end of the first wire of the first coil located at an outermost first coil perimeter, the third terminal is electrically connected to the first end of the second coil positioned at a second coil outer perimeter, and the second terminal is electrically connected to the second end of the second coil located along an interior perimeter of the second coil.

[0135] One or more embodiments include wherein a selection circuit is electrically connected to the first, second and third terminals, wherein the selection circuit electrically connects two of the first, second and third terminals to generate a tunable inductance. One or more embodiments include wherein N_1 is at least one and N_2 is at least two. One or more embodiments include wherein N_3 is at least one. One or more embodiments include wherein N_3 is at least one. One or more embodiments include wherein each terminal has a terminal lead portion that extends between a coil connection point and a terminal end, the coil connection point electrically connected to either of the first, second, and third conductive wires of the first, second, and third coils, respectively, and wherein the terminal lead portion extends over at least a portion of either of the first, second, and third conductive wires of the first, second, and third coils, respectively. One or more embodiments include wherein a plurality of second vias are positioned adjacently along a right side of a length of the terminal lead portion and a plurality of third vias are positioned along a left side of the length of the terminal lead portion and opposed from the plurality of second vias so that each of the plurality of second vias opposes one of the plurality of third vias, wherein the respective opposing vias of the plurality of second and third vias are electrically connected to the same conductive wire of either of the first, second, and third coils, thereby establishing a conductive electrical path therebetween that bypasses the terminal lead portion.

[0136] One or more embodiments include wherein a selection circuit is electrically connected to two of the first, second, and third terminal ends. One or more embodiments include wherein the selection circuit comprises at least one of an electrical component selected from the group consisting of a resistor, a capacitor and an inductor. One or more embodiments include wherein at least one of the first, second, and third conductive wires has a variable wire width. One or more embodiments include the antenna having a quality factor greater than 10. One or more embodiments include wherein an electrical signal is selected from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof is receivable or transmittable by at least one of the first, second, and third coils. One or more embodiments include wherein the substrate material is composed of an electrically insulative material selected from the group consisting of a polyimide, an acrylic, fiberglass, polyester, polyether imide, polytetrafluoroethylene, polyethylene, polyetheretherketone (PEEK), polyethylene naphthalate, fluoropolymers, copolymers, a ceramic material, a ferrite material, and combinations thereof. One or more embodiments include wherein the antenna is capable of receiving a frequency band selected from the group consisting of about 100 kHz to about 250 kHz, about 250 kHz to about 500 kHz, 6.78 MHz, 13.56 MHz, and combinations thereof. One or more embodiments include wherein the antenna is capable of receiving or transmit frequencies of at least 100 kHz.

[0137] One or more embodiments include a single structure multi mode antenna, comprising: a substrate composed of an electrically insulative material having opposing top and bottom surfaces; a first conductive wire forming a first coil having N_1 number of turns, the first coil capable of exhibiting a first inductance disposed on the substrate top surface and a second conductive wire forming a second coil having N_2 number of turns, the second coil capable of exhibiting a second inductance disposed within an inner perimeter of the first coil on the substrate top surface, wherein the first and second coil are connected in electrical series; a third conductive wire forming a third coil having N_3 number of turns, the third coil capable of exhibiting a third inductance disposed on the opposing bottom substrate surface; at least one first via electrically connecting the third conductive wire to at least one of the first and second conductive wires; a first terminal electrically connected to the first end of the first coil, a second terminal electrically connected to the second end of the second coil and a third terminal electrically connected along either of the first, second, or third; and wherein a tunable

inductance is generatable by selecting a connection between two of the first, second and third terminals. The antenna, wherein a first gap is disposed between the inner perimeter of the first coil and an outer perimeter of the second coil. The antenna, wherein a length of the first gap is at least about 0.1 mm. The antenna, wherein at least one of the first second and third conductive wires comprise two or more filars electrically connected in parallel. The antenna, wherein a fourth conductive wire forming a fourth coil having N_4 number of turns, the fourth coil capable of exhibiting a fourth inductance is disposed within an inner perimeter of the third coil on the bottom substrate surface, wherein the third and fourth coils are connected in electrical series. The antenna wherein the first terminal is electrically connected to the first end of the first coil, the first end of the first coil disposed at an end of the first wire of the first coil located at an outermost first coil perimeter, the third terminal is electrically connected to the first end of the second coil positioned at a second coil outer perimeter, and the second terminal is electrically connected to the second end of the second coil located along an interior perimeter of the second coil. The antenna wherein a selection circuit is electrically connected to the first, second and third terminals, wherein the selection circuit electrically connects two of the first, second and third terminals to generate a tunable inductance. The antenna wherein N_1 is at least one and N_2 is at least two. The antenna, wherein N_3 is at least one. The antenna, wherein each terminal has a terminal lead portion that extends between a coil connection point and a terminal end, the coil connection point electrically connected to either of the first, second, and third conductive wires of the first, second, and third coils, respectively, and wherein the terminal lead portion extends over at least a portion of either of the first, second, and third conductive wires of the first, second, and third coils, respectively. The antenna, wherein a plurality of second vias are positioned adjacently along a right side of a length of the terminal lead portion and a plurality of third vias are positioned along a left side of the length of the terminal lead portion and opposed from the plurality of second vias so that each of the plurality of second vias opposes one of the plurality of third vias, wherein the respective opposing vias of the plurality of second and third vias are electrically connected to the same conductive wire of either of the first, second, and third coils, thereby establishing a conductive electrical path therebetween that bypasses the terminal lead portion. The antenna, wherein a selection circuit is electrically connected to two of the first, second, and third terminal ends. The antenna wherein the selection circuit comprises at least one of an electrical component selected from the group consisting of a resistor, a capacitor and an inductor. The antenna wherein at least one of the first, second, and third conductive wires has a variable wire width. The antenna having a quality factor greater than 10. The antenna wherein an electrical signal is selected from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof is receivable or transmittable by at least one of the first, second, and third coils. The antenna wherein the substrate material is composed of an electrically insulative material selected from the group consisting of a polyimide, an acrylic, fiberglass, polyester, polyether imide, polytetrafluoroethylene, polyethylene, polyetheretherketone (PEEK), polyethylene naphthalate, fluoropolymers, copolymers, a ceramic material, a ferrite material, and combinations thereof. The antenna wherein the antenna is capable of receiving a frequency band selected from the group consisting of about 100 kHz to about 250 kHz, about 250 kHz to about 500 kHz, 6.78 MHz, 13.56 MHz, and combinations thereof. The antenna wherein the antenna is capable of receiving or transmit frequencies of at least 100 kHz.

[0138] In at least one of the embodiments of the present disclosure, a single structure multi mode antenna includes a substrate composed of a material having a permeability greater than 10. In addition, the antenna includes a first conductive wire forming a first coil capable of generating a first inductance having N_1 number of turns with spaced apart first and second first coil ends, and wherein the first coil is disposed on a surface of the substrate. The antenna also includes a second conductive wire forming a second coil disposed on the substrate surface having N_2 number of turns with spaced apart first and second second coil ends, the second coil capable of generating a second inductance, is positioned within an inner perimeter formed by the first coil. In addition, the antenna includes a first terminal electrically connected to the first end of the first coil, a second terminal electrically connected to the second end of the second coil and a third terminal electrically connected along either of the first or second coils. The antenna also includes wherein a tunable inductance is generatable by selecting a connection between two of the first, second and third terminals.

[0139] One or more embodiments include wherein the substrate material is a ferrite material selected from the group consisting of manganese-zinc, nickel-zinc, copper-zinc, magnesium-zinc, and combinations thereof. One or more embodiments include wherein the first coil is disposed on a first portion of the substrate, and wherein the first substrate portion comprises a first ferrite material having a permeability greater than about 40. One or more embodiments include wherein the second coil is disposed on a second portion of the substrate, and wherein the second substrate portion comprises a second ferrite material having a permeability greater than about 40. One or more embodiments include wherein a gap is disposed between the inner perimeter of the first coil and an outer perimeter of the second coil. One or more embodiments include wherein the gap is at least about 0.1 mm. One or more embodiments include wherein the first conductive wire comprises two or more filars electrically connected in parallel. One or more embodiments include wherein the second conductive wire comprises two or more filars electrically connected in parallel.

[0140] One or more embodiments include wherein the first terminal is electrically connected to the first end of the first coil, wherein the first end of the first coil is disposed at an end of the first wire of the first coil located at an outermost first coil perimeter, the third terminal is electrically connected to the first end of the second coil positioned at a second

coil outer perimeter, and the second terminal is electrically connected to the second end of the second coil located along an interior perimeter of the second coil. One or more embodiments include wherein a selection circuit is electrically connected to the first, second and third terminals, the selection circuit electrically connecting two of the first, second and third terminals to generate a tunable inductance. One or more embodiments include wherein the selection circuit comprises at least one electrical component selected from the group consisting of a resistor, a capacitor and an inductor. One or more embodiments include wherein N_1 is at least one and N_2 is at least two. One or more embodiments include wherein N_2 is greater than N_1 .

[0141] One or more embodiments include wherein each terminal has a terminal lead portion that extends between a coil connection point and a terminal end, the coil connection point electrically connected to one of either of the first and second conductive wires of the first and second coils, respectively, and wherein the terminal lead portion extends over at least a portion of either of the first and second conductive wires of the first and second coils, respectively. One or more embodiments include wherein a plurality of first vias are positioned adjacently along a right side of a length of the terminal lead portion and a plurality of second vias are positioned along a left side of a length of the terminal lead portion and opposed from the plurality of first vias so that each of the plurality of first vias opposes one of the plurality of second vias, wherein the respective opposing vias of the plurality of first and second vias are electrically connected to the same conductive wire of either of the first or second coils, thereby establishing a conductive electrical path therebetween that bypasses the terminal lead portion.

[0142] One or more embodiments include wherein the antenna is capable of receiving or transmitting within a frequency band selected from the group consisting of about 100 kHz to about 250 kHz, about 250 kHz to about 500 kHz, 6.78 MHz, 13.56 MHz, and combinations thereof. One or more embodiments include wherein the antenna is capable of receiving or transmitting frequencies of at least 100 kHz. One or more embodiments include wherein an electrical signal selected from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof is receivable or transmittable by at least the first and second coils. One or more embodiments include wherein at least the first or second coil has a variable wire width. One or more embodiments include the antenna having a quality factor of at least 10.

[0143] One or more embodiments include a single structure multi mode antenna, comprising: a substrate composed of a material having a permeability greater than 10; a first conductive wire forming a first coil having N_1 number of turns with spaced apart first and second first coil ends that are disposed on the substrate surface, wherein the first coil is capable of generating a first inductance; a second conductive wire forming a second coil having N_2 number of turns with spaced apart first and second second coil ends, the second coil capable of generating a second inductance positioned within an inner perimeter formed by the first coil on the substrate surface; a first terminal electrically connected to the first end of the first coil, a second terminal electrically connected to the second end of the second coil and a third terminal electrically connected along either of the first or second coils; and wherein a tunable inductance is generatable by selecting a connection between two of the first, second and third terminals. The antenna, wherein the substrate material is a ferrite material selected from the group consisting of manganese-zinc, nickel-zinc, copper-zinc, magnesium-zinc, and combinations thereof. The antenna, wherein the first coil is disposed on a first portion of the substrate, and wherein the first substrate portion comprises a first ferrite material having a permeability greater than about 40. The antenna, wherein the second coil is disposed on a second portion of the substrate, and wherein the second substrate portion comprises a second ferrite material having a permeability greater than about 40. The antenna, wherein a gap is disposed between the inner perimeter of the first coil and an outer perimeter of the second coil. The antenna, wherein the gap is at least about 0.1 mm. The antenna, wherein the first conductive wire comprises two or more filars electrically connected in parallel. The antenna, wherein the second conductive wire comprises two or more filars electrically connected in parallel. The antenna, wherein the first terminal is electrically connected to the first end of the first coil, wherein the first end of the first coil is disposed at an end of the first wire of the first coil located at an outermost first coil perimeter, the third terminal is electrically connected to the first end of the second coil positioned at a second coil outer perimeter, and the second terminal is electrically connected to the second end of the second coil located along an interior perimeter of the second coil. The antenna, wherein a selection circuit is electrically connected to the first, second and third terminals, the selection circuit electrically connecting two of the first, second and third terminals to generate a tunable inductance. The antenna, wherein the selection circuit comprises at least one electrical component selected from the group consisting of a resistor, a capacitor and an inductor. The antenna, wherein N_1 is at least one and N_2 is at least two. The antenna, wherein N_2 is greater than N_1 . The antenna, wherein each terminal has a terminal lead portion that extends between a coil connection point and a terminal end, the coil connection point electrically connected to one of either of the first and second conductive wires of the first and second coils, respectively, and wherein the terminal lead portion extends over at least a portion of either of the first and second conductive wires of the first and second coils, respectively. The antenna, wherein a plurality of first vias are positioned adjacently along a right side of a length of the terminal lead portion and a plurality of second vias are positioned along a left side of a length of the terminal lead portion and opposed from the plurality of first vias so that each of the plurality of first vias opposes one of the plurality of second vias, wherein the respective opposing vias of the plurality of first and second vias are electrically connected to the same conductive wire

of either of the first or second coils, thereby establishing a conductive electrical path therebetween that bypasses the terminal lead portion. The antenna, wherein the antenna is capable of receiving or transmitting within a frequency band selected from the group consisting of about 100 kHz to about 250 kHz, about 250 kHz to about 500 kHz, 6.78 MHz, 13.56 MHz, and combinations thereof. The antenna, wherein the antenna is capable of receiving or transmitting frequencies of at least 100 kHz. The antenna, wherein an electrical signal selected from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof is receivable or transmittable by at least the first and second coils. The antenna, wherein at least the first or second coil has a variable wire width. The antenna having a quality factor of at least 10.

[0144] In at least one of the embodiments of the present disclosure, a system that includes a single structure multi mode antenna is provided. The system includes an antenna having a first conductive wire forming a first coil capable of generating a first inductance having N_1 number of turns with spaced apart first and second first coil ends, the first coil is contactable to a substrate surface. The antenna also includes a second conductive wire forming a second coil capable of generating a second inductance having N_2 number of turns with spaced apart first and second second coil ends, the second coil is positioned within an inner perimeter formed by the first coil. The antenna further includes a first terminal electrically connected to the first end of the first coil, a second terminal electrically connected to the second end of the second coil and a third terminal electrically connected along either of the first or second coils. The antenna also includes wherein a tunable inductance or frequency that is generatable by selecting a connection between two of the first, second and third terminals. The system also includes a control circuit that is electrically connected to at least one of the first, second and third antenna terminals. The control circuit of the system is capable of controlling the operation of the antenna.

[0145] One or more embodiments include wherein the control circuit comprises at least one of an electrical resistor, a capacitor and an inductor. One or more embodiments include wherein a gap is disposed between the inner perimeter of the first coil and an outer perimeter of the second coil. One or more embodiments include wherein the gap is at least about 0.1 mm. One or more embodiments include wherein the first conductive wire or the second conductive wire comprises two or more filars electrically connected in parallel. One or more embodiments include wherein the first terminal is electrically connected to the first end of the first coil, the first end of the first coil disposed at an end of the first wire of the first coil located at an outermost first coil perimeter, the third terminal electrically connected to the first end of the second coil positioned at a second coil outer perimeter, and the second terminal is electrically connected to the second end of the second coil located along an interior perimeter of the second coil.

[0146] One or more embodiments include wherein a selection circuit is electrically connected to the first, second, and third terminals of the antenna, wherein actuation of the selection circuit electrically connects two of the three terminal ends so that an antenna operating frequency is modified. One or more embodiments include wherein the selection circuit comprises at least one of an electrical component selected from the group consisting of a resistor, a capacitor, and an inductor. One or more embodiments include wherein the third terminal of the antenna is electrically connected to an electrical switch circuit comprising at least one capacitor, wherein the electrical switch circuit is electrically connected to the second end of the first coil and the first end of the second coil, and wherein actuation of the electrical switch electrically connects two of the three antenna terminal ends so that an antenna operating frequency is modified. One or more embodiments include wherein N_1 is at least one and N_2 is at least two. One or more embodiments include wherein N_2 is greater than N_1 .

[0147] One or more embodiments include wherein each terminal has a terminal lead portion that extends between a coil connection point and a terminal end, the coil connection point electrically connected to either of the first and second conductive wires of the first and second coils, respectively, and wherein the terminal lead portion extends over at least a portion of either of the first and second conductive wires of the first and second coils, respectively. One or more embodiments include wherein a plurality of first vias are positioned adjacently along a right side of a length of the terminal lead portion and a plurality of second vias are positioned along a left side of the length of the terminal lead portion and opposed from the plurality of first vias so that each of the plurality of first vias opposes one of the plurality of second vias, wherein the respective opposing vias of the plurality of first and second vias are electrically connected to the same conductive wire of either of the first or second coils, thereby establishing a conductive electrical path therebetween that bypasses the terminal lead portion. One or more embodiments include wherein at least the first or second coil has a variable wire width. One or more embodiments include the antenna having a quality factor greater than 10.

[0148] One or more embodiments include wherein an electrical signal selected from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof is receivable by at least the first and second coils. One or more embodiments include wherein an electrical signal selected from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof is transmittable by at least the first and second coils. One or more embodiments include wherein the substrate comprises material composed of an electrically insulative material selected from the group consisting of a polyimide, an acrylic, fiberglass, polyester, polyether imide, polytetrafluoroethylene, polyethylene, polyetheretherketone (PEEK), polyethylene naphthalate, fluoropolymers, copolymers, a ceramic material, a ferrite material, and combinations thereof. One or more embodiments include wherein the antenna is capable of receiving or transmitting within a frequency band selected from the group consisting of about 100 kHz to about 250

kHz, about 250 kHz to about 500 kHz, 6.78 MHz, 13.56 MHz, and combinations thereof. One or more embodiments include wherein the antenna is capable of receiving or transmitting at frequencies of at least 100 kHz.

[0149] One or more embodiments include an electrical system, comprising: a) an antenna, including: a first conductive wire forming a first coil having N_1 number of turns with spaced apart first and second first coil ends contactable to a substrate surface, wherein the first coil is capable of generating a first inductance; a second conductive wire forming a second coil having N_2 number of turns with spaced apart first and second second coil ends, the second coil capable of generating a second inductance positioned within an inner perimeter formed by the first coil; and a first terminal electrically connected to the first end of the first coil, a second terminal electrically connected to the second end of the second coil and a third terminal electrically connected along either of the first or second coils; a control circuit electrically connected to at least one of the first, second and third antenna terminals, wherein the control circuit is capable of controlling the operation of the antenna; and wherein a tunable inductance is generatable by selecting an electrical connection between two of the first, second and third terminals. The electrical system, wherein the control circuit comprises at least one of an electrical resistor, a capacitor and an inductor. The electrical system, wherein a gap is disposed between the inner perimeter of the first coil and an outer perimeter of the second coil. The electrical system, wherein the gap is at least about 0.1 mm. The electrical system, wherein the first conductive wire or the second conductive wire comprises two or more filars electrically connected in parallel. The electrical system, wherein the first terminal is electrically connected to the first end of the first coil, the first end of the first coil disposed at an end of the first wire of the first coil located at an outermost first coil perimeter, the third terminal electrically connected to the first end of the second coil positioned at a second coil outer perimeter, and the second terminal is electrically connected to the second end of the second coil located along an interior perimeter of the second coil. The electrical system, wherein a selection circuit is electrically connected to the first, second, and third terminals of the antenna, wherein actuation of the selection circuit electrically connects two of the three terminal ends so that an antenna operating frequency is modified. The electrical system, wherein the selection circuit comprises at least one of an electrical component selected from the group consisting of a resistor, a capacitor, and an inductor. The electrical system, wherein the third terminal of the antenna is electrically connected to an electrical switch circuit comprising at least one capacitor, wherein the electrical switch circuit is electrically connected to the second end of the first coil and the first end of the second coil, and wherein actuation of the electrical switch electrically connects two of the three antenna terminal ends so that an antenna operating frequency is modified. The antenna, wherein N_1 is at least one and N_2 is at least two. The antenna, wherein N_2 is greater than N_1 . The antenna, wherein each terminal has a terminal lead portion that extends between a coil connection point and a terminal end, the coil connection point electrically connected to either of the first and second conductive wires of the first and second coils, respectively, and wherein the terminal lead portion extends over at least a portion of either of the first and second conductive wires of the first and second coils, respectively. The antenna, wherein a plurality of first vias are positioned adjacently along a right side of a length of the terminal lead portion and a plurality of second vias are positioned along a left side of the length of the terminal lead portion and opposed from the plurality of first vias so that each of the plurality of first vias opposes one of the plurality of second vias, wherein the respective opposing vias of the plurality of first and second vias are electrically connected to the same conductive wire of either of the first or second coils, thereby establishing a conductive electrical path therebetween that bypasses the terminal lead portion. The antenna, wherein at least the first or second coil has a variable wire width. The antenna, the antenna having a quality factor greater than 10. The antenna, wherein an electrical signal selected from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof is receivable by at least the first and second coils. The antenna, wherein an electrical signal selected from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof is transmittable by at least the first and second coils. The antenna, wherein the substrate comprises material composed of an electrically insulative material selected from the group consisting of a polyimide, an acrylic, fiberglass, polyester, polyether imide, polytetrafluoroethylene, polyethylene, polyetheretherketone (PEEK), polyethylene naphthalate, fluoropolymers, copolymers, a ceramic material, a ferrite material, and combinations thereof. The antenna, wherein the antenna is capable of receiving or transmitting within a frequency band selected from the group consisting of about 100 kHz to about 250 kHz, about 250 kHz to about 500 kHz, 6.78 MHz, 13.56 MHz, and combinations thereof. The antenna, wherein the antenna is capable of receiving or transmitting at frequencies of at least 100 kHz.

[0150] In at least one of the embodiments of the present disclosure, a method of providing a single structure multi mode antenna is provided. The method includes forming a first coil capable of generating a first inductance contactable to a substrate surface with a first conductive wire having N_1 number of turns with spaced apart first and second first coil ends. The method also includes forming a second coil capable of generating a second inductance having N_2 number of turns with spaced apart first and second second coil ends, the second coil positioned within an inner perimeter formed by the first coil. The method further includes electrically connecting a first terminal to the first end of the first coil, electrically connecting a second terminal to the second end of the second coil and electrically connecting a third terminal along either of the first or second coils. The method also includes selecting a connection between two of the first, second and third terminals to tune an inductance or frequency that is generatable by the antenna.

[0151] One or more embodiments include further comprising providing a gap between the inner perimeter of the first

coil and an outer perimeter of the second coil. One or more embodiments include further comprising providing a gap size of at least about 0.1 mm. One or more embodiments include further comprising providing the first conductive wire with two or more filars electrically connected in parallel. One or more embodiments include further comprising providing the second conductive wire with two or more filars electrically connected in parallel. One or more embodiments include further comprising electrically connecting the first terminal to the first end of the first coil, wherein the first end of the first coil is disposed at an end of the first wire of the first coil located at an outermost first coil perimeter, electrically connecting the third terminal to the first end of the second coil positioned at a second coil outer perimeter, and electrically connecting the second terminal to the second end of the second coil located along an interior perimeter of the second coil.

[0152] One or more embodiments include further comprising providing a selection circuit and electrically connecting the selection circuit to the first, second, and third terminals, wherein the selection circuit actively connects two of the first, second and third terminals to generate a tunable inductance. One or more embodiments include wherein the selection circuit comprises at least one electrical component selected from the group consisting of a resistor, a capacitor, and an inductor. One or more embodiments include further comprising providing N_1 at least one and N_2 at least two. One or more embodiments include further comprising providing N_2 greater than N_1 . One or more embodiments include further comprising providing each terminal with a terminal lead portion that extends between a coil connection point and a terminal end, the coil connection point electrically connected to either of the first and second conductive wires of the first and second coils, respectively, and wherein the terminal lead portion extends over at least a portion of either of the first and second conductive wires of the first and second coils, respectively.

[0153] One or more embodiments include further comprising providing a plurality of first vias positioned adjacently along a right side of a length of the terminal lead portion and a plurality of second vias positioned along a left side of the length of the terminal lead portion and opposed from the plurality of first vias so that each of the plurality of first vias opposes one of the plurality of second vias, wherein the respective opposing vias of the plurality of first and second vias are electrically connected to the same conductive wire of either of the first or second coils, thereby establishing a conductive electrical path therebetween that bypasses the terminal lead portion. One or more embodiments include further comprising providing at least the first and the second coil with a variable wire width. One or more embodiments include further comprising providing a quality factor greater than 10. One or more embodiments include further comprising receiving an electrical signal from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof by at least one of the first and second coils.

[0154] One or more embodiments include further comprising transmitting an electrical signal from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof by at least one of the first and second coils. One or more embodiments include further comprising selecting a substrate material from the group consisting of a polyimide, an acrylic, fiberglass, polyester, polyether imide, polytetrafluoroethylene, polyethylene, polyetheretherketone (PEEK), polyethylene naphthalate, fluropolymers, copolymers, a ceramic material, a ferrite material, and combinations thereof. One or more embodiments include wherein the antenna is capable of receiving or transmitting within a frequency band selected from the group consisting of about 100 kHz to about 250 kHz, about 250 kHz to about 500 kHz, 6.78 MHz, 13.56 MHz, and combinations thereof. One or more embodiments include wherein the antenna is capable of receiving or transmitting at frequencies of at least 100 kHz. One or more embodiments include further comprising selecting a connection between two of the first, second, and third terminals to generate a tunable operating frequency.

[0155] One or more embodiments include a method of providing a single structure multi mode antenna, the method comprising: forming a first coil with a first conductive wire having N_1 number of turns with spaced apart first and second first coil ends contactable to a substrate surface, wherein the first coil is capable of generating a first inductance; forming a second coil with a second conductive wire having N_2 number of turns with spaced apart first and second coil ends, the second coil capable of generating a second inductance positioned within an inner perimeter formed by the first coil; electrically connecting a first terminal to the first end of the first coil, electrically connecting a second terminal to the second end of the second coil and electrically connecting a third terminal along either of the first or second coils; and selecting a connection between two of the first, second and third terminals to tune an inductance that is generatable by the antenna. The method further comprising providing a gap between the inner perimeter of the first coil and an outer perimeter of the second coil. The method further comprising providing a gap size of at least about 0.1 mm. The method further comprising providing the first conductive wire with two or more filars electrically connected in parallel. The method further comprising providing the second conductive wire with two or more filars electrically connected in parallel. The method further comprising electrically connecting the first terminal to the first end of the first coil, wherein the first end of the first coil is disposed at an end of the first wire of the first coil located at an outermost first coil perimeter, electrically connecting the third terminal to the first end of the second coil positioned at a second coil outer perimeter, and electrically connecting the second terminal to the second end of the second coil located along an interior perimeter of the second coil. The method further comprising providing a selection circuit and electrically connecting the selection circuit to the first, second, and third terminals, wherein the selection circuit actively connects two of the first, second and third terminals to generate a tunable inductance. The method wherein the selection circuit comprises at least one electrical component

selected from the group consisting of a resistor, a capacitor, and an inductor. The method further comprising providing N_1 at least one and N_2 at least two. The method further comprising providing N_2 greater than N_1 . The method further comprising providing each terminal with a terminal lead portion that extends between a coil connection point and a terminal end, the coil connection point electrically connected to either of the first and second conductive wires of the first and second coils, respectively, and wherein the terminal lead portion extends over at least a portion of either of the first and second conductive wires of the first and second coils, respectively. The method further comprising providing a plurality of first vias positioned adjacently along a right side of a length of the terminal lead portion and a plurality of second vias positioned along a left side of the length of the terminal lead portion and opposed from the plurality of first vias so that each of the plurality of first vias opposes one of the plurality of second vias, wherein the respective opposing vias of the plurality of first and second vias are electrically connected to the same conductive wire of either of the first or second coils, thereby establishing a conductive electrical path therebetween that bypasses the terminal lead portion. The method further comprising providing at least the first and the second coil with a variable wire width. The method further comprising providing a quality factor greater than 10. The method further comprising receiving an electrical signal from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof by at least one of the first and second coils. The method further comprising transmitting an electrical signal from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof by at least one of the first and second coils. The method further comprising selecting a substrate material from the group consisting of a polyimide, an acrylic, fiberglass, polyester, polyether imide, polytetrafluoroethylene, polyethylene, polyetheretherketone (PEEK), polyethylene naphthalate, fluropolymers, copolymers, a ceramic material, a ferrite material, and combinations thereof. The method wherein the antenna is capable of receiving or transmitting within a frequency band selected from the group consisting of about 100 kHz to about 250 kHz, about 250 kHz to about 500 kHz, 6.78 MHz, 13.56 MHz, and combinations thereof. The method wherein the antenna is capable of receiving or transmitting at frequencies of at least 100 kHz. The method further comprising selecting a connection between two of the first, second, and third terminals to generate a tunable operating frequency.

[0156] In at least one of the embodiments of the present disclosure, a method of operating a single structure multi mode antenna is provided. The method of operating the antenna includes providing an antenna that includes a first conductive wire forming a first coil capable of generating a first inductance having N_1 number of turns with spaced apart first and second first coil ends, the first coil contactable to a substrate surface. The antenna also includes a second conductive wire forming a second coil capable of generating a second inductance having N_2 number of turns with spaced apart first and second second coil ends, the second coil positioned within an inner perimeter formed by the first coil. The antenna further includes a first terminal electrically connected to the first end of the first coil, a second terminal electrically connected to the second end of the second coil and a third terminal electrically connected along either of the first or second coils. The method also includes providing a control circuit that is electrically connected to the antenna. Furthermore, the method includes selecting a connection between two of the first, second and third terminals to achieve a desired antenna inductance or operating frequency so that an electrical signal can be received or transmitted.

[0157] One or more embodiments include providing a gap between the inner perimeter of the first coil and an outer perimeter of the second coil of the antenna. One or more embodiments include providing a gap size of at least about 0.1 mm. One or more embodiments include providing the first conductive wire with two or more filars electrically connected in parallel. One or more embodiments include providing the second conductive wire with two or more filars electrically connected in parallel. One or more embodiments include electrically connecting the first terminal to the first end of the first coil, wherein the first end of the first coil is disposed at an end of the first wire of the first coil located at an outermost first coil perimeter, electrically connecting the third terminal to the first end of the second coil positioned at a second coil outer perimeter, and electrically connecting the second terminal to the second end of the second coil located along an interior perimeter of the second coil.

[0158] One or more embodiments include providing a selection circuit electrically connected to the first, second, and third terminals, wherein the selection circuit electrically connects two of the first, second and third terminals to generate a tunable inductance. One or more embodiments include wherein the selection circuit comprises at least one electrical component selected from the group consisting of a resistor, a capacitor and an inductor. One or more embodiments include providing N_1 at least one and N_2 at least two. One or more embodiments include providing N_2 greater than N_1 . One or more embodiments include providing each terminal with a terminal lead portion that extends between a coil connection point and a terminal end, the coil connection point electrically connected to either of the first and second conductive wires of the first and second coils, respectively, and wherein the terminal lead portion extends over at least a portion of either of the first and second conductive wires of the first and second coils, respectively. One or more embodiments include providing a plurality of first vias positioned adjacently along a right side of a length of the terminal lead portion and a plurality of second vias positioned along a left side of the length of the terminal lead portion and opposed from the plurality of first vias so that each of the plurality of first vias opposes one of the plurality of second vias, wherein the respective opposing vias of the plurality of first and second vias are electrically connected to the same conductive wire of either of the first or second coils, thereby establishing a conductive electrical path therebetween that

bypasses the terminal lead portion.

[0159] One or more embodiments include providing at least the first or second coil with a variable wire width. One or more embodiments include providing a quality factor greater than 10. One or more embodiments include receiving the electrical signal from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof, wherein the electrical signal is receivable by at least one of the first and second coils. One or more embodiments include transmitting the electrical signal from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof, wherein the electrical signal is transmittable by at least one of the first and second coils. One or more embodiments include selecting the substrate material from the group consisting of a polyimide, an acrylic, fiberglass, polyester, polyether imide, polytetrafluoroethylene, polyethylene, polyetheretherketone (PEEK), polyethylene naphthalate, fluropolymers, copolymers, a ceramic material, a ferrite material and combinations thereof. One or more embodiments include receiving or transmitting within a frequency band selected from the group consisting of about 100 kHz to about 250 kHz, about 250 kHz to about 500 kHz, 6.78 MHz, 13.56 MHz, and combinations thereof. One or more embodiments include receiving or transmitting at frequencies of at least 100 kHz. One or more embodiments include wherein the control circuit comprises at least one of an electrical resistor, a capacitor and an inductor.

[0160] One or more embodiments include a method of operating a single structure multi mode antenna, the method comprising: providing an antenna by: forming a first coil with a first conductive wire having N_1 number of turns with spaced apart first and second first coil ends contactable to a substrate surface, wherein the first coil is capable of generating a first inductance; forming a second coil with a second conductive wire having N_2 number of turns with spaced apart first and second second coil ends, the second coil capable of generating a second inductance positioned within an inner perimeter formed by the first coil; and electrically connecting a first terminal to the first end of the first coil, electrically connecting a second terminal to the second end of the second coil and electrically connecting a third terminal along either of the second or third coils; providing a control circuit electrically connected to the antenna; and selecting a connection between two of the first, second and third terminals to achieve a desired antenna operating frequency so that an electrical signal can be received or transmitted. The method further comprising providing a gap between the inner perimeter of the first coil and an outer perimeter of the second coil. The method further comprising providing a gap size of at least about 0.1 mm. The method further comprising providing the first conductive wire with two or more filars electrically connected in parallel. The method further comprising providing the second conductive wire with two or more filars electrically connected in parallel. The method further comprising electrically connecting the first terminal to the first end of the first coil, wherein the first end of the first coil is disposed at an end of the first wire of the first coil located at an outermost first coil perimeter, electrically connecting the third terminal to the first end of the second coil positioned at a second coil outer perimeter, and electrically connecting the second terminal to the second end of the second coil located along an interior perimeter of the second coil. The method further comprising providing a selection circuit and electrically connecting the selection circuit to the first, second, and third terminals, wherein the selection circuit actively connects two of the first, second and third terminals to generate a tunable inductance. The method wherein the selection circuit comprises at least one electrical component selected from the group consisting of a resistor, a capacitor, and an inductor. The method further comprising providing N_1 at least one and N_2 at least two. The method further comprising providing N_2 greater than N_1 . The method further comprising providing each terminal with a terminal lead portion that extends between a coil connection point and a terminal end, the coil connection point electrically connected to either of the first and second conductive wires of the first and second coils, respectively, and wherein the terminal lead portion extends over at least a portion of either of the first and second conductive wires of the first and second coils, respectively. The method further comprising providing a plurality of first vias positioned adjacently along a right side of a length of the terminal lead portion and a plurality of second vias positioned along a left side of the length of the terminal lead portion and opposed from the plurality of first vias so that each of the plurality of first vias opposes one of the plurality of second vias, wherein the respective opposing vias of the plurality of first and second vias are electrically connected to the same conductive wire of either of the first or second coils, thereby establishing a conductive electrical path therebetween that bypasses the terminal lead portion. The method further comprising providing at least the first and the second coil with a variable wire width. The method further comprising providing a quality factor greater than 10. The method further comprising receiving an electrical signal from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof by at least one of the first and second coils. The method further comprising transmitting an electrical signal from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof by at least one of the first and second coils. The method further comprising selecting a substrate material from the group consisting of a polyimide, an acrylic, fiberglass, polyester, polyether imide, polytetrafluoroethylene, polyethylene, polyetheretherketone (PEEK), polyethylene naphthalate, fluropolymers, copolymers, a ceramic material, a ferrite material, and combinations thereof. The method wherein the antenna is capable of receiving or transmitting within a frequency band selected from the group consisting of about 100 kHz to about 250 kHz, about 250 kHz to about 500 kHz, 6.78 MHz, 13.56 MHz, and combinations thereof. The method wherein the antenna is capable of receiving or transmitting at frequencies of at least 100 kHz. The method further comprising selecting a connection between two of the first, second, and third terminals to generate a tunable operating frequency.

[0161] In at least one of the embodiments of the present disclosure, a method of fabricating a single structure multi mode antenna is provided. The method of fabricating the antenna includes providing a substrate having a surface composed of an electrically insulative material. In addition, the method includes forming a first coil capable of generating a first inductance disposed on the substrate surface, the first coil formed of a first conductive wire having N_1 number of turns with spaced apart first and second first coil ends. The method also includes forming a second coil capable of generating a second inductance that is positioned within an inner perimeter formed by the first coil, the second coil formed of a second conductive wire having N_2 number of turns with spaced apart first and second second coil ends. The method further includes electrically connecting a first terminal to the first end of the first coil, electrically connecting a second terminal to the second end of the second coil and electrically connecting a third terminal along either of the second or third coils. The method further includes selecting an electrical connection between two of the first, second, and third terminals to selectively tune an inductance or frequency that is generatable by the antenna.

[0162] One or more embodiments include wherein the first and second conductive wires are formed by at least one of the following methods: a surface printing technique, photolithography, chemical or laser etching, laser cladding, laser cutting, physical or chemical vapor deposition, electrochemical deposition, molecular beam epitaxy, atomic layer deposition, stamping, or chemical processing. One or more embodiments include creating a gap between the inner perimeter of the first coil and an outer perimeter of the second coil. One or more embodiments include providing a gap size of at least about 0.1 mm. One or more embodiments include further comprising providing the first conductive wire with two or more filars electrically connected in parallel. One or more embodiments include providing the second conductive wire with two or more filars electrically connected in parallel. One or more embodiments include electrically connecting the first terminal to the first end of the first coil, wherein the first end of the first coil is disposed at an end of the first wire of the first coil located at an outermost first coil perimeter, electrically connecting the third terminal to the first end of the second coil positioned at a second coil outer perimeter, and electrically connecting the second terminal to the second end of the second coil located along an interior perimeter of the second coil.

[0163] One or more embodiments include providing a selection circuit comprising at least one of a capacitor, a resistor, and an inductor electrically connected to the first, second, and third terminals. One or more embodiments include wherein the selection circuit actively connects two of the first, second, and third terminals to generate a tunable inductance. One or more embodiments include providing N_1 at least one and N_2 at least two. One or more embodiments include providing N_2 greater than N_1 . One or more embodiments include providing each terminal with a terminal lead portion that extends between a coil connection point and a terminal end, the coil connection point electrically connected to one of either of the first and second conductive wires of the first and second coils, respectively, and wherein the terminal lead portion extends over at least a portion of either of the first and second conductive wires of the first and second coils, respectively. One or more embodiments include providing a plurality of first vias are positioned adjacently along a right side of a length of the terminal lead portion and a plurality of second vias are positioned along a left side of a length of the terminal lead portion and opposed from the plurality of first vias so that each of the plurality of first vias opposes one of the plurality of second vias, wherein the respective opposing vias of the plurality of first and second vias are electrically connected to the same conductive wire of either of the first or second coils thereby establishing a conductive electrical path therebetween that bypasses the terminal lead portion.

[0164] One or more embodiments include providing at least the first or second wires with a variable wire width. One or more embodiments include providing a quality factor greater than 10. One or more embodiments include selecting an electrical signal from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof receivable by at least one of the first and second coils. One or more embodiments include selecting an electrical signal from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof transmittable by at least one of the first and second coils. One or more embodiments include selecting the substrate material from the group consisting of a polyimide, an acrylic, fiberglass, polyester, polyether imide, polytetrafluoroethylene, polyethylene, polyetheretherketone (PEEK), polyethylene naphthalate, fluropolymers, copolymers, a ceramic material, a ferrite material and combinations thereof. One or more embodiments include wherein the antenna is capable of receiving or transmitting within a frequency band selected from the group consisting of about 100 kHz to about 250 kHz, about 250 kHz to about 500 kHz, 6.78 MHz, 13.56 MHz, and combinations thereof. One or more embodiments include wherein the antenna is capable of receiving or transmitting at frequencies of at least 100 kHz.

