

AO 120 (Rev. 08/10)

TO: <b>Mail Stop 8</b> <b>Director of the U.S. Patent and Trademark Office</b> <b>P.O. Box 1450</b> <b>Alexandria, VA 22313-1450</b>	<b>REPORT ON THE</b> <b>FILING OR DETERMINATION OF AN</b> <b>ACTION REGARDING A PATENT OR</b> <b>TRADEMARK</b>
---	---

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Western District of Texas on the following  
 Trademarks or  Patents. (  the patent action involves 35 U.S.C. § 292.);

DOCKET NO. 6:21-cv-00579-ADA	DATE FILED 6/7/2021	U.S. DISTRICT COURT Western District of Texas
PLAINTIFF SCRAMOGE TECHNOLOGY LIMITED		DEFENDANT APPLE INC.
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1 10,622,842	4/14/2020	Scramoge Technology Limited
2 9,806,565	10/31/2017	Scramoge Technology Limited
3 10,804,740	10/13/2020	Scramoge Technology Limited
4 9,843,215	12/12/2017	Scramoge Technology Limited
5 10,424,941	9/24/2019	Scramoge Technology Limited

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED 6/18/2021	INCLUDED BY <input checked="" type="checkbox"/> Amendment <input type="checkbox"/> Answer <input type="checkbox"/> Cross Bill <input type="checkbox"/> Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1 9,997,962	6/12/2018	Scramoge Technology Limited
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT
--------------------

CLERK	(BY) DEPUTY CLERK	DATE
-------	-------------------	------

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director  
 Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

AO 120 (Rev. 08/10)

TO: <b>Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450</b>	<b>REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK</b>
---	---

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Western District of Texas on the following  
 Trademarks or  Patents. (  the patent action involves 35 U.S.C. § 292.);

DOCKET NO. 6:21-cv-00616	DATE FILED 6/15/2021	U.S. DISTRICT COURT Western District of Texas
PLAINTIFF SCRAMOGE TECHNOLOGY LIMITED		DEFENDANT GOOGLE LLC
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1 9,843,215	12/12/2017	Scramoge Technology Limited
2 10,367,370	7/30/2019	Scramoge Technology Limited
3 10,804,740	10/13/2020	Scramoge Technology Limited
4 9,997,962	6/12/2018	Scramoge Technology Limited
5		

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY <input type="checkbox"/> Amendment <input type="checkbox"/> Answer <input type="checkbox"/> Cross Bill <input type="checkbox"/> Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE
-------	-------------------	------

Copy 1—Upon initiation of action, mail this copy to Director    Copy 3—Upon termination of action, mail this copy to Director  
 Copy 2—Upon filing document adding patent(s), mail this copy to Director    Copy 4—Case file copy



AO 120 (Rev. 08/10)

TO: <b>Mail Stop 8</b> <b>Director of the U.S. Patent and Trademark Office</b> <b>P.O. Box 1450</b> <b>Alexandria, VA 22313-1450</b>	<b>REPORT ON THE</b> <b>FILING OR DETERMINATION OF AN</b> <b>ACTION REGARDING A PATENT OR</b> <b>TRADEMARK</b>
---	---

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Western District of Texas on the following  
 Trademarks or  Patents. (  the patent action involves 35 U.S.C. § 292.);

DOCKET NO. 6:21-cv-00579	DATE FILED 6/7/2021	U.S. DISTRICT COURT Western District of Texas
PLAINTIFF SCRAMOGE TECHNOLOGY LIMITED		DEFENDANT APPLE INC.
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1 10,622,842	4/14/2020	Scramoge Technology Limited
2 9,806,565	10/31/2017	Scramoge Technology Limited
3 10,804,740	10/13/2020	Scramoge Technology Limited
4 9,843,215	12/12/2017	Scramoge Technology Limited
5 10,424,941	9/24/2019	Scramoge Technology Limited

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY <input type="checkbox"/> Amendment <input type="checkbox"/> Answer <input type="checkbox"/> Cross Bill <input type="checkbox"/> Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE
-------	-------------------	------

Copy 1—Upon initiation of action, mail this copy to Director    Copy 3—Upon termination of action, mail this copy to Director  
 Copy 2—Upon filing document adding patent(s), mail this copy to Director    Copy 4—Case file copy



AO 120 (Rev. 08/10)

<b>TO:</b> <b>Mail Stop 8</b> <b>Director of the U.S. Patent and Trademark Office</b> <b>P.O. Box 1450</b> <b>Alexandria, VA 22313-1450</b>	<b>REPORT ON THE</b> <b>FILING OR DETERMINATION OF AN</b> <b>ACTION REGARDING A PATENT OR</b> <b>TRADEMARK</b>
---	---

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Western District of Texas on the following  
 Trademarks or  Patents. (  the patent action involves 35 U.S.C. § 292.);

DOCKET NO. 6:21-cv-00579	DATE FILED 6/7/2021	U.S. DISTRICT COURT Western District of Texas
PLAINTIFF SCRAMOGE TECHNOLOGY LIMITED		DEFENDANT APPLE INC.
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1 10,622,842	4/14/2020	Scramoge Technology Limited
2 9,806,565	10/31/2017	Scramoge Technology Limited
3 10,804,740	10/13/2020	Scramoge Technology Limited
4 9,843,215	12/12/2017	Scramoge Technology Limited
5 10,424,941	9/24/2019	Scramoge Technology Limited

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY <input type="checkbox"/> Amendment <input type="checkbox"/> Answer <input type="checkbox"/> Cross Bill <input type="checkbox"/> Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE
-------	-------------------	------

Copy 1—Upon initiation of action, mail this copy to Director    Copy 3—Upon termination of action, mail this copy to Director  
 Copy 2—Upon filing document adding patent(s), mail this copy to Director    Copy 4—Case file copy





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 NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/264,360	01/31/2019	JEONG WOOK AN	SUN.LGI.420D3

**CONFIRMATION NO. 7253**

**POA ACCEPTANCE LETTER**

151145  
Shami Messinger PLLC  
1000 Wisconsin Ave. NW  
Suite 200  
Washington, DC 20007



Date Mailed: 04/12/2021

**NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY**

This is in response to the Power of Attorney filed 04/06/2021.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth 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.

/byemane/  

---



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 NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/264,360	01/31/2019	JEONG WOOK AN	SUN.LGI.420D3

**CONFIRMATION NO. 7253**

**POWER OF ATTORNEY NOTICE**



23557  
SALIWANCIK, LLOYD & EISENSCHENK  
A PROFESSIONAL ASSOCIATION  
P.O. BOX 142950  
GAINESVILLE, FL 32614

Date Mailed: 04/12/2021

**NOTICE REGARDING CHANGE OF POWER OF ATTORNEY**

This is in response to the Power of Attorney filed 04/06/2021.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

Questions about the contents of this notice and the requirements it sets forth 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.

/byemane/

## 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:

151145

OR

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):

Scramoge Technology Limited

- 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 <i>[Handwritten Signature]</i>	Date (Optional) FEB 19 2021
Name <i>CLAREN O'GARA</i>	
Title <i>Director</i>	

**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 \_\_\_\_\_ forms are submitted

This collection of information is required by 37 CFR 1.131, 1.22, 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 1480, Alexandria, VA 22313-1480. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1480, Alexandria, VA 22313-1480.

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

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.

**STATEMENT UNDER 37 CFR 3.73(c)**

Applicant/Patent Owner: SCRAMOGE TECHNOLOGY LIMITED

Application No./Patent No.: 10,804,740 Filed/Issue Date: 10-13-2020

Titled: Wireless Power Receiver and Method of Manufacturing the Same

SCRAMOGE TECHNOLOGY LIMITED, a Corporation

(Name of Assignee)

(Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

- 1.  The assignee of the entire right, title, and interest.
- 2.  An assignee of less than the entire right, title, and interest (check applicable box):
  - The extent (by percentage) of its ownership interest is \_\_\_\_\_%. Additional Statement(s) by the owners holding the balance of the interest **must be submitted** to account for 100% of the ownership interest.
  - There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

Additional Statement(s) by the owner(s) holding the balance of the interest **must be submitted** to account for the entire right, title, and interest.

- 3.  The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

Additional Statement(s) by the owner(s) holding the balance of the interest **must be submitted** to account for the entire right, title, and interest.

- 4.  The recipient, via a court proceeding or the like (e.g., bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

- A.  An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel \_\_\_\_\_, Frame \_\_\_\_\_, or for which a copy thereof is attached.
- B.  A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: AN, JEONG WOOK, LEE, JUNG OH, LEEM, SUNG HYUN, KIM, YANG HYUN To: LG INNOTEK CO., LTD.

The document was recorded in the United States Patent and Trademark Office at  
Reel 029219, Frame 0323, or for which a copy thereof is attached.

2. From: LG INNOTEK CO., LTD. To: SCRAMOGE TECHNOLOGY LIMITED

The document was recorded in the United States Patent and Trademark Office at  
Reel 055335, Frame 0652, or for which a copy thereof is attached.

[Page 1 of 2]

This collection of information is required by 37 CFR 3.73(b). 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 12 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.*



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.

**STATEMENT UNDER 37 CFR 3.73(c)**

3. From: \_\_\_\_\_ To: \_\_\_\_\_

The document was recorded in the United States Patent and Trademark Office at  
Reel \_\_\_\_\_, Frame \_\_\_\_\_, or for which a copy thereof is attached.

4. From: \_\_\_\_\_ To: \_\_\_\_\_

The document was recorded in the United States Patent and Trademark Office at  
Reel \_\_\_\_\_, Frame \_\_\_\_\_, or for which a copy thereof is attached.

5. From: \_\_\_\_\_ To: \_\_\_\_\_

The document was recorded in the United States Patent and Trademark Office at  
Reel \_\_\_\_\_, Frame \_\_\_\_\_, or for which a copy thereof is attached.

6. From: \_\_\_\_\_ To: \_\_\_\_\_

The document was recorded in the United States Patent and Trademark Office at  
Reel \_\_\_\_\_, Frame \_\_\_\_\_, or for which a copy thereof is attached.

Additional documents in the chain of title are listed on a supplemental sheet(s).

As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Khaled Shami/  
\_\_\_\_\_

Signature

**Khaled Shami**  
\_\_\_\_\_

Printed or Typed Name

**April 6, 2021**  
\_\_\_\_\_

Date

**38,745**  
\_\_\_\_\_

Title or Registration 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.

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.

## 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	16/264,360
Filing Date	01-31-2019
First Named Inventor	JEONG WOOK AN
Title	Wireless Power Receiver and Method of Manufacturing the Same
Art Unit	2836
Examiner Name	DEBERADINIS, ROBERT L
Attorney Docket Number	0106.001POA1

### SIGNATURE of Applicant or Patent Practitioner

Signature	/Khaled Shami/	Date (Optional)	
Name	Khaled Shami	Registration Number	38,745
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 \_\_\_\_\_ 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.*

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.

**CHANGE OF  
CORRESPONDENCE ADDRESS**  
*Patent*

Address to:  
Mail Stop Post Issue  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Patent Number	10,804,740
Issue Date	10-13-2020
Application Number	16/264,360
Filing Date	01-31-2019
First Named Inventor	JEONG WOOK AN
Attorney Docket Number	0106.001POA1

Please change the Correspondence Address for the above-identified patent to:

 The address associated with Customer Number:

151145

**OR**
 Firm or  
Individual Name
**Address****City****State****ZIP****Country****Telephone****Email**

This form cannot be used to change the data associated with a Customer Number. To change the data associated with an existing Customer Number use "Request for Customer Number Data Change" (PTO/SB/124).

This form will not affect any "fee address" provided for the above-identified patent. To change a "fee address" use the "Fee Address Indication Form" (PTO/SB/47).

I am the:

 Patentee.

 If the Patentee was not the applicant for patent (37 CFR 1.42), then a Statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is enclosed or was filed on \_\_\_\_\_. See 37 CFR 3.71.

 Attorney or agent of record. Registration Number 38,745.

 Patent practitioner acting in a representative capacity whose correspondence address is the correspondence address of record. Notice has been given to the patentee or owner. Registration Number 38,745.

Signature /Khaled Shami/

Typed or  
Printed Name KHALED SHAMI

Date April 6, 2021

Telephone 202-516-6901

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below\*.

 \*Total of \_\_\_\_\_ forms are submitted.

This collection of information is required by 37 CFR 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: Mail Stop Post Issue, 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.

## 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.

## Electronic Acknowledgement Receipt

<b>EFS ID:</b>	42375419
<b>Application Number:</b>	16264360
<b>International Application Number:</b>	
<b>Confirmation Number:</b>	7253
<b>Title of Invention:</b>	Wireless Power Receiver and Method of Manufacturing the Same
<b>First Named Inventor/Applicant Name:</b>	JEONG WOOK AN
<b>Customer Number:</b>	23557
<b>Filer:</b>	Khaled Shami/Susanh Perez
<b>Filer Authorized By:</b>	Khaled Shami
<b>Attorney Docket Number:</b>	SUN.LGI.420D3
<b>Receipt Date:</b>	06-APR-2021
<b>Filing Date:</b>	31-JAN-2019
<b>Time Stamp:</b>	15:34:31
<b>Application Type:</b>	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	Power of Attorney	0106000000_POASigned.pdf	1055768 a163da1e2fda2ffb59b2385b929b44750ed33a63	no	1

### Warnings:

Information:					
2	Assignee showing of ownership per 37 CFR 3.73	Pat_10804740_373_aia0096.pdf	137362 b8fe7bec4bd8afc6e8d5b003ce2daaf66ba72343	no	3
Warnings:					
Information:					
3	Transmittal Letter	Pat_10804740_POA_Transmittal.pdf	211493 f7bd87e7556f65e66290e2a49d7d10f222f7e73b	no	1
Warnings:					
Information:					
4	Change of Address	Pat_10804740_aia0123.pdf	245967 b8168fcd4f0a6c03c12559af70293b9be277a56a	no	2
Warnings:					
Information:					
<b>Total Files Size (in bytes):</b>				1650590	
<p><b>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.</b></p> <p><b><u>New Applications Under 35 U.S.C. 111</u></b>  <b>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.</b></p> <p><b><u>National Stage of an International Application under 35 U.S.C. 371</u></b>  <b>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.</b></p> <p><b><u>New International Application Filed with the USPTO as a Receiving Office</u></b>  <b>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.</b></p>					



# 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.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/264,360	10/13/2020	10804740	SUN.LGI.420D3	7253

23557                      7590                      09/23/2020  
SALIWANCHIK, LLOYD & EISENSCHENK  
A PROFESSIONAL ASSOCIATION  
P.O. BOX 142950  
GAINESVILLE, FL 32614

## ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

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

The Patent Term Adjustment is 85 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

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.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

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 Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site <http://pair.uspto.gov> for additional applicants):

LG INNOTEK CO., LTD., Seoul, KOREA, REPUBLIC OF;  
JEONG WOOK AN, Seoul, KOREA, REPUBLIC OF;  
JUNG OH LEE, Seoul, KOREA, REPUBLIC OF;  
SUNG HYUN LEEM, Seoul, KOREA, REPUBLIC OF;  
YANG HYUN KIM, Seoul, KOREA, REPUBLIC OF;

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 USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit [SelectUSA.gov](http://SelectUSA.gov).



**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)

23557 7590 06/24/2020  
SALIWANCHIK, LLOYD & EISENSCHENK  
A PROFESSIONAL ASSOCIATION  
P.O. BOX 142950  
GAINESVILLE, FL 32614

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.

**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.
16/264,360	01/31/2019	JEONG WOOK AN	SUN.LGI.420D3	7253

TITLE OF INVENTION: Wireless Power Receiver and Method of Manufacturing the Same

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$1000	\$0.00	\$0.00	\$1000	09/24/2020

EXAMINER	ART UNIT	CLASS-SUBCLASS
DEBERADINIS, ROBERT L	2836	307-104000

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/SB/122) attached.
- "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 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.

Saliwanchik, Lloyd &  
1. Eisenschek  
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

LG INNOTEK CO., LTD.

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

Seoul, 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. 190065

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: 3 Sept. 2020  
Typed or printed name: Jeff Lloyd Registration No. 35,589

## Electronic Patent Application Fee Transmittal

<b>Application Number:</b>	16264360			
<b>Filing Date:</b>	31-Jan-2019			
<b>Title of Invention:</b>	Wireless Power Receiver and Method of Manufacturing the Same			
<b>First Named Inventor/Applicant Name:</b>	JEONG WOOK AN			
<b>Filer:</b>	Jeff Lloyd/Natalie Stevenson			
<b>Attorney Docket Number:</b>	SUN.LGI.420D3			
Filed as Large Entity				
<b>Filing Fees for Utility under 35 USC 111(a)</b>				
<b>Description</b>	<b>Fee Code</b>	<b>Quantity</b>	<b>Amount</b>	<b>Sub-Total in USD(\$)</b>
<b>Basic Filing:</b>				
<b>Pages:</b>				
<b>Claims:</b>				
<b>Miscellaneous-Filing:</b>				
<b>Petition:</b>				
<b>Patent-Appeals-and-Interference:</b>				
<b>Post-Allowance-and-Post-Issuance:</b>				
UTILITY APPL ISSUE FEE	1501	1	1000	1000

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
<b>Extension-of-Time:</b>				
<b>Miscellaneous:</b>				
<b>Total in USD (\$)</b>				<b>1000</b>

## Electronic Acknowledgement Receipt

<b>EFS ID:</b>	40469173
<b>Application Number:</b>	16264360
<b>International Application Number:</b>	
<b>Confirmation Number:</b>	7253
<b>Title of Invention:</b>	Wireless Power Receiver and Method of Manufacturing the Same
<b>First Named Inventor/Applicant Name:</b>	JEONG WOOK AN
<b>Customer Number:</b>	23557
<b>Filer:</b>	Jeff Lloyd/Natalie Stevenson
<b>Filer Authorized By:</b>	Jeff Lloyd
<b>Attorney Docket Number:</b>	SUN.LGI.420D3
<b>Receipt Date:</b>	03-SEP-2020
<b>Filing Date:</b>	31-JAN-2019
<b>Time Stamp:</b>	16:45:29
<b>Application Type:</b>	Utility under 35 USC 111(a)

### Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	\$1000
RAM confirmation Number	E202093G46439262
Deposit Account	190065
Authorized User	Natalie Stevenson

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)

37 CFR 1.19 (Document supply fees)  
 37 CFR 1.20 (Post Issuance fees)  
 37 CFR 1.21 (Miscellaneous fees and charges)

**File Listing:**

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	IFP-AF.pdf	140606	no	1
			dfd74f88ef31d827fa5053b7e91e86901892e4aa		

**Warnings:**

**Information:**

2	Fee Worksheet (SB06)	fee-info.pdf	30426	no	2
			b3c603276073534228bd6eaf62ae4ab178577252		

**Warnings:**

**Information:**

<b>Total Files Size (in bytes):</b>	171032
-------------------------------------	--------

**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.



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

NOTICE OF ALLOWANCE AND FEE(S) DUE

23557 7590 06/24/2020
SALIWANCIK, LLOYD & EISENSCHENK
A PROFESSIONAL ASSOCIATION
P.O. BOX 142950
GAINESVILLE, FL 32614

EXAMINER
DEBERADINIS, ROBERT L

ART UNIT PAPER NUMBER
2836

DATE MAILED: 06/24/2020

Table with 5 columns: APPLICATION NO., FILING DATE, FIRST NAMED INVENTOR, ATTORNEY DOCKET NO., CONFIRMATION NO.
Values: 16/264,360, 01/31/2019, JEONG WOOK AN, SUN.LGI.420D3, 7253

TITLE OF INVENTION: Wireless Power Receiver and Method of Manufacturing the Same

Table with 7 columns: APPLN. TYPE, ENTITY STATUS, ISSUE FEE DUE, PUBLICATION FEE DUE, PREV. PAID ISSUE FEE, TOTAL FEE(S) DUE, DATE DUE
Values: nonprovisional, UNDISCOUNTED, \$1000, \$0.00, \$0.00, \$1000, 09/24/2020

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 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity 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 and an extra copy of the form should be submitted. 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)

23557                      7590                      06/24/2020  
**SALIWANCIK, LLOYD & EISENSCHENK**  
 A PROFESSIONAL ASSOCIATION  
 P.O. BOX 142950  
 GAINESVILLE, FL 32614

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.

**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.
16/264,360	01/31/2019	JEONG WOOK AN	SUN.LGI.420D3	7253

TITLE OF INVENTION: Wireless Power Receiver and Method of Manufacturing the Same

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$1000	\$0.00	\$0.00	\$1000	09/24/2020

EXAMINER	ART UNIT	CLASS-SUBCLASS
DEBERADINIS, ROBERT L	2836	307-104000

<p>1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).</p> <p><input type="checkbox"/> Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.</p> <p><input type="checkbox"/> "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. <b>Use of a Customer Number is required.</b></p>	<p>2. For printing on the patent front page, list</p> <p>(1) The names of up to 3 registered patent attorneys or agents OR, alternatively, _____ 1</p> <p>(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. _____ 2</p> <p>_____ 3</p>
---	---

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. \_\_\_\_\_



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

Table with 5 columns: APPLICATION NO., FILING DATE, FIRST NAMED INVENTOR, ATTORNEY DOCKET NO., CONFIRMATION NO.
Row 1: 16/264,360, 01/31/2019, JEONG WOOK AN, SUN.LGI.420D3, 7253
Row 2: 23557, 7590, 06/24/2020, EXAMINER DEBERADINIS, ROBERT L.
Row 3: SALIWANCIK, LLOYD & EISENSCHENK, ART UNIT 2836, PAPER NUMBER
Row 4: A PROFESSIONAL ASSOCIATION, DATE MAILED: 06/24/2020
Row 5: P.O. BOX 142950
Row 6: GAINESVILLE, FL 32614

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.

<b>Notice of Allowability</b>	<b>Application No.</b> 16/264,360	<b>Applicant(s)</b> AN et al.	
	<b>Examiner</b> ROBERT L DEBERADINIS	<b>Art Unit</b> 2836	<b>AIA (FITF) Status</b> No

**-- 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 12/10/19.  
 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 21-40. 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](http://www.uspto.gov/patents/init_events/pph/index.jsp) or send an inquiry to [PPHfeedback@uspto.gov](mailto: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. <input type="checkbox"/> Notice of References Cited (PTO-892)  | 5. <input type="checkbox"/> Examiner's Amendment/Comment                             |
| 2. <input checked="" type="checkbox"/> Information Disclosure Statements (PTO/SB/08),<br>Paper No./Mail Date <u>12/10/19,4/26/19, 1/31/19</u> . | 6. <input checked="" type="checkbox"/> Examiner's Statement of Reasons for Allowance |
| 3. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit<br>of Biological Material _____.                               | 7. <input type="checkbox"/> Other _____.   |
| 4. <input type="checkbox"/> Interview Summary (PTO-413),<br>Paper No./Mail Date. _____.   |  |

/ROBERT L DEBERADINIS/  
Primary Examiner, Art Unit 2836

**DETAILED ACTION**

***Notice of Pre-AIA or AIA Status***

The present application is being examined under the pre-AIA first to invent provisions.

***Allowable Subject Matter***

Claims 21-20 allowed.

The following is an examiner's statement of reasons for allowance: the prior art of record does not disclose or suggest a wireless power receiver, comprising, inter alia, a connecting unit as claimed.

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."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ROBERT L DEBERADINIS whose telephone number is (571)272-2049. The examiner can normally be reached on 9 am to 6 pm.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at <http://www.uspto.gov/interviewpractice>.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jared Fureman can be reached on 571 272 2391. 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 <https://ppair-my.uspto.gov/pair/PrivatePair>. Should you have questions on access to the Private PAIR system, contact


Application/Control Number: 16/264,360  
Art Unit: 2836

Page 3

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.

June 12, 2020

/ROBERT L DEBERADINIS/  
Primary Examiner, Art Unit 2836

<b><i>Search Notes</i></b> 	<b>Application/Control No.</b> 16/264,360	<b>Applicant(s)/Patent Under Reexamination</b> AN et al.
	<b>Examiner</b> ROBERT L DEBERADINIS	<b>Art Unit</b> 2836

CPC - Searched*		
Symbol	Date	Examiner
H02J 50/10,50/12,50/70,5/005,7/025, B60L 53/12, G06K 19/0723, H01F 38/14,41/14, H04B 5/0081,5/0037, Y10T 29/4902, H04W 4/80, Y02T 10/7005,10/7072,90/122,90/14,90/16, G06K 19/07, H02J 5/00,7/02, H04B 5/00	06/12/2020	RLD

CPC Combination Sets - Searched*		
Symbol	Date	Examiner


US Classification - Searched*			
Class	Subclass	Date	Examiner

\* 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
TEXT	06/12/2020	RLD

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
INTERFEREN CE		06/12/2020	RLD


/ROBERT L DEBERADINIS/ Primary Examiner, Art Unit 2836	
---	--

<b>Issue Classification</b> 	<b>Application/Control No.</b> 16/264,360	<b>Applicant(s)/Patent Under Reexamination</b> AN et al.
	<b>Examiner</b> ROBERT L DEBERADINIS	<b>Art Unit</b> 2836

CPC						
Symbol					Type	Version
H02J	/	50	/	10	F	2016-02-01
H02J	/	50	/	70	I	2016-02-01
G06K	/	19	/	0723	I	2013-01-01
H02J	/	5	/	005	I	2020-01-01
H02J	/	7	/	025	I	2020-01-01
B60L	/	53	/	12	I	2019-02-01
H01F	/	41	/	14	I	2013-01-01
H04B	/	5	/	0037	I	2013-01-01
H04B	/	5	/	0081	I	2013-01-01
H02J	/	50	/	12	I	2016-02-01
H01F	/	38	/	14	I	2013-01-01
Y10T	/	29	/	4902	A	2015-01-15
Y02T	/	10	/	7005	A	2013-01-01
Y02T	/	90	/	16	A	2013-01-01
Y02T	/	90	/	14	A	2013-01-01
Y02T	/	10	/	7072	A	2013-01-01
Y02T	/	90	/	122	A	2013-01-01
H04W	/	4	/	80	A	2018-02-01

CPC Combination Sets				
Symbol	Type	Set	Ranking	Version
/	/			

NONE		<b>Total Claims Allowed:</b>	
(Assistant Examiner)	(Date)	20	
/ROBERT L DEBERADINIS/ Primary Examiner, Art Unit 2836	12 June 2020	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	21	1

<b>Issue Classification</b> 	<b>Application/Control No.</b> 16/264,360	<b>Applicant(s)/Patent Under Reexamination</b> AN et al.
	<b>Examiner</b> ROBERT L DEBERADINIS	<b>Art Unit</b> 2836


<b>INTERNATIONAL CLASSIFICATION</b>			
<b>CLAIMED</b>			
H02J		50	10

<b>NON-CLAIMED</b>			
G06K19/07		19	07
H02J5/00		5	00
H02J7/02		7	02
H04B5/00		5	00

<b>US ORIGINAL CLASSIFICATION</b>	
<b>CLASS</b>	<b>SUBCLASS</b>

<b>CROSS REFERENCES(S)</b>					
<b>CLASS</b>	<b>SUBCLASS (ONE SUBCLASS PER BLOCK)</b>				

NONE		<b>Total Claims Allowed:</b>	
(Assistant Examiner)	(Date)	20	
/ROBERT L DEBERADINIS/ Primary Examiner, Art Unit 2836	12 June 2020	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	21	1

<b>Issue Classification</b> 	<b>Application/Control No.</b> 16/264,360	<b>Applicant(s)/Patent Under Reexamination</b> AN et al.
	<b>Examiner</b> ROBERT L DEBERADINIS	<b>Art Unit</b> 2836

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		10		19	8	28	17	37						
	2		11		20	9	29	18	38						
	3		12	1	21	10	30	19	39						
	4		13	2	22	11	31	20	40						
	5		14	3	23	12	32								
	6		15	4	24	13	33								
	7		16	5	25	14	34								
	8		17	6	26	15	35								
	9		18	7	27	16	36								

NONE		<b>Total Claims Allowed:</b>	
(Assistant Examiner)	(Date)	20	
/ROBERT L DEBERADINIS/ Primary Examiner, Art Unit 2836	12 June 2020	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	21	1



PTO/SB/08A (08-03)

Approved for use through 07/31/2006. 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 1449A/PTO  <b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  (use as many sheets as necessary)			<b>Complete if Known</b>		
			Application Number	16/264,360	
			Filing Date	January 31, 2019	
			First Named Inventor	Jeong Wook An	
			Art Unit	2836	
			Examiner Name		
Sheet	1	of	1	Attorney Docket Number	SUN.LGI.420D3

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. <sup>1</sup>	Document Number Number - Kind Code <sup>2</sup> (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
/R.L.D./	U1	8,177,137-B2	05-15-2012	Arai	ALL
/R.L.D./	U2	9,053,406-B2	06-09-2015	Higashiyama	ALL

FOREIGN PATENT DOCUMENTS						
Examiner Initials*	Cite No. <sup>1</sup>	Foreign Patent Document Country Code <sup>3</sup> - Number <sup>4</sup> - Kind Code <sup>5</sup> (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T <sup>6</sup>
/R.L.D./	F1	CN-101140635-A (with English Abstract) (Equivalent to U.S. Patent No. 8,177,137-B2)	03-12-2008	SEMICONDUCTOR ENERGY LAB	ALL	
/R.L.D./	F2	JP-2004-153463-A (with English Abstract)	05-27-2004	SONY ERICSSON MOBILECOMMUNIC ATIONS JAPAN INC	ALL	
/R.L.D./	F3	JPH11-175676-A (with English Abstract)	07-02-1999	HITACHI MAXELL LTD	ALL	
/R.L.D./	F4	JP-2007-311407-A (with English Abstract)	11-29-2007	DAINIPPON PRINTING CO LTD	ALL	
/R.L.D./	F5	JP-2012-008857-A (with English Abstract) (Equivalent to U.S. Patent No. 9,053,406-B2)	01-12-2012	TOYO ALUMINIUM KK	ALL	

ON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No. <sup>1</sup>	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 <sup>2</sup>
/R.L.D./	R1	Office Action dated February 2, 2019 in Chinese Application No. 201710325326.5.	
/R.L.D./	R2	Office Action dated February 25, 2019 in Japanese Application No. 2018-012053.	

Examiner Signature	/ROBERT L DEBERADINIS/	Date Considered	06/12/2020
--------------------	------------------------	-----------------	------------

\*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.

<sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> Applicant is to place a check mark here if English language Translation is attached.

This collection of information is required by 37 CFR 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 2 hours 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, 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 (1-800-786-9199) and select option 2.

PTO/SB/08A (08-03)  
 Approved for use through 07/31/2006. 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 1449A/PTO  <b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  (use as many sheets as necessary)			<b>Complete if Known</b>		
			Application Number		
			Filing Date		January 31, 2019
			First Named Inventor		Jeong Wook AN
			Art Unit		
			Examiner Name		
Sheet	1	of	15	Attorney Docket Number	SUN.LGI.420D3

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. <sup>1</sup>	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number - Kind Code <sup>2</sup> (if known)			
	U1	2003/0141590-A1	07-31-2003	Kamiya <i>et al.</i>	ALL
	U2	2005/0046573-A1	03-03-2005	De Velasco <i>et al.</i>	ALL
	U3	2005/0072595-A1	04-07-2005	Se-hoon Cho	ALL
	U4	2005/0079820-A1	04-14-2005	Yamashita	ALL
	U5	2005/0116874-A1	06-02-2005	El-Mahdawy <i>et al.</i>	ALL
	U6	2005/0275497-A1	12-15-2005	Ramadan <i>et al.</i>	ALL
	U7	2006/0166506-A1	07-27-2006	Okawa <i>et al.</i>	ALL
	U8	2007/0001921-A1	01-04-2007	Takahashi <i>et al.</i>	ALL
	U9	2007/0007661-A1	01-11-2007	Burgess <i>et al.</i>	ALL
	U10	2007/0020932-A1	01-25-2007	Maruyama <i>et al.</i>	ALL
	U11	2007/0069961-A1	03-29-2007	Akiho <i>et al.</i>	ALL
	U12	2007/0095913-A1	05-03-2007	Takahashi <i>et al.</i>	ALL
	U13	2007/0254432-A1	11-01-2007	Yamazaki <i>et al.</i>	ALL
	U14	2007/0279002-A1	12-06-2007	Afshin Partovi	ALL
	U15	2008/0055046-A1	03-06-2008	Shimizu	ALL
	U16	2008/0129439-A1	06-05-2008	Nishikawa <i>et al.</i>	ALL
	U17	2008/0164840-A1	07-10-2008	Kato <i>et al.</i>	ALL
	U18	2008/0197957-A1	08-21-2008	Kondo Yoichiro <i>et al.</i>	ALL
	U19	2008/0200210-A1	08-21-2008	Lim <i>et al.</i>	ALL
	U20	2008/0246664-A1	10-09-2008	Ikemoto <i>et al.</i>	ALL
	U21	2008/0266748-A1	10-30-2008	Hyung-Joo Lee	ALL

Examiner Signature	/ROBERT L DEBERADINIS/	Date Considered	06/12/2020
--------------------	------------------------	-----------------	------------

\*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. <sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> See Kind Codes of USPTO Patent Documents at [www.uspto.gov](http://www.uspto.gov) or MPEP901.04. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached.

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 2 hours 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, 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 (1-800-786-9199) and select option 2.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /R.L.D./

J:\SUNLGI\420D3\MDS-Ref\sl-31-19\PTO-SB-08.doc\lcm

PTO/SB/08A (08-03)

Approved for use through 07/31/2006 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 1449A/PTO  <b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  (use as many sheets as necessary)			<b>Complete if Known</b>			
			Application Number			
			Filing Date		January 31, 2019	
			First Named Inventor		Jeong Wook AN	
			Art Unit			
			Examiner Name			
Sheet	2	of	15	Attorney Docket Number	SUN.LGI.420D3	

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. <sup>1</sup>	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number - Kind Code <sup>2</sup> (if known)			
	U22	2008/0122570-A1	05-29-2008	Takaishi Konomu	ALL
	U23	2008/0154178-A1	06-26-2008	Carter Darrick <i>et al.</i>	ALL
	U24	2008/0303735-A1	12-11-2008	Fujimoto <i>et al.</i>	ALL
	U25	2009/0029185-A1	01-29-2009	Lee <i>et al.</i>	ALL
	U26	2009/0058737-A1	03-05-2009	TSUJIMURA <i>et al.</i>	ALL
	U27	2009/0108974-A1	04-30-2009	Raggam <i>et al.</i>	ALL
	U28	2009/0115681-A1	05-07-2009	Lai <i>et al.</i>	ALL
	U29	2009/0314842-A1	12-24-2009	Charrin	ALL
	U30	2009/0315680-A1	12-24-2009	Arimura	ALL
	U31	2009/0058358-A1	03-05-2009	Inoue Tetsuo <i>et al.</i>	ALL
	U32	2010/0156735-A1	06-24-2010	Nakamura <i>et al.</i>	ALL
	U33	2010/0265041-A1	10-21-2010	ALMOG <i>et al.</i>	ALL
	U34	2010/0277004-A1	11-04-2010	Suzuki <i>et al.</i>	ALL
	U35	2010/0289341-A1	11-18-2010	Ozaki <i>et al.</i>	ALL
	U36	2010/0295682-A1	11-25-2010	August <i>et al.</i>	ALL
	U37	2010/0308187-A1	12-09-2010	Pi-Fen Lin	ALL
	U38	2011/0032685-A1	02-10-2011	Akiba <i>et al.</i>	ALL
	U39	2011/0127070-A1	06-02-2011	Ahn <i>et al.</i>	ALL
	U40	2011/0267248-A1	11-03-2011	Remski <i>et al.</i>	ALL

Examiner Signature	/ROBERT L DEBERADINIS/	Date Considered	06/12/2020
--------------------	------------------------	-----------------	------------

\*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. <sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> See Kind Codes of USPTO Patent Documents at [www.uspto.gov](http://www.uspto.gov) or MPEP901.04. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached.

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 2 hours 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, 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 (1-800-786-9199) and select option 2.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /R.L.D/

PTO/SB/08A (08-03)  
 Approved for use through 07/31/2006. 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 1449A/PTO  <b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  (use as many sheets as necessary)		<i>Complete if Known</i>	
		Application Number	
		Filing Date	January 31, 2019
		First Named Inventor	Jeong Wook AN
		Art Unit	
		Examiner Name	
Sheet	3	of	15
		Attorney Docket Number	SUN.LGI.420D3

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. <sup>1</sup>	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number - Kind Code <sup>2</sup> (if known)			
	U41	2011/0285494-A1	11-24-2011	Jeong <i>et al.</i>	ALL
	U42	2011/0302770-A1	12-15-2011	Radenne <i>et al.</i>	ALL
	U43	2011/0312382-A1	12-22-2011	Itay <i>et al.</i>	ALL
	U44	2011/0050164-A1	03-03-2011	Partovi <i>et al.</i>	ALL
	U45	2012/0001701-A1	01-05-2012	Taniguchi <i>et al.</i>	ALL
	U46	2012/0019075-A1	01-26-2012	In-Kui Cho <i>et al.</i>	ALL
	U47	2012/0044114-A1	02-23-2012	Eom <i>et al.</i>	ALL
	U48	2012/0049986-A1	03-01-2012	In-Kui Cho <i>et al.</i>	ALL
	U49	2012/0057322-A1	03-08-2012	Waffenschmidt Eberhard	ALL
	U50	2012/0058722-A1	03-08-2012	LO <i>et al.</i>	ALL
	U51	2012/0092222-A1	04-19-2012	KATO <i>et al.</i>	ALL
	U52	2012/0187767-A1	07-26-2012	Kanno <i>et al.</i>	ALL
	U53	2012/0248981-A1	10-04-2012	Karalis <i>et al.</i>	ALL
	U54	2012/0249276-A1	10-04-2012	FONTANA <i>et al.</i>	ALL
	U55	2012/0274148-A1	11-01-2012	Sung <i>et al.</i>	ALL
	U56	2013/0038278-A1	02-14-2013	Park <i>et al.</i>	ALL
	U57	2013/0038497-A1	02-14-2013	Chae <i>et al.</i>	ALL
	U58	2013/0069444-A1	03-21-2013	Waffenschmidt <i>et al.</i>	ALL
	U59	2013/0106198-A1	05-02-2013	Kuk <i>et al.</i>	ALL
	U60	2013/0113422-A1	05-09-2013	LEE <i>et al.</i>	ALL

Examiner Signature	/ROBERT L DEBERADINIS/	Date Considered	06/12/2020
--------------------	------------------------	-----------------	------------

\*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. <sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> See Kind Codes of USPTO Patent Documents at [www.uspto.gov](http://www.uspto.gov) or MPEP901.04. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached.

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 2 hours 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, 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 (1-800-786-9199) and select option 2.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /R.L.D/

PTO/SB/08A (08-03)

Approved for use through 07/31/2006. 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 1449A/PTO <b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b> (use as many sheets as necessary)				<b>Complete if Known</b>		
				Application Number		
Sheet		4	of	15	Attorney Docket Number	SUN.LGI.420D3
					Filing Date	January 31, 2019
					First Named Inventor	Jeong Wook AN
					Art Unit	
					Examiner Name	

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. <sup>1</sup>	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number - Kind Code <sup>2</sup> (if known)			
	U61	2013/0176179-A1	07-11-2013	Park	ALL
	U62	2013/0200716-A1	08-08-2013	Kesler <i>et al.</i>	ALL
	U63	2013/0249302-A1	09-26-2013	AN <i>et al.</i>	ALL
	U64	2013/0267170-A1	10-10-2013	CHONG <i>et al.</i>	ALL
	U65	2013/0271328-A1	10-17-2013	Nickel <i>et al.</i>	ALL
	U66	2013/0285783-A1	10-31-2013	YUSSOF <i>et al.</i>	ALL
	U67	2013/0308256-A1	11-21-2013	Lehr <i>et al.</i>	ALL
	U68	2014/0062827-A1	03-06-2014	KATO	ALL
	U69	2014/0091640-A1	04-03-2014	Scholz <i>et al.</i>	ALL
	U70	2014/0091758-A1	04-03-2014	Hidaka <i>et al.</i>	ALL
	U71	2014/0145906-A1	05-29-2014	KATO <i>et al.</i>	ALL
	U72	2014/0168019-A1	06-19-2014	Hirobe <i>et al.</i>	ALL
	U73	2014/0168026-A1	06-19-2014	Nakamura <i>et al.</i>	ALL
	U74	2014/0176384-A1	07-26-2014	YOSUI <i>et al.</i>	ALL
	U75	2014/0184462-A1	07-03-2014	YOSUI	ALL
	U76	2014/0210406-A1	07-31-2014	Na <i>et al.</i>	ALL
	U77	2014/0226293-A1	08-14-2014	SATO	ALL
	U78	2014/0266030-A1	09-18-2014	PARK <i>et al.</i>	ALL
	U79	2015/0054455-A1	02-26-2015	Kim <i>et al.</i>	ALL
	U80	2015/0054457-A1	02-26-2015	Kim	ALL
	U81	2015/0061400-A1	03-05-2015	PARK <i>et al.</i>	ALL

Examiner Signature	/ROBERT L DEBERADINIS/	Date Considered	06/12/2020
--------------------	------------------------	-----------------	------------

\*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. <sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> See Kind Codes of USPTO Patent Documents at [www.uspto.gov](http://www.uspto.gov) or MPEP901.04. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached.

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 2 hours 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, 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 (1-800-786-9199) and select option 2.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /R.L.D./

PTO/SB/08A (08-03)  
 Approved for use through 07/31/2006. 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 1449A/PTO				<b>Complete if Known</b>	
				Application Number	
<b>INFORMATION DISCLOSURE                  STATEMENT BY APPLICANT</b>  (use as many sheets as necessary)				Filing Date	January 31, 2019
				First Named Inventor	Jeong Wook AN
				Art Unit	
				Examiner Name	
				Attorney Docket Number	SUN.LGI.420D3
Sheet	5	of	15		

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. <sup>1</sup>	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number - Kind Code <sup>2</sup> (if known)			
	U82	2015/0077296-A1	03-19-2015	An <i>et al.</i>	ALL
	U83	2015/0116178-A1	04-30-2015	Kim <i>et al.</i>	ALL
	U84	2015/0123604-A1	05-07-2015	Lee <i>et al.</i>	ALL
	U85	2015/0145635-A1	05-28-2015	Kurz <i>et al.</i>	ALL
	U86	2015/0171519-A1	06-18-2015	Han <i>et al.</i>	ALL
	U87	2015/0207207-A1	07-23-2015	Park <i>et al.</i>	ALL
	U88	2015/0222017-A1	08-06-2015	KUMURA <i>et al.</i>	ALL
	U89	2015/0281873-A1	10-01-2015	OJALA	ALL
	U90	2016/0064814-A1	03-03-2016	Jang <i>et al.</i>	ALL
	U91	2016/0118711-A1	04-28-2016	Finn <i>et al.</i>	ALL
	U92	2016/0126002-A1	05-05-2016	CHIEN <i>et al.</i>	ALL
	U93	2016/0188926-A1	06-30-2016	Pachler <i>et al.</i>	ALL
	U94	2016/0204836-A1	07-14-2016	LEE <i>et al.</i>	ALL
	U95	2016/0224975-A1	08-04-2016	NA <i>et al.</i>	ALL
	U96	2016/0315497-A1	10-27-2016	KIM <i>et al.</i>	ALL
	U97	2016/0345125-A1	11-24-2016	Kim <i>et al.</i>	ALL
	U98	2017/0040696-A1	02-09-2017	Peralta <i>et al.</i>	ALL
	U99	2017/0054213-A1	02-23-2017	Singh <i>et al.</i>	ALL
	U100	2017/0213644-A1	07-27-2017	Lee <i>et al.</i>	ALL
	U101	2017/0317519-A1	11-02-2017	YEOM <i>et al.</i>	ALL
	U102	2017/0338562-A1	11-23-2017	Ozenne <i>et al.</i>	ALL

Examiner Signature	/ROBERT L DEBERADINIS/	Date Considered	06/12/2020
--------------------	------------------------	-----------------	------------

\*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. <sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> See Kind Codes of USPTO Patent Documents at [www.uspto.gov](http://www.uspto.gov) or MPEP901.04. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached.

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 2 hours 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, 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 (1-800-786-9199) and select option 2.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /R.L.D/

PTO/SB/08A (08-03)  
 Approved for use through 07/31/2006. 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 1449A/PTO <b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b> (use as many sheets as necessary)				<b>Complete if Known</b>		
				Application Number		
Sheet		6	of	15	Filing Date	January 31, 2019
					First Named Inventor	Jeong Wook AN
					Art Unit	
					Examiner Name	
					Attorney Docket Number	SUN.LGI.420D3

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. <sup>1</sup>	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number - Kind Code <sup>2</sup> (if known)			
	U103	2017/0345535-A1	11-30-2017	KIM <i>et al.</i>	ALL
	U104	2018/0076650-A1	03-15-2018	Yamaguchi <i>et al.</i>	ALL
	U105	2018/0189627-A1	07-05-2018	Kwon <i>et al.</i>	ALL
	U106	2018/0248255-A1	08-30-2018	NOH <i>et al.</i>	ALL
	U107	2018/0287243-A1	10-04-2018	KO <i>et al.</i>	ALL
	U108	4,947,180-A	08-07-1990	Scholz	ALL
	U109	5,574,470-A	11-12-1996	de Vall	ALL
	U110	6,008,622-A	12-28-1999	Nakawatase Norio	ALL
	U111	6,575,374-B1	06-10-2003	Boyadjian <i>et al.</i>	ALL
	U112	6,950,023-B1	09-27-2005	Martin	ALL
	U113	7,113,137-B2	09-26-2006	Bisig	ALL
	U114	7,259,672-B2	08-21-2007	Takei	ALL
	U115	7,712,672-B2	05-11-2010	Takahashi <i>et al.</i>	ALL
	U116	7,971,339-B2	07-05-2011	Finn	ALL
	U117	8,159,182-B2	04-17-2012	Kato <i>et al.</i>	ALL
	U118	8,514,135-B2	08-20-2013	Jang <i>et al.</i>	ALL
	U119	8,792,837-B2	07-29-2014	Deguchi <i>et al.</i>	ALL
	U120	8,947,189-B2	02-03-2015	Maruyama <i>et al.</i>	ALL
	U121	9,105,967-B2	08-11-2015	Park	ALL

Examiner Signature	/ROBERT L DEBERADINIS/	Date Considered	06/12/2020
--------------------	------------------------	-----------------	------------

\*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. <sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> See Kind Codes of USPTO Patent Documents at [www.uspto.gov](http://www.uspto.gov) or MPEP901.04. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached.

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 2 hours 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, 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 (1-800-786-9199) and select option 2.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /R.L.D/

PTO/SB/08A (08-03)  
 Approved for use through 07/31/2006. 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 1449A/PTO  <b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  (use as many sheets as necessary)				<b>Complete if Known</b>		
				Application Number		
Sheet		7	of	15	Filing Date	January 31, 2019
					First Named Inventor	Jeong Wook AN
					Art Unit	
					Examiner Name	
					Attorney Docket Number	SUN.LGI.420D3

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. <sup>1</sup>	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number - Kind Code <sup>2</sup> (if known)			
	U122	9,165,708-B2	10-20-2015	Lim <i>et al.</i>	ALL
	U123	9,276,642-B2	03-01-2016	Shostak	ALL
	U124	9,450,303-B2	09-20-2016	Su <i>et al.</i>	ALL
	U125	9,460,847-B2	10-04-2016	Lee <i>et al.</i>	ALL
	U126	9,484,768-B2	11-01-2016	Park <i>et al.</i>	ALL
	U127	9,515,513-B2	12-06-2016	Suzuki <i>et al.</i>	ALL
	U128	9,543,653-B2	01-10-2017	Han <i>et al.</i>	ALL
	U129	9,553,476-B2	01-24-2017	An <i>et al.</i>	ALL
	U130	9,607,757-B2	03-28-2017	Hirobe <i>et al.</i>	ALL
	U131	9,673,509-B2	06-06-2017	Park <i>et al.</i>	ALL
	U132	9,674,646-B2	06-06-2017	Jang <i>et al.</i>	ALL
	U133	9,761,928-B2	09-12-2017	Han <i>et al.</i>	ALL
	U134	9,825,484-B2	11-21-2017	Van Bosch <i>et al.</i>	ALL
	U135	9,843,215-B2	12-12-2017	Yeom <i>et al.</i>	ALL
	U136	9,941,576-B2	04-10-2018	Ito <i>et al.</i>	ALL
	U137	9,941,729-B2	04-10-2018	Peralta <i>et al.</i>	ALL
	U138	9,941,743-B2	04-10-2018	Peralta <i>et al.</i>	ALL
	U139	9,948,129-B2	04-17-2018	Singh <i>et al.</i>	ALL
	U140	9,960,629-B2	05-01-2018	Rajagopalan <i>et al.</i>	ALL
	U141	9,991,735-B1	06-05-2018	Yamaguchi <i>et al.</i>	ALL

Examiner Signature	/ROBERT L DEBERADINIS/	Date Considered	06/12/2020
--------------------	------------------------	-----------------	------------

\*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. <sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> See Kind Codes of USPTO Patent Documents at [www.uspto.gov](http://www.uspto.gov) or MPEP901.04. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached.

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 2 hours 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, 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 (1-800-786-9199) and select option 2.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /R.L.D./



PTO/SB/08A (08-03)  
 Approved for use through 07/31/2006 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 1449A/PTO  <b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  (use as many sheets as necessary)			<b>Complete if Known</b>					
			Application Number					
			Filing Date			January 31, 2019		
			First Named Inventor			Jeong Wook AN		
			Art Unit					
			Examiner Name					
Sheet	8	of	15	Attorney Docket Number	SUN.LGI.420D3			

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. <sup>1</sup>	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number - Kind Code <sup>2</sup> (if known)			
	U142	9,991,744-B2	06-05-2018	Lee <i>et al.</i>	ALL
	U143	10,003,120-B2	06-19-2018	Kang <i>et al.</i>	ALL
	U144	10,063,100-B2	08-28-2018	Singh <i>et al.</i>	ALL
	U145	10,014,577-B2	07-03-2018	Cao	ALL
	U146	10,110,052-B2	10-23-2018	YEOM <i>et al.</i>	ALL
	U147	2013/0169398-A1	07-04-2013	Sugita <i>et al.</i>	ALL

FOREIGN PATENT DOCUMENTS							
Examiner Initials*	Cite No. <sup>1</sup>	Foreign Patent Document		Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T <sup>6</sup>
		Country Code <sup>3</sup>	Number <sup>4</sup> - Kind Code <sup>5</sup> (if known)				
	F1		CN-101256876-A (With English Abstract)	09-03-2008	TDK Corp.	ALL	
	F2		CN-101924398-A (With English Abstract)	12-22-2010	Zhongyou <i>et al.</i>	ALL	
	F3		CN-102083280-A (With English Abstract)	06-01-2011	LG Innotek Co., Ltd.	ALL	
	F4		CN-102360718-A (With English Abstract)	02-22-2012	Samsung Electro Mechanics K.K.	ALL	
	F5		CN-1784510-A (With English Abstract)	06-07-2006	TDK Corp.	ALL	
	F6		EP-02642632-A2 (Equivalent to US 2013/0249302-A1)	09-25-2013	LG Innoteck Co., Ltd.	ALL	
	F7		EP-02752943-A1 (Equivalent to US 9,460,847-B2)	07-09-2014	LG Innoteck Co., Ltd.	ALL	

Examiner Signature	/ROBERT L DEBERADINIS/	Date Considered	06/12/2020
--------------------	------------------------	-----------------	------------

\*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. <sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> See Kind Codes of USPTO Patent Documents at [www.uspto.gov](http://www.uspto.gov) or MPEP901.04. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached.

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 2 hours 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, 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 (1-800-786-9199) and select option 2.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /R.L.D./

PTO/SB/08A (08-03)

Approved for use through 07/31/2006. 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 1449A/PTO  <b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  (use as many sheets as necessary)			<i>Complete if Known</i>			
			Application Number			
			Filing Date		January 31, 2019	
			First Named Inventor		Jeong Wook AN	
			Art Unit			
			Examiner Name			
Sheet	9	of	15	Attorney Docket Number	SUN.LGI.420D3	

FOREIGN PATENT DOCUMENTS							
Examiner Initials*	Cite No. <sup>1</sup>	Foreign Patent Document		Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T <sup>6</sup>
		Country Code <sup>3</sup>	Number <sup>4</sup> - Kind Code <sup>5</sup> (if known)				
	F8		JP-2004110854-A (With English Abstract)	04-08-2004	Toshiba Corp. <i>et al.</i>	ALL	
	F9		JP-2004364199-A (With English Abstract)	12-24-2004	Sony Corp.	ALL	
	F10		JP-2006-042519-A (With English Abstract)	02-09-2006	Seiko Epson Corp.	ALL	
	F11		JP-2008-027015-A (With English Abstract)	02-07-2008	Dainippon Printing Co., Ltd.	ALL	
	F12		JP-2008-172872-A (With English Abstract)	07-24-2008	Sony Ericsson Mobile Comm, et al.	ALL	
	F13		JP-2008-205215-A (With English Abstract)	09-04-2008	Seiko Epson Corp.	ALL	
	F14		JP-2008-210861-A (With English Abstract)	09-11-2008	Yonezawa Densen <i>et al.</i>	ALL	
	F15		JP-2009033106-A (With English Abstract)	02-12-2009	Taida Electronic Ind. Co. Ltd.	ALL	
	F16		JP-2011-097534-A (With English Abstract)	05-12-2011	Tokai Rika Co., Ltd.	ALL	
	F17		JP-2012-010533-A (With English Abstract)	01-12-2012	Murata MFG Co., Ltd.	ALL	
	F18		JP-2012-0191134-A (With English Abstract)	10-04-2012	Murata Manufacturing Co.	ALL	
	F19		JP-2012019302-A (With English Abstract)	01-26-2012	Nec Tokin Corp.	ALL	
	F20		JP-2012-178959-A (With English Abstract)	09-13-2012	Equos Res. Co. Ltd.	ALL	
	F21		JP-H04-51115-U (With English Abstract)	04-30-1992	Hitachi Ferrite, Ltd.	ALL	

Examiner Signature	/ROBERT L DEBERADINIS/	Date Considered	06/12/2020
--------------------	------------------------	-----------------	------------

\*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. <sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> See Kind Codes of USPTO Patent Documents at [www.uspto.gov](http://www.uspto.gov) or MPEP901.04. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached.

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 2 hours 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, 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 (1-800-786-9199) and select option 2.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /R.L.D/

PTO/SB/08A (08-03)  
 Approved for use through 07/31/2006. 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 1449A/PTO				<b>Complete if Known</b>	
				<b>Application Number</b>	
<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  (use as many sheets as necessary)				<b>Filing Date</b>	January 31, 2019
				<b>First Named Inventor</b>	Jeong Wook AN
				<b>Art Unit</b>	
				<b>Examiner Name</b>	
				<b>Attorney Docket Number</b>	SUN.LGI.420D3
Sheet	10	of	15		

FOREIGN PATENT DOCUMENTS							
Examiner Initials*	Cite No. <sup>1</sup>	Foreign Patent Document		Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T <sup>6</sup>
		Country Code <sup>3</sup>	Number <sup>4</sup> - Kind Code <sup>5</sup> (if known)				
	F22	JP-H06-267746-A	(With English Abstract)	09-22-1994	Murata MFG Co., Ltd.	ALL	
	F23	JP-H07-074038-A	(With English Abstract)	03-17-1995	TDK Corp.	ALL	
	F24	JP-H08-79976-A	(With English Abstract)	03-22-1996	TDK Corp.	ALL	
	F25	JP-H10282232-A	(With English Abstract)	10-23-1998	Toshiba Corp.	ALL	
	F26	JP-S56-78415-U	(With English Abstract)	06-25-1981	Omron Corporation	ALL	
	F27	JP-S61-69811-U	(With English Abstract)	05-13-1986	Fui Denki Kagaku Kabushiki Kaisha	ALL	
	F28	KR-10-1177302-B1	(With English Abstract)	08-30-2012	Nanomag Co., Ltd.	ALL	
	F29	KR-1020040063286-A	(With English Abstract)	07-14-2004	Flex-Tech Co., Ltd.	ALL	
	F30	KR-10-2005-0120481-A	(With English Abstract)	12-22-2005	Samsung Techwin Co., Ltd.	ALL	
	F31	KR-10-2006-0008332-A	(With English Abstract)	01-26-2006	Sony Corp.	ALL	
	F32	KR-10-2008-0074640-A	(With English Abstract)	08-13-2008	Anyquitous Co., Ltd.	ALL	
	F33	KR-10-2010-0130480-A	(With English Abstract)	12-13-2010	UK Tech. Co. Ltd., et al.	ALL	
	F34	KR-10-2012-0016778-A	(With English Abstract)	02-27-2012	Samsung Electronics Co., Ltd.	ALL	
	F35	KR-10-2012-0123375-A	(With English Abstract)	11-08-2012	Asahi Glass Co., Ltd.	ALL	

Examiner Signature	/ROBERT L DEBERADINIS/	Date Considered	06/12/2020
--------------------	------------------------	-----------------	------------

\*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. <sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> See Kind Codes of USPTO Patent Documents at [www.uspto.gov](http://www.uspto.gov) or MPEP901.04. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached.

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 2 hours 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, 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 (1-800-786-9199) and select option 2.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /R.L.D/

PTO/SB/08A (08-03)

Approved for use through 07/31/2006. 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 1449A/PTO <b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b> (use as many sheets as necessary)				<b>Complete if Known</b>		
				Application Number		
Sheet		11	of	15	Filing Date	January 31, 2019
					First Named Inventor	Jeong Wook AN
					Art Unit	
					Examiner Name	
					Attorney Docket Number	SUN.LGI.420D3

FOREIGN PATENT DOCUMENTS							
Examiner Initials*	Cite No. <sup>1</sup>	Foreign Patent Document		Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T <sup>6</sup>
		Country Code <sup>3</sup>	Number <sup>4</sup> - Kind Code <sup>5</sup> (if known)				
	F36		KR-1020130015618-A (With English Abstract)	02-14-2013	EMW Co., Ltd.	ALL	
	F37		KR-10-2013-0028301-A (With English Abstract)	03-19-2013	Se Gi Synthetic Environment Co., Ltd.	ALL	
	F38		KR-10-2013-0028302-A (With English Abstract)	03-19-2013	Osung Mega Power Co., Ltd.	ALL	
	F39		KR-10-2014-0113205-A (With English Abstract)	09-24-2014	LG INNOTEK CO., LTD	ALL	
	F40		TW-M424550-U1 (With English Abstract)	03-11-2012	TDK Taiwan Corp.	ALL	
	F41		WO-2012008693-A2 (With English Abstract)	01-19-2012	Hanrim Postech. Co. Ltd. <i>et al.</i>	ALL	
	F42		WO-2012150293-A1 (With English Abstract)	11-08-2012	Scholz <i>et al.</i>	ALL	
	F43		CN-1816945-A (With English Abstract) (Equivalent to US 2007/0095913)	08-09-2006	SONY CORP	ALL	
	F44		CN-2888666-Y (With English Abstract)	04-11-2007	BEIJING WATCH DATA SYSTEM CO., LTD	ALL	
	F45		CN-1592986-A (With English Abstract) (Equivalent to US 7,113,137-B2)	03-09-2005	ETA SA MANUFACTURE HORLOGERE S	ALL	
	F46		CN-202120299-U (With English Abstract)	01-18-2012	SMART APPROACH TECHNOLOGY CO., LTD	ALL	
	F47		CN-1462413-A (With English Abstract) (Equivalent to US 6,950,023)	12-17-2003	GEMPLUS	ALL	

Examiner Signature	/ROBERT L DEBERADINIS/	Date Considered	06/12/2020
--------------------	------------------------	-----------------	------------

\*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.<sup>1</sup> Applicant's unique citation designation number (optional).<sup>2</sup> See Kind Codes of USPTO Patent Documents at [www.uspto.gov](http://www.uspto.gov) or MPEP901.04. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached.

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 2 hours 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, 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 (1-800-786-9199) and select option 2.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /R.L.D/

PTO/SB/08A (08-03)  
 Approved for use through 07/31/2006. 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 1449A/PTO				<b>Complete if Known</b>	
<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  (use as many sheets as necessary)				Application Number	
				Filing Date	January 31, 2019
				First Named Inventor	Jeong Wook AN
				Art Unit	
				Examiner Name	
Sheet	12	of	15	Attorney Docket Number	SUN.LGI.420D3

FOREIGN PATENT DOCUMENTS							
Examiner Initials*	Cite No. <sup>1</sup>	Foreign Patent Document		Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T <sup>6</sup>
		Country Code <sup>3</sup>	Number <sup>4</sup> - Kind Code <sup>5</sup> (if known)				
	F48	JP	2001-027687-A (With English Abstract)	01-30-2001	ISHIKAWAJIMA HARIMA HEAVY IND CO LTD	ALL	
	F49	JP	2002-299138-A (With English Abstract)	10-11-2002	Kawasaki Steel Corp.	ALL	
	F50	CN	101573716-A (With English Abstract) (Equivalent to US 7,971,339)	11-04-2009	ASSA ABLOY IDENTIFICATION TECH <i>et al.</i>	ALL	

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No. <sup>1</sup>	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 <sup>2</sup>
	R1	Dainippon Printing (JP 2008-027015) Translation F5; February 2008.	
	R2	European Patent Communication dated October 19, 2017, in European Application No. 13763524.9-1806.	
	R3	European Search Report dated August 29, 2017 in European Application No. 17157643.2.	
	R4	European Search Report dated August 8, 2017 in European Application No. 16206292.1.	
	R5	European Search Report dated February 4, 2016 in European Application No. 13763524.9.	
	R6	European Search Report dated July 1, 2014 in European Application No. 12190583.0.	

Examiner Signature	/ROBERT L DEBERADINIS/	Date Considered	06/12/2020
--------------------	------------------------	-----------------	------------

\*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.

<sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> Applicant is to place a check mark here if English language Translation is attached. This collection of information is required by 37 CFR 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 2 hours 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, 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 (1-800-786-9199) and select option 2.*

**ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /R.L.D./**

PTO/SB/08A (08-03)

Approved for use through 07/31/2006. 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 1449A/PTO				<b>Complete if Known</b>	
<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  <i>(use as many sheets as necessary)</i>				Application Number	
				Filing Date	January 31, 2019
				First Named Inventor	Jeong Wook AN
				Art Unit	
				Examiner Name	
Sheet	13	of	15	Attorney Docket Number	SUN.LGI.420D3

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No. <sup>1</sup>	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 <sup>2</sup>
	R7	International Search Report dated July 25, 2013 in International Application No. PCT/KR2013/002406.	
	R8	International Search Report dated July 26, 2013 in International Application No. PCT/KR2013/002412.	
	R9	International Search Report in International Application No. PCT/KR2013/002412, filed March 22, 2013.	
	R10	Murata (JP 2012-191134) - Translated patent; October 2012.	
	R11	Office Action dated August 10, 2016 in Japanese Application No. 2015-172306.	
	R12	Office Action dated August 24, 2015 in US Application No.13/663,012.	
	R13	Office Action dated August 24, 2016 in Taiwanese Application No. 103130766.	
	R14	Office Action dated December 21, 2015 in Chinese Application No. 201380026460.5.	
	R15	Office Action dated February 13, 2015 in US Application No.13/663,012.	
	R16	Office Action dated February 14, 2017 in Japanese Application No. 2015501586.	
	R17	Office Action dated February 24, 2014 in Korean Application No. 10-2013-0028301.	

Examiner Signature	/ROBERT L DEBERADINIS/	Date Considered	06/12/2020
--------------------	------------------------	-----------------	------------

\*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.

<sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> Applicant is to place a check mark here if English language Translation is attached.

This collection of information is required by 37 CFR 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 2 hours 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, 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 (1-800-786-9199) and select option 2.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /R.L.D/

PTO/SB/08A (08-03)

Approved for use through 07/31/2006 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 1449A/PTO				<i>Complete if Known</i>	
				Application Number	
<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  <i>(use as many sheets as necessary)</i>				Filing Date	January 31, 2019
				First Named Inventor	Jeong Wook AN
				Art Unit	
				Examiner Name	
				Attorney Docket Number	SUN.LGI.420D3
Sheet	14	of	15		

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No. <sup>1</sup>	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 <sup>2</sup>
	R18	Office Action dated February 24, 2014 in Korean Application No. 10-2013-0028302.	
	R19	Office Action dated July 1, 2014 in European Application No.12190583.0.	
	R20	Office Action dated June 2, 2016 in U.S. Application No. 14/387,521.	
	R21	Office Action dated June 29, 2016 in Chinese Application No. 201510084340.1.	
	R22	Office Action dated November 11, 2013 in Korean Application No. 10-2012-0123375.	
	R23	Office Action dated November 12, 2013 in Japanese Application No.2012-238615.	
	R24	Office Action dated October 7, 2014 in Japanese Application No.2012-238615.	
	R25	Office Action dated September 28, 2016 in Korean Application No. 1020130028300.	
	R26	Office Action dated November 27, 2017 in U.S. Application No. 15/362,367.	
	R27	Office Action dated May 2, 2018 in Chinese Application No. 201610391052.5.	
	R28	Office Action dated April 30, 2018 in U.S. Application No. 15/362,367.	

Examiner Signature	/ROBERT L DEBERADINIS/	Date Considered	06/12/2020
--------------------	------------------------	-----------------	------------

\*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.

<sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> Applicant is to place a check mark here if English language Translation is attached.

This collection of information is required by 37 CFR 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 2 hours 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, 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 (1-800-786-9199) and select option 2.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /R.L.D./

PTO/SB/08A (08-03)  
 Approved for use through 07/31/2006. 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 1449A/PTO				<i>Complete if Known</i>	
<b>INFORMATION DISCLOSURE                  STATEMENT BY APPLICANT</b>  <i>(use as many sheets as necessary)</i>				Application Number	
				Filing Date	January 31, 2019
				First Named Inventor	Jeong Wook AN
				Art Unit	
				Examiner Name	
Sheet	15	of	15	Attorney Docket Number	SUN.LGI.420D3

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No. <sup>1</sup>	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 <sup>2</sup>
	R29	Office Action dated June 15, 2018 in U.S. Application No. 15/360,425.	
	R30	Office Action dated July 10, 2018 in U.S. Application No. 15/430,173.	

Examiner Signature	/ROBERT L. DEBERADINIS/	Date Considered	06/12/2020
--------------------	-------------------------	-----------------	------------

\*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.

<sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> Applicant is to place a check mark here if English language Translation is attached. This collection of information is required by 37 CFR 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 2 hours 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, 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 (1-800-786-9199) and select option 2.*

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /R.L.D/



## Bibliographic Data

Application No: 16/264,360

Foreign Priority claimed:  Yes  No

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

Verified and Acknowledged: /ROBERT L DEBERADINIS/

Examiner's Signature

Initials

Title:

Wireless Power Receiver and Method of Manufacturing the Same

---

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
01/31/2019	307	2836	SUN.LGI.420D3
<b>RULE</b>			

### APPLICANTS

LG INNOTEK CO., LTD., Seoul, KOREA, REPUBLIC OF

### INVENTORS

JEONG WOOK AN Seoul, KOREA, REPUBLIC OF

JUNG OH LEE Seoul, KOREA, REPUBLIC OF

SUNG HYUN LEEM Seoul, KOREA, REPUBLIC OF

YANG HYUN KIM Seoul, KOREA, REPUBLIC OF

### CONTINUING DATA

This application is a CON of 15430173 02/10/2017 PAT 10277071

15430173 is a CON of 15360425 11/23/2016 PAT 10270291

15360425 is a CON of 13663012 10/29/2012 PAT 9806565

### FOREIGN APPLICATIONS

KOREA, REPUBLIC OF 10-2012-0029987 03/23/2012

KOREA, REPUBLIC OF 10-2012-0079004 07/19/2012

### IF REQUIRED, FOREIGN LICENSE GRANTED\*\*

02/21/2019

### STATE OR COUNTRY

KOREA, REPUBLIC OF

### ADDRESS

SALIWANCIK, LLOYD & EISENSCHENK

A PROFESSIONAL ASSOCIATION

P.O. BOX 142950

GAINESVILLE, FL 32614

UNITED STATES

**FILING FEE RECEIVED**

\$1,720

## EAST Search History

### EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	163	(H02J 50/10) AND (wireless same power adj receiver same substrate)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/12 16:24
L2	163	(H02J 50/12) AND (wireless same power adj receiver same substrate)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/12 16:30
L3	163	(H02J 50/70) AND (wireless same power adj receiver same substrate)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/12 16:31
L4	163	(H02J 5/005) AND (wireless same power adj receiver same substrate)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/12 16:31
L5	163	(H02J 7/025) AND (wireless same power adj receiver same substrate)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/12 16:32
L6	163	(H02J 7/02) AND (wireless same power adj receiver same substrate)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/12 16:32
L7	165	(H02J 5/00) AND (wireless same power adj receiver same substrate)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/12 16:33
L8	17	(B60L 53/12) AND (wireless same power adj receiver same substrate)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/12 16:33
L9	12	(G06K 19/0723) AND (wireless same power adj receiver same substrate)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/12 16:35
L10	12	(G06K 19/07) AND (wireless same power adj receiver same substrate)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/12 16:36

L11	98	(H01F 38/14) AND (wireless same power adj receiver same substrate)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/12 16:37
L12	98	(H01F 41/14) AND (wireless same power adj receiver same substrate)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/12 16:38
L13	48	(H04B 5/0037) AND (wireless same power adj receiver same substrate)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/12 16:39
L14	48	(H04B 5/0081) AND (wireless same power adj receiver same substrate)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/12 16:39
L15	51	(H04B 5/00) AND (wireless same power adj receiver same substrate)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/12 16:40
L16	3	(Y10T 29/4902) AND (wireless same power adj receiver same substrate)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/12 16:41
L17	9	(H04W 4/80) AND (wireless same power adj receiver same substrate)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/12 16:42
L18	7	(Y02T 10/7005) AND (wireless same power adj receiver same substrate)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/12 16:43
L19	7	(Y02T 10/7072) AND (wireless same power adj receiver same substrate)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/12 16:43
L20	7	(Y02T 90/122) AND (wireless same power adj receiver same substrate)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/12 16:44
L21	7	(Y02T 90/14) AND (wireless same power adj receiver same substrate)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/12 16:44
L22	7	(Y02T 90/16) AND (wireless same power adj receiver same substrate)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/12 16:44

L23	12	(G06K 19/07) AND (wireless same power adj receiver same substrate)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/12 16:45
S457	233	wireless same power adj receiver same substrate	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/12 15:05
S458	53	(wireless same power adj receiver same substrate).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/12 15:06

6/12/2020 4:47:49 PM

C:\Users\rdeberadinis\Documents\EAST\Workspaces\AutoSave\~auto.01312019.094453.bak.wsp

## EAST Search History

### EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L24	29	(wireless same power adj receiver same substrate).CLM.	US-PGPUB	OR	ON	2020/06/12 16:45

6/12/2020 4:48:02 PM

C:\Users\rdeberadinis\Documents\EAST\Workspaces\AutoSave\~auto.01312019.094453.bak.wsp

PTO/SB/08A (08-03)

Approved for use through 07/31/2006. 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 1449A/PTO  <b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  <i>(use as many sheets as necessary)</i>			<b>Complete if Known</b>	
			Application Number	16/264,360
Sheet <span style="margin-left: 100px;">1</span> of <span style="margin-left: 100px;">1</span>			Filing Date	January 31, 2019
			First Named Inventor	Jeong Wook An
			Art Unit	2836
			Examiner Name	James P Evans
			Attorney Docket Number	SUN.LGI.420D3

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. <sup>1</sup>	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number - Kind Code <sup>2</sup> (if known)			
/R.L.D./	U1	2012/0218068-A1	08-30-2012	Yamakawa et al.	ALL

FOREIGN PATENT DOCUMENTS							
Examiner Initials*	Cite No. <sup>1</sup>	Foreign Patent Document		Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T <sup>6</sup>
		Country Code <sup>3</sup>	Number <sup>4</sup> - Kind Code <sup>5</sup> (if known)				
/R.L.D./	F1		CN-102651499-A (With English Abstract) (Equivalent to US 2012/0218068-A1)	08-29-2012	EQUOS RES CO LTD	ALL	
/R.L.D./	F2		CN-102971908-A (With English Abstract)	03-13-2013	SONY CHEM & INF DEVICE CORP	ALL	
/R.L.D./	F3		JP-2011-66627-A (With English Abstract)	03-31-2011	SMART KK	ALL	

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No. <sup>1</sup>	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 <sup>2</sup>
R.L.D./	R1	Office Action dated September 29, 2019 in Chinese Application No. 201710325326.5.	

Examiner Signature	/ROBERT L DEBERADINIS/	Date Considered	06/12/2020
--------------------	------------------------	-----------------	------------

\*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.

<sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> Applicant is to place a check mark here if English language Translation is attached. This collection of information is required by 37 CFR 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 2 hours 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, 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 (1-800-786-9199) and select option 2.

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 1449A/PTO			<b>Complete if Known</b>	
			<b>Application Number</b>	16/264,360
<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  (use as many sheets as necessary)			<b>Filing Date</b>	January 31, 2019
			<b>First Named Inventor</b>	Jeong Wook An
			<b>Art Unit</b>	2836
			<b>Examiner Name</b>	James P Evans
			<b>Attorney Docket Number</b>	SUN.LGI.420D3
Sheet	1	of	1	

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. <sup>1</sup>	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number - Kind Code <sup>2</sup> (if known)			
	U1	2012/0218068-A1	08-30-2012	Yamakawa et al.	ALL

FOREIGN PATENT DOCUMENTS						
Examiner Initials*	Cite No. <sup>1</sup>	Foreign Patent Document	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T <sup>6</sup>
		Country Code <sup>3</sup> - Number <sup>4</sup> - Kind Code <sup>5</sup> (if known)				
	F1	CN-102651499-A (With English Abstract) (Equivalent to US 2012/0218068-A1)	08-29-2012	EQUOS RES CO LTD	ALL	
	F2	CN-102971908-A (With English Abstract)	03-13-2013	SONY CHEM & INF DEVICE CORP	ALL	
	F3	JP-2011-66627-A (With English Abstract)	03-31-2011	SMART KK	ALL	

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No. <sup>1</sup>	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 <sup>2</sup>
	R1	Office Action dated September 29, 2019 in Chinese Application No. 201710325326.5.	

Examiner Signature		Date Considered	
--------------------	--	-----------------	--

\*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.

<sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> Applicant is to place a check mark here if English language Translation is attached.

This collection of information is required by 37 CFR 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 2 hours 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, 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 (1-800-786-9199) and select option 2.



I hereby certify that this correspondence is being electronically filed in the United States Patent and Trademark Office on December 10, 2019.

  
\_\_\_\_\_  
Jeff Lloyd, Patent Attorney, Reg. No. 35,589

SUPPLEMENTAL INFORMATION  
DISCLOSURE STATEMENT  
UNDER 37 C.F.R. §§ 1.97 AND 1.98  
Examining Group 2649  
Patent Application  
Docket No. SUN.LGI.420D3  
Serial No. 16/264,360

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Examiner : James P. Evans  
Art Unit : 2836  
Applicants : Jeong Wook An, Jung Oh Lee, Sung Hyun Leem, Yang Hyun Kim  
Serial No. : 16/264,360  
Filed : January 31, 2019  
Conf. No. : 7253  
For : WIRELESS POWER RECEIVER AND METHOD OF  
MANUFACTURING THE SAME

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

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT  
UNDER 37 C.F.R. §§ 1.97 AND 1.98

Sir:

In accordance with 37 C.F.R. § 1.56, the references listed on the attached form PTO/SB/08 are being brought to the attention of the Examiner for consideration in connection with the examination of the patent application identified above. Copies of the cited references are attached. However, Applicants have not submitted a copy of the published U.S. Patent Application cited on attached Form PTO/SB/08 pursuant to 37 CFR 1.98(a)(2)(ii).

The undersigned hereby certifies that each item of information contained in this Supplemental Information Disclosure Statement was first cited in a communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this Supplemental Information Disclosure Statement. Applicants are attaching a copy of the Chinese Office Action.

J:\SUN\LGI\420D3\IDS-Refs\12-10-19\SUN-LGI-420D3-SIDS.DOC/lea

It is respectfully requested that the Examiner indicate consideration of the cited references by returning a copy of the attached form PTO/SB/08 with initials or other appropriate marks.

Applicants respectfully assert that the substantive provisions of 37 C.F.R. §§ 1.56, 1.97, and 1.98 are met by the foregoing statements.

The Commissioner is hereby authorized to charge any fees under 37 C.F.R. §§ 1.16 or 1.17 as required by this paper to Deposit Account 19-0065.

Respectfully submitted,



Jeff Lloyd

Patent Attorney

Registration No. 35,589

Phone No.: 352-375-8100

Fax No.: 352-372-5800

Address: Saliwanchik, Lloyd & Eisenschenk  
A Professional Association  
P.O. Box 142950  
Gainesville, FL 32614-2950

JL/lea

Attachments: Form PTO/SB/08; copies of references cited.



Espacenet

**Bibliographic data: CN102651499 (A) — 2012-08-29**

---

Antenna

**Inventor(s):** HIROYUKI YAMAKAWA; YASUO ITO; KENICHIRO SATO;  
SHIGENORI SHIMOKAWA ± (YAMAKAWA HIROYUKI, ; ITO YASUO,  
; SATO KENICHIRO, ; SHIMOKAWA SHIGENORI)

**Applicant(s):** EQUOS RES CO LTD ± (EQUOS RES CO.,LTD)

**Classification:** - international: H01Q1/36; H01Q1/38; H01Q1/42; H01Q1/52;  
H02J17/00  
- cooperative: B60L53/12 (EP); H01F27/365 (EP); H01F38/14 (EP);  
H01Q1/3225 (EP); H01Q7/04 (EP); Y02T10/7005  
(EP); Y02T10/7072 (EP); Y02T90/122 (EP);  
Y02T90/14 (EP)

**Application number:** CN201110342659 20111027 Global Dossier

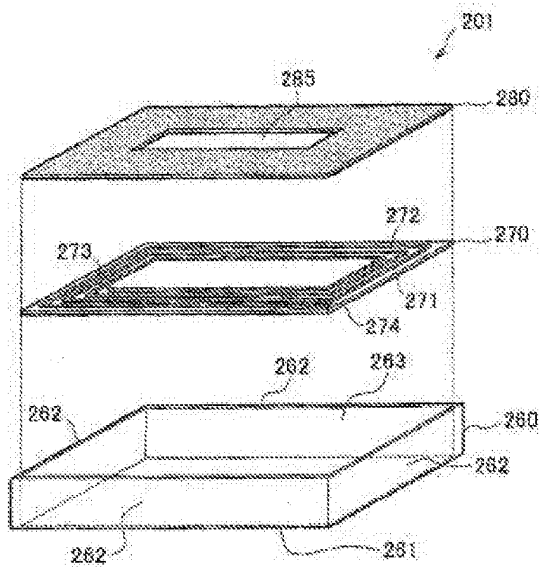
**Priority number(s):** JP20110041945 20110228 ; JP20110041943 20110228 ;  
JP20110041947 20110228 ; JP20110041944 20110228 ;  
JP20110041946 20110228

**Also published as:** EP2493016 (A2) EP2493016 (A3) US2012218068 (A1)

Abstract of CN102651499 (A)

The invention refers to an antenna (201) that includes: a case body (260) having a bottom plate portion (261), side plate portions (262) extending from the bottom plate portion (261), and an opening portion (263) surrounded by the side plate portions (262); a magnetic resonance antenna portion (270) placed in the case body (260); and a magnetic shield body (280) disposed on a side closer to the opening portion (263) than the magnetic resonance antenna portion (270).

FIG. 3





# (12) 发明专利申请

(10) 申请公布号 CN 102651499 A

(43) 申请公布日 2012.08.29

(21) 申请号 201110342659.1

*H01Q 1/52* (2006.01)

(22) 申请日 2011.10.27

*H02J 17/00* (2006.01)

### (30) 优先权数据

2011-041943 2011.02.28 JP

2011-041944 2011.02.28 JP

2011-041945 2011.02.28 JP

2011-041946 2011.02.28 JP

2011-041947 2011.02.28 JP

(71) 申请人 株式会社爱考斯研究

地址 日本东京都

(72) 发明人 山川博幸 伊藤泰雄 佐藤健一郎

下川茂则

(74) 专利代理机构 北京集佳知识产权代理有限

公司 11227

代理人 康建峰 王娜丽

### (51) Int. Cl.

*H01Q 1/42* (2006.01)

*H01Q 1/36* (2006.01)

*H01Q 1/38* (2006.01)

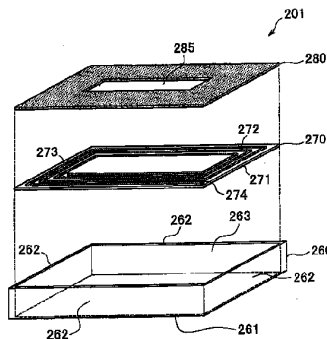
权利要求书 2 页 说明书 15 页 附图 19 页

### (54) 发明名称

天线

### (57) 摘要

本发明涉及天线。一种天线 (201) 包括:箱体 (260), 箱体 (260) 具有底板部 (261)、从底板部 (261) 延伸的侧板部 (262) 以及被侧板部 (262) 环绕的开口部 (263); 磁共振天线部 (270), 磁共振天线部 (270) 被安置在箱体 (260) 中; 以及磁屏蔽体 (280), 磁屏蔽体 (280) 被布置在比磁共振天线部 (270) 更靠近开口部 (263) 的侧上。



1. 一种天线 (201), 其特征在于包括:  
箱体 (260), 所述箱体 (260) 包括底板部 (261)、从所述底板部 (261) 延伸的侧板部 (262) 以及被所述侧板部 (262) 环绕的开口部 (263);  
磁共振天线部 (270), 所述磁共振天线部 (270) 被安置在所述箱体 (260) 中; 以及  
磁屏蔽体 (280), 所述磁屏蔽体 (280) 被布置在比所述磁共振天线部 (270) 更靠近所述开口部 (263) 的侧上。
2. 根据权利要求 1 所述的天线, 其中比所述磁共振天线部 (270) 更靠近所述开口部 (263) 的所述侧是关于所述磁共振天线部 (270) 的上侧, 且所述天线被构造为在所述开口部 (263) 处附接于车辆底部。
3. 根据权利要求 1 所述的天线, 其中所述开口部 (263) 被布置于所述磁共振天线部 (270) 的下方, 且比所述磁共振天线部 (270) 更靠近所述开口部 (263) 的所述侧是关于所述磁共振天线部 (270) 的下侧。
4. 根据权利要求 1 所述的天线, 还包括在所述箱体 (260) 的上侧处覆盖所述箱体 (260) 的金属体 (290)。
5. 一种天线, 其特征在于包括:  
箱体 (260), 所述箱体 (260) 包括底板部 (261) 和从所述底板部 (261) 延伸的侧板部 (262);  
线圈单元 (270), 所述线圈单元 (270) 被安置在所述箱体 (260) 中;  
平板状磁屏蔽体 (280), 所述平板状磁屏蔽体 (280) 被布置在所述线圈单元 (270) 上方且具有孔部 (285); 以及  
金属体 (290), 所述金属体 (290) 在所述箱体 (260) 的上侧处覆盖所述箱体 (260)。
6. 一种天线, 其特征在于包括:  
箱体 (260), 所述箱体 (260) 包括底板部 (261)、从所述底板部 (261) 延伸的侧板部 (262) 以及被所述侧板部 (262) 环绕的上开口部 (263);  
线圈单元 (270), 所述线圈单元 (270) 被安置在所述箱体 (260) 中; 以及  
磁屏蔽体 (280), 所述磁屏蔽体 (280) 被布置在所述线圈单元 (270) 上方且包括多个磁屏蔽片 (282)。
7. 根据权利要求 6 所述的天线, 还包括在所述箱体 (260) 的上侧处覆盖所述箱体 (260) 的金属体 (290)。
8. 一种天线, 其特征在于包括:  
箱体 (260), 所述箱体 (260) 包括底板部 (261) 和从所述底板部 (261) 延伸的侧板部 (262);  
磁共振天线部 (270), 所述磁共振天线部 (270) 被安置在所述箱体 (260) 中; 以及  
磁屏蔽体 (280), 所述磁屏蔽体 (280) 被布置在所述磁共振天线部 (270) 上方以与所述磁共振天线部 (270) 相隔第一距离 ( $d_1$ )。
9. 根据权利要求 8 所述的天线, 还包括被布置在所述磁屏蔽体 (280) 上方以与所述磁屏蔽体 (280) 相隔第二距离 ( $d_2$ ) 的金属体 (290)。
10. 根据权利要求 9 所述的天线, 其中所述第一距离 ( $d_1$ ) 大于所述第二距离 ( $d_2$ )。
11. 根据权利要求 4、5、7、9 以及 10 中任一项所述的天线, 其中所述金属体 (290) 包括

多个金属片 (292)。

12. 根据权利要求 1 至 10 中任一项所述的天线,其中不相互接触的多个散热部件 (300) 被布置在所述侧板部 (262) 上。

13. 根据权利要求 11 所述的天线,其中不相互接触的多个散热部件 (300) 被布置在所述侧板部 (262) 上。

14. 根据权利要求 1 至 10 中任一项所述的天线,其中品质因数大于等于 100。

15. 根据权利要求 11 所述的天线,其中品质因数大于等于 100。

16. 一种天线,特征在于包括:

基部 (310),所述基部 (310) 具有第一表面 (311) 和关于所述第一表面 (311) 为背面的第二表面 (312);

第一表面导电部 (330),所述第一表面导电部 (330) 被形成在所述基部 (310) 的所述第一表面 (311) 上,且所述第一表面导电部 (330) 的两端是第一表面第一端部 (331) 和第一表面第二端部 (332);

第二表面导电部 (350),所述第二表面导电部 (350) 被形成在所述基部 (310) 的所述第二表面 (312) 上,且所述第二表面导电部 (350) 的两端是第二表面第一端部 (351) 和第二表面第二端部 (352),其中当从所述第一表面侧透明地观看所述第二表面 (312) 的方向时时所述第二表面导电部 (350) 与所述第一表面导电部 (330) 重合;

第一通孔传导部 (341),所述第一通孔传导部 (341) 在所述第一表面 (311) 和所述第二表面 (312) 之间贯穿且允许所述第一表面第一端部 (331) 和所述第二表面第一端部 (351) 相互电连接;以及

第二通孔传导部 (342),所述第二通孔传导部 (342) 在所述第一表面 (311) 和所述第二表面 (312) 之间贯穿且允许所述第一表面第二端部 (332) 和所述第二表面第二端部 (352) 相互电连接。

17. 一种天线,特征在于包括:

多个导电部 (330、350、360),所述多个导电部 (330、350、360) 以插在相邻导电部之间的基部 (310) 而分层,每个导电部具有第一端部 (331、351、361) 和第二端部 (332、352、362);

贯穿所述基部 (310) 且允许所述导电部 (330、350、360) 的所述第一端部 (331、351、361) 相互电连接的通孔传导部 (341、343);以及

贯穿所述基部 (310) 且允许所述导电部 (330、350、360) 的所述第二端部 (332、352、362) 相互电连接的通孔传导部 (342、344),其中当沿着分层方向透明地观看所述多个导电部 (330、350、360) 时全部的所述多个导电部 (330、350、360) 相互重合。

## 天线

### 技术领域

[0001] 本发明涉及在磁共振型无线电力传输系统中使用并用于发射 / 接收电力的天线。

### 背景技术

[0002] 近年来,已经有力地开发了未使用电源电缆等而无线传输电力(电能)的技术。在无线传输电力的各种类型的方法中,有一种被称为磁共振方法的技术,其受到了广泛的关注。麻省理工学院的研究小组于2007年提出了磁共振方法,并且在例如PCT申请号2009-501510(JP-A-2009-501510)的公开的日语翻译中描述了相关技术。

[0003] 在磁共振无线电力传输系统中,发射天线的共振频率与接收天线的共振频率被设置为相互相等,且使用具有高Q因数(大于等于100)的天线,由此能量被有效地从发射天线发射到接收天线。优势之一是传输电力的距离是几十厘米到几米。

[0004] 已经提出了关于上述磁共振无线电力传输系统中使用的天线的具体构造的几种建议。例如,日本专利申请公开号2010-73976(JP-A-2010-73976)描述了用于无线传输系统中的、将电力从电力提供电路无线发射至电力接收电路的通信线圈的结构,为电力提供电路和电力接收电路中的每个都设置了通信线圈,其中通信线圈包括由具有大于等于1的相对介电常数的材料制成的印制电路板、设置在印制电路板的第一层且包括带有至少一个环的导电图案的初级线圈、以及设置在印制电路板的第二层且由螺旋导电图案形成的共振线圈。

[0005] 当如上所述的磁共振电力传输系统被用来将电力提供至车辆(诸如纯电动车辆(EV)和混合电动车辆(HEV))时,可以想到,发射天线被埋在地下而接收天线被安装在车辆的底部上。然而在JP-A-2009-501510描述的线圈结构中,没有实现用于将线圈安装到由金属制造的车辆的底部上的设计优化,因此,当在线圈被安装在车辆的底部的状态中使用线圈时,限制了电力传输效率。

[0006] 另外,在用于传统电力传输系统的电力传输天线中,作为电力传输的重要参数的Q(quality factor,品质因数)的值并不总是高,且电力传输效率可能低。

### 发明内容

[0007] 本发明的第一方面是一种天线,该天线包括:箱体,箱体具有底板部、从底板部延伸的侧板部以及被侧板部环绕的开口部;磁共振天线部,磁共振天线部被安置在箱体中;以及磁屏蔽体,磁屏蔽体被布置在比磁共振天线部更靠近开口部的侧上。

[0008] 在上述第一方面的天线中,可以采用以下构造:比磁共振天线部更靠近开口部的侧是关于磁共振天线部的上侧,且天线被构造为在开口部处附接于车辆底部。在上述第一方面的天线中,可以采用以下构造:开口部被布置在磁共振天线部的下方,且比磁共振天线部更靠近开口部的侧是关于磁共振天线部的下侧。

[0009] 优选的是,上述第一方面的天线还包括在箱体的上侧处覆盖箱体的金属体。

[0010] 本发明的第二方面是一种天线,该天线包括:箱体,箱体具有底板部和从底板部延



伸的侧板部；线圈单元，线圈单元被安置在箱体中；平板状金属屏蔽体，平板状金属屏蔽体被布置在线圈单元上方且具有孔部；以及金属体，金属体在箱体的上侧处覆盖箱体。

[0011] 本发明的第三方面是一种天线，该天线包括：箱体，箱体具有底板部、从底板部延伸的侧板部的箱体以及被侧板部环绕的上开口部；线圈单元，线圈单元被安置在箱体中；以及磁屏蔽体，磁屏蔽体被布置在线圈单元上方且具有多个金属屏蔽片。

[0012] 优选的是，上述第三方面的天线还包括在箱体的上侧处覆盖箱体的金属体。

[0013] 本发明的第四方面是一种天线，该天线包括：箱体，箱体具有底板部和从底板部延伸的侧板部；磁共振天线部，磁共振天线部被安置在箱体中；以及磁屏蔽体，磁屏蔽体被布置在磁共振天线部的上方以与磁共振天线部相隔第一距离。

[0014] 优选的是，上述第四方面的天线还包括被布置在磁屏蔽体的上方以与磁屏蔽体相隔第二距离的金属体。

[0015] 优选的是，在上述第四方面的天线中，第一距离大于第二距离。

[0016] 优选地是，在上述第一至第四方面的天线中，金属体包括多个金属片。

[0017] 优选地是，在上述第一至第四方面的天线中，不相互接触的多个散热部件被布置在侧板上。

[0018] 优选地是，在上述第一至第四方面的天线中，Q 因数大于等于 100。

[0019] 本发明的第五方面是一种天线，该天线包括：基座，基座具有第一表面和关于第一表面是背面的第二表面；第一表面导电部，第一表面导电部被形成在基部的第一表面上，且第一表面导电部的两端是第一表面第一端部和第一表面第二端部；第二表面导电部，第二表面导电部被形成在基部的第二表面上，且第二表面导电部的两端是第二表面第一端部和第二表面第二端部，其中当从第一表面侧透明地观看第二表面的方向时，第二表面导电部与第一表面导电部重合；第一通孔传导部，第一通孔传导部在第一表面和第二表面之间贯穿，允许第一表面第一端部和第二表面第一端部相互电连接；以及第二通孔传导部，第二通孔传导部在第一表面和第二表面之间贯穿，允许第一表面第二端部和第二表面第二端部相互电连接。

[0020] 本发明的第六方面是天线，该天线包括：多个导电部，多个导电部以插入相邻导电部之间的基部而分层，每个导电部具有第一端部和第二端部；贯穿基部且允许多个导电部的多个第一端部相互电连接的通孔传导部；以及贯穿基部且允许多个导电部的多个第二端部相互电连接的通孔传导部，其中当沿着分层方向透明地观看多个导电部时全部的多个导电部相互重合。

[0021] 当磁屏蔽体被布置在线圈单元上方时，即便将天线安装在车辆的底部上，也抑制了车身的金属部件的影响，且天线的 Q 因数被保持为高，这使得可以有效地发射电力。

[0022] 使用诸如阻抗分析仪的测量工具测量天线的 Q 因数。

[0023] 另外，当设置了覆盖上开口部的金属体时，不管安装有天线的车辆的类型如何均可以稳定地传输电力。

[0024] 当金属体包括多个金属片时，可以更加有效地发射电力。

[0025] 当布置了多个不相互接触的散热部件时，可以有效地散去线圈单元生成的热量并同时有效地发射电力。

[0026] 当天线被构造为使得第一表面导电部和被形成为与第一表面导电部重合的第二

表面导电部经由在两个端部处的通孔电连接时,因为降低了电阻率且提高了 Q(品质因数)而未显著地降低电感,所以提高了天线之间的传输效率。

#### 附图说明

[0027] 下面将参照附图描述本发明示例实施例的特征、优点以及技术和工业重要性,在附图中相似标号标注相似元件,并且在附图中:

[0028] 图 1 是其中使用了根据本发明实施例的天线的电力传输系统的框图;

[0029] 图 2 是示出电力传输系统的逆变器部的图;

[0030] 图 3 是根据本发明第一实施例的接收天线 201 的分解透视图;

[0031] 图 4 是示出如何经由根据本发明第一实施例的接收天线 201 传输电力的部分的示意图;

[0032] 图 5 是根据本发明第二实施例的接收天线 201 的透视图;

[0033] 图 6A 和 6B 是示出当仿效散热部件 300 的金属板被布置在线圈单元 270 上方时电力传输效率的测量结果的图;

[0034] 图 7 是根据本发明第三实施例的接收天线 201 的分解透视图;

[0035] 图 8 是示出如何经由根据本发明第三实施例的接收天线 201 传输电力的部分的示意图;

[0036] 图 9 是示出磁屏蔽体 280 的位置和传输效率之间的关系的测量结果的曲线图;

[0037] 图 10A 和 10B 是说明由具有孔部 285 的磁屏蔽体 280 带来的效果的验证结果的图;

[0038] 图 11 是根据本发明第四实施例的接收天线 201 的分解透视图;

[0039] 图 12 是示出如何经由本发明第四实施例的天线 201 传输电力的部分的示意图;

[0040] 图 13A 和 13B 是用于说明通过划分金属体 290 带来的效果的验证结果的图;

[0041] 图 14 是根据本发明第五实施例的接收天线 201 的分解透视图;

[0042] 图 15 是示出如何经由根据本发明第五实施例的接收天线 201 传输电力的部分的示意图;

[0043] 图 16A 和 16B 是用于说明通过划分磁屏蔽体 280 带来的效果的验证结果的图;

[0044] 图 17 是根据本发明第六实施例的接收天线 201 的分解透视图;

[0045] 图 18 是示出如何经由根据本发明第六实施例的接收天线 201 传输电力的部分的示意图;

[0046] 图 19 是根据本发明第七实施例的接收天线 201 的分解透视图;

[0047] 图 20 是示出如何经由根据本发明第七实施例的接收天线 201 传输电力的部分的示意图;

[0048] 图 21A 和 21B 是示出当天线位置偏差变动时传输效率的变化的曲线图;以及

[0049] 图 22 是根据本发明第八实施例的接收天线 201 的分解透视图。

#### 具体实施方式

[0050] 下面将参照附图描述本发明实施例。图 1 是其中使用了根据本发明实施例的天线的电力传输系统的框图。本发明的天线可以被用作接收天线或发射天线,这些天线中的每

个都是电力传输系统中的构成元件。关于下述实施例,描述了本发明的天线被用作接收天线的示例。

[0051] 其中使用了本发明的天线的电力传输系统的可以想到的例子是用于给车辆(诸如,纯电动车辆(EV)和混合电动车辆(HEV))充电的系统。为了以非接触的方式将电力发射至上述车辆,将电力传输系统安装在可以停车的停车空间中。用作车辆充电空间的停车空间被构造为使得发射天线 105 被埋在地下。车辆用户将车辆停在其中安装了电力传输系统的停车空间中,并使得安装在车辆上的接收天线 201 面对发射天线 105,以使车辆接收来自电力传输系统的电力。当车辆被停在停车空间中时,安装在车辆上的接收天线 201 被使得与发射天线 105 具有一定位置关系以便使传输效率最大化。

[0052] 在电力传输系统中,为了有效地将电力从发射天线 105 发射至接收天线 201,将发射天线 105 的共振频率和接收天线 201 的共振频率设置为相互相等,以便将电能从发射天线有效地发射至接收天线。

[0053] 电力发射方系统 100 中的交流-直流(AC/DC)转换器部 101 是将接收到的商业电力供应转换为一定直流电的转换器。来自 AC/DC 转换器部 101 的输出在一些情况中在高压发生器部 102 中提高到预定高压。可以通过主控制部 110 控制高压发生器部 102 中生成电压的设置。

[0054] 逆变器部 103 根据高压发生器部 102 提供的高压来生成预定交流(AC)电压,并将 AC 电压提供至匹配单元 104。图 2 是示出电力传输系统的逆变器部的图。例如如图 2 所示,逆变器部 103 包括  $Q_A$  至  $Q_D$  这四个全桥连接的场效应晶体管(FET)。

[0055] 在该实施例中,匹配单元 104 被连接在节点 T1 和节点 T2 之间,其中节点 T1 在串联连接的开关元件  $Q_A$  和开关元件  $Q_B$  之间,而节点 T2 在串联连接的开关元件  $Q_C$  和开关元件  $Q_D$  之间。当开关元件  $Q_A$  和开关元件  $Q_D$  是导通状态时,使开关元件  $Q_B$  和开关元件  $Q_C$  为截止状态,而当开关元件  $Q_B$  和开关元件  $Q_C$  为导通状态时,使开关元件  $Q_A$  和开关元件  $Q_D$  被导致为截止状态,由此在节点 T1 和 T2 之间生成矩形波 AC 电压。在该实施例中,通过开关该开关元件而生成的矩形波的频率的范围通常在几百千赫到几千千赫。

[0056] 从主控制部 110 接收用于驱动上述逆变器部 103 中包括的开关元件  $Q_A$  至  $Q_D$  的驱动信号。系统被构造使得主控制部 110 可以控制驱动逆变器部 103 的频率。

[0057] 匹配单元 104 包括具有预定电路常数的无源元件并接收来自逆变器部 103 的输出。将来自匹配单元 104 的输出提供至发射天线 105。系统被构造为使得根据从主控制部 110 接收的指令来调节包括在匹配单元 104 中的无源元件的电路常数。主控制部 110 将指令发送至匹配单元 104 使得发射天线 105 和接收天线 201 相互共振。

[0058] 发射天线 105 包括具有感抗分量的线圈,并且与安装在车辆上并被安置为与发射天线 105 相对的接收天线 201 共振,由此从发射天线 105 输出的电能被发送到接收天线 201。

[0059] 电力发射方系统 100 的主控制部 110 是包括中央处理单元(CPU)、存储 CPU 执行的程序的只读存储器(ROM)、提供 CPU 的工作区的随机存取存储器(RAM)等的通用信息处理单元。主控制部 110 与连接至主控制部 110 的示出部件协作操作。

[0060] 通信部 120 被构造为与车辆方通信部 220 无线通信以能够在通信部 120 和车辆之间交换数据。将通信部 120 接收的数据传输到主控制部 110,且主控制部 110 被构造为能够

将预定信息经由通信部 120 发送至车辆。

[0061] 接下来,将描述设置在车辆方上的部件。在车辆的电力接收系统中,接收天线 201 与发射天线 105 共振以接收从发射天线 105 输出的电能。将这样的接收天线 201 构造为能够安装在车辆的底部上。

[0062] 整流器部 202 对接收天线 201 所接收到的 AC 电力进行整流且经整流的电力通过充电控制部 203 被充电至电池 204。充电控制部 203 根据从主控制部 210 接收的指令控制对电池 204 的充电。将充电控制部 203 构造为能够管理电池 204 中剩余的电力。

[0063] 主控制部 210 是包括 CPU、存储 CPU 执行的程序的 ROM、提供工作区的 RAM 等的通用信息处理部。主控制部 210 与示出的连接至主控制部 210 的部件协作操作。

[0064] 将包括显示设备、按钮、触摸板、扬声器等的接口部件 220 安装在车辆中的司机座位部分,将预定信息等提供给用户(司机)并接收来自用户的操作或输入。当用户执行预定操作时,接口部 230 将操作数据发送至主控制部 210 且在主控制部 210 中处理该操作数据。当将预定信息提供给用户时,主控制部 210 将用于显示预定信息的显示指令数据发射至接口部 230。

[0065] 车辆方通信部 220 被构造为与电力发射方通信部 120 无线通信以能够在通信部 220 和发射系统之间交换数据。将通信部 220 接收的数据传输到主控制部 210,且主控制部 210 被构造为能够将预定信息经由通信部 220 发送至电力发射方系统。

[0066] 打算经由电力传输系统接收电力的用户将车辆停在上述设置有电力发射方系统的停车空间中,并通过接口部 23 执行输入操作以执行充电。响应于此,主控制部 210 从充电控制部 203 获取电池 204 中剩余的电力,并计算为电池 204 充电要求的电力。将关于计算出的电力的信息和发射电力的请求从车辆方通信部 220 发射至电力发射方系统的通信部 120。已经接收到信息的电力发射方系统的主控制部 110 控制高压发生器部 102、逆变器部 103 以及匹配单元 104 以向车辆发射电力。

[0067] 接下来,将描述如上所构造的电力传输系统中使用的天线的具体构造。虽然下面描述了其中根据本发明的构造被应用于接收天线 201 的示例,但是根据本发明的天线也可以被用作发射天线 105。

[0068] 图 3 是根据本发明第一实施例的接收天线 201 的分解透视图。图 4 是示出如何经由根据本发明第一实施例的接收天线 201 传输电力的部分的示意图。图 4 中的箭头示意地示出了磁力线。注意,虽然在实施例的如下描述中将矩形平板状线圈作为线圈单元 270 的示例,但是本发明天线的线圈不限于具有这样形状的线圈。圆形平板状线圈也可以用作线圈单元 270。这样的线圈单元 270 起到接收天线 201 中的磁共振天线部的作用。“磁共振天线部”不但包括线圈单元 270 的电感分量还包括线圈单元 270 的寄生电容的电容分量和/或人工添加的电容器的电容。在一些情况下本说明书中以线圈单元 270 的形式描述的本发明的限制在权利要求书中通过上述包括电容分量的“磁共振天线部”来表达。

[0069] 箱体 260 被用来容纳具有感抗分量的接收天线 201 的线圈单元 270。箱体 260 例如由诸如聚碳酸酯的树脂制成,且具有含有开口的盒形状。侧板部 262 被设置为从箱体 260 的矩形底板部 261 的每个边垂直于底板部 261 而延伸。在箱体 260 的上侧形成侧板部 262 环绕的上开口部 263。将其中安装了接收天线 201 的箱体 260 固定至上开口部 263 侧的车身上。可以通过已知方法在车身上安装箱体 260。注意,可以将法兰部件等设置在上开口部

263 周围以增加车身上的安装容易性。

[0070] 线圈单元 270 包括矩形平板状玻璃环氧基部 271 和形成在基部 271 上的螺旋导电部 272。导线（未示出）电连接至置于螺旋导电部 272 的径向内侧上的第一端部 273 和置于螺旋导电部 272 的径向外侧上的第二端部 274。因此，将接收天线 201 接收的电力传导至整流器部 202。将这样的线圈单元 270 置于箱体 260 的矩形底板部 261 上并通过适合的固定装置固定至底板部 261。

[0071] 磁屏蔽体 280 是具有孔部 285 的平板状磁部件。磁屏蔽体 280 优选地由具有高电阻率、高磁导率以及小磁滞的材料制成，并且例如可以使用诸如铁素体的磁材料。磁屏蔽体 280 通过适合的固定装置固定至箱体 260 使得磁屏蔽体 280 被布置为在线圈单元 270 上方形成空间。这种布局增加了发射天线 105 生成的磁力线中穿过磁屏蔽体 280 的比例，使得降低了当将电力从发射天线 105 发射至接收天线 201 时产生的车身的金属部件对磁力线的影响。

[0072] 如上构造的接收天线 201 的 Q 因数等于或高于 100。使用诸如阻抗分析仪的测量工具测量天线的 Q 因数。

[0073] 如上所述，根据第一实施例的接收天线 201，将磁屏蔽体 280 布置在线圈单元 270 的上方，使得即便接收天线 201 被安装在车辆的底部上，也可以抑制车身的金属部件的影响，这使得可以有效地发射电力。

[0074] 如上所述的接收天线 201 的结构可以用于电力发射方系统 100 中包括的发射天线。在这种情况下，如图 4 所示，发射天线被构造为使得发射天线和接收天线 201 关于水平面对称（镜像对称）。

[0075] 具体来说，当上述结构被应用于发射天线 105 时，发射天线 105 的结构使得发射天线 105 包括：箱体 260，箱体 260 具有底板部 261、从底板部 261 延伸的侧板部 262、以及被侧板部 262 环绕的开口部 263；线圈单元 270，线圈单元 270 被放置在箱体 260 中；以及磁屏蔽体 280，磁屏蔽体 280 被布置在线圈单元 270 下方，并且开口部 263 被布置在线圈单元 270 下方。