[0165] One or more embodiments include a method of fabricating a single structure multi mode antenna, comprising: providing a substrate having a surface composed of an electrically insulative material; forming a first coil of a first conductive wire having N_1 number of turns with spaced apart first and second first coil ends that are disposed on the substrate surface, wherein the first coil is capable of generating a first inductance; forming a second coil of a second conductive wire having N_2 number of turns with spaced apart first and second second coil ends, the second coil capable of generating a second inductance positioned within an inner perimeter formed by the first coil on the substrate surface; electrically connecting a first terminal to the first end of the first coil, electrically connecting a second terminal to the second end of the second coil and electrically connecting a third terminal along either of the second or third coils; and selecting an electrical connection between two of the first, second, and third terminals to selectively tune an inductance

generatable by the antenna. The method further comprising providing a gap between the inner perimeter of the first coil and an outer perimeter of the second coil of the antenna. The method further comprising providing a gap size of at least about 0.1 mm. The method further comprising providing the first conductive wire with two or more filars electrically connected in parallel. The method further comprising providing the second conductive wire with two or more filars electrically connected in parallel. The method further comprising electrically connecting the first terminal to the first end of the first coil, wherein the first end of the first coil is disposed at an end of the first wire of the first coil located at an outermost first coil perimeter, electrically connecting the third terminal to the first end of the second coil positioned at a second coil outer perimeter, and electrically connecting the second terminal to the second end of the second coil located along an interior perimeter of the second coil. The method further comprising providing a selection circuit electrically connected to the first, second, and third terminals, wherein the selection circuit electrically connects two of the first, second and third terminals to generate a tunable inductance. The method wherein the selection circuit comprises at least one electrical component selected from the group consisting of a resistor, a capacitor and an inductor. The method further comprising providing N_1 at least one and N_2 at least two. The method further comprising providing N_2 greater than N_1 . The method further comprising providing each terminal with a terminal lead portion that extends between a coil connection point and a terminal end, the coil connection point electrically connected to either of the first and second conductive wires of the first and second coils, respectively, and wherein the terminal lead portion extends over at least a portion of either of the first and second conductive wires of the first and second coils, respectively. The method further comprising providing a plurality of first vias positioned adjacently along a right side of a length of the terminal lead portion and a plurality of second vias positioned along a left side of the length of the terminal lead portion and opposed from the plurality of first vias so that each of the plurality of first vias opposes one of the plurality of second vias, wherein the respective opposing vias of the plurality of first and second vias are electrically connected to the same conductive wire of either of the first or second coils, thereby establishing a conductive electrical path therebetween that bypasses the terminal lead portion. The method further comprising providing at least the first or second coil with a variable wire width. The method further comprising providing a quality factor greater than 10. The method further comprising receiving the electrical signal from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof, wherein the electrical signal is receivable by at least one of the first and second coils. The method further comprising transmitting the electrical signal from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof, wherein the electrical signal is transmittable by at least one of the first and second coils. The method further comprising selecting the substrate material from the group consisting of a polyimide, an acrylic, fiberglass, polyester, polyether imide, polytetrafluoroethylene, polyethylene, polyetheretherketone (PEEK), polyethylene naphthalate, fluropolymers, copolymers, a ceramic material, a ferrite material and combinations thereof. The method further comprising receiving or transmitting within a frequency band selected from the group consisting of about 100 kHz to about 250 kHz, about 250 kHz to about 500 kHz, 6.78 MHz, 13.56 MHz, and combinations thereof. The method further comprising receiving or transmitting at frequencies of at least 100 kHz. The method wherein the control circuit comprises at least one of an electrical resistor, a capacitor and an inductor.

[0166] In at least one of the embodiments of the present disclosure, a single structure multi mode antenna includes a first coil portion capable of generating a first inductance having N_1 number of turns with spaced apart first and second first coil portion ends. In addition, the antenna includes a second coil portion capable of generating a second inductance having N_2 number of turns with spaced apart first and second second coil portion ends, the second coil portion positioned within an inner perimeter formed by the first coil portion, and wherein the first end of the second coil portion is electrically connected to the second end of the first coil portion, thereby forming a unitary antenna body. The antenna further includes a first terminal electrically connected to the first end of the first coil portion, a second terminal electrically connected to the second end of the second coil portion and a third terminal electrically connected along either of the first or second coil portions. The antenna also includes wherein a tunable inductance or frequency is generatable by selecting a connection between two of the first, second and third terminals.

[0167] One or more embodiments include wherein the first and second coil portions are formed from a single wire structure. One or more embodiments include wherein the wire structure of the first and second coil portions comprise a width that is not the same. One or more embodiments include a gap disposed between the inner perimeter of the first coil portion and an outer perimeter of the second coil portion. One or more embodiments include wherein the gap is at least about 0.1 mm. One or more embodiments include wherein the first terminal is electrically connected to the first end of the first coil portion located at an outermost perimeter of the first coil portion, the second terminal is electrically connected to the second end of the second coil portion, and the third terminal is electrically connected at a junction where the first and second coil portions meet. One or more embodiments include wherein a selection circuit is electrically connected to at least one of the first, second, and third terminals. One or more embodiments include wherein the selection circuit comprises at least one component selected from the group consisting of a capacitor, a resistor, and an inductor. One or more embodiments include wherein N_1 is at least one and N_2 is at least two.

[0168] One or more embodiments include wherein N_2 is greater than N_1 . One or more embodiments include the antenna having a quality factor greater than 10. One or more embodiments include wherein an electrical signal selected

from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof is receivable by at least the first and second coil portions. One or more embodiments include wherein an electrical signal selected from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof is transmittable by at least the first and second coil portions. One or more embodiments include wherein the antenna is capable of receiving or transmitting within a frequency band selected from the group consisting of about 100 kHz to about 250 kHz, about 250 kHz to about 500 kHz, 6.78 MHz, 13.56 MHz, and combinations thereof. One or more embodiments include wherein the antenna is capable of receiving or transmitting at frequencies of at least 100 kHz. One or more embodiments include wherein a tunable operating frequency is generatable by selecting a connection between two of the first, second, and third terminals.

[0169] One or more embodiments include a single structure multi mode antenna, comprising: a first coil portion having N_1 number of turns with spaced apart first and second first coil portion ends, wherein the first coil portion is capable of generating a first inductance; a second coil portion having N_2 number of turns with spaced apart first and second second coil portion ends, the second coil portion capable of generating a second inductance positioned within an inner perimeter formed by the first coil portion, wherein the first end of the second coil portion is electrically connected to the second end of the first coil portion, thereby forming a unitary antenna body; a first terminal electrically connected to the first end of the first coil portion, a second terminal electrically connected to the second end of the second coil portion and a third terminal electrically connected along either of the first or second coil portions; and wherein a tunable inductance is generatable by selecting a connection between two of the first, second and third terminals. The antenna wherein the first and second coil portions are formed from a single wire structure. The antenna wherein the wire structure of the first and second coil portions comprise a width that is not the same. The antenna further comprising a gap disposed between the inner perimeter of the first coil portion and an outer perimeter of the second coil portion. The antenna wherein the gap is at least about 0.1 mm. The antenna wherein the first terminal is electrically connected to the first end of the first coil portion located at an outermost perimeter of the first coil portion, the second terminal is electrically connected to the second end of the second coil portion, and the third terminal is electrically connected at a junction where the first and second coil portions meet. The antenna wherein a selection circuit is electrically connected to at least one of the first, second, and third terminals. The antenna wherein the selection circuit comprises at least one component selected from the group consisting of a capacitor, a resistor, and an inductor. The antenna wherein N_1 is at least one and N_2 is at least two. The antenna wherein N_2 is greater than N_1 . The antenna having a quality factor greater than 10. The antenna wherein an electrical signal selected from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof is receivable by at least the first and second coil portions. The antenna wherein an electrical signal selected from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof is transmittable by at least the first and second coil portions. The antenna wherein the antenna is capable of receiving or transmitting within a frequency band selected from the group consisting of about 100 kHz to about 250 kHz, about 250 kHz to about 500 kHz, 6.78 MHz, 13.56 MHz, and combinations thereof. The antenna wherein the antenna is capable of receiving or transmitting at frequencies of at least 100 kHz. The antenna wherein a tunable operating frequency is generatable by selecting a connection between two of the first, second, and third terminals.

[0170] In at least one of the embodiments of the present disclosure, a method of providing a single structure multi mode antenna having a unitary body is provided. The method of providing the antenna includes providing a blank of metal. The method further includes providing a die and mold. The method also includes positioning the blank of metal between the die and mold. The method further includes stamping the metal blank to form an antenna having a unitary antenna body. The antenna includes a first coil portion capable of generating a first inductance having N_1 number of turns with spaced apart first and second first coil portion ends. In addition, the antenna includes a second coil portion capable of generating a second inductance having N_2 number of turns with spaced apart first and second second coil portion ends, the second coil portion positioned within an inner perimeter formed by the first coil portion, and wherein the first end of the second coil portion is electrically connected to the second end of the first coil portion, thereby forming a unitary antenna body. The method further includes electrically connecting a first terminal to a first end of the first coil portion, a second terminal to a second end of the second coil portion and a third terminal along either of the first or second coil portions.

[0171] One or more embodiments include wherein the first and second coil portions are formed from a single metal structure. One or more embodiments include wherein the wire structure of the first and second coil portions comprise a width that is not the same. One or more embodiments include wherein a gap is disposed between the inner perimeter of the first coil portion and an outer perimeter of the second coil portion. One or more embodiments include wherein the gap is at least about 0.1 mm. One or more embodiments include wherein the first terminal is electrically connected to the first end of the first coil portion located at an outermost perimeter of the first coil portion, the second terminal is electrically connected to the second end of the second coil portion, and the third terminal is electrically connected at a junction where the first and second coil portions meet. One or more embodiments include wherein a selection circuit is electrically connected to at least one of the first, second, and third terminals. One or more embodiments include wherein the selection circuit comprises at least one component selected from the group consisting of a capacitor, a resistor, and

an inductor.

[0172] One or more embodiments include wherein N_1 is at least one and N_2 is at least two. One or more embodiments include wherein N_2 is greater than N_1 . One or more embodiments include wherein the antenna has a quality factor greater than 10. One or more embodiments include wherein an electrical signal selected from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof is receivable by at least the first and second coil portions. One or more embodiments include wherein an electrical signal selected from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof is transmittable by at least the first and second coil portions. One or more embodiments include wherein the antenna is capable of receiving or transmitting within a frequency band selected from the group consisting of about 100 kHz to about 250 kHz, about 250 kHz to about 500 kHz, 6.78 MHz, 13.56 MHz, and combinations thereof. One or more embodiments include wherein the antenna is capable of receiving or transmitting at frequencies of at least 100 kHz. One or more embodiments include wherein a tunable operating frequency is generatable by selecting a connection between two of the first, second, and third terminals.

[0173] In one or more embodiments of the present disclosure, a method of providing a single structure multi mode antenna having a unitary body is provided. The method of providing the antenna comprising: providing a blank of metal; providing a die and mold; positioning the blank of metal between the die and mold; stamping the metal blank, thereby forming an antenna having a unitary antenna body, the unitary antenna body comprising: a first coil portion having N_1 number of turns with spaced apart first and second first coil portion ends, wherein the first coil portion is capable of generating a first inductance; and a second coil portion having N_2 number of turns with spaced apart first and second second coil portion ends, the second coil portions capable of generating a second inductance positioned within an inner perimeter formed by the first coil portion; and electrically connecting a first terminal to the first end of the first coil portion, a second terminal to the second end of the second coil portion and a third terminal along either of the first or second coil portions. The method wherein the first and second coil portions are formed from a single metal structure. The method wherein the wire structure of the first and second coil portions comprise a width that is not the same. The method wherein a gap is disposed between the inner perimeter of the first coil portion and an outer perimeter of the second coil portion. The method wherein the gap is at least about 0.1 mm. The method wherein the first terminal is electrically connected to the first end of the first coil portion located at an outermost perimeter of the first coil portion, the second terminal is electrically connected to the second end of the second coil portion, and the third terminal is electrically connected at a junction where the first and second coil portions meet. The method wherein a selection circuit is electrically connected to at least one of the first, second, and third terminals. The method wherein the selection circuit comprises at least one component selected from the group consisting of a capacitor, a resistor, and an inductor. The method wherein N_1 is at least one and N_2 is at least two. The method wherein N_2 is greater than N_1 . The method wherein the antenna has a quality factor greater than 10. The method wherein an electrical signal selected from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof is receivable by at least the first and second coil portions. The method wherein an electrical signal selected from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof is transmittable by at least the first and second coil portions. The method wherein the antenna is capable of receiving or transmitting within a frequency band selected from the group consisting of about 100 kHz to about 250 kHz, about 250 kHz to about 500 kHz, 6.78 MHz, 13.56 MHz, and combinations thereof. The method wherein the antenna is capable of receiving or transmitting at frequencies of at least 100 kHz. The method wherein a tunable operating frequency is generatable by selecting a connection between two of the first, second, and third terminals.

[0174] As used herein, the phrase "at least one of" preceding a series of items, with the term "and" or "or" to separate any of the items, modifies the list as a whole, rather than each member of the list (i.e., each item). The phrase "at least one of" does not require selection of at least one of each item listed; rather, the phrase allows a meaning that includes at least one of any one of the items, and/or at least one of any combination of the items, and/or at least one of each of the items. By way of example, the phrases "at least one of A, B, and C" or "at least one of A, B, or C" each refer to only A, only B, or only C; any combination of A, B, and C; and/or at least one of each of A, B, and C.

[0175] The predicate words "configured to", "operable to", and "programmed to" do not imply any particular tangible or intangible modification of a subject, but, rather, are intended to be used interchangeably. In one or more embodiments, a processor configured to monitor and control an operation or a component may also mean the processor being programmed to monitor and control the operation or the processor being operable to monitor and control the operation. Likewise, a processor configured to execute code can be construed as a processor programmed to execute code or operable to execute code.

[0176] A phrase such as "an aspect" does not imply that such aspect is essential to the subject technology or that such aspect applies to all configurations of the subject technology. A disclosure relating to an aspect may apply to all configurations, or one or more configurations. An aspect may provide one or more examples of the disclosure. A phrase such as an "aspect" may refer to one or more aspects and vice versa. A phrase such as an "embodiment" does not imply that such embodiment is essential to the subject technology or that such embodiment applies to all configurations of the subject technology. A disclosure relating to an embodiment may apply to all embodiments, or one or more em-

bodiments. An embodiment may provide one or more examples of the disclosure. A phrase such as an "embodiment" may refer to one or more embodiments and vice versa. A phrase such as a "configuration" does not imply that such configuration is essential to the subject technology or that such configuration applies to all configurations of the subject technology. A disclosure relating to a configuration may apply to all configurations, or one or more configurations. A configuration may provide one or more examples of the disclosure. A phrase such as a "configuration" may refer to one or more configurations and vice versa.

[0177] The word "exemplary" is used herein to mean "serving as an example, instance, or illustration." Any embodiment described herein as "exemplary" or as an "example" is not necessarily to be construed as preferred or advantageous over other embodiments. Furthermore, to the extent that the term "include," "have," or the like is used in the description or the claims, such term is intended to be inclusive in a manner similar to the term "comprise" as "comprise" is interpreted when employed as a transitional word in a claim. Furthermore, to the extent that the term "include," "have," or the like is used in the description or the claims, such term is intended to be inclusive in a manner similar to the term "comprise" as "comprise" is interpreted when employed as a transitional word in a claim.

[0178] All structural and functional equivalents to the elements of the various aspects described throughout this disclosure that are known or later come to be known to those of ordinary skill in the art are expressly incorporated herein by reference and are intended to be encompassed by the claims. Moreover, nothing disclosed herein is intended to be dedicated to the public regardless of whether such disclosure is explicitly recited in the claims. No claim element is to be construed under the provisions of 35 U.S.C. § 112, sixth paragraph, unless the element is expressly recited using the phrase "means for" or, in the case of a method claim, the element is recited using the phrase "step for."

[0179] Reference to an element in the singular is not intended to mean "one and only one" unless specifically so stated, but rather "one or more." Unless specifically stated otherwise, the term "some" refers to one or more. Pronouns in the masculine (e.g., his) include the feminine and neuter gender (e.g., her and its) and vice versa. Headings and subheadings, if any, are used for convenience only and do not limit the subject disclosure.

[0180] While this specification contains many specifics, these should not be construed as limitations on the scope of what may be claimed, but rather as descriptions of particular implementations of the subject matter. Certain features that are described in this specification in the context of separate embodiments can also be implemented in combination in a single embodiment. Conversely, various features that are described in the context of a single embodiment can also be implemented in multiple embodiments separately or in any suitable subcombination. Moreover, although features may be described above as acting in certain combinations and even initially claimed as such, one or more features from a claimed combination can in some cases be excised from the combination, and the claimed combination may be directed to a subcombination or variation of a subcombination.

[0181] Further features, aspects and embodiments are provided below in the following clauses:

Clause 1: An antenna, comprising:

- a) a first conductive wire forming a first coil having N_1 number of turns with spaced apart first and second first coil ends, the first coil contactable to a substrate surface, wherein the first coil is capable of generating a first inductance;
- b) a second conductive wire forming a second coil having N_2 number of turns with spaced apart first and second second coil ends, the second coil capable of generating a second inductance positioned within an inner perimeter formed by the first coil;
- c) a first terminal electrically connected to the first end of the first coil, a second terminal electrically connected to the second end of the second coil and a third terminal electrically connected along either of the first or second coils; and
- d) wherein at least one of a tunable inductance and operating frequency is generatable by selecting a connection between two of the first, second, and third terminals.

Clause 2: The antenna of clause 1, further comprising a gap disposed between the inner perimeter of the first coil and an outer perimeter of the second coil.

Clause 3: The antenna of clause 1, wherein at least one of the first and second conductive wires comprises two or more filars electrically connected in parallel.

Clause 4: The antenna of clause 1, wherein the first terminal is electrically connected to the first end of the first coil, the first end of the first coil disposed at an end of the first wire of the first coil located at an outermost first coil perimeter, the third terminal is electrically connected to the first end of the second coil positioned at a second coil outer perimeter, and the second terminal is electrically connected to the second end of the second coil located along an interior perimeter of the second coil pattern.

Clause 5: The antenna of clause 1, further comprising a selection circuit, wherein the selection circuit comprises at least one component selected from the group of a capacitor, a resistor, and an inductor, and wherein the selection circuit is electrically connected to at least one of the first, second, and third terminals, and wherein actuation of the selection circuit electrically connects two of the three terminals so that a tunable operating frequency or tunable inductance is generatable.

Clause 6: The antenna of clause 1, wherein each terminal has a terminal lead portion that extends between a coil connection point and a terminal end, the coil connection point electrically connected to either of the first and second conductive wires of the first and second coils respectively, and wherein the terminal lead portion extends over at least a portion of either of the first and second conductive wires of the first and second coils respectively.

Clause 7: The antenna of clause 6, wherein a plurality of first vias are positioned adjacently along a right side of a length of the terminal lead portion and a plurality of second vias are positioned along a left side of the length of the terminal lead portion and opposed from the plurality of first vias so that each of the plurality of first vias opposes one of the plurality of second vias, wherein the respective opposing vias of the plurality of first and second vias are electrically connected to the same conductive wire of either of the first or second coils, thereby establishing a conductive electrical path therebetween that bypasses the terminal lead portion.

Clause 8: The antenna of clause 1, wherein at least one of the first conductive wire and the second conductive wire has a variable wire width.

Clause 9: The antenna of clause 1, the antenna having a quality factor greater than 10.

Clause 10: The antenna of clause 1, wherein an electrical signal selected from the group consisting of a data signal, an electrical voltage, an electrical current, and combinations thereof is receivable or transmittable by at least the first and second coils.

Clause 11: The antenna of clause 1, wherein the antenna is capable of receiving or transmitting at frequencies of at least 100 kHz.

Clause 12: The antenna of clause 1, further comprising an electrical switch circuit wherein the electrical switch circuit comprises at least one component selected from the group of a capacitor, a resistor, and an inductor, wherein the electrical switch circuit is electrically connected along either of the first or second coils, and wherein actuation of the electrical switch circuit electrically connects two of the three terminals so that at least one of the inductance and the operating frequency is modified.

Clause 13: The antenna of clause 1, further comprising a substrate having opposed top and bottom surfaces, wherein the first and second conductive wires are disposed on the substrate top surface and a third conductive wire is disposed on the opposed substrate bottom surface, a via connecting the third conductive wire to at least one of the first and second conductive wires.

Clause 14: The antenna of clause 13, wherein the substrate is composed of a material having a permeability greater than 10.

Clause 15: The antenna of clause 1, further comprising a control circuit that is electrically connected to at least one of the first, second and third antenna terminals, wherein the control circuit is capable of controlling the operation of the antenna.

Claims

1. An antenna, comprising:

a) a first conductive wire forming a first coil contactable to a substrate surface configured to generate a first inductance and a first resonant frequency, the first coil comprising a continuous electrically conductive path that extends along the first conductive wire from a first coil first end that resides at an end of an outermost turn of the first coil to a first coil second end that resides at an end of an inner most turn of the first coil, the first coil comprising N1 number of turns, wherein a first gap extends between adjacent turns within the first coil;

b) a second conductive wire forming a second coil configured to generate a second inductance and a second resonant frequency, wherein the first resonant frequency is different than the second resonant frequency, the second coil comprising a continuous electrically conductive path that extends along the second conductive wire from a second coil, first end that resides at an end of an outermost turn of the second coil to a second coil second end that resides at an end of an inner most turn of the second coil, wherein the second coil is disposed on the substrate surface positioned one of within an inner perimeter formed by the innermost turn of the first coil and adjacent the first coil, the second coil comprising N2 number of turns, wherein a second gap extends between adjacent turns within the second coil, and wherein the first end of the second coil meets and joins the second end of the first coil forming a continuous junction therebetween;

c) a third gap separating the outermost turn of the second coil from the innermost turn of the first coil, wherein the third gap is greater than the first and second gaps;

d) a first terminal electrically connected to the first end of the first coil, a second terminal electrically connected to the second end of the second coil and a third terminal electrically connected to either of the first or second coils; and

e) wherein a tunable inductance is generatable by electrically connecting two of the first, second and third terminals;

f) wherein the first resonant frequency of the first coil differs from the second resonant frequency of the second coil by at least 100 kHz;

g) wherein at least the first conductive wire or the second conductive wire has a variable wire width; and

h) wherein at least one of the first coil and the second coil operates at about 100 kHz to about 500 kHz.

2. The antenna of claim 1, wherein the N2 number of turns comprises at least 10 turns.
3. The antenna of claim 1, wherein a width of a portion of the second conductive wire is between 0.5 mm and 1.5 mm.
4. The antenna of claim 1, wherein the second gap is between 0.1 mm and 0.5 mm.
5. The antenna of claim 1, wherein the second gap is between 0.05 mm and 0.3 mm.
6. The antenna of claim 1, wherein the third gap is between 0.05 mm and 10 mm.
7. The antenna of claim 1, wherein the second conductive wire has a first turn having a portion of the first turn including a first width and a second turn having a portion of the second turn include a second width, wherein the second width is different than the first width.
8. The antenna of claim 7, wherein the first turn is disposed adjacent the second turn.
9. The antenna of claim 7, wherein the first turn is the outermost turn of the second coil and the second turn is the inner most turn of the second coil and the first width is greater than the second width.
10. The antenna of claim 7, wherein the first width is between 0.5 mm and 1.5 mm and the second width is between 0.2 mm and 1.0 mm.
11. The antenna of claim 1, further including a shielding material disposed adjacent one of the first coil, the second coil, and both the first coil and the second coil, wherein the shielding material is a ferrite material, wherein the combination of the second coil and shielding material provide a quality factor greater than 10.
12. The antenna of claim 1, wherein the second inductance is greater than 4.2 μ H and the second coil operates at a frequency selected from a frequency range between 100 kHz and 350 kHz.
13. The antenna of claim 1, wherein the first coil and the second coil are disposed on one or more flexible substrates.
14. The antenna of claim 1, wherein the antenna is disposed in a mobile device.
15. The antenna of claim 1, the first conductive wire and the second conductive wire comprises an electrically conductive material from the group consisting of a trace, a filar, a filament, and combinations thereof.

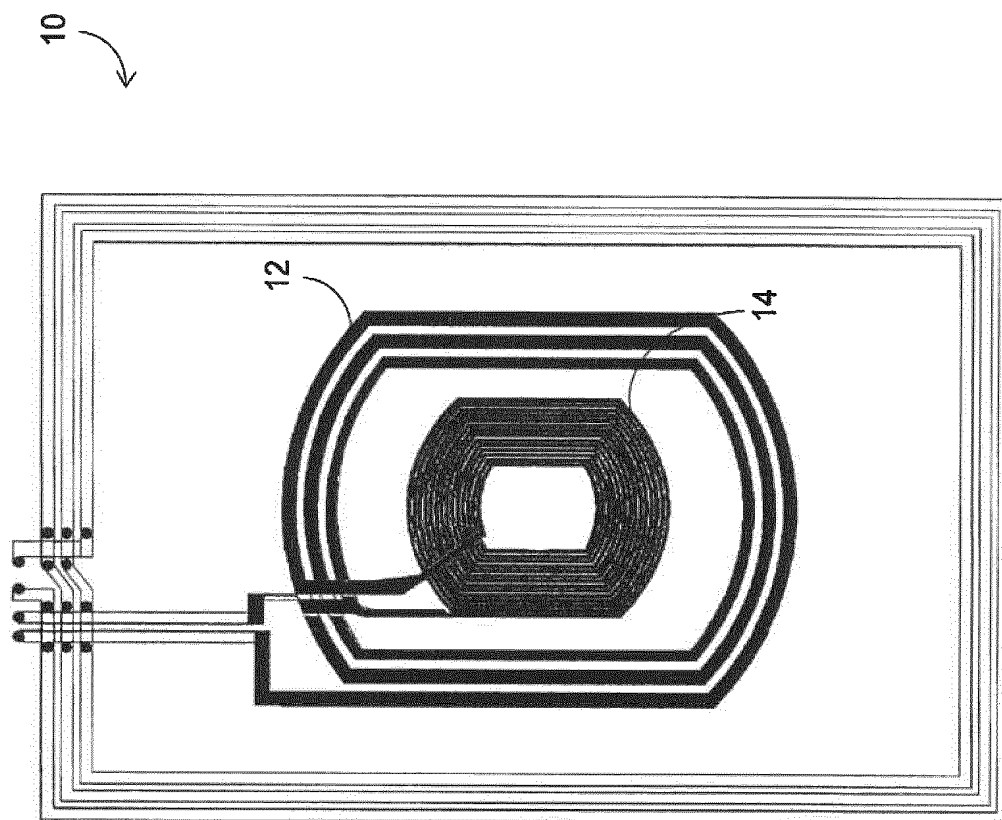
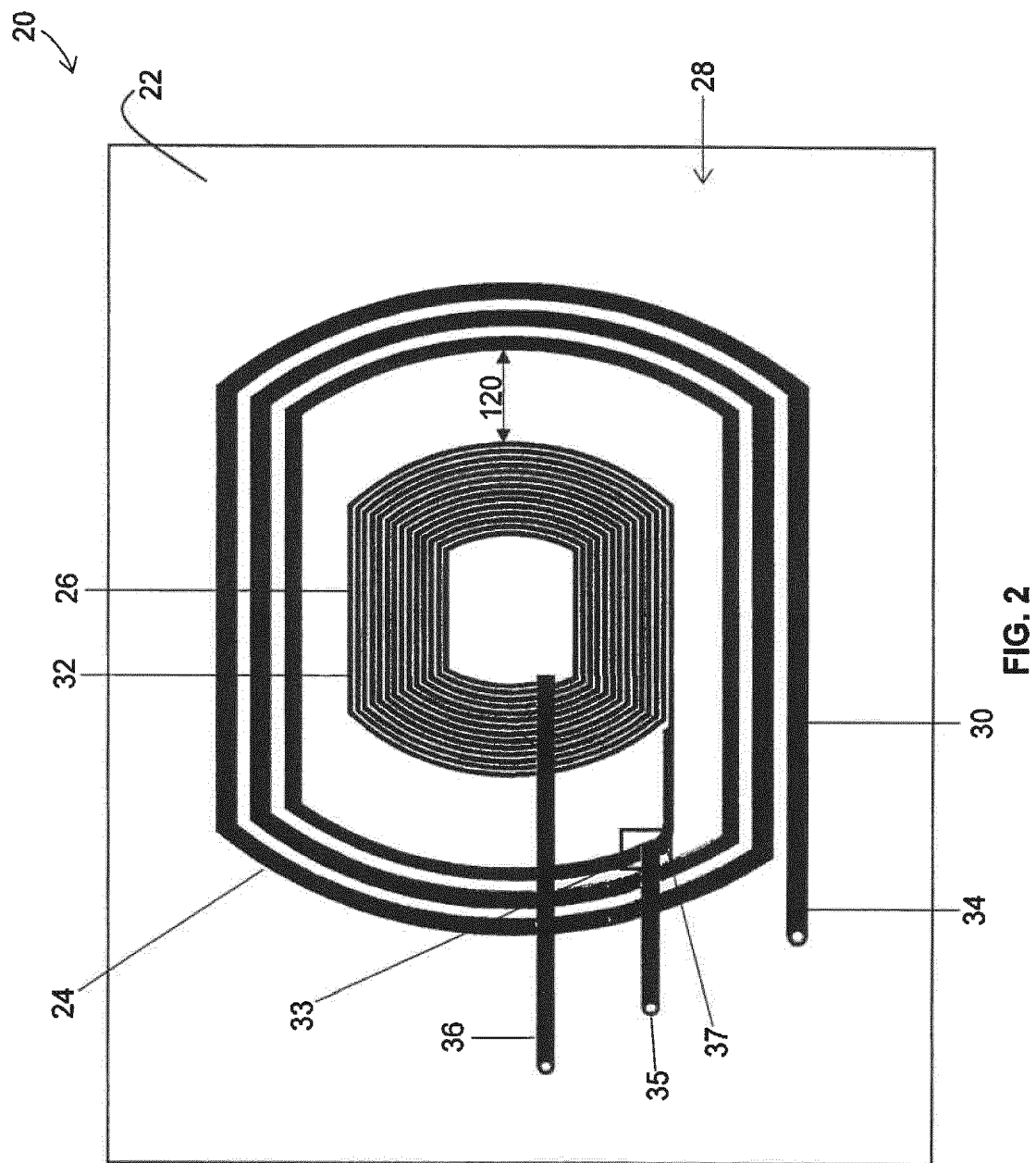


FIG. 1
PRIOR ART



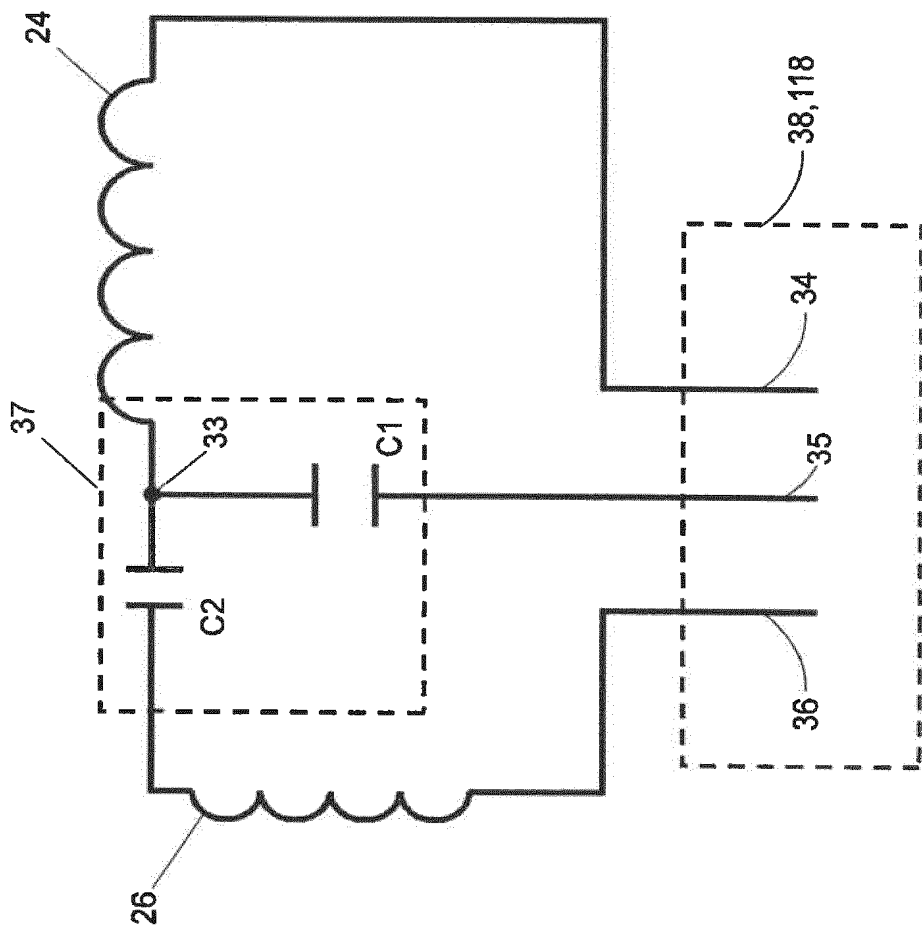


FIG. 2A

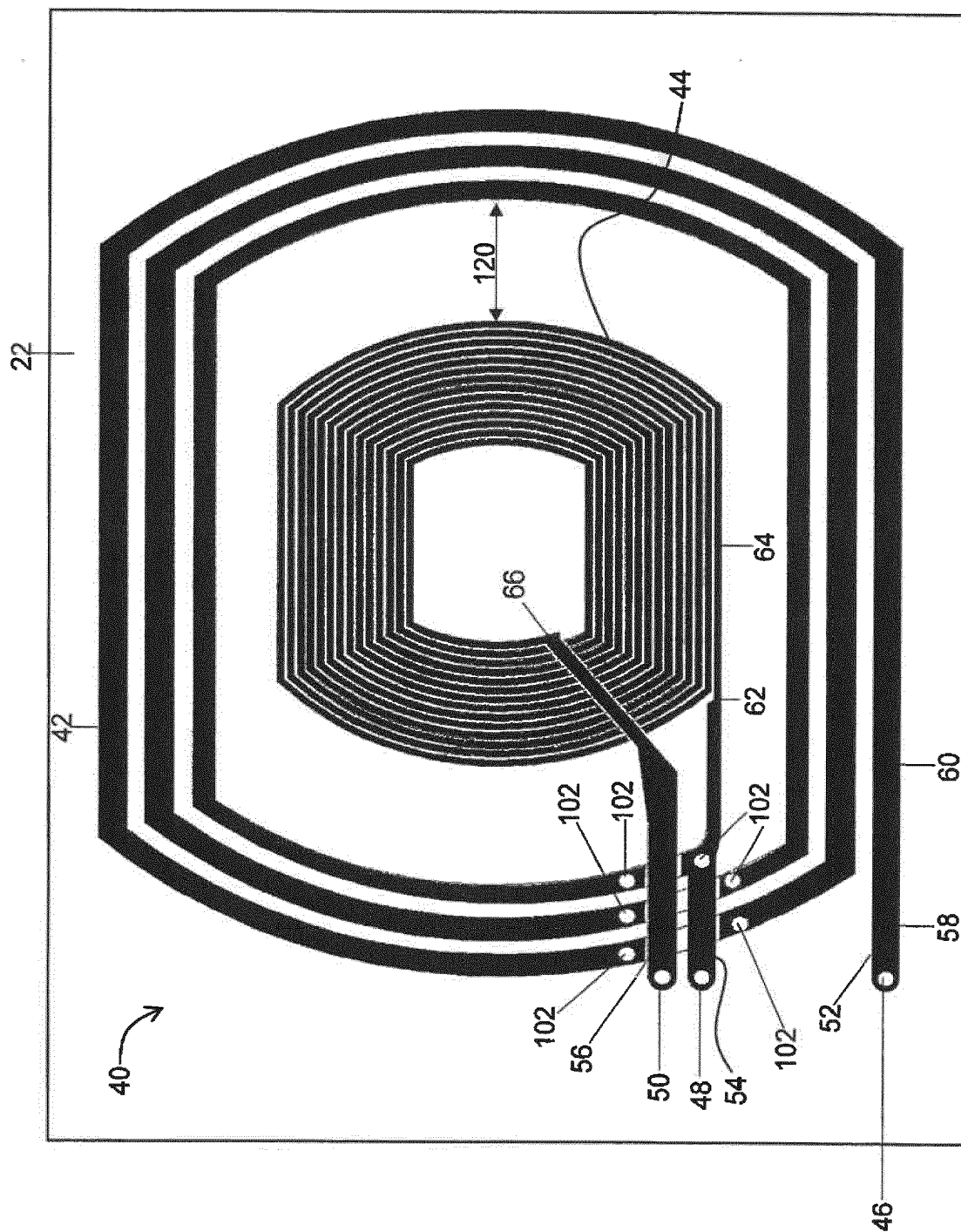
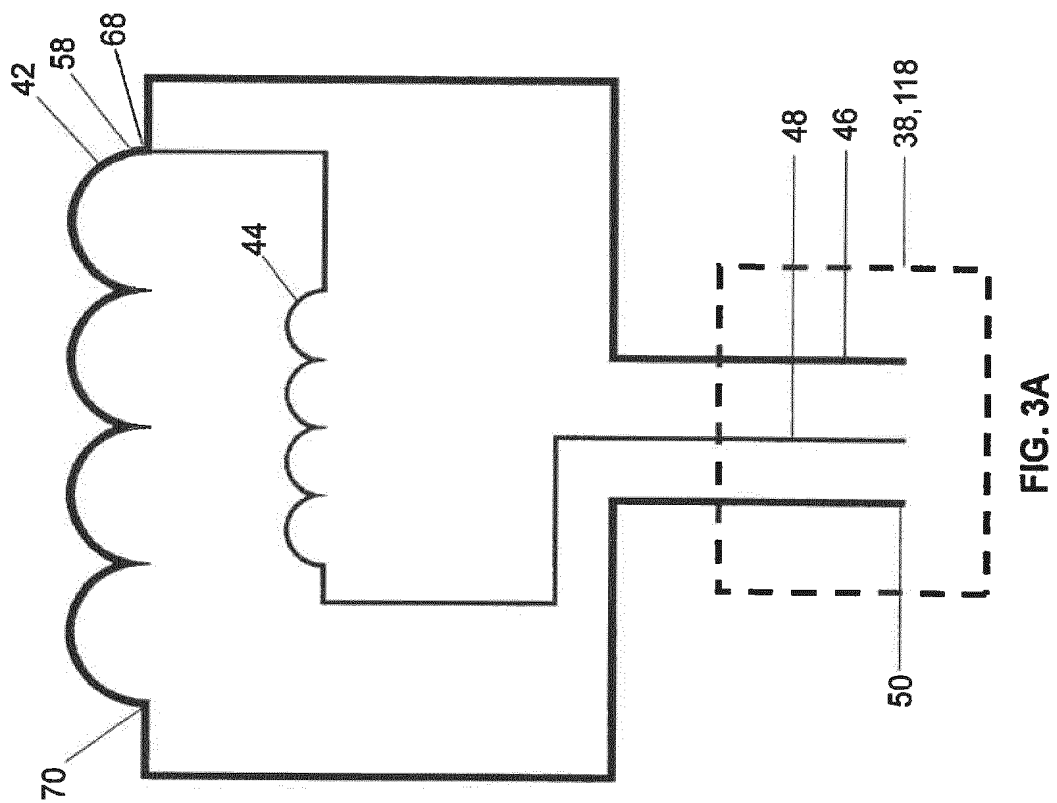