[0076] 接下来，将描述本发明的另一实施例。图 5 是根据本发明第二实施例的接收天线 201 的透视图。第二实施例与第一实施例的不同之处在于，添加了用于通过散去第一实施例的接收天线 201 的线圈单元 270 产生的热量来冷却天线的散热部件 300。第二实施例的描述中所描述的散热部件 300 也可以用于根据第三及随后的实施例的天线，用于散去来自天线的热。

[0077] 散热部件 300 由具有高热传导性的诸如铜的金属制成，且包括附接板部 301 和散热片部 (fin portion) 302，其中附接板部 301 为附接于从其散热的物体的附接部，而散热片部 302 被设置为竖立在附接板部 301 上且具有提供与空气大面积接触以将附接部 301 中的热散入空气中的功能。散热部件 300 不限于上述的散热部件，而可以使用具有其它形状的部件。

[0078] 通过诸如螺栓和螺母（未示出）等的固定装置将散热部件 300 附接于接收天线 201 的箱体 260 的侧板部 262。在根据第二实施例的天线中，在箱体 260 的侧板部 262 上设置了多个散热部件 300 使得不相互接触。具体地，例如，设置在一个侧板部 262 上的多个散热部件 300 与侧板部 262 附接使得相隔例如图 5 中 g 表示的预定间隔。

[0079] 单看从接收天线 201 的散热, 优选地的是在箱体 260 的侧板部 262 上散热部件 300 被设置得没有间隔  $g$ 。然而, 在第二实施例的接收天线 201 中, 多个散热部件 300 被有意地设置为不相互接触使得将电力传输效率的水平保持为高。

[0080] 图 6A 和 6B 是示出了当在线圈单元 270 上布置仿效散热部件 300 的金属板时的电路传输效率的测量结果的图。图 6A 是示出了测量结果的曲线图。图 6B 是示出了执行测量时的前提条件的图。测量的前提条件如下: (1) 当金属板 (P、Q) 被布置在矩形平板状线圈单元 270 的相对两侧时执行电力传输效率的测量; (2) 当金属板 (P、Q、R) 被布置在矩形平板状线圈单元 270 的三侧时执行电力传输效率的测量; (3) 当金属板 (P、Q、R、S) 被布置在矩形平板状线圈单元 270 的所有侧时执行电力传输效率的测量。

[0081] 根据示出上述前提条件下的进行的测量的结果的图 6A, 在金属板被布置在线圈单元 270 的两侧和金属板被布置在线圈单元 270 的三侧的任何一种情况下, 电力传输效率没有显著差异, 然而当金属板被无间隔地布置在线圈单元 270 的所有侧上时显著地降低了电力传输效率。在第二实施例的天线中, 考虑到这些知识, 多个散热部件 300 被设置在箱体 260 的侧板部 262 上以不相互接触。

[0082] 注意, 在通过形成环的金属板来环绕矩形平板状线圈单元 270 的上述情况 (3) 中, 可也想到, 在环中出现涡流, 这增加了损耗且降低了传输效率。

[0083] 如上所述, 凭借根据第二实施例的天线, 布置了没有相互接触的多个散热部件 300, 使得能够有效地散去线圈单元 270 的产生的热量并同时有效地发射电力。

[0084] 接下来, 将描述本发明第三实施例。图 7 是根据本发明第三实施例的接收天线 201 的分解透视图。图 8 是示出如何经由本发明第三实施例的接收天线 201 传输电力的部分的示意图。

[0085] 同样在第三实施例的情况中, 箱体 260 被用来容纳具有感抗分量的接收天线 201 的线圈单元 270。箱体 260 例如由诸如聚碳酸酯的树脂制成且具有含有开口的盒形状。侧板部 262 被设置为从箱体 260 的矩形底板部 261 的每个边垂直于底板部 261 而延伸。在箱体 260 的上侧形成由侧板部 262 所环绕的上开口部 263。

[0086] 同样在第三实施例的情况中, 线圈单元 270 包括矩形平板状屏蔽玻璃环氧基部 271 和形成在基部 271 上的螺旋导电部 272。导线 (未示出) 电连接至置于螺旋导电部 272 的径向内侧上的第一端部 273 和置于螺旋导电部 272 的径向外侧上的第二端部 274 上。因此, 接收天线 201 接收的电力被传导至整流器部 202。这样的线圈单元 207 被置于箱体 260 的矩形底板 261 上且通过适合的固定装置固定至底板部 261。

[0087] 磁屏蔽体 280 是具有孔部 285 的平板状磁部件。可以使用诸如铁素体的磁材料来制造磁屏蔽体 280。磁屏蔽体 280 通过适合的固定装置固定至箱体 260 使得磁屏蔽体 280 被布置在线圈单元 270 上方与线圈单元 270 相隔第一距离 ( $d_1$ )。这种布局增加了发射天线 105 生成的磁力线中穿过磁屏蔽体 280 的比例, 使得降低了当将电力从发射天线 105 发射至接收天线 201 时产生的车身的金属部件对磁力线的影响。

[0088] 在箱体 260 的上开口部 263 处, 覆盖上开口部 263 的矩形平板状金属体 290 被布置在屏蔽体 280 上方使得与屏蔽体 280 相隔第二距离 ( $d_2$ )。任何材料都可以用作用于这样的金属体 290 的金属材料, 例如在该实施例中使用了铝。

[0089] 在该实施例中, 金属体 290 被布置为覆盖上开口部 263, 使得抑制了车身金属部件

对线圈单元 270 的影响且能够固定接收天线 201 的天线特性。根据该实施例,由于天线特性固定,所以不管附接了接收天线 201 的车辆类型如何都能预期相似电力传输特性,这增加了天线的使用多样性。

[0090] 另外,在该实施例中,通过覆盖上开口部 263 金属体 290 将接收天线 201 附接于车身,这样通过金属体 290 将天线附接至车辆使得能够确保附接于车辆的高强度。只要合适,就可以通过已知方法执行金属体 290 到车身的固定。注意,可以在上开口部 263 周围设置法兰部件等以增加在车身上的安装容易性。

[0091] 下面将描述通过将磁屏蔽体 280 布置在线圈单元 270 上方使得与线圈单元 270 相隔第一距离 ( $d_1$ ) 而带来的效果的验证。图 9 是示出了磁屏蔽体 280 的位置与传输效率之间的关系的测量结果的曲线图。图 9 的曲线图示出了当在图 8 中发射天线 105 的线圈单元 170、以及接收天线 201 的线圈单元 270 和金属体 290 固定而在垂直方向移动磁屏蔽体 280 时传输效率的测量结果的曲线图。具体来说,发射天线 105 的线圈单元 170 和接收天线 201 的线圈单元 270 之间的距离  $G$  是常数并等于 20cm,且线圈单元 270 和金属体 290 之间的距离  $D$  是常数且等于 6cm。

[0092] 磁屏蔽体 280 的位置由距线圈单元 270 的上表面的距离  $d_1$  限定。磁屏蔽体 280 和金属体 290 之间的第二距离  $d_2$  和第一距离具有如下关系  $d_2 = D - d_1$ 。使用了分别由磁材料 A 和磁材料 B 制成的两种磁屏蔽体 280。

[0093] 根据图 9,在磁材料 A 的情况下,当距离  $d_1$  等于大约 0.9cm 时传输效率最高,而在磁材料 B 的情况下,当距离  $d_1$  等于大约 5cm 时传输效率最高。由此可见,为了实现高传输效率,优选的是磁屏蔽体 280 被布置在线圈单元 270 上方与线圈单元 270 相隔第一距离 ( $d_1$ ) 而金属体 290 被布置在磁屏蔽体 280 上方与磁屏蔽体 280 相隔第二距离。

[0094] 如上所述,在根据第三实施例的接收天线 201 中,磁屏蔽体 280 被布置在线圈单元 270 上方与线圈单元 270 相隔第一距离 ( $d_1$ ),使得即便在车辆底部上安装接收天线 201,也抑制了车身的金属部件的影响,这使得能有效发射电力。

[0095] 另外,在根据第三实施例的接收天线 201 中,覆盖上开口部 263 的金属体 290 被布置在磁屏蔽体 280 上方与磁屏蔽体 280 相隔第二距离 ( $d_2$ ),使得不管安装有接收天线 201 的车辆类型如何均能够有效且稳定地发射电力。

[0096] 在根据第三实施例的天线中,优选的是,在布置在线圈单元 270 上方的平板状磁屏蔽体 280 中形成孔部 285。当在磁屏蔽体 280 中形成孔部 285 时,降低了磁屏蔽体 280 本身的损耗,且使得能够使磁屏蔽体 280 的屏蔽效应最大化。另外,在磁屏蔽体 280 具有孔部 285 的情况下,该部件的面积小且使得能够降低天线成本。优选的是,孔部 285 的面积使得当沿着分层方向观看时磁屏蔽体 280 与线圈单元 270 的导电部 272 之间的重叠没有减小。

[0097] 下面将描述上述验证结果。图 10A 和 10B 是说明带有孔部 285 的磁屏蔽体 280 带来的效果的验证结果的图。图 10A 是示出传输效率的测量结果的图,而图 10B 是示出在执行测量时的前提条件的图。测量的前提条件如下:(1) 当使用了没有孔部 285 的磁屏蔽体 280 时执行电力传输效率的测量;(2) 当使用了具有孔部 285 的磁屏蔽体 280 时执行电力传输效率的测量。在每种情况下,使用如图 8 所示的布局的天线来测量传输效率。

[0098] 从图 10A 可以看出,在具有孔部 285 的屏蔽体 280 的天线的情况下的传输效率高于在不具有孔部 285 的屏蔽体的天线的情况下的传输效率。

[0099] 在根据上述第三实施例的接收天线 201 中,在线圈单元 270 上方布置具有孔部 285 的平板状磁屏蔽体 280 和覆盖上开口部 263 的金属体 290,使得即便在车辆底部上安装了接收天线 201,也抑制了车身金属部件的影响,这使得能够有效发射电力。

[0100] 接下来,将描述本发明的另一实施例。图 11 是根据本发明第四实施例的接收天线 201 的分解透视图。图 12 是示出如何经由根据本发明第四实施例的接收天线 201 传输电力的部分的示意图。

[0101] 根据第四实施例的天线与根据第三实施例的天线的不同之处在于,金属体 290 包括多个金属片 292。在根据第三实施例的接收天线 201 中,使用了一个板状金属体 290,然而在根据第四实施例的接收天线 201 中,金属片 292 被排列为  $3 \times 4$  的矩阵布置的金属体被用作金属体 290。金属片 292 被以预定间隔排列在例如由聚碳酸酯制成的金属体支撑板 291 上且固定至金属体支撑板 291。在该实施例中,包括布置在金属体支撑板 290 上的多个金属片 292 的金属体 290 被构造为靠近箱体 260 的上开口部 263。任何材料均可用于在这样金属片 292 中使用的金属材料,且例如在该实施例中,使用了铝。

[0102] 图 13A 和 13B 是说明通过划分金属体 290 带来的效果的验证结果的图。图 13A 是示出测量结果的曲线图。图 13B 是示出在执行测量时的前提条件的图。测量的前提条件如下:(1) 金属体 290 包括八个金属片 292 且在改变频率的同时进行电力传输效率的测量;(2) 金属体 290 包括四个金属片 292 且在改变频率的同时进行电力传输效率的测量;(3) 金属体 290 包括两个金属片 292 且在改变频率的同时进行电力传输效率的测量;(4) 金属体 290 是金属板且在改变频率的同时进行电力传输效率的测量。

[0103] 从如图 13A 所示的示出结果的曲线图来看,在金属体 290 中包括的金属片 292 的数量越多,传输效率的峰值越高。

[0104] 在根据上述第四实施例的接收天线 201 中,金属体 290 包括多个金属片 292,使得能够更加有效地发射电力。

[0105] 可以将其中金属体 290 包括多个金属片 292 的实施例应用至其中使用了金属体 290 的其它实施例。

[0106] 接下来,将描述本发明的另一实施例。图 14 是根据本发明第五实施例的接收天线 201 的分解透视图。图 15 是示出如何经由根据本发明第五实施例的接收天线 201 传输电力的部分的示意图。

[0107] 根据第五实施例的天线与根据第三实施例的天线的区别在于,磁屏蔽体 280 包括多个磁屏蔽片 282。在根据第三实施例的接收天线 201 中,使用了一个板状磁屏蔽体 280,然而在根据第五实施例的接收天线 201 中,其中十个磁屏蔽片 282 被环状地排列以形成孔部 285 的磁屏蔽体,被用作磁屏蔽体 280。磁屏蔽片 282 被以预定间隔排列在例如由聚碳酸酯制成的磁屏蔽体支撑板 281 上,并固定于磁屏蔽体支撑板 281。在该实施例中,包括布置在磁屏蔽体支撑板 281 上的多个磁屏蔽片 282 的磁屏蔽体 280 被布置在线圈单元 270 上方以与线圈单元 270 相隔预定距离。诸如铁素体的磁材料可以用于制作磁屏蔽片 282。同样在该实施例中,磁屏蔽体 280 具有孔部 285。

[0108] 图 16A 和 16B 是用于说明通过划分屏蔽体 280 带来的效果的验证结果的图。图 16A 是示出测量结果的曲线图。图 16B 是示出在执行测量时的前提条件的图。测量的前提调节如下:(1) 当磁屏蔽体 280 是磁屏蔽板时进行电力传输效率的测量;(2) 当磁屏蔽体 280



包括八个磁屏蔽片 282 时进行电力传输效率的测量,如图 16B 所示;(3) 磁屏蔽体 280 包括二十八个磁屏蔽片 282 时进行电力传输效率的测量,如图 16B 所示;(4) 磁屏蔽体 280 包括四十个磁屏蔽片 282 时进行电力传输效率的测量,如图 16B 所示。

[0109] 从如图 16A 所示的示出结果的曲线图可以看出,在磁屏蔽体 280 中包括的磁屏蔽片 282 的数量越多,提高的传输效率越高。可以想到,这是由于当磁屏蔽片 282 的数量增加时由于出现在磁屏蔽体 280 中的涡流而导致的损耗降低。同时,同样可以从图 16A 看出,当磁屏蔽体 280 中包括的磁屏蔽片 282 的数量增加时传输效率在一定水平上平稳。

[0110] 当磁屏蔽体 280 中包括的磁屏蔽片 282 的数量增加时,同样也增加了制造工作负担等等。另外,即便增加了数量,传输效率也平稳。因此,可以理解,优选的是适当地限制包括在磁屏蔽体 280 中的磁屏蔽片 282 的数量。例如,如图 14 所示,被构造为包括大约十个磁屏蔽片 282 的磁屏蔽体 280 是优选实施例。

[0111] 在根据上述第五实施例的接收天线 201 中,金属体 290 以及包括多个磁屏蔽片 282 的磁屏蔽体 280 被布置在线圈单元 270 上方,使得即便在车辆底部上安装了接收天线 201,也抑制了车身金属部件的影响,这使得能够有效发射电力。

[0112] 磁屏蔽体 280 包括多个磁屏蔽片 282 的实施例可以用于其它使用了磁屏蔽体 280 的实施例。

[0113] 接下来将描述本发明的另一实施例。图 17 是根据本发明第六实施例的接收天线 201 的分解透视图。图 18 是示出如何经由根据本发明第六实施例的接收天线 201 传输电力的部分的示意图。

[0114] 根据第六实施例的接收天线 201 的特征在于,与根据第四实施例的接收天线 201 的情况一样,金属体 290 包括多个金属片 292,并且与根据第五实施例的接收天线 201 的情况一样,磁屏蔽体 280 包括多个磁屏蔽片 282。

[0115] 凭借上述第六实施例的接收天线 201,可以预期的是能够提供上述实施例中的具有最高传输效率的接收天线 201。

[0116] 如上所述,在根据第六实施例的天线中,在线圈单元上方布置磁屏蔽体,使得即便在车辆的底部上安装了天线也能抑制车身金属部件的影响,这使得能够有效发射电力。

[0117] 另外,在根据第六实施例的天线中,设置了覆盖上开口部的金属体,使得不管安装有天线的车辆的类型如何均能够稳定地发射电力。

[0118] 在根据第六实施例的天线中,金属体包括多个金属片,使得能够更有效地发射电力。

[0119] 在根据第六实施例的天线中,当布置了没有相互接触的多个散热部件时,使得能够散去线圈单元产生的热量并同时有效地发射电力。

[0120] 接下来,将描述本发明的另一实施例。图 19 是根据本发明第七实施例的接收天线 201 的分解透视图。在图 19 的右侧的图中,在厚度方向上将形成线圈单元 270 的基部 310 放大。图 20 是示出如何经由根据本发明第七实施例的接收天线 201 传输电力的部分的示意图。注意,虽然在如下实施例的描述中将矩形平板状线圈描述为线圈单元 270 的一个示例,但是本发明的天线的线圈不限于具有这样形状的线圈。圆形板状线圈可以用作线圈单元 270。

[0121] 这样的线圈单元 270 在接收天线 201 中起到磁共振天线部的作用。“磁共振天线

部”不但包括线圈单元 270 的电感分量也包括线圈单元 270 的寄生电容的电感分量和 / 或人工添加的电容器的电容。

[0122] 箱体 260 用来容纳具有电感分量的接收天线 201 的线圈单元 270。箱体 260 例如由诸如聚碳酸酯的树脂制成,且具有含有开口的盒形状。

[0123] 侧板部 262 被设置为从箱体 260 的矩形底板部 261 的每个边垂直于底板部 261 而延伸。在箱体 260 的上侧形成侧板部 262 环绕的上开口部 263。可以通过已知方法在车身上安装箱体 260。注意,可以在上开口部 263 周围设置法兰部件等以增加在车身上安装容易性。

[0124] 线圈单元 270 包括矩形平板状玻璃环氧基部 310 和形成在基部 310 上表面和下表面上的导电部。更具体地,基部 310 具有作为主表面的第一表面 311 和关于第一表面 311 为背面的第二表面 312,且在第一表面 311 和第二表面 312 的每个上形成螺旋导电部,由此接收天线 201 被提供有电感分量。

[0125] 在基部 310 的第一表面 311 上形成螺旋第一表面导电部 330,在第一表面导电部 330 的径向内侧处设置第一表面第一端部 331,以及在第一表面导电部 330 的径向外侧处设置第一表面第二端部 332。

[0126] 相似地,在基部 310 的第二表面 312 上形成螺旋第二表面导电部 350,在第二表面导电部 350 的径向内侧处设置第二表面第一端部 351,以及在第二表面导电部 350 的径向外侧处设置第二表面第二端部 352。

[0127] 第一表面导电部 330 和第二表面导电部 350 被构造为当在第二表面 312 的方向上从第一表面 311 侧透明地观看时第一表面导电部 330 和第二表面导电部 350 相互重合。根据这样的构造,促进了调整或设计第一表面 311 上的第一表面导电部 330 的电感分量和第二表面 312 上的第二表面导电部 350 上的电感分量之间的互感。

[0128] 在基部 310 中,在第一表面 311 和第二表面 312 之间贯穿的第一通孔传导部 341 允许第一表面第一端部 331 和第二表面第一端部 351 相互电连接。另外,在第一表面 311 和第二表面 312 之间贯穿的第二通孔传导部 342 允许第一表面第二端部 332 和第二表面第二端部 352 相互电连接。

[0129] 导线(未示出)电连接至置于上述螺旋第一表面导电部 330 的径向内侧上的第一表面第一端部 331 和螺旋第一表面导电部 330 的径向外侧上的第一表面第二端部 332 上。因此,接收天线 201 接收的电力被传导至整流器部 202。这样的线圈单元 270 被安置于箱体 260 的矩形底板部 261 上,且通过合适的固定装置固定于底板部 261 上。

[0130] 根据上述第七实施例的天线具有第一表面 311 上的第一表面导电部 330 的电感分量、第二表面 312 上的第二表面导电部 350 的电感分量、以及第一表面导电部 330 和形成成为与第一表面导电部 330 重叠的第二表面导电部 350 之间的互感,使得电感没有明显降低,且同时由于第一表面导电部 330 和第二表面导电部 350 相互平行连接所以降低了天线电路的电阻率。根据上述构造,提高了品质因数且因此提高了天线之间的传输效率。

[0131] 磁屏蔽体 280 是具有孔部 285 的平板状磁部件。可以使用诸如铁素体的磁材料来制造磁屏蔽体 280。将磁屏蔽体 280 通过合适的固定装置固定至箱体 260,使得磁屏蔽体 280 被布置为线圈单元 270 上方形成空间。这样的布局增加了发射天线 105 生成的磁力线中穿过磁屏蔽体 280 的比例,使得降低了车身的金属部件对当从发射天线 105 发射电力至

接收天线 201 时产生的磁力线的影响。

[0132] 在根据第七实施例的天线中,优选的是,在布置在线圈单元 270 上方的平板状磁屏蔽体 280 中形成孔部 285。当在磁屏蔽体 280 中形成孔部 285 时,降低了磁屏蔽体 280 本身的损耗且使得能够将磁屏蔽体 280 的屏蔽效应最大化。另外,在具有孔部 285 的磁屏蔽体 280 的情况下,部件面积小且使得能够降低天线成本。优选的是,孔部 285 的面积使得当沿着分层方向观看时磁屏蔽体 280 与线圈单元 270 的导电部 272 之间的重叠没有被减小。

[0133] 图 21A 和 21B 是示出了当天线位置偏差变动时传输效率的变动的曲线图。在图 21A 和 21B 中,在第七实施例的情况下,根据第七实施例的天线被用作发射天线 105 和接收天线 201 中的一个,然而在第一实施例的情况下,其中在发射天线 105 和接收天线 201 中的每个中使用只为第一表面(一个表面)设置了导电部。

[0134] 图 21A 是示出了当接收天线 201(或发射天线 105)在沿着包括天线的水平面中的长边的方向上从发射天线 105 和接收天线 201 相对的预定相对位置偏移时的效率变动的曲线图。图 21B 是示出了当接收天线 201(或发射天线 105)在沿着包括天线的水平面中的短边的方向上从发射天线 105 和接收天线 201 相对的预定相对位置偏移时的效率变动的曲线图。如图 19 的右侧图所示,基于矩形基部 310 的边的长度来确定长边和短边。根据使用向量网络分析仪(VNA)进行的测量的结果而绘制图 21A 和 21B。

[0135] 如图 21A 和 21B 所示,可以理解在任何一种情况中,在使用根据第七实施例的天线发射电力时的传输效率高于是使用根据第一实施例的天线发射电力时的传输效率。

[0136] 表 1 是根据第七实施例的天线和根据第一实施例的天线的特性的特性表。在该表中,天线本身的特性被列在了上侧,而发射电力时的特性被列在了下侧。

[0137] 表 1

		根据第七实施例的天线	根据第一实施例的天线
[0138] 天线本身特性	R【Ω】	1.28	1.39
	L【H】	$1.35 \times 10^{-4}$	$1.37 \times 10^{-4}$
	C【F】	$9.72 \times 10^{-10}$	$9.73 \times 10^{-10}$
	Q	291.15	269.93
[0138] 发射电力时的特性	第一共振频率【Hz】	$4.120 \times 10^5$	$4.094 \times 10^5$
	第二共振频率【Hz】	$4.716 \times 10^5$	$4.684 \times 10^5$
	耦合系数 K	0.135	0.134
	KQ	39.28	36.29
	$\alpha$	1542.73	1316.89
	效率 $\eta$ 【%】	95.04	94.64

[0139] 在该表中,  $\alpha$  和频率  $\eta$  具有如下关系式 (1) 表示的关系

$$[0140] \quad \eta = \frac{1}{1 + \frac{2(1 + \sqrt{1 + \alpha})}{\alpha}} \dots (1)$$

[0141] 其中当发射天线和接收天线的 Q 因数分别为 Q1 和 Q2 时,  $\alpha$  等于  $k^2 * Q1 * Q2$ 。当发射天线和接收天线具有基本相同的特性时, 即, 当可以假设  $Q1 \approx Q2 = Q$  时,  $\alpha$  被定义为  $(kQ)^2$ 。

[0142] 可以理解, 在根据第七实施例的天线中, 由于 R 降低提高了天线本身的特性 Q。另外, 在根据第七实施例的天线中, 通过结合设置在基部 310 的表面的第一表面导电部 330 的电感和第二表面导电部 350 的电感带来的电感 (互感) 的增加将整个天线中的电感的减少抑制到 2  $\mu$  H (大约总电感的 1.5%)。从上述方面来看, 可以理解根据第七实施例的天线具有天线性能 (效率) 方面的优势。

[0143] 如上所述, 根据第七实施例的天线被构造使得第一表面导电部 330 和被形成覆盖第一表面导电部 330 的第二表面导电部 350 通过两个端部处的通孔而电连接。凭借根据上述构造的第七实施例的天线, 因为降低了电阻且提高了 Q (品质因数) 而没有显著降低电感, 所以提高了天线之间的传输效率。

[0144] 接下来, 将描述本发明的第八实施例。第八实施例与第七实施例的不同之处在于, 第七实施例被构造为使得在基部 310 的表面上设置线圈单元 270 的导电部, 而在第八实施

例中还在基部 310 的中间层处设置线圈单元 270 的导电部。接下来,将描述线圈单元 270 的构造的不同之处。

[0145] 图 22 是根据本发明第八实施例的接收天线 201 的分解透视图。在图 22 中的右侧图,在宽带方向放大了形成线圈单元 270 的基部 310。

[0146] 线圈单元 270 包括矩形平板状玻璃环氧基部 310 和形成在基部 310 上表面和下表面上以及基部 310 的中间层处的导电部。更具体地,基部 310 具有作为主表面的第一表面 311、关于第一表面 311 是背面的第二表面 312 以及第一表面 311 和第二表面 312 之间的中间层 313,且在第一表面 311 和第二表面 312 的每个上以及在中间层处形成螺旋导电部,由此接收天线 201 被提供有电感分量。

[0147] 在基部 310 的第一表面 311 上形成螺旋第一表面导电部 330,在第一表面导电部 330 的径向内侧处设置第一表面第一端部 331,以及在第一表面导电部 330 的径向外侧处设置第一表面第二端部 332。

[0148] 相似的,在基部 310 的中间层 313 处形成螺旋中间层导电部 360,在中间层导电部 360 的径向内侧处设置中间层第一端部 361,以及在中间层导电部 260 的径向外侧处设置中间层第二端部 362。

[0149] 相似地,在基部 310 的第二表面 312 上形成螺旋第二表面导电部 350,在第二表面导电部 350 的径向内侧处设置第二表面第一端部 351,以及在第二表面导电部 350 的径向外侧处设置第二表面第二端部 352。

[0150] 第一表面导电部 330、中间层导电部 360 以及第二表面导电部 350 被构造为使得当从第一表面 311 透明地观看第二表面 312 的方向时第一表面导电部 330、中间层导电部 360 以及第二表面导电部 350 相互重合。根据这样的构造促进了调节或设计第一表面 311 上的第一表面导电部 330 的电感分量、中间层 313 的中间层导电部 360 的电感分量以及第二表面 312 上的第二表面导电部 350 的电感分量的互感。

[0151] 在基部 310 中,在第一表面 311 和中间层 313 之间贯穿的第一通孔传导部 341 允许第一表面第一端部 331 和中间层第一端部 361 相互电连接。另外,在第一表面 311 和中间层 313 之间贯穿的第二通孔传导部 342 允许第一表面第二端部 332 和中间层第二端部 362 相互电连接。

[0152] 另外,在中间层 313 和第二表面 312 之间贯穿的第三通孔传导部 343 允许中间层第一端部 361 和第二表面第一端部 351 相互电连接。另外,在中间层 313 和第二表面 312 之间贯穿的第四通孔传导部 344 允许中间层第二端部 362 和第二表面第二端部 352 相互电连接。

[0153] 同样在上述构造的具有线圈单元 270 的第八实施例中,能够带来与上述第七实施例的效果相似的效果。虽然在第八实施例中,在第一表面 311 和第二表面 312 上以及在中间层 313 处各形成了导电部且这些导电部的端部中的每对端部通过贯穿基部的通孔传导部电连接,但是可以采用其中设置了两个或多个中间层且用于提供导电部的层的数量大于等于 4 的构造。

[0154] 虽然在第八实施例的描述中已经描述了玻璃环氧板被用作基部 310 的示例,但是可以使用高散热陶瓷基部,或可选地,可以使用其中在金属基板上形成了绝缘膜的基部,诸如铝基部。不用说,可以使用其中使用了柔性印制板的基部作为该基部。

[0155] 通过将第一至第六实施例的特征结合到第七实施例或至第八实施例而获得的实施例也在本发明的范围内。例如,在第七实施例或第八实施例中,可以像第二实施例的情况一样将多个散热部件 300 附接于侧板部 262。

[0156] 如上所述,根据第七和第八实施例的天线被构造为使得至少第一表面导电部和被形成为与第一表面导电部重叠的第二表面导电部通过在两个端部处的通孔而电连接。根据上述的构造的天线,由于降低了电阻且提高了 Q(品质因数)而未显著降低电感,所以提高了天线之间的传输效率。