FIG. 3



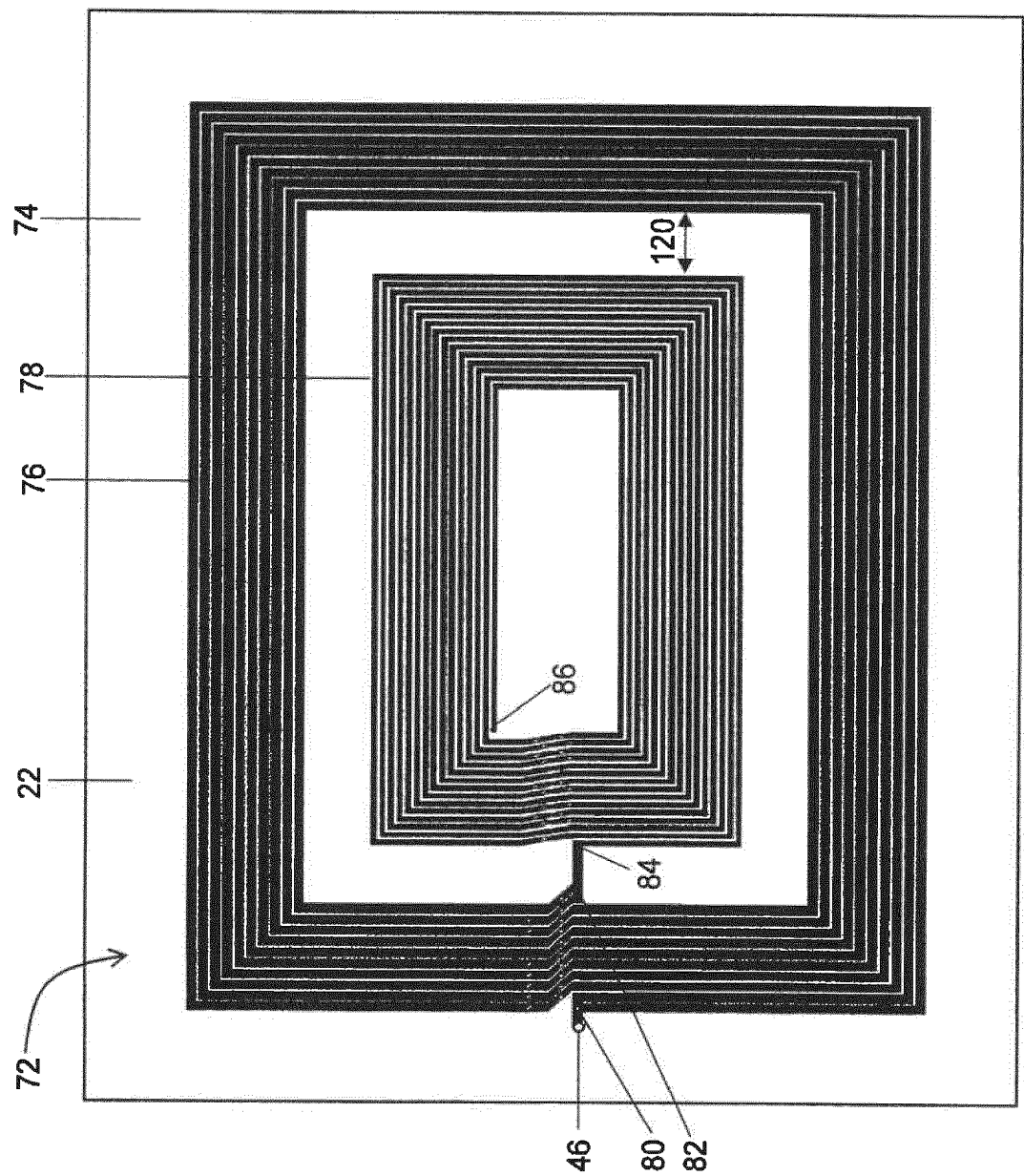


FIG. 3B

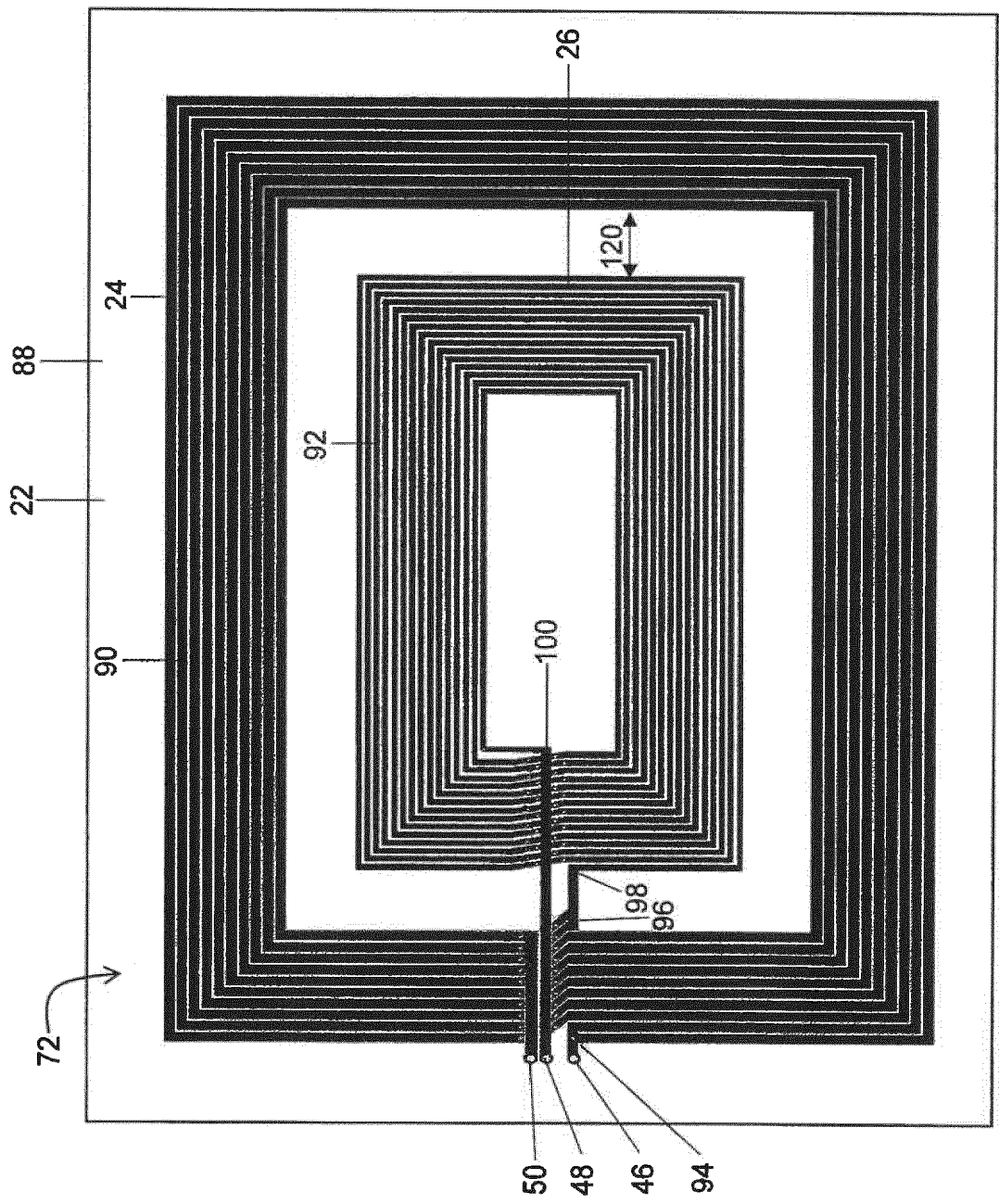


FIG. 3C

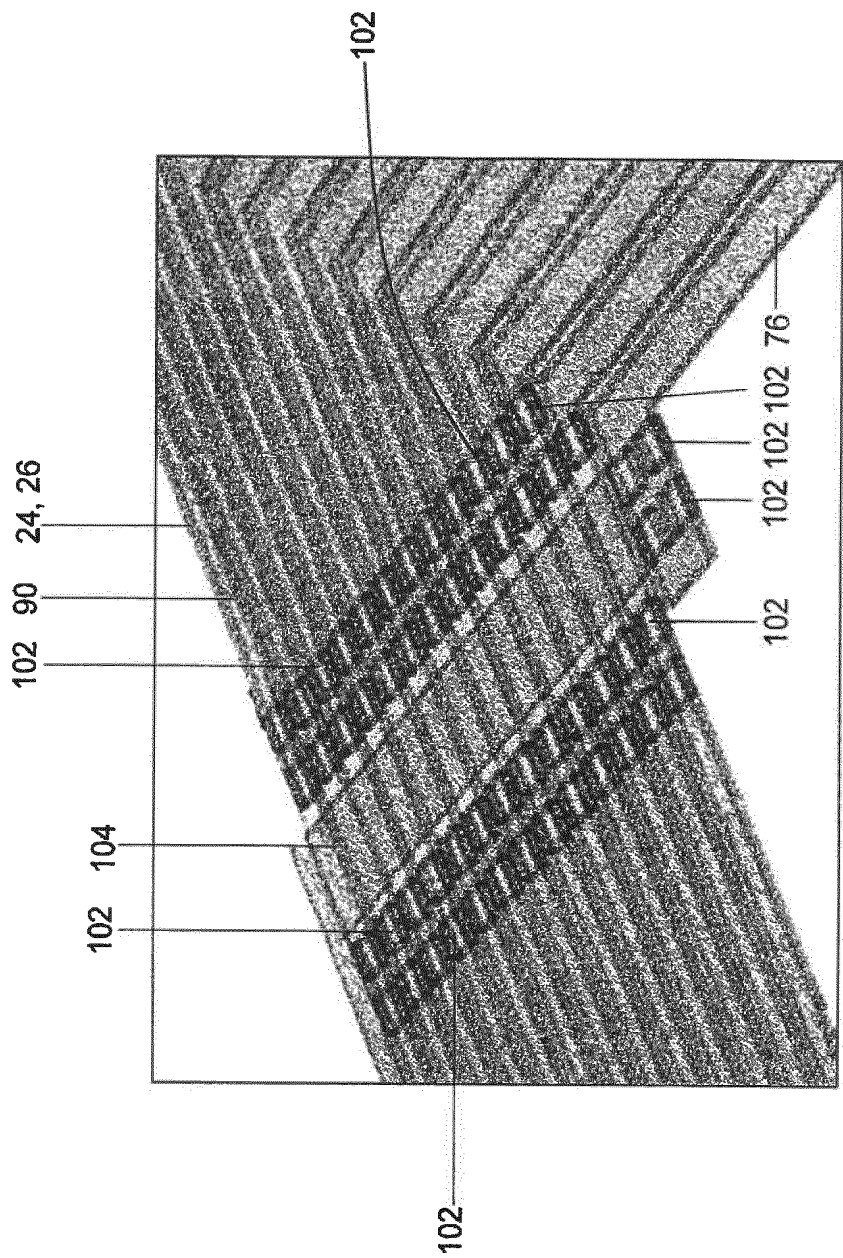


FIG. 3D

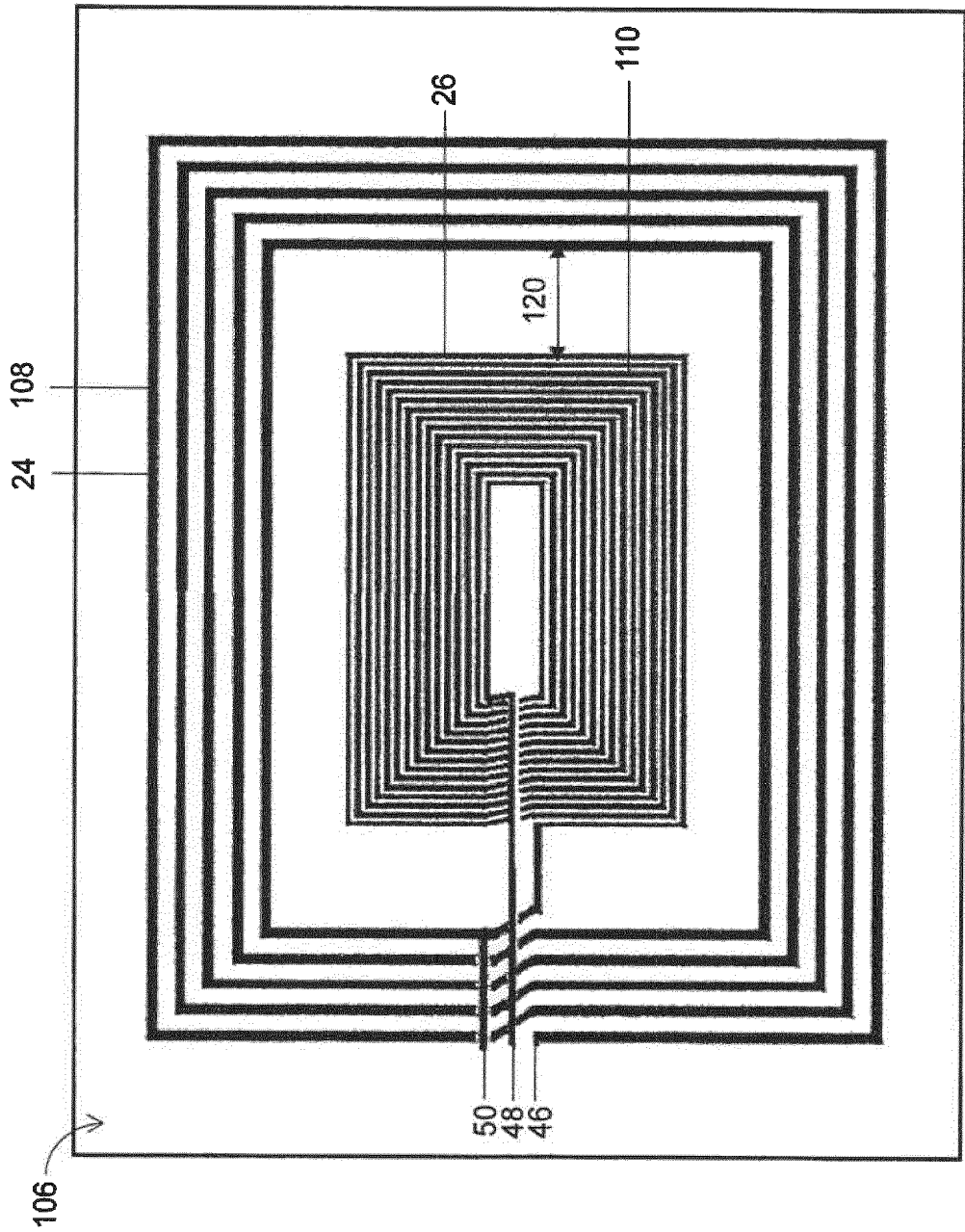


FIG. 3E

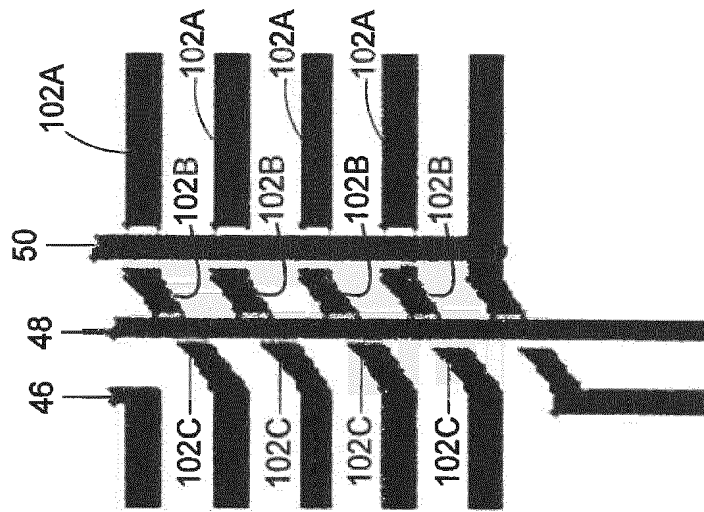


FIG. 3F

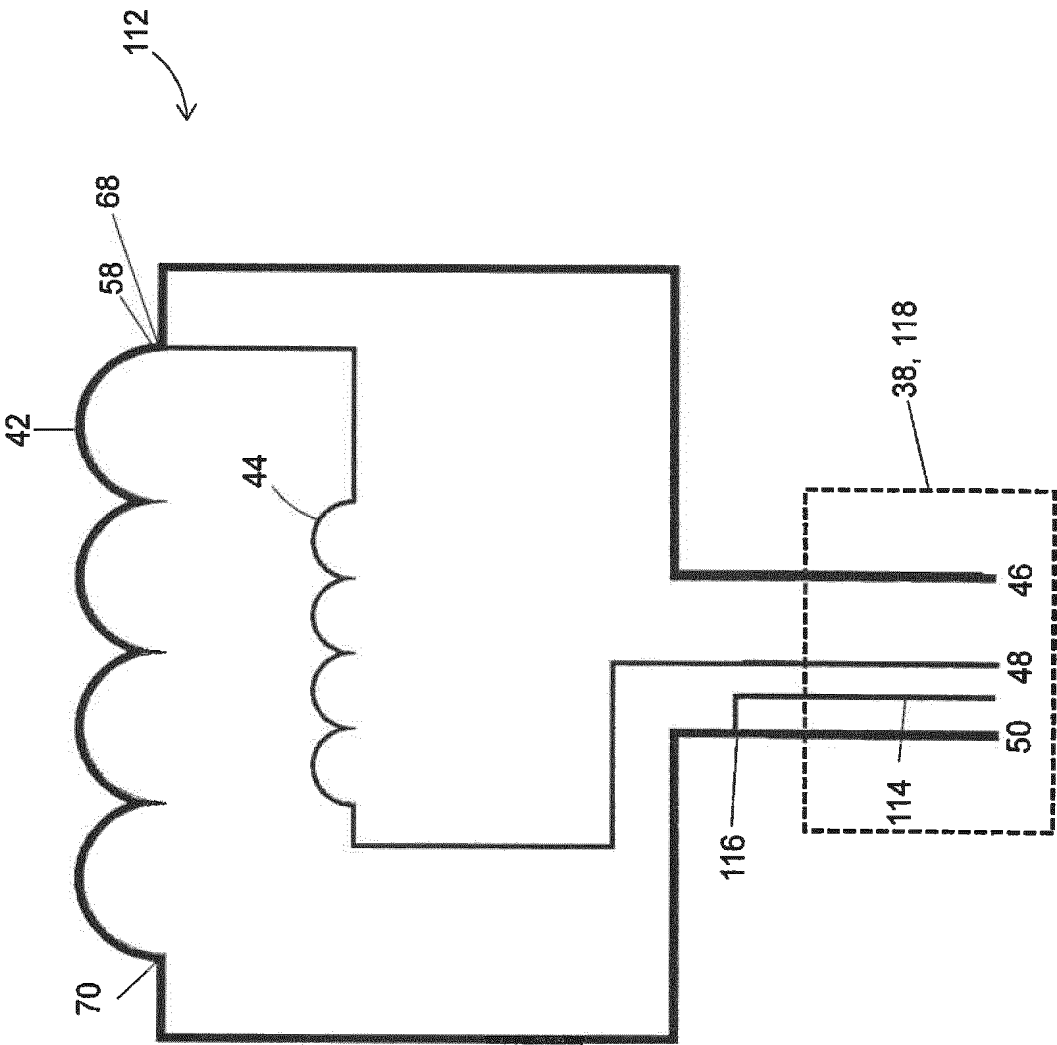


FIG. 4

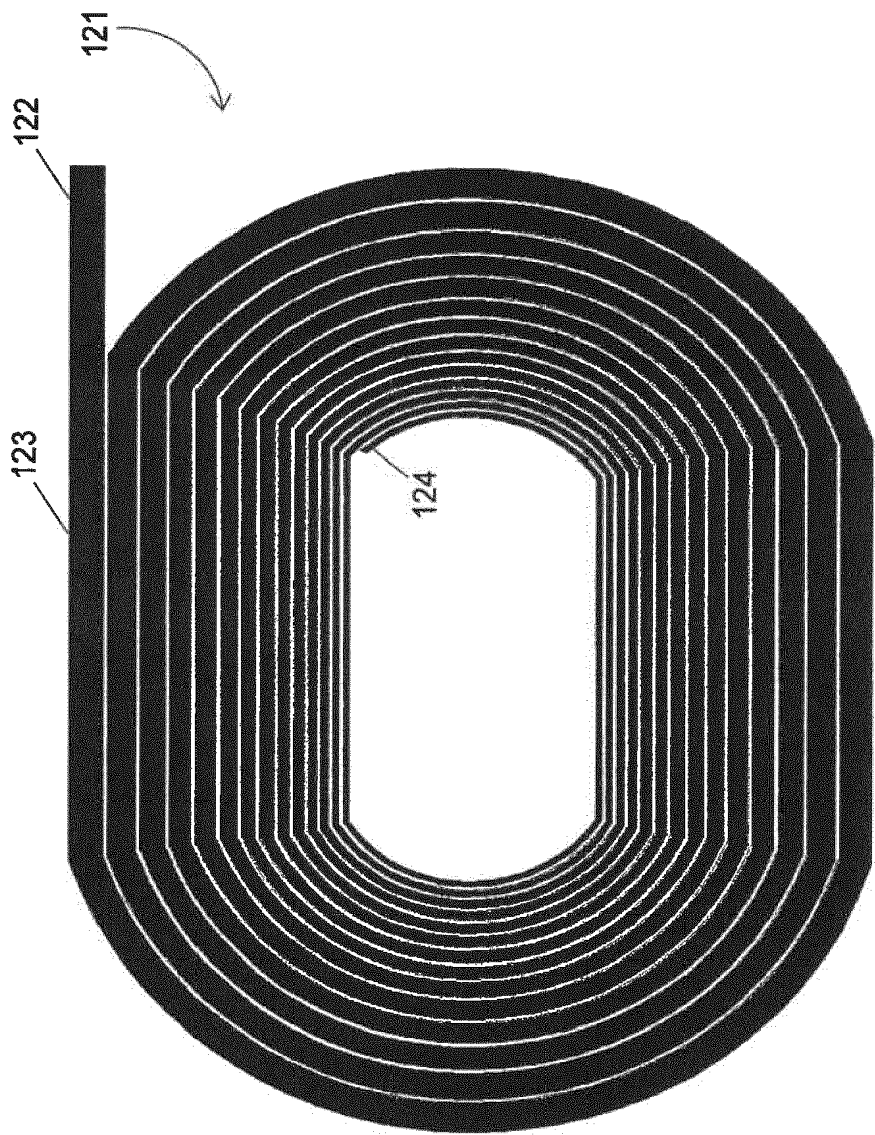


FIG. 5

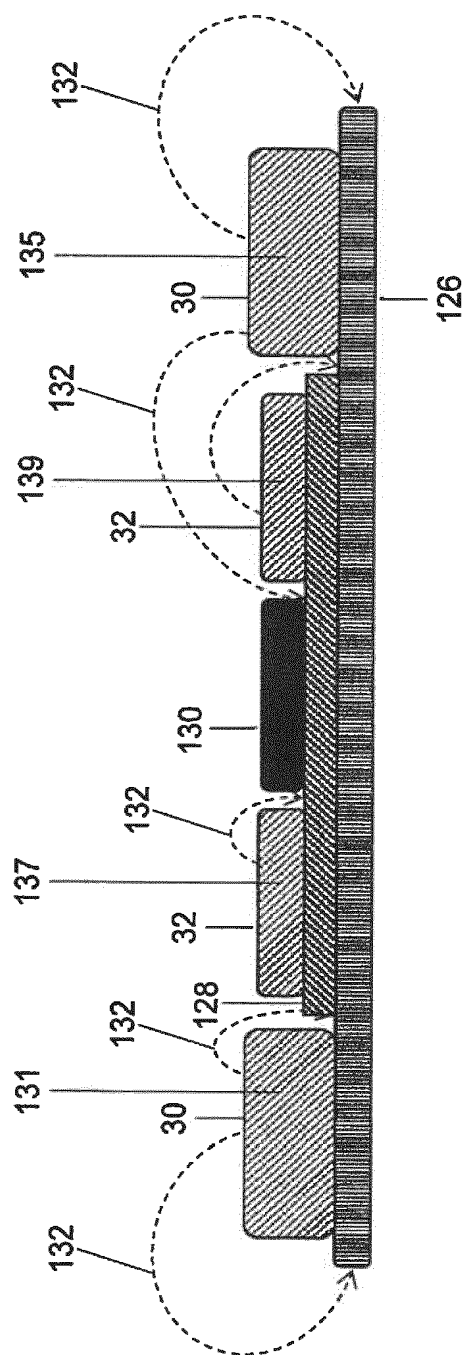


FIG. 6A

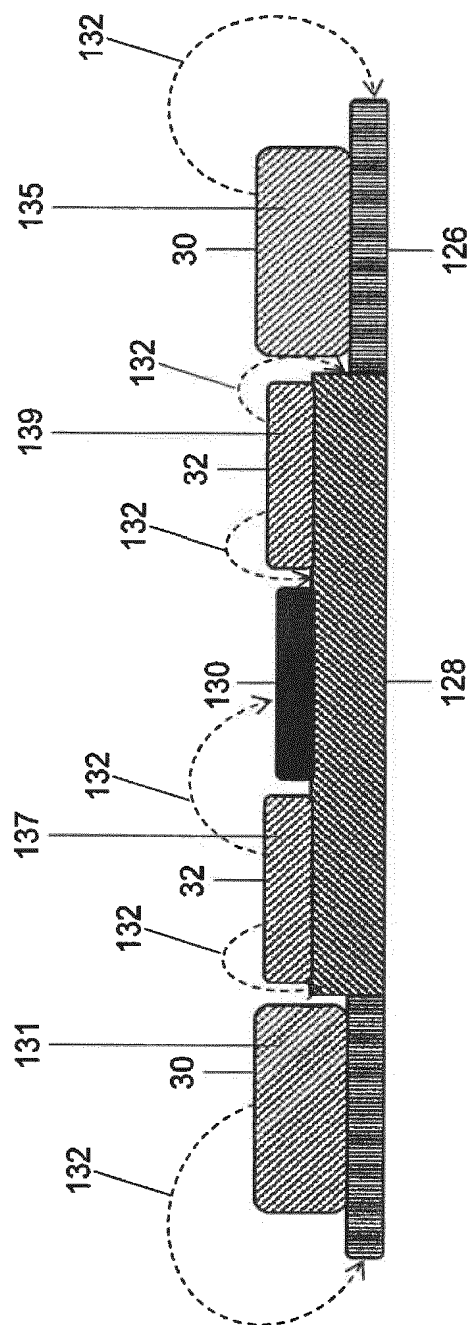


FIG. 6B

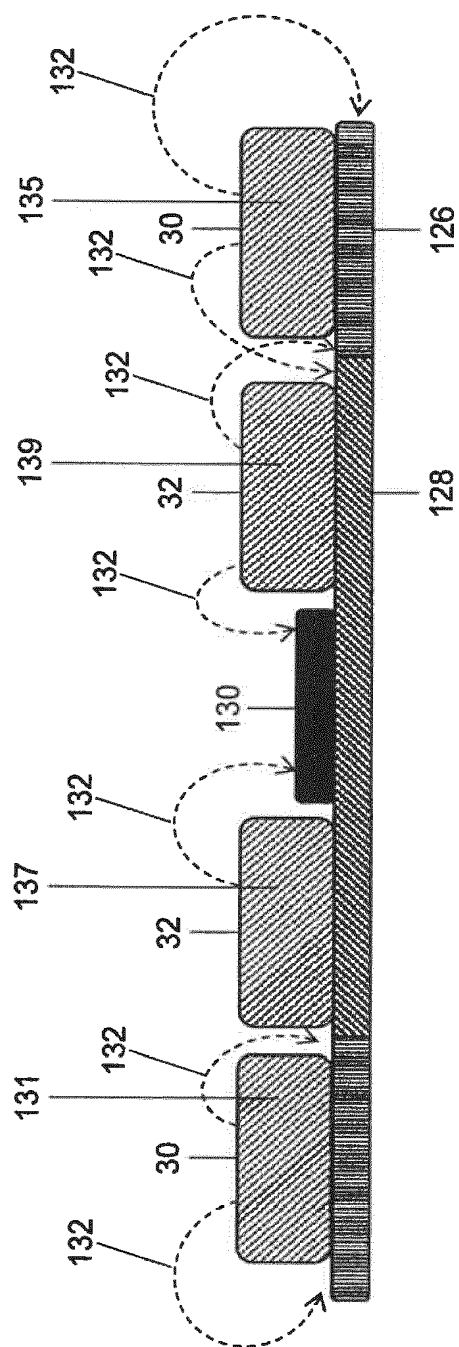


FIG. 6C

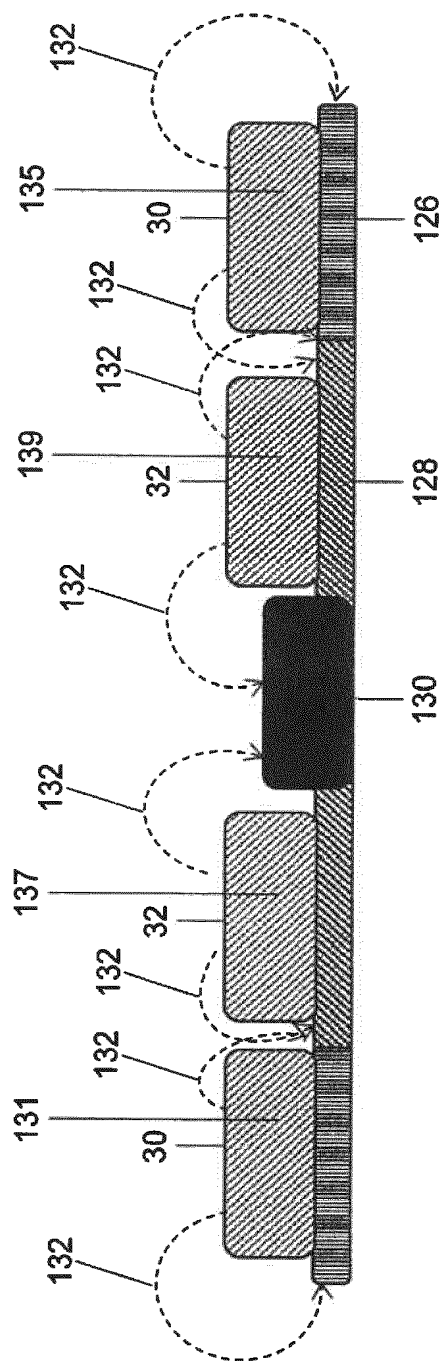


FIG. 6D

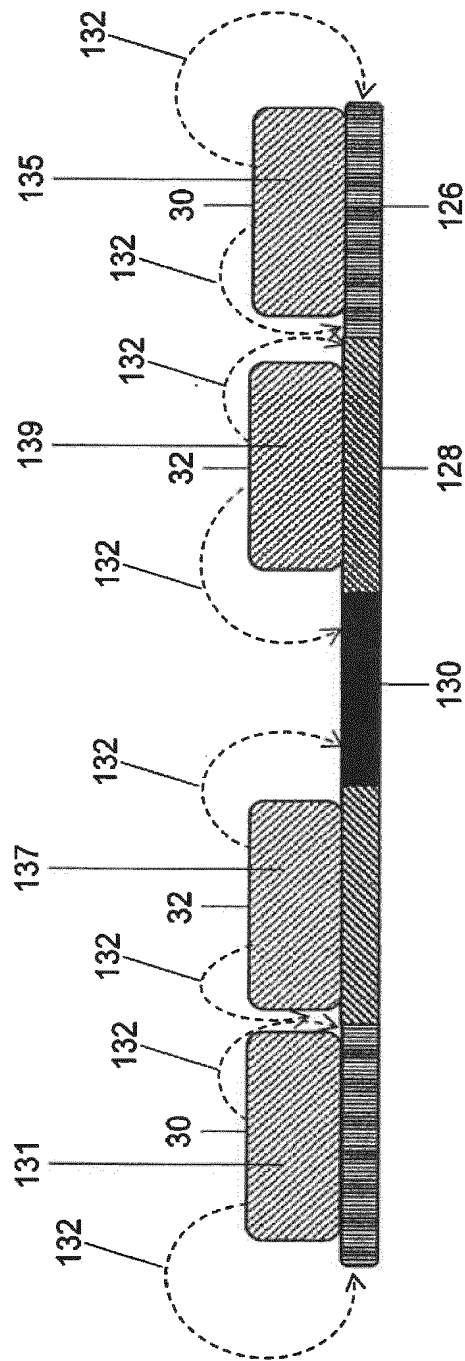


FIG. 6E

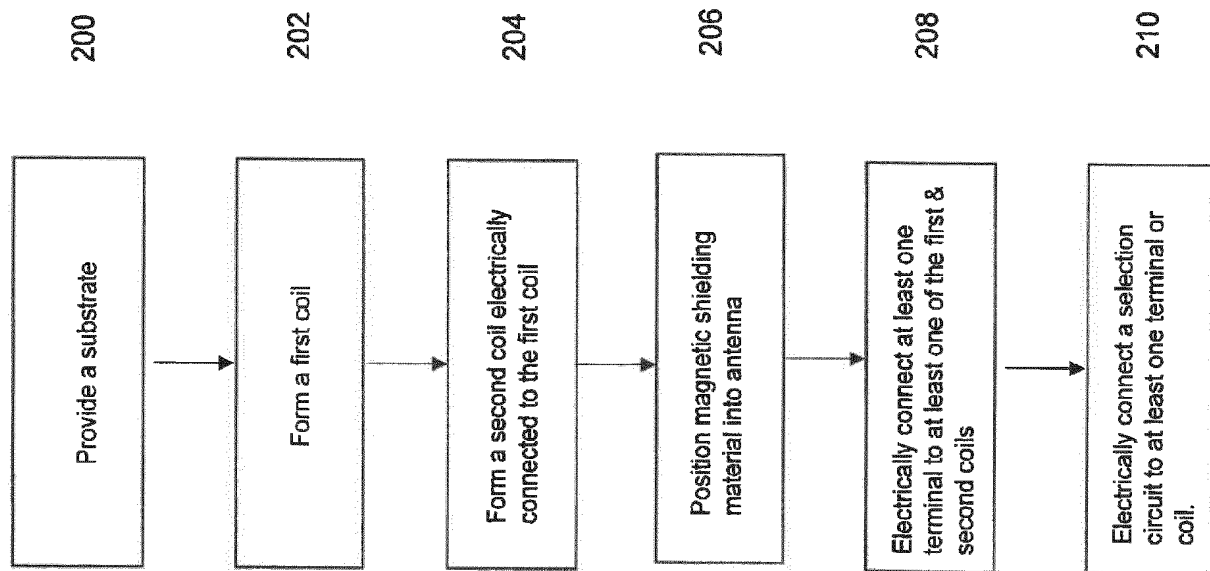


FIG. 7

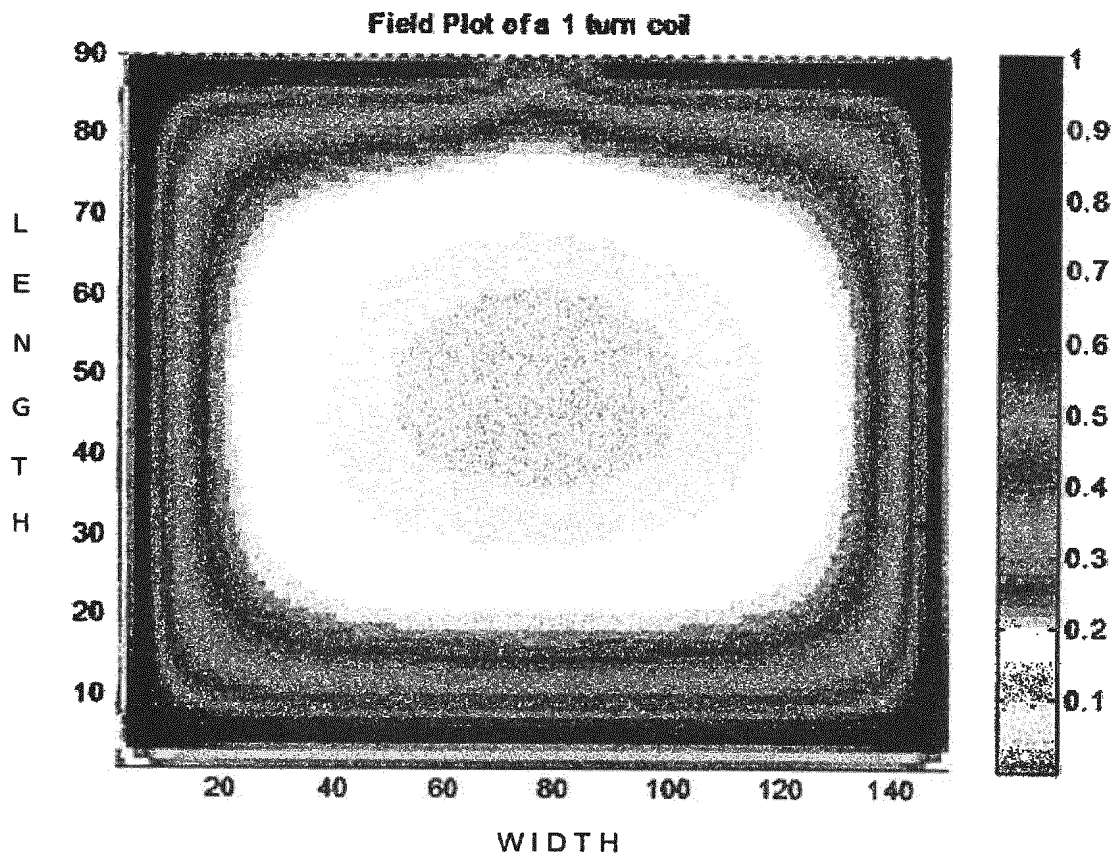


FIG. 8A

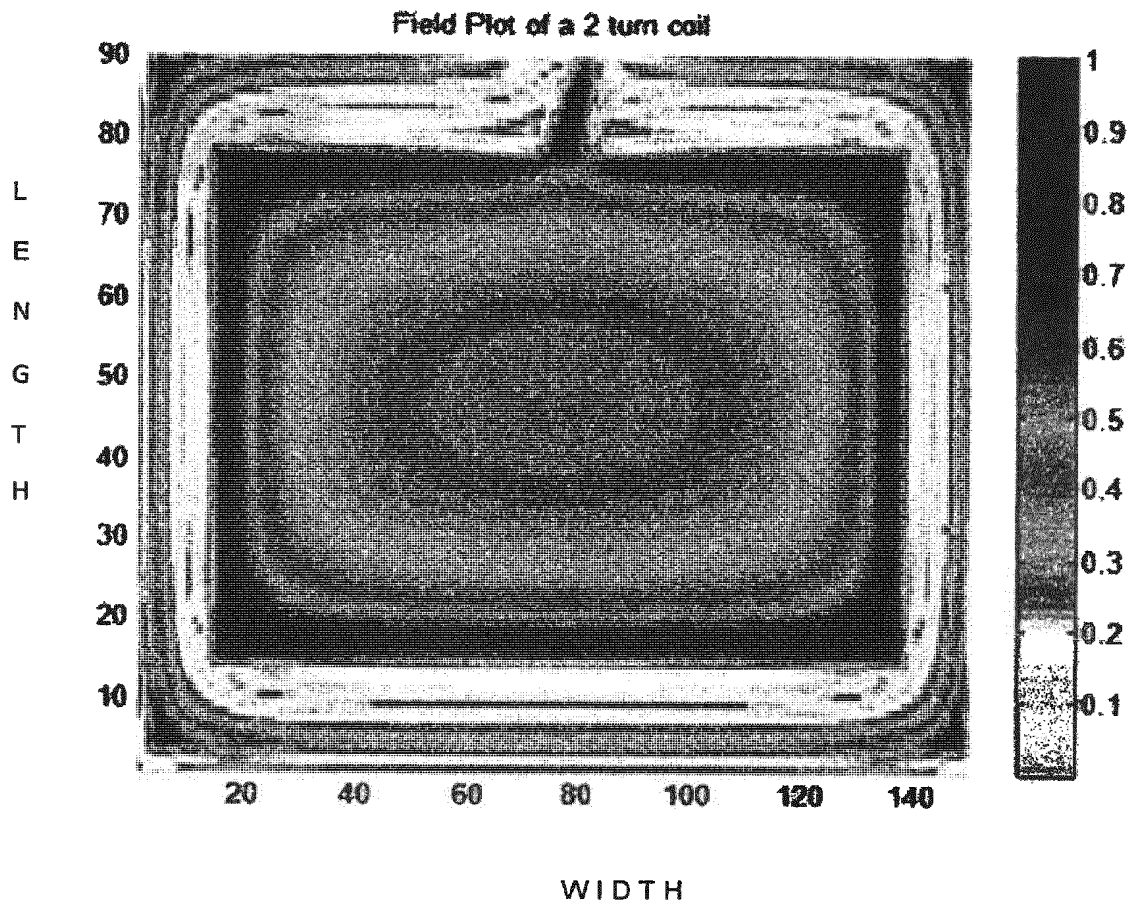


FIG. 8B

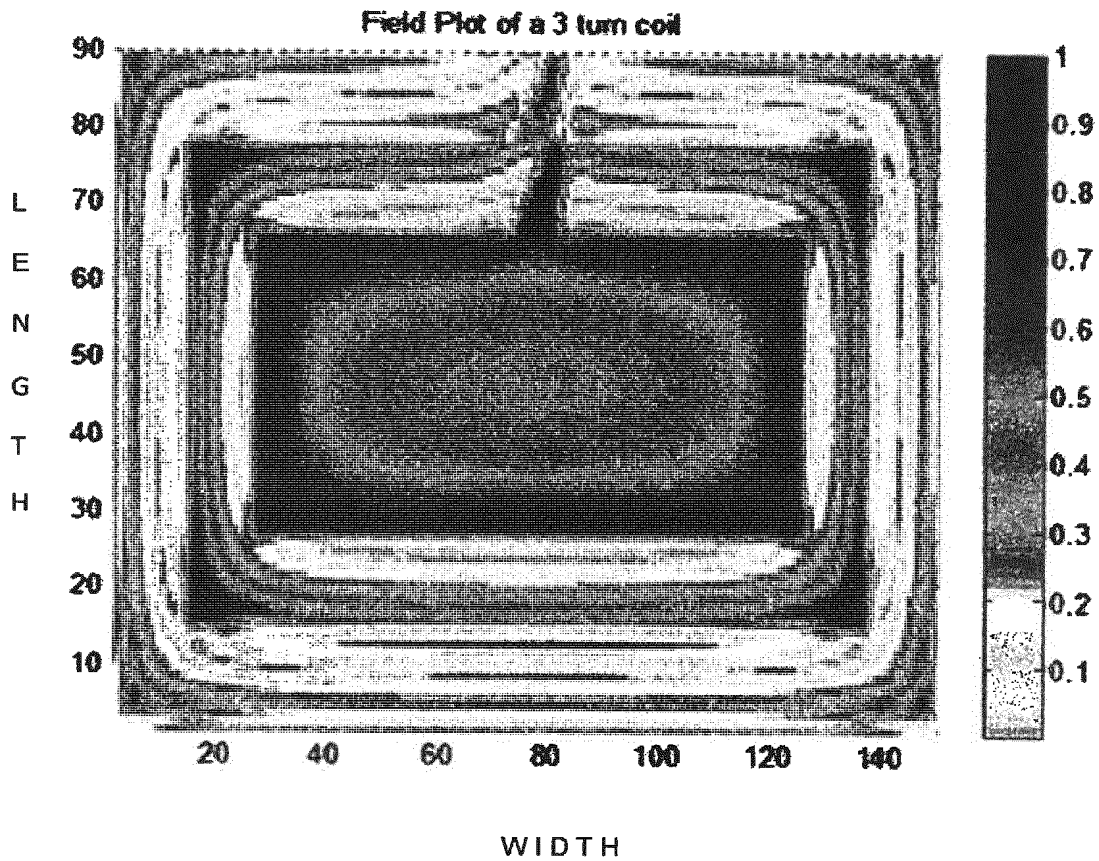


FIG. 8C

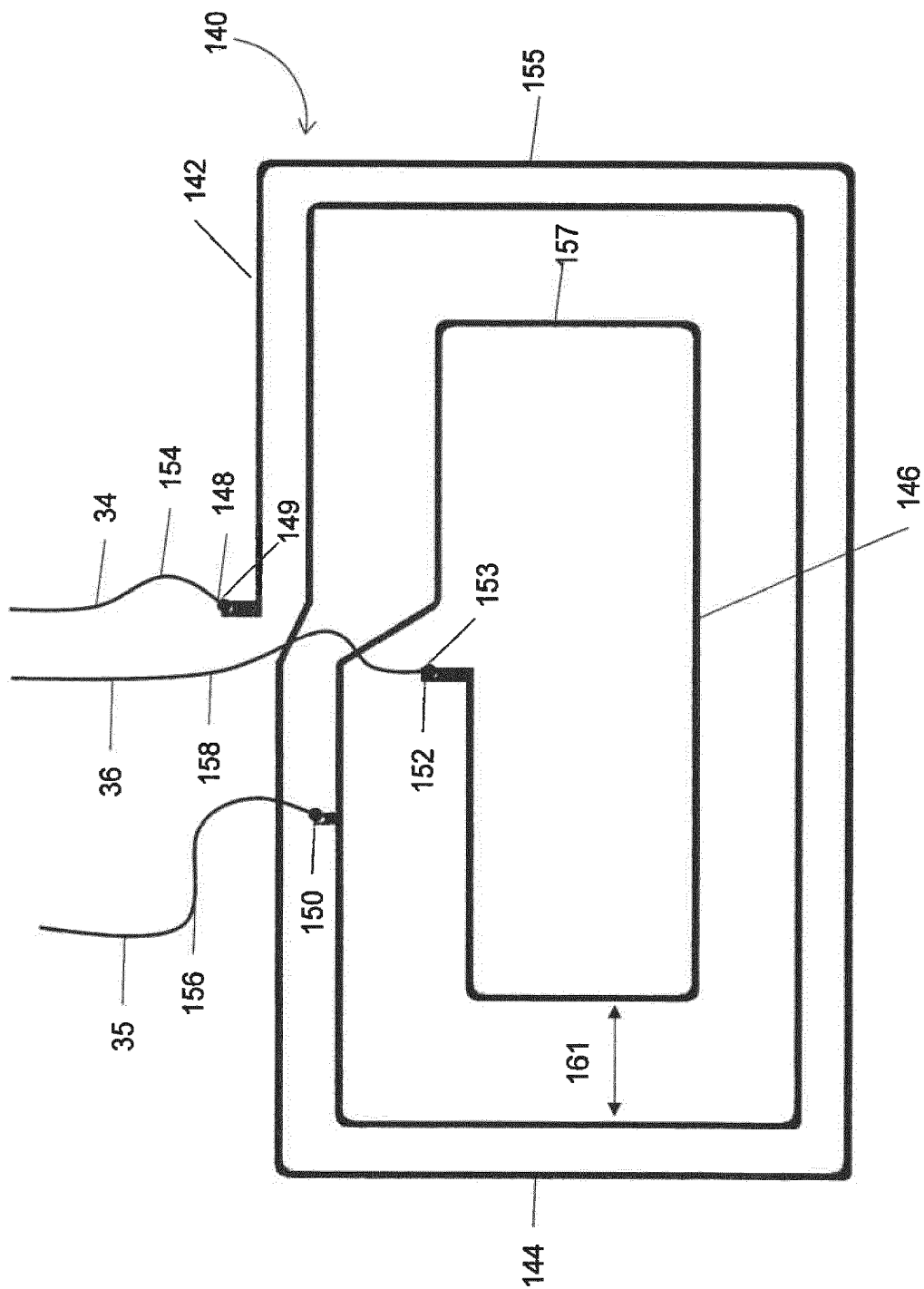


FIG. 9

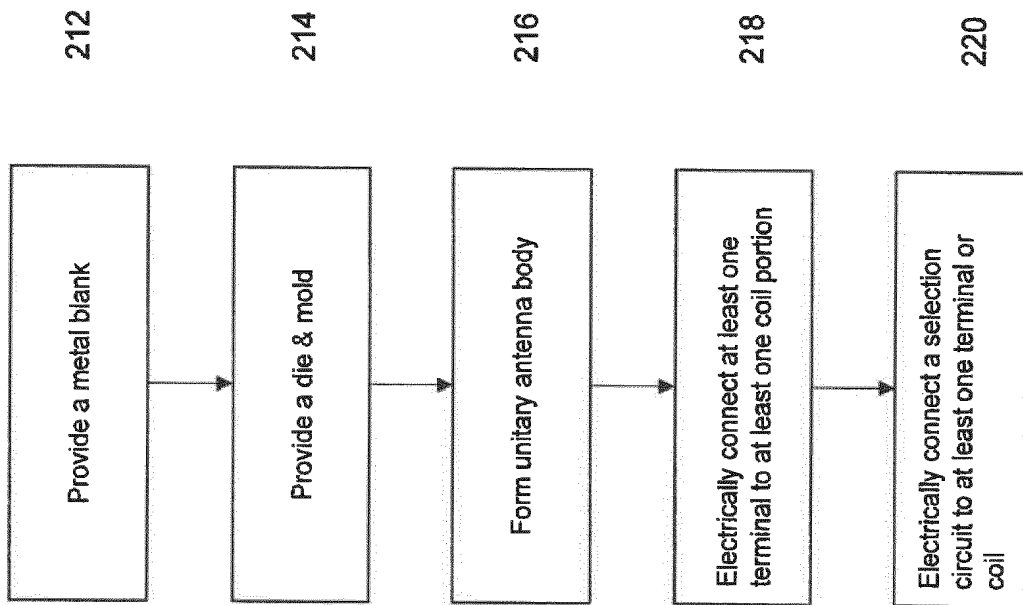


FIG. 10

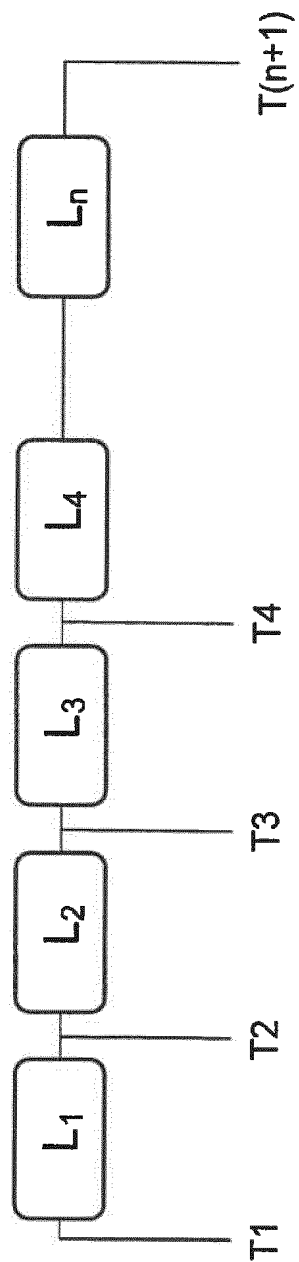


FIG. 11

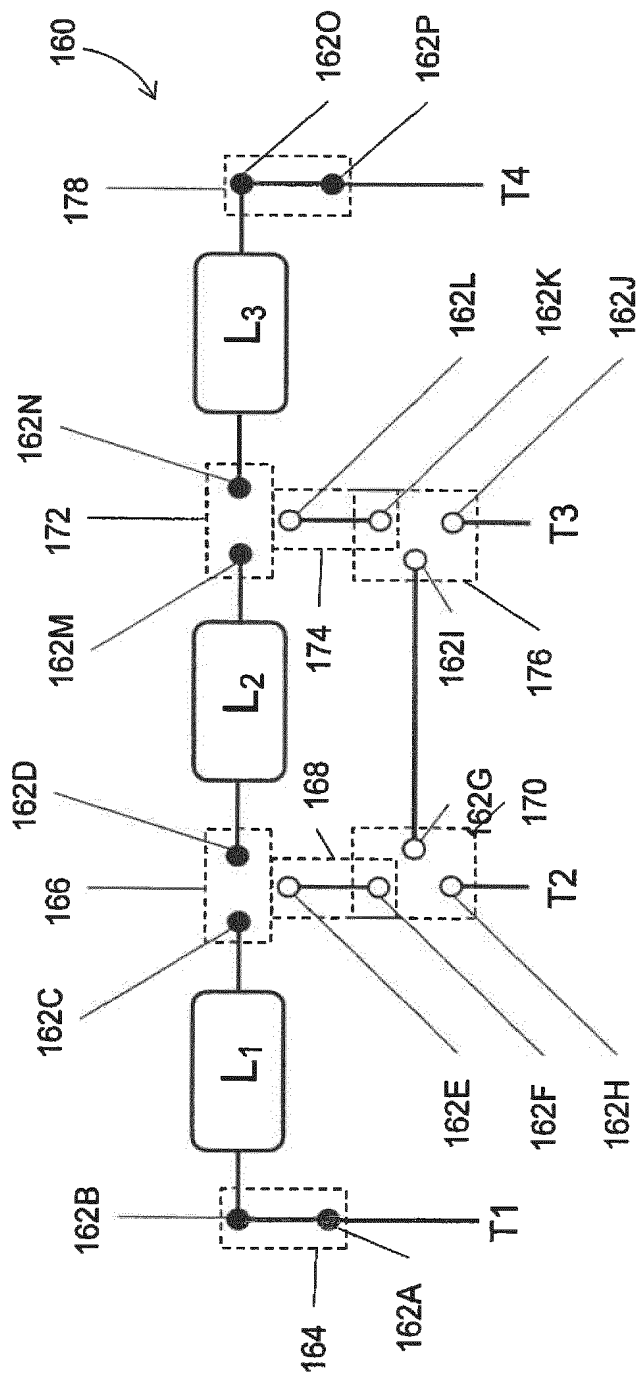


FIG. 12A

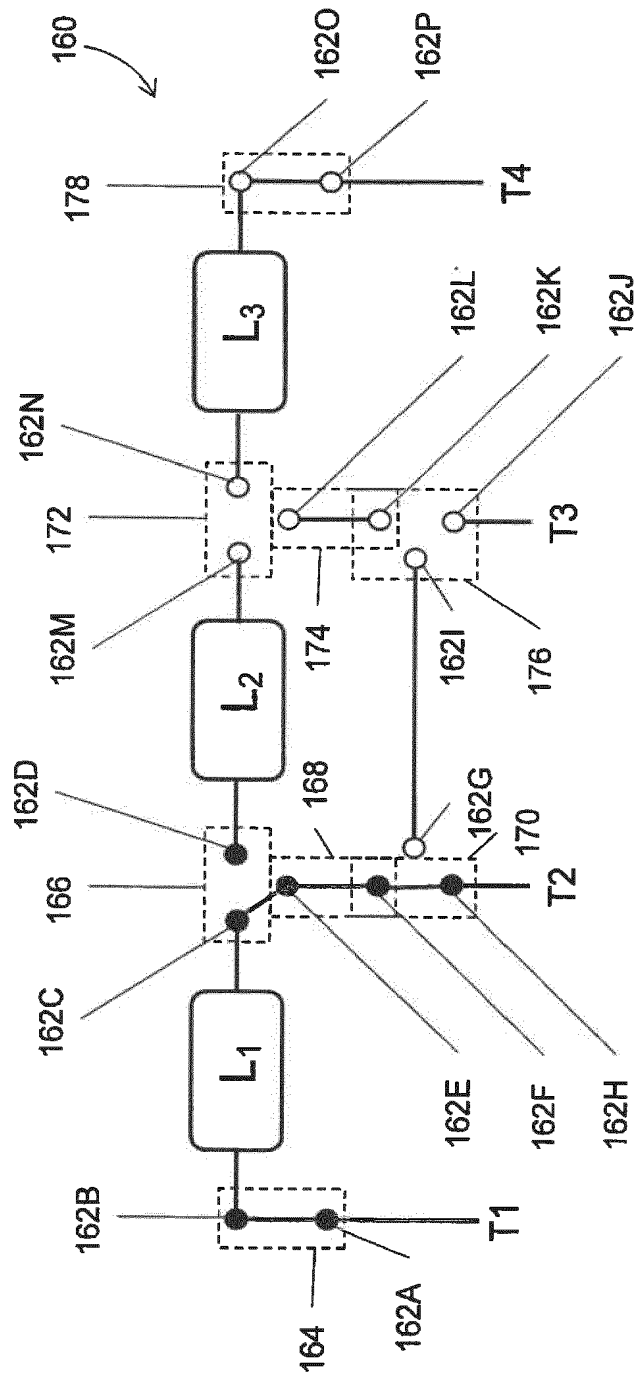


FIG. 12B

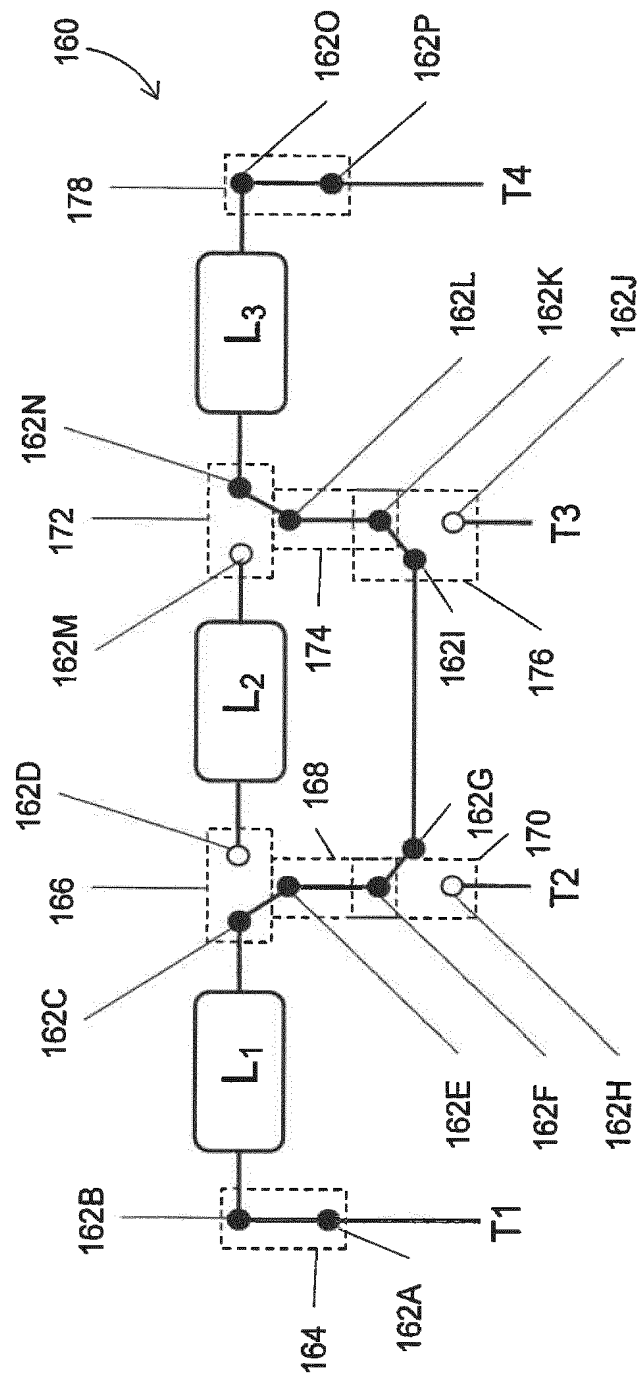


FIG. 12C

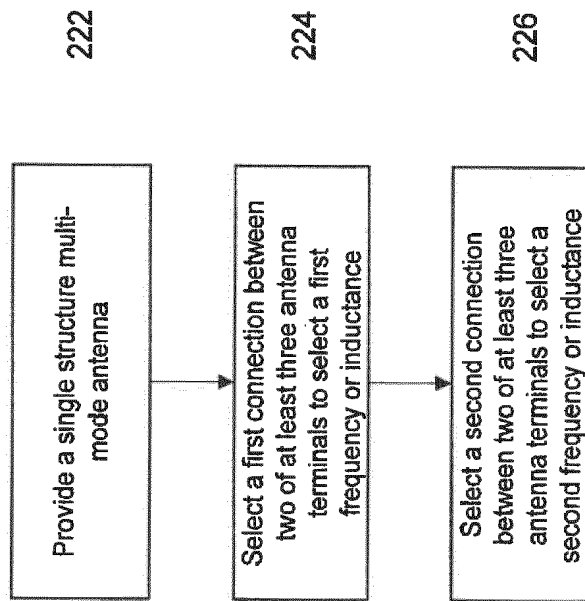


FIG. 13



EUROPEAN SEARCH REPORT

Application Number
EP 19 21 6241

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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	US 2009/230777 A1 (BAARMAN DAVID W [US] ET AL) 17 September 2009 (2009-09-17) * pages 4,5,2 * * paragraphs [0006], [0046] - [0052] * -----	1-15	INV. H01F38/14 H01F21/12 H01F29/02 H01F27/28 H01F27/38 H01Q1/00 H01Q1/22 H01Q1/24 H01Q5/15 H01Q9/27 H01Q21/30 H02J5/00 H02J7/02 H02J50/12
X	US 2011/241437 A1 (KANNO HIROSHI [JP]) 6 October 2011 (2011-10-06) * figures 3-6,8-13 * * paragraphs [0052] - [0121] * -----	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			H01F H02J H01Q
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 8 April 2020	Examiner Weisser, Wolfgang
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 19 21 6241

5 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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08-04-2020

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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

Electronic Patent Application Fee Transmittal

Application Number:	17955126			
Filing Date:	28-Sep-2022			
Title of Invention:	SMARTPHONE ANTENNA IN FLEXIBLE PCB			
First Named Inventor/Applicant Name:	Sang Hoon LEE			
Filer:	Mincheol Kim/YOON JEE LEE			
Attorney Docket Number:	1959706.00056/AQCRP.41C3			
Filed as Small Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	2501	1	480	480

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	2806	1	104	104
Total in USD (\$)				584

Electronic Acknowledgement Receipt

EFS ID:	47916262
Application Number:	17955126
International Application Number:	
Confirmation Number:	5216
Title of Invention:	SMARTPHONE ANTENNA IN FLEXIBLE PCB
First Named Inventor/Applicant Name:	Sang Hoon LEE
Customer Number:	45200
Filer:	Mincheol Kim/US Patent Mail
Filer Authorized By:	Mincheol Kim
Attorney Docket Number:	1959706.00056/AQCRP.41C3
Receipt Date:	27-APR-2023
Filing Date:	28-SEP-2022
Time Stamp:	17:07:30
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	\$584
RAM confirmation Number	E20234QH08468113
Deposit Account	021818
Authorized User	US Patent Mail

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	2023-04-27_0_Cover_Letter_A QCRP-41C3.pdf	95942	no	1
			b25fb39c545d8d60e0c77501f044caca5f35e2d4		
Warnings:					
Information:					
2	Issue Fee Payment (PTO-85B)	2023-04-27_1_Issue_Fee_Transmittal_AQCRP-41C3.pdf	216756	no	1
			674ed67b7d42067854afd0bb2f984dbaa1d426fe		
Warnings:					
Information:					
3	Miscellaneous Incoming Letter	2023-04-27_3_Applicant_Comments_on_Examiner_Statment_Reasons_for_Allowance_AQCRP-41C3.pdf	98438	no	2
			a04fde94b2923f06bcb8c2bddfd63d4bcf1b134c		
Warnings:					
Information:					
4	Information Disclosure Statement (IDS) Form (SB08)	2023-04-27_4_ab_IDS_form_PTO-SB-08a_and_PTO-SB-08b_AQCRP-41C3.pdf	146258	no	3
			4ff326676e188f7eb3d2053b0f1d5bca5f13863f		
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
5	Letter specifying the conditions for filing under 37 CFR 1.97	2023-04-27_4_c_IDS_Transmittal_AQCRP_41C3.pdf	77309	no	1
			107e1f2acb73f44e3f2c12fae01425f7d153abc3		
Warnings:					
Information:					
6	Foreign Reference	FP1_WO2019151693_A1.pdf	1729801	no	48
			b836ff4bfec94cb045a177179c8f8ab4814641a6		
Warnings:					

Information:					
7	Foreign Reference	FP2_WO2017200236_A1.pdf	1987937	no	52
			41e5656a9f1c5867868d6ae4d44ae349520cf0bb		
Warnings:					
Information:					
8	Foreign Reference	FP3_KR101649259_B1.pdf	1744006	no	44
			cf3618cf987e9c663f284898e50fa17e941b089b		
Warnings:					
Information:					
9	Foreign Reference	FP4_KR101532052_B1.pdf	1837567	no	18
			270d5635ba16f3fad1d130aae24fba8455a66774		
Warnings:					
Information:					
10	Foreign Reference	FP5_KR101574322_B1.pdf	1066346	no	43
			12c50be88376e56993e0d96d9c9cfa4fd5e5d07a		
Warnings:					
Information:					
11	Foreign Reference	FP6_CN103219808_A_rgb.pdf	2971056	no	14
			7ff29ca4d67ef08a508d5669bbc428f46df81295		
Warnings:					
Information:					
12	Foreign Reference	FP7_KR101991011_B1_rgb.pdf	8574675	no	21
			88c457fda4003962bf16249cfdfe2d0ffe6134c2		
Warnings:					
Information:					
13	Foreign Reference	FP8_KR20180046243_A_rgb.pdf	24031636	no	35
			8f019e051f7d9e61c524dd36f494107ebd1d2966		
Warnings:					
Information:					

14	Foreign Reference	FP9_KR101697303_B1.pdf	733164	no	36
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Information:					
15	Foreign Reference	FP10_KR101719915_B1_rgb.pdf	10082633	no	22
			f5aec5d426cb138d3dd049b2501ca5d5f0cfce2bb		
Warnings:					
Information:					
16	Foreign Reference	FP11_KR101640023_B1.pdf	1831304	no	32
			beafab89add467ab455120e77bdb789a4214630f		
Warnings:					
Information:					
17	Foreign Reference	FP12_CN203103042U_U_rgb.pdf	6250581	no	16
			59ace09235b4217679e42fe152f6e34eadac9879		
Warnings:					
Information:					
18	Foreign Reference	FP13_KR101811611_B1_rgb.pdf	1064540	no	63
			2271ebdf4096d16d85d3c72061b9c839177fed0d		
Warnings:					
Information:					
19	Foreign Reference	FP14_CN209015853U_U.pdf	833303	no	17
			63bcc587550773a37e41da259659907536cf3130		
Warnings:					
Information:					
20	Foreign Reference	FP15_EP3657519A1.pdf	5251974	no	67
			d6a725d4a7ff7ddc285b28785ca6b23f8e3efdf3c		
Warnings:					
Information:					

21	Non Patent Literature	NPL2_A_Dual_Resonance.pdf	249231 4eadb9d05fd31064b59af7cb55eb036c19144068	no	4
Warnings:					
Information:					
22	Non Patent Literature	NPL1_Dual-Directional_Near_Field_rgb.pdf	2724878 daa583d31c51eb85dcc35d5f2cbd79a5bb45c9ab	no	3
Warnings:					
Information:					
23	Non Patent Literature	NPL3_Transparent_Electrode_rgb.pdf	3416126 18c62fa4bcaa7d4f84044fd660bb9c4a580ba947	no	3
Warnings:					
Information:					
24	Fee Worksheet (SB06)	fee-info.pdf	40424 f267b39c223b35159fb0d502e94df4542514ecb7	no	2
Warnings:					
Information:					
Total Files Size (in bytes):			77055885		
<p>This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.</p> <p><u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.</p> <p><u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.</p> <p><u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.</p>					

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	LEE, Sang Hoon
App. No.	:	17/955,126
Filed	:	September 28, 2022
Examiner	:	BALTZELL, Andrea J Lindgren
Art Unit	:	2843
Conf No.	:	5216

COVER LETTER**Mail Stop Issue Fee**

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

The followings are submitted in the captioned application:

1. Issue Fee Transmittal
2. The issue fee being paid via EFS-Web.
3. Applicant's Comments on Examiner's Statement Reason for Allowance
4. Information Disclosure Statement 37 CFR § 1.97(d) which includes:
 - a. PTO/SB/08a Form
 - b. PTO/SB/08b Form
 - c. Statement under 37 CFR § 1.97(e)(2)
 - d. Fee 37 CFR § 1.97(d)(2) – being paid via EFS-Web.

Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 02-1818.

Respectfully submitted,

K&L GATES, LLP

Dated: April 27, 2023

By: /Mincheol Kim/
Mincheol Kim
Registration No. 51,306
Attorney of Record
Customer No. 45,200
(949) 623-3611

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

45200 7590 01/30/2023
K&L Gates LLP-Orange County
1 Park Plaza
Twelfth Floor
Irvine, CA 92614

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/955,126	09/28/2022	Sang Hoon LEE	1959706.00056/ AQCRP.41C3	5216

TITLE OF INVENTION: SMARTPHONE ANTENNA IN FLEXIBLE PCB

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	\$480	\$0.00	\$0.00	\$480	05/01/2023

EXAMINER	ART UNIT	CLASS-SUBCLASS
LINDGREN BALTZEL, ANDREA J	2845	336-192000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 K&L Gates LLP

2

3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

AQ CORPORATION

Seongnam-si, Gyeonggi-do, Republic of Korea

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☒ Issue Fee ☐ Publication Fee (if required) ☐ Advance Order - # of Copies _____

4b. Method of Payment: (Please first reapply any previously paid fee shown above)

☒ Electronic Payment via EFS-Web ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 02-1818

5. Change in Entity Status (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

☐ Applicant asserting small entity status. See 37 CFR 1.27

☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Mincheol Kim/

Date April 27, 2023

Typed or printed name Mincheol Kim

Registration No. 51,306

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor	:	LEE, Sang Hoon
App. No.	:	17/955,126
Filed	:	September 28, 2022
Examiner	:	BALTZELL, Andrea J Lindgren
Art Unit	:	2843
Conf. No.	:	5216

**APPLICANT'S COMMENTS ON THE EXAMINER'S STATEMENT OF
REASONS FOR ALLOWANCE**

Mail Stop Issue Fee

Commissioner for Patents

P.O. Box 1450

Alexandria, VA 22313-1450

In response to the Statement of Reasons for Allowance in the Notice of Allowability, Applicant agrees that the claimed subject matter is patentable. Applicant respectfully asserts that there may be additional reasons for patentability of the claimed subject matter not explicitly stated in this record, and Applicant does not waive its rights to such arguments by not further addressing such reasons herein. Moreover, to the extent that there is any implication in the Statement that the patentability of the claims rests on the recitation of a single feature or the combination of particular features in a particular claim, Applicant respectfully disagrees, since patentability rests on each claim taken as a whole.

Applicant also respectfully reserves the right to traverse the characterizations of what any particular reference shows or teaches, of what any combination of references shows or teaches, or the appropriateness of combining references. Further, Applicant is not conceding that previously pending claims are not patentable. Applicant reserves the right to pursue at a later date any previously pending or other broader or narrower claims that capture any subject matter supported by the application's disclosure. Accordingly, reviewers of this or any parent, child, or related