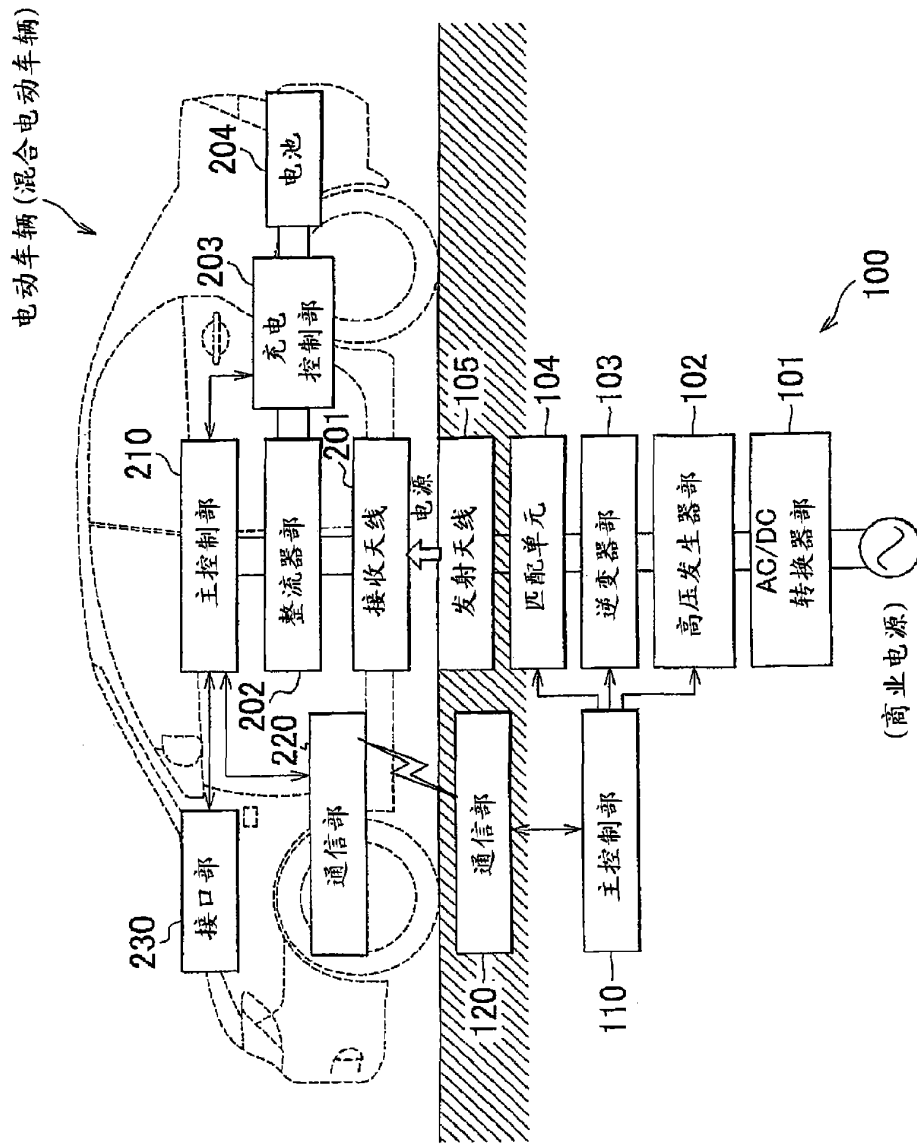


图 1

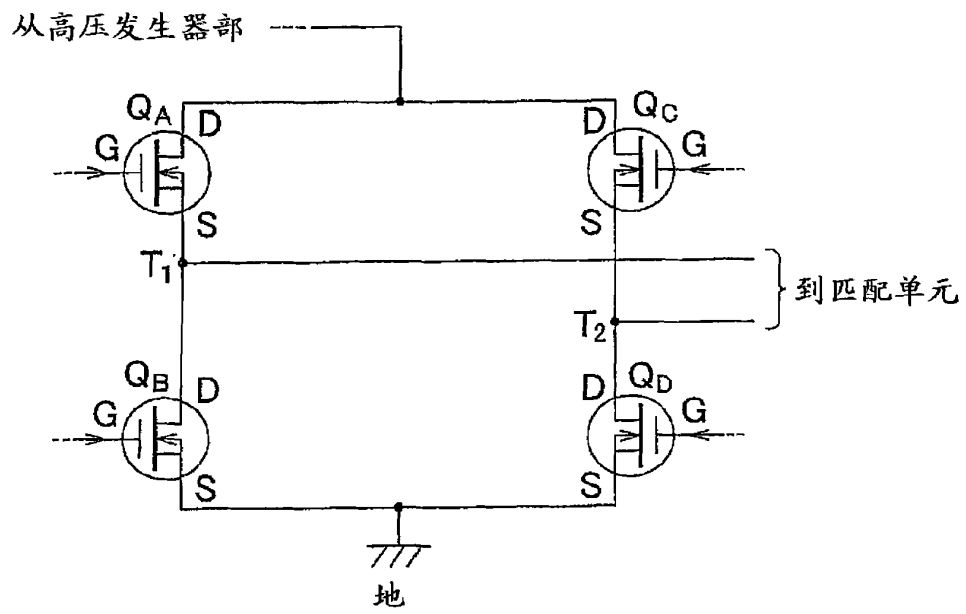


图 2



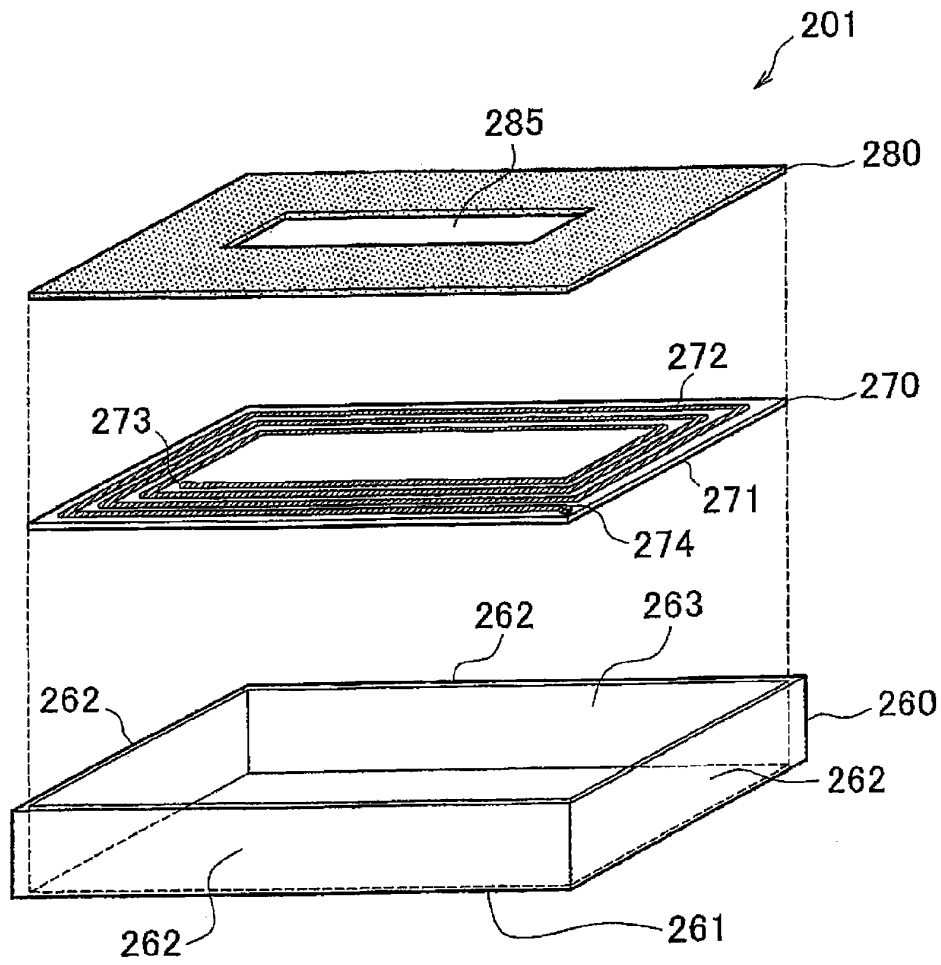


图 3

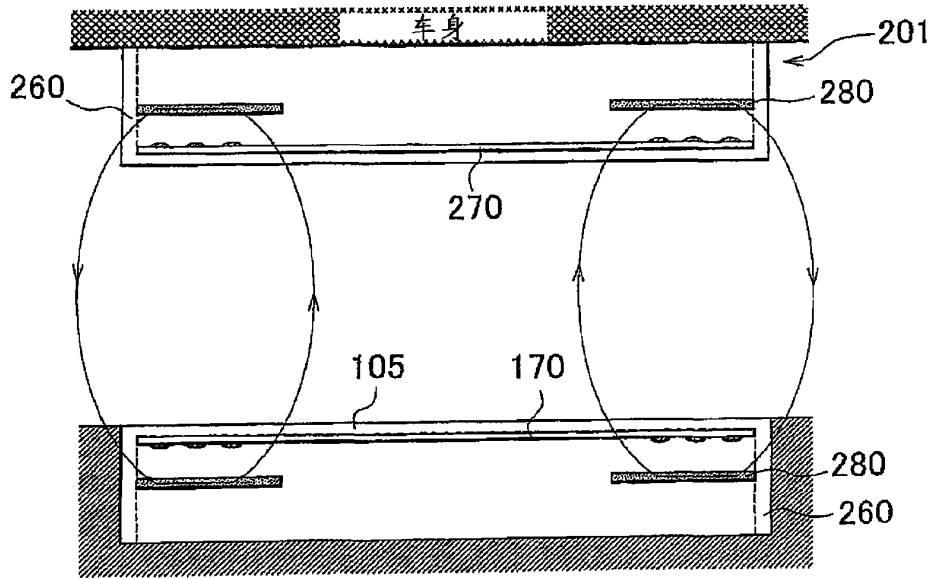


图 4

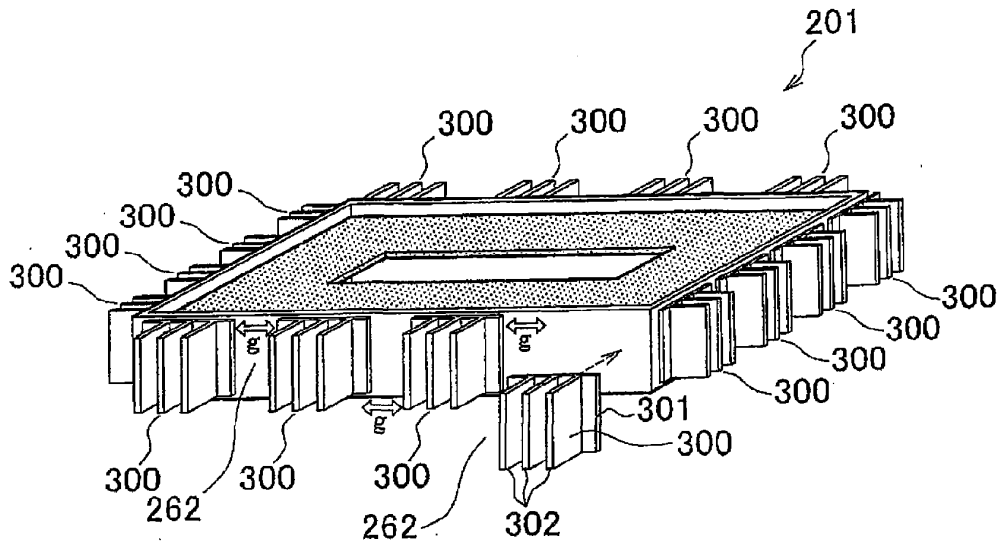


图 5

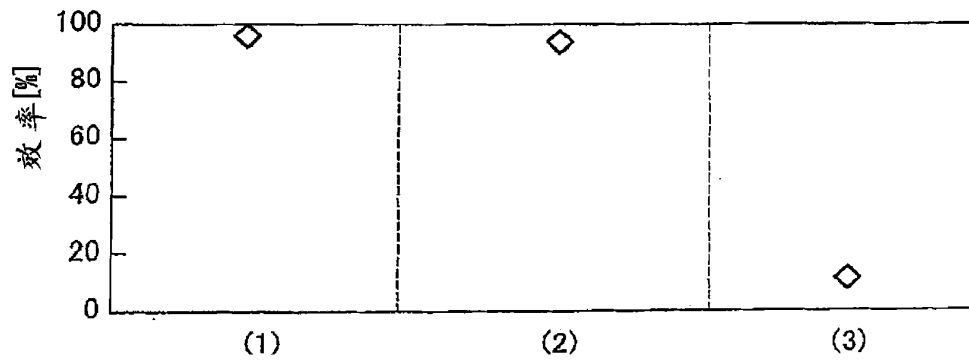


图 6A

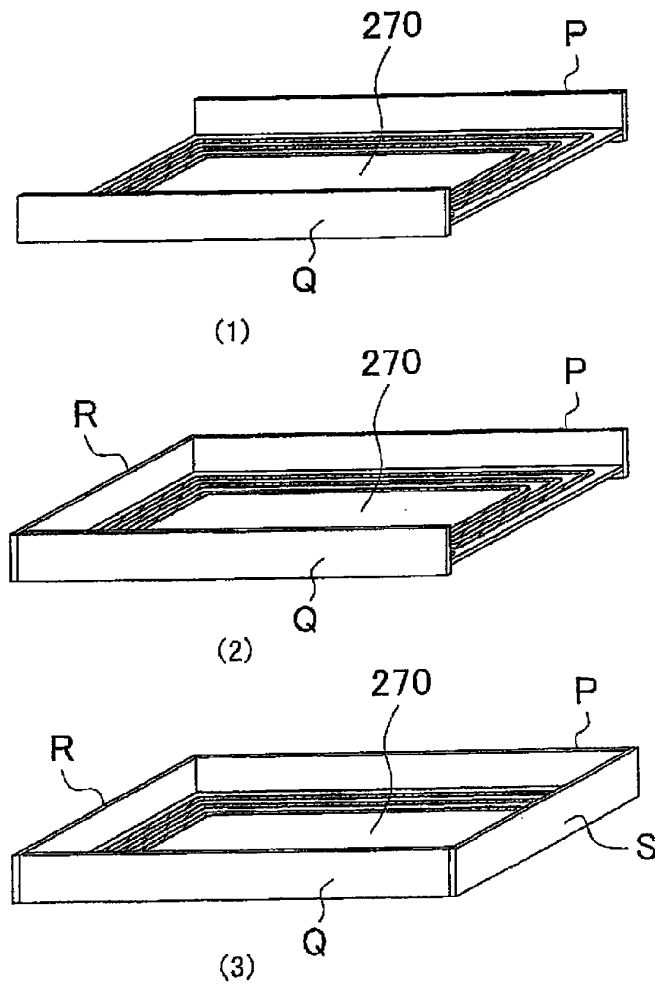


图 6B

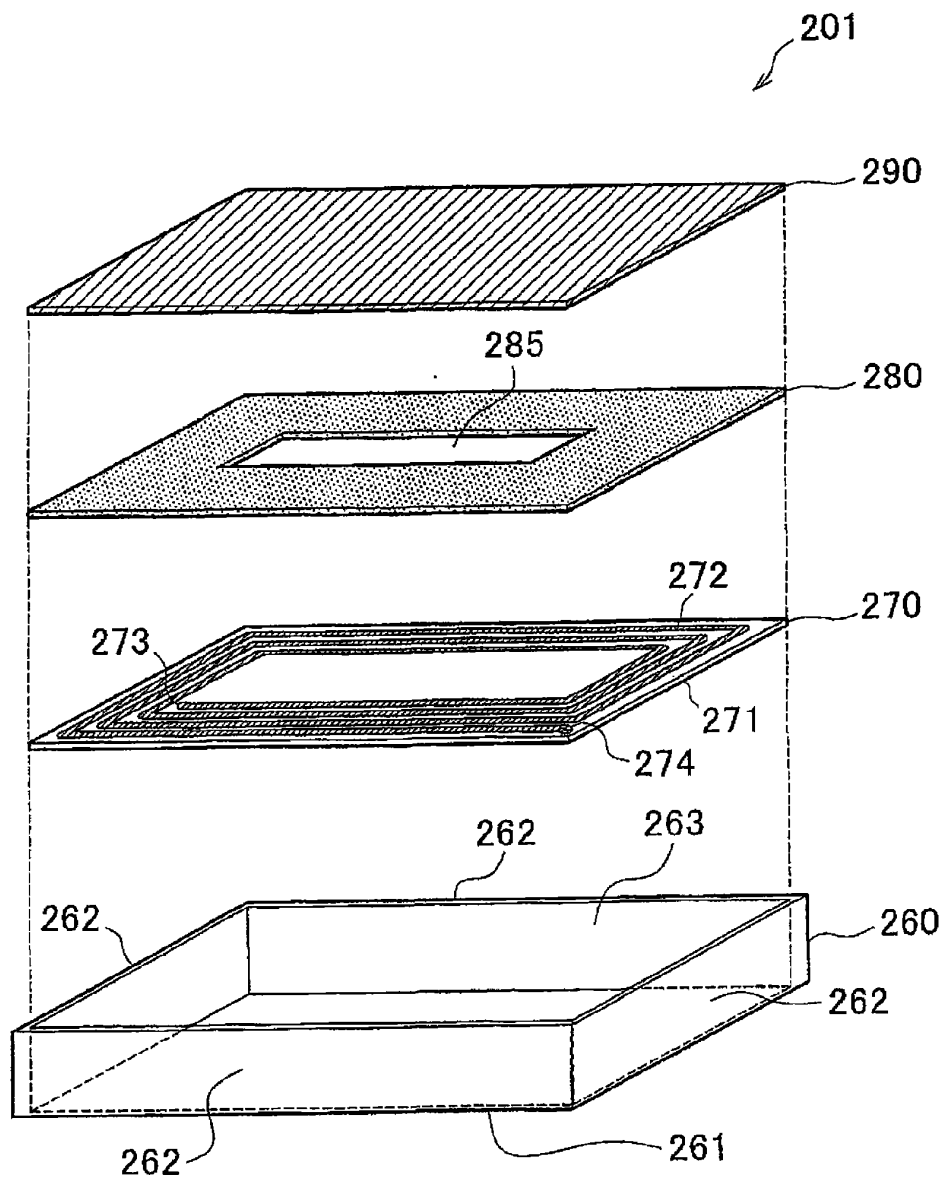


图 7

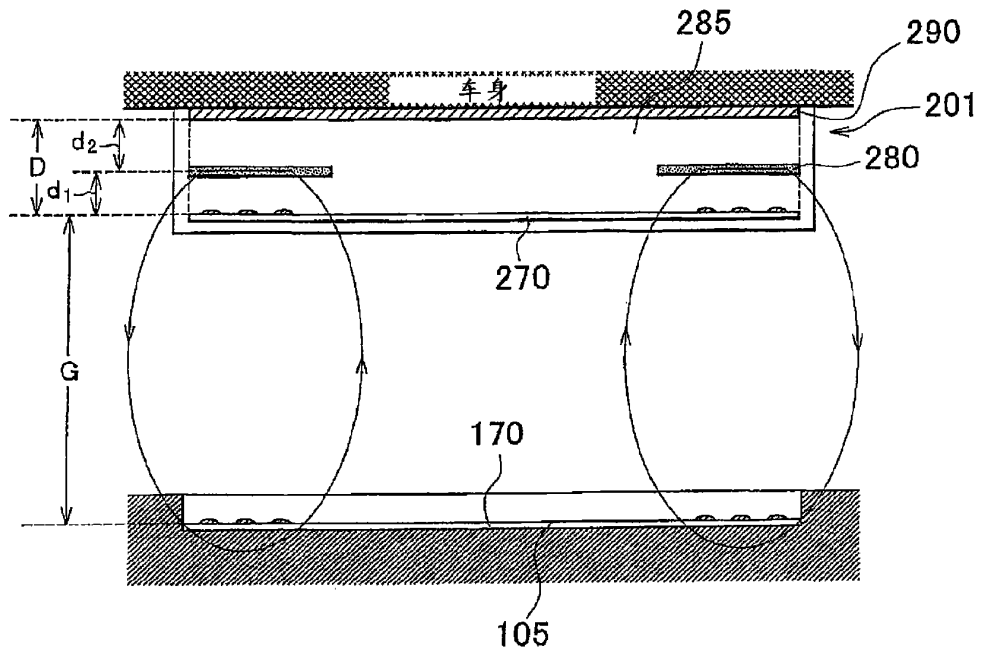


图 8

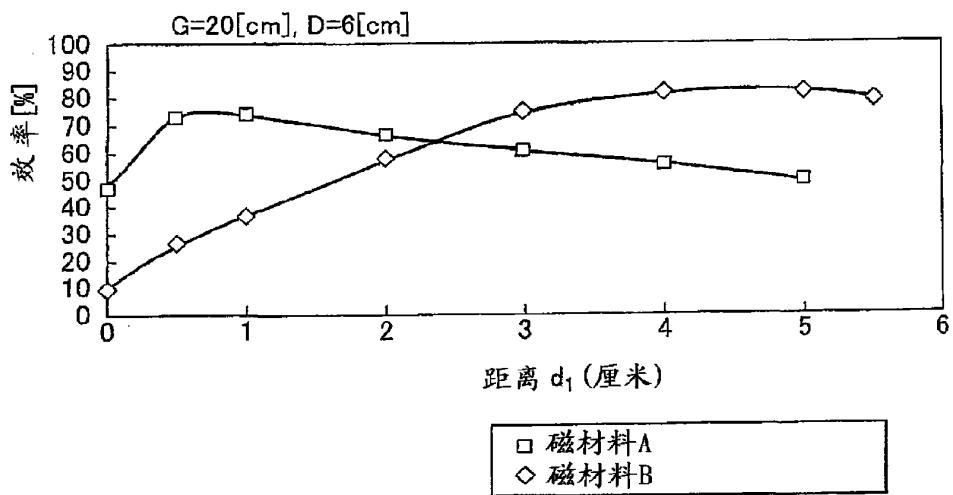


图 9

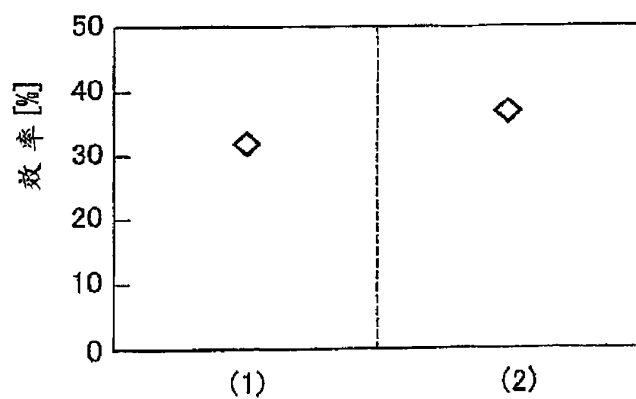


图 10A

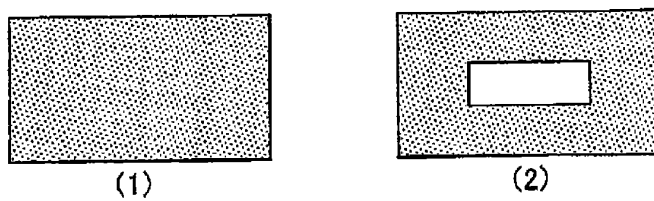


图 10B

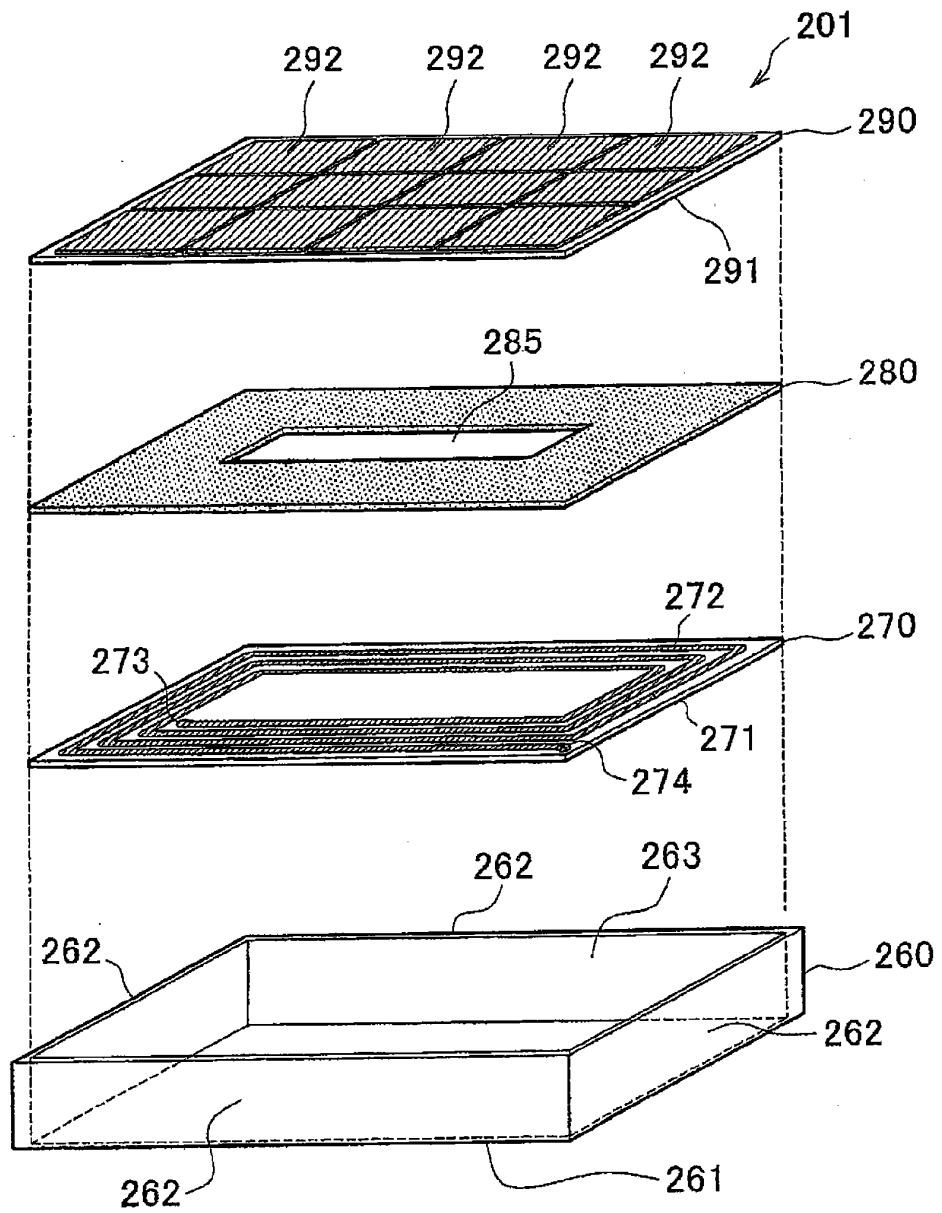


图 11

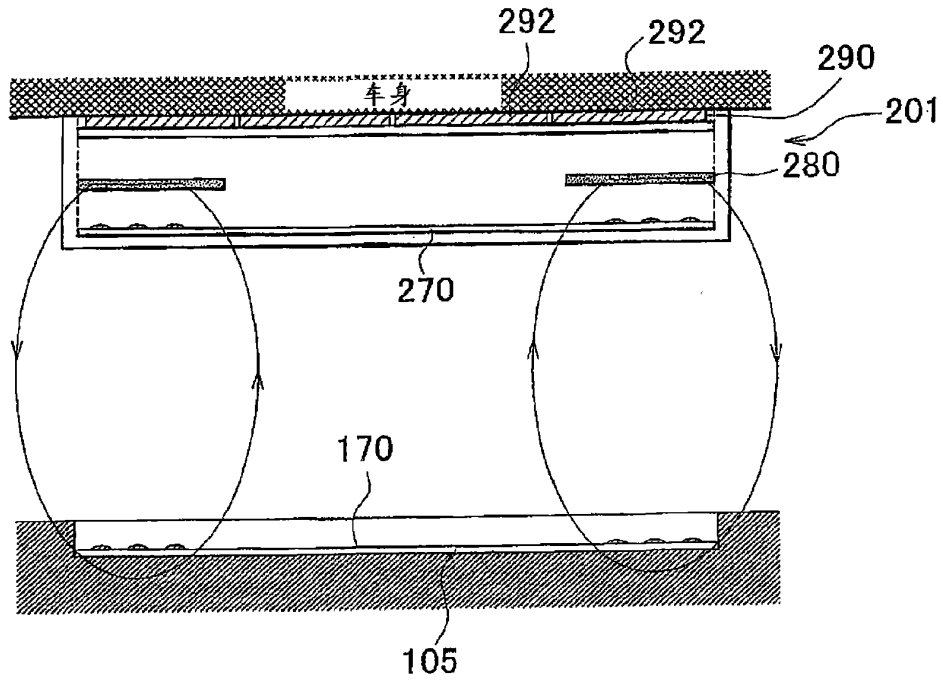


图 12

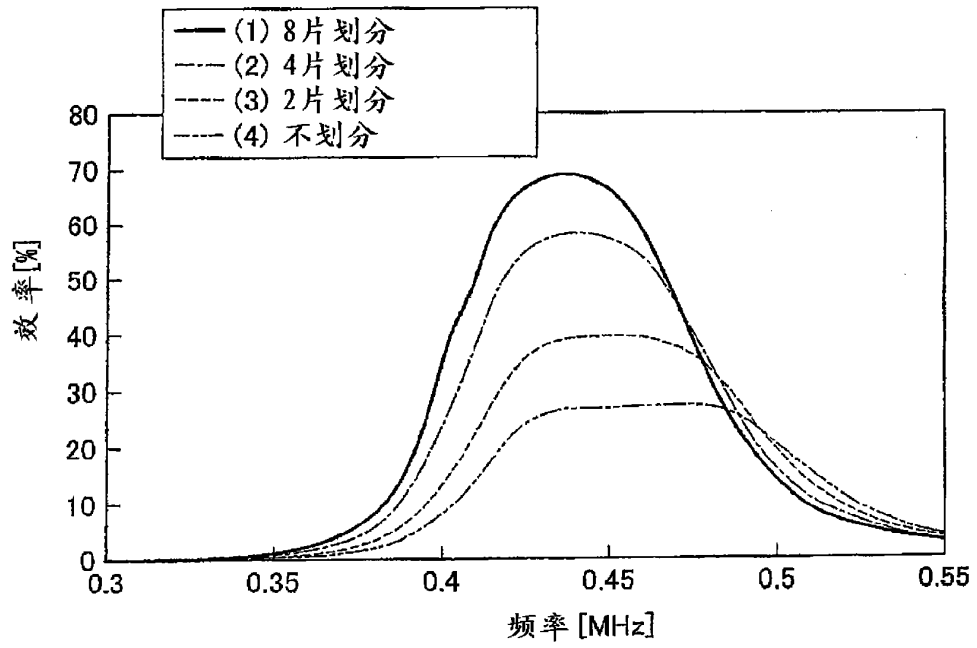


图 13A



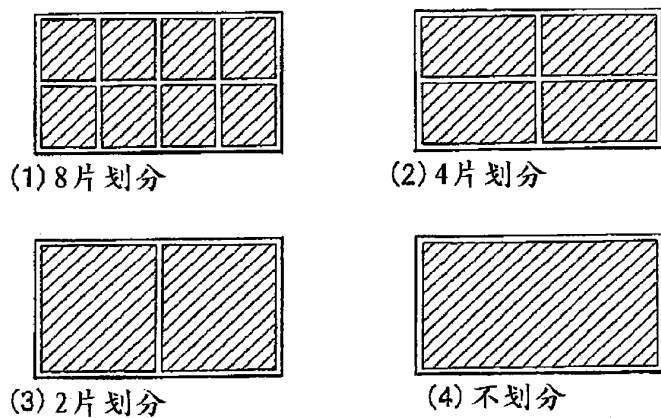


图 13B

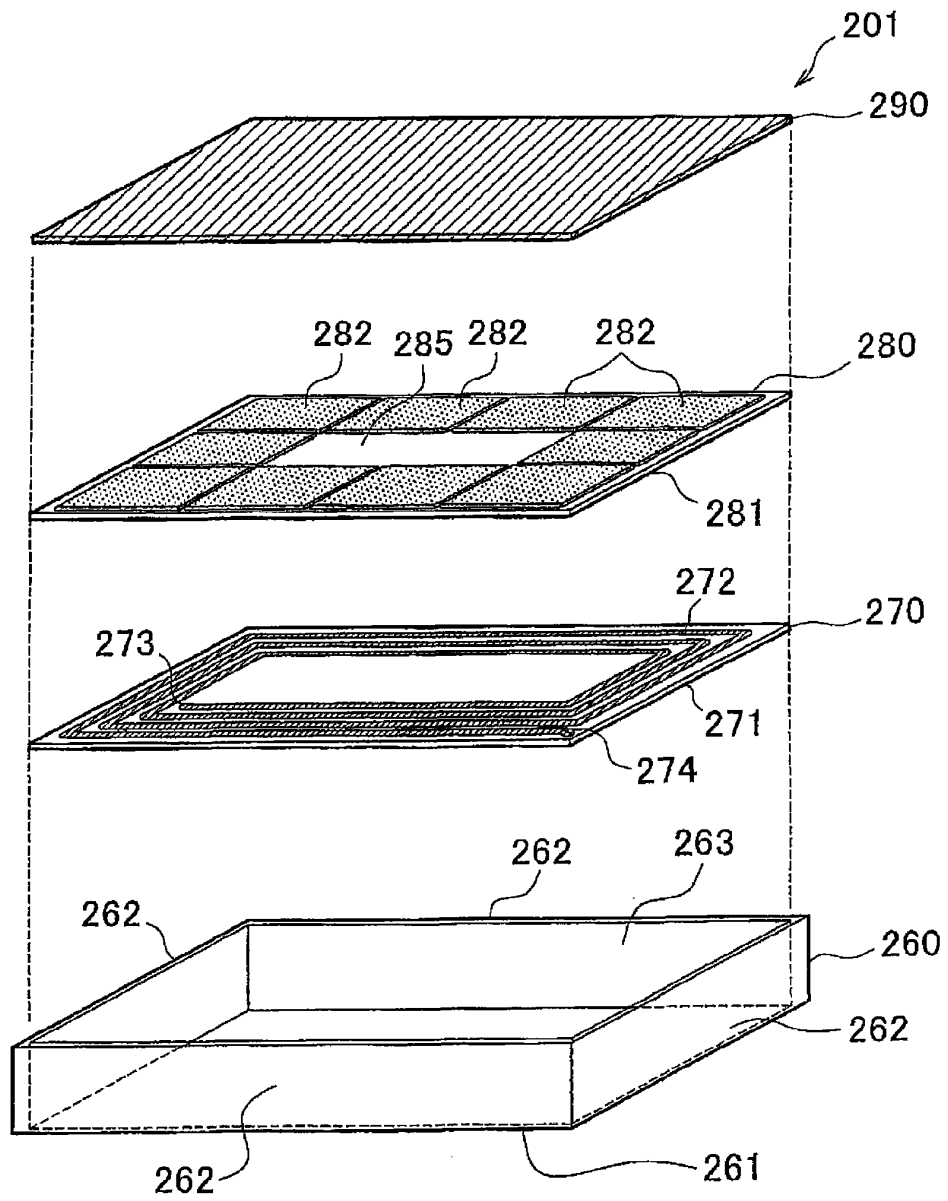


图 14

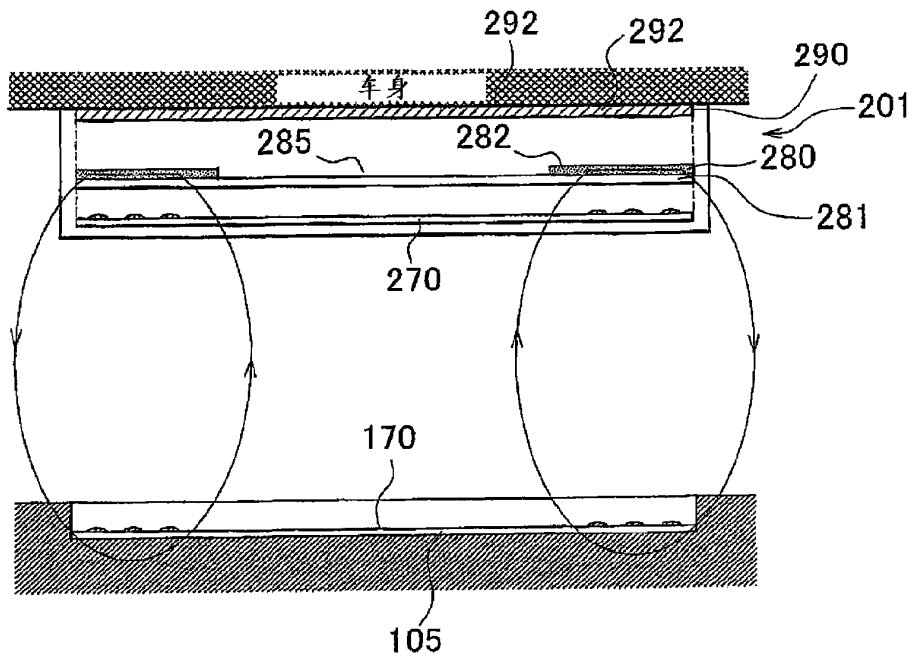


图 15

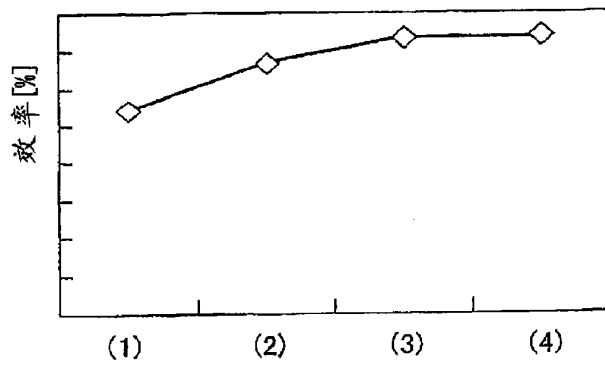


图 16A

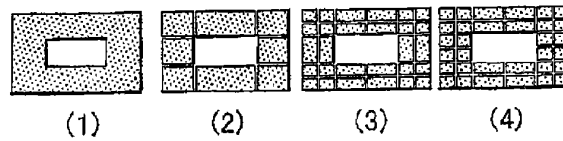


图 16B

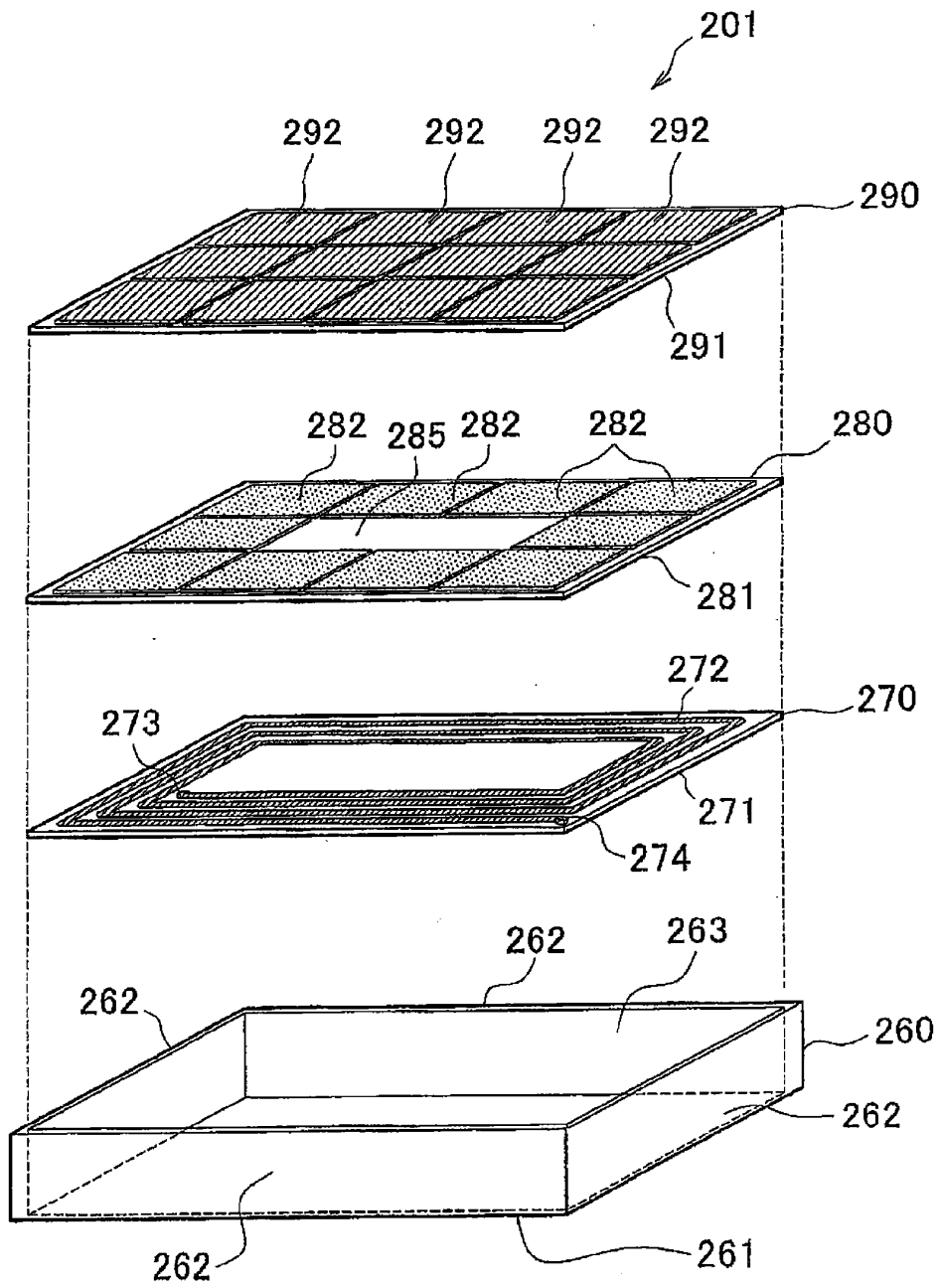


图 17

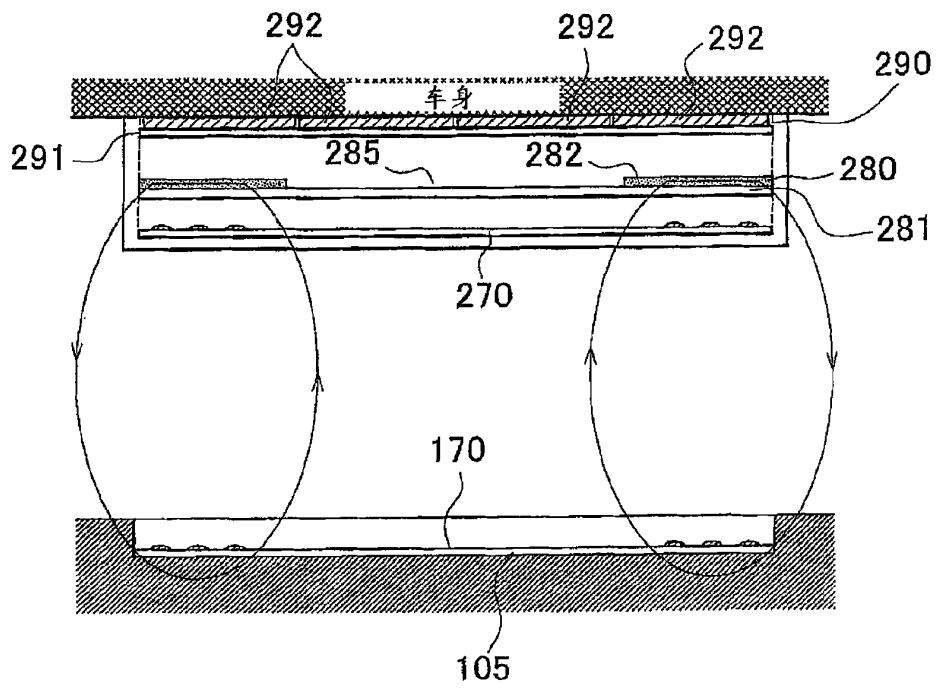


图 18

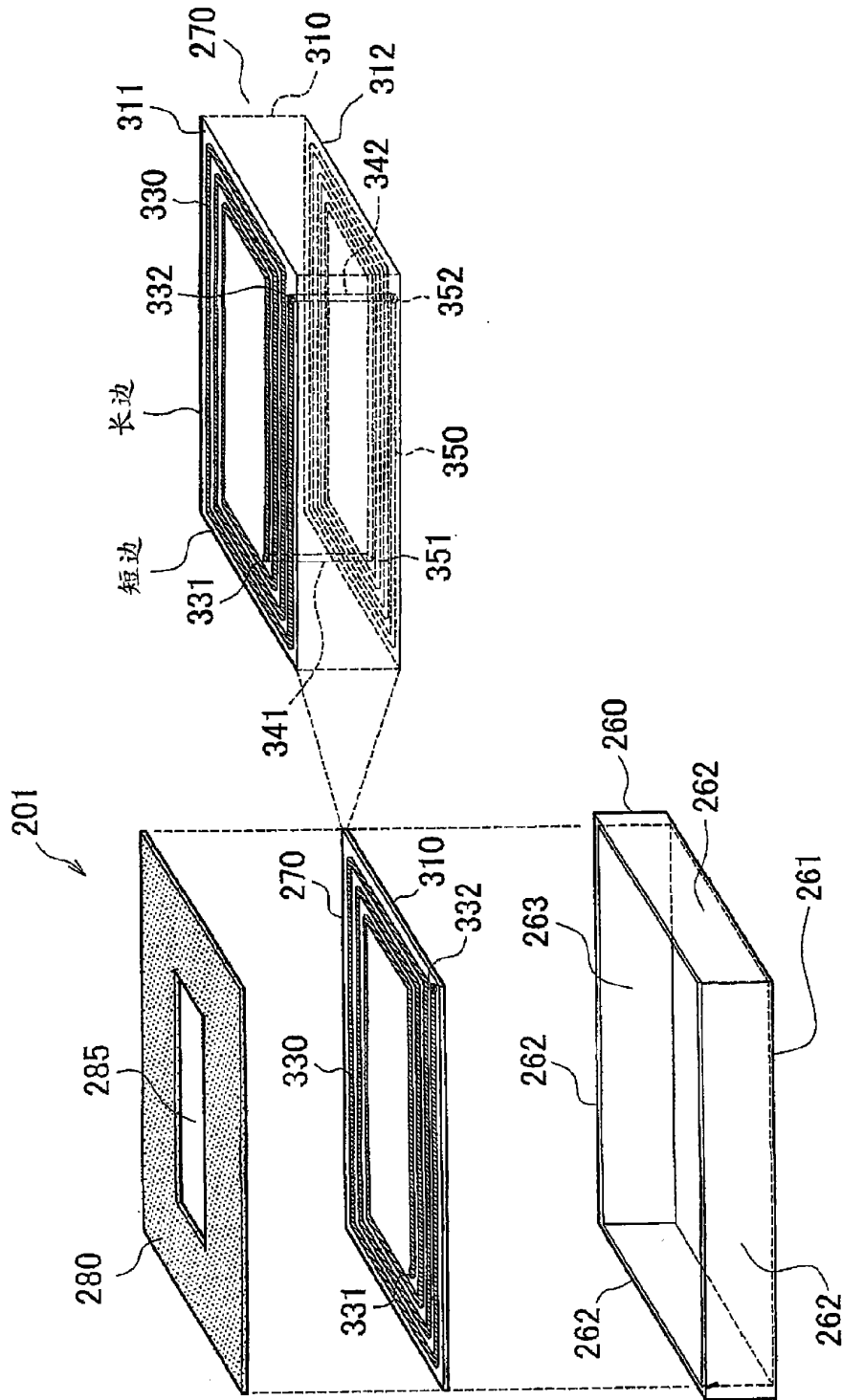


图 19

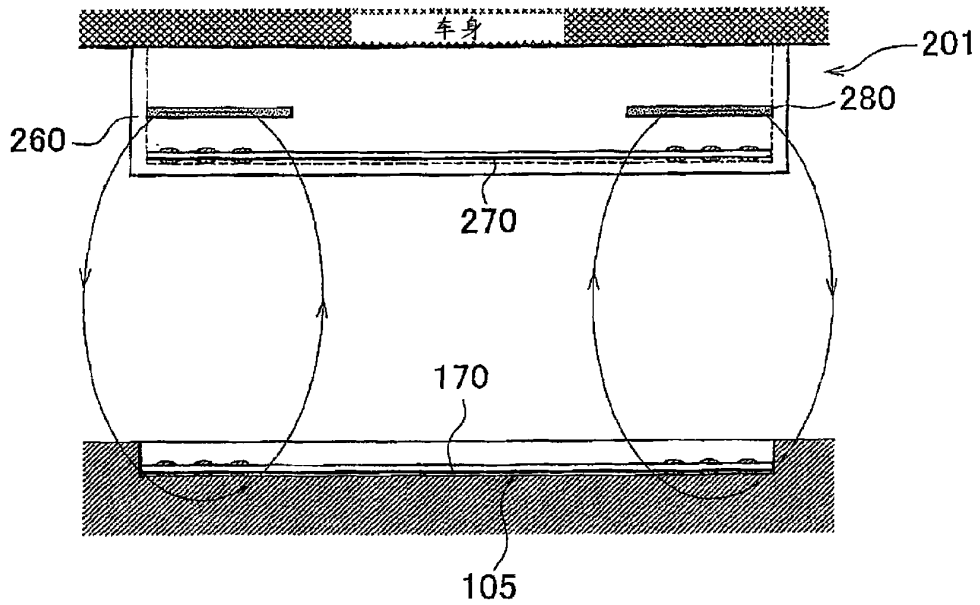


图 20

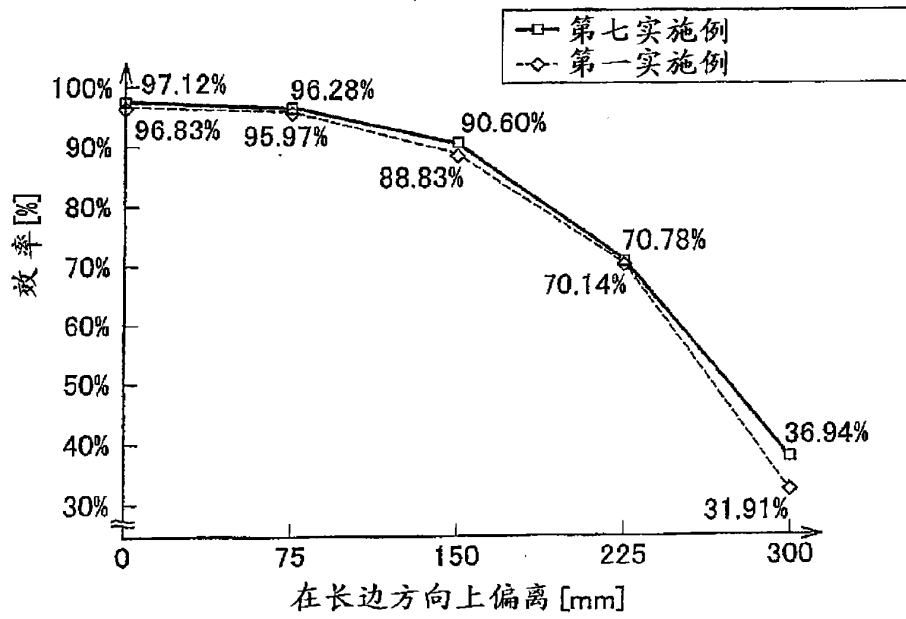


图 21A

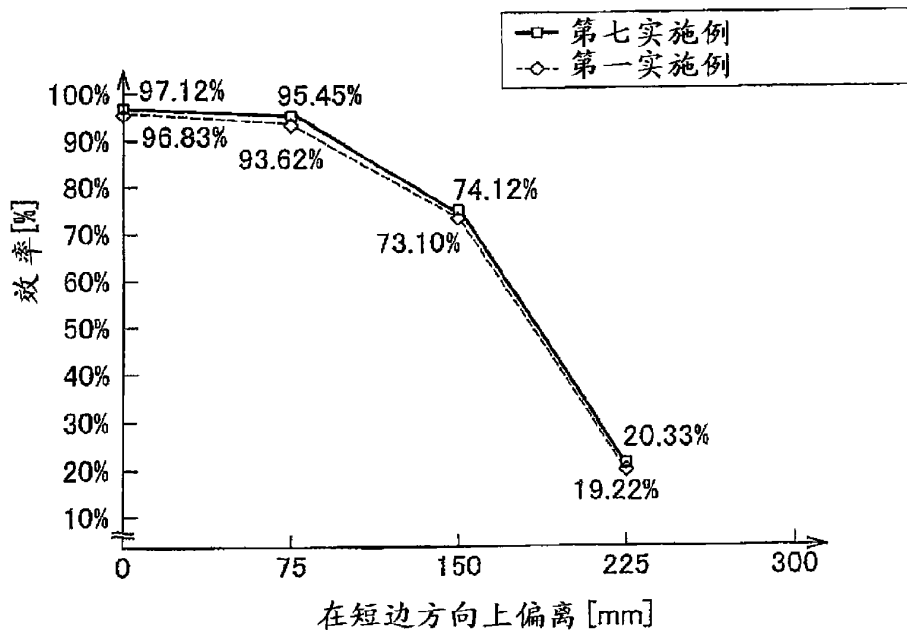


图 21B



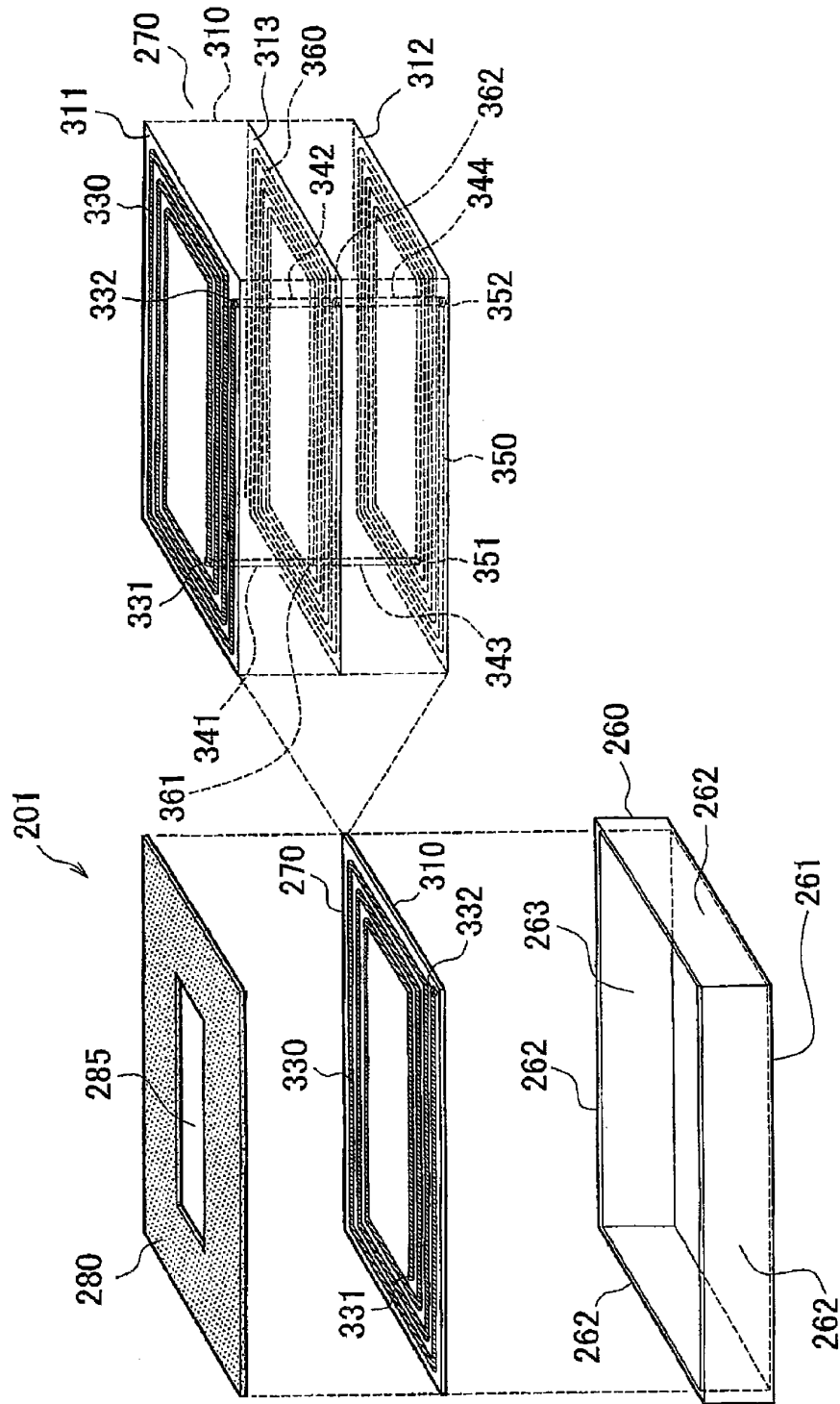


图 22



Espacenet

**Bibliographic data: CN102971908 (A) — 2013-03-13**

---

Antenna device and communication device

**Inventor(s):** SUGITA SATORU; YOKOTA TOSHIAKI; TAKAHASHI YOSHIMI;  
ORIHARA KATSUHISA ± (SUGITA SATORU, ; YOKOTA TOSHIAKI, ;  
TAKAHASHI YOSHIMI, ; ORIHARA KATSUHISA)

**Applicant(s):** SONY CHEM & INF DEVICE CORP ± (SONY CHEMICAL &  
INFORMATION DEVICE CORPORATION)

**Classification:** - **international:** G06K19/07; H01Q1/38  
- **cooperative:** H01F38/14 (US); H01Q1/002 (EP, US); H01Q1/2225  
(EP, US); H01Q1/243 (EP, US); H01Q7/00 (EP, US)

**Application number:** CN20118031241 20111116 Global Dossier

**Priority number(s):** WO2011JP76455 20111116 ; JP20100268395 20101201

**Also published as:** CN102971908 (B) HK1179419 (A1) JP2012119974 (A)  
JP5162648 (B2) KR20130141346 (A) TW201228121 (A)  
TWI523335 (B) US2013169398 (A1) US9082545 (B2)  
WO2012073704 (A1) less

**Abstract of CN102971908 (A)**

The present invention provides an antenna device which is capable of reliably performing communication by maintaining a resonant frequency to be substantially constant even if the temperature changes without increasing the space of the entire device. The present invention is provided with: an antenna circuit (11) which has an antenna coil (11a) which receives a magnetic field generated at a predetermined oscillation frequency from a reader/writer (2) and a capacitor (11b) electrically connected to the antenna coil (11a), wherein the antenna circuit (11) is inductively coupled to the reader/writer (2) so as to be capable of communication; and a magnetic sheet (12) which is formed at a position overlapping the antenna coil (11a) and which changes the inductance of the antenna coil (11a); wherein the antenna coil (11a) has temperature properties such that the inductance changes as a result of temperature change, and the magnetic sheet (12) comprises a magnetic material which has temperature characteristics that change the inductance of the antenna coil (11a) so as to have inverse characteristics of the change in inductance of the antenna coil (11a) accompanying the temperature change in a predetermined temperature range of usage so as to cause the resonant frequency of the antenna circuit (11) to substantially match the oscillation frequency in the temperature range of usage.



(12) 发明专利申请

(10) 申请公布号 CN 102971908 A

(43) 申请公布日 2013.03.13

(21) 申请号 201180031241.7

(74) 专利代理机构 中国专利代理(香港)有限公司 72001

(22) 申请日 2011.11.16

代理人 何欣亭 王忠忠

(30) 优先权数据

2010-268395 2010.12.01 JP

(51) Int. Cl.

H01Q 1/38 (2006.01)

(85) PCT申请进入国家阶段日

2012.12.24

G06K 19/07 (2006.01)

(86) PCT申请的申请数据

PCT/JP2011/076455 2011.11.16

(87) PCT申请的公布数据

WO2012/073704 JA 2012.06.07

(71) 申请人 迪睿合电子材料有限公司

地址 日本东京都

(72) 发明人 杉田悟 横田敏昭 高桥芳美

折原胜久

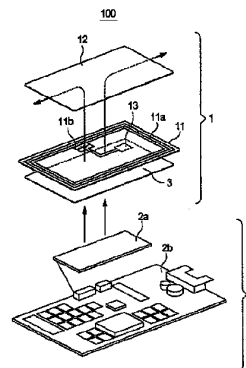
权利要求书 1 页 说明书 7 页 附图 15 页

(54) 发明名称

天线装置以及通信装置

(57) 摘要

本发明提供一种天线装置,不使装置整体的空间变大,即使温度变化,通过将谐振频率维持为大体一定,也能够稳定进行通信。包括:天线电路(11),具有接受从读写器(2)以既定的振荡频率发送的磁场的天线线圈(11a)、和与天线线圈(11a)电连接的电容器(11b),能够与读写器(2)感应耦合来通信;以及磁性片(12),在与天线线圈(11a)重叠的位置形成,使天线线圈(11a)的电感变化,天线线圈(11a)具有电感根据温度变化而变化的温度特性,磁性片(12)由具有如下温度特性的磁性材料构成:以伴随着既定的使用温度区域的温度变化的、天线线圈(11a)的电感的变化特性相反的方式,使天线线圈(11a)的电感变化,在使用温度区域下使天线电路(11)的谐振频率与振荡频率大体一致。



CN 102971908 A

1. 一种天线装置,包括:

谐振电路,具有接受从发送器以既定的振荡频率发送的磁场的天线线圈、和与该天线线圈电连接的电容器,能够与该发送器感应耦合来通信;以及

磁性片,在与所述天线线圈重叠的位置形成,使该天线线圈的电感变化,

所述天线线圈具有电感根据温度变化而变化的温度特性,

所述天线装置的特征在于,

所述磁性片由具有如下温度特性的磁性材料构成:以与伴随着既定的使用温度区域的温度变化的、所述天线线圈的电感的变化特性相反的方式,使该天线线圈的电感变化,在该使用温度区域下使所述谐振电路的谐振频率与所述振荡频率大体一致。

2. 如权利要求 1 所述的天线装置,其特征在于,

所述天线线圈具有随着所述使用温度区域的温度变化,电感单调增加的温度特性,

所述磁性片具有随着所述使用温度区域的温度变化,将所述天线线圈的电感单调减少的温度特性。

3. 如权利要求 2 所述的天线装置,其特征在于,

所述磁性片是在 Ni-Zn-Cu 类的磁性材料含有 Sb 氧化物和 Co 氧化物的铁氧体。

4. 如权利要求 3 所述的天线装置,其特征在于,所述磁性片是在所述磁性材料含有换算为  $Sb_2O_3$  的 0.7 重量百分比至 1.25 重量百分比的所述 Sb 氧化物、和换算为 CoO 的 0 至 0.2 重量百分比的所述 Co 氧化物的铁氧体。

5. 一种通信装置,包括:

谐振电路,具有接受从发送器以既定的振荡频率发送的磁场的天线线圈、和与该天线线圈电连接的电容器,能够与该发送器感应耦合来通信;

磁性片,在与所述天线线圈重叠的位置形成,使该天线线圈的电感变化;以及

通信处理部,利用流过所述谐振电路的电流来驱动,与所述发送器之间进行通信,

所述天线线圈具有电感跟温度变化而变化的温度特性,

所述通信装置的特征在于,

所述磁性片由具有如下温度特性的磁性材料构成:以与伴随着既定的使用温度区域的温度变化的、所述天线线圈的电感的变化特性相反的方式,使该天线线圈的电感变化,在该使用温度区域下使所述谐振电路的谐振频率与所述振荡频率大体一致。

## 天线装置以及通信装置

### 技术领域

[0001] 本发明涉及利用在对置的一对电极间的电磁场耦合来行进信息通信的天线装置、以及装入有该天线装置的通信装置。

[0002] 本申请主张以 2010 年 12 月 1 日在日本提交的申请号为特愿 2010-268395 的日本专利申请作为基础的优先权,通过参照将这些申请引用在本申请中。

### 背景技术

[0003] 近年来,确立了利用电磁感应来交换信号的非接触通信技术,广泛用作交通类车票和电子货币。另外,存在的倾向是这样的非接触通信功能也能被装载于移动电话机,期待今后会有进一步的发展。不仅是利用电磁感应的近距离通信,而且在物流中可隔开数 m 的距离进行读写的 IC 标签也被商品化。另外,由于这样的非接触通信技术不仅能非接触地进行通信,而且还能够同时进行电力传输,因此能够安装在本身没有电池等电源的 IC 卡。

[0004] 作为适用了这样的非接触通信技术的 RFID(Radio Frequency Identification: 射频识别)用的天线模块,以往使用有如下多个种类。第 1,有使用 FPC(Flexible Printed Circuit: 柔性印制电路)、刚性基板,将线圈图案制作在平面上的天线模块。第 2,有使圆线成为绕组来制作线圈的天线模块。第 3,有使 FPC、FFC(Flexible Flat Cable: 柔性扁平电缆)等成为电线束,使该电线束成为环状来形成线圈的天线模块。

[0005] 上述的天线模块根据考虑了器件的配置、形状的设计而适当选择,被装入电子设备并使用。

[0006] 在电子设备内配置天线模块的情况下,由于电子设备的金属制壳体和内部器件所使用的金属的影响,无法高效地将读写器振荡产生的磁通引入天线线圈。为了不受这样的金属的影响,在天线模块中,在天线的周边安装磁导率比较高、损耗系数小的铁氧体制的磁性片。

[0007] 例如在图 12 中,从左依次分别示出天线线圈单体的电感、有金属体接近的天线线圈的电感、在天线线圈与金属体之间配置了磁性片时的天线线圈的电感。

[0008] 这样,磁特性良好的铁氧体制的磁性片通过配置得与天线模块重叠,防止磁场进入配置在天线模块的周围的金属内成为涡电流而变为热量。另外,为了得到良好的通信性能,铁氧体制的磁性片的形状、组合等被进行了最优化。另外,为了力图实现移动电话机等便携式电子设备的薄型化,期望天线模块在与铁氧体制的磁性片贴合的状态下尽可能地变薄。

[0009] 另外,在适用了这样的非接触通信的通信系统中,为了在读写器与非接触数据载体之间进行非接触的通信和电力传输,通过在环形天线连接谐振用电容器,使由  $f = 1 / (2\pi(LC)^{1/2})$  表示的谐振频率与系统的规定频率一致,从而读写器与非接触数据载体进行稳定的通信,使通信距离最大。由环形天线和谐振用电容器的特性决定的 L、C 具有若干变动原因,并非一定成为设想的值。例如,在规定频率为 13.56 [MHz],用途为交通类车票和电子货币的通信系统中,从可靠性的观点而言,要求即使受到上述变动原因的影响,也能控制

为天线模块的谐振电路的谐振频率为 13.56 [MHz] ± 200 [KHz] 左右。

[0010] 此处,在非接触数据载体中,为了降低成本,环形天线由铜箔图案制作,L 的值由于图案宽度的偏离等而变化。若对一般的由片状电容器的特性决定的 C、由天线线圈的特性决定的 L 的各温度变化率进行观察,则有的情况下 L 的偏差相对于 C 在级别上有 100 倍左右。例如,在 L 的值以 2.5 [μH] 移位 1% 的情况下,由于谐振频率偏离 70KHz,因此期望相对于 L 值的温度尽可能不变动。

[0011] 专利文献 1 中记载了一种通信装置,为了防止上述的温度变化引起谐振频率的变动,包括温度检测部以及频率偏移,该频率偏移部根据由该温度检测部检测出的温度,使由调谐部调谐的谐振频率进行偏移。

[0012] 现有技术文献

专利文献

专利文献 1 :日本特开 2007-104092 号公报。

## 发明内容

[0013] 本发明要解决的问题

另外,天线线圈的电感的温度特性还会根据磁性片的组成而变化,该磁性片配置在与制作有天线线圈的基板接近的位置。此处,图 13 示出将由组成不同的 2 个铁氧体的磁性材料 KM11、KM21 所构成的各磁性片贴在制作有天线线圈的印制电路板的各天线模块的电感的温度特性。在该图 13 中,示出横轴为温度,纵轴为伴随着相对于作为设计中心的一个例子而设定的 20°C 时的电感 L20 的温度变化的电感 Lx 的差值的比率  $(Lx - L20) \times 100 / L20$  的值。

[0014] 观察图 13 可知,存在的问题是:在各磁性片中,在 -20°C 至 60°C 的温度区域中,相对于设计中心的 20°C 时的电感 L20,最大分别偏离 1.0%、2.0% 左右,结果谐振频率会大幅偏离。

[0015] 对于这样的温度特性,上述的专利文献 1 所记载的通信装置由于用电路上的对策来进行频率补正处理,因此,例如难以内置在移动电话机等要求小空间的电子设备。

[0016] 本发明是鉴于这样的实际情况而提出的,其目的在于提供一种天线装置以及装入有该天线装置的通信装置,所述天线装置不使装置整体的空间变大,即使温度变化,通过将谐振频率维持为大体一定,从而也能够稳定进行通信。

[0017] 用于解决问题的方法

作为用于解决上述的问题的方案,本发明所涉及的天线装置的特征在于,包括:谐振电路,具有接受从发送器以既定的振荡频率发送的磁场的天线线圈、和与天线线圈电连接的电容器,能够与发送器感应耦合来通信;以及磁性片,在与天线线圈重叠的位置形成,使天线线圈的电感变化,天线线圈具有电感根据温度变化而变化的温度特性,磁性片由具有如下温度特性的磁性材料构成:以与伴随着既定的使用温度区域的温度变化的、天线线圈的电感的变化特性相反的方式,使天线线圈的电感变化,在使用温度区域下使谐振电路的谐振频率与振荡频率大体一致。

[0018] 另外,本发明所涉及的天线装置的特征在于,包括:谐振电路,具有接受从发送器以既定的振荡频率发送的磁场的天线线圈、和与天线线圈电连接的电容器,能够与发送器

感应耦合来通信；磁性片，在与天线线圈重叠的位置形成，使天线线圈的电感变化；以及通信处理部，利用流过谐振电路的电流来驱动，与发送器之间进行通信，天线线圈具有电感根据温度变化而变化的温度特性，磁性片由具有如下温度特性的磁性材料构成：以与伴随着既定的使用温度区域的温度变化的、天线线圈的电感的变化特性相反的方式，使天线线圈的电感变化，在使用温度区域下使谐振电路的谐振频率与振荡频率大体一致。

[0019] 本发明将磁性片与天线线圈重叠而形成，该磁性片具有使天线线圈的电感变化以与伴随着使用温度区域的温度变化的、天线线圈的电感的变化特性相反的温度特性，在使用温度区域下使谐振电路的谐振频率与振荡频率大体一致。这样，本发明利用与磁性片的温度特性相应的天线线圈的电感的变化，抵消与温度变化相应的天线线圈的电感的变化所导致的谐振频率的变化。因此，本发明由于不用电路上的对策来进行频率校正处理，因此不使装置整体的空间变大，在预先设定的使用温度区域，即使温度变化，也能将谐振频率维持为大体一定，稳定进行通信。

#### 附图说明

[0020] 图 1 是示出无线通信系统的整体结构的图。

[0021] 图 2 是示出无线通信系统所涉及的电路结构的图。

[0022] 图 3 是用于说明铁氧体制的磁性片的温度特性的图。

[0023] 图 4A 和图 4B 是用于说明实施例所涉及的天线模块 1 的外形形状的图。

[0024] 图 5 是示出横轴为温度，纵轴为伴随着相对于设计中心即 20°C 时的电感 L20 的温度变化的电感 Lx 的差值的比率  $(Lx - L20) \times 100 / L20$  的值的图。

[0025] 图 6A 和图 6B 是用于说明使用了加工为环圈状的环的磁性片的磁特性的测定的图。

[0026] 图 7 是用于说明在 Ni-Zn-Cu 类的磁性材料含有 Sb 氧化物和 Co 氧化物的铁氧体的磁特性的图。

[0027] 图 8 是用于说明本实施方式所涉及的天线线圈的电感的温度特性的图。

[0028] 图 9 是用于说明实施例所涉及的天线模块的截面形状的图。

[0029] 图 10 是示出使 ADH 片的厚度变化时的电感的变化的图。

[0030] 图 11A 至图 11C 是用于说明与柔性印制电路板与 ADH 片的厚度的合计值的变化相应地，天线线圈的电感的温度特性的图。

[0031] 图 12 是用于说明与天线线圈接近配置的磁性片的功能的图。

[0032] 图 13 是示出横轴为温度，纵轴为伴随着相对于作为设计中心的一个例子而设定的 20°C 时的电感 L20 的温度变化的电感 Lx 的差值的比率  $(Lx - L20) \times 100 / L20$  的值的图。

#### 具体实施方式

[0033] 以下，参照附图详细说明该“具体实施方式”。此外，本发明不仅限于以下的实施方式，当然可以在不脱离本发明的要点的范围内进行各种变更。

[0034] <整体结构>

适用了本发明的天线模块是利用在与发送电磁波的发送器之间产生的电磁感应而成

为可通信状态的天线装置,例如装入图 1 所示的 RFID(Radio Frequency Identification)用的无线通信系统 100 来使用。

[0035] 无线通信系统 100 由适用了本发明的天线模块 1、对天线模块 1 进行访问的读写器 2 构成。

[0036] 读写器 2 包括:作为对天线模块 1 发送磁场的发送器起作用,具体而言向天线模块 1 发送磁场的天线 2a;以及与经由天线 2a 感应耦合的天线模块 1 进行通信的控制基板 2b。

[0037] 即,读写器 2 配设有与天线 2a 电连接的控制基板 2b。在该控制基板 2b 安装有由一个或者多个集成电路芯片等电子元器件构成的控制电路。该控制电路基于从天线模块 1 接收的数据,执行各种处理。例如,在向天线模块 1 写入数据的情况下,控制电路对数据进行编码,基于经编码的数据对既定频率(例如 13.56MHz)的载波进行调制,将经调制的调制信号放大,用放大的调制信号来驱动天线 2a。另外,在从天线模块 1 读出数据的情况下,控制电路将由天线 2a 接收的数据的调制信号放大,对放大的数据的调制信号进行解调,对经解调的数据进行解码。此外,在控制电路中,使用一般的读写器所使用的编码方式和调制方式,例如使用曼彻斯特编码方式、ASK(Amplitude Shift Keying:幅移键控)调制方式。

[0038] 装入电子设备的壳体 3 内部的天线模块 1 包括:天线电路 11,安装有能够与感应耦合的读写器 2 之间进行通信的天线线圈 11a;磁性片 12,为了将磁场引入天线线圈 11a,在与天线线圈 11a 重叠的位置形成;以及通信处理部 13,利用流过天线电路 11 的电流驱动,与读写器 2 之间进行通信。

[0039] 天线电路 11 是相当于本发明所涉及的谐振电路的电路,包括:天线线圈 11a、以及与天线线圈 11a 电连接的电容器 11b。

[0040] 若天线电路 11 用天线线圈 11a 接受从读写器 2 发送的磁场,则通过与读写器 2 感应耦合而磁耦合,接收经调制的电磁波,将接收信号供给至通信处理部 13。

[0041] 磁性片 12 为了将从读写器 2 发送的磁场引入天线线圈 11a,形成于与天线线圈 11a 重叠的位置,与没有该磁性片 12 的情况相比,使天线线圈 11a 的电感以增加的方式变化。具体而言,磁性片 12 为了抑制设在便携式电子设备的壳体 3 内部的金属器件将从读写器 2 发送的磁场挡回或产生涡电流,采取粘贴在磁场辐射来的方向的相反侧的构造。

[0042] 通信处理部 13 利用流过电连接的天线电路 11 的电流来驱动,与读写器 2 之间进行通信。具体而言,通信处理部 13 对接收的调制信号进行解调,对经解调的数据进行解码,将经解码的数据写入后述的存储器 133。另外,通信处理部 13 从存储器 133 读出发送至读写器 2 的数据,对读出的数据进行编码,基于编码后的数据对载波进行调制,经由通过感应耦合而磁耦合的天线电路 11,将调制后的电波发送至读写器 2。

[0043] 参照图 2 说明在由以上这样的结构构成的无线通信系统 100 中,天线模块 1 的天线电路 11 的具体的电路结构。

[0044] 如上所述,天线电路 11 包括天线线圈 11a、电容器 11b。

[0045] 天线线圈 11a 例如形成为矩形,与由读写器 2 的天线 2a 辐射的磁通中与天线线圈 11a 交链的磁通的变化相应地产生逆电动势。电容器 11b 与天线线圈 11a 连接,构成谐振电路。

[0046] 这样,天线电路 11 的天线线圈 11a 与电容器 11b 电连接,构成谐振电路,利用天线线圈 11a 的电感 L 和电容器 11b 的电容 C,设定由  $f = 1 / (2\pi(LC)^{1/2})$  表示的谐振频率。