prosecution history shall not reasonably infer that Applicants has made any disclaimers or disavowals of any subject matter.

Respectfully submitted,

K&L GATES, LLP

Dated: April 27, 2023

By: /Mincheol Kim/
Mincheol Kim
Registration No. 51,306
Attorney of Record
Customer No. 45,200
(949) 623-3611



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/955,126	09/28/2022	Sang Hoon LEE	1959706.00056/ AQCRP.41C3	5216
45200	7590	06/22/2023	EXAMINER	
K&L Gates LLP-Orange County			LOTTER, DAVID E	
1 Park Plaza			ART UNIT	
Twelfth Floor			PAPER NUMBER	
Irvine, CA 92614			2845	
			NOTIFICATION DATE	DELIVERY MODE
			06/22/2023	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

uspatentmail@klgates.com

Corrected Notice of Allowability	Application No. 17/955,126	Applicant(s) LEE et al.	
	Examiner DAVID E LOTTER	Art Unit 2845	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--
 All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 4/27/2023.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☒ The allowed claim(s) is/are 1-22. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a) ☐ All b) ☐ Some* c) ☐ None of the:

1. ☐ Certified copies of the priority documents have been received.

2. ☐ Certified copies of the priority documents have been received in Application No. _____.

3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.

☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892) 2. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date <u>4/27/2023, 4/27/2023</u> . 3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____. 4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.	5. ☐ Examiner's Amendment/Comment 6. ☐ Examiner's Statement of Reasons for Allowance 7. ☐ Other _____.
--	---

/DAVID E LOTTER/
 Primary Examiner, Art Unit 2845

1959706.00056/AQCRP.41C3

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor : Sang Hoon Lee
App. No. : 17/955,126
Filed : September 28, 2022
Examiner : BALTZELL, Andrea J Lindgren
Art Unit : 2843
Conf No. : 5216

STATEMENT UNDER 37 CFR § 1.97(e)(2)

That no item of information contained in the information disclosure statement (accompanied PTO/SB/08a Form and PTO/SB/08b Form) was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in § 1.56(c) more than three months prior to the filing of the information disclosure statement.

Respectfully submitted,

K&L GATES, LLP

Dated: April 27, 2023

By: /Mincheol Kim/
Mincheol Kim
Registration No. 51,306
Attorney of Record
Customer No. 45,200
(949) 623-3611

CONSIDERED: /D.E.L./

/DAVID E LOTTER/

06/13/2023

PTO/SB/08a (07-09)

Approved for use through 05/31/2024. OMB 0651-0031

U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number

Substitute for form 1449/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT <i>(use as many sheets as necessary)</i>				Complete if Known	
				Application Number	17/955,126
				Filing Date	September 28, 2022
				First Named Inventor	LEE, Sang Hoon
				Art Unit	2843
				Examiner Name	BALTZELL, Andrea J Lindgren
Sheet	1	of	2	Attorney Docket Number	1959706.00056/AQCRP.41C3

U.S. PATENT DOCUMENTS						
Examiner Initials*	Cite No. ¹	Document Number		Publication Date YYYY-MM-DD	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number - Kind Code ² (<i>if known</i>)				
	1	9607757	B2	2017-03-28	Hirobe et al.	
	2	10389183	B2	2019-08-20	Han et al.	
	3	10475571	B2	2019-11-12	Jang	
	4	20190393604	A1	2019-12-26	Ichikawa	
	5	10607770	B2	2020-03-31	Noh et al.	
	6	10608340	B2	2020-03-31	Kim et al.	
	7	10658870	B2	2020-05-19	Jang	
	8	10784044	B2	2020-09-22	Qi et al.	
	9	10784030	B2	2020-09-22	Lee et al.	
	10	10931151	B2	2021-02-23	Baek et al.	

FOREIGN PATENT DOCUMENTS							
Examiner Initials*	Cite No. ¹	Foreign Patent Document		Publication Date YYYY-MM-DD	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T ⁶
		Country Code ³ -Number ⁴ -Kind Code ⁵ (<i>if known</i>)					
	1	WO 2019/151693	A1	2019-08-08	Lg Innotek Co., Ltd.		V
	2	WO 2017/200236	A1	2017-11-23	Emw Co., Ltd.		V
	3	KR 10-1649259	B1	2016-08-19	Imtech Inc		V
	4	KR 10-1532052	B1	2015-06-29	Elentec		V
	5	KR 10-1574322	B1	2015-12-04	Imtech Inc		V
	6	CN 103219808	A	2013-07-24	Shenzhen Sunshine Good Electronics		V
	7	KR 10-1991011	B1	2019-06-19	Hansol Technics Inc.		V

Examiner Signature	/DAVID E LOTTER/	Date Considered	06/13/2023
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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. ¹ Applicant's unique citation designation number (optional). ² See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. ³ Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). ⁴ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁵ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁶ Applicant is to place a check mark here if English language Translation is attached.

A Federal agency may not conduct or sponsor, and a person is not required to respond to, nor shall a person be subject to a penalty for failure to comply with an information collection subject to the requirements of the Paperwork Reduction Act of 1995, unless the information collection has a currently valid OMB Control Number. The OMB Control Number for this information collection is 0651-0031. Public burden for this form is estimated to average 2 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the information collection. Send comments regarding this burden estimate or any other aspect of this information collection, including suggestions for reducing this burden to the Chief Administrative Officer, United States Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450 or email InformationCollection@uspto.gov. **DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS.** If filing this completed form by mail, send to: **Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 (1-800-786-9199) and select option 2.

PTO/SB/08a (07-09)

Approved for use through 05/31/2024. OMB 0651-0031

U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number

Substitute for form 1449/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT <i>(use as many sheets as necessary)</i>				Complete if Known	
				Application Number	17/955,126
				Filing Date	September 28, 2022
				First Named Inventor	LEE, Sang Hoon
				Art Unit	2843
				Examiner Name	BALTZELL, Andrea J Lindgren
Sheet	2	of	2	Attorney Docket Number	1959706.00056/AQCRP.41C3

U.S. PATENT DOCUMENTS						
Examiner Initials*	Cite No. ¹	Document Number		Publication Date YYYY-MM-DD	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number - Kind Code ² (if known)				
	11	11539401	B2	2022-12-27	Baek et al.	
	12	20180248255	A1	2018-08-30	NOH et al.	
	13	20170345535	A1	2017-11-30	KIM et al.	
	14	10868356	B1	2020-12-15	Da Costa Bras Lima et al.	
	15	20190027826	A1	2019-01-24	WON et al.	

FOREIGN PATENT DOCUMENTS							
Examiner Initials*	Cite No. ¹	Foreign Patent Document		Publication Date YYYY-MM-DD	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T ⁶
		Country Code ³ -Number ⁴ -Kind Code ⁵ (<i>if known</i>)					
	8	KR 10-2018-0046243	A	2018-05-08	Doosung Industrial		V
	9	KR 10-1697303	B1	2017-01-17	Amosense Co., Ltd.		V
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	13	KR 10-1811611	B1	2021-12-26	Lg Electronics Inc.		V
	14	CN 209015853	U	2019-06-21	Shenzhen Chuangxingqi Communication Co Ltd		V
	15	EP 3657519	A1	2020-05-27	NuCurrent, Inc.		

Examiner Signature	/DAVID E LOTTER/	Date Considered	06/13/2023
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				Application Number	17/955,126
				Filing Date	September 28, 2022
				First Named Inventor	LEE, Sang Hoon
				Art Unit	2843
				Examiner Name	BALTZELL, Andrea J Lindgren
Sheet	1	of	1	Attorney Docket Number	1959706.00056/AQCRP.41C3

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No. ¹	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published	T ²
	1	Hong, S., Lee, S., Jeong, S., Kim, D. H., Song, J., Kim, H., & Kim, J. (2017, May). Dual-Directional Near Field Communication Tag Antenna with Effective Magnetic Field Isolation from Wireless Power Transfer System. In 2017 IEEE Wireless Power Transfer Conference (WPTC) (pp. 1-3).	
	2	Hong, S., Jeong, S., Lee, S., Sim, B., Kim, H., & Kim, J. (2019, July). A Dual Resonance Near Field Communication Coil for EMF Reduction in Near Field Communication and Wireless Power Transfer Dual Coil System. In 2019 IEEE International Symposium on Electromagnetic Compatibility, Signal & Power Integrity (EMC+ SIPI) (pp. 644-647).	
	3	Lee, H. H., Kang, S. H., & Jung, C. W. (2016, August). Transparent Electrode Resonators for MR-WPT. In 2016 URSI Asia-Pacific Radio Science Conference (URSI AP-RASC) (pp. 716-718).	
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Examiner Signature	/DAVID E LOTTER/	Date Considered	06/13/2023
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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/955,126	08/15/2023	11728564	1959706.00056/AQCRP.41C3	5216

45200 7590 07/26/2023

K&L Gates LLP-Orange County
1 Park Plaza
Twelfth Floor
Irvine, CA 92614

ISSUE NOTIFICATION

The projected patent number and issue date are specified above. The patent will issue electronically. The electronically issued patent is the official patent grant pursuant to 35 U.S.C. § 153. The patent may be accessed on or after the issue date through Patent Center at <https://patentcenter.uspto.gov/>. The patent will be available in both the public and the private sides of Patent Center. Further assistance in electronically accessing the patent, or about Patent Center, is available by calling the Patent Electronic Business Center at 1-888-217-9197.

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If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

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INVENTOR(s) (Please see PAIR WEB site <http://pair.uspto.gov> for additional inventors):

Sang Hoon LEE, Suwon-si, KOREA, REPUBLIC OF;
Kyoung Jun CHOI, Seoul, KOREA, REPUBLIC OF;
Sae Rom LEE, Incheon, KOREA, REPUBLIC OF;

APPLICANT(s) (Please see PAIR WEB site <http://pair.uspto.gov> for additional applicants):

AQ CORPORATION, Seongnam-si, KOREA, REPUBLIC OF;

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grants to the person(s) having title to this patent the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States of America or importing the invention into the United States of America, and if the invention is a process, of the right to exclude others from using, offering for sale or selling throughout the United States of America, products made by that process, for the term set forth in 35 U.S.C. 154(a)(2) or (c)(1), subject to the payment of maintenance fees as provided by 35 U.S.C. 41(b). See the Maintenance Fee Notice on the inside of the cover.

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US011728564B2

(12) **United States Patent**
Lee et al.