[0047] 通信处理部 13 由包括调制解调电路 131、CPU 132、存储器 133 的微型计算机构成。

[0048] 调制解调电路 131 进行调制处理,生成将从天线电路 11 向读写器 2 发送出的数据叠加于载波的调制波。

[0049] 另外,调制解调电路 131 进行解调处理,由从读写器 2 输出的调制波提取数据。

[0050] CPU 132 控制调制解调电路 131,以将从存储器 133 读出的数据发送至读写器 2,另外,进行将由调制解调电路 131 解调的数据写入存储器 133 的处理。

[0051] 在与具有上述结构的的天线模块 1 进行通信的读写器 2 中,天线 2a 包括天线线圈 21 和电容器 22,控制基板 2b 包括调制解调电路 23、CPU 24 和存储器 25。

[0052] 天线线圈 21 例如形成为矩形,通过与天线模块 1 侧的天线线圈 11a 磁耦合,对命令、写入数据等各种数据进行收发,还供给天线模块 1 所使用的电力。

[0053] 电容器 22 与天线线圈 21 连接,构成谐振电路。调制解调电路 23 进行调制处理,用于生成将从读写器 2 向天线模块 1 发送出的数据叠加于载波的调制波。另外,调制解调电路 23 进行解调处理,由从天线模块 1 发送的调制波提取数据。

[0054] CPU 24 控制调制解调电路 23,以将从存储器 25 读出的数据发送至天线模块 1,另外,进行将由调制解调电路 23 解调的数据写入存储器 25 的处理。

[0055] 从实现稳定的通信的观点而言,调整天线模块 1 的天线电路 11 的天线线圈 11a 的电感 L 和电容器 11b 的电容 C,使得天线电路 11 的谐振频率与读写器 2 的振荡频率一致。

[0056] <温度补偿>

对于由以上这样的结构构成的天线模块 1,从防止天线电路 11 的谐振频率随着使用温度区域的温度变化而偏离的观点而言,注意到通过线圈的大小根据与温度变化相应的导电性材料的伸缩而变化,从而天线线圈 11a 的电感 L 会变化的特性,磁性片 12 具有如下特性。

[0057] 即,磁性片 12 由具有如下温度特性的磁性材料构成:以与伴随着使用温度区域的温度变化的、天线线圈 11a 的电感的变化特性相反的方式,使天线线圈 11a 的电感变化,在使用温度区域下使天线电路 11 的谐振频率与读写器 2 的振荡频率大体一致。

[0058] 作为具体例,在本实施方式中,天线线圈 11a 其线圈数为 3 至 10,具有的特性是,电感在天线电路 11 的谐振频率即 13.56 MHz 下的变化单调增加。对于这样的天线线圈 11a 的温度特性,磁性片 12 具有的特性是,在  $20^{\circ}\text{C} \pm 5^{\circ}\text{C}$  以上,天线线圈 11a 的电感随着温度变化而单调减少。而且,磁性片 12 通过与这样的天线线圈 11a 以接合距离为  $10\ \mu\text{m}$  至  $255\ \mu\text{m}$  的方式接近配置,利用与磁性片 12 的温度特性相应的天线线圈 11a 的电感的变化,抵消与温度变化相应的天线线圈 11a 的电感的单调增加。

[0059] 磁性片 12 是实现如上所述的温度补偿的磁性材料即可,但在作为磁性材料使用  $\mu'$  比较高的铁氧体的情况下,具有的温度特性如图 3 所示,以随着温度变化出现 2 个峰值的方式,使天线线圈 11a 的电感变化。

[0060] 例如,在使用温度区域为  $-20^{\circ}\text{C}$  至  $60^{\circ}\text{C}$  的情况下,磁性片 12 使第二次出现的峰值(以下称作二次峰值。)的温度为  $-20^{\circ}\text{C}$  至  $20^{\circ}\text{C}$ ,在温度比该二次峰值高的区域,为了抵消与温度变化相应的天线线圈 11a 的电感单调增加的特性,优选使用如下组成的构成。

[0061] 即,磁性片 12 是在 Ni-Zn-Cu 类的磁性材料含有 Sb 氧化物与 Co 氧化物的铁氧体,还满足如下条件。此处,磁性片 12 含有换算为  $\text{Sb}_2\text{O}_3$  的 0.7 重量百分比(重量%)至 1.25 重量百分比的 Sb 氧化物、以及换算为 CoO 的 0 至 0.2 重量百分比的 Co 氧化物。

[0062] 通过这样,天线模块 1 利用与磁性片 12 的温度特性相应的天线线圈 11a 的电感的变化,抵消与温度变化相应的天线线圈 11a 的电感的变化所导致的谐振频率的变化。因此,天线模块 1 由于不用电路上的对策来进行频率补正处理,因此不使装置整体的空间变大,在预先设定的使用温度区域,即使温度变化,也能将谐振频率维持为大体一定,稳定进行通信。

#### [0063] 实施例 1

作为装入移动电话机等的天线模块的具体例,使用如下天线模块。即,天线线圈 11a 如图 4A 所示,使用在外形形状为 36 [mm]×29 [mm]、厚度为 0.09 [mm] 的柔性印制电路板 11c 利用构图处理而制作的天线线圈。另外,磁性片 12 如图 4B 所示,使用外形形状为 36 [mm]×29 [mm],在 13.56MHz 的频率下  $\mu' = 119$ 、 $\mu'' = 1.33$  的铁氧体。另外,制作有天线线圈 11a 的柔性印制电路板 11c 与磁性片 12 经由作为粘着剂的、厚度为 0.3mm 的丙烯酸类 ADH 片而接合。

[0064] 首先,对未接合磁性片 12 的柔性印制电路板 11c 单体,线匝数分别为 3、5、10,导线为 Cu 时的,各天线线圈 11a 的电感的温度特性进行测定的结果如图 5 所示。

[0065] 在该图 5 中,示出纵轴为温度,横轴为伴随着相对于作为设计中心即 20°C 时的电感  $L_{20}$  的温度变化的电感  $L_x$  的差值的比率  $(L_x - L_{20}) \times 100 / L_{20}$  的值。此外,图 5 的凡例的“3t”、“5t”、“10t”分别示出天线线圈 11a 的线圈数是 3、5、10。

[0066] 如图 5 所示,所有 3 种天线线圈 11a 的电感与温度变化相应地单调增加。特别是在所有 3 种天线线圈 11a 中,匝数较多的天线模块的电感相对于温度的变化比较大。这是因为:天线线圈 11a 的导线即 Cu 的线膨胀系数  $\alpha$  为 16.5,比较大,由于图案长度相对于温度而变化,所以天线线圈 11a 的面积  $S$  会变化,从而由  $L = AN^2S$  表示的电感  $L$  变化。此处  $A$  是比例系数, $N$  示出线圈数。

[0067] 接下来,由于磁性片 12 以单体形态无法测定电感,因此,例如将磁性片 12 的磁性材料制作成如图 6A 所示的,加工为内径  $3\text{mm} \pm 0.03\text{mm}$ 、外径  $7\text{mm} \pm 0.03\text{mm}$ 、厚度  $0.1\text{mm} \pm 0.01$  的环圈状的环 4,如图 6B 所示,在该环 4 卷绕导线 5,测定在导线流过 13.56MHz 的信号时的电感。通过这样测定的电感可以作为磁性材料的特性值来评价。

[0068] 作为为了利用使用了这样的环圈的测定来对天线线圈 11a 的电感进行温度补偿,而在 Ni-Zn-Cu 类的磁性材料含有 Sb 氧化物与 Co 氧化物的铁氧体的具体例,使用图 7 所示的温度特性的磁性材料。在本实施例所涉及的磁性片中,使用含有换算为  $\text{Sb}_2\text{O}_3$  的 1.2 重量百分比的 Sb 氧化物和换算为 CoO 的 0.2% 的 Co 氧化物的铁氧体。这是满足上述的含有换算为  $\text{Sb}_2\text{O}_3$  的 0.7 重量百分比至 1.25 重量百分比的 Sb 氧化物、换算为 CoO 的 0 至 0.2 重量百分比的 Co 氧化物的这样的条件的一个例子。即,如图 7 所示,使用的磁性材料 KM30 具有的温度特性是:在 -10°C 附近有二次峰值,在其以上的温度变化下电感单调减少。此处,在图 7 中,示出上述的柔性印制电路板 11c 单体的、线圈数为 10 的天线线圈 11a 的电感的温度特性,示出对于该温度特性、将纵轴的比例尺比设为 1 / 10 而表示的磁性材料 KM30 利用环圈来测定的电感的温度特性。

[0069] 该实施例所涉及的天线模块 1 通过将由这样的磁性材料 KM30 构成的磁性片 12 经由厚度为 0.3mm 的 ADH 片,与制作由上述的线圈数为 10 的天线线圈 11a 的柔性印制电路板 11c 接合,如图 8 所示,至少在 -10°C 至 40°C 的温度区域能够将天线线圈 11a 的电感保持为

一定。

[0070] 在图 8 中,作为实测值 (KM30)、与实测值 (KM30) 大体一致的计算值,示出如下 2 个计算值。即,这些计算值是指将使用了图 7 所示的环圈的特性值即计算值,作为相对于 FPC(单体)的实测值的贡献度,加权相加了 13%、11.5% 的计算值。从该图 8 可知,磁性片 12 给天线线圈 11a 的电感的温度特性带来约 11.5%~13% 左右的影响。从该结果可知,通过使用使用了环圈的特性值来评价相对于天线线圈 11a 的电感的温度补偿的程度,能够容易实现电感的温度特性大体一致的设计。

[0071] 此外,由于具有二次峰值在 -20℃ 左右、且在该二次峰值以上的温度直到 60℃ 附近电感单调减少的温度特性的铁氧体的磁性片 12,通过在上述的 Ni-Zn-Cu 类的磁性材料以既定的条件含有 Sb 氧化物与 Co 氧化物来实现,在 -20℃ 至 60℃ 的温度区域,能够将天线线圈 11a 的电感保持为一定。

[0072] 此处,如图 9 所示,说明通过改变 ADH 片 11d 的厚度,使磁性片 12 与天线线圈 11a 的接合距离变化时的电感的变化。该图 9 是示出天线模块 1 的截面形状的图,柔性印制电路板 11c 与 ADH 片 11d 的厚度的合计值为 a,ADH 片 11d 的厚度为 b。

[0073] 图 10 是示出使 ADH 片 11d 的厚度 b 变化时的电感的变化的图,从该图 10 可知,若磁性片 12 与天线线圈 11a 的接合距离变长,则电感单调减少;反之若该接合距离短,则天线线圈 11a 产生的磁通会较强地受到磁性片 12 的影响,从而电感提高。具体而言,设厚度 b 为变量 x,则电感的近似函数 y 由  $y = -0.0015x + 3.1622$  表示。此时,相关系数 R 的平方  $R^2$  是 0.9938。

[0074] 另外,图 11A 示出各天线线圈 11a 的电感的温度特性,在磁性片 12 与柔性印制电路板接合的状态下,柔性印制电路板 11c 与 ADH 片 11d 的厚度的合计值 a 为 255  $\mu\text{m}$ 、155  $\mu\text{m}$ 、55  $\mu\text{m}$ ,使得至少在 -10℃ 至 40℃ 的温度区域,将天线线圈 11a 的电感保持为一定。

[0075] 从图 11A 可知,所处于的倾向是,磁性片 12 与天线线圈 11a 的离开距离越短,电感的温度变化特性越大。

[0076] 这样,天线模块 1 通过调整磁性片 12 与天线线圈 11a 的离开距离,能够调整在使用温度区域的上下限值容许的电感的温度特性所导致的变化。

[0077] 另外,在图 11B 示出,在上述的厚度的合计值 a 为 255  $\mu\text{m}$  的条件下,使用了由本实施例所涉及的磁性材料 KM30 构成的磁性片 12 的电感的温度变化特性、和作为比较例使用了由图 13 所示的磁性材料 KM11 构成的磁性片的电感的温度变化特性。

[0078] 并且,图 11C 示出,在上述的厚度的合计值 a 为 55  $\mu\text{m}$  的条件下,使用了由本实施例所涉及的磁性材料 KM30 构成的磁性片 12 的电感的温度变化特性、和作为比较例使用了由图 13 所示的磁性材料 KM11 构成的磁性片的电感的温度变化特性。

[0079] 从这些图 11B 和图 11C 可知,例如,相对于使用了由磁性材料 KM11 构成的磁性片的现有例,本实施例所涉及的天线模块 1,能够抑制处于因为磁性片 12 与天线线圈 11a 的离开距离缩短而增大的倾向的电感的温度变化特性。

100

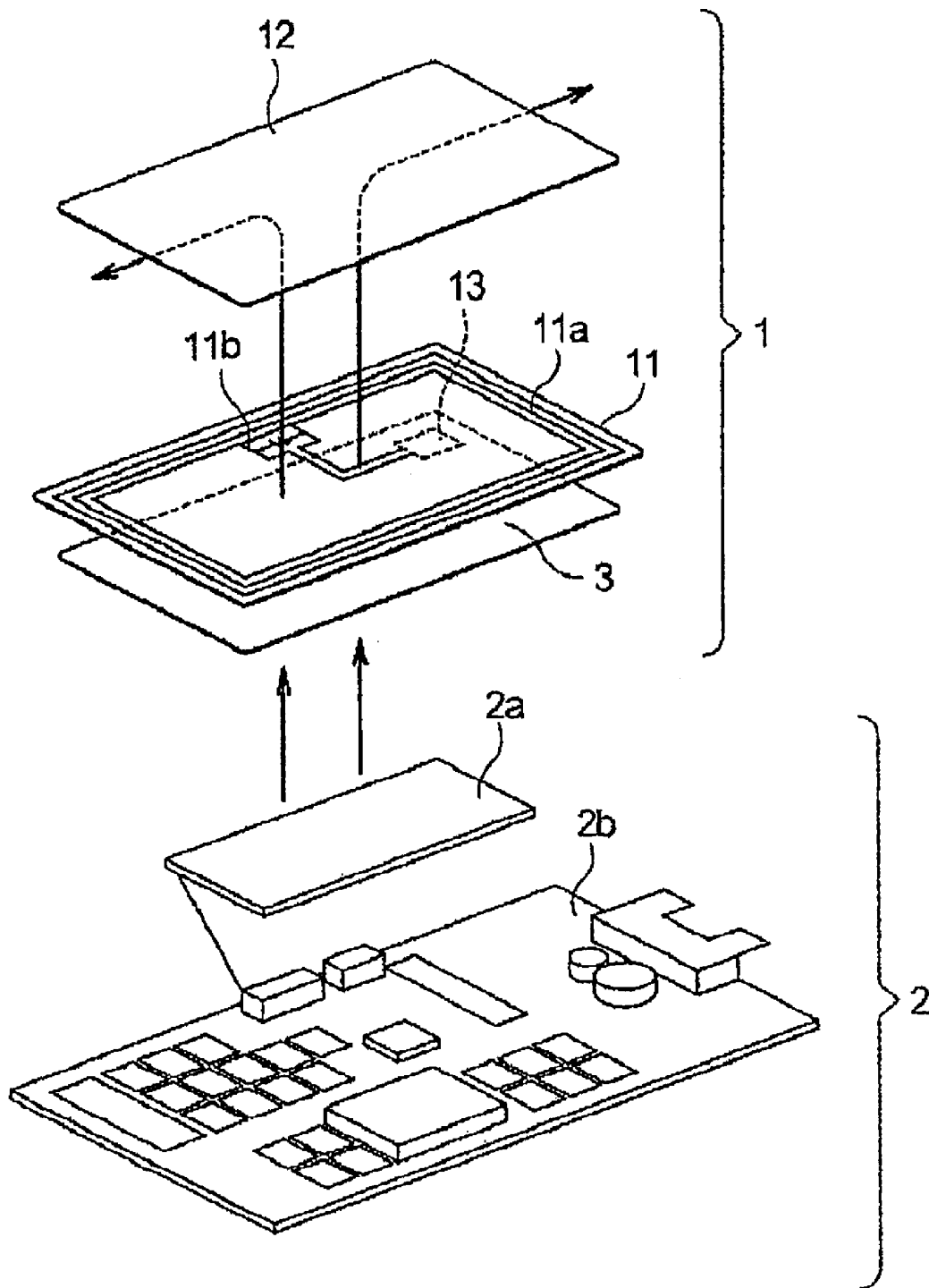


图 1

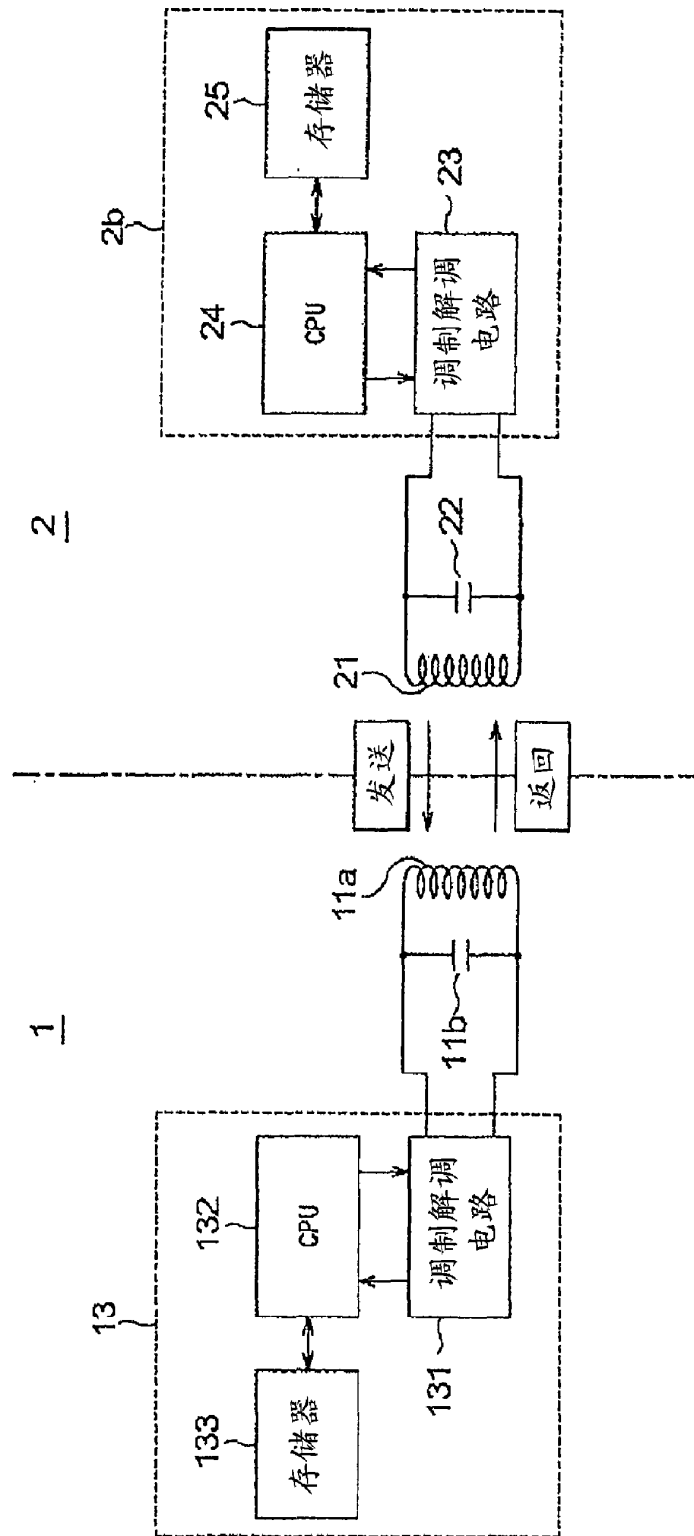


图 2

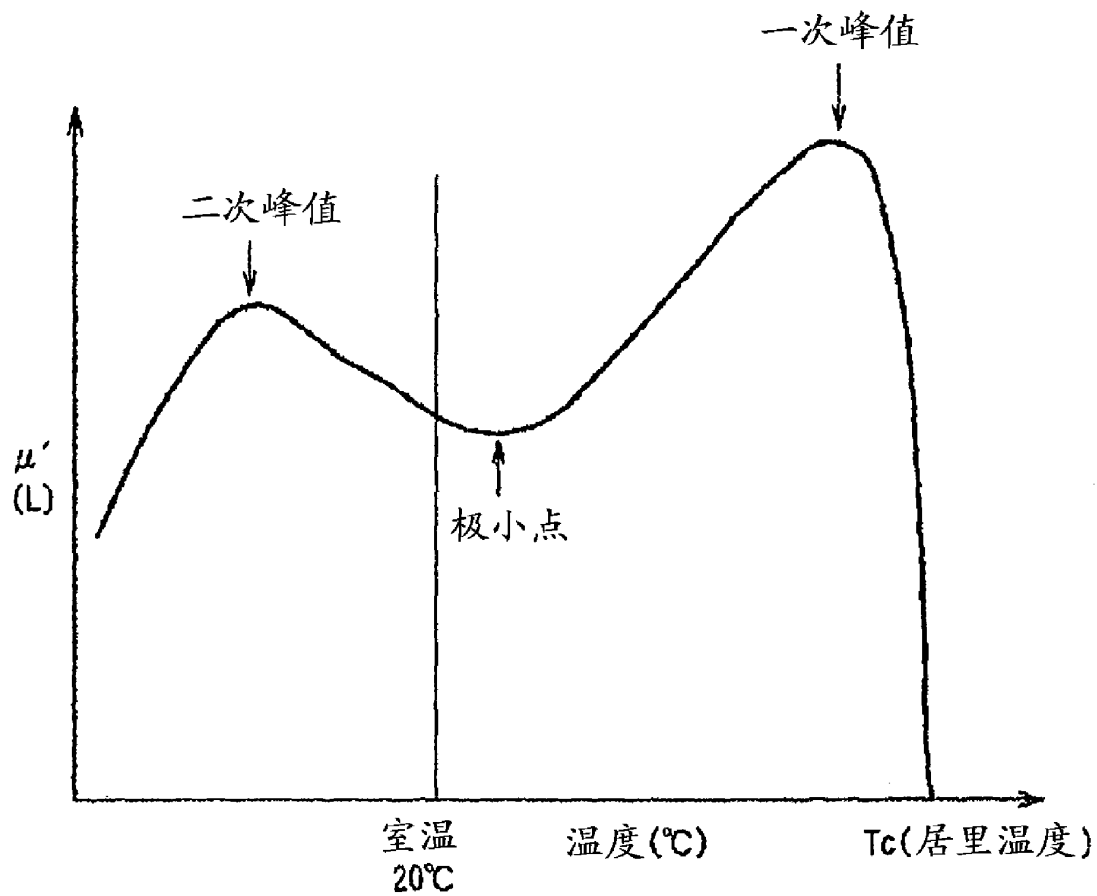


图 3

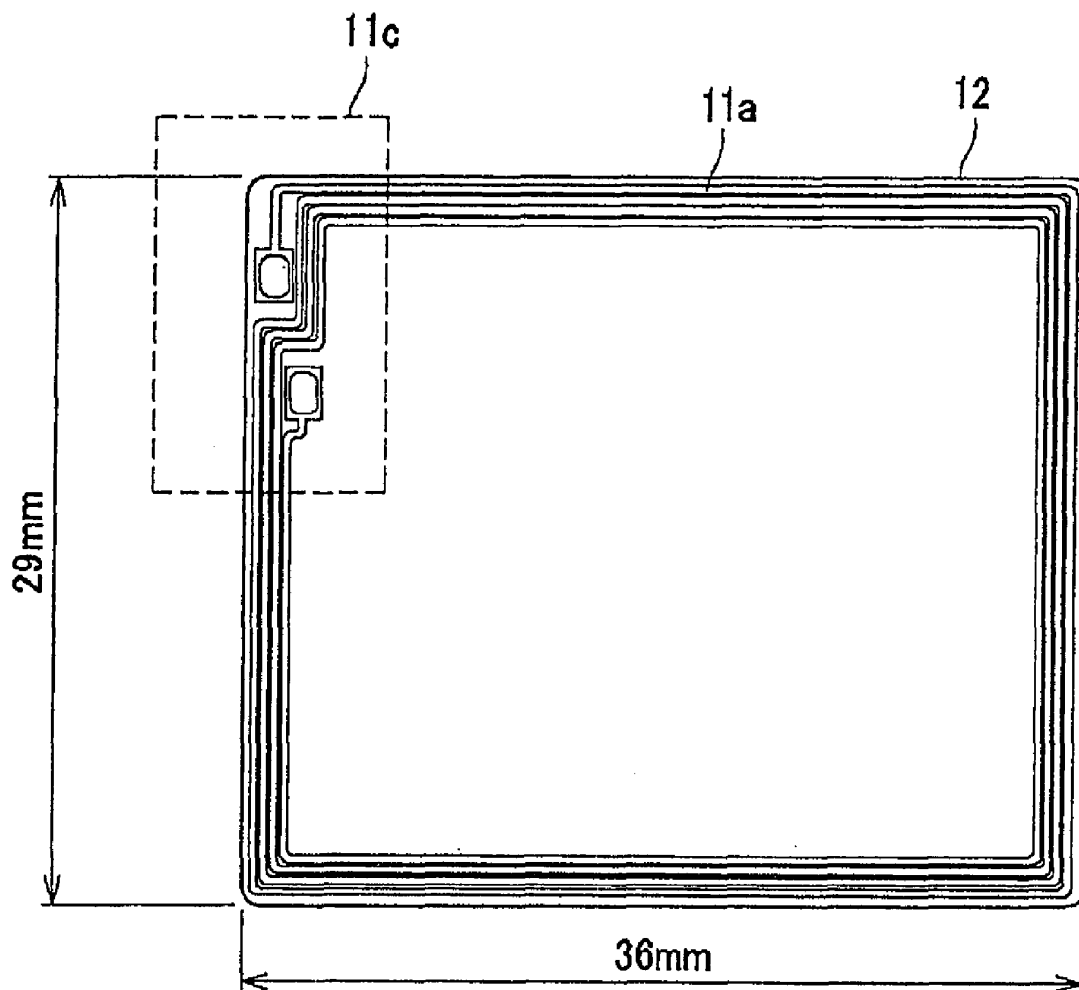


图 4A

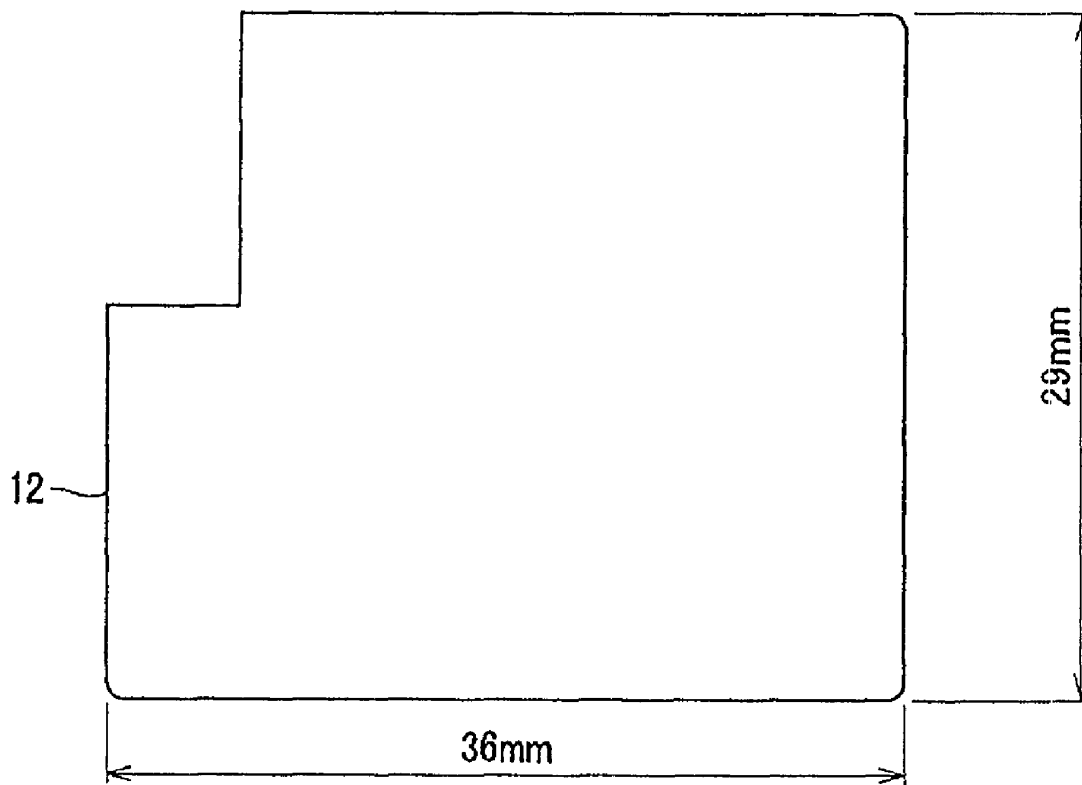


图 4B



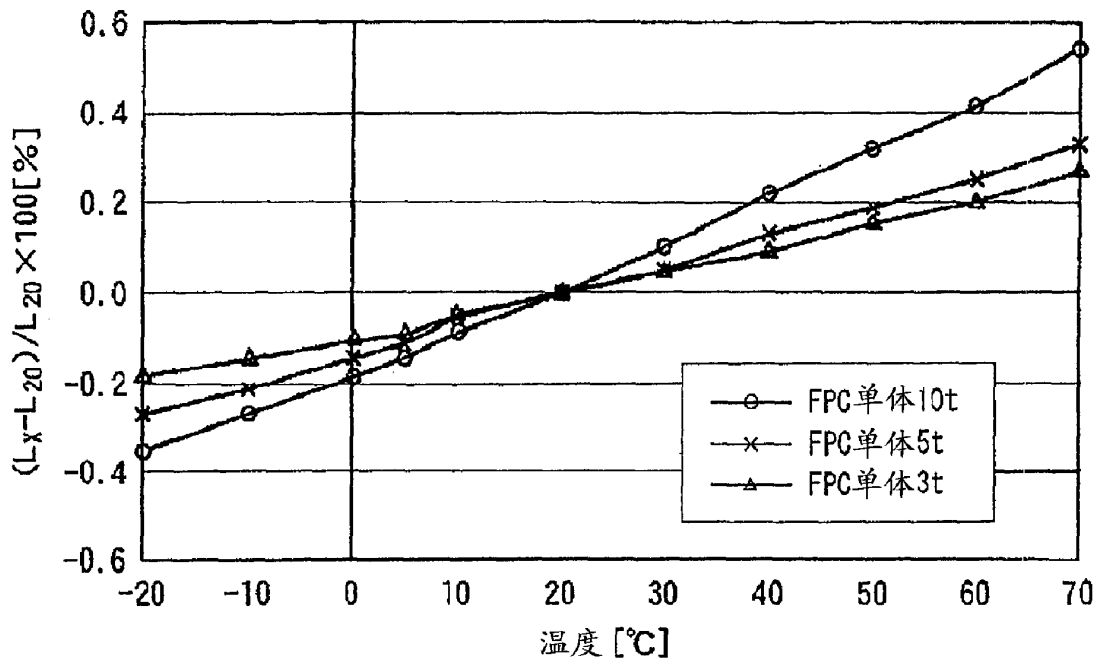


图 5

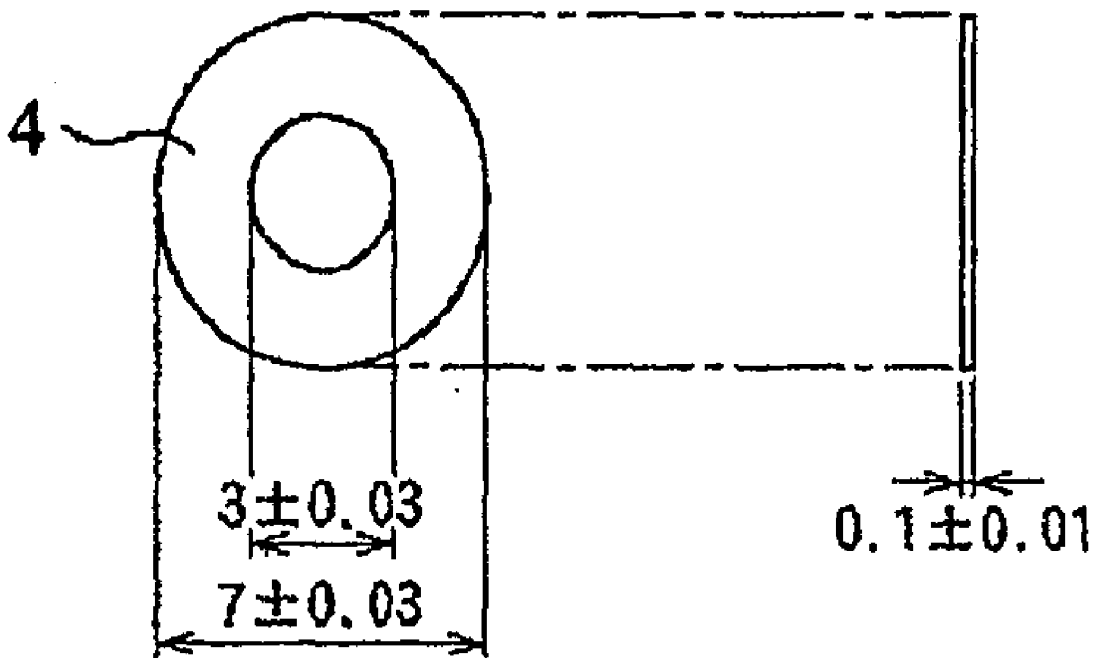


图 6A

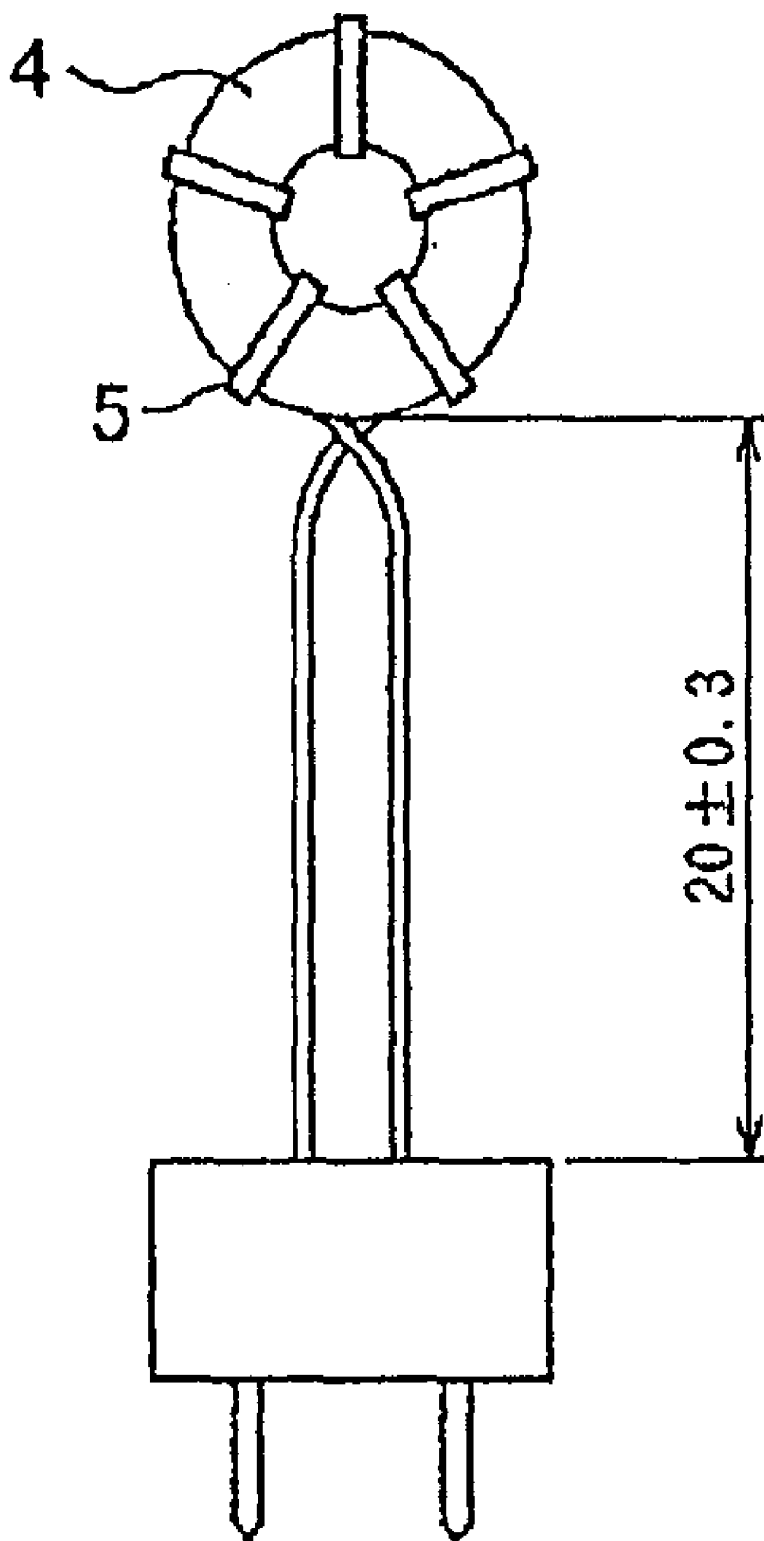


图 6B

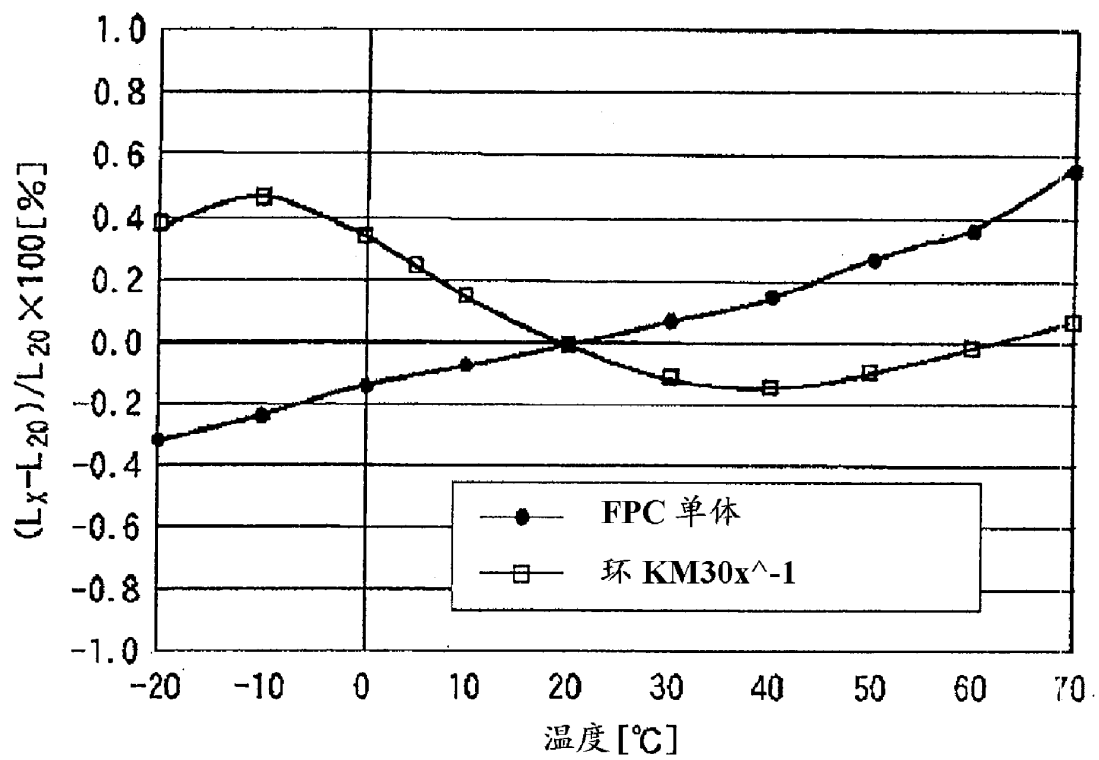


图 7

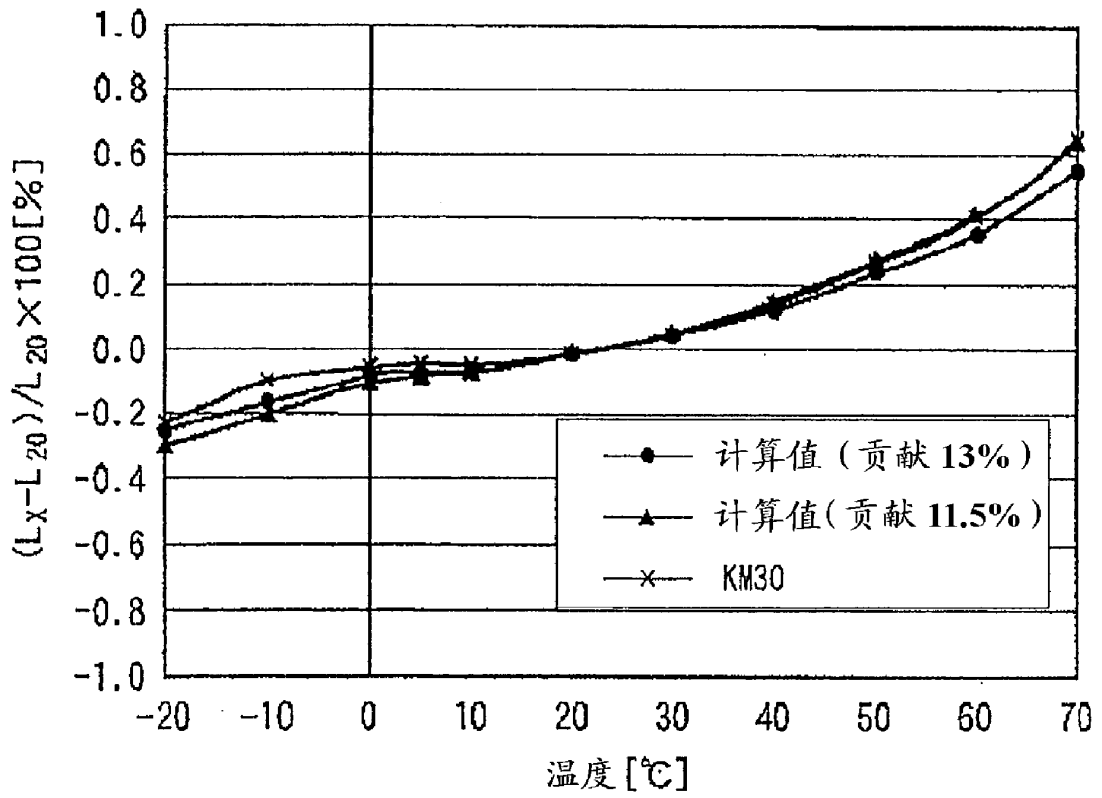


图 8

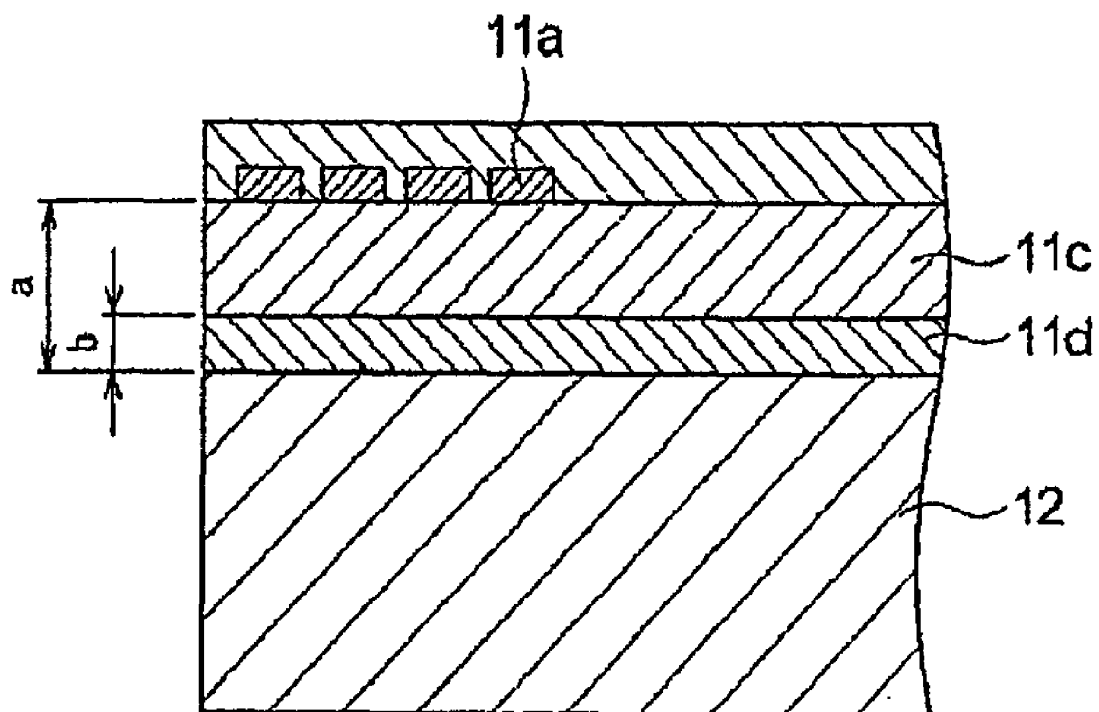


图 9

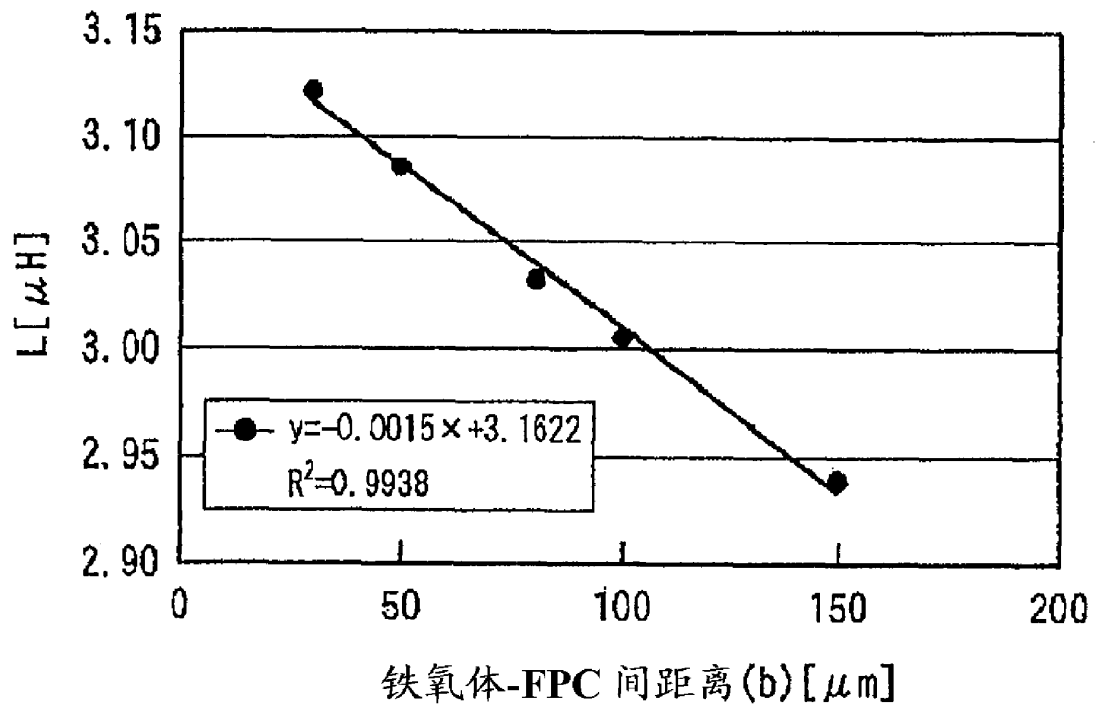


图 10

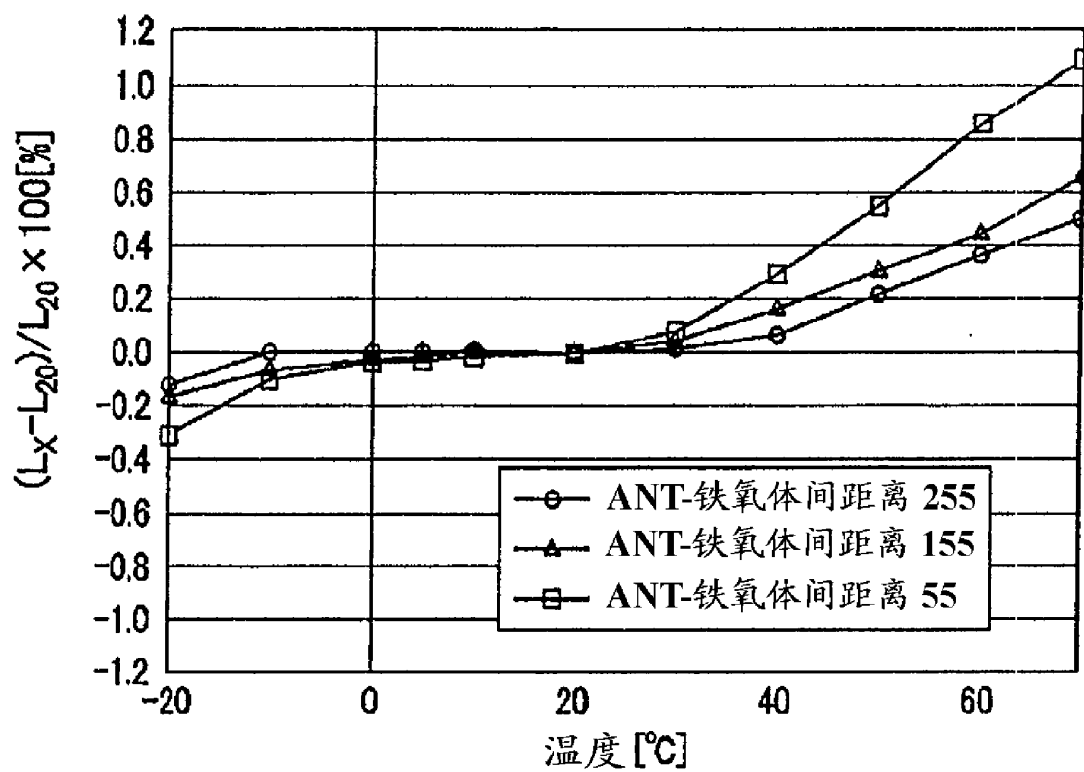


图 11A

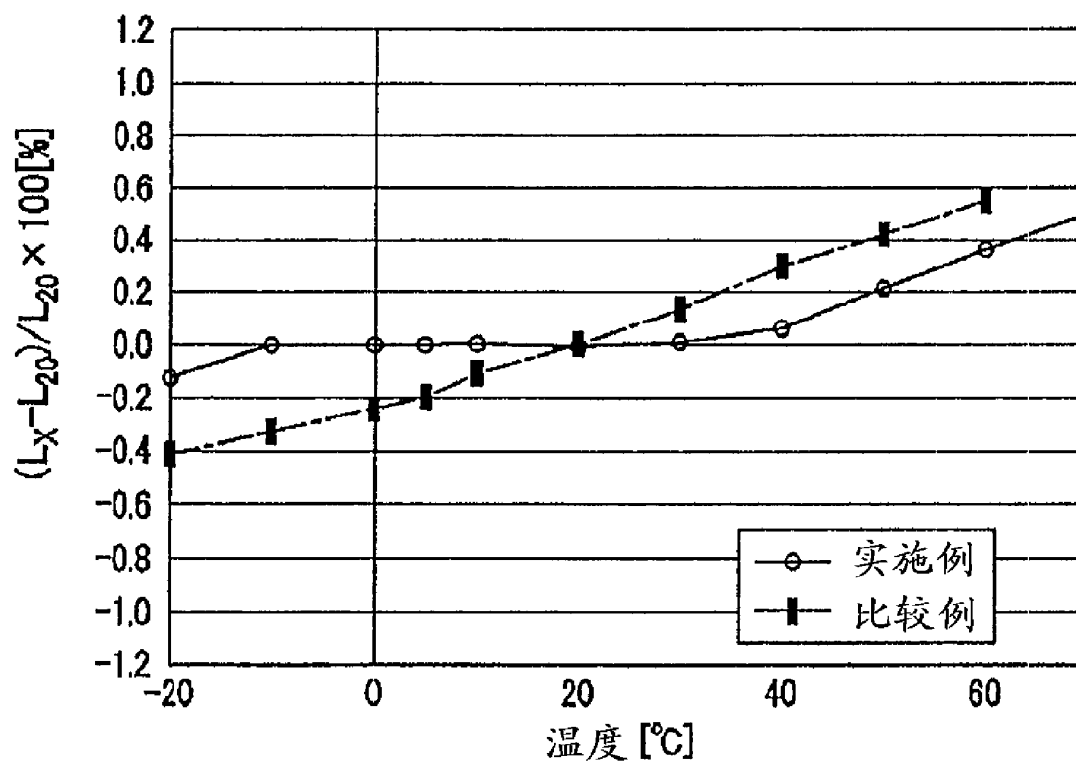


图 11B



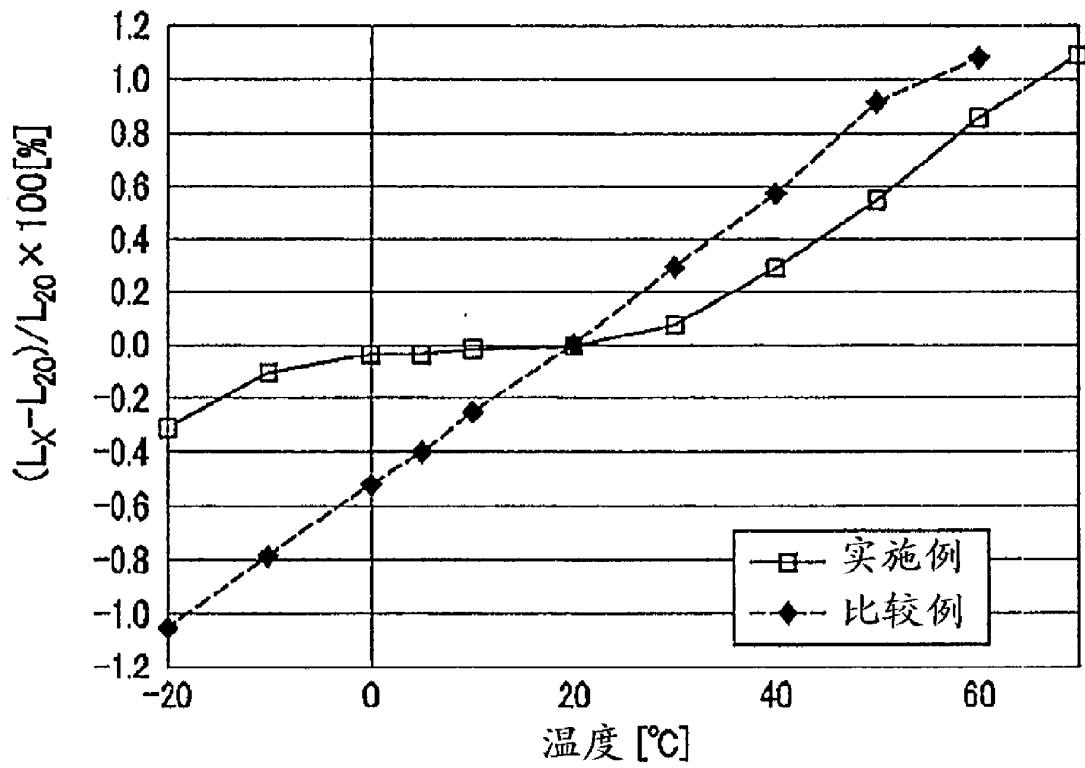


图 11C

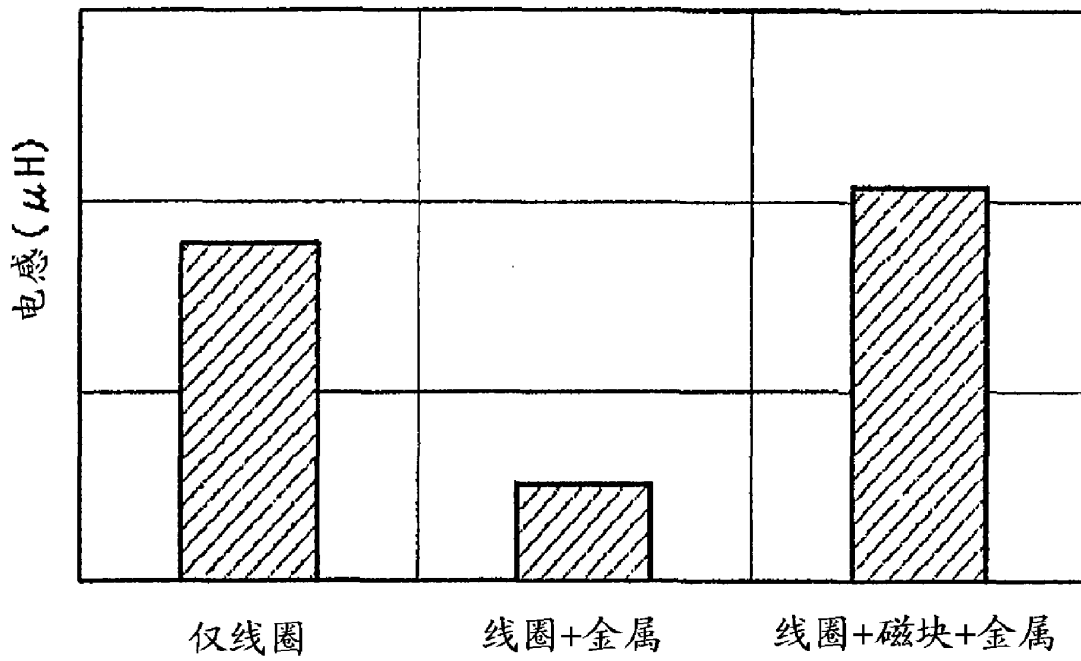


图 12

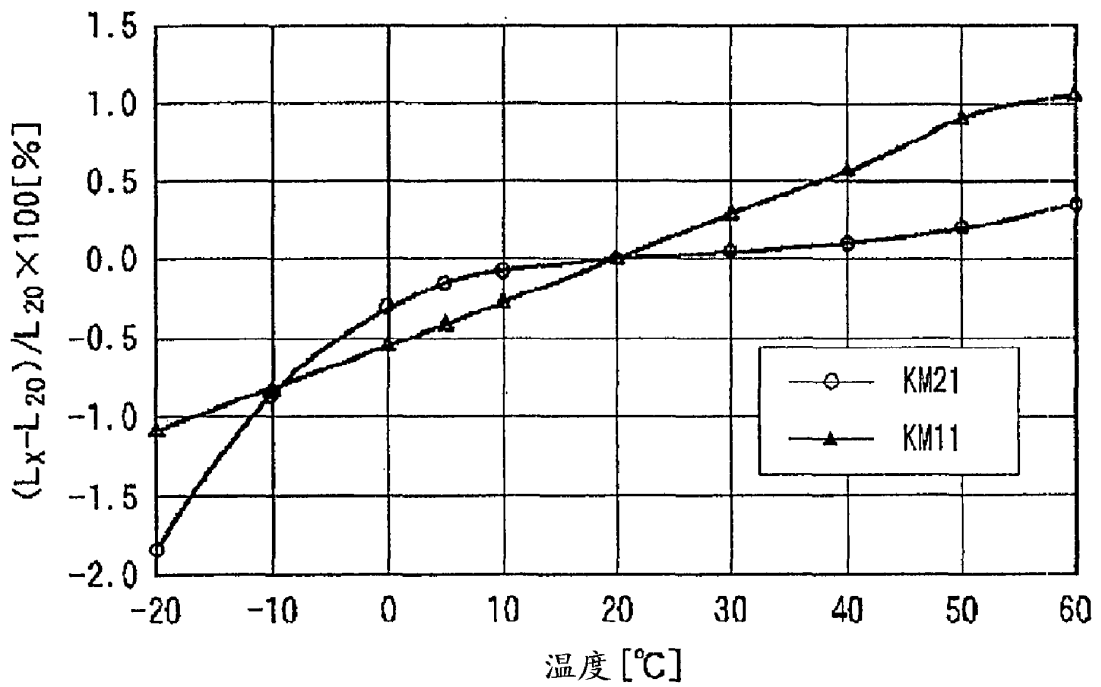


图 13



Espacenet

Bibliographic data: JP2011066627 (A) — 2011-03-31

---

**NFC SENSOR ANTENNA**

**Inventor(s):** ARIMURA KUNITAKA; TAKAHASHI SATORU ± (ARIMURA KUNITAKA, ; TAKAHASHI SATORU)

**Applicant(s):** SMART KK ± (SMART:KK)

**Classification:** - **international:** G06K19/07; G06K19/077; H01Q1/38; H01Q1/50; H01Q7/06; H04B5/02  
- **cooperative:**