(10) **Patent No.:** **US 11,728,564 B2**
(45) **Date of Patent:** **Aug. 15, 2023**

(54) **SMARTPHONE ANTENNA IN FLEXIBLE PCB**

(71) Applicant: **AQ CORPORATION**, Seongnam-si (KR)

(72) Inventors: **Sang Hoon Lee**, Suwon-si (KR);
Kyoung Jun Choi, Seoul (KR); **Sae Rom Lee**, Incheon (KR)

(73) Assignee: **AQ CORPORATION**, Seongnam-si (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **17/955,126**

(22) Filed: **Sep. 28, 2022**

(65) **Prior Publication Data**

US 2023/0013445 A1 Jan. 19, 2023

Related U.S. Application Data

(63) Continuation of application No. 17/864,078, filed on Jul. 13, 2022, now Pat. No. 11,495,875, which is a continuation of application No. 17/546,893, filed on Dec. 9, 2021, now Pat. No. 11,437,712, which is a continuation of application No. 17/105,012, filed on Nov. 25, 2020, now Pat. No. 11,303,011.

(60) Provisional application No. 62/941,636, filed on Nov. 27, 2019.

(51) **Int. Cl.**
H01Q 1/38 (2006.01)
H01Q 1/24 (2006.01)
H01Q 7/00 (2006.01)

(52) **U.S. Cl.**
CPC **H01Q 1/243** (2013.01); **H01Q 1/38** (2013.01); **H01Q 7/00** (2013.01)

(58) **Field of Classification Search**

CPC H01Q 1/24; H01Q 1/138; H01Q 7/00

USPC 336/192

See application file for complete search history.

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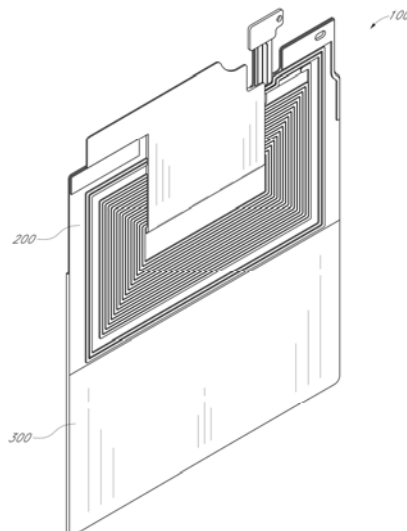
Primary Examiner — Andrea Lindgren Baltzell

(74) *Attorney, Agent, or Firm* — K&L Gates LLP

(57) **ABSTRACT**

A thin, flexible antenna module is provided for use in a smartphone. When the antenna module is assembled in the smartphone, the antenna module provides an MST antenna and an NEC antenna. For this, the antenna module includes a flexible PCB containing coils and further includes a magnetic sheet engaged with flexible PCB. The flexible PCB and the magnetic sheet are attached to each other to form a single body.

22 Claims, 52 Drawing Sheets



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FIG. 1

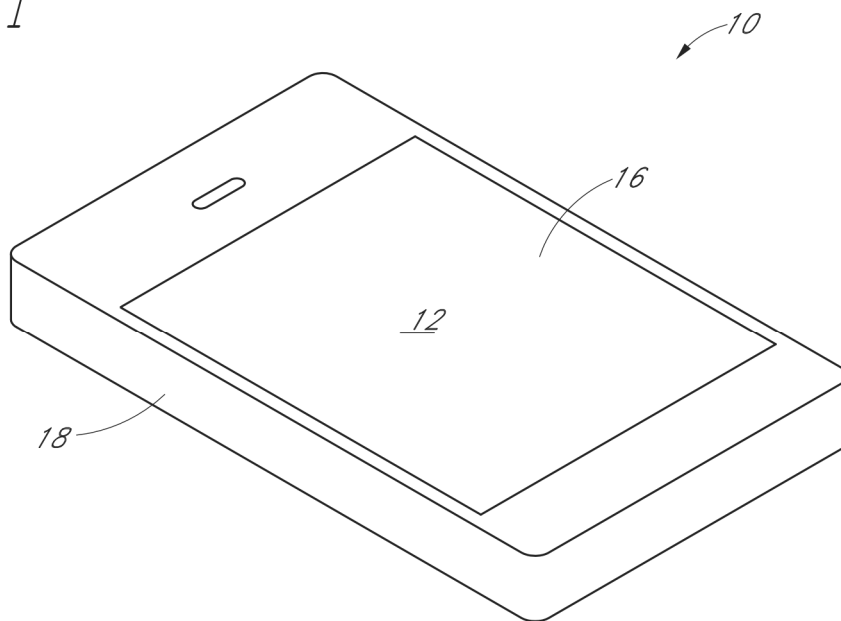
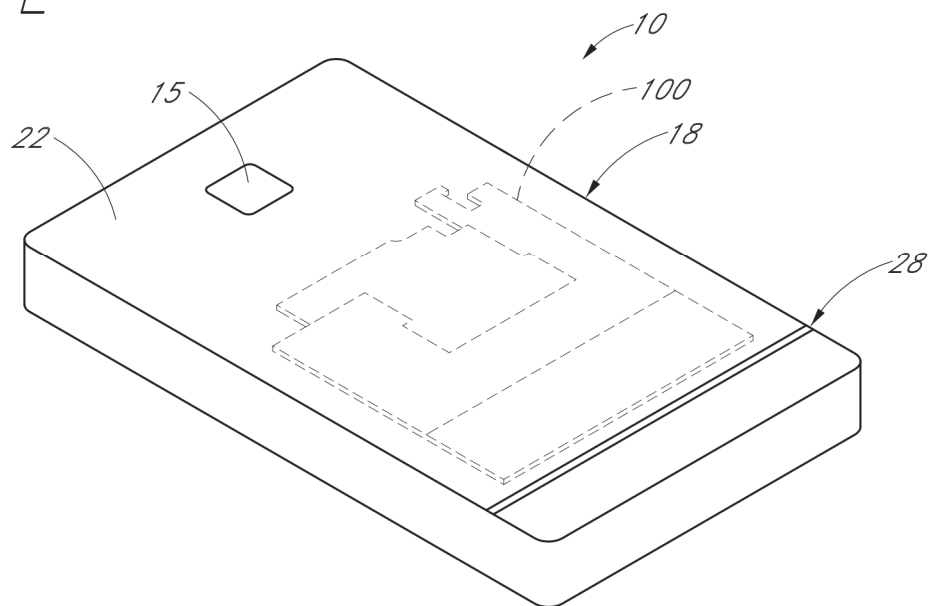
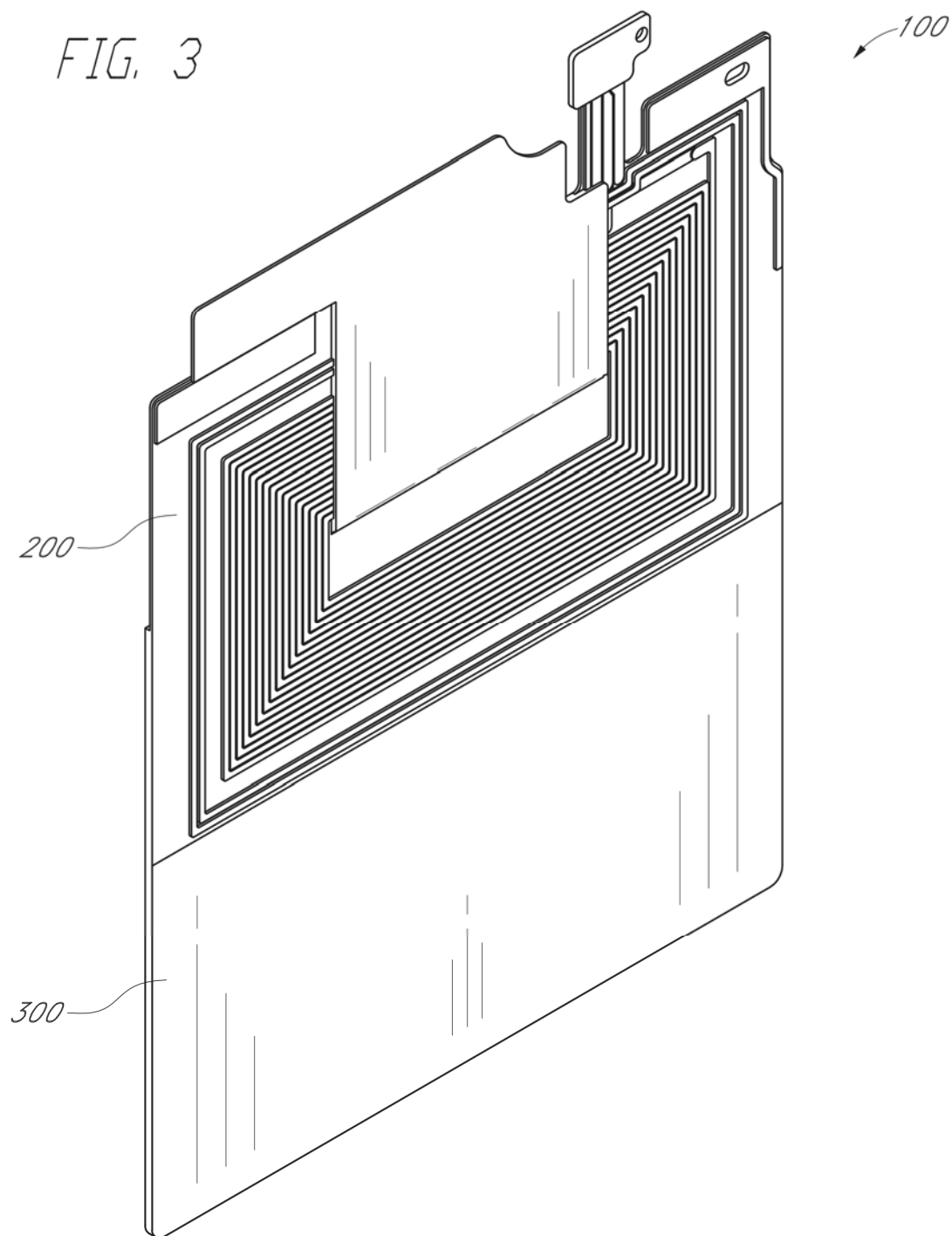


FIG. 2





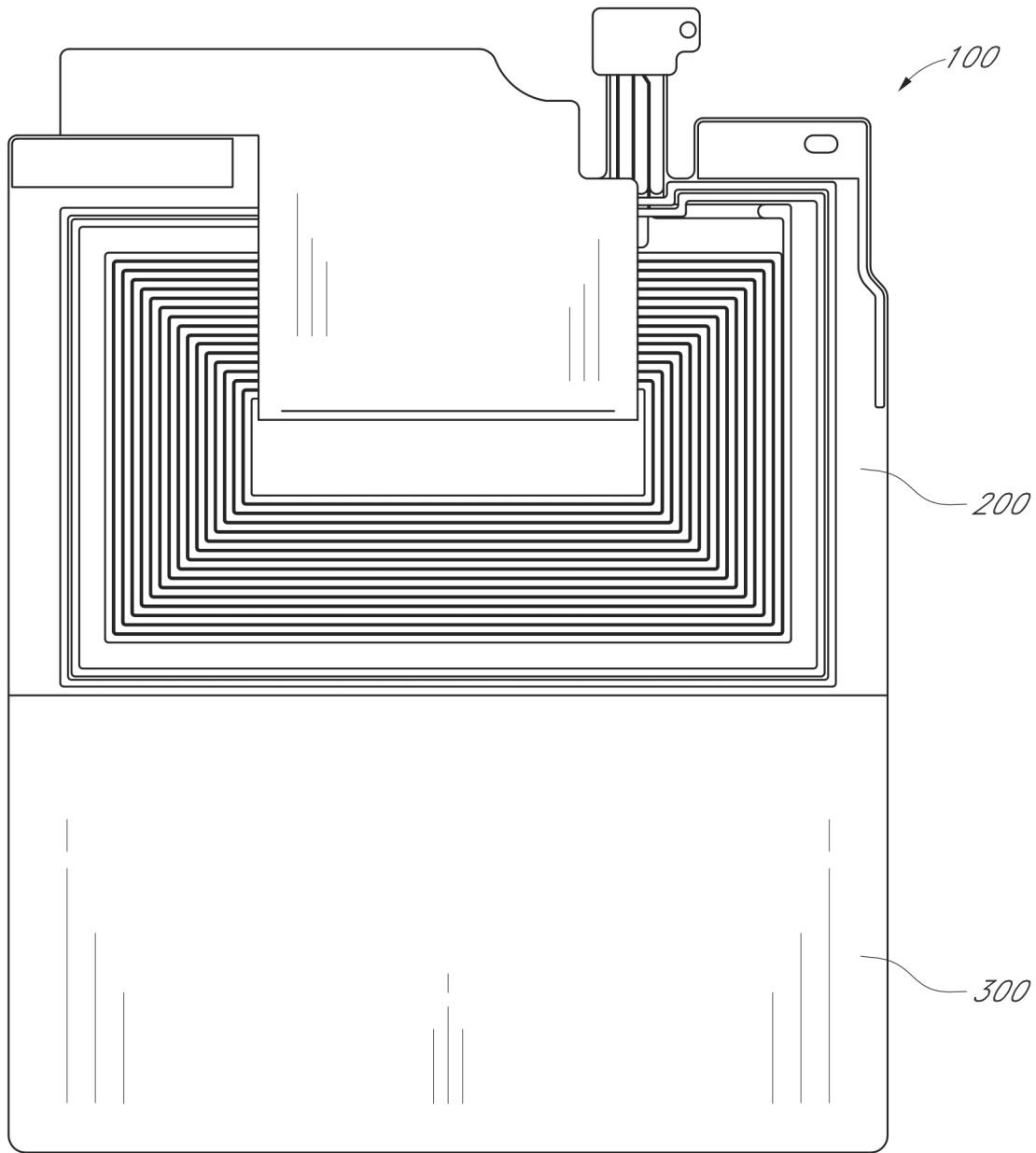
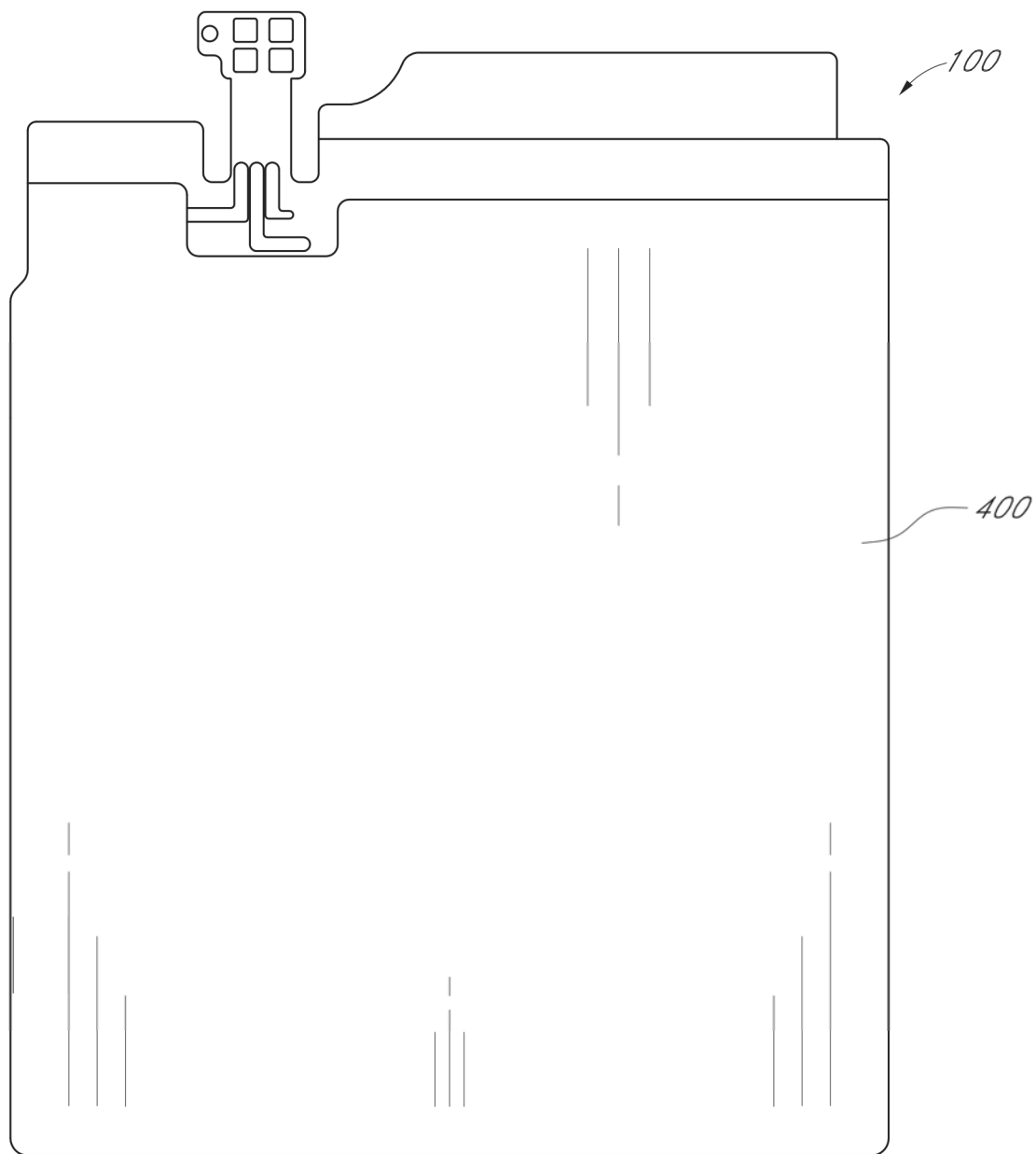


FIG. 4

*FIG. 5*

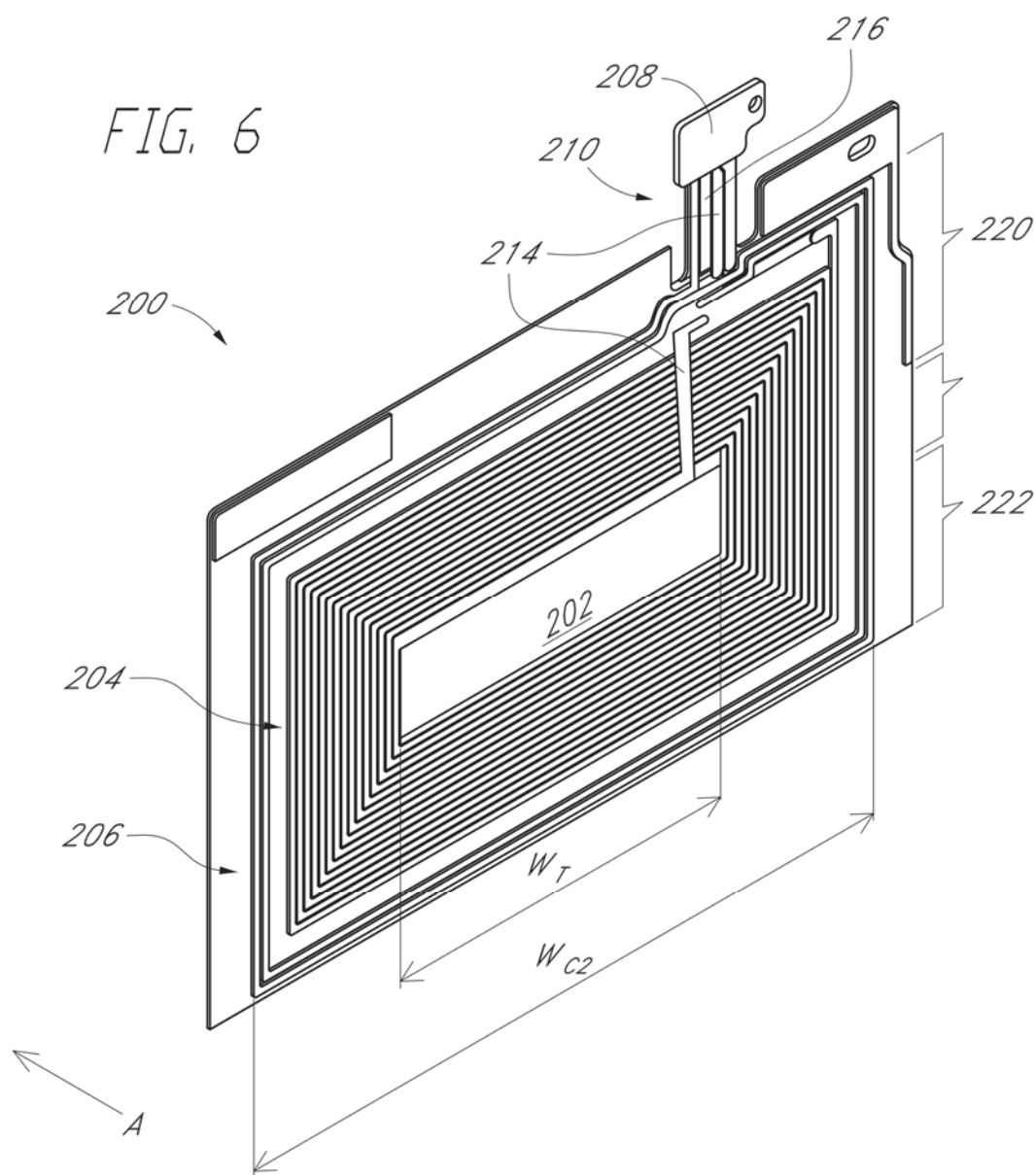
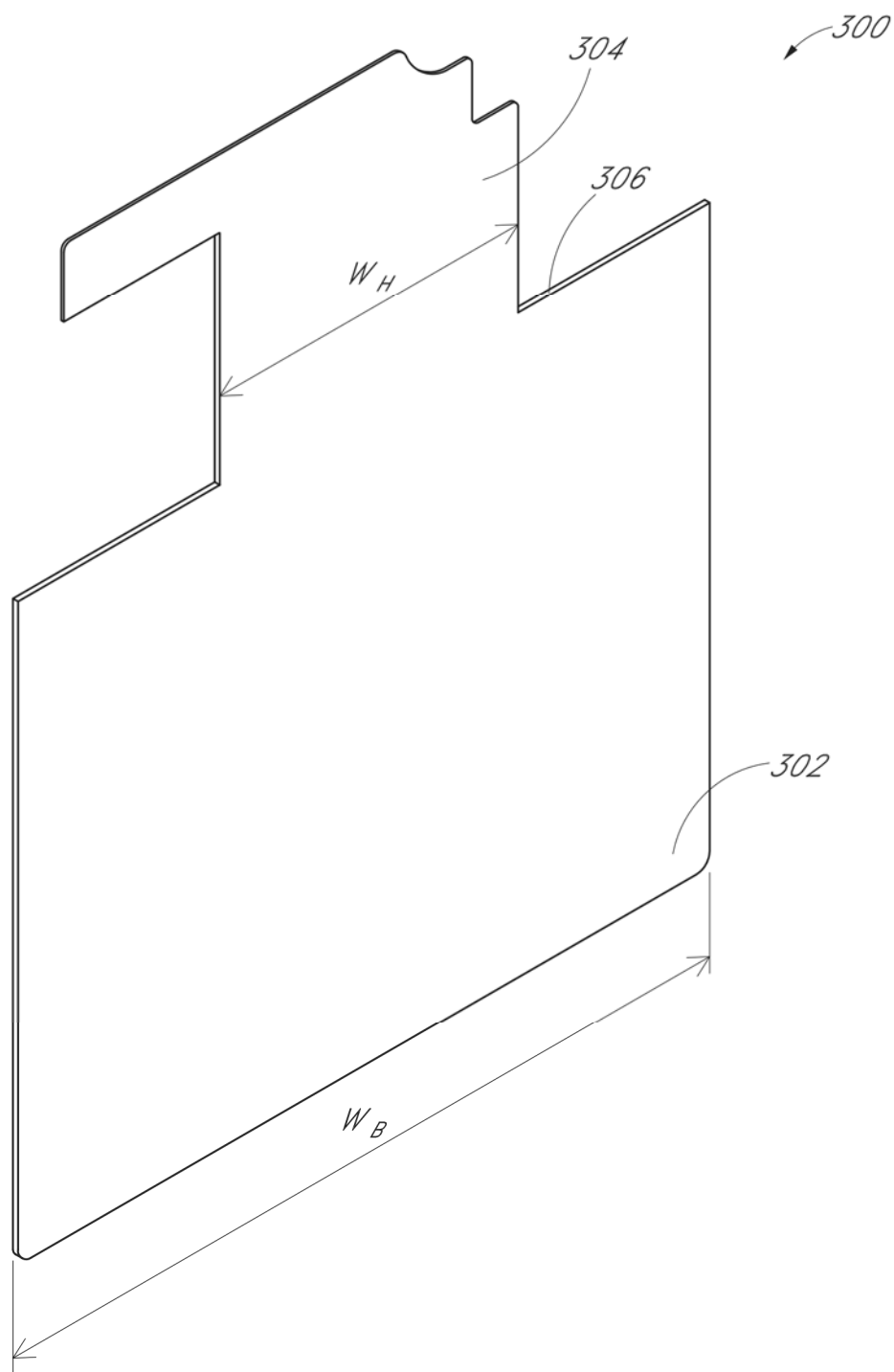
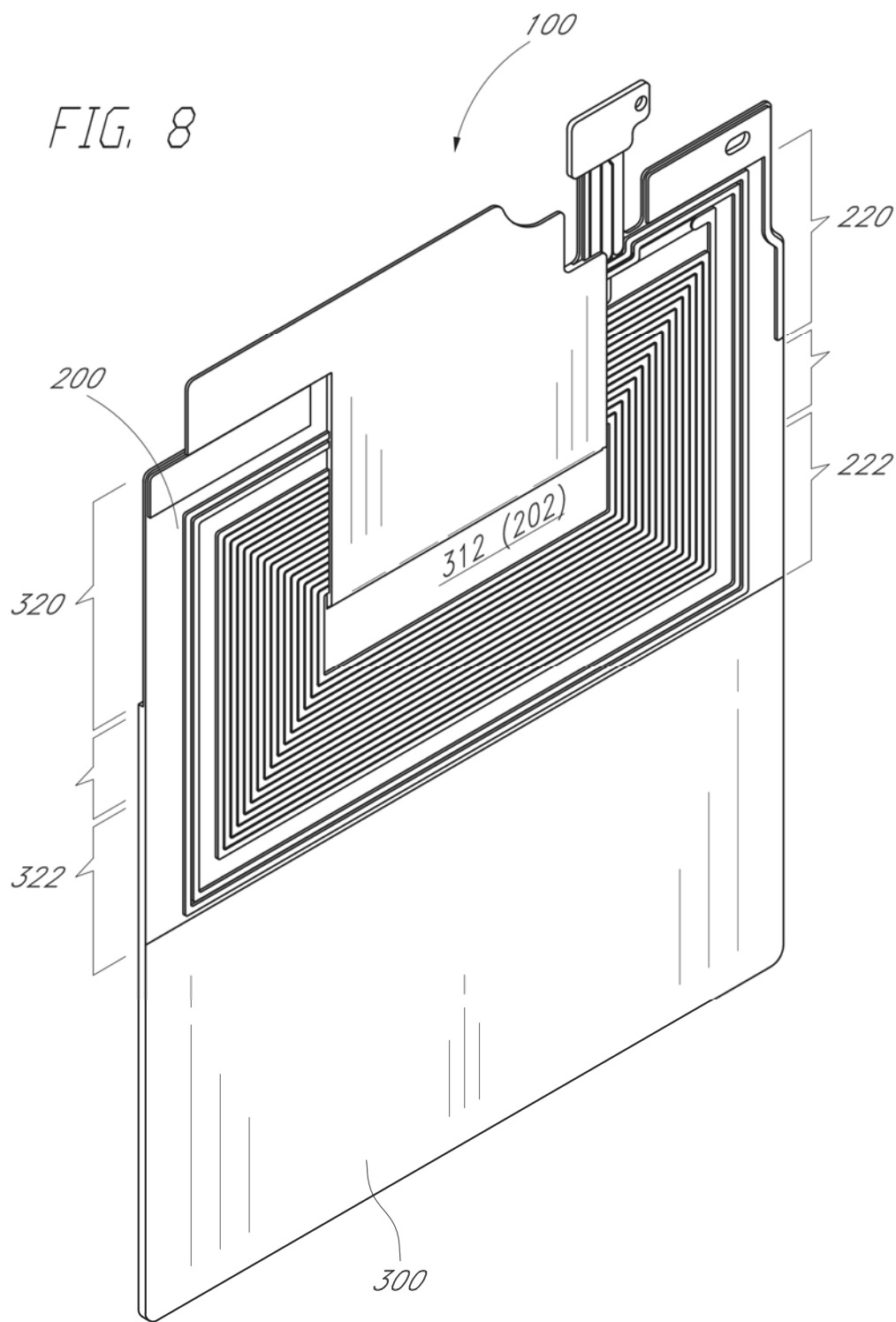


FIG. 7





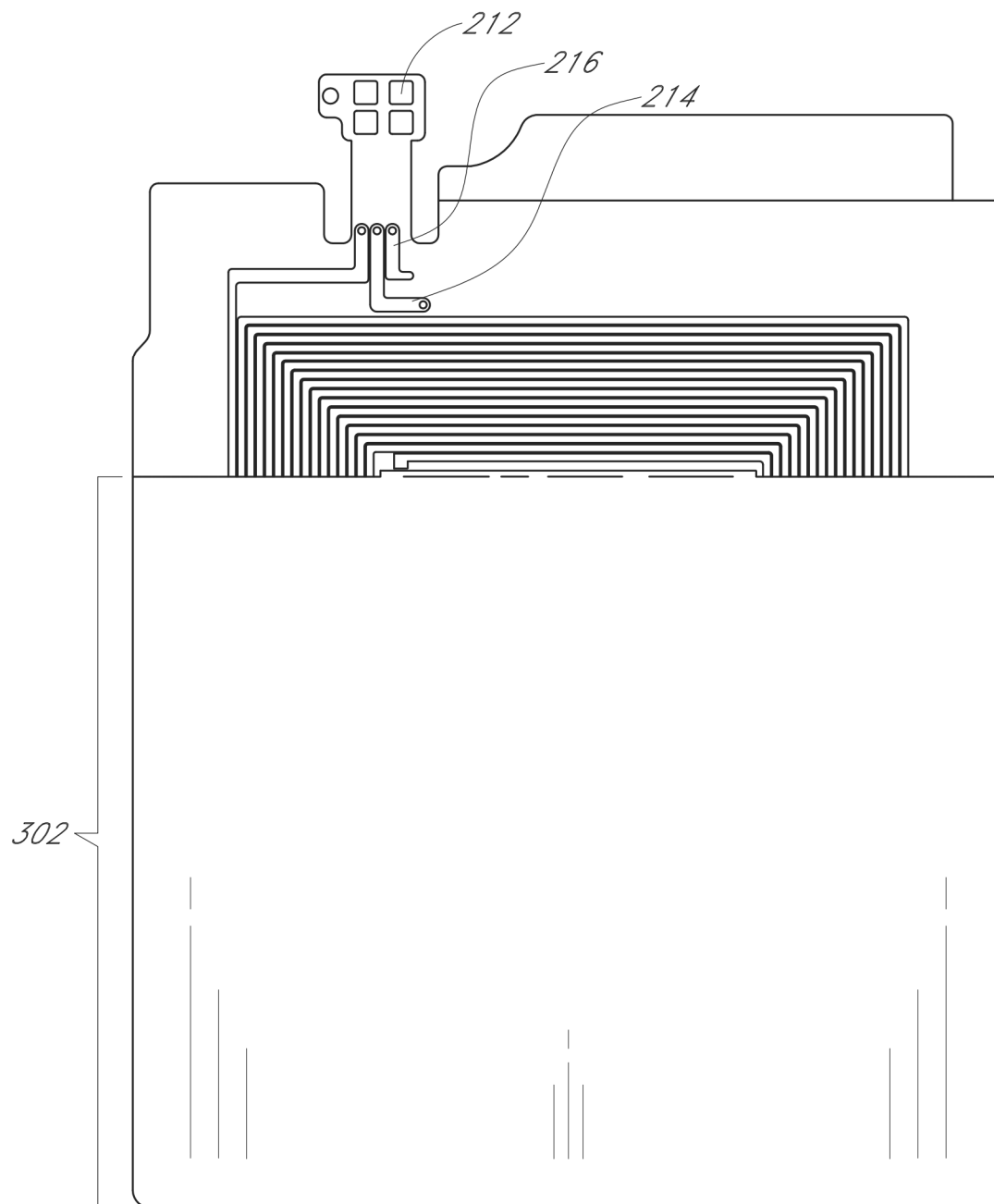


FIG. 9

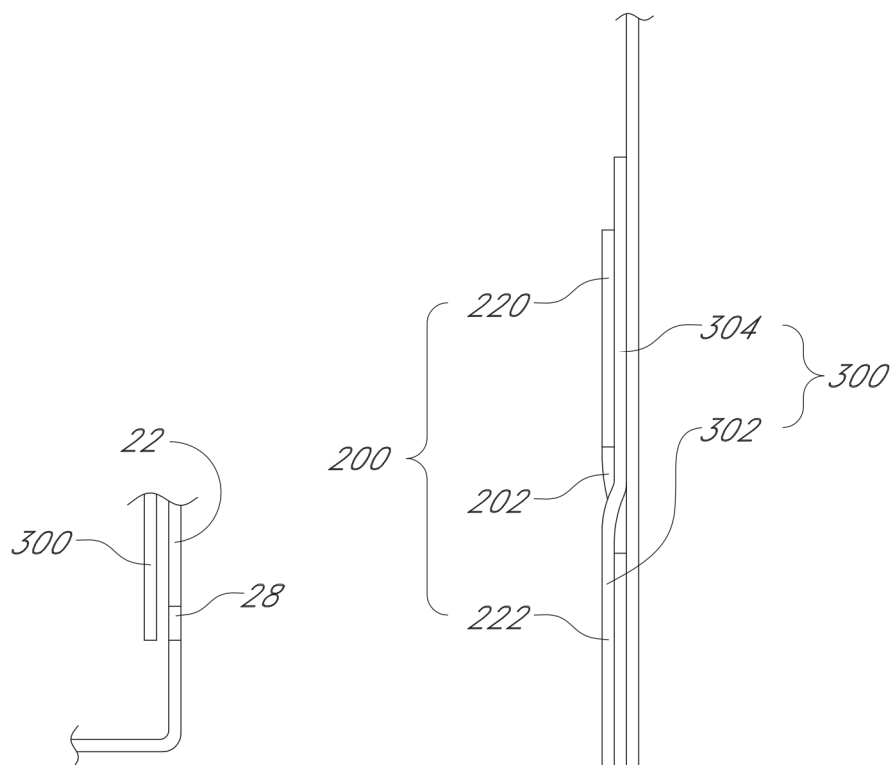


FIG. 13

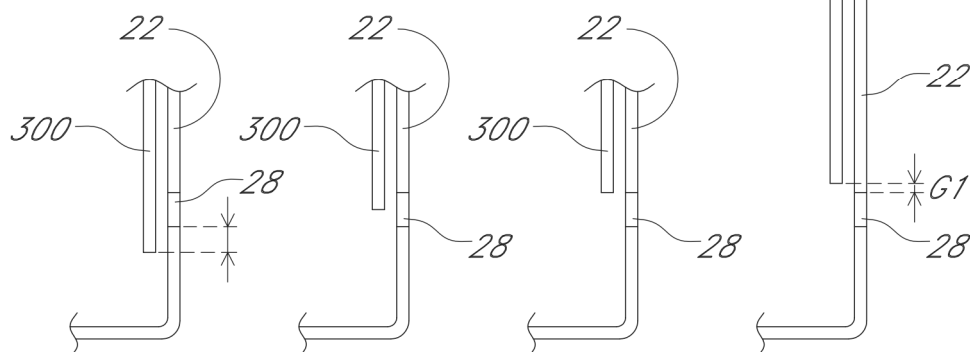


FIG. 14

FIG. 12

FIG. 11

FIG. 10

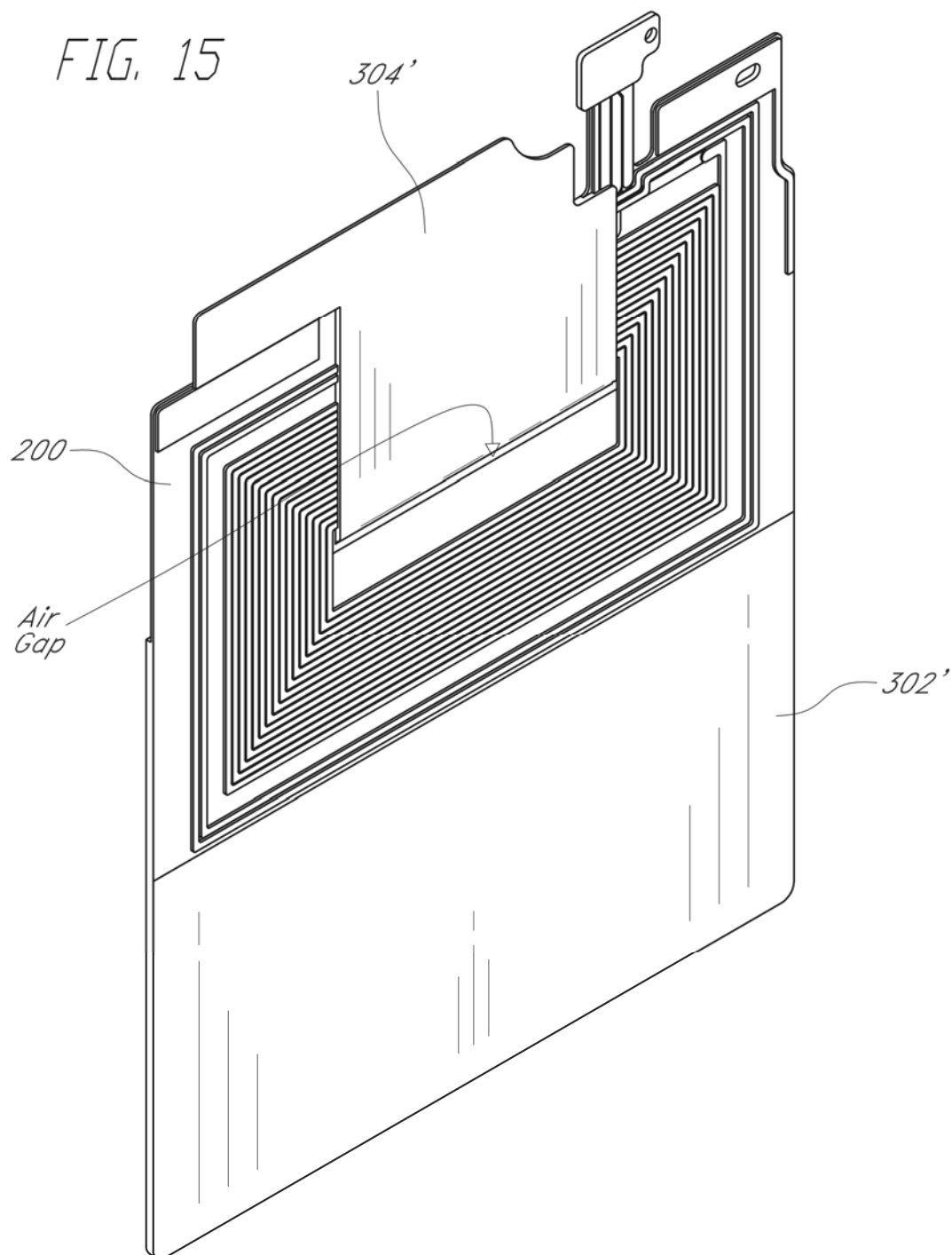
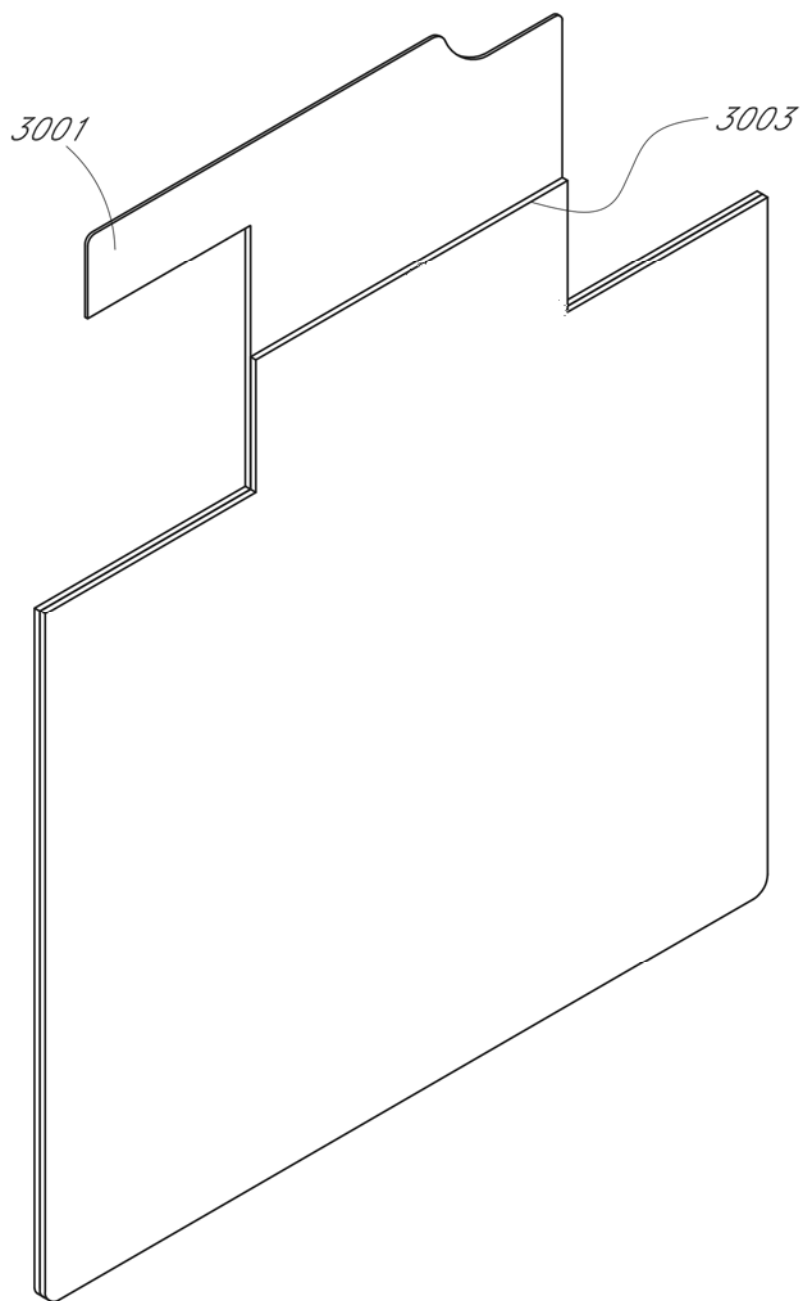