**Application number:** JP20090214676 20090916 [Global Dossier](#)

**Priority number (s):** JP20090214676 20090916

**Abstract of JP2011066627 (A)**

PROBLEM TO BE SOLVED: To provide an NFC sensor antenna having an NFC antenna matching box for improving data communication performance with an IC card using 13.56 MHz, by improving the matching characteristics of the NFC sensor antenna of an IC card reader/writer available in the market. ;SOLUTION: The NFC sensor antenna, which is used for the IC card using the frequency band of 13.56 MHz, a tag and the IC card reader/writer, includes: an NFC antenna unit obtained by laminating a printed circuit board with an antenna coil wired, a magnetic sheet and a metal plate; and a communication part comprising an IC element for transmission and reception and a peripheral circuit element on the printed circuit board. In an impedance value of an antenna coil in which the resonance frequency of the NFC antenna matching box for performing impedance matching with the antenna coil is 13.56 MHz, a resistance component is 5 to 20 Ω, and a reactance component is 200 to 300 Ω. ;COPYRIGHT: (C)2011,JPO&INPIT

(19) 日本国特許庁(JP)

(12) 公開特許公報(A)

(11) 特許出願公開番号

特開2011-66627  
(P2011-66627A)

(43) 公開日 平成23年3月31日(2011.3.31)

(51) Int. Cl.			F 1	テーマコード (参考)	
HO4B	5/02	(2006.01)	HO4B	5/02	5B035
GO6K	19/07	(2006.01)	GO6K	19/00	H 5J046
GO6K	19/077	(2006.01)	GO6K	19/00	K 5K012
HO1Q	1/38	(2006.01)	HO1Q	1/38	
HO1Q	1/50	(2006.01)	HO1Q	1/50	

審査請求 未請求 請求項の数 7 O L (全 11 頁) 最終頁に続く

(21) 出願番号	特願2009-214676 (P2009-214676)	(71) 出願人	599154663 株式会社スマート 神奈川県川崎市高津区坂戸三丁目2番1号 K S P 内
(22) 出願日	平成21年9月16日 (2009.9.16)	(74) 代理人	100066061 弁理士 丹羽 宏之
		(74) 代理人	100143340 弁理士 西尾 美良
		(72) 発明者	有村 國孝 神奈川県川崎市高津区坂戸3丁目2番1号 K S P 内 株式会社スマート内
		(72) 発明者	高橋 哲 神奈川県川崎市高津区坂戸3丁目2番1号 K S P 内 株式会社スマート内

Fターム(参考) 5B035 AA00 BB09 CA22 CA23  
最終頁に続く

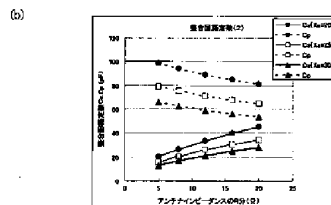
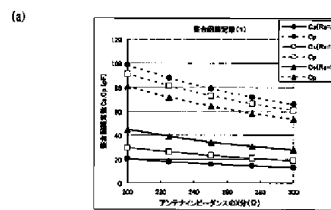
(54) 【発明の名称】 NFCセンサアンテナ

(57) 【要約】

【課題】市販されているICカード読取/書込装置のNFCセンサアンテナの整合特性を改善し、13.56MHzを利用したICカードとのデータ通信性能を向上させるNFCアンテナ整合器を有したNFCセンサアンテナを提供することを目的とする。

【解決手段】アンテナコイルが配線されたプリント基板、磁性体シート、金属板を貼り合わせたNFCアンテナ部と、プリント基板上に送受信用IC素子と周辺回路素子からなる通信部が構成された13.56MHzの周波数帯域を使用するICカード、タグ及びICカード読取/書込装置のNFCセンサアンテナであって、アンテナコイルとのインピーダンス整合を行うNFCアンテナ整合器の共振周波数が13.56MHzとなるアンテナコイルのインピーダンス値が、抵抗成分が5~20Ω、リアクタンス成分が200~300Ωであることを特徴とするNFCセンサアンテナ。

【選択図】 図2



## 【特許請求の範囲】

## 【請求項 1】

アンテナコイルが周回状に複数ターン配線されたプリント基板と金属板との間に磁性体シートを挟み込むように貼り合わせて一体化して構成される N F C アンテナ部と、前記プリント基板に実装された送受信 I C 素子、及びその周辺回路素子からなる通信部とから構成され、13.56MHz の周波数帯域を使用する I C カード、タグ及び I C カード読取／書込装置の N F C センサアンテナであって、

該 N F C センサアンテナが前記アンテナコイルとのインピーダンス整合を行う複数の整合回路定数からなる N F C アンテナ整合器を有し、

該 N F C アンテナ整合器の共振周波数が前記周波数 13.56MHz となる前記アンテナコイルのインピーダンス値が、挿入抵抗を含む抵抗成分が 5～20Ω、リアクタンス成分が 200～300Ω の範囲内であることを特徴とする N F C センサアンテナ。

10

## 【請求項 2】

前記アンテナコイルのインピーダンス値の使用範囲内に亘って前記 N F C アンテナ整合器の複数の整合回路定数を計算により求めたインピーダンス値をグラフにすることで、該グラフより決まる前記整合回路定数とすることを条件として前記アンテナコイルのインピーダンス値を測定し、前記グラフに当てはめて整合回路定数を決定することを特徴とする請求項 1 記載の N F C センサアンテナ。

## 【請求項 3】

前記プリント基板上の前記アンテナコイルの共振周波数 13.56MHz の場合に、前記挿入抵抗が 1～5Ω の範囲内であることを特徴とする請求項 1 または請求項 2 記載の N F C センサアンテナ。

20

## 【請求項 4】

前記 N F C アンテナ部の前記金属板と、前記プリント基板に実装された送受信 I C 素子、及びその周辺回路素子からなる通信部とが、同じ電位となるように共通の接地で接続されていることを特徴とする請求項 1 乃至 3 いずれか記載の N F C センサアンテナ。

## 【請求項 5】

前記 N F C アンテナ部において、前記アンテナコイルを形成したプリント基板には送受信 I C 素子及びその周辺回路素子は一切実装せず、これらの部品を別基板に実装し、この基板とアンテナコイルの基板をアンテナ給電線で接続するようにし、磁性体シートと金属板を含めたアンテナ全体の厚みを薄くしたことを特徴とする請求項 1 乃至 4 いずれか記載の N F C センサアンテナ。

30

## 【請求項 6】

前記磁性体シートの中央部分に窓のような切り欠きを入れ、前記プリント基板に実装される前記送受信 I C 素子及びその周辺素子からなる前記通信部が、前記磁性体シートの切り欠きの中に収まるように前記プリント基板に実装することで厚みが緩和され、前記 N F C アンテナ部を更に薄くしたことを特徴とする請求項 1 乃至 4 いずれか記載の N F C センサアンテナ。

## 【請求項 7】

前記アンテナコイルのインピーダンス値を測定し、前記グラフに当てはめて整合回路定数を決定する際、予め金属板上で調整して金属面の影響を予め考慮することで、金属板を設ける必要がなくなり金属板の厚み分を薄くできることを特徴とする請求項 1 乃至 6 いずれか記載の N F C センサアンテナ。

40

## 【発明の詳細な説明】

## 【技術分野】

## 【0001】

本発明は、R F I D 規格 ( I S O / I E C 14443、15693、18092 ) に準拠した周波数 13.56MHz を使用した I C カード、タグおよび I C カード読取／書込装置の N F C アンテナのインピーダンス整合特性を改善する N F C アンテナ整合器を有した N F C センサアンテナに関する。

50

**【背景技術】****【0002】**

現在市販されている13.56MHz帯の周波数を使用するICカードやRFIDタグとICカード読取/書込装置との間のデータ通信を行う場合、RFIDタグに関する互換性を確保する近接型通信インターフェース実装に関する規約が非特許文献1に開示されており、その中には互換性評価試験方法等が紹介されている。この評価試験で互換性を達成した製品が流通している。

**【0003】**

図6は、ICカードとICカード読取/書込装置との間のデータ通信の動作原理図である。ICカードは、ICカード読取/書込装置のアンテナコイルの電磁誘導による電力供給とデータ通信が行われる。

10

**【0004】**

図7は、RFID規格(ISO/IEC14443)のICカードのType A、Type Bそれぞれのデータ通信の周波数帯域を示している。ICカード読取/書込装置からNFCアンテナを介して搬送周波数13.56MHzに共振周波数の設定することでICカードやRFIDタグには、電磁誘導による電圧が発生し電力供給がなされる。

**【0005】**

Type A、Type B、及びType CのICカードから読取/書込されるデータ信号は、最初にASK変調(Amplitude Shift Keying)した後、更に搬送周波数13.56MHzに合成する負荷変調を行うことで13.56MHz±340kHzの副搬送波にデータを乗せた信号波を送受信することでデータ通信が行なわれる。しかしType BのICカードの場合は、アップリンクの際はBPSK変調方式(Binary Phase Shift Keying)でデータ通信が行われ、13.56MHz±106kHzの副搬送波によってデータ通信が行われている。

20

**【0006】**

市販されているNFCアンテナは、この搬送周波数13.56MHzとデータ信号が含まれる13.56MHz±340kHzの副搬送波の周波数帯をカバーできるように共振特性(Q係数)を設定されている。例えば、特許文献1に開示されているNFC素子とアンテナとの結合するための方法が紹介されている。

**【先行技術文献】**

30

**【特許文献】****【0007】**

【特許文献1】特開2008-259200号公報

**【非特許文献】****【0008】**

【非特許文献1】近接型通信インターフェース実装規約書、財団法人ニューメディア開発協会、平成16年3月

**【発明の概要】****【発明が解決しようとする課題】****【0009】**

40

しかし、市販されているICカード読取/書込装置を使用して13.56MHzを利用した既存のICカードの交信距離の評価を行った所、市販されている汎用のICカード読取/書込装置ではType BのELWISEカードを読み取ることができなかった。原因として図8に示すように、ICカードをICカード読取/書込装置のNFCセンサアンテナにかざした時に、ICカードの金属板の影響でNFCセンサアンテナのインピーダンスが変動し、搬送周波数13.56MHzのピーク周波数値が高くなる方向へズレが生じてしまう。そのためQ特性の高いICカードでは、共振周波数が変動することで電力供給が低下し必要な起電力を得られないためデータ通信ができなくなる課題があった。

**【0010】**

本願発明は、上記課題を解決するためになされたもので一般に市販されているICカー

50

ド及びICカード読取／書込装置のNFCセンサアンテナの整合特性を改善し、既存の13.56MHzを利用したICカードとのデータ通信性能を向上させるNFCアンテナ整合器を有したNFCセンサアンテナを提供することを目的とする。

【課題を解決するための手段】

【0011】

本発明は、上述の目的を達成するため、以下(1)～(7)の構成を備えるものである。

【0012】

(1) アンテナコイルが周回状に複数ターン配線されたプリント基板と金属板との間に磁性体シートを挟み込むように貼り合わせて一体化して構成されるNFCアンテナ部と、前記プリント基板に実装された送受信IC素子、及びその周辺回路素子からなる通信部とから構成され、13.56MHzの周波数帯域を使用するICカード、タグ及びICカード読取／書込装置のNFCセンサアンテナであって、該NFCセンサアンテナが前記アンテナコイルとのインピーダンス整合を行う複数の整合回路定数からなるNFCアンテナ整合器を有し、該NFCアンテナ整合器の共振周波数が前記周波数13.56MHzとなる前記アンテナコイルのインピーダンス値が、挿入抵抗を含む抵抗成分が5～20Ω、リアクタンス成分が200～300Ωの範囲内であることを特徴とするNFCセンサアンテナ。

10

【0013】

(2) 前記アンテナコイルのインピーダンス値の使用範囲内に亘って前記NFCアンテナ整合器の複数の整合回路定数を計算により求めたインピーダンス値をグラフにすることで、該グラフより決まる前記整合回路定数とすることを条件として前記アンテナコイルのインピーダンス値を測定し、前記グラフに当てはめて整合回路定数を決定することを特徴とする前記(1)記載のNFCセンサアンテナ。

20

【0014】

(3) 前記プリント基板上的前記アンテナコイルの共振周波数13.56MHzの場合に、前記挿入抵抗が1～5Ωの範囲内であることを特徴とする前記(1)または(2)記載のNFCセンサアンテナ。

【0015】

(4) 前記NFCアンテナ部の前記金属板と、前記プリント基板に実装された送受信IC素子、及びその周辺回路素子からなる通信部とが、同じ電位となるように共通の接地で接続されていることを特徴とする前記(1)乃至(3)いずれか記載のNFCセンサアンテナ。

30

【0016】

(5) 前記NFCアンテナ部において、前記アンテナコイルを形成したプリント基板には送受信IC素子及びその周辺回路素子は一切実装せず、これらの部品を別基板に実装し、この基板とアンテナコイルの基板をアンテナ給電線で接続するようにし、磁性体シートと金属板を含めたアンテナ全体の厚みを薄くしたことを特徴とする前記(1)乃至(4)いずれか記載のNFCセンサアンテナ。

40

【0017】

(6) 前記磁性体シートの中央部分に窓のような切り欠きを入れ、前記プリント基板に実装される前記送受信IC素子及びその周辺素子からなる前記通信部が、前記磁性体シートの切り欠きの中に収まることで厚みが更に緩和され、アンテナ全体を更に薄形となるようにしたことを特徴とする前記(1)乃至(4)いずれか記載のNFCセンサアンテナ。

【0018】

(7) 前記アンテナコイルのインピーダンス値を測定し、前記グラフに当てはめて整合回路定数を決定する際、予め金属板上で調整して金属面の影響を予め考慮することで、金属板を設ける必要がなくなり金属板の厚み分を薄くできることを特徴とする前記(1)乃至(6)いずれか記載のNFCセンサアンテナ。

50

## 【発明の効果】

## 【0019】

本発明によれば、上記構成を有することで周波数13.56MHzを使用したICカード及びICカード読取/書込装置のNFCセンサアンテナのインピーダンス整合特性を改善することで、ICカードとのデータ通信性能が向上させるNFCアンテナ整合器を有したNFCセンサアンテナを提供できる。

## 【図面の簡単な説明】

## 【0020】

【図1】本実施例に係るNFCセンサアンテナ図、(a)NFCセンサアンテナ外観図、(b)NFCセンサアンテナ回路図

10

【図2】本実施例に係るNFCセンサアンテナの整合回路定数、(a)整合回路定数(1)、(b)整合回路定数(2)

【図3】本実施例に係るNFCセンサアンテナと市販品との交信距離比較図

【図4】本実施例に係るNFCセンサアンテナの薄型構成例

【図5】本実施例に係るNFCセンサアンテナの別の薄型構成例

【図6】ICカードとICカード読取/書込装置との基本動作回路図

【図7】RFID規格のICカードの周波数特性

【図8】金属板の影響によるインピーダンスの変化を示すグラフ

## 【発明を実施するための形態】

## 【0021】

20

以下に、本発明を実施するための形態を、実施例により詳しく説明する。

## 【実施例1】

## 【0022】

本発明を図面に基づいて説明する。

## 【0023】

図1は、本実施例に係るNFCセンサアンテナである。図1(a)はNFCセンサアンテナの外観図である。図1(b)はNFCセンサアンテナの回路図である。図中において、1は四角あるいは矩形のプリント基板である。プリント基板1には一辺が25~70mm程度の長さ(パソコンの場合40~50mm角程度、携帯電話の場合25~30mm角程度の大きさ)、厚さ0.4mm以下0.1mm程度のものを用いる。1aはプリント基板1に周回状に複数ターン配線し形成されたNFCアンテナコイルである。1bはプリント基板1に実装されたNFCの周辺回路素子である。8はプリント基板1に実装されたNFCの送受信IC(例えばPN531、PN532、PN533等)を示す。整合回路を含む周辺回路素子1bの実装位置はこのIC周辺で行いこのプリント基板の領域7を7a、7bで示す。1cはパソコン等の機器のUSBと接続するための信号線である。2は磁性体シートで、大きさはプリント基板1とほぼ同じである。磁性体シート2の厚さは0.5mm程度以下で比透磁率は100以上のものを使用する。3は金属板で、大きさはプリント基板1と大体同じ、厚さは0.1mm程度、材質はアルミニウムやステンレスのものを使用する。銅箔やアルミ箔でもよい。プリント基板1、磁性体シート2、金属板3は接着剤でお互いに貼り合わせ一体化させている。4は本実施例に係るNFCセンサアンテナの本体である。

30

40

## 【0024】

RFID規格(ISO/IEC14443, 15693, 18092)のType A及びType CのICカードでは共振周波数13.56MHzと、13.56MHz±340KHzの副搬送波に負荷変調によりデータを乗せた信号波を送受信することでデータ通信が行われ、Type BのICカードでは、アップリンクの際はBPSK変調方式でデータ通信が行われ、13.56MHz±106KHzの副搬送波によってデータ通信が行われている。ICカードをICカード読取/書込装置に付属するNFCセンサアンテナ4にかざすことで、電磁誘導によりICカードへの電力供給は共振周波数13.56MHzによって行われる。

50



## 【0025】

しかし、実際には図8に示すように、ICカードをICカード読取/書込装置のNFCセンサアンテナ4にかざした時に、金属板3の影響でNFCセンサアンテナ4のインピーダンスが変動して搬送周波数13.56MHzの周波数値が高くなる方向へズレが生じることが知られている。従ってQ特性の高いTypeBのICカードでは、共振周波数のズレにより電磁誘導による起電力が得られず、或いは起電力が得られても有効電力は大きく減少するためICカードとICカード読取/書込装置との間隔が狭い範囲に限定され、或いはデータ通信の周波数帯を外れることでデータ通信にエラーが生じてしまう。

## 【0026】

また、ICカードやICカード読取/書込装置のアンテナに貼り合わされた金属板3とプリント基板1のグラウンドとが接続されていない場合、プリント基板1と金属板3との間に浮遊容量が発生して共振周波数の変動要因となるため、金属板3とプリント基板1のグラウンドとの電位を共通にする接地が必要である。しかし、この共通接地の設定が市販のNFCセンサアンテナ4ではされていないため、インピーダンスが変化して共振周波数のズレが生じる原因でもある。そのため本実施例に係るNFCセンサアンテナ4では、図1(b)の回路図に示すように金属板3に共通接地を設けることで金属板3とプリント基板1のグラウンドとの電位を共通にする接地をおこなっている。

## 【0027】

次に、NFCセンサアンテナ4の整合回路定数を変更しアンテナインピーダンスの整合について検証する。図1(b)のプリント基板1上の、送受信IC素子8とNFCアンテナコイル1aとの間の周辺回路素子1bに含まれるNFCアンテナ整合器の整合回路定数(Cs, Cp)を変更することにより検証した。

## 【0028】

図2(a)及び図2(b)はアンテナインピーダンス整合回路定数のグラフである。図1(b)のNFCセンサアンテナ4の回路図において、EMCフィルタ部の回路定数を考慮し、且つアンテナインピーダンスZaが所定の範囲内において整合させる(Zo=50Ωとする)ための整合回路定数(Cs, Cp)を計算してグラフ化したものである。このグラフを使えばアンテナインピーダンスZaを実測すれば簡単に整合回路定数が求められるため、複雑な計算式に値を代入して計算する必要がない。

## 【0029】

また、グラフに示した整合回路定数(Cs, Cp)の値を、この範囲に納まるように整合回路を組まなければ整合が取れない。周波数13.56MHzにおいて、アンテナインピーダンスZaの抵抗分が5Ω~20Ω(Raを含む)、リアクタンス分が200Ω~300Ωの値に設定してNFCセンサアンテナ4のインピーダンス整合を行うことで、より優れた送受信性能が得られる。

## 【0030】

図1(b)の回路図に示す挿入抵抗Raは、NFCアンテナコイル1aのQ特性を30以下に押さえるためのもので1~5Ω程度(実際は約3Ω)でなければならない。この抵抗Raの働きによりNFCアンテナコイル1aの共振周波数のQ特性を30以下に押さえ、電界強度を低下させることなく有効な電力を供給できる共振周波数帯域が広く取れるQ特性を持つ。その結果、図2に示す整合回路定数(Cs, Cp)を最適な設定にすることで、多種多様な既存のICカード、ICタグに対して夫々の金属板3の影響による搬送周波数のズレ幅をカバーすることが可能となる。

## 【0031】

図3に示す市販のNFCセンサアンテナとの交信距離の比較表から、本実施例のNFCセンサアンテナ4はNFCアンテナ整合特性を改善するNFCアンテナ整合器によってデータ通信の交信距離を飛躍的に延ばすことが可能となり、更にデータ通信ができなかったTypeBのELWISEカードの読取/書込のデータ通信が可能となった。

## 【0032】

次に、NFCセンサアンテナ4を薄くする設定方法を示す。市販のNFCセンサアンテ

10

20

30

40

50

ナ 4 の場合、図 1 ( a ) の外観図に示す形状が一般的である。

【 0 0 3 3 】

図 1 ( a ) に示すアンテナ部を真横から見た側面図からプリント基板 1 と基板上の通信部の送受信用 I C 素子 8 と周辺回路素子 1 b と磁性体シート 2 と金属板 3 を含めたアンテナ全体の厚さは 2 mm 以下 ( 1 . 7 mm 程度 ) である。しかし、I C カードや I C カード読取 / 書込装置のアンテナ部は、あらかじめ金属面上で N F C センサアンテナ 4 の整合回路定数 ( C s , C p ) を最適な設定に調整した場合には、金属面の影響が考慮されるので金属板 3 を当てる必要がなく、金属板 3 の厚み分を薄くすることができる。

【 0 0 3 4 】

図 4 は N F C センサアンテナ 4 のアンテナ部を薄くするための構成である。図 4 ( a ) は、プリント基板 1 には送受信用 I C 素子 8 及びその周辺回路素子 1 b は一切実装せず、これらの部品を別のプリント基板の領域 7 を設けてパソコン等の機器の本体基板に実装し、この送受信用 I C 素子 8 、及びその周辺回路素子 1 b の通信部が実装されたプリント基板の領域 7 からなる本体基板と、アンテナコイルのプリント基板 1 をアンテナ給電線 1 d で接続するようにした。図 4 ( b ) は図 4 ( a ) のアンテナ部を真横から見た図で、アンテナ全体の厚さを 1 mm 以下 ( 0 . 6 5 ~ 0 . 7 mm 程度 ) に薄くすることができる。また、前述のように金属面上で調整した場合は 0 . 5 5 ~ 0 . 6 mm 程度となり更に薄くすることができる。

【 0 0 3 5 】

図 5 に N F C センサアンテナ 4 構成で別の構成例を示す。図 1 ( a ) に示す市販の N F C センサアンテナ 4 との違いは、図 5 ( a ) に示すように磁性体シート 2 の中央部分に切り欠きを入れ、プリント基板 1 に実装する通信部 ( 送受信用 I C 素子 8 およびその周辺回路素子 1 b ) を磁性体シート 2 がある側の基板面に実装し、前記磁性体シート 2 a の切り欠きの中に収まるように構成した。図 5 ( b ) に示す磁性体シート 2 の厚みが 0 . 3 8 mm 程度と薄い場合、I C 素子の厚みが 0 . 8 mm 程度であれば、図 5 ( c ) に示すように 0 . 4 2 mm 程の空間を埋めるため約 0 . 4 mm 厚プラスチック枠 1 2 をあてがってもよい。プラスチック枠 1 2 を用いる代わりに磁性体シート 2 の厚みを増やしてもよいが、磁性体は高価なので最低限の厚みの磁性体でカバーし、この磁路により磁界を通し金属面による影響を回避させ、余分な厚みは安価なプラスチックを用いた方が経済的である。

【 0 0 3 6 】

上述したように実装部品の出っ張りや磁性体の厚み分を少なくすることでアンテナ全体の厚さが薄くすることが可能となる。更に、金属板 ( 厚み約 0 . 1 mm ) にも切り欠きを設け、この部分の厚みにも実装部分の突起が収まるようにすれば全体で約 0 . 4 8 ~ 0 . 5 mm 薄くすることもできる。

【 0 0 3 7 】

磁性体シート 2 を薄くする例として、磁性体のグリーンシートを焼結し、プラスチックラミネートで固定した 0 . 1 9 mm 厚の磁性体シート 2 を 1 ~ 2 枚用いることができる。1 枚の場合には磁路が狭く十分な特性が得られないが、2 枚用いた 0 . 3 8 mm 厚とする場合には十分な特性が得られる。0 . 1 9 mm の磁性体 1 枚でも特性は劣るが通信距離 1 0 ~ 2 0 mm 程度であれば使用は可能である。0 . 3 mm 厚の磁性体シート 2 を 1 枚用いた場合は、前記の 0 . 1 9 mm の磁性体 2 枚重ねの特性に近い値が得られる。

【 0 0 3 8 】

以上、本願発明は一般に市販されている I C カード読取 / 書込装置の N F C センサアンテナの整合特性を改善し、既存の 1 3 . 5 6 M H z を利用した既存の I C カードとのデータ通信性能を向上させる N F C アンテナ整合器を有した高感度の N F C センサアンテナを提供することができる。

【 符号の説明 】

【 0 0 3 9 】

C s 整合回路定数  
C p 整合回路定数

10

20

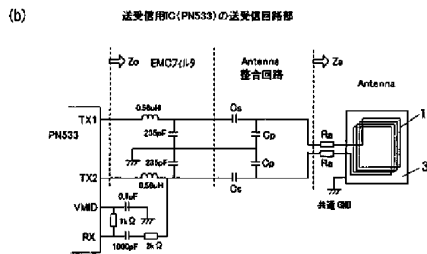
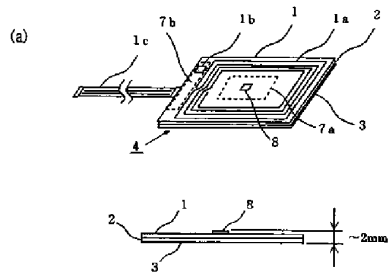
30

40

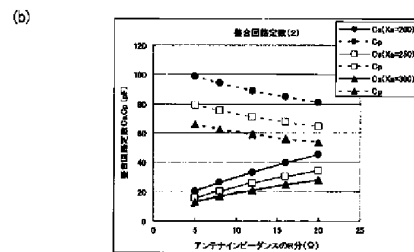
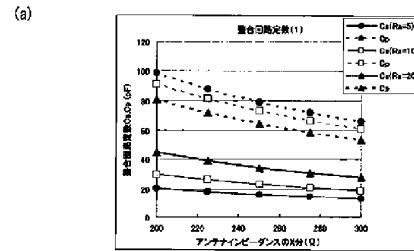
50

- R a 抵抗
- Z a アンテナインピーダンス
- 1 プリント基板
- 1 a N F C アンテナコイル
- 1 b 周辺回路素子
- 1 c 信号線
- 2 磁性体シート
- 3 金属板
- 4 N F C センサアンテナ
- 7 I C 周辺回路領域
- 8 N F C 送受信用 I C 素子
- 1 2 プラスチック枠

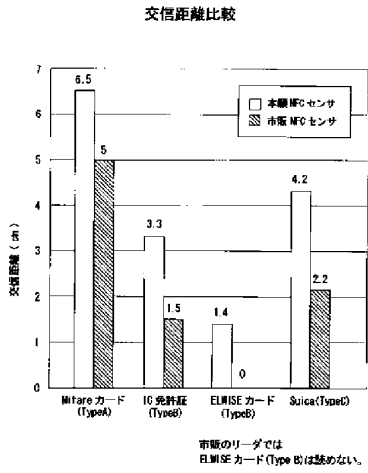
【図 1】



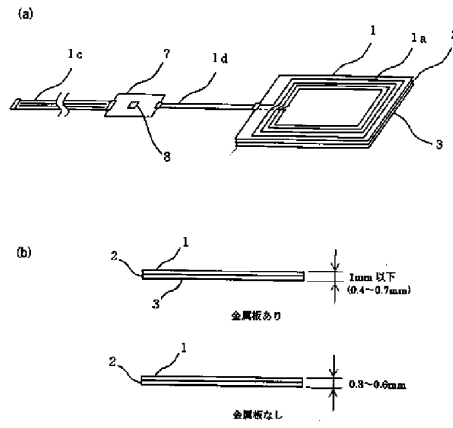
【図 2】



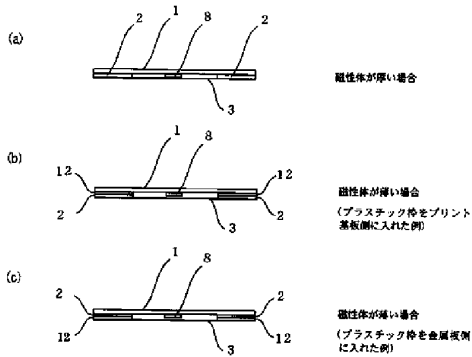
【図3】



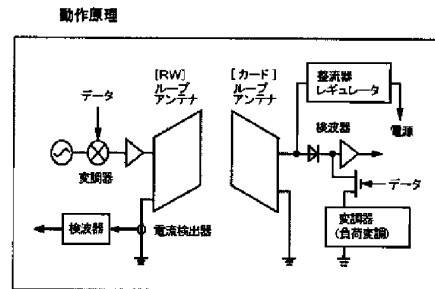
【図4】



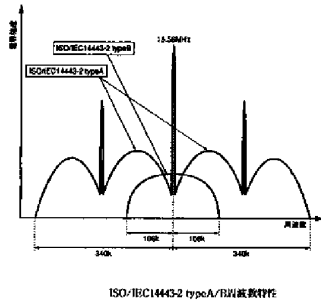
【図5】



【図6】

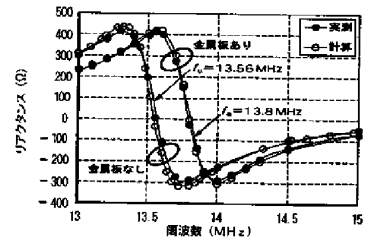
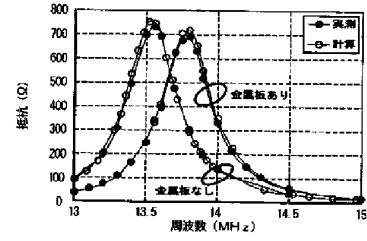


【図7】



【図8】

金属の影響



---

フロントページの続き

(51) Int. Cl.

H 0 1 Q 7/06

(2006.01)

F I

H 0 1 Q 7/06

テーマコード (参考)

Fターム(参考) 5J046 AA04 AB11 PA06 TA03

5K012 AA01 AB18 AC06

## Electronic Acknowledgement Receipt

<b>EFS ID:</b>	37981186
<b>Application Number:</b>	16264360
<b>International Application Number:</b>	
<b>Confirmation Number:</b>	7253
<b>Title of Invention:</b>	Wireless Power Receiver and Method of Manufacturing the Same
<b>First Named Inventor/Applicant Name:</b>	JEONG WOOK AN
<b>Customer Number:</b>	23557
<b>Filer:</b>	Jeff Lloyd/Larann Arzie
<b>Filer Authorized By:</b>	Jeff Lloyd
<b>Attorney Docket Number:</b>	SUN.LGI.420D3
<b>Receipt Date:</b>	10-DEC-2019
<b>Filing Date:</b>	31-JAN-2019
<b>Time Stamp:</b>	12:01:45
<b>Application Type:</b>	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		SUN-LGI-420D3-SIDS-AF.pdf	200067 a357a36a3eead5af04a3ac6bbab39b2c7c9619fe	yes	3

Multipart Description/PDF files in .zip description					
Document Description			Start	End	
Information Disclosure Statement (IDS) Form (SB08)			3	3	
Transmittal Letter			1	2	
<b>Warnings:</b>					
<b>Information:</b>					
2	Foreign Reference	F1.pdf	1968398	no	39
			9d524e363e7edc1d2dc53da788a9615fc05b2c2d		
<b>Warnings:</b>					
<b>Information:</b>					
3	Foreign Reference	F2.pdf	979036	no	25
			50ab29df2655a007a3371a47186d765c4ea04698		
<b>Warnings:</b>					
<b>Information:</b>					
4	Foreign Reference	F3.pdf	433619	no	12
			604ee0120e8c5800b8ad1ab478ee814f5b487f3d		
<b>Warnings:</b>					
<b>Information:</b>					
5	Other Reference-Patent/App/Search documents	R1.pdf	827307	no	11
			5ab31968809da316da63bf25b8684629133a29cf		
<b>Warnings:</b>					
<b>Information:</b>					
<b>Total Files Size (in bytes):</b>			4408427		



**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.**



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

Table with 4 columns: APPLICATION NUMBER (16/264,360), FILING OR 371(C) DATE (01/31/2019), FIRST NAMED APPLICANT (JEONG WOOK AN), ATTY. DOCKET NO./TITLE (SUN.LGI.420D3)

CONFIRMATION NO. 7253

PUBLICATION NOTICE

23557
SALIWANCIK, LLOYD & EISENSCHENK
A PROFESSIONAL ASSOCIATION
PO Box 142950
GAINESVILLE, FL 32614



Title:Wireless Power Receiver and Method of Manufacturing the Same

Publication No.US-2019-0165609-A1

Publication Date:05/30/2019

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

I hereby certify that this correspondence is being electronically transmitted via EFS to the United States Patent and Trademark Office on the date shown below:

10 MAY 2019



Jeff Lloyd, Patent Attorney, Reg. No. 35,589

SUPPLEMENTAL PRELIMINARY AMENDMENT

Examining Group 2836  
Patent Application  
Docket No. SUN.LGI.420D3  
Serial No. 16/264,360

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Art Unit : 2836  
Applicants : Jeong Wook An, Jung Oh Lee, Sung Hyun Leem, Yang Hyun Kim  
Serial No. : 16/264,360  
Filed : January 31, 2019  
Confirm. No. : 7253  
For : Wireless Power Receiver and Method of Manufacturing the Same

Mail Stop **Amendment**  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

SUPPLEMENTAL PRELIMINARY AMENDMENT

Sir:

Prior to examination, Applicants respectfully request that the application identified above be amended as follows:

## Electronic Patent Application Fee Transmittal

<b>Application Number:</b>	16264360			
<b>Filing Date:</b>	31-Jan-2019			
<b>Title of Invention:</b>	Wireless Power Receiver and Method of Manufacturing the Same			
<b>First Named Inventor/Applicant Name:</b>	JEONG WOOK AN			
<b>Filer:</b>	Jeff Lloyd/Larann Massey			
<b>Attorney Docket Number:</b>	SUN.LGI.420D3			
Filed as Large Entity				
<b>Filing Fees for Utility under 35 USC 111(a)</b>				
<b>Description</b>	<b>Fee Code</b>	<b>Quantity</b>	<b>Amount</b>	<b>Sub-Total in USD(\$)</b>
<b>Basic Filing:</b>				
<b>Pages:</b>				
<b>Claims:</b>				
INDEPENDENT CLAIMS IN EXCESS OF 3	1201	1	460	460
<b>Miscellaneous-Filing:</b>				
<b>Petition:</b>				
<b>Patent-Appeals-and-Interference:</b>				
<b>Post-Allowance-and-Post-Issuance:</b>				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
<b>Extension-of-Time:</b>				
<b>Miscellaneous:</b>				
<b>Total in USD (\$)</b>				<b>460</b>

## Electronic Acknowledgement Receipt

<b>EFS ID:</b>	35981411
<b>Application Number:</b>	16264360
<b>International Application Number:</b>	
<b>Confirmation Number:</b>	7253
<b>Title of Invention:</b>	Wireless Power Receiver and Method of Manufacturing the Same
<b>First Named Inventor/Applicant Name:</b>	JEONG WOOK AN
<b>Customer Number:</b>	23557
<b>Filer:</b>	Jeff Lloyd/Larann Massey
<b>Filer Authorized By:</b>	Jeff Lloyd
<b>Attorney Docket Number:</b>	SUN.LGI.420D3
<b>Receipt Date:</b>	10-MAY-2019
<b>Filing Date:</b>	31-JAN-2019
<b>Time Stamp:</b>	15:58:05
<b>Application Type:</b>	Utility under 35 USC 111(a)

### Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	\$460
RAM confirmation Number	051319INTEFSW00002635190065
Deposit Account	190065
Authorized User	Larann Massey

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)

37 CFR 1.19 (Document supply fees)  
 37 CFR 1.20 (Post Issuance fees)  
 37 CFR 1.21 (Miscellaneous fees and charges)

**File Listing:**

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		SUN-LGI-420D3-SuppPreAmd-AF.pdf	319899 c7f45471f059aae41070ee9d58a287124a9b21b7	yes	7
<b>Multipart Description/PDF files in .zip description</b>					
	<b>Document Description</b>		<b>Start</b>		<b>End</b>
	Applicant Arguments/Remarks Made in an Amendment		7		7
	Claims		2		6
	Preliminary Amendment		1		1
<b>Warnings:</b>					
<b>Information:</b>					
2	Fee Worksheet (SB06)	fee-info.pdf	30612 ee4046a8de8d797da674b8561597186867d9f587	no	2
<b>Warnings:</b>					
<b>Information:</b>					
<b>Total Files Size (in bytes):</b>			350511		

**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.**



Remarks

Claims 1-20 are pending in the subject application. Claims 1-20 are canceled and claims 21-40 are added. No new matter is introduced by these amendments. Upon entry of these amendments, claims 21-40 will be before the Examiner. Favorable consideration of the pending claims is respectfully requested.

Applicants invite the Examiner to call the undersigned if clarification is needed on any of this response, or if the Examiner believes a telephonic interview would expedite the prosecution of the subject application to completion.

The Commissioner is hereby authorized to charge any fees under 37 C.F.R. §§ 1.16 or 1.17 as required by this paper to Deposit Account 19-0065.

Respectfully submitted,



Jeff Lloyd

Patent Attorney

Registration No. 35,589

Phone No.: 352-375-8100

Fax No.: 352-372-5800

Address: Saliwanchik, Lloyd & Eisenschenk  
A Professional Association  
P.O. Box 142950  
Gainesville, FL 32614-2950

JL/lea

In the Claims

This listing of claims will replace all prior versions and listings of claims in the application.

1-20. (Canceled)

21. (New) A wireless power receiver, comprising:  
a magnetic substrate comprising a first receiving space and a second receiving space;  
a coil on the magnetic substrate;  
a first connection terminal connected to an outer end of the coil;  
a second connection terminal connected to an inner end of the coil; and  
a connecting unit comprising a third connection terminal connected to the first connection terminal, and a fourth connection terminal connected to the second connection terminal,  
wherein the first connection terminal and the third connection terminal overlap the first receiving space in a vertical direction perpendicular to the magnetic substrate,  
wherein the second connection terminal and the fourth connection terminal overlap the second receiving space in the vertical direction, and  
wherein the connecting unit comprises:  
a wiring layer connected to the third connection terminal and the fourth terminal.

22. (New) The wireless power receiver of claim 21, wherein the first receiving space is positioned outside the coil, and  
wherein the second receiving space is positioned inside the coil.

23. (New) The wireless power receiver of claim 21, wherein the wiring layer is connected to a receiving circuit, and  
wherein the receiving circuit is disposed outside the first receiving space and the second receiving space.

24. (New) The wireless power receiver of claim 21, wherein the connecting unit comprises:

- a first region on which the third connection terminal is disposed;
- a second region on which the fourth connection terminal is disposed; and
- a third region connecting the first region and the second region, wherein the third region overlaps the coil in the vertical direction.

25. (New) The wireless power receiver of claim 24, wherein the connecting unit comprises:

- a fourth region not overlapping the magnetic substrate in the vertical direction.

26. (New) A wireless power receiver, comprising:

- an adhesive layer comprising a receiving space;
- a coil on the adhesive layer;
- a first connection terminal connected to an outer end of the coil;
- a second connection terminal connected to an inner end of the coil; and
- a connecting unit overlapping the receiving space in a vertical direction perpendicular to the adhesive layer,

wherein the connecting unit comprises:

- a third connection terminal connected to the first connection terminal;
- a fourth connection terminal connected to the second connection terminal; and
- a wiring layer connected to the third connection terminal and the fourth terminal.

27. (New) The wireless power receiver of claim 26, wherein the receiving space extends from inside the coil to outside the coil.

28. (New) The wireless power receiver of claim 26,

- wherein the wiring layer is connected to a receiving circuit, and
- wherein the receiving circuit is disposed outside the first receiving space and the second receiving space.

29. (New) The wireless power receiver of claim 26, wherein the connecting unit comprises:

- a first region on which the third connection terminal is disposed;
- a second region on which the fourth connection terminal is disposed; and
- a third region connecting the first region and the second region, wherein the third region overlaps the coil in the vertical direction.

30. (New) The wireless power receiver of claim 29, wherein the connecting unit comprises:

- a fourth region not overlapping the adhesive layer in the vertical direction.

31. (New) A wireless power receiver, comprising:

- a magnetic substrate comprising a first receiving space and a second receiving space;
- a coil on the magnetic substrate;
- a first connection terminal connected to one end of the coil;
- a second connection terminal connected to an other end of the coil; and
- a connecting unit comprising a third connection terminal connected to the first connection terminal, and a fourth connection terminal connected to the second connection terminal, wherein the first connection terminal and the third connection terminal is disposed corresponding to the first receiving space, wherein the second connection terminal and the fourth connection terminal is disposed corresponding to the second receiving space, wherein the connecting unit comprises a wiring layer connected to the third connection terminal and the fourth terminal.

32. (New) The wireless power receiver of claim 31, wherein the first receiving space is positioned outside the coil, and wherein the second receiving space is positioned inside the coil.

33. (New) The wireless power receiver of claim 31, wherein the wiring layer is connected to a receiving circuit, and  
wherein the receiving circuit is disposed outside the first receiving space and the second receiving space.

34. (New) The wireless power receiver of claim 31, wherein the connecting unit comprises:  
a first region on which the third connection terminal is disposed;  
a second region on which the fourth connection terminal is disposed; and  
a third region on the coil.

35. (New) The wireless power receiver of claim 34, wherein the connecting unit comprises:  
a fourth region which is not disposed on the magnetic substrate.

36. (New) A wireless power receiver, comprising:  
an adhesive layer comprising a receiving space;  
a coil on the adhesive layer;  
a first connection terminal connected to one end of the coil;  
a second connection terminal connected to an other end of the coil; and  
a connecting unit disposed corresponding to the receiving space,  
wherein the connecting unit comprises:  
a third connection terminal connected to the first connection terminal;  
a fourth connection terminal connected to the second connection terminal; and  
a wiring layer connected to the third connection terminal and the fourth terminal.

37. (New) The wireless power receiver of claim 36, wherein the receiving space extends from inside the coil to outside the coil.

38. (New) The wireless power receiver of claim 36, wherein the wiring layer is connected to a receiving circuit, and

wherein the receiving circuit is disposed outside the first receiving space and the second receiving space.

39. (New) The wireless power receiver of claim 36, wherein the connecting unit comprises:

a first region on which the third connection terminal is disposed;

a second region on which the fourth connection terminal is disposed; and

a third region on the coil.

40. (New) The wireless power receiver of claim 39, wherein the connecting unit comprises:

a fourth region which is not disposed on the adhesive layer.

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.

<b>PATENT APPLICATION FEE DETERMINATION RECORD</b> Substitute for Form PTO-875	Application or Docket Number 16/264,360	Filing Date 01/31/2019	<input type="checkbox"/> To be Mailed
---	--	---------------------------	---------------------------------------

ENTITY:  LARGE  SMALL  MICRO

**APPLICATION AS FILED - PART I**

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE (\$)	FEE (\$)
<input type="checkbox"/> BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
<input type="checkbox"/> SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A	
<input type="checkbox"/> EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 = *		x \$100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 = *		x \$460 =	
<input type="checkbox"/> 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).			
<input type="checkbox"/> MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

**APPLICATION AS AMENDED - PART II**

	(Column 1)		(Column 2)	(Column 3)	RATE (\$)	ADDITIONAL FEE (\$)
<b>AMENDMENT</b>	05/10/2019		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		
	Total (37 CFR 1.16(i))	* 20	Minus ** 20	= 0	x \$100 =	0
	Independent (37 CFR 1.16(h))	* 4	Minus *** 3	= 1	x \$460 =	460
	<input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))					
<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	460
<b>AMENDMENT</b>			HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		
	Total (37 CFR 1.16(i))	*	Minus **	=	x \$0 =	
	Independent (37 CFR 1.16(h))	*	Minus ***	=	x \$0 =	
	<input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))					
<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	

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

LIE

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

/ANGELA S WHITE/

\*\*\* 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 number found in the appropriate box in column 1.

This collection of information is required by 37 CFR 1.16. 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 12 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.

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 1449A/PTO			<b>Complete if Known</b>		
<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  (use as many sheets as necessary)			<b>Application Number</b>	16/264,360	
			<b>Filing Date</b>	January 31, 2019	
			<b>First Named Inventor</b>	Jeong Wook An	
			<b>Art Unit</b>	2836	
			<b>Examiner Name</b>		
<b>Sheet</b>	1	of	1	<b>Attorney Docket Number</b>	SUN.LGI.420D3

U.S. PATENT DOCUMENTS						
Examiner Initials*	Cite No. <sup>1</sup>	Document Number Number - Kind Code <sup>2</sup> (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	
	U1	8,177,137-B2	05-15-2012	Arai	ALL	
	U2	9,053,406-B2	06-09-2015	Higashiyama	ALL	
FOREIGN PATENT DOCUMENTS						
Examiner Initials*	Cite No. <sup>1</sup>	Foreign Patent Document Country Code <sup>3</sup> - Number <sup>4</sup> - Kind Code <sup>5</sup> (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T <sup>6</sup>
	F1	CN-101140635-A (with English Abstract) (Equivalent to U.S. Patent No. 8,177,137-B2)	03-12-2008	SEMICONDUCTOR ENERGY LAB	ALL	
	F2	JP-2004-153463-A (with English Abstract)	05-27-2004	SONY ERICSSON MOBILECOMMUNIC ATIONS JAPAN INC	ALL	
	F3	JPH11-175676-A (with English Abstract)	07-02-1999	HITACHI MAXELL LTD	ALL	
	F4	JP-2007-311407-A (with English Abstract)	11-29-2007	DAINIPPON PRINTING CO LTD	ALL	
	F5	JP-2012-008857-A (with English Abstract) (Equivalent to U.S. Patent No. 9,053,406-B2)	01-12-2012	TOYO ALUMINIUM KK	ALL	
ON PATENT LITERATURE DOCUMENTS						
Examiner Initials*	Cite No. <sup>1</sup>	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 <sup>2</sup>
	R1	Office Action dated February 2, 2019 in Chinese Application No. 201710325326.5.				
	R2	Office Action dated February 25, 2019 in Japanese Application No. 2018-012053.				