FIG. 16



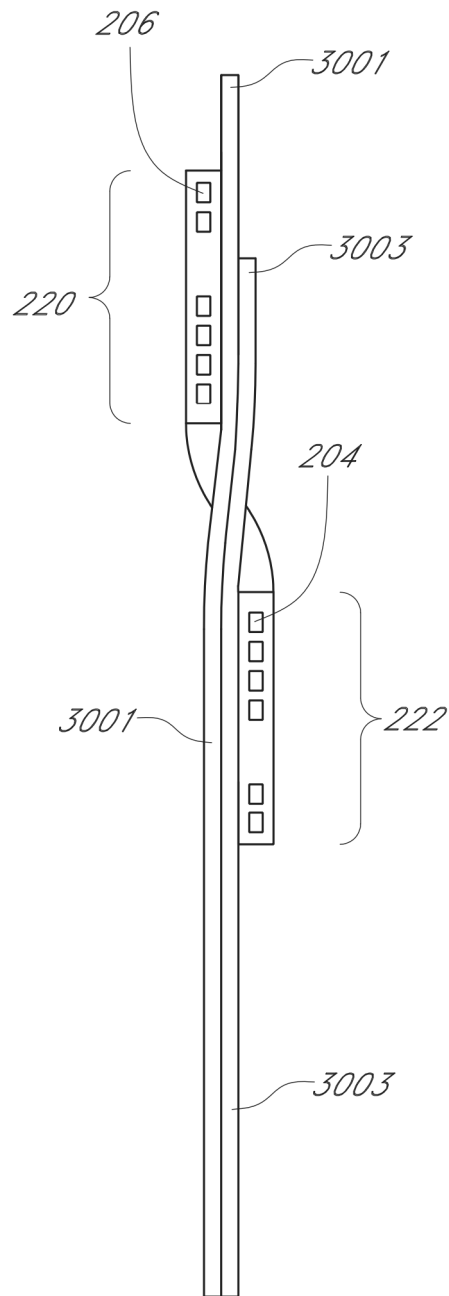


FIG. 17

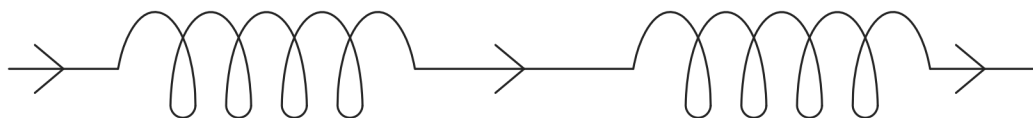
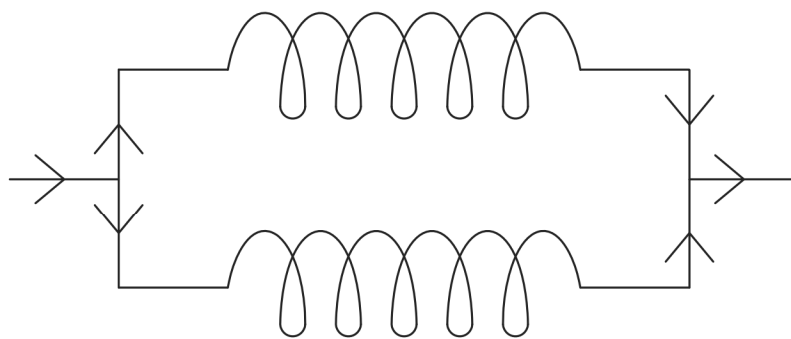
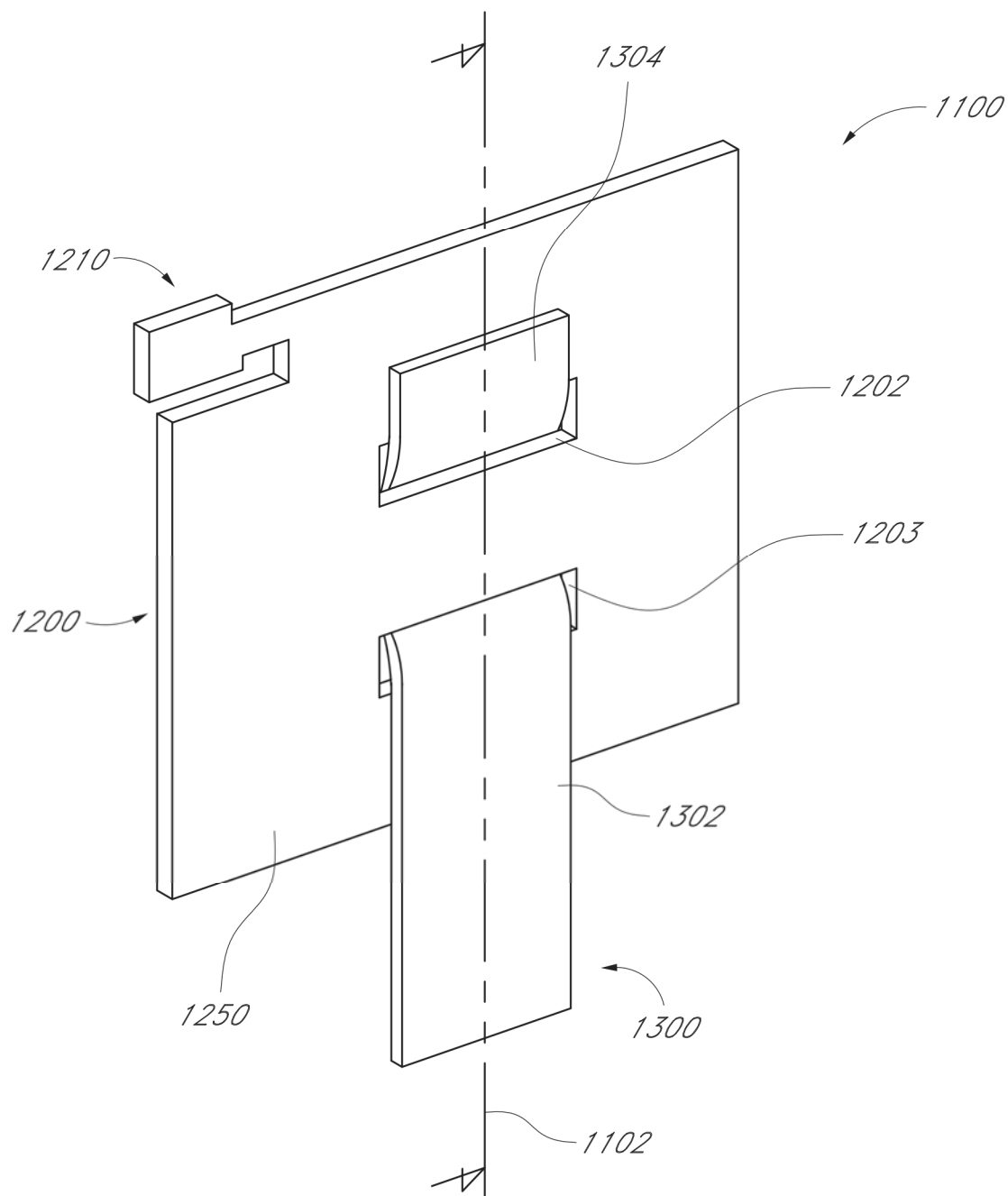
*FIG. 18A**FIG. 18B*

FIG. 19



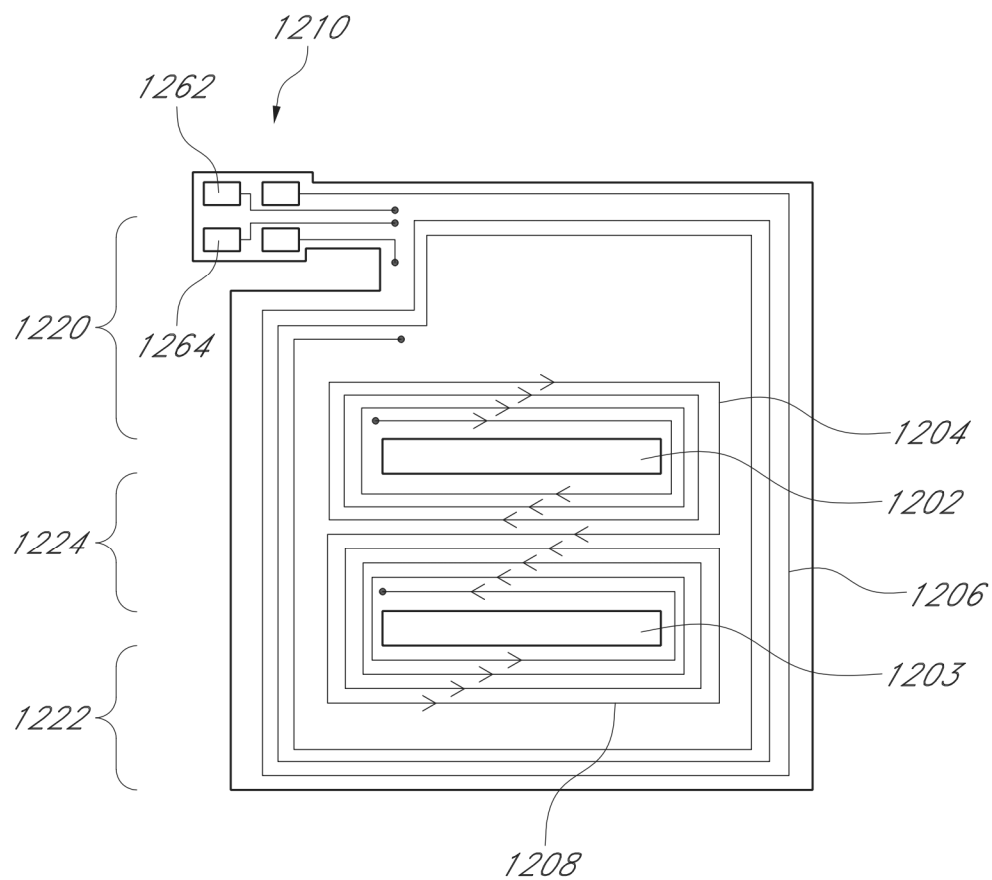


FIG. 20

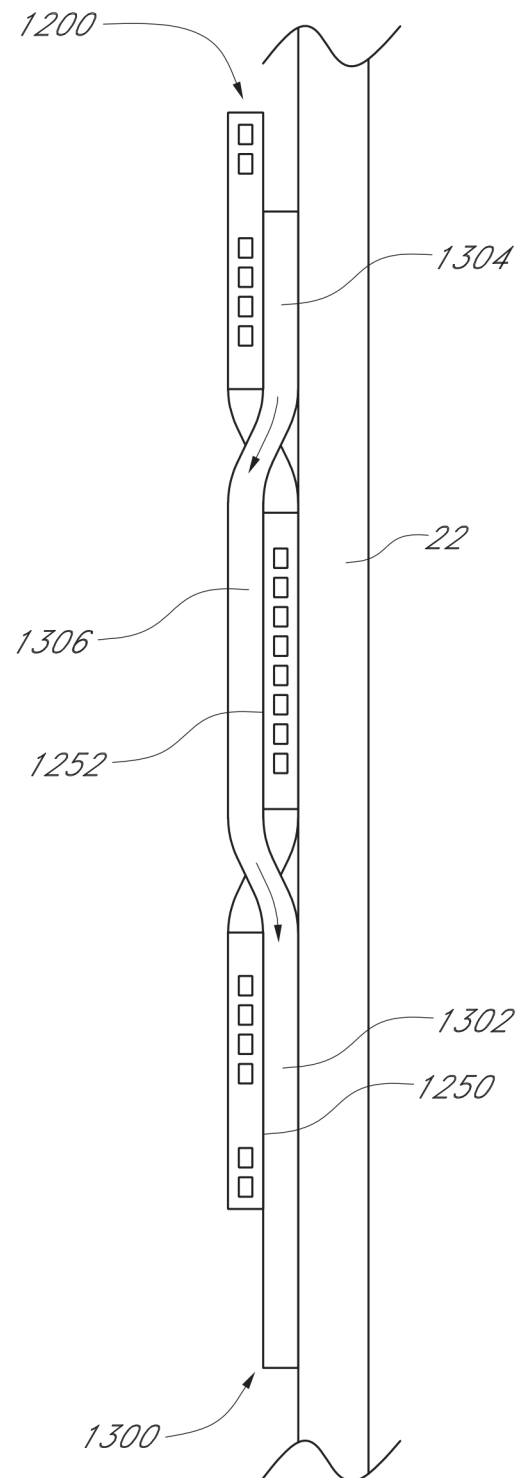


FIG. 21

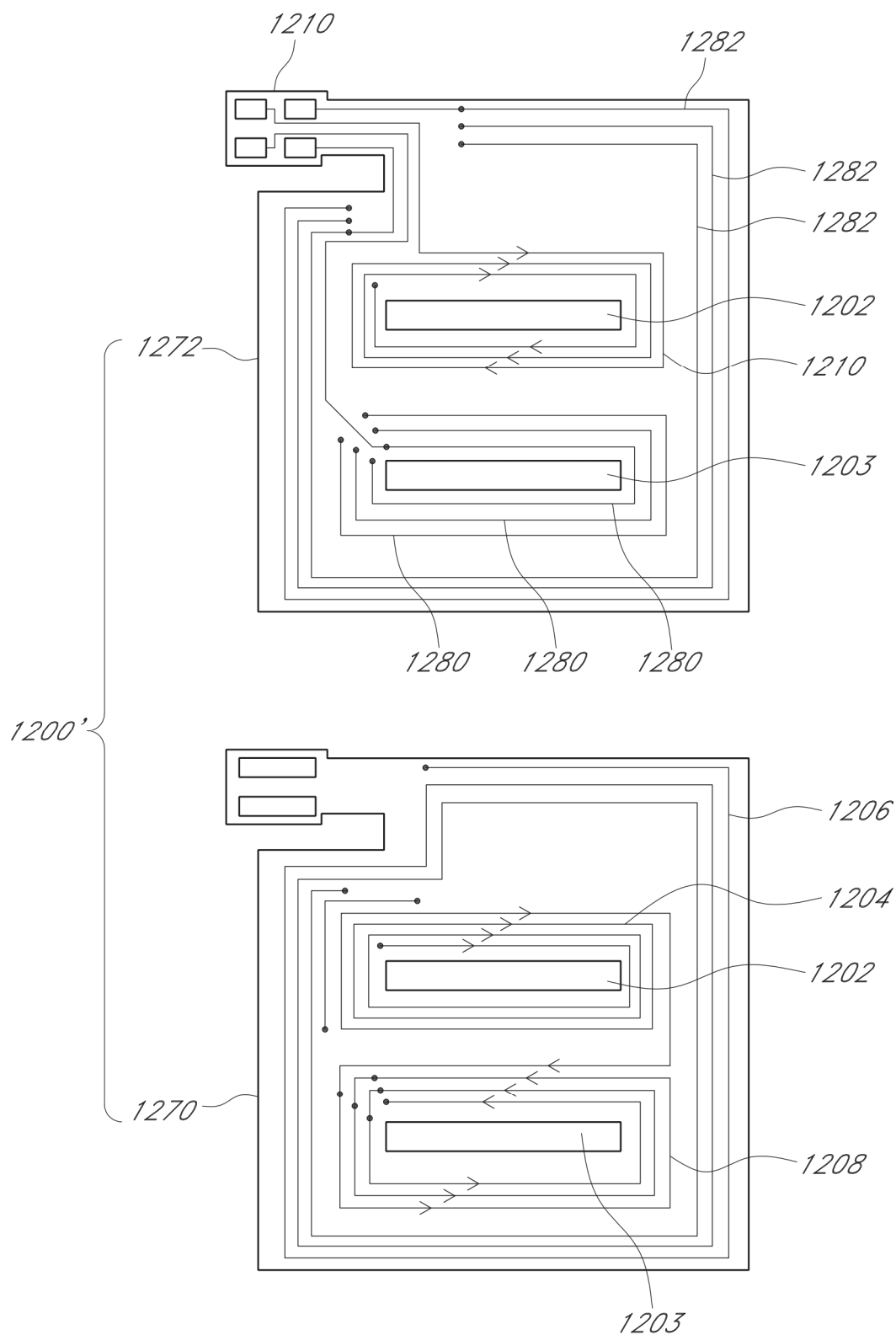


FIG. 22

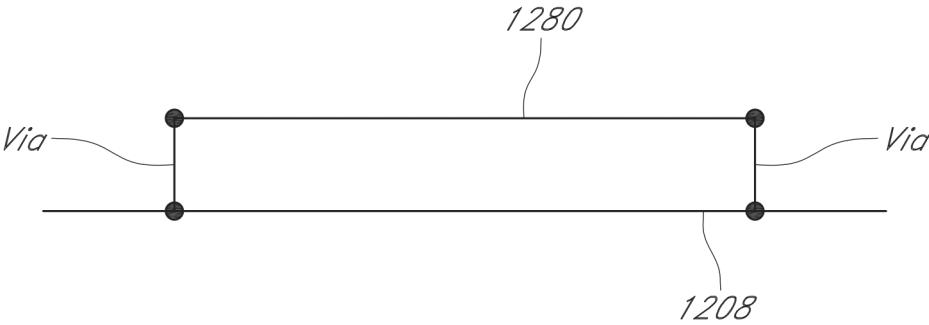


FIG. 23A

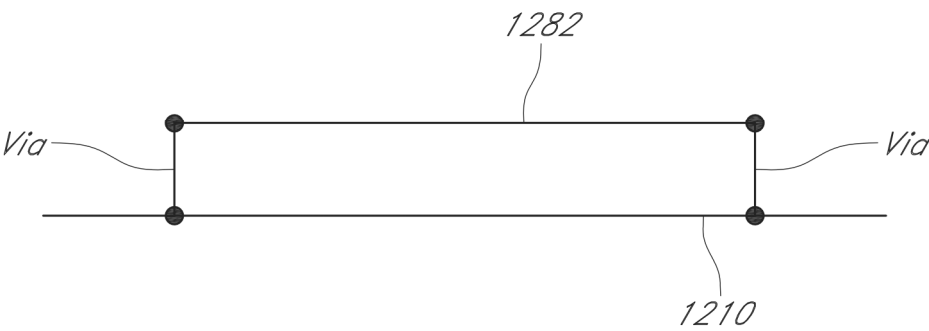
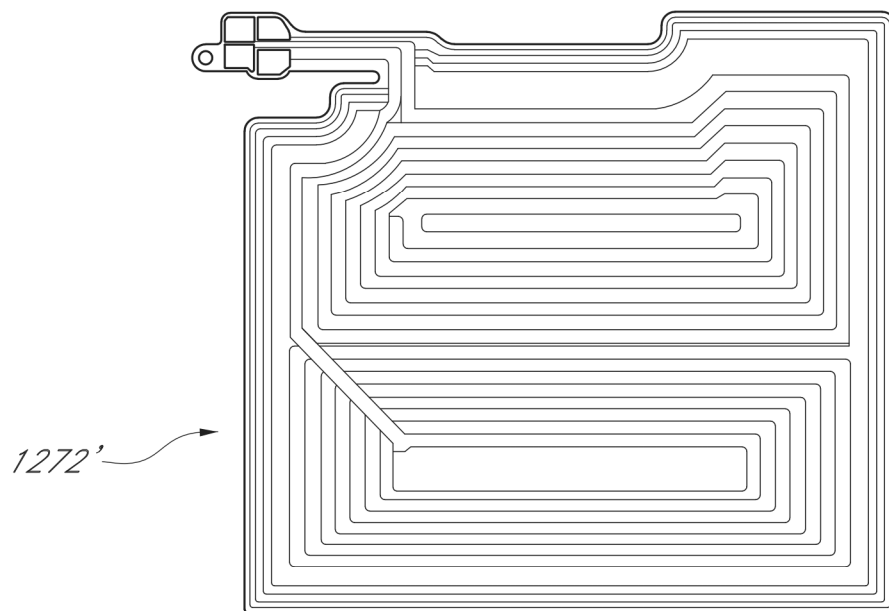
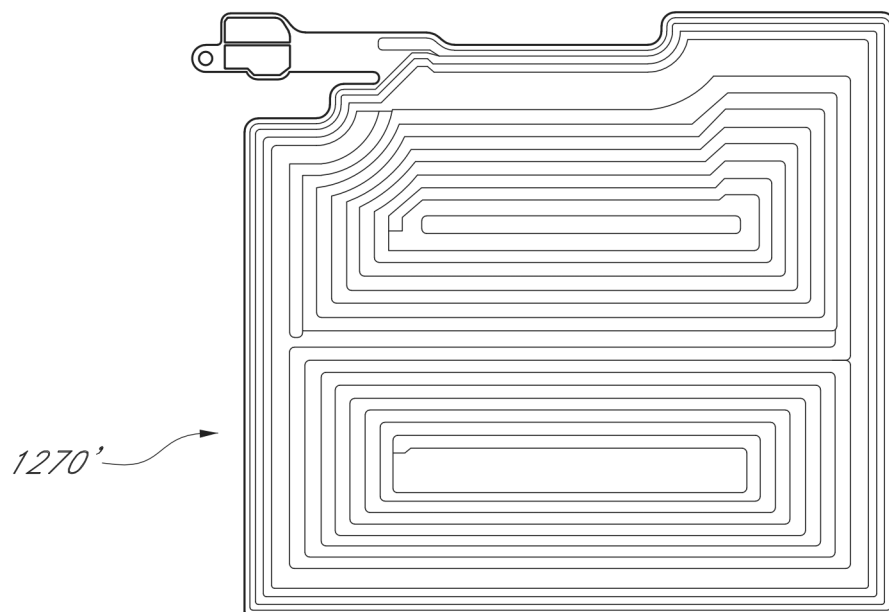


FIG. 23B

FIG. 24



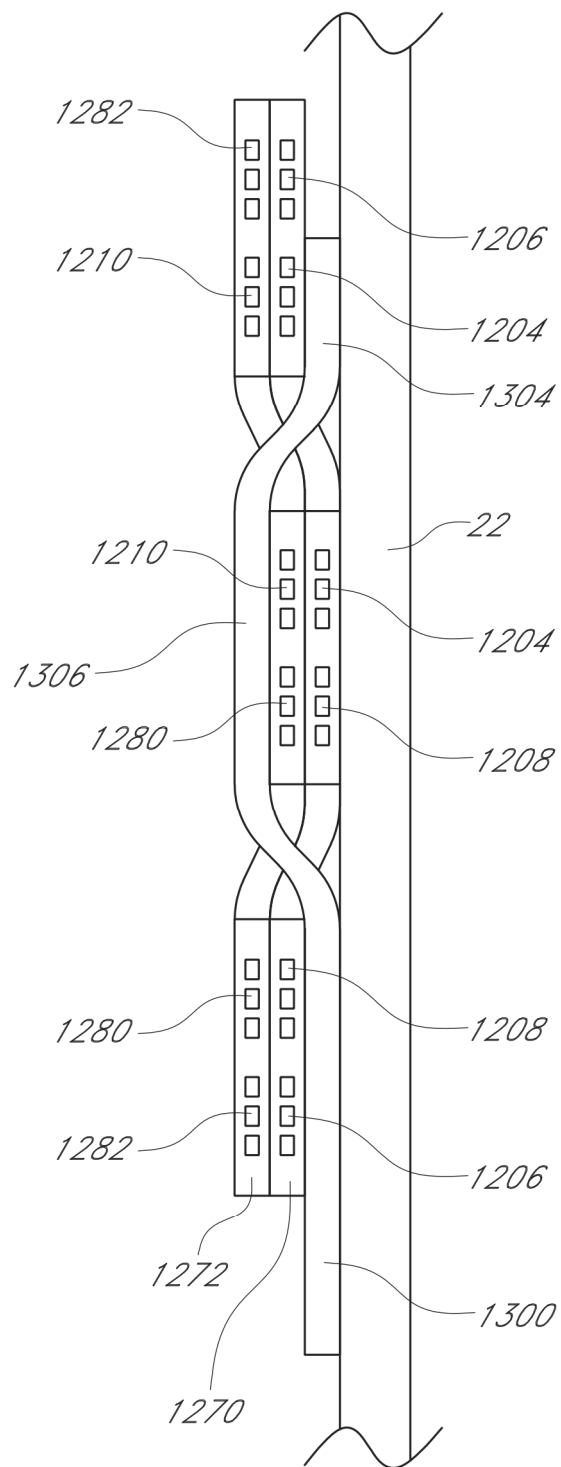
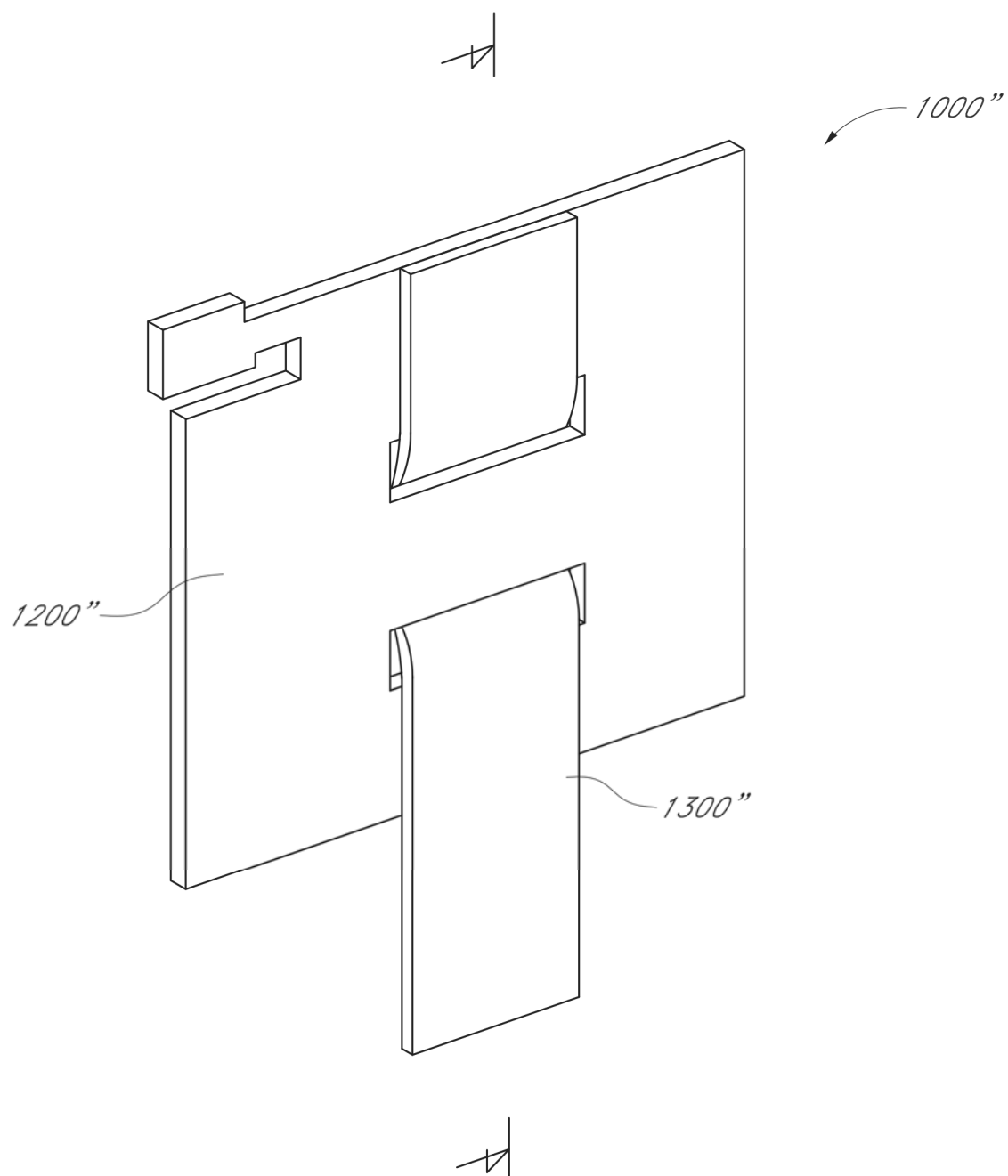


FIG. 25

FIG. 26



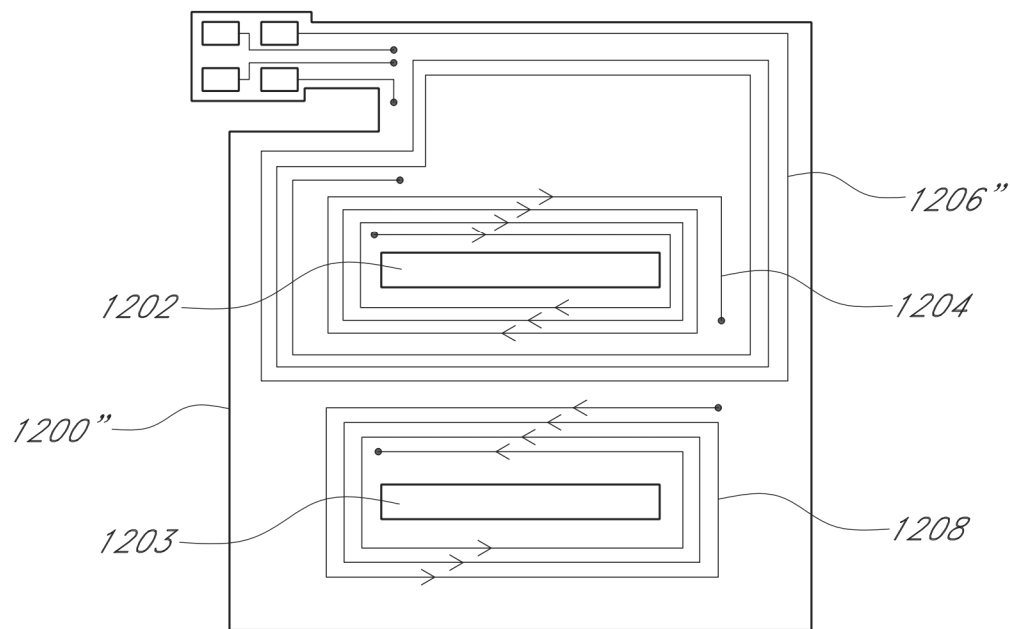


FIG. 27

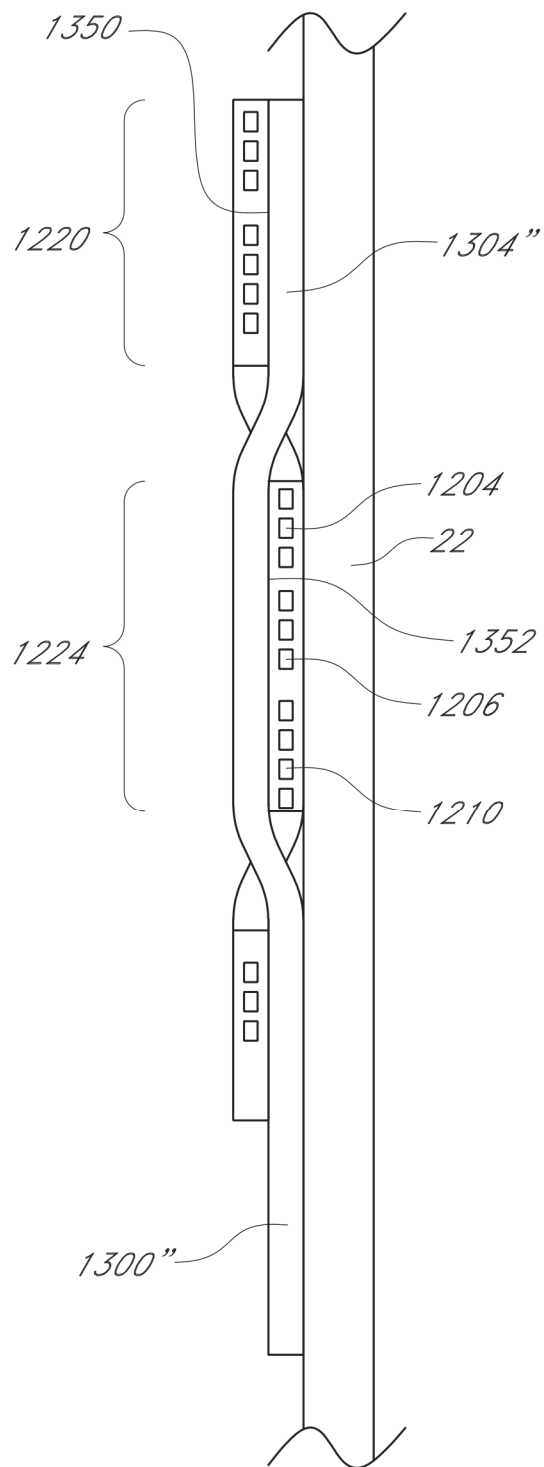


FIG. 28

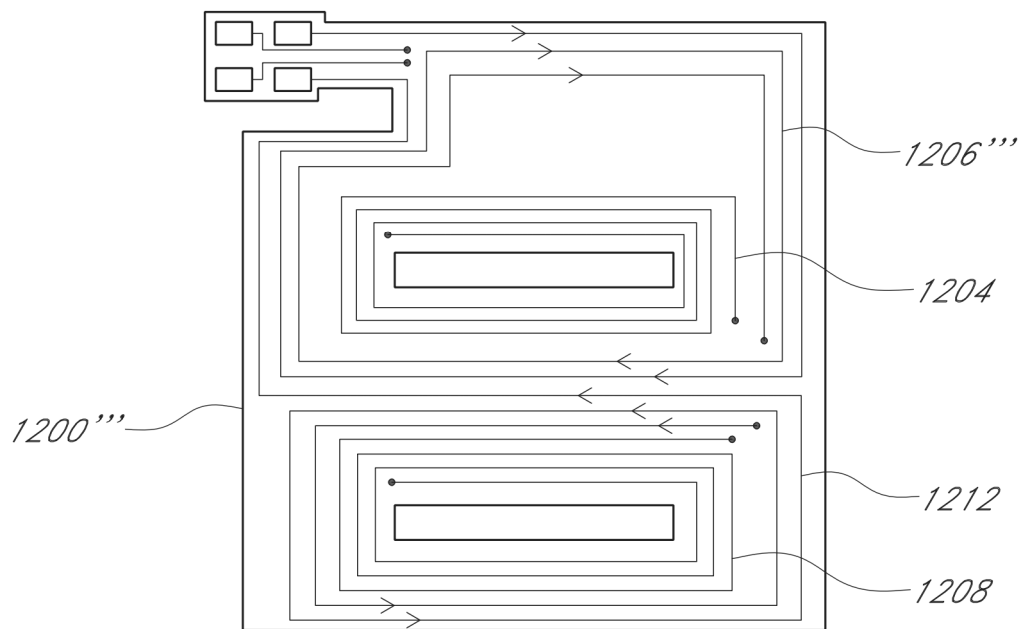


FIG. 29

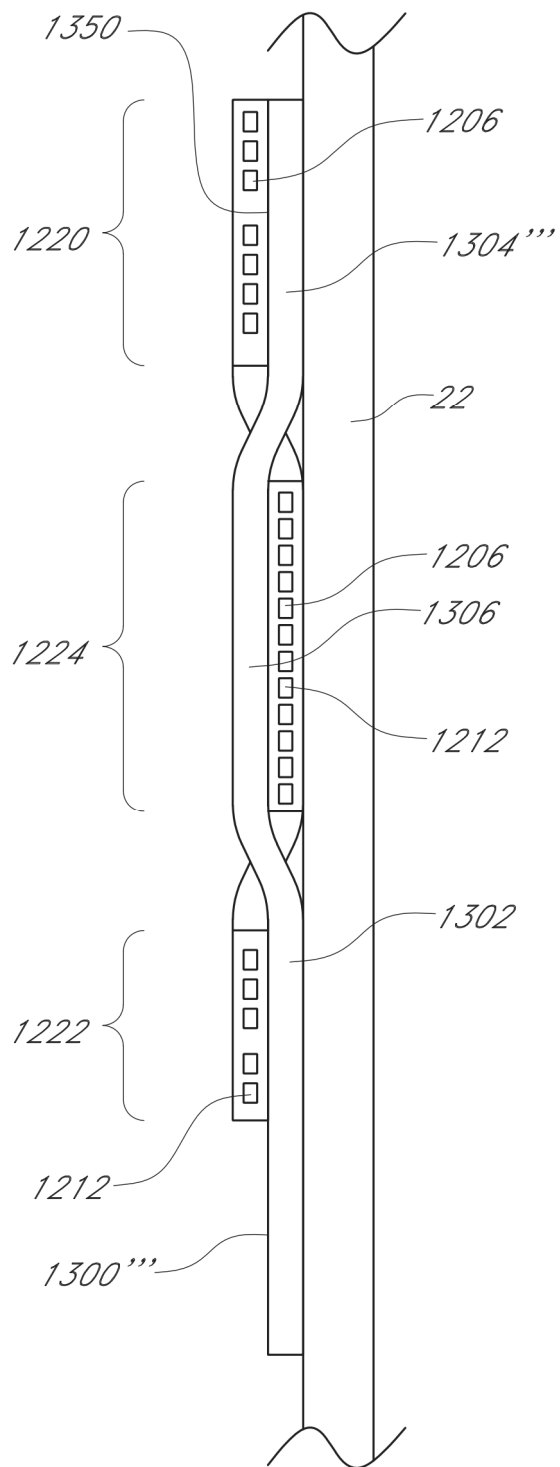
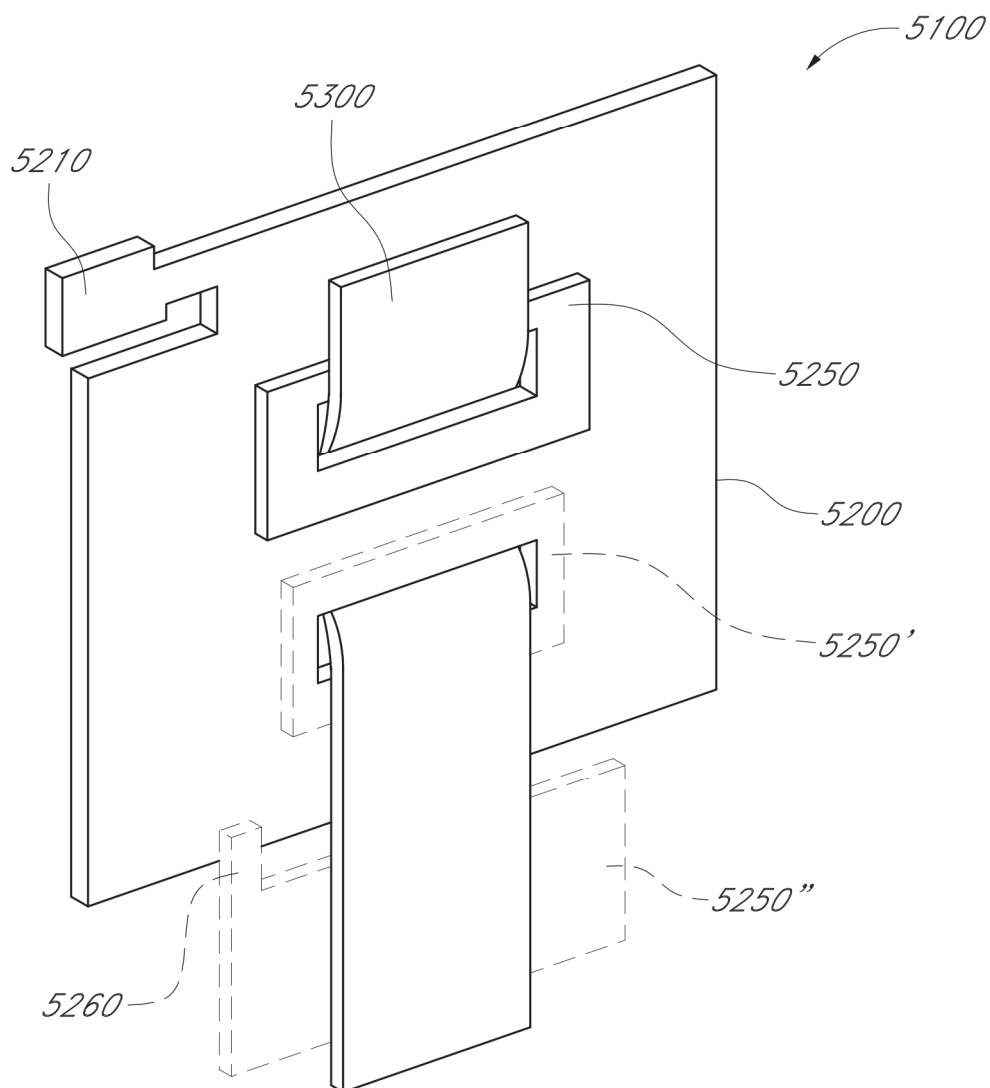