<b>Examiner Signature</b>		<b>Date Considered</b>	
---------------------------	--	------------------------	--

\*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.

<sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> Applicant is to place a check mark here if English language Translation is attached.

This collection of information is required by 37 CFR 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 2 hours 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, 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 (1-800-786-9199) and select option 2.





Espacenet

## Bibliographic data: CN101140635 (A) — 2008-03-12

Sensor device having non-contact charge function and containers having the same

**Inventor(s):** YASUYUKI ARAI [JP] ± (ARAI YASUYUKI)

**Applicant(s):** SEMICONDUCTOR ENERGY LAB [JP] ± (SEMICONDUCTOR ENERGY LAB)

**Classification:** - **international:** *G01D21/02; G06K19/077; H02J17/00*  
- **cooperative:** *H01Q1/2208; H01Q21/28; H01Q21/29; H01Q7/00*

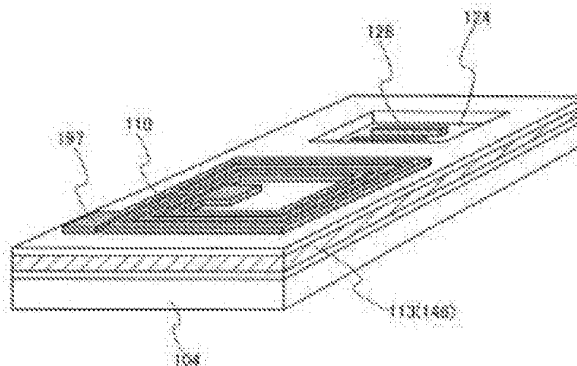
**Application number:** CN20071153638 20070907

**Priority number(s):** JP20060243775 20060908

**Also published as:** CN101140635(B) JP2008065660(A) JP5052079(B2)  
KR101388158(B1) KR20080023114(A) more

### Abstract of CN101140635 (A)

A first base having a first antenna receiving electromagnetic waves and a second base having a sensor portion are separated. An antenna is provided over each of the first base and the second base such that the antennas are electromagnetically coupled. The first antenna constantly receives electromagnetic waves to generate electromotive force and charges a power storage portion. Since the electric power of the power storage portion is also used for driving of a sensor portion, the sensor portion operates even without communication with the external device. Provision of the first antenna receiving electromagnetic waves and the sensor portion on different bases permits miniaturization of a base having the sensor portion. Further, provision of the power storage portion storing electric power converted from electromagnetic waves received by the antenna enables operating the sensor actively.



[19] 中华人民共和国国家知识产权局



# [12] 发明专利申请公布说明书

[21] 申请号 200710153638.9

[51] Int. Cl.

G06K 19/077 (2006.01)

G01D 21/02 (2006.01)

H02J 17/00 (2006.01)

[43] 公开日 2008年3月12日

[11] 公开号 CN 101140635A

[22] 申请日 2007.9.7

[21] 申请号 200710153638.9

[30] 优先权

[32] 2006.9.8 [33] JP [31] 2006-243775

[71] 申请人 株式会社半导体能源研究所

地址 日本神奈川

[72] 发明人 荒井康行

[74] 专利代理机构 中国国际贸易促进委员会专利商  
标事务所

代理人 秦晨

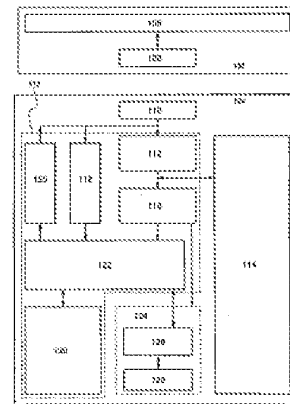
权利要求书 4 页 说明书 20 页 附图 18 页

## [54] 发明名称

具有非接触充电功能的传感装置及包括该装置的容器类

## [57] 摘要

将具有接收电磁波的第一天线的第一基体和具有传感部的第二基体分离。第一基体和第二基体都设置有天线来实现电磁耦合。第一天线稳定地接收电磁波来产生电动势并以其电力对蓄电部进行充电。由于蓄电部的电力也用来驱动传感部，所以即使当不与外部装置进行通信时也可以使传感部工作。通过将接收电磁波的第一天线和传感部设置在不同基体上，可以使具有传感部的基体小型化。另外，通过提供以天线接收电磁波并将它转换成电力来存储该电力的蓄电部，可以使传感器主动地工作。



1. 一种传感装置, 包括:

第一天线, 该第一天线形成在第一基体上并用来接收从外部装置发送的电磁波;

第二天线, 该第二天线形成在所述第一基体上并电连接到所述第一天线;

第三天线, 该第三天线形成在第二基体上并与所述第二天线电磁耦合;

蓄电部, 该蓄电部用来存储对所述第三天线所接收的电磁波进行整流而获得的电力; 以及

传感部, 该传感部形成在所述第二基体上并以从所述蓄电部提供的电力而工作,

其中, 所述第一基体和所述第二基体彼此分离。

2. 一种传感装置, 包括:

在第一基体上的第一天线, 该第一天线用来接收从外部装置发送的电磁波;

在所述第一基体上的蓄电部, 该蓄电部用来存储对所述第一天线所接收的电磁波进行整流而获得的电力;

在所述第一基体上的第二天线, 该第二天线用来发送在从所述蓄电部提供之后被调制的电力;

在第二基体上的第三天线, 该第三天线与所述第二天线电磁耦合; 以及

在所述第二基体上的传感部, 该传感部以对所述第三天线所接收的电磁波进行整流而获得的电力而工作。

3. 根据权利要求1所述的传感装置, 其中所述第一天线是多频共用天线。

4. 根据权利要求2所述的传感装置, 其中所述第一天线是多频共用天线。

5. 一种传感装置, 包括:

第一基体, 该第一基体设置有用来接收从外部装置发送的电磁波的天线部、用来存储转换所述天线部所接收的电磁波而获得的电力的蓄电部、以及第一线圈天线; 以及

第二基体, 该第二基体设置有能够测量对象物的物理量的传感部、以及第二线圈天线,

其中, 通过执行电磁耦合的所述第一线圈天线及所述第二线圈天线进行所述第一基体和所述第二基体之间的通信及电力收发。

6. 一种传感装置, 包括:

第一基体, 该第一基体设置有用来接收从外部装置发送的电磁波的天线部、以及第一线圈天线; 以及

第二基体, 该第二基体包括能够测量对象物的物理量的传感部、用来存储转换所述天线部所接收的电磁波而获得的电力的蓄电部、以及第二线圈天线,

其中, 通过执行电磁耦合的所述第一线圈天线及所述第二线圈天线进行所述第一基体和所述第二基体之间的通信及电力收发,

并且, 所述第一基体和所述第二基体彼此分离。

7. 根据权利要求5所述的传感装置, 其中所述天线部包括多频共用天线。

8. 根据权利要求6所述的传感装置, 其中所述天线部包括多频共用天线。

9. 根据权利要求1所述的传感装置, 其中所述蓄电部是电容器。

10. 根据权利要求2所述的传感装置, 其中所述蓄电部是电容器。

11. 根据权利要求5所述的传感装置, 其中所述蓄电部是电容器。

12. 根据权利要求6所述的传感装置, 其中所述蓄电部是电容器。

13. 根据权利要求9所述的传感装置, 其中所述电容器是双电层电容器。

14. 根据权利要求10所述的传感装置, 其中所述电容器是双电层电容器。

15.根据权利要求11所述的传感装置，其中所述电容器是双电层电容器。

16.根据权利要求12所述的传感装置，其中所述电容器是双电层电容器。

17.根据权利要求1所述的传感装置，其中所述第一基体的一部分和所述第二基体的一部分彼此重叠。

18.根据权利要求2所述的传感装置，其中所述第一基体的一部分和所述第二基体的一部分彼此重叠。

19.根据权利要求5所述的传感装置，其中所述第一基体的一部分和所述第二基体的一部分彼此重叠。

20.根据权利要求6所述的传感装置，其中所述第一基体的一部分和所述第二基体的一部分彼此重叠。

21.一种容器，包括：

在主体外装部的天线，该天线用来接收电磁波；

在主体内侧的蓄电部，该蓄电部用来存储对当所述天线吸收电磁波时产生的感应电动势进行整流而获得的电力；

在所述主体内侧的中央计算处理部，该中央计算处理部以来自所述蓄电部的电力供给而工作；以及

在所述主体内侧的传感部，该传感部用来将信号输入到所述中央计算处理部。

22.一种容器，包括：

在主体外装部的天线，该天线用来接收电磁波；

在所述主体外装部的蓄电部，该蓄电部用来存储对当所述天线吸收电磁波时产生的感应电动势进行整流而获得的电力；

在所述主体外装部的中央计算处理部，该中央计算处理部以来自所述蓄电部的电力供给而工作；以及

在主体内侧的传感部，该传感部以来自所述蓄电部的电力供给而工作。

23.一种容器，包括：

在主体外装部的第一基体,该第一基体设置有用来接收电磁波的第一天线及与该第一天线电连接的第二天线; 以及

在主体内侧的第二基体,该第二基体设置有与所述第二天线电磁耦合的第三天线、用来存储对因所述第三天线而产生的感应电动势进行整流而获得的电力的蓄电部、以来自所述蓄电部的电力供给而工作的中央计算处理部、以及用来将信号输入到所述中央计算处理部的传感部。

24.一种容器, 包括:

在主体外装部的第一基体,该第一基体设置有用来接收电磁波的第一天线、与该第一天线电连接的第二天线、用来存储对当所述第一天线吸收电磁波时产生的感应电动势进行整流而获得的电力的蓄电部、以及以来自所述蓄电部的电力供给而工作的中央计算处理部; 以及

在主体内侧的第二基体,该第二基体设置有与所述第二天线电磁耦合的第三天线、以及以来自所述蓄电部的电力供给而工作的传感部。

## 具有非接触充电功能的传感装置 及包括该装置的容器类

### 技术领域

本发明涉及非接触地进行数据通信及驱动电力收发的传感装置及包括该装置的容器类。

### 背景技术

在市场上流通的物品如食品、医药品及它们的原材料等大多保存在能够密封的容器内，以进行安全卫生或品质维持的管理。例如，将新鲜食品、清凉饮料放在能够控制室内温度的车辆里来运输，以保持新鲜度。在医药品或食品类中，有的商品一旦拆开保存容器则失掉其商品价值。也就是，有可能会失去商品安全性的信用。

但是，对在零售阶段购买商品的消费者而言，不能准确地把握在流通过程中该商品是怎样被管理的。例如，即使贴在商品上的签条被篡改，也很难辨别其真假。

使用微小的 IC 芯片进行物品识别或认证以管理商品的方法引人注目。IC 芯片与天线连接，或者将天线形成在 IC 芯片上，通过无线通信进行信号收发。这种认证方法因为在 IC 芯片中存储识别信息等并将该 IC 芯片安装在商品标签或商品签条上而可以有效地利用电脑进行管理。关于存储在 IC 芯片中的信息的读取，使用称为读写器的外部装置进行无线通信。此时，IC 芯片工作所需要的电力使用因从外部装置输出的电磁波而产生的感应电动势来提供。

另外，正在探讨怎样使 IC 标签更加主动地工作，而不仅仅只将其用于认证的方法。例如，有人提出这样一种利用 IC 标签的方法：在能够与外部装置进行无线通信的 IC 标签上安装能够测量对象物的物理量的传感器（参照专利文件 1）。该附带传感器的 IC 标签除了包括通信部、CPU 及温度传感器以外还包括能够接收来自外部装置的电

力用电波而被充电的电池。

专利文件 1 日本专利申请公开 2001-187611 号公报

发明内容

在采用通过接收电力用电波来充电的电池的情况下，需要使天线的尺寸大型化，以提高天线的灵敏度而能够充分地进行充电。因此，出现一个问题是，其中安装有通过电力用电波能够充电的电池的附带传感器的 IC 标签不能实现小型化。这样，由于附带传感器的 IC 标签的用途广泛，当将它贴到小型容器上来使用时，非常不利。

鉴于上述问题，本发明的目的在于使具有非接触充电功能及信号收发功能的附带传感器的 IC 标签或传感装置小型化。换言之，本发明的目的在于提供可容易贴到小型容器类上或放在小型容器类中的附带传感器的 IC 标签或传感装置。

作为传感装置，提供有：接收电磁波的天线；对因天线吸收电磁波而产生的感应电动势进行整流并存储其电力的蓄电部；接收来自蓄电部的电力供给而工作的中央计算处理部（也称为 CPU（中央处理器），是根据程序进行数据移动、加工及相关设备的控制的电路，并由进行计算的算术逻辑单元（ALU）、暂时存储数据的寄存器、与存储器或外围设备进行输入及输出的总线接口、控制整个 CPU 的控制部分等构成。下面，包括在传感装置中并进行逻辑计算处理的功能元件也称为 CPU）、以及将信号输入到所述 CPU 的传感部。通过吸收在空中传播的电磁波来产生感应电动势而对蓄电部进行充电，可以具有非接触充电功能。在此情况下，接收电磁波的天线优选为多频共用天线。另外，所述传感装置也可以包括控制蓄电部的电力的充放电控制电路、存储数据或程序的存储电路、以及具有其他特定功能的电路。

对蓄电部进行充电的工作是由天线稳定地接收在空中传播的电磁波来产生电动势而进行充电。或者，当外部装置发送电磁波时，天线也可以接收该电磁波来产生电动势，而对蓄电部进行充电。无论怎样，根据本发明的传感装置具有如下结构：组合天线、整流电路及蓄电部，并有效地利用在空中传播的电磁波，来产生该装置工作所需要



的电力。

在具有上述结构的传感装置中，天线和传感部形成在不同基体上，并且该不同基体之间通过执行电磁耦合的天线进行电力及信号的收发。通过使接收电磁波的基体和设有传感部的基体分离，可以提高蓄电功能并实现传感部的小型化。

根据本发明，通过将接收电磁波的天线和传感部设置在不同基体上，可以使设有传感部的基体小型化。另外，通过提供以天线接收电磁波并将它转换成电力来存储该电力的蓄电部，可以使传感器主动地工作来检测出作为对象的检查材料的物理量。在此情况下，可以获得能够使接收电磁波的天线大型化的利点。并且与此相反，可以使包括传感部的第二基体小型化，而可以将第二基体放在小型容器或微囊中。

#### 附图说明

图 1 是表示根据实施方式 1 的传感装置的结构图；

图 2A 至 2D 是表示由第一基体和第二基体构成的传感装置的结构图；

图 3 是包括具有第一天线及第二天线的第一基体、具有第三天线、蓄电部及传感部的第二基体的传感装置的等效电路图；

图 4 是表示根据实施方式 2 的传感装置的结构图；

图 5A 至 5D 是表示由第一基体和第二基体构成的传感装置的结构图；

图 6 是包括具有第一天线、蓄电部及第二天线的第一基体、具有第三天线及传感部的第二基体的传感装置的等效电路图；

图 7 是表示根据实施方式 3 的具有多个天线的传感装置的结构图；

图 8 是表示根据实施方式 3 的具有多个天线的传感装置的结构图；

图 9 是表示根据实施方式 4 的具有多个天线的传感装置的结构图；

图 10 是表示可以形成实施方式 1 至实施方式 4 的电路部的晶体管的结构的图；

图 11 是表示可以形成实施方式 1 至实施方式 4 的电路部的晶体管的结构的图；

图 12 是适用于实施方式 1 至实施方式 4 的第二基体的透视图；

图 13 是说明形成在第二基体上的传感部的一个例子的图；

图 14A 和 14B 是说明形成在第二基体上的传感部的一个例子的图；

图 15 是说明形成在第二基体上的传感部的一个例子的图；

图 16A 和 16B 是表示设置有传感装置的容器类的一个结构例子的图；

图 17 是说明设置有传感装置的容器类的重要部分的图；

图 18 是表示收纳在包装体中的容器类的图。

#### 具体实施方式

根据本发明的传感装置在第一基体上包括接收从外部装置发送的电磁波的第一天线、以及电连接到第一天线的第二天线。在第二基体上包括与第二天线电磁耦合的第三天线、对第三天线所接收的电磁波进行整流来作为电力存储的蓄电部、以及以蓄电部所提供的电力而工作的传感部。在所述传感装置中，第一基体和第二基体分离。

在本发明中，对第一天线接收的电磁波的频率没有特别限制，包括如下任一频率：例如亚毫米波的 300GHz 到 3THz、毫米波的 30GHz 到 300GHz、微波的 3GHz 到 30GHz、极超短波的 300MHz 到 3GHz、超短波的 30MHz 到 300MHz、短波的 3MHz 到 30MHz、中波的 300kHz 到 3MHz、长波的 30kHz 到 300kHz、以及超长波的 3kHz 到 30kHz。至少在第一天线中具有能够接收这些频带的电磁波的一部分或全部的功能，即可。

另外，也可以是如下传感装置：在第一基体上包括接收从外部装置发送的电磁波的第一天线、对第一天线所接收的电磁波进行整流来作为电力存储的蓄电部、以及调制从蓄电部提供的电力并将该电力发送出去的第二天线，而在第二基体上包括与第二天线电磁耦合的第三天线、以及以对第三天线所接收的电磁波进行了整流的电力而工作的

传感部。

根据所述结构，可以使第二基体小型化。换言之，本发明的传感装置包括第一基体和第二基体，该第一基体包括接收从外部装置发送的电磁波的天线部，而该第二基体包括能够测量对象物的物理量的传感部、以及将天线部所接收的电磁波转换成电力来存储的蓄电部，其中通过执行电磁耦合的线圈天线进行第一基体和第二基体之间的通信及电力收发。

下面，参照附图说明本发明的实施方式。但是，本发明可以通过多种不同的方式来实施，本领域人员可以很容易地理解一个事实就是其方式和详细内容可以被变换为各种各样的形式，而不脱离本发明的宗旨及其范围。因此，本发明不应该被解释为仅限定在实施方式所记载的内容中。注意，在以下示出的附图中，使用同一标号表示同一部分或具有同样的功能的部分，省略其重复说明。

#### 实施方式 1

在本实施方式中，参照附图说明如下结构：接收电磁波的天线和传感部设置在不同基体上，以使具有非接触充电功能的传感装置小型化。在本实施方式中，说明接收电磁波的第一天线形成在第一基体上，而 CPU、传感部及向它们提供电力的蓄电部设置在第二基体上的传感装置的结构。

图 1 是表示根据本实施方式的传感装置的结构框图。该传感装置由第一基体 102 和与此分离的第二基体 104 构成。在第一基体 102 上设置有接收电磁波的第一天线 106。第一天线 106 接收在空中传播的电磁波，并稳定地接收亚毫米波频带至超长波频带的电磁波。或者，能够接收从外部装置发送的电磁波。外部装置包括发送电磁波的天线，而且包括称为 RFID（射频识别）的以无线通信读取并改写存储在 IC 芯片中的数据的技术的读写装置等。

作为第一天线 106 的形式，可以根据所接收的频率适当地采用各种天线如环形天线、螺旋线圈天线、单极天线、偶极天线、平板天线等。另外，还可以使用能够接收多个频带如 13MHz 频带、900MHz

频带、2GHz 频带等的电磁波的多频共用天线。

在第一基体 102 上设置有与第一天线 106 电连接的第二天线 108。第二天线 108 与设置在第二基体 104 上的第三天线 110 电磁耦合。通过使用所述第二天线 108，可以将第一天线 106 所接收的电磁波传送到第二基体 104。

第二天线 108 和第三天线 110 优选由例如螺旋线圈天线构成以在该两者之间实现电磁耦合。第二天线 108 和第一天线 106 是彼此独立的，第二天线 108 可以根据第三天线的形状最合适地设计其大小及形状。另一方面，第一天线 106 可以通过增加匝数或者增加匝径等的大型化，以提高接收灵敏度。

因第三天线 110 接收电磁波而产生的感应电动势在电路部 113 中用于信号处理及驱动电力的生成。通过整流电路 112 而产生的直流或者被进行了半波整流的电力存储在蓄电部 114。优选提供恒压电路 116，以使从蓄电部 114 提供的电力稳定化来将它提供给 CPU122。

解调电路 118 所解调的信号包括控制传感部 124 的信号、控制存储部 130 的信号、使存储部 130 存储的信息等。另外，从传感部 124 输出的信号和从存储部 130 读出的信息通过 CPU122 输出到调制电路 120。调制电路 120 将这种信号调制为能够进行通信的信号，并通过第三天线 110 输出它。

传感部 124 包括传感器驱动电路 126 和传感器 128。传感器 128 由电阻元件、电容耦合元件、感应耦合元件、光电动势元件、光电转换元件、热电动势元件、晶体管、热敏电阻器、二极管等的半导体元件构成。传感器驱动电路 126 检测出阻抗、电抗、感应系数、电压或电流的变化，并进行模拟/数字转换（A/D 转换）来将信号输出到 CPU122。

存储部 130 是通过组合读出专用存储器、能够改写的存储器及非易失性存储器的一种或多种而构成的。为了存储传感部 124 所检测出的信号，存储部 130 可以由静态随机存取存储器、能够电改写的 ROM（电可擦可编程只读存储器）、具有浮栅或电荷存储层的非易失性存

储器等构成。另外，也可以在存储部 130 提供掩模 ROM 或可编程 ROM 并通过 CPU122 进行工作。此时，CPU122 根据存储在存储部 130 中的程序控制传感部 124。

通过使用半导体集成电路，可以形成包括整流电路 112、解调电路 118、调制电路 120、CPU122、传感部 124 及存储部 130 的电路部 113。例如，可以在单晶半导体衬底上形成 MOS 结构的晶体管来构成电路部 113。另外，也可以通过使用由 10nm 至 200nm 厚的半导体膜构成的晶体管（所谓的薄膜晶体管）形成电路部 113。

蓄电部 114 可以由通过利用化学反应进行充放电的二次电池或存储电荷的电容器构成。为了使提供有传感部 124 的第二基体 104 小型化，蓄电部 114 优选由叠层陶瓷电容器或双电层电容器构成。

像这样，第一基体 102 和第二基体 104 分离，因此即使使第一天线 106 大型化以提高接收灵敏度，也不影响到包括传感部 124 的第二基体 104。换言之，可以使包括传感部 124 的第二基体 104 小型化，因此传感装置可适用于各种用途。例如，通过将具有传感部的第二基体 104 提供到小型容器或微囊，可以检测出其内容物的物理量。另外，由于是通过第三天线 110 接收电磁波来产生电力并将该电力存储在第二基体 104 的蓄电部 114 的结构，所以可以使蓄电部 114 小型化。再者，因为从蓄电部 114 提供电力，所以即使不从外部发送信号也可以使传感部 114 工作来测量检查材料的物理量。

图 2A 至 2D 是表示由第一基体 102 和第二基体 104 构成的传感装置的图。图 2A 是第一基体 102 的平面图，而图 2B 表示沿图 2A 的 A-B 线截断的第一基体 102 的截面结构。另外，图 2C 是第二基体 104 的平面图，而图 2D 表示沿图 2C 的 C-D 线截断的第二基体 104 的截面结构。

在图 2A 和 2B 中，在第一基体 102 上形成有第一天线 106 和第二天线 108。只要根据进行通信的频带适当地设计第一天线 106，即可。例如，电磁波的频带可以采用直到 135kHz 的长波频带、6 至 60MHz（典型地说是 13.56 MHz）的短波频带、400 至 950 MHz 的超短波频

带、2至25GHz的微波频带等。作为长波频带或短波频带的天线，使用利用了根据环形天线的电磁感应的天线。除此以外，也可以是利用了相互感应作用（电磁耦合方式）或根据静电的感应作用（静电耦合方式）的天线。图2A和2B表示第一天线106和第二天线108由螺旋天线构成的情况。第一天线106和第二天线108的一端直接连接，而另一端通过共振电容107连接。

第一天线106优选由铝、铜、银等的良导体材料构成。例如，通过采用丝网印刷、胶印刷、喷墨方式的印刷法，可以以铜或银的膏状组成物形成第一天线106。另外，也可以通过溅射法形成铝膜，并进行蚀刻加工来形成第一天线106。除此以外，也可以使用电镀法、无电镀法形成第一天线106。第二天线108也以类似方法形成。在塑料膜、塑料衬底、无纺布、纸、玻璃环氧衬底、玻璃衬底等具有绝缘表面的基体上，可以形成第一天线106及第二天线108。通过使用贯穿第一基体102的布线，在与第一天线106相反一侧的面上形成共振电容107。共振电容107例如由芯片电容器等的外部部件构成。

在图2C和2D中，在第二基体104上形成有第三天线110。通过将电路部113形成为其中间夹着绝缘层与第三天线110部分重叠，以实现小型化。另外，传感部124形成在第二基体104上。还可以将蓄电部114和第二基体104形成为一体。即使当使用叠层陶瓷电容器或双电层电容器形成蓄电部114时，也需要一定程度的安装面积，因此蓄电部114优选形成在与形成有第三天线110的一面相反一侧的面上，以与第二基体104形成为一体。

图3表示具有第一天线106和第二天线108的第一基体102、以及具有第三天线110、蓄电部114及传感部124的第二基体104的等效电路。第一基体102和第二基体104分离，当处于第二天线108和第三天线110进行电磁耦合的距离时，它们彼此联动地工作。另外，当在蓄电部114中存储有电力时，第二基体104能够单独地继续工作。

在根据本实施方式的传感装置中，通过将接收电磁波的天线和传感部形成在不同基体上，可以使提供有传感部的基体小型化。另外，

通过提供以天线接收电磁波并将它转换成电力来存储该电力的蓄电部，可以使传感器主动地工作来检测出作为对象的检查材料的物理量。在此情况下，可以获得能够使接收电磁波的天线大型化的利点。另外，由于可以使包括传感部的第二基体小型化，所以也可以将第二基体放在小型容器或微囊中。

#### 实施方式 2

在本实施方式中，说明与实施方式 1 不同的将接收电磁波的天线和传感部设置在不同基体上，以实现使具有非接触充电功能的传感装置小型化的结构。在本实施方式中，说明接收电磁波的第一天线、CPU 及蓄电部形成在第一基体上，而传感部设置在第二基体上的传感装置的结构。

图 4 是表示根据本实施方式的传感装置的结构框图。该传感装置由第一基体 102 和第二基体 104 构成。第一基体 102 和第二基体 104 是不同的基体。在第一基体 102 上设置有蓄电部 114 和第一基体的电路部 144。并且，在第二基体 104 上设置有第二基体的电路部 146 和传感部 124。

在第一基体 102 上设置有接收电磁波的第一天线 131。第一天线 131 接收在空中传播的电磁波，并稳定地接收亚毫米波频带至超长波频带的电磁波。或者，能够接收从外部装置发送的电磁波。另外，也能够接收从电子设备泄漏的电磁波。

因第一天线 131 接收电磁波而产生的电动势的一部分被整流电路 112 进行整流并存储在蓄电部 114 中。蓄电部 114 提供 CPU122、存储部 130、在第二基体 104 上的传感部 124 及其他电路工作所需要的电力。也可以设置充放电控制电路 119，以当能够以第一天线 131 获得充分的电动势时优先采用其电力供给并停止来自蓄电部 114 的供给。充放电控制电路 119 提供在蓄电部 114 和恒压电路 116 之间。通过提供充放电控制电路 119，可以有效地利用存储在蓄电部 114 中的电力，并可以延长电力的稳定供给时间。在第一基体 102 上的第一天线 131 及蓄电部 114 的结构与实施方式 1 相同。

存储在蓄电部 114 中的电力通过恒压电路 116、振荡电路 117、调制电路 120、以及第二天线 108 提供给第二基体 104。第二天线 108 和第三天线 110 电磁耦合。因第三天线 110 接收电磁波而产生的感应电动势用作第二基体的电路部 146 及传感部 124 的工作电力。电容部 140 是暂时存储所述电力的电容器。通过整流电路 138 而产生的直流或者被进行了半波整流的电力存储在电容部 140。优选提供恒压电路 142, 以使从电容部 140 提供的电力稳定化来将它提供给控制电路 136。

解调电路 132 所解调的信号包括控制传感部 124 的信号。另外, 从传感部 124 输出的信号通过控制电路 136 输出到调制电路 134。调制电路 134 将这种信号调制为能够进行通信的信号, 并通过第三天线 110 将它传送到第二天线 108。

传感部 124 包括传感器驱动电路 126 和传感器 128。其结构与实施方式 1 相同。

像这样, 通过在第一基体 102 上提供接收电磁波的第一天线 131、进行所接收的电磁波的信号处理及直流电力生成等的第二基体的电路部 144 及蓄电部 114, 可以使具有测量检查材料的物理量的传感部 124 的第二基体 104 小型化。例如, 通过将具有传感部的第二基体 104 提供到小型容器或微囊, 可以检测出其内容物的物理量。另一方面, 在第一基体 102 上, 可以使用电容大的陶瓷电容器或双电层电容器作为蓄电部 114。

图 5A 至 5D 是表示由第一基体 102 和第二基体 104 构成的传感装置的图。图 5A 是第一基体 102 的平面图, 而图 5B 表示沿图 5A 的 E-F 线截断的第一基体 102 的截面结构。另外, 图 5C 是第二基体 104 的平面图, 而图 5D 表示沿图 5C 的 G-H 线截断的第二基体 104 的截面结构。

在图 5A 和 5B 中, 在第一基体 102 上形成有第一天线 131 和第二天线 108。只要根据进行通信的频带适当地设计第一天线 131, 即可。例如, 电磁波的频带可以采用直到 135kHz 的长波频带、6 至 60MHz (典型地说是 13.56 MHz) 的短波频带、400 至 950 MHz 的超短波频



带、2至25GHz的微波频带等。作为长波频带或短波频带的天线，使用利用了根据环形天线的电磁感应的天线。除此以外，也可以是利用了相互感应作用（电磁耦合方式）或根据静电的感应作用（静电耦合方式）的天线。图5A和5B表示第一天线131由偶极天线构成而第二天线108由螺旋天线构成的情况。

在图5C和5D中，在第二基体104上形成有第三天线110。通过将第二基体的电路部146形成为其中间夹着绝缘层与第三天线110部分重叠，以实现小型化。另外，传感部124形成在第二基体104上。该第二基体104的结构与实施方式1相同。

图6表示由具有第一天线131、蓄电部114及第二天线108的第一基体102、以及具有第三天线110和传感部124的第二基体104构成的传感装置的等效电路。第一基体102和第二基体104分离，当处于第二天线108和第三天线110进行电磁耦合的距离时，它们彼此联动地工作。另外，当在蓄电部114中存储有电力时，第一基体102也能够将电力从蓄电部114提供给第二基体104。

在根据本实施方式的传感装置中，通过将接收电磁波的天线及蓄电部、以及传感部形成在不同基体上，可以使提供有传感部的基体小型化。另外，通过提供以天线接收电磁波并将它转换成电力来存储该电力的蓄电部，可以使传感器主动地工作来检测出作为对象的检查材料的物理量。这样可以获得能够使接收电磁波的天线大型化的利点。另外，由于可以使包括传感部的第二基体小型化，所以也可以将第二基体放在小型容器或微囊中。

### 实施方式3

在本实施方式中，参照图7和图8说明与实施方式2不同的第一基体102的结构。在本实施方式中，示出具有多个天线以接收宽频带的电磁波来存储电力的传感装置的例子。

在图7所示的第一基体102中，作为第一基体的电路部144的结构，整流电路112、恒压电路116、振荡电路117、解调电路118、调制电路120、CPU122、存储部130的结构具有与图4所说明的第一基

体的电路部相同的功能。

第一天线 131 用来与外部装置进行控制命令、通信数据的通信。与第一天线 131 连接的解调电路 148 和调制电路 150 是进行控制命令、通信数据的调制及解调的电路。第二天线 108 与第二基体的天线电磁耦合。形成有多个用来接收电磁波来对蓄电部进行充电的天线。第一充电用天线 152 和第二充电用天线 154 连接到整流电路 112，并以感应电动势对蓄电部 114 进行充电。第一充电用天线 152 和第二充电用天线 154 设计为能够接收的频带互不相同。或者，第一充电用天线 152 和第二充电用天线 154 设计为其结构互不相同，以可对应于电磁耦合型、电磁感应型、微波型、静电耦合型等的各种传送介质方式。通过提供多个充电用天线，可以接收 10MHz 至 6GHz 的宽频带的电磁波，而可以提高充电功能。

图 8 是表示第一基体 102 的结构图。在图 8 中，在第一基体 102 上形成有第一天线 131、第二天线 108、第一充电用天线 152 及第二充电用天线 154。第一充电用天线 152 接收 UHF 频带（868MHz、915MHz、950 MHz）的电磁波，其形成为偶极天线的形状。第二充电用天线 154 接收 13MHz 频带的电磁波，其形成为螺旋天线的形状。再者，还可以提供接收微波频带（2GHz 至 5GHz）的电波的天线。这些天线可以通过印刷法等形成在作为第一基体 102 的绝缘片上。像这样，通过用于接收多个频带的电磁波的多个天线作为充电用天线，可以有效地接收在空中传播的电磁波而提高充电能力。

这些天线与第一基体的电路部 144 及蓄电部 114 之间的连接、以及与具有传感部的第二基体之间的关系与实施方式 2 相同。

根据本实施方式，通过将多个充电用天线提供到第一基体上，可以接收宽频带的电磁波来存储电力。因此，可以将充分的电力提供给具有传感部 124 的第二基体。在这种情况下，也可以使具有传感部的第二基体小型化。

#### 实施方式 4

在本实施方式中，参照图 9 说明天线的结构与实施方式 3 不同的

具有多个天线的传感装置。

图9表示在第一基体102上的天线结构。用来与外部装置进行控制命令、通信数据的通信的第一天线131、第一充电用天线152及第二充电用天线154连结并在共同接触部153中与第一基体的电路部144连接。第二天线108在其他部分中与第一基体的电路部144接触。

在安装有多个充电用天线的情况下,若在每个天线中分别形成与第一基体的电路部144的接触部,则第一基体的电路部144的电路配置因该接触部的占有面积而受到限制。而通过共同使用多个天线和电路部之间的连接部,可以避免这种问题。

其他结构与实施方式3相同。通过将多个充电用天线设置在第一基体上,可以接收宽频带的电磁波来存储电力。因此,可以将充分的电力提供给具有传感部124的第二基体。在这种情况下,也可以使提供有传感部的第二基体小型化。

#### 实施方式5

在本实施方式中,示出可形成实施方式1至4的电路部的晶体管的结构例子。

图10表示形成在具有绝缘表面的衬底178上的薄膜晶体管。作为衬底178,使用铝硅酸盐玻璃等的玻璃衬底、石英衬底等。衬底178的厚度为400至700 $\mu\text{m}$ 。或者,也可以通过进行抛光使衬底178薄片化,其厚度为5至100 $\mu\text{m}$ 。

在衬底178上,也可以形成有由氮化硅或氧化硅构成的第一绝缘层180。第一绝缘层180具有使薄膜晶体管的特性稳定化的效果。半导体层182优选为多晶硅。另外,半导体层182也可以是在与栅电极186重叠的沟道形成区域中晶粒界面不会影响到载流子漂移的单晶硅薄膜。

作为其他结构,可以举出衬底178由硅半导体构成且第一绝缘层180由氧化硅构成的结构。在此情况下,半导体层182可以由单晶硅构成。换言之,可以使用SOI(Silicon on Insulator; 绝缘体上硅)衬底。

栅电极186形成在半导体层182上,其中间夹有栅极绝缘层184。

在栅电极186的两侧也可以形成有侧壁，因此，也可以在半导体层182中形成有低浓度漏极。第二绝缘层188由氧化硅、氮氧化硅等构成。该第二绝缘层188是所谓的层间绝缘层，并且第一布线190形成在该层间绝缘层上。第一布线190与形成在半导体层182中的源极区域及漏极区域接触。

再者，通过使用氮化硅、氧氮化硅、氧化硅等形成第三绝缘层192、以及第二布线194。虽然在图10中示出第一布线190和第二布线194，但是可以根据电路结构适当地选择布线的叠层数量。至于布线结构，也可以在接触孔中实现钨选择性生长来形成埋入插头，或者，也可以使用金属镶嵌工序形成铜布线。

天线层197形成在衬底178上。优选通过印刷法或镀敷法使用铜或银形成天线层197，以谋求低电阻化。天线层197本身可以形成天线，或者，天线层197也可以用作与形成在其他基体上的天线连接的连接端子。总之，优选将第四绝缘层196形成在天线层197的周围，以不引起与第二布线194之间的短路。第四绝缘层196优选由涂敷形成的氧化硅构成，以使表面平整化。

实施方式1至实施方式4的电路部及传感部可以通过本实施方式所示的晶体管、天线层及与它连接的布线来实现。

#### 实施方式6

在本实施方式中，示出可形成实施方式1至4的电路部的晶体管的结构例子。注意，使用同一标号表示起到与实施方式5相同作用的部分。

图11表示MOS (Metal Oxide Semiconductor; 金属氧化物半导体) 晶体管，它形成在半导体衬底198上。作为半导体衬底198，典型的是采用单晶硅衬底。半导体衬底198的厚度为100 $\mu\text{m}$ 至300 $\mu\text{m}$ 。或者，也可以通过进行抛光使半导体衬底198薄片化，其厚度为10 $\mu\text{m}$ 至100 $\mu\text{m}$ 。这是因为可以通过与第一基体或第二基体组合来保持强度的缘故。

在半导体衬底198上形成有元件分离绝缘层200。通过在半导体衬

底198上使用形成氮化膜等的掩模并进行热氧化来形成元件分离用氧化膜的LOCOS (Local Oxidation of Silicon; 硅局部氧化) 技术, 可以形成元件分离绝缘层200。另外, 也可以通过使用STI (Shallow Trench Isolation; 浅槽隔离) 技术在半导体衬底198中形成槽, 并将绝缘膜填入该槽中, 且进行平整化, 来形成元件分离绝缘层200。通过使用STI技术, 可以使元件分离绝缘层200的侧壁陡峭, 因此可以减少元件分离宽度。

在半导体衬底198上, 可以形成n井202和p井204, 来以所谓的双井结构形成n沟道型晶体管及p沟道型晶体管。或者, 也可以采用单井结构。栅极绝缘层184、栅电极186、第二绝缘层188、第一布线190、第三绝缘层192、第二布线194、天线层197、以及第四绝缘层196与实施方式5相同。

如上所述, 通过使用MOS晶体管形成集成电路, 可以形成通过接收RF频带 (典型地说, 13.56MHz) 至微波频带 (2.45GHz) 的通信信号来进行工作的电路部。

#### 实施方式7

图12是适用于实施方式1至4的第二基体104的透视图。通过使用实施方式5或6的晶体管形成电路部113 (或第二基体的电路部146)。第三天线110形成在第二基体104上。这就是所谓的片上天线 (on-chip antenna) 结构。也可以将由无机绝缘材料或有机绝缘材料构成的保护膜形成在第三天线110上。另外, 还设置有传感部124。在传感部124中, 有时设有光入射窗口或用来测量静电电容的电极, 通过暴露传感器128来测量检查材料的物理量。

像这样, 通过将电路部113 (或第二基体的电路部146) 和第三天线110形成为一体, 可以使具有传感部124的第二基体104小型化。

#### 实施方式8

在本实施方式中, 说明包括在实施方式1至4及实施方式7中的传感部的一个例子。

图13表示检测温度的传感部的结构。传感器128由使用了晶体管

的多级环形振荡器206构成。其利用环形振荡器206的振荡频率随着温度而变化的现象。晶体管的阈值电压随着温度上升而降低。导通电流因阈值电压的降低而上升。环形振荡器206具有晶体管的导通电流越高振荡频率越高的特性。通过利用该特性，可以将环形振荡器206用作温度传感器。通过使用传感器驱动电路126的脉冲计数器208，可以测量环形振荡器206的振荡频率。脉冲计数器208的信号可以直接或者升压到逻辑电压来输出到CPU122。

图14A表示检测周围亮度或有无光照射的传感器的一个例子。传感器128由光电二极管、光电晶体管等构成。传感器驱动电路126包括传感器驱动部210、检测部212、以及A/D转换部214。

图14B是说明检测部212的电路图。当复位用晶体管216处于导通状态时，传感器128被施加负偏压。这里，传感器128的负侧端子的电位被充电到电源电压的电位的工作被称为“复位”。然后，使复位用晶体管216处于非导通状态。此时，电位状态因传感器128的电动势而随时间改变。换言之，被充电到电源电压的电位的传感器128的负侧端子的电位因光电转换产生的电荷而逐渐降低。在经过一定时间后，当偏置用晶体管220处于导通状态时，信号通过放大用晶体管218被输出到输出侧。在此情况下，放大用晶体管218和偏置用晶体管220用作所谓的源极跟随电路。

图14B示出了用n沟道型晶体管形成源极跟随电路的例子。但也可以用p沟道型晶体管来形成源极跟随电路。放大侧电源线222被施加电源电压Vdd。偏置侧电源线224被施加标准电位0伏。放大用晶体管218的漏端子连接到放大侧电源线，而源端子连接到偏置用晶体管220的漏端子。

偏置用晶体管220的源端子连接到偏置侧电源线224。偏置用晶体管220的栅端子被施加偏压Vb，且偏置电流Ib流过此晶体管。偏置用晶体管220基本上用作恒流源。放大用晶体管218的栅端子被施加输入电压Vin，且源端子用作输出端子。源极跟随电路的输入输出关系为 $V_{out}=V_{in}-V_b$ 。输出电压Vout被A/D转换部214转换成数字信号。数字

信号被输出到CPU122。

图15表示在传感器128中提供检测静电电容的元件的例子。用来检测静电电容的元件具有一对电极。在电极之间填充有进行检测的对象物如液体或气体等。通过检测一对电极之间的静电电容的变化，例如判断密封在容器中的内容物的状态。另外，也可以通过在一对电极之间插入聚酰亚胺、丙烯、其他吸湿性电介质来读取电阻的微小变化，以检测湿度变化。

下面，说明传感器驱动电路126的结构。脉冲发生器226产生测量标准信号，并将该信号输入到传感器128的电极。此时的电压也输入到电压检测电路228。电压检测电路228所检测出的标准信号被转换电路232转换成表示有效值的电压信号。由电流检测电路230检测流过传感器128的电极之间的电流。

电流检测电路230所检测出的信号被转换电路234转换成表示有效值的电流信号。计算电路238对作为转换电路232的输出的电压信号、以及作为转换电路234的输出的电流信号进行计算处理来计算出阻抗或导纳等的电参数。电压检测电路228的输出和电流检测电路230的输出输入到相位比较电路236。相位比较电路236将这些信号的相位差输出到计算电路240。计算电路240使用计算电路238和相位比较电路236的输出信号计算出静电电容。并且，将其信号输出到CPU122。

这些传感器及传感器驱动电路可以通过实施方式5或实施方式6的晶体管来实现。例如，使用实施方式5的晶体管，可以在玻璃等的绝缘衬底上形成传感器驱动电路126及传感器128。

#### 实施方式9

在本实施方式中，说明根据本发明的包括传感装置的容器类的一种形式。该容器类的目的在于在不开封的状态下测量其内容物的物理量。

图16A和16B表示在诸如PET瓶之类的由塑料或玻璃构成的主体242上设置有传感装置的一个结构例子。图16A表示主体242的外观，而图16B表示揭开主体242上的签条244的状态。

在主体242上提供有表示商品名、内容物及制造商等的签条244。在该签条244的表面或背面上设置有第一天线246和第二天线248。例如，如实施方式1所示，第一天线246和第二天线248可以电连接。在此情况下，第一天线246和第二天线248的一端直接连接，而另一端通过共振电容250连接。

也可以将形成在第一基体245上的第一天线246和第二天线248提供到签条244上。在此情况下，可以使用诸如塑料膜之类的柔性衬底来将第一基体245形成得很薄，因此其可以被提供到签条244上而不影响到其外观。另外，也可以将第一天线246和第二天线248直接形成在签条244上。形成有传感部的第二基体252设置在主体242的内侧。在该第二基体252上设置有与图1所示的电路部113相同的部分及蓄电部。

图17是沿图16A的J-K线截断的截面图。在主体242的外侧提供有签条244及第一基体245。在主体242的内侧提供有具有传感部253及第三天线249的第二基体252。第二天线248和第三天线249优选配置为能够实现电磁耦合。在此情况下，也可以在主体242的内侧固定第二基体252。

像这样，通过使形成有与外部装置进行通信的第一天线246的第一基体245与形成有传感部的第二基体252分离，并使它们以无线通信进行联系，可以获得密封容器的内容物的信息。在此情况下，可以使传感部小型化，因此不需要使容器大型化。另外，不需要在主体242上开孔以形成连结第一基体和第二基体的布线，因此是优选的。

图16A和16B及图17表示根据实施方式1所示的传感装置的结构容器类。根据本发明的容器类也可以根据实施方式2至实施方式4的传感装置的结构而构成。例如，也可以根据图4所示的结构而在贴到主体上的签条上设置第一天线及第二天线，除此以外还设置整流电路、CPU、调制电路、解调电路、存储部等的电路部及蓄电部，并在第二基体上设置第三天线和传感部等。另外，第一天线也可以是多频共用天线。在采用这种结构的情况下，也可以起到与实施方式1至实



施方式4相同的作用。

图18表示收纳在包装体241中的主体242。该主体242具有与图16A和16B相同的结构。通过使用进行控制信号收发的外部装置256，可以获得主体242的内容物的信息。当使外部装置256为具有避免串扰的功能的结构时，可以获得放在包装体241中的多个主体242的信息。由电脑254控制外部装置256。当电脑254能够与因特网等的网络连接时，可以对外部装置256进行遥控来获得包装体241中的信息。

这种方式例如可应用于商品流通。当将外部装置256设在运输车辆如卡车等的装货台并将主体242放在包装体241中来运输时，可以适用上述方式。通过使外部装置256工作，可以有效地把握作为被载货物的主体242的内容物的状态。另外，可以立即检查出被载货物的品质是否变化。在此情况下，由于提供到主体242的传感装置具有蓄电部，所以即使没有外部装置256的信号也可以测量出主体242的内容物的物理量。另外，也可以在保管包装体241的仓库中设置外部装置256来同样地使传感装置工作。除此以外，也可以使用便携式信息终端258代替外部装置256。

如上所述，作为根据本发明的包括传感装置的容器类，至少包括如下容器类。

一种容器类，其中在主体的外装部包括接收电磁波的天线，并在所述主体的内侧包括对因天线吸收电磁波而产生的感应电动势进行整流来存储其电力的蓄电部、接收来自蓄电部的电力供给而工作的中央计算处理部、以及将信号输入到中央计算处理部的传感部。

一种容器类，其中在主体的外装部包括接收电磁波的天线、对因天线吸收电磁波而产生的感应电动势进行整流来存储其电力的蓄电部、以及以来自蓄电部的电力供给而工作的中央计算处理部，并在所述主体的内侧包括接收来自蓄电部的电力供给而工作的传感部。

一种容器类，其中在主体的外装部具有第一基体，并在所述主体的内侧具有第二基体，该第一基体包括接收电磁波的第一天线及与该第一天线电连接的第二天线，而该第二基体包括与第二天线电磁耦合

的第三天线、对因该第三天线而产生的感应电动势进行整流来存储其电力的蓄电部、接收来自蓄电部的电力供给而工作的中央计算处理部、以及将信号输入到中央计算处理部的传感部。

一种容器类，其中在主体的外装部具有第一基体，并在所述主体的内侧具有第二基体，该第一基体包括接收电磁波的天线、对因天线吸收电磁波而产生的感应电动势进行整流来存储其电力的蓄电部、以及接收来自蓄电部的电力供给而工作的中央计算处理部，而该第二基体包括与第二天线电磁耦合的第三天线、以及以来自蓄电部的电力供给而工作的传感部。

根据本实施方式，通过将传感装置提供于容器类，可以把握商品的流通履历或内容物的状态。在此情况下，由于在传感装置具有蓄电部，所以即使没有进行信号收发的外部装置也可以使传感装置工作，以检测内容物的状态。此外，根据本发明的容器类不局限于图16A和16B所示的容器类，也可以应用于虽然其目的或用途不同但具有相同结构的容器类。