FIG. 30

FIG. 31



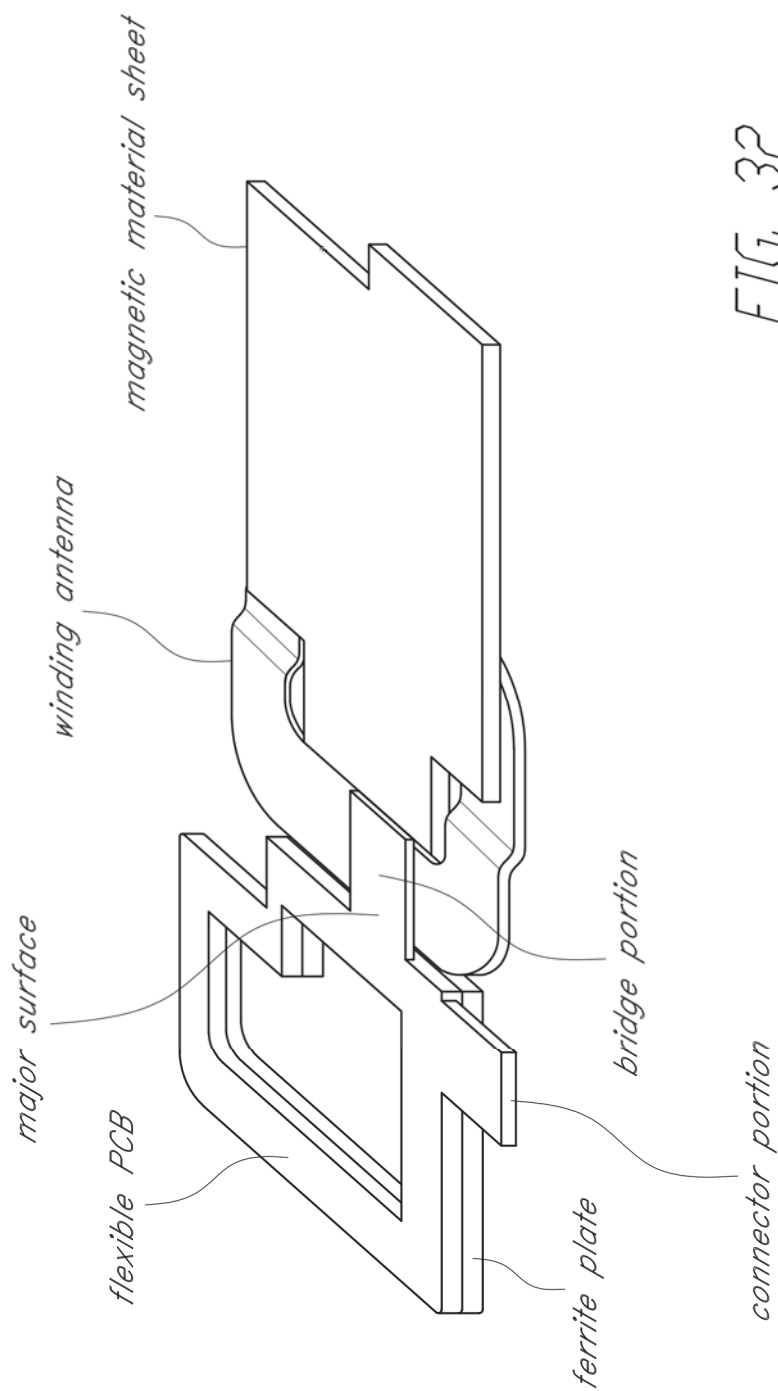
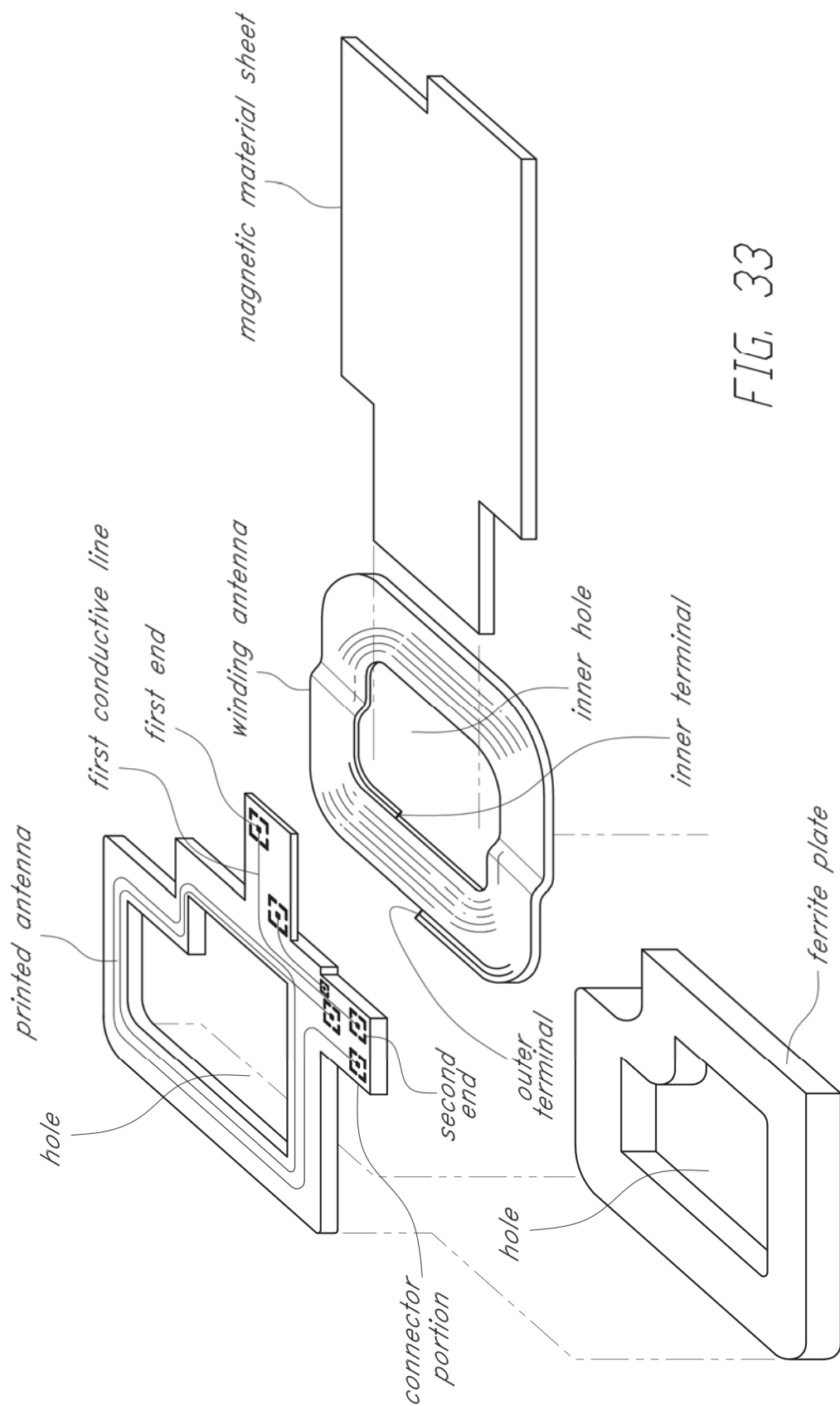


FIG. 32



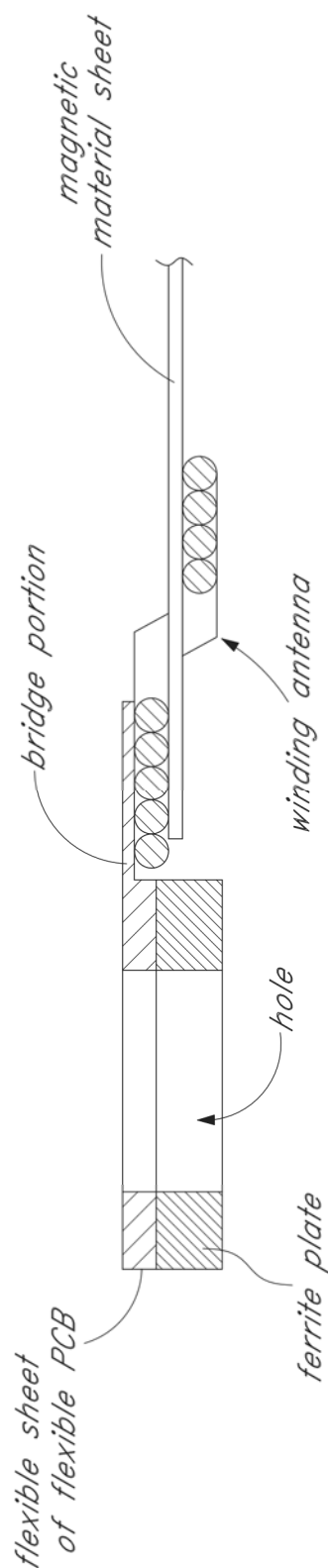


FIG. 34

FIG. 35

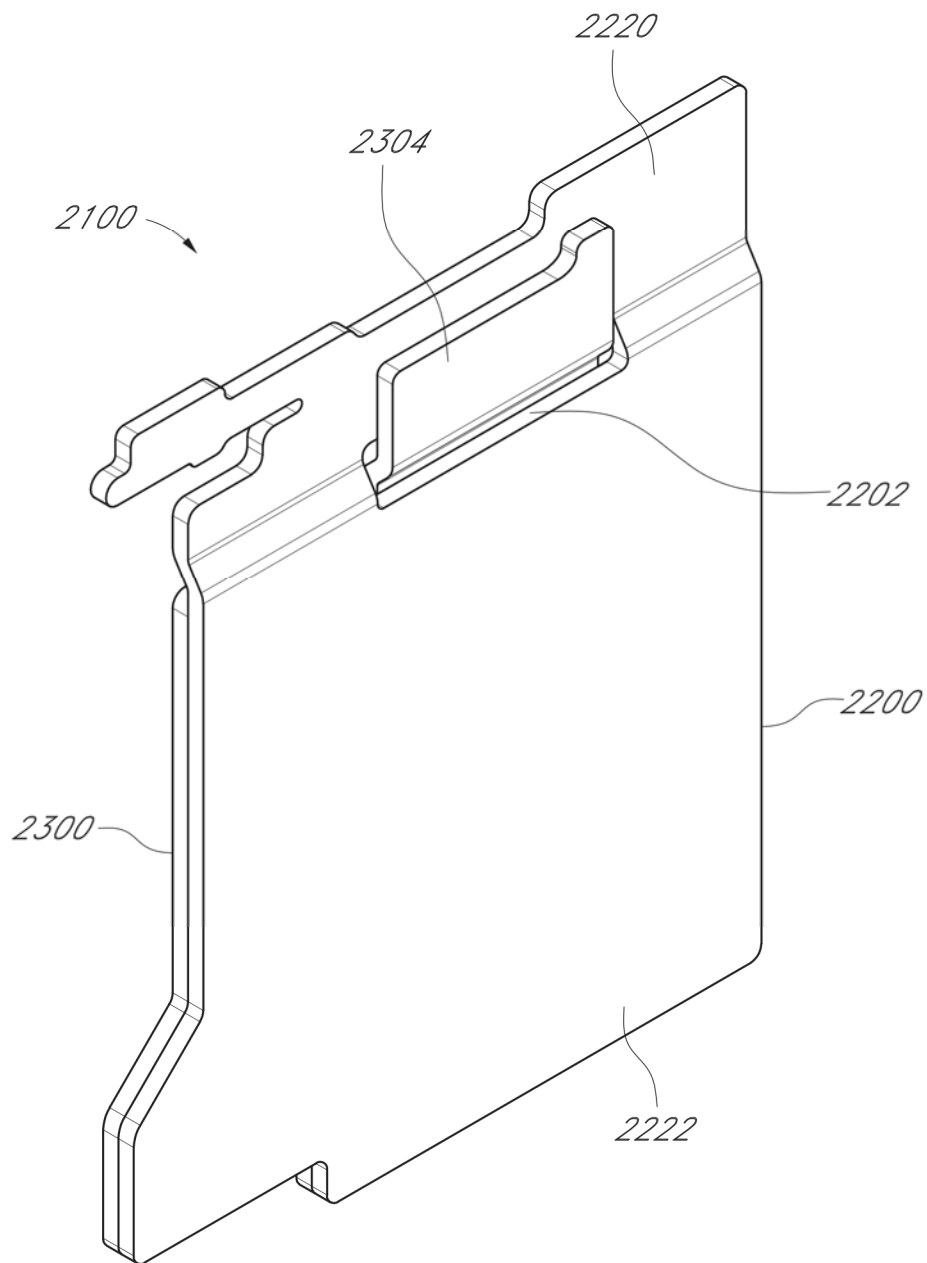


FIG. 36

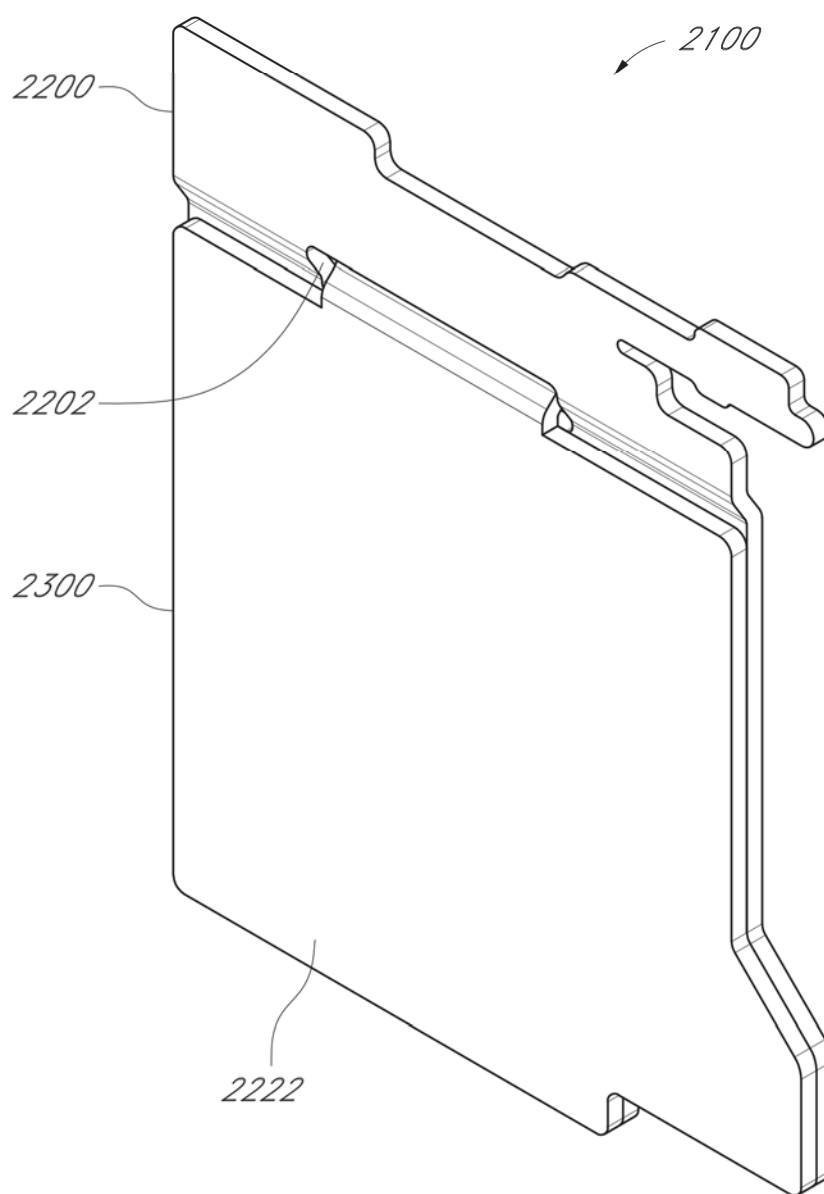


FIG. 37

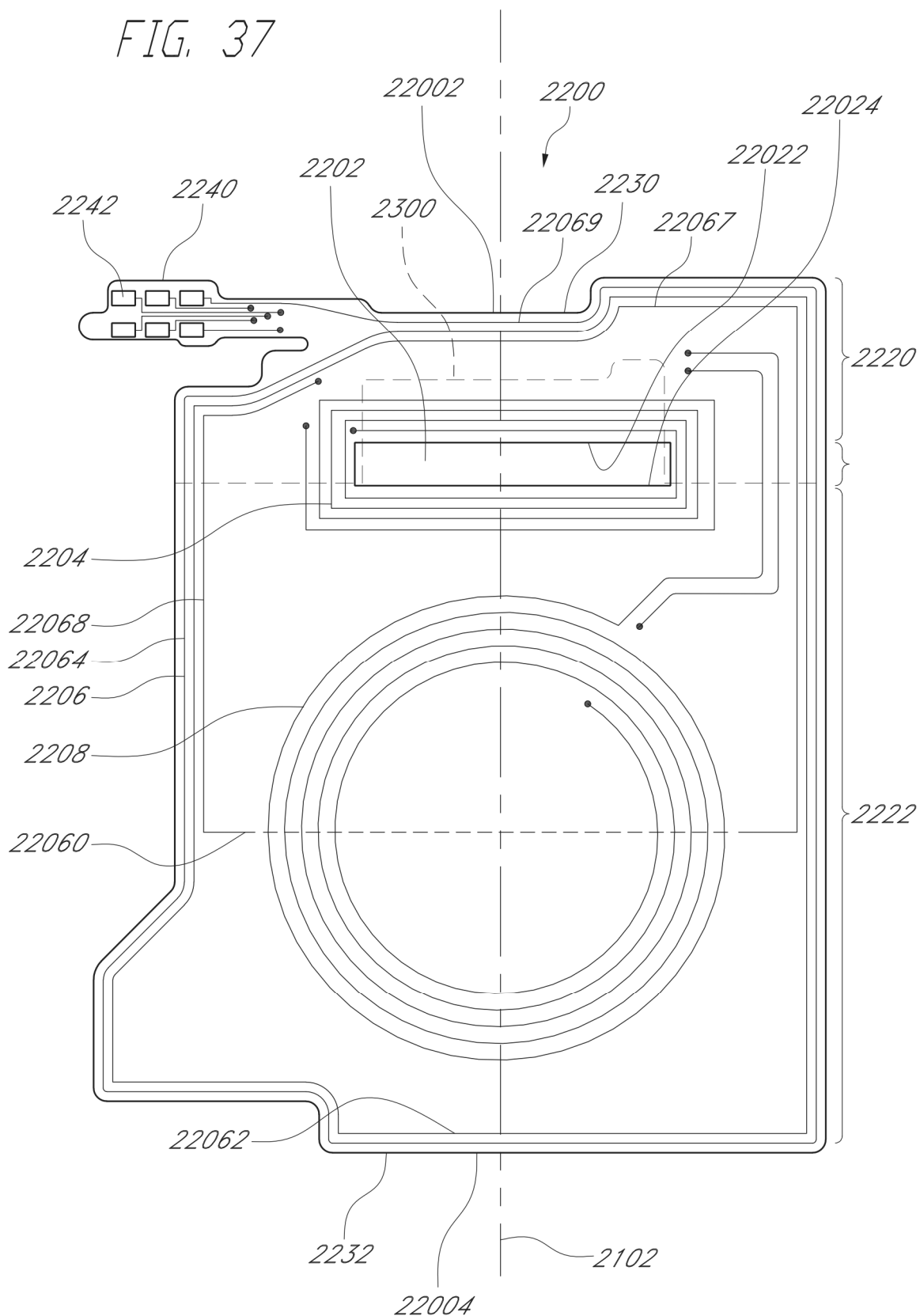


FIG. 38

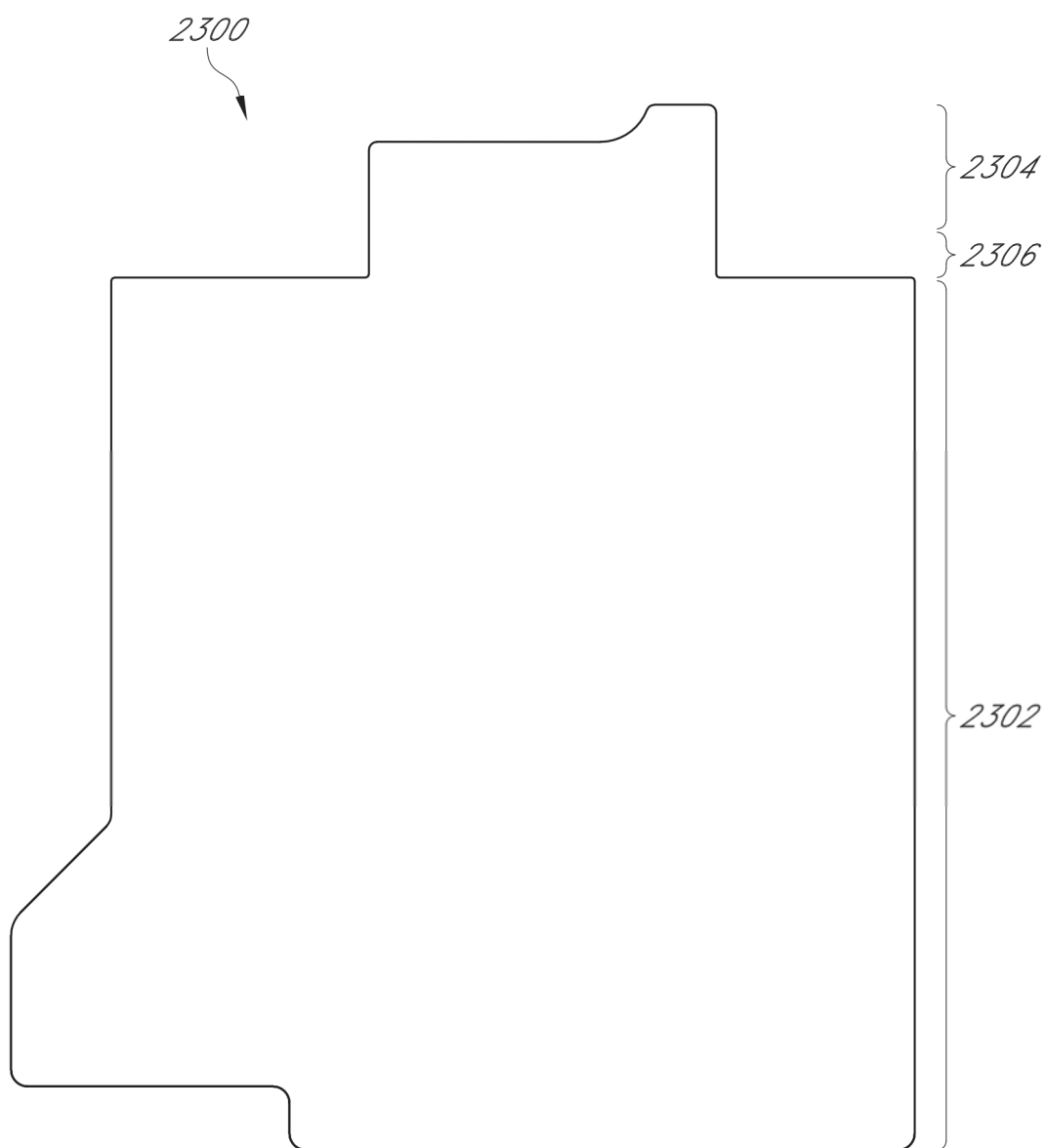


FIG. 39

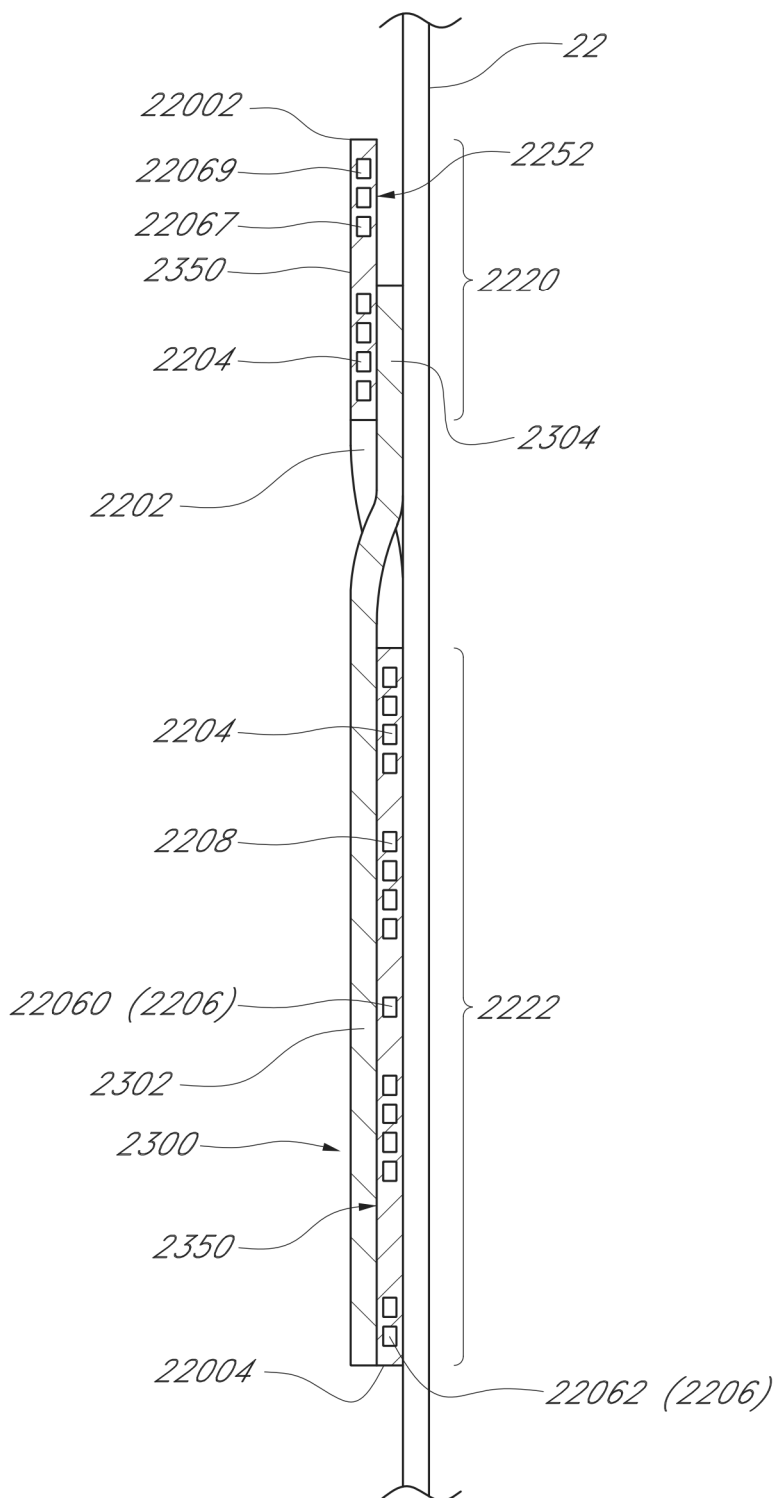


FIG. 40

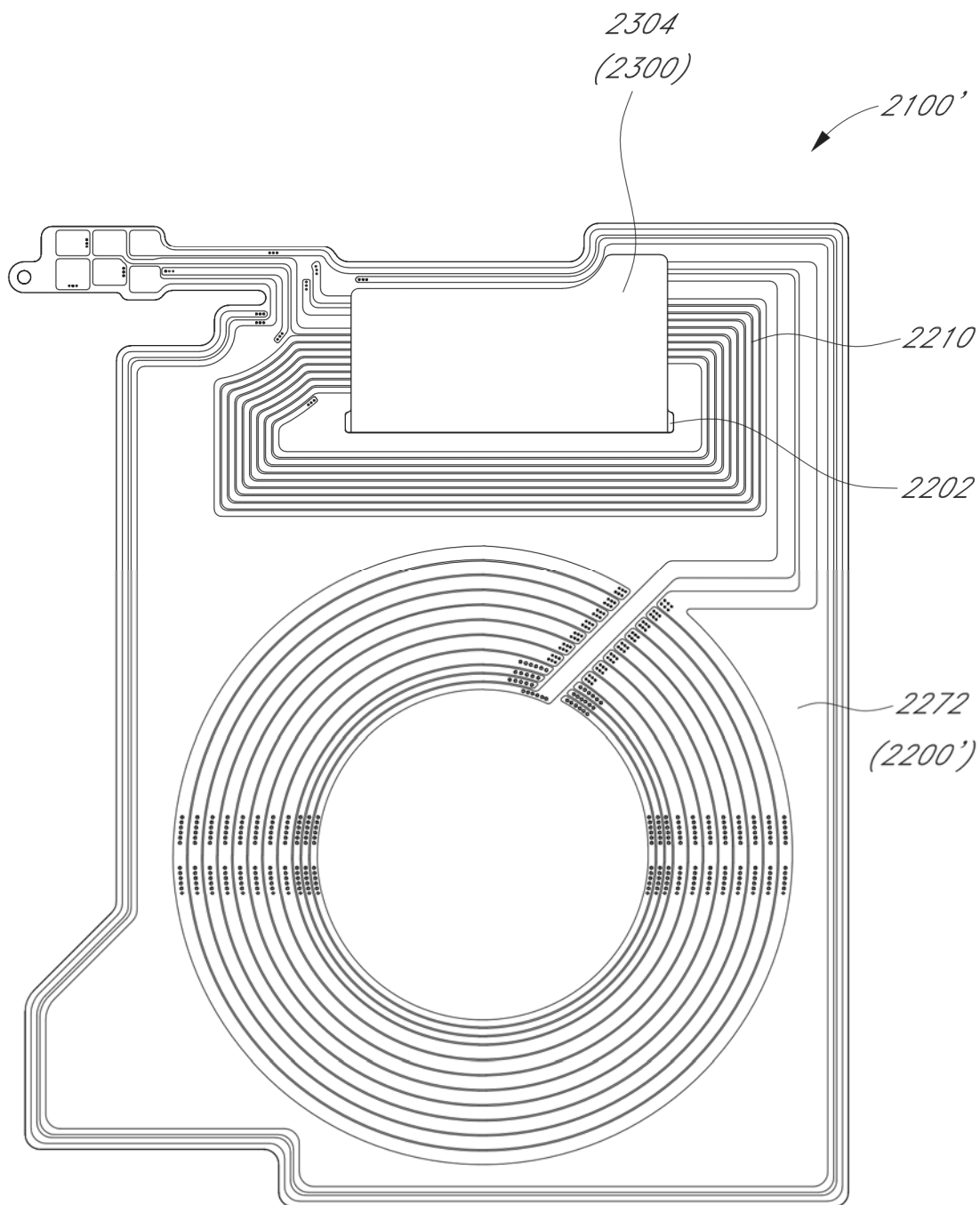


FIG. 41

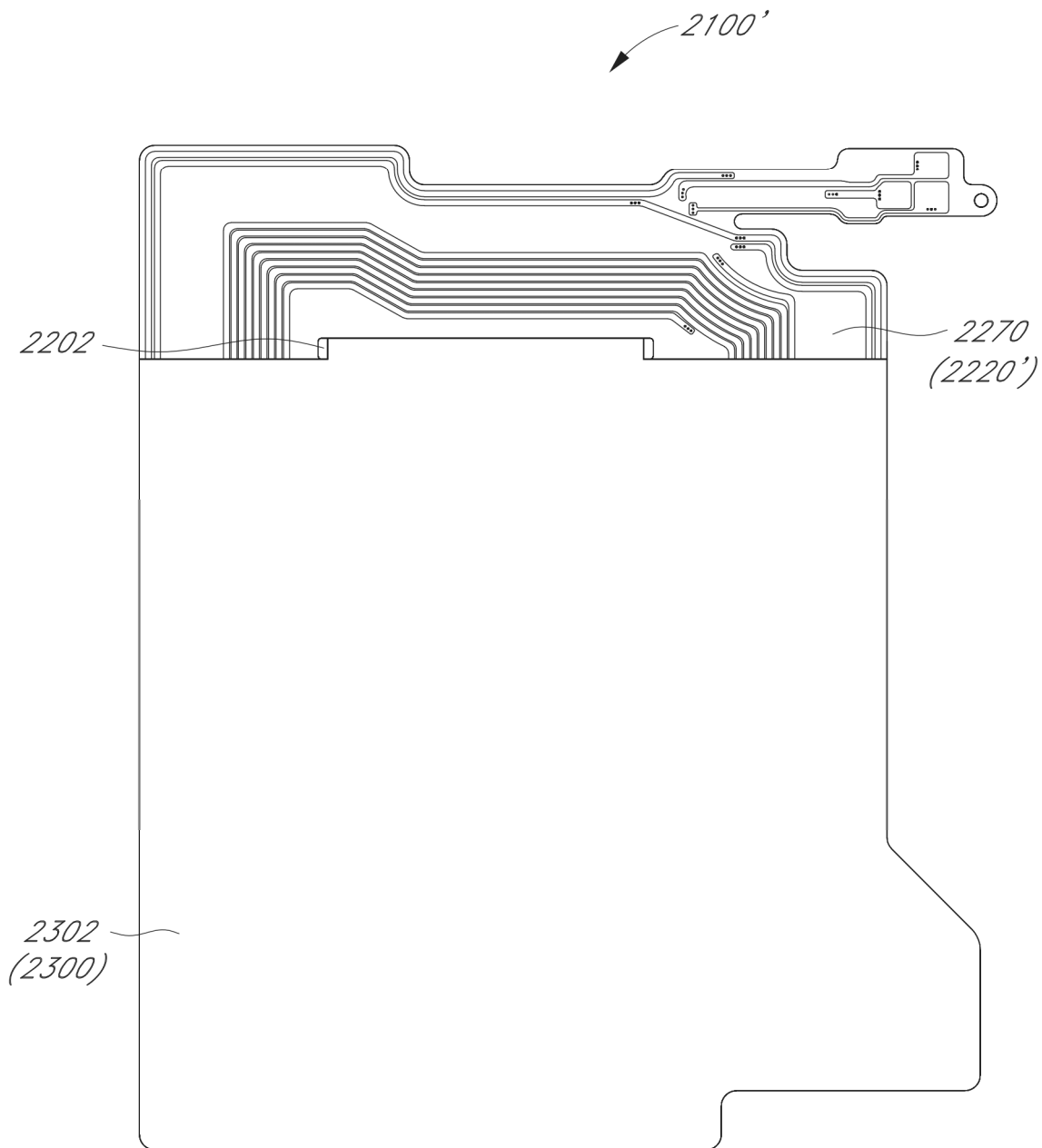


FIG. 42

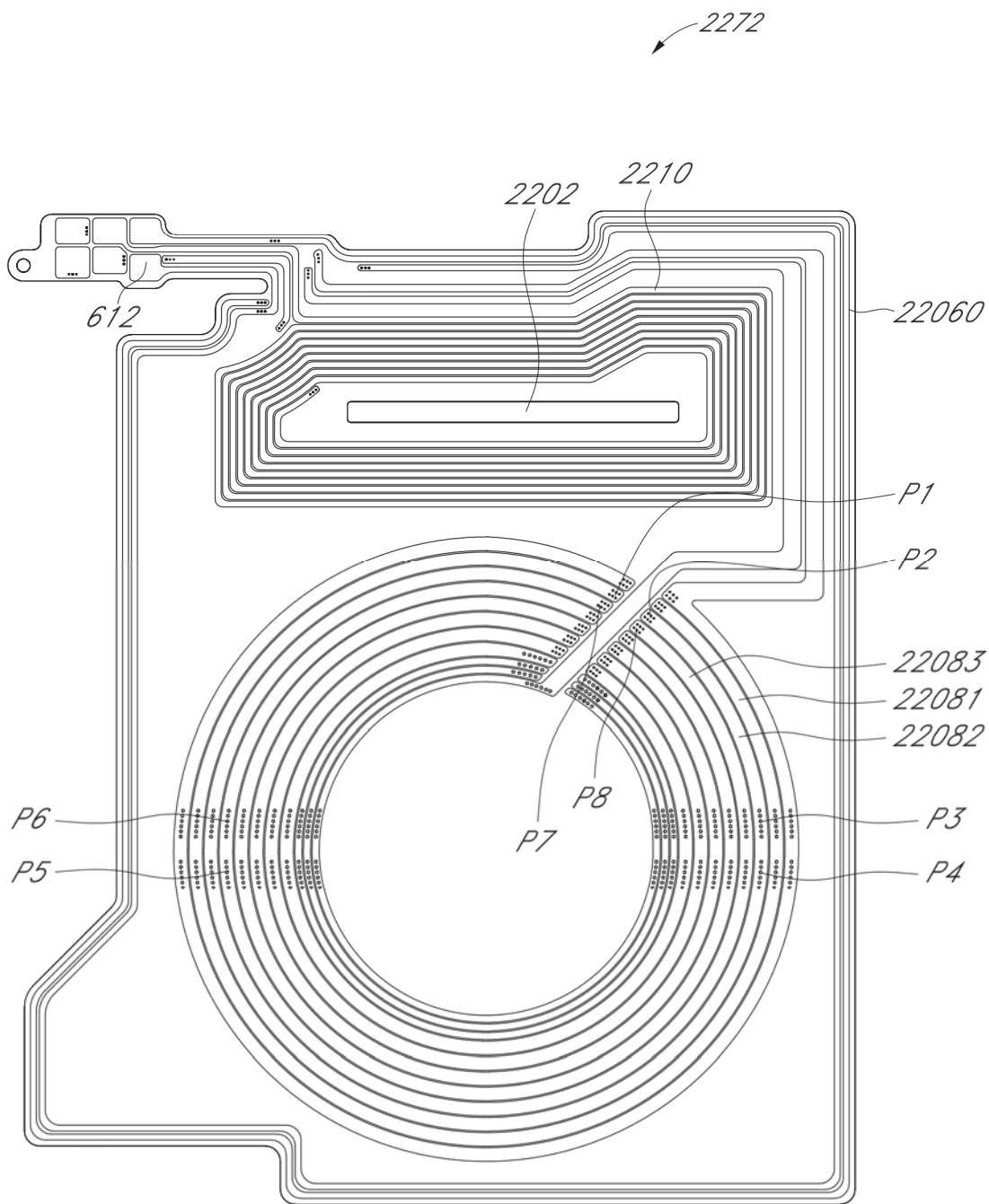
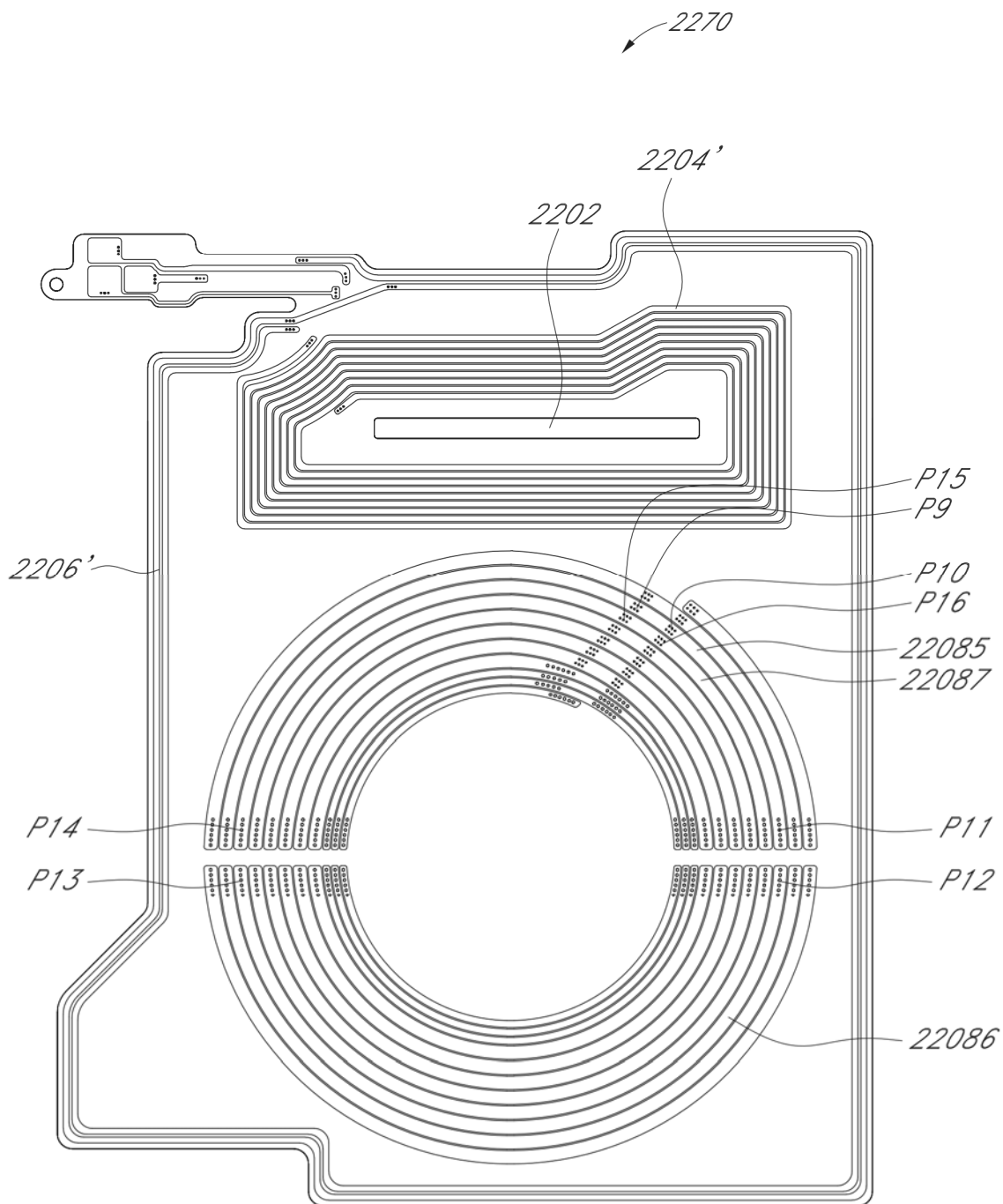