本说明书根据2006年9月8日在日本专利局受理的日本专利申请编号2006-243775而制作，所述申请内容包括在本说明书中。

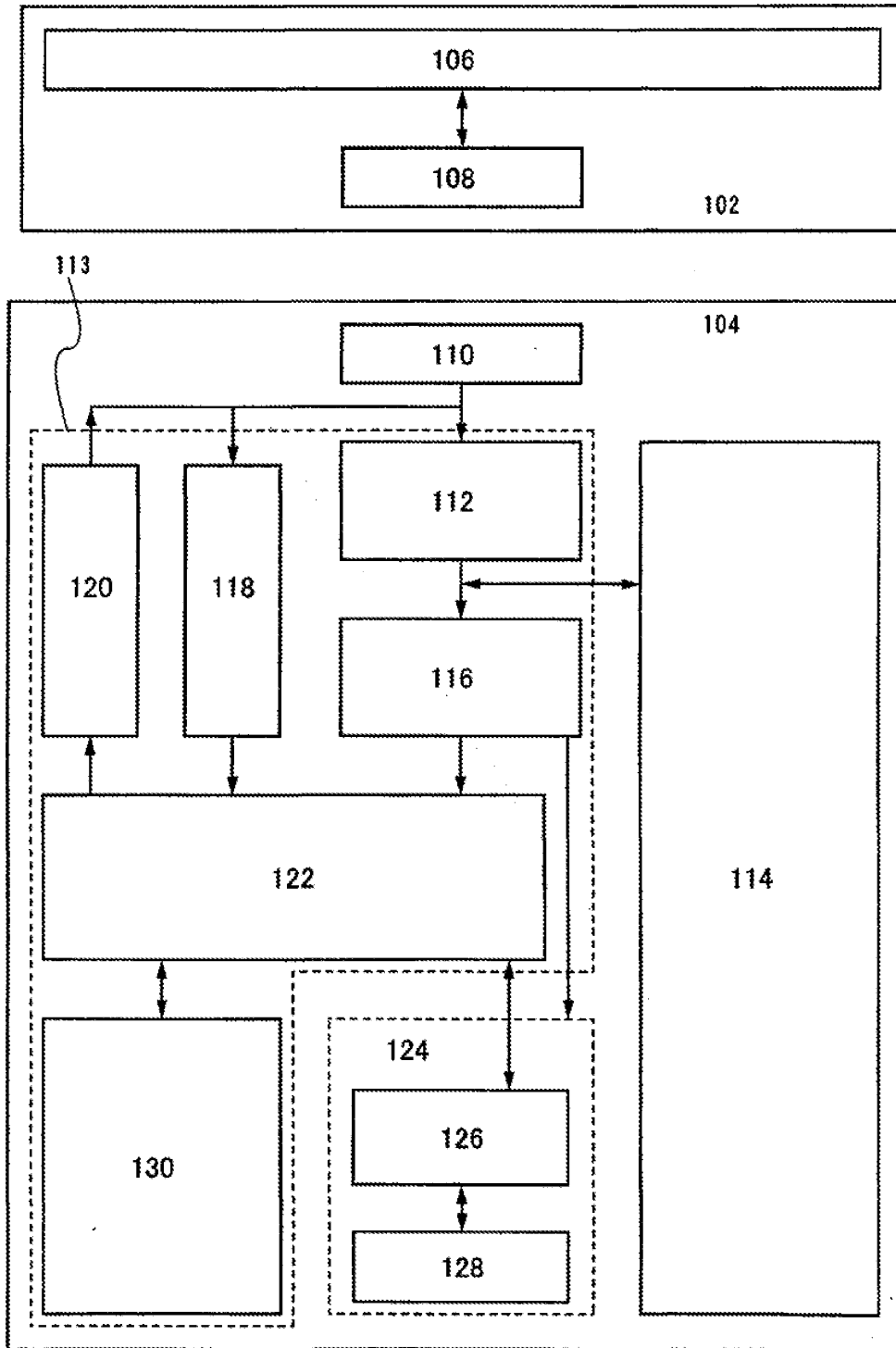


图 1

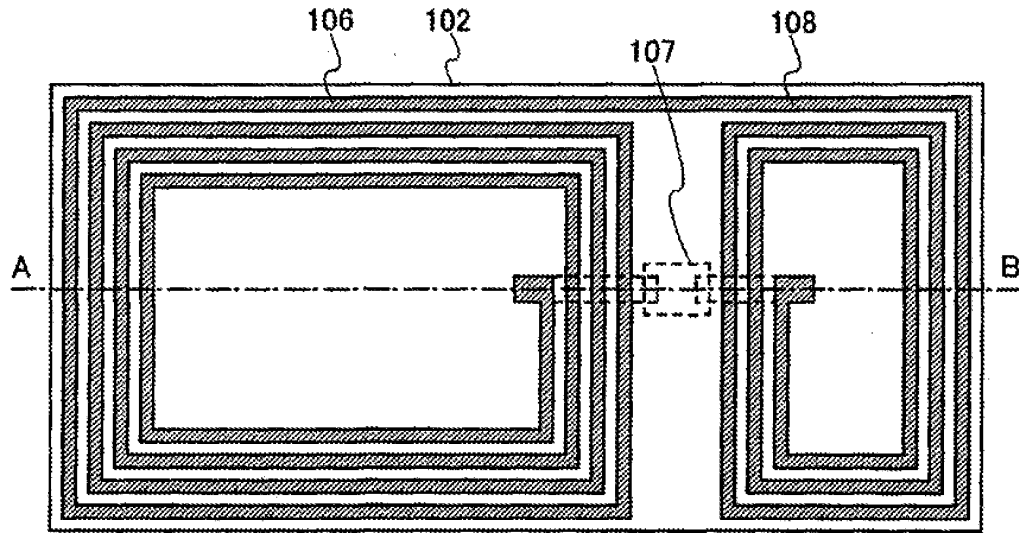


图 2A

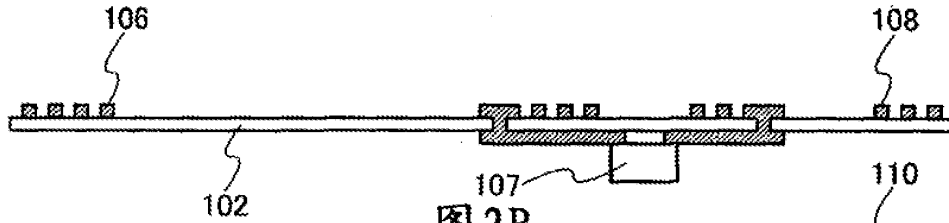


图 2B

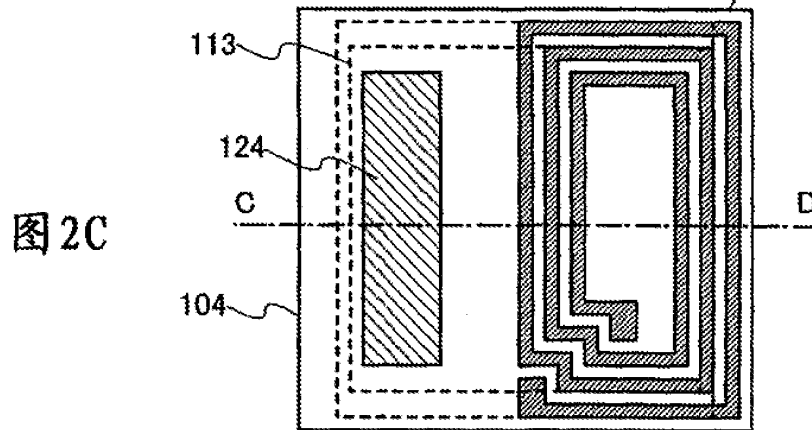


图 2C

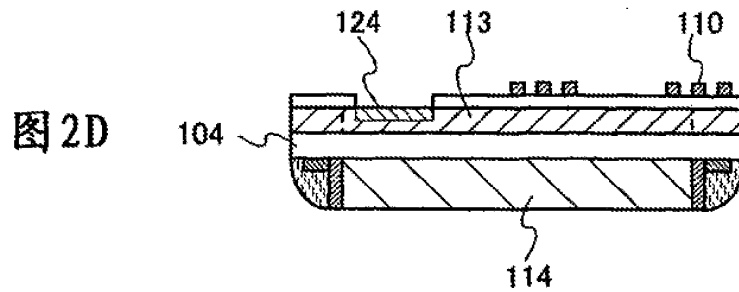


图 2D

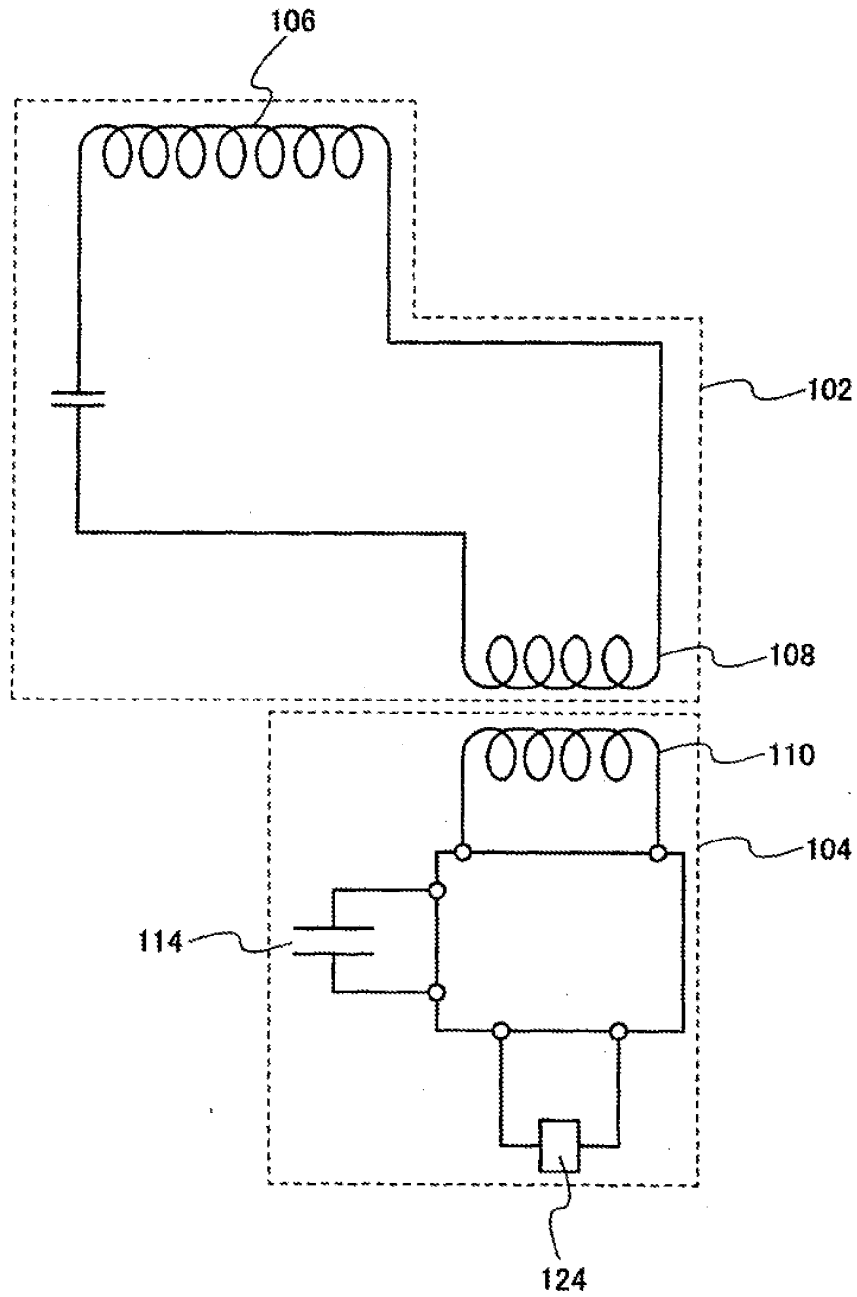


图 3

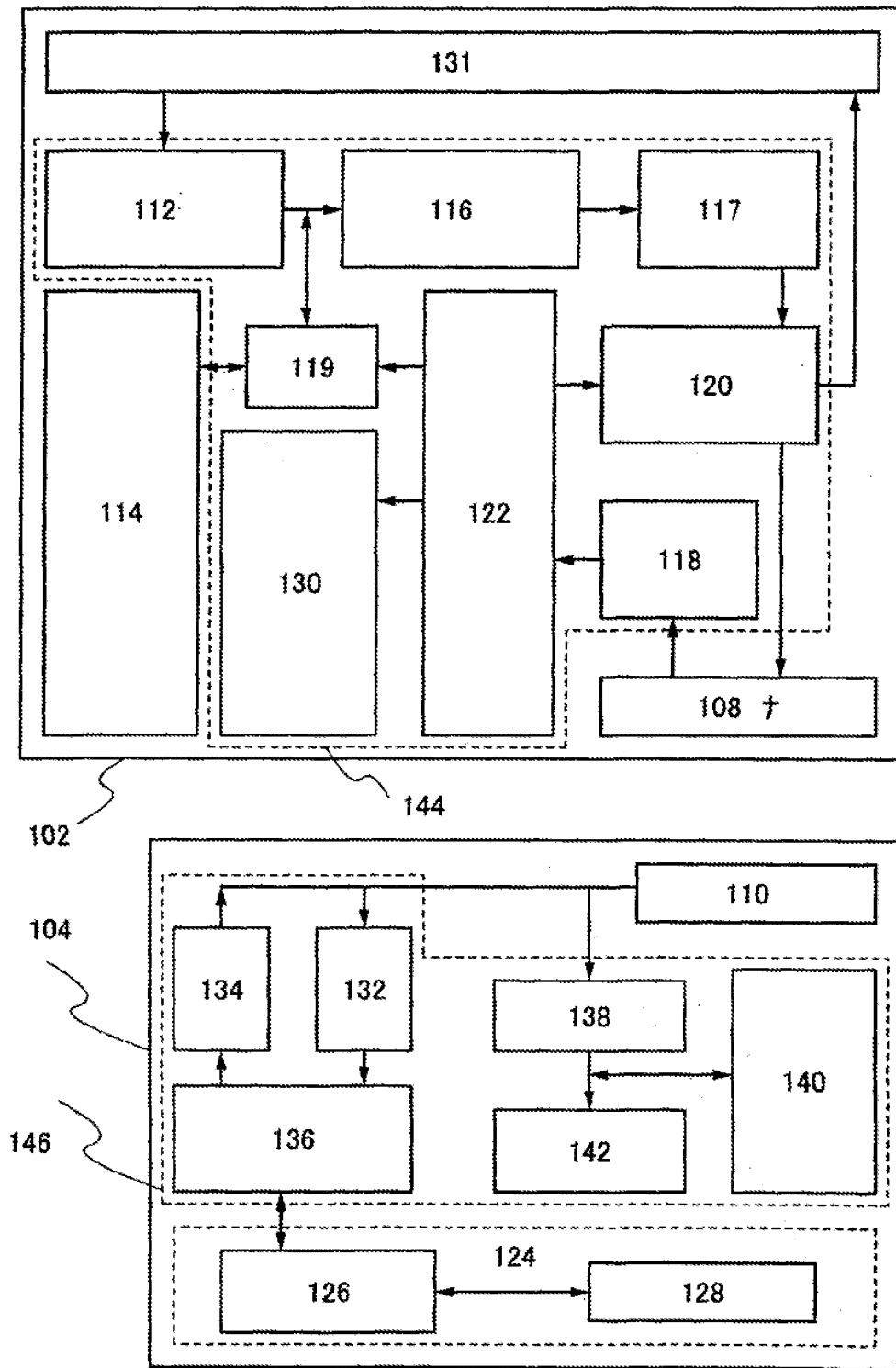


图4

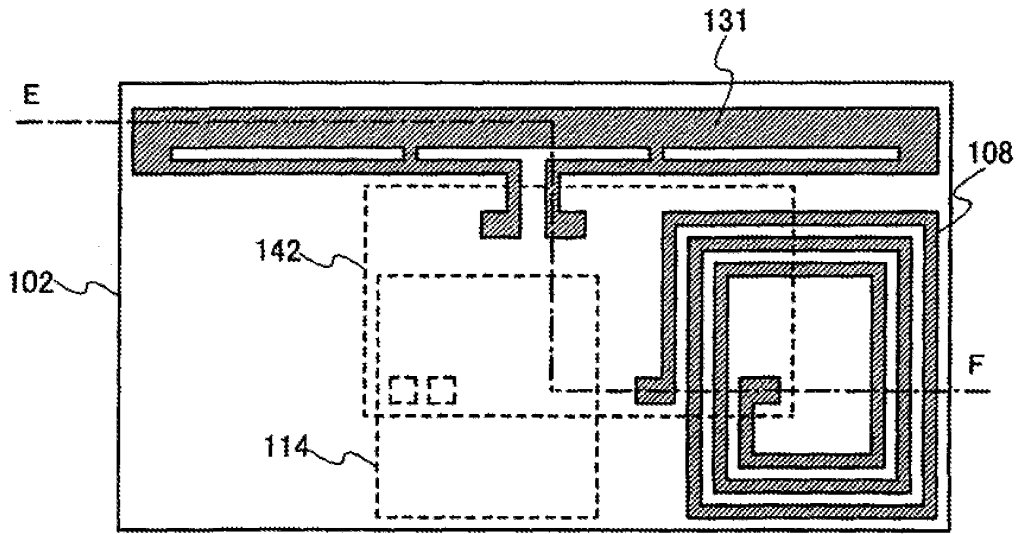


图 5A

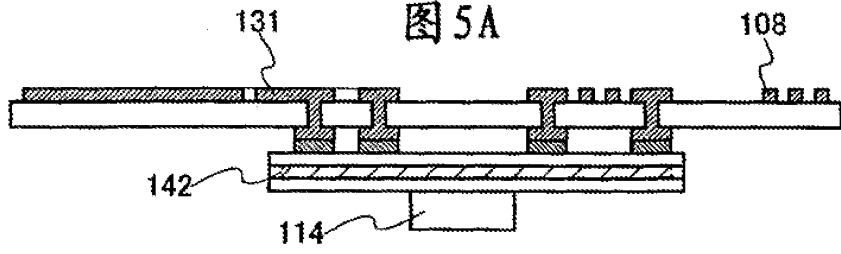


图 5B

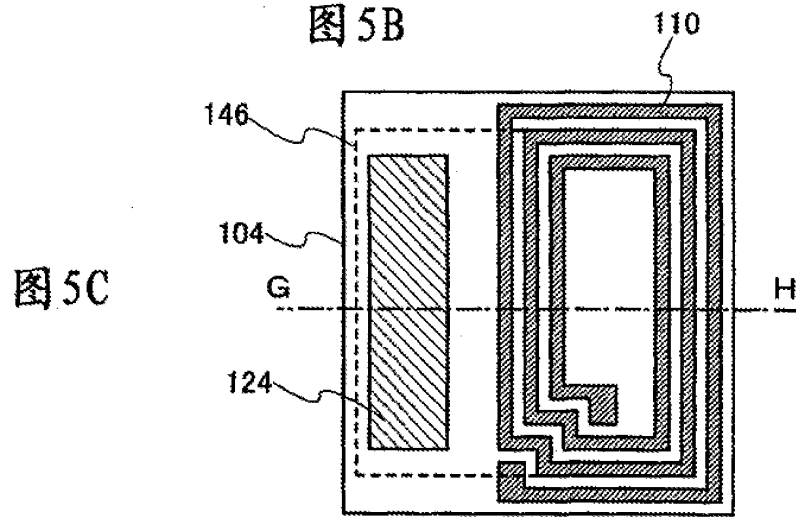


图 5C

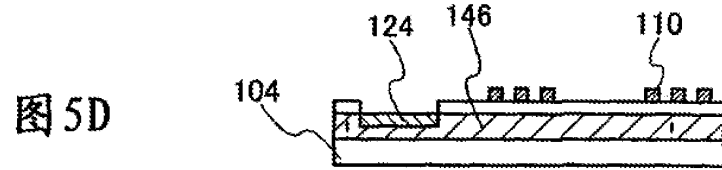


图 5D

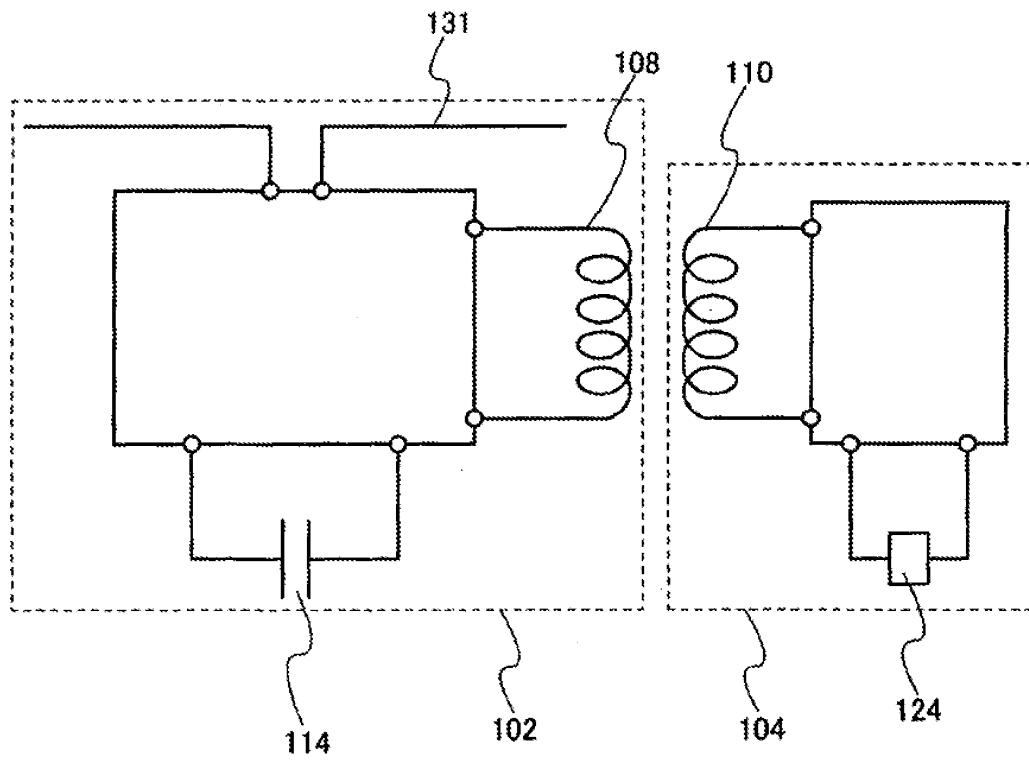


图6



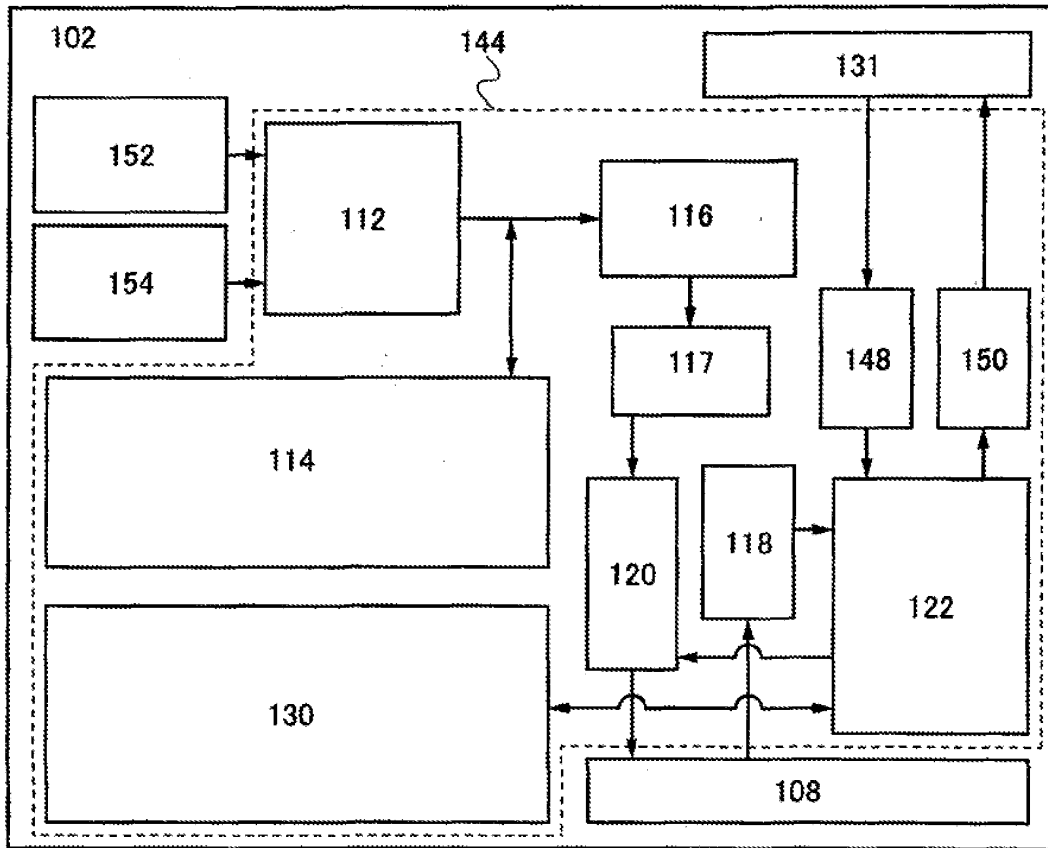


图7

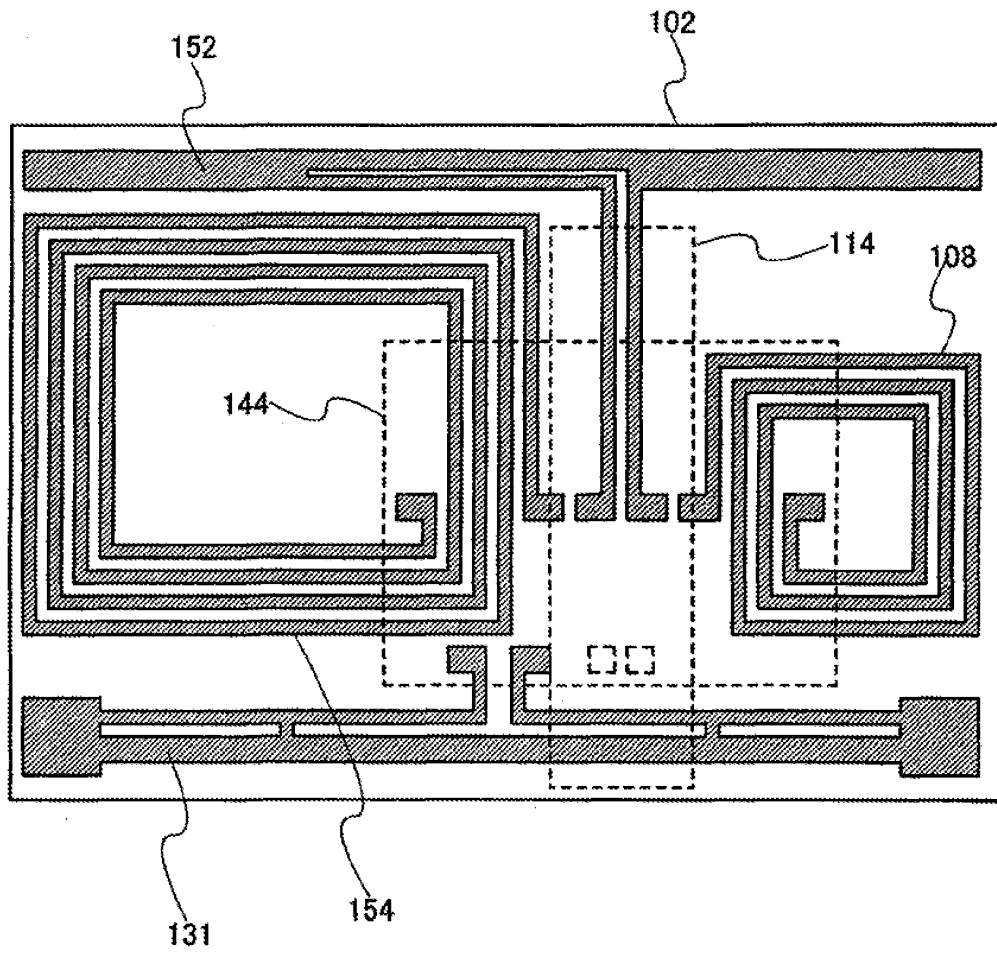


图 8

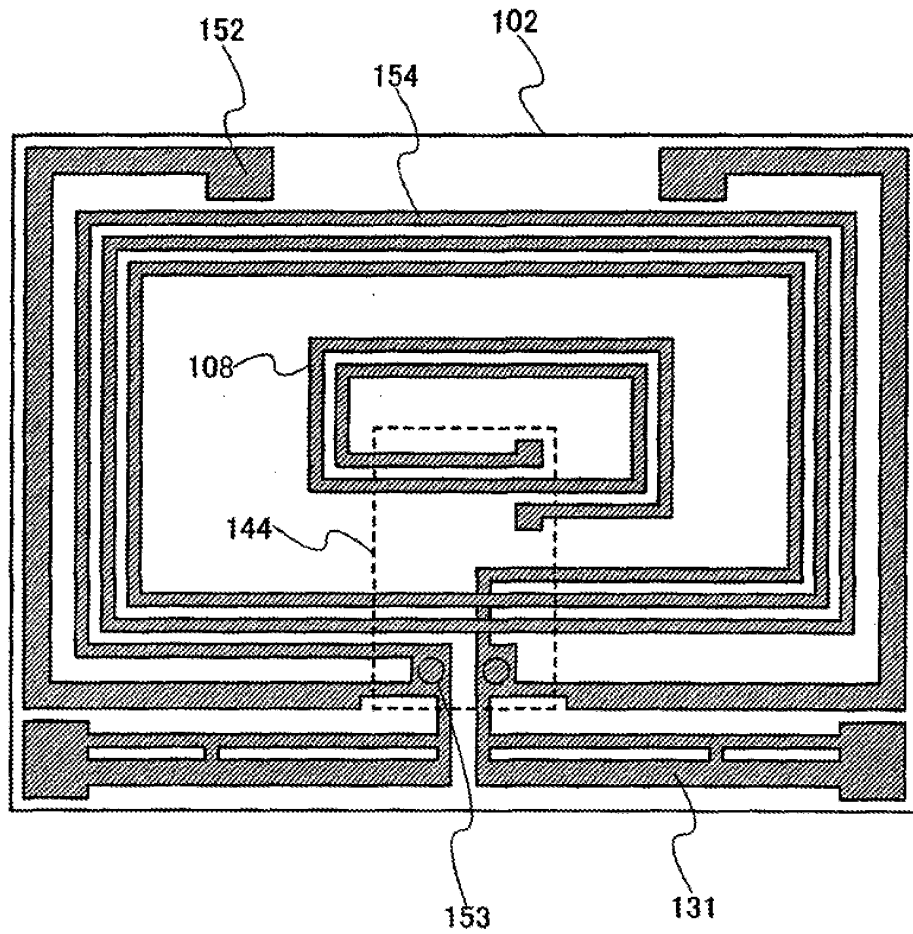


图9

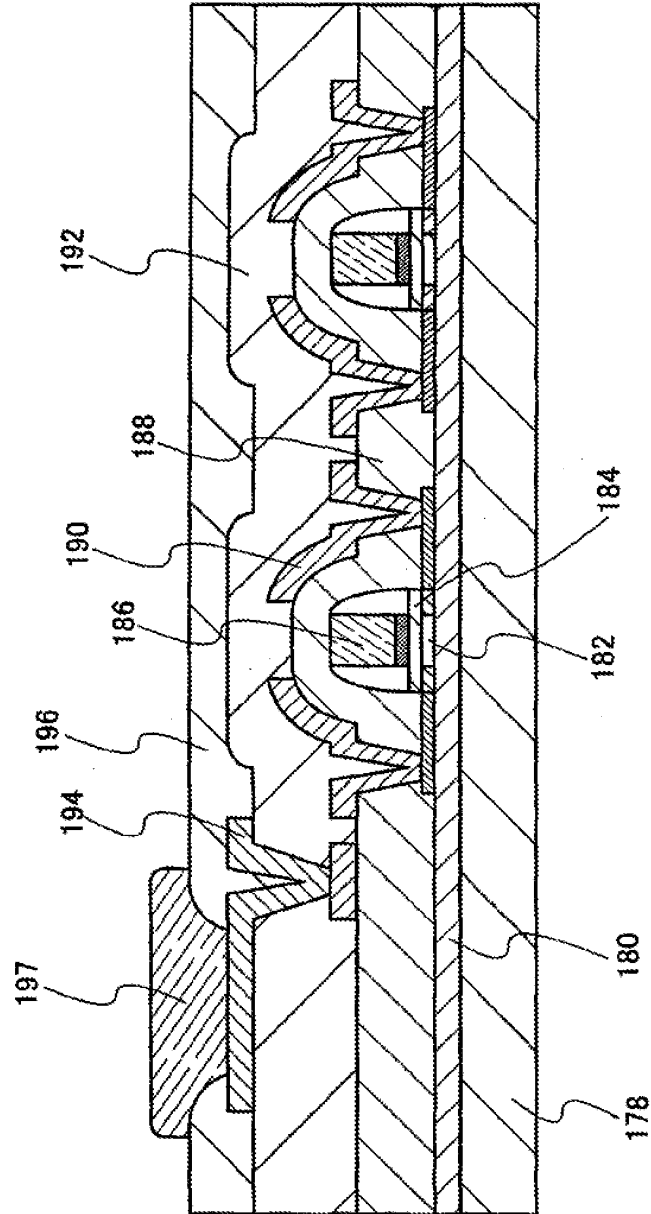


图 10

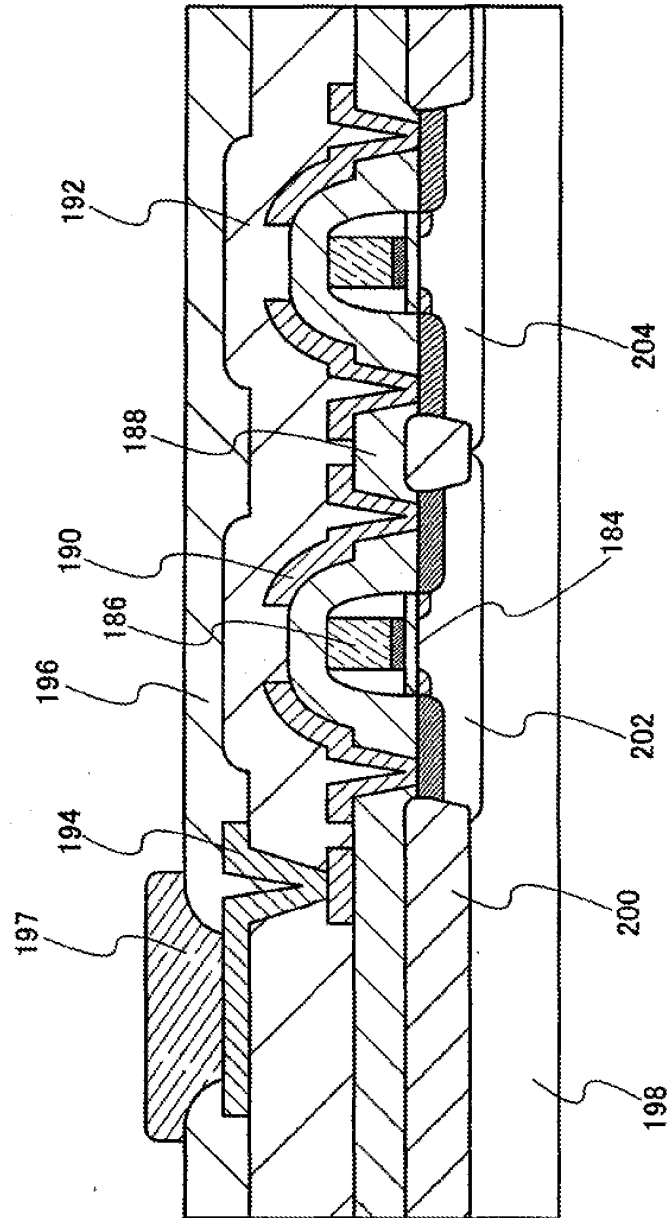


图11

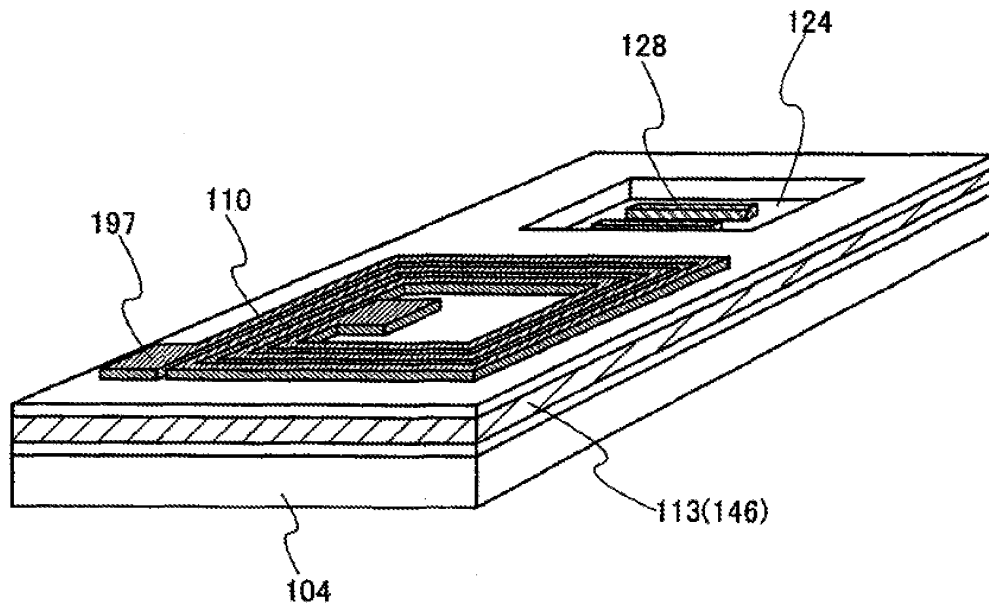


图12

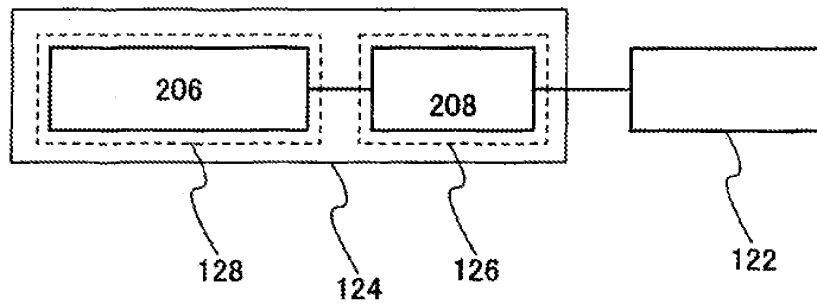


图13

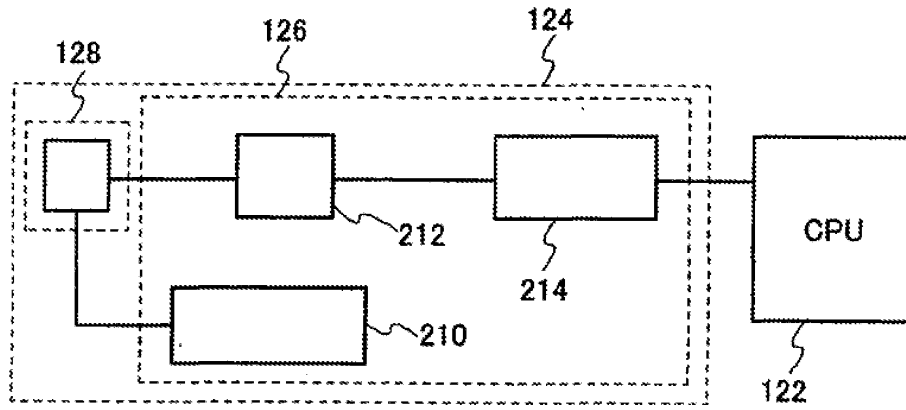


图 14A

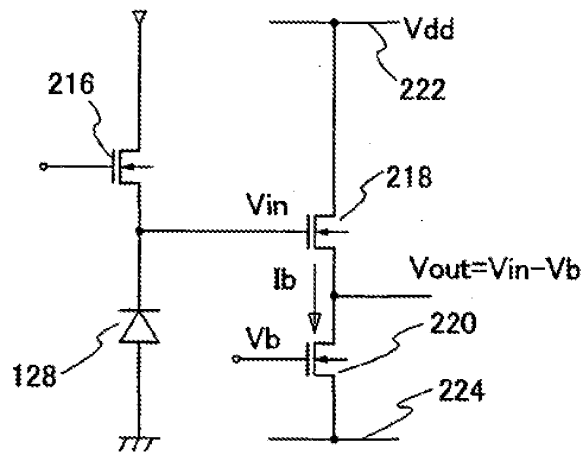


图 14B



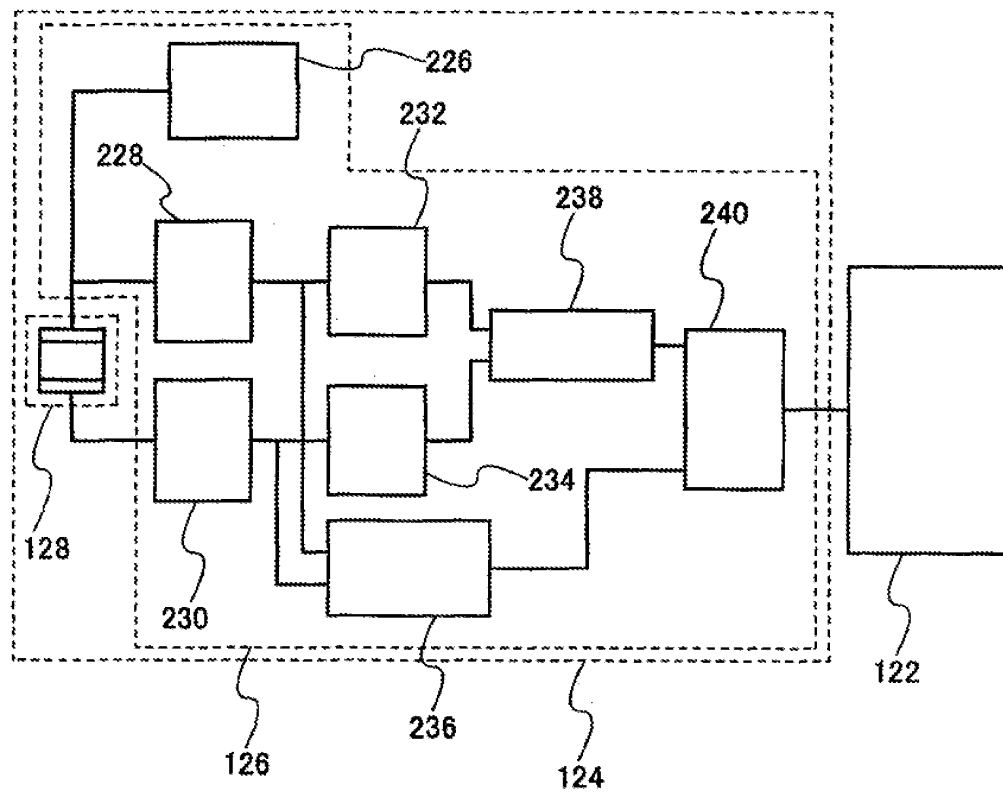


图15

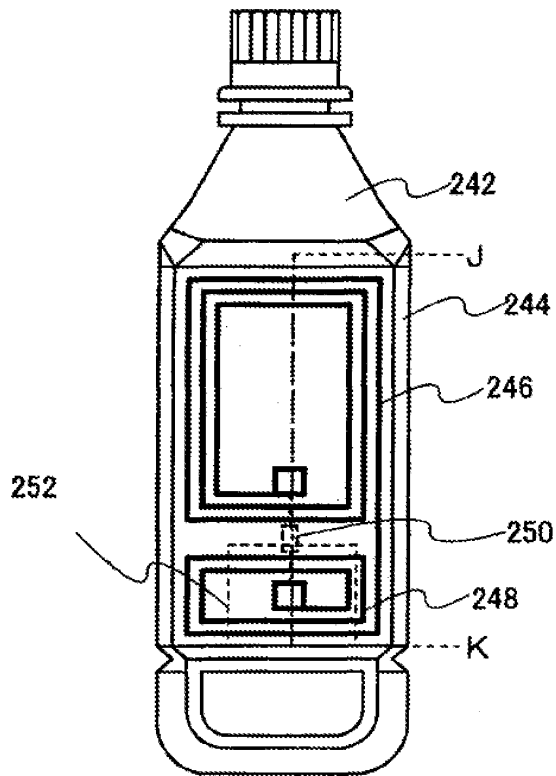


图 16A

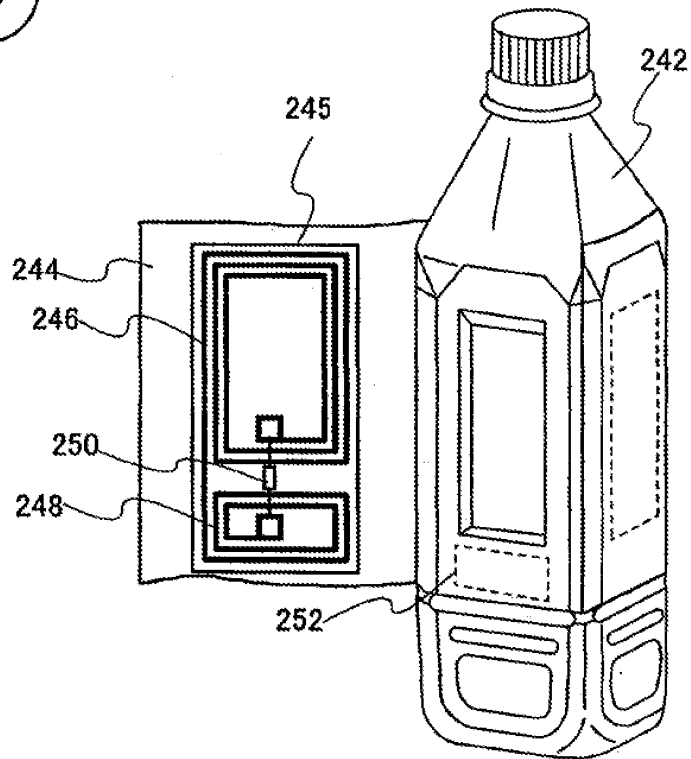


图 16B

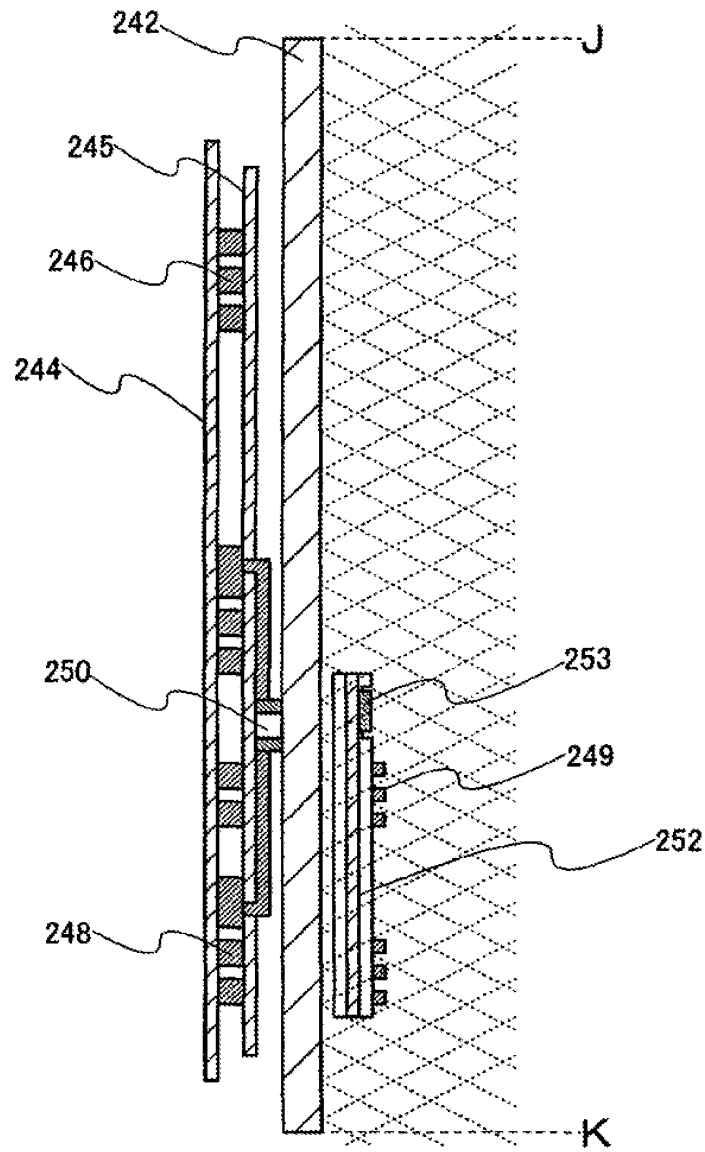


图17

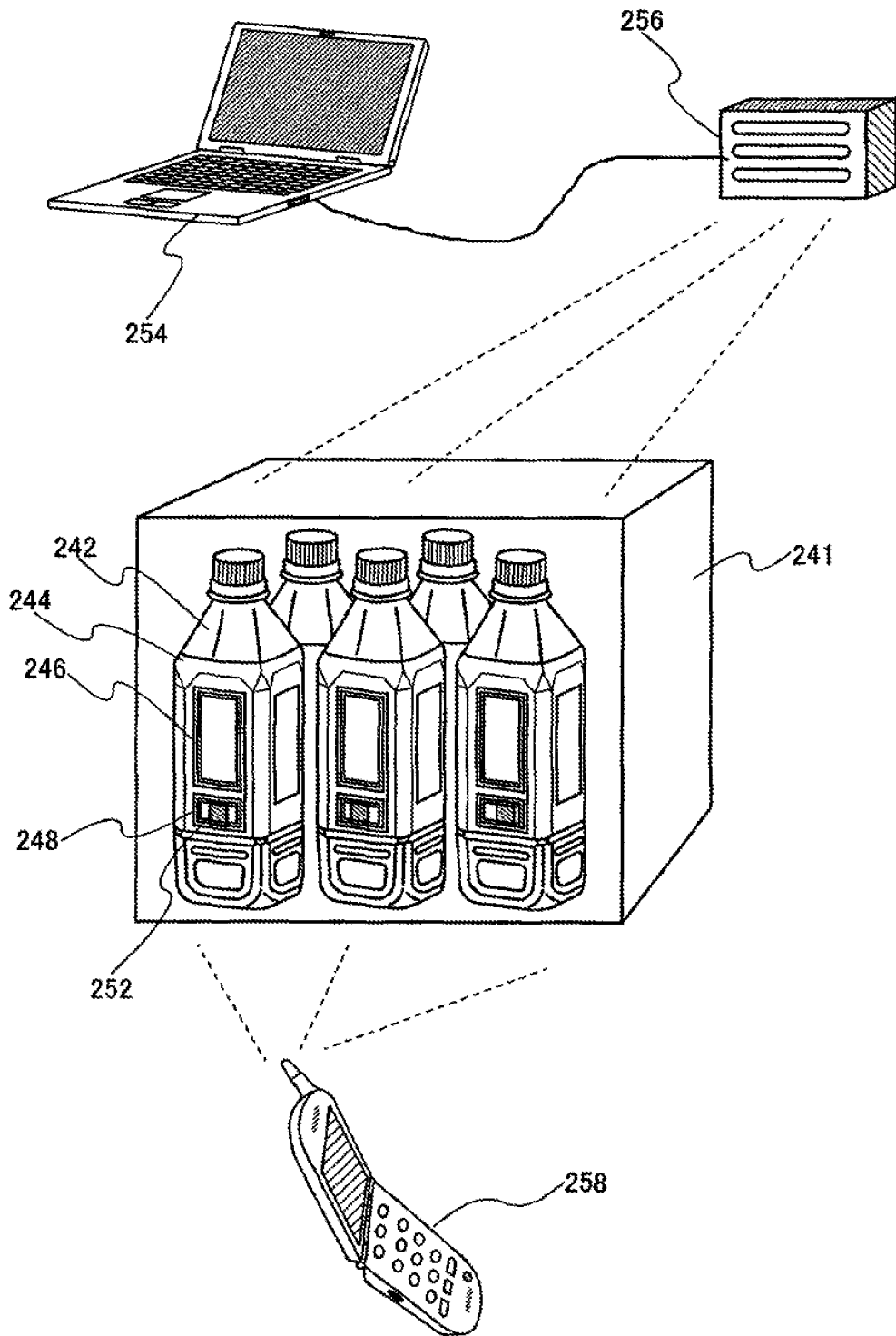


图 18



Espacenet

Bibliographic data: JP2004153463 (A) — 2004-05-27

---

MOBILE COMMUNICATION TERMINAL

**Inventor(s):** SHIMIZU KANJIRO ± (SHIMIZU KANJIRO)

**Applicant(s):** SONY ERICSSON MOBILE COMM JP ± (SONY ERICSSON MOBILECOMMUNICATIONS JAPAN INC)

**Classification:** - **international:** G06K17/00; H01Q1/24; H01Q1/38; H01Q1/52; H01Q17/00; H01Q7/00; H04M1/02;  
(IPC1-7): G06K17/00; H01Q1/24; H01Q1/38; H01Q1/52; H01Q17/00; H01Q7/00; H04M1/02; H04Q7/32

- **cooperative:**

**Application number:** JP20020314908 20021029

**Priority number(s):** JP20020314908 20021029

**Also published as:** JP3919100 (B2)

Abstract of JP2004153463 (A)

PROBLEM TO BE SOLVED: To provide a mobile communication terminal which makes a non-contact coil antenna improved in communication performance small in size and thin in thickness compatibly as a whole. ;SOLUTION: The mobile communication terminal 1 such as a mobile phone is provided with an upper case 3 having an electronic apparatus 10 in its inside, a flexible sheet base material 17 having the non-contact coil antenna is adhered onto an inner face (inner face 8a of a cover 8) of the upper case 3, and a soft magnetic radio wave absorbing sheet body 2 for covering the non-contact coil antenna is adhered onto the flexible base material 17. ;COPYRIGHT: (C)2004,JPO

(19) 日本国特許庁 (JP)

(12) 公開特許公報 (A)

(11) 特許出願公開番号

特開2004-153463

(P2004-153463A)

(43) 公開日 平成16年5月27日 (2004. 5. 27)

(5) Int. Cl. <sup>7</sup>	F 1	テーマコード (参考)
H01Q 7/00	H01Q 7/00	5B058
G06K 17/00	G06K 17/00	5J020
H01Q 1/24	H01Q 1/24	5J046
H01Q 1/38	H01Q 1/38	5J047
H01Q 1/52	H01Q 1/52	5K023

審査請求 未請求 請求項の数 2 O L (全 8 頁) 最終頁に続く

(21) 出願番号	特願2002-314908 (P2002-314908)	(71) 出願人	501431073 ソニー・エリクソン・モバイルコミュニケーションズ株式会社 東京都港区港南1丁目8番15号 Wビル 100117514
(22) 出願日	平成14年10月29日 (2002. 10. 29)	(74) 代理人	弁理士 佐々木 敦朗
		(72) 発明者	清水 實二郎 東京都港区港南1丁目8番15号 ソニー・エリクソン・モバイルコミュニケーションズ株式会社内
		F ターム (参考)	5B058 CA17 KA40 YA20 5J020 EA02 EA06 EA09 5J046 AA02 AB11 PA07 PA09 5J047 AA02 AB11 FC06 5K023 AA07 BB03 LL05 5K067 AA24 BB04 EE02 KK01 KK17

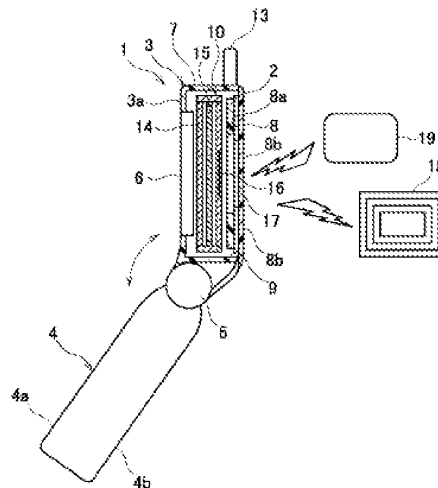
(64) 【発明の名称】 携帯通信端末

(57) 【要約】

【課題】 非接触型コイルアンテナの通信性能の向上と全体の小型化・薄型化とを両立して図ることが可能な携帯通信端末を提供する。

【解決手段】 携帯電話機などの携帯通信端末1は、電子機器10をその内部に有する上筐体3を備え、この上筐体3の内面(カバー8の内面8a)上に、非接触型コイルアンテナを有するシート状のフレキシブル基材17を貼着し、そのフレキシブル基材17上に非接触型コイルアンテナを覆うシート状の軟磁性体電波吸収体2を貼着する。

【選択図】 図1



## 【特許請求の範囲】

## 【請求項1】

電子機器を有する筐体と、  
非接触型コイルアンテナを有し、前記筐