FIG. 43



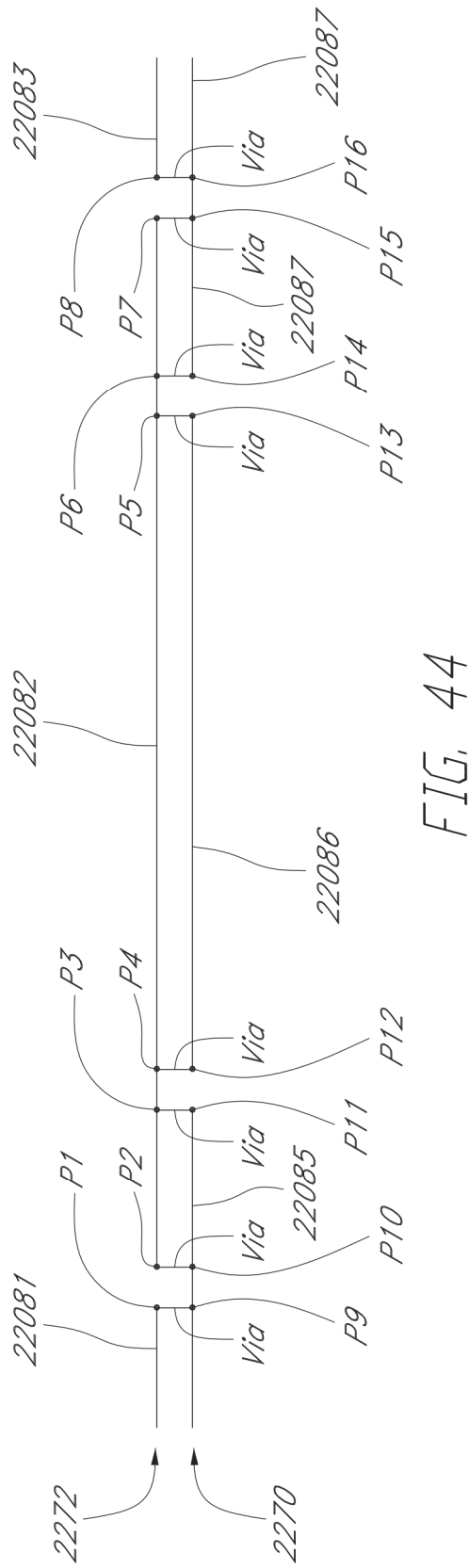


FIGURE 45

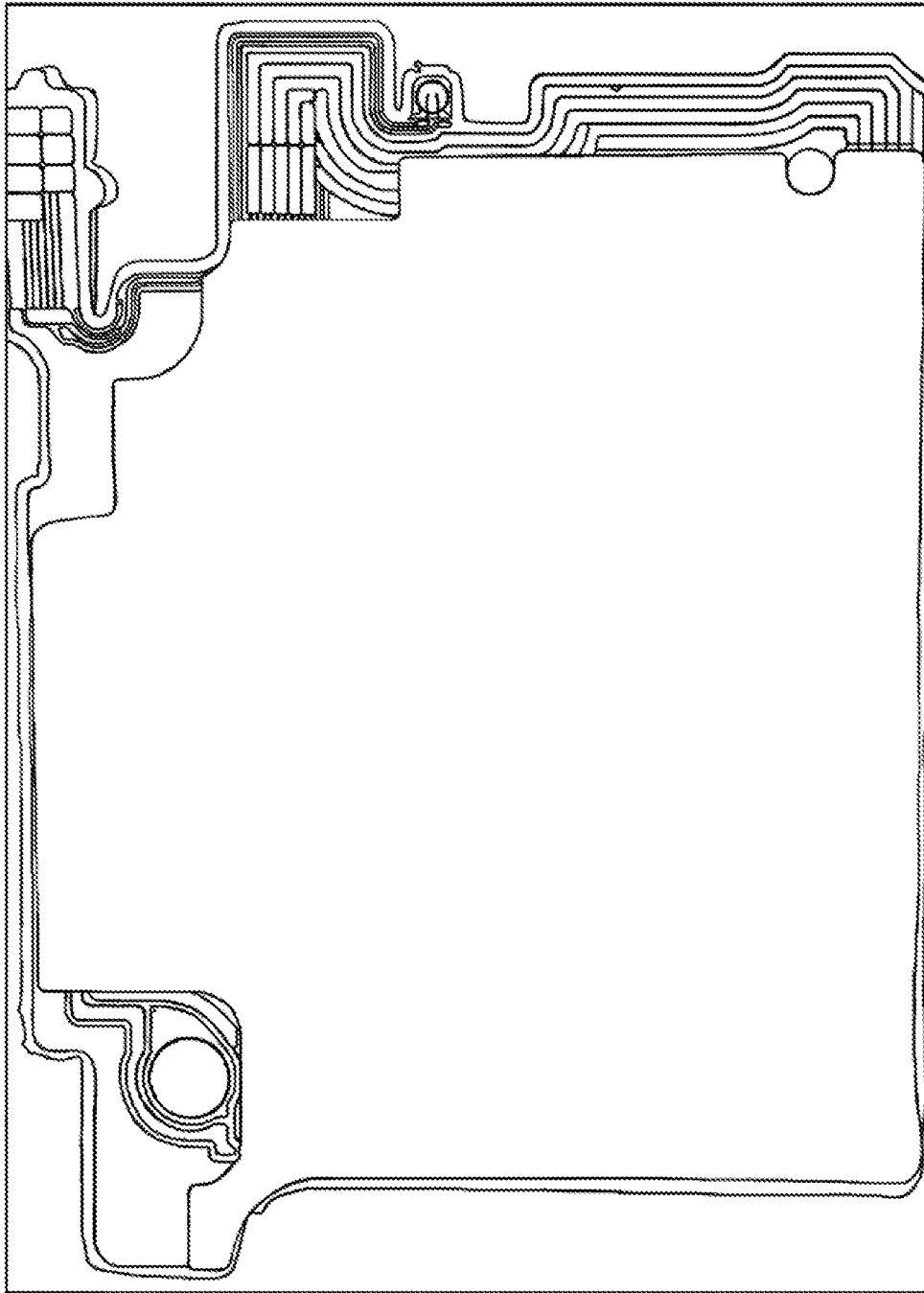
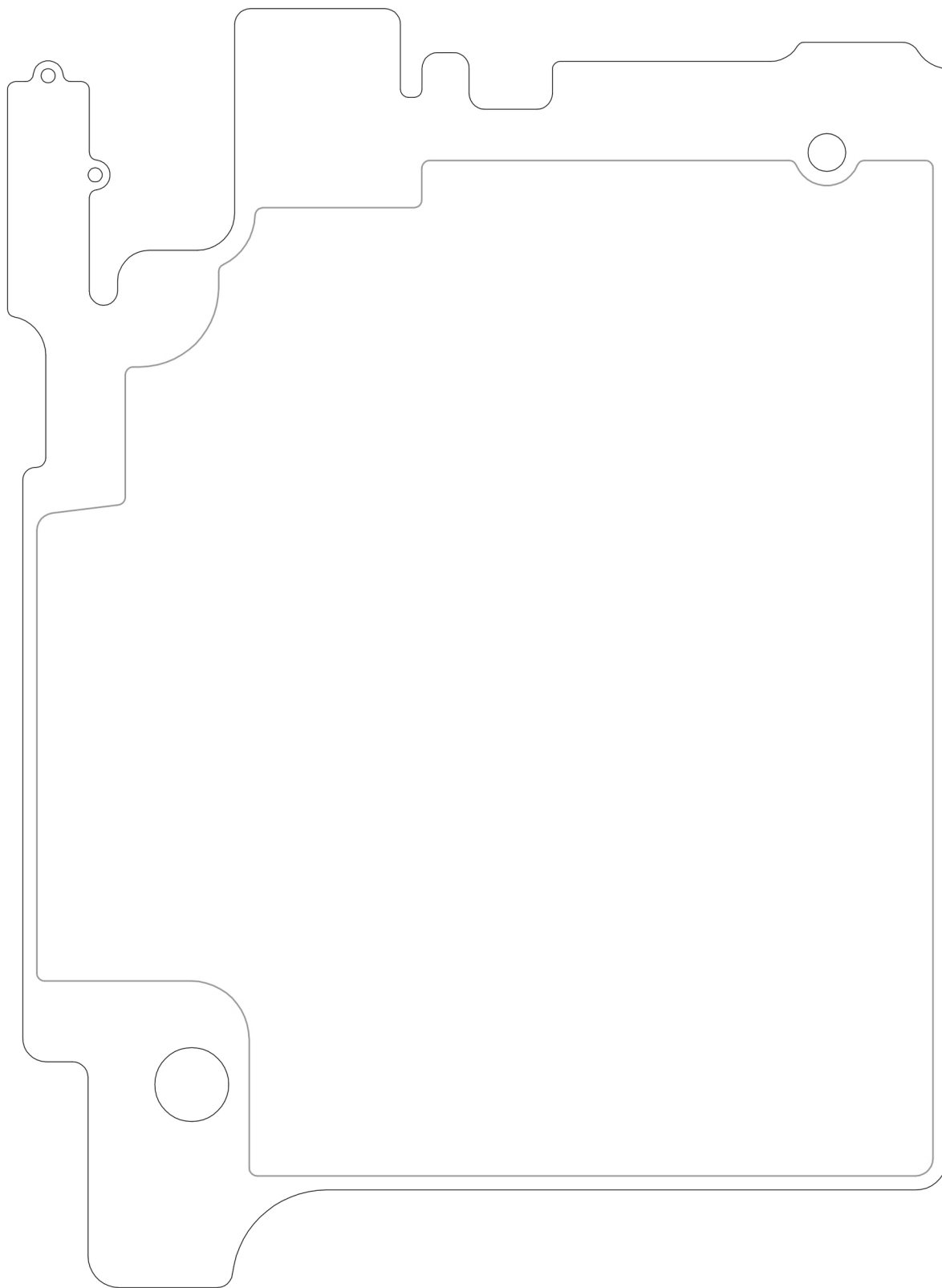


FIGURE 46



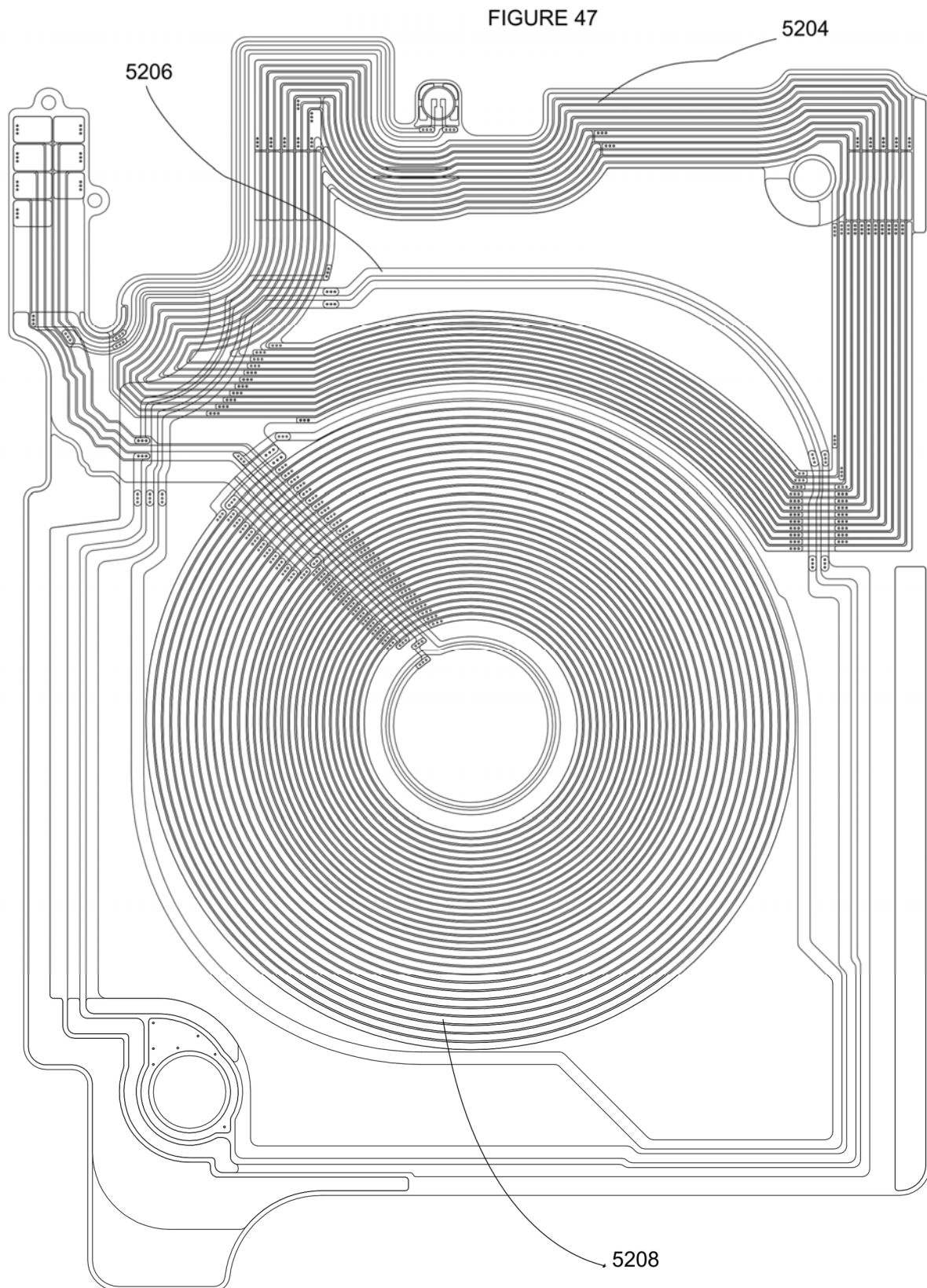


FIGURE 48

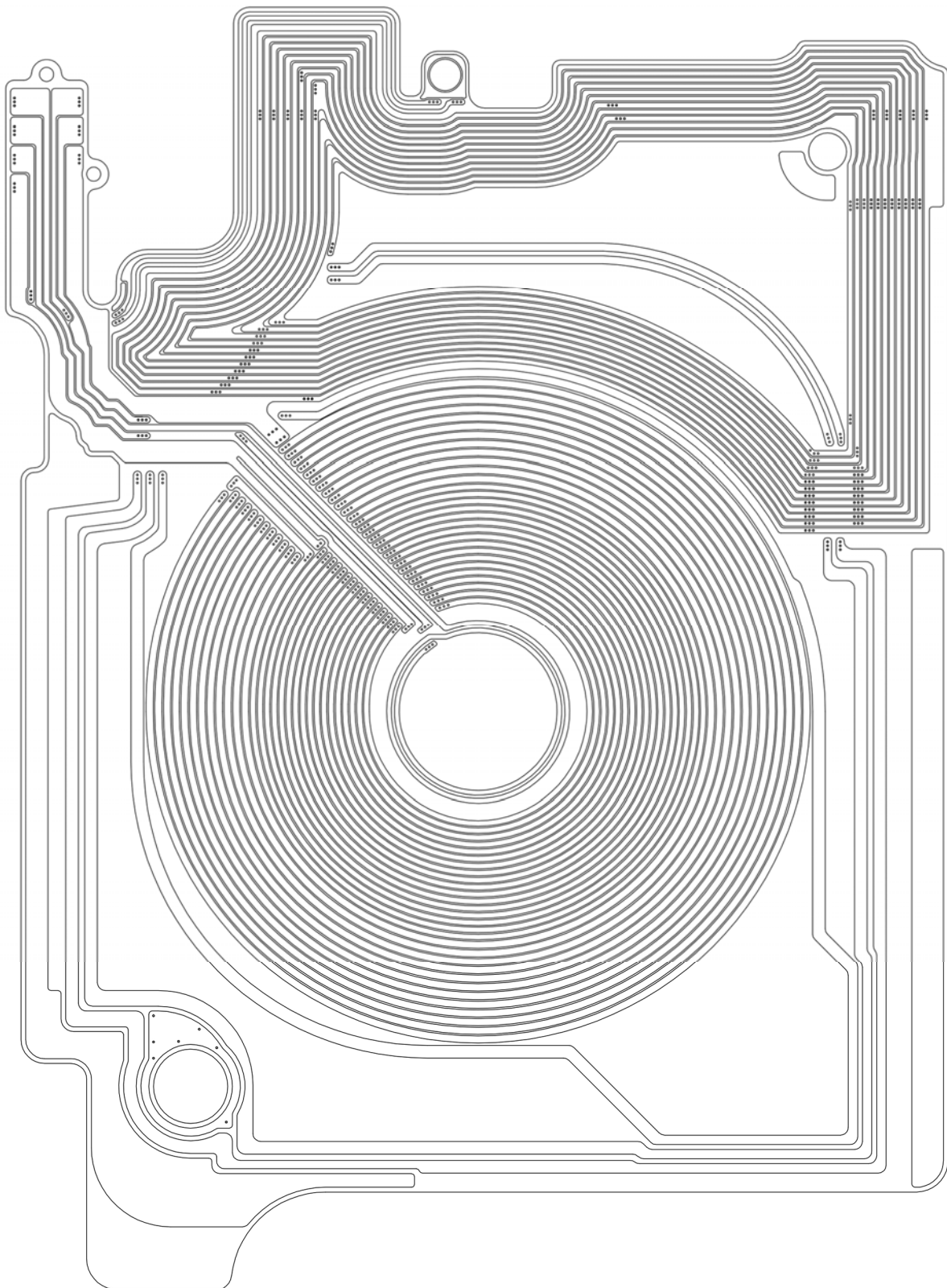


FIGURE 49

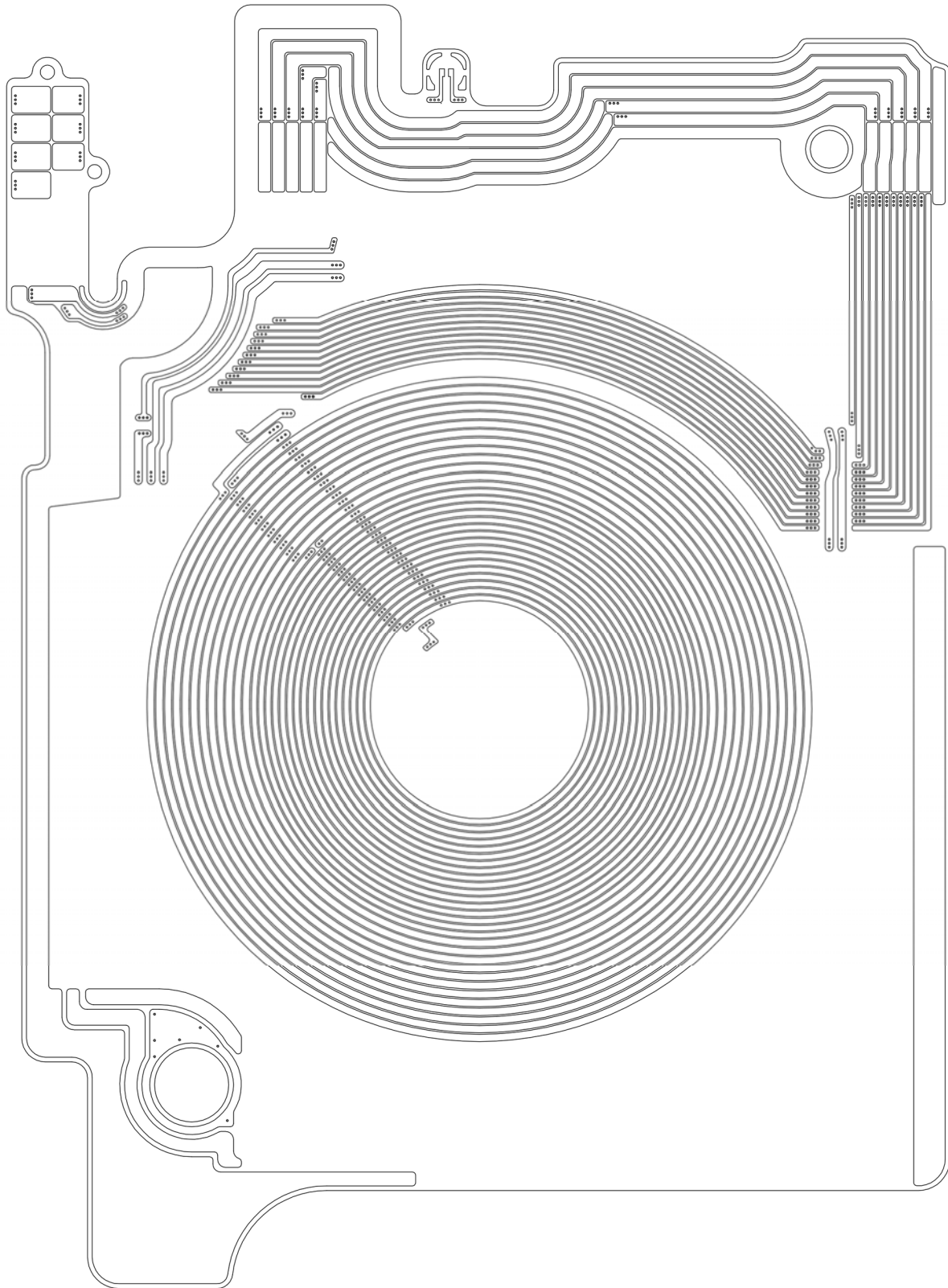
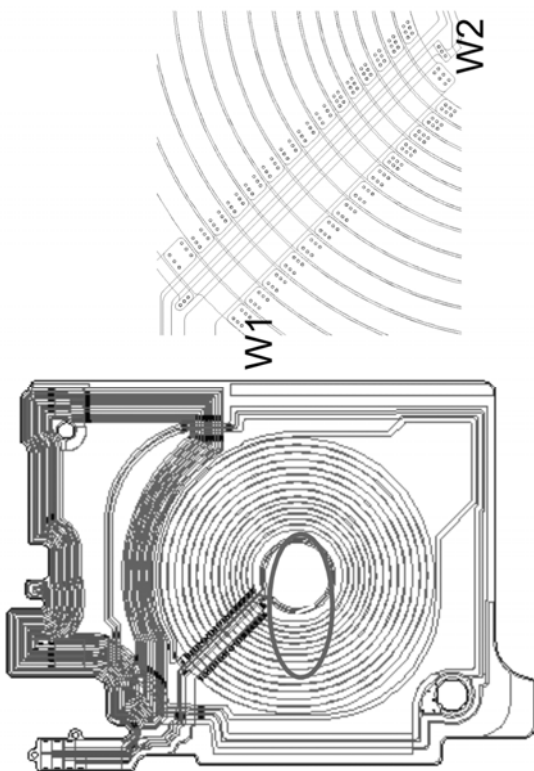
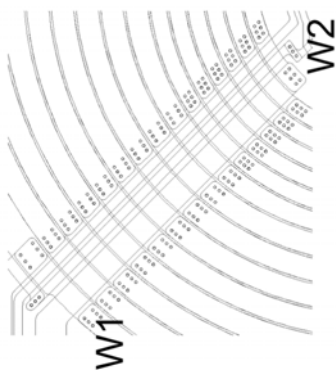
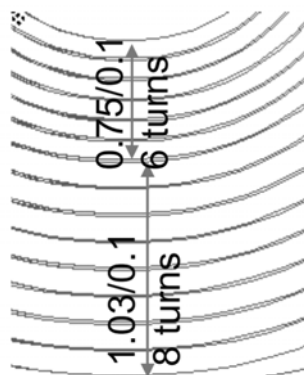


FIGURE 50

FIGURE 51

Examples of sheet-like smartphone antenna with different WPC coil design

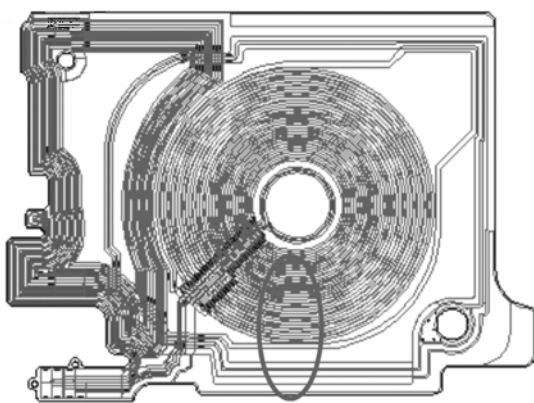
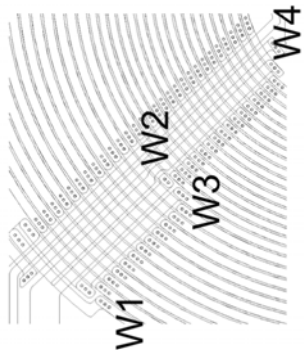
<Example of non-parallel-coil design>



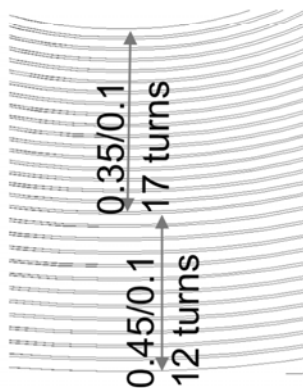
Total 14 turns (9.35uH / 0.27Ω)

(a)

<Example of parallel-coil design>



<Outer coil>
line width 0.45 mm
12 turns
space 0.1mm
<Inner coil>
line width 0.35mm
17 turns
space 0.1mm



Total 29 Turns (10.52uH / 0.3Ω)

(b)

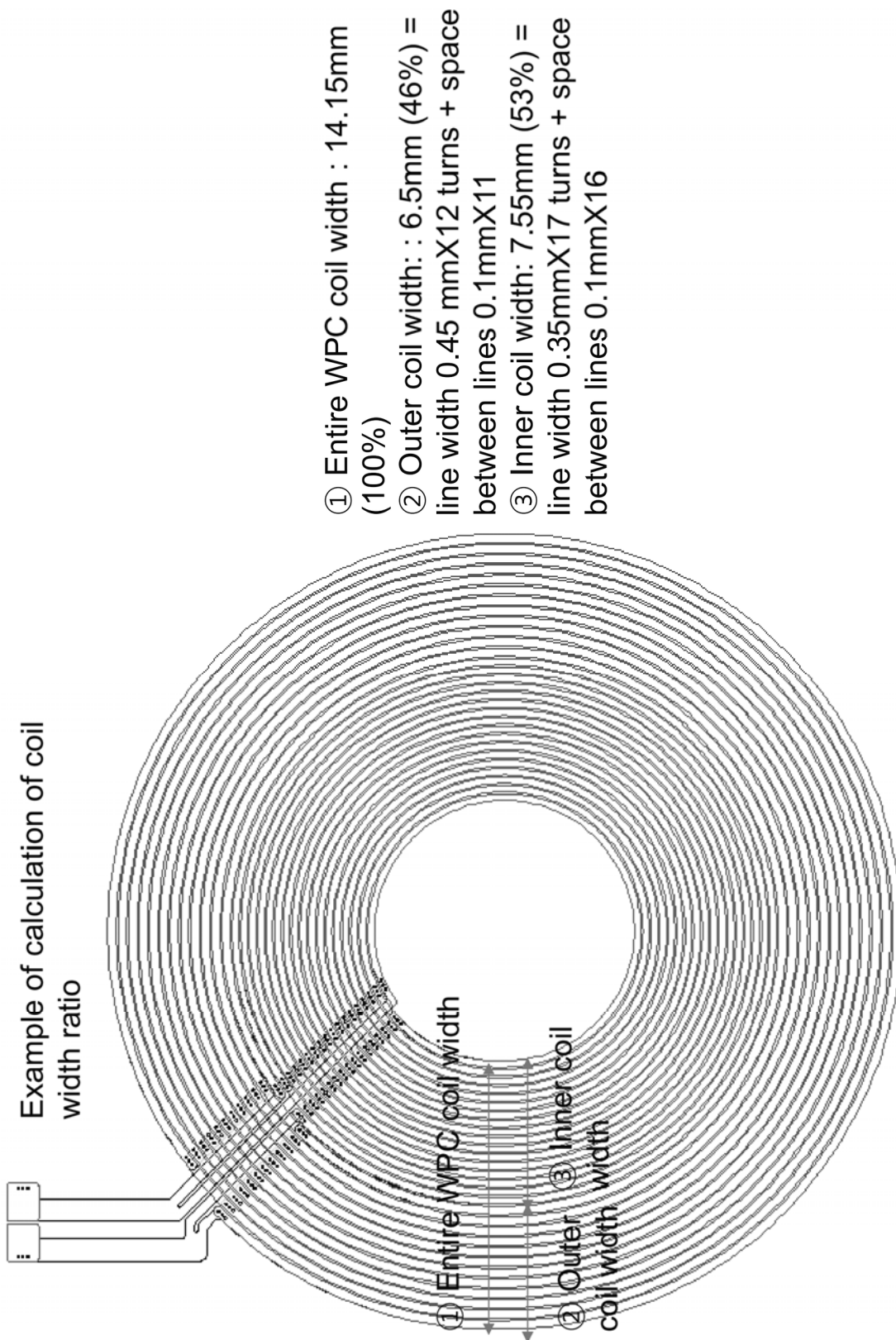


FIGURE 52

Examples of WPC coil – outer diameter: 42 ϕ , inner diameter: 14 ϕ

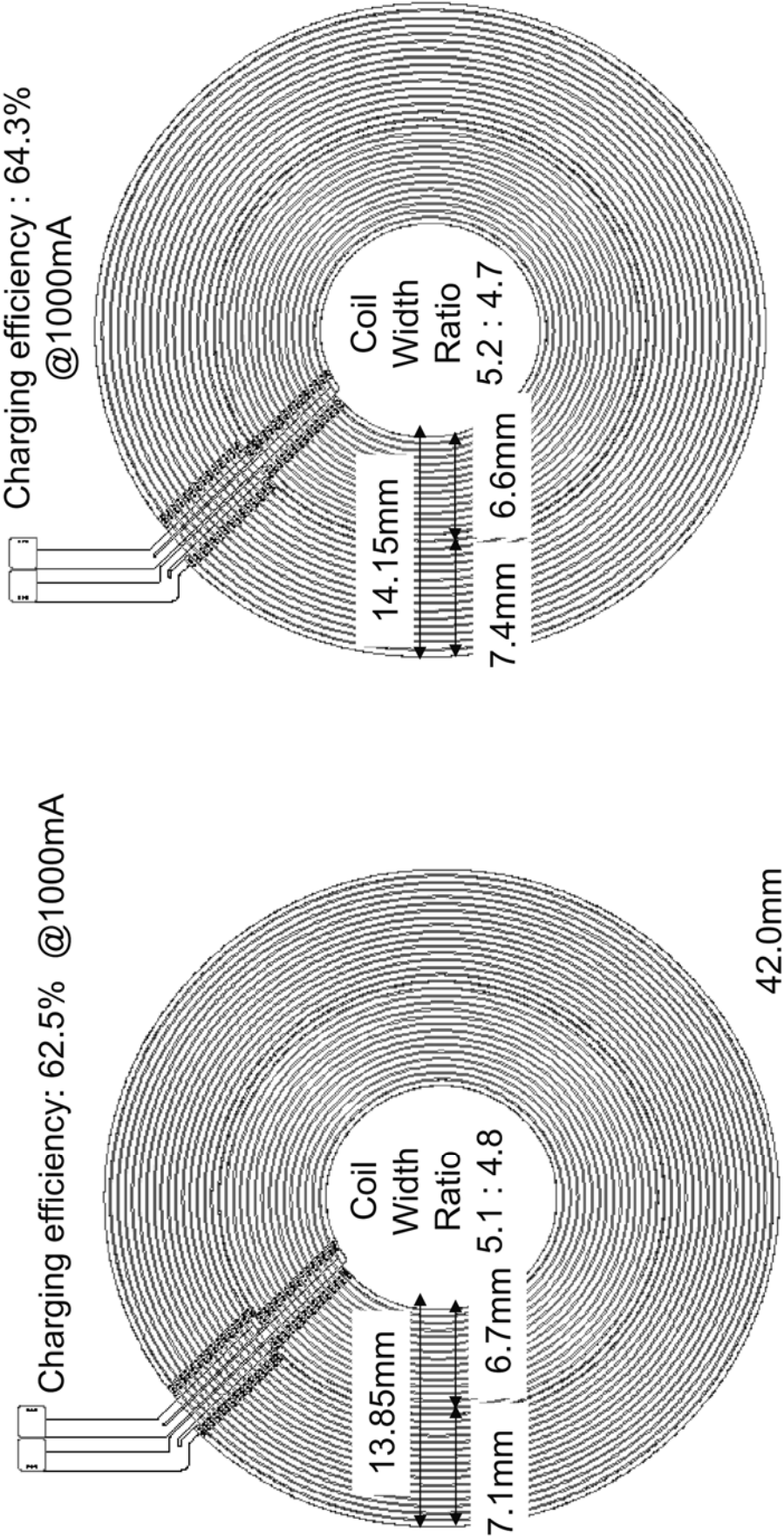


FIGURE 53B

FIGURE 53A

Example of WPC coil – outer diameter: 42 ϕ , inner diameter: 14 ϕ

Charging efficiency: 66.0% @1000mA

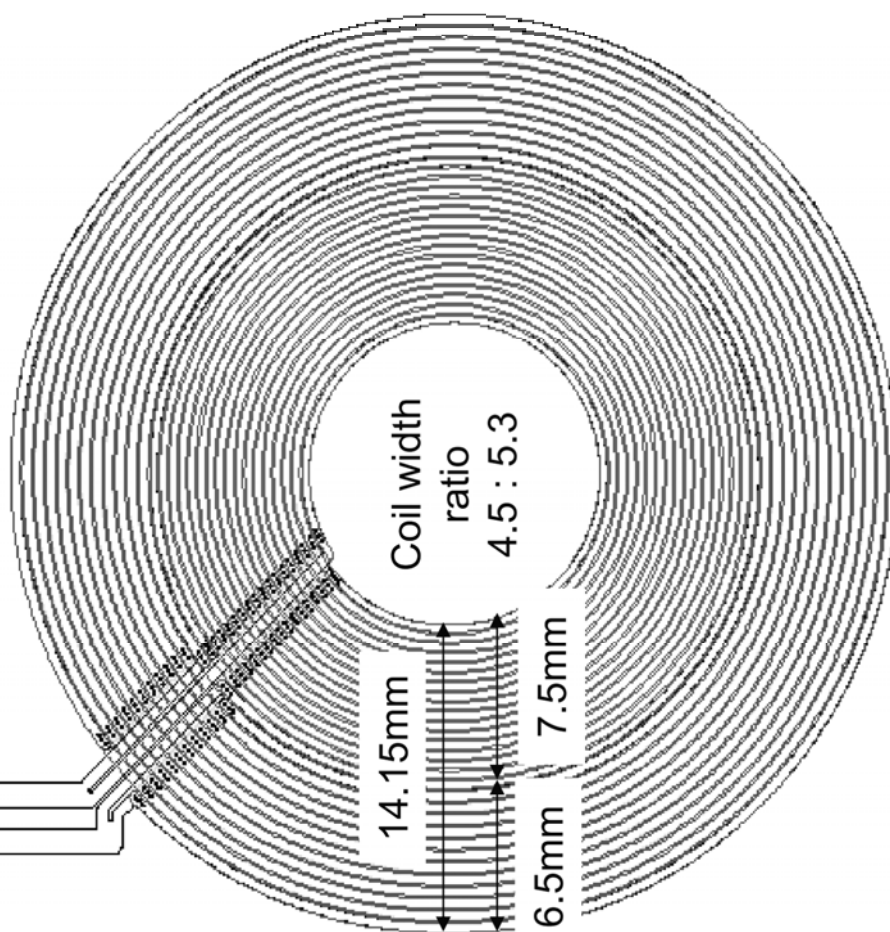


FIGURE 53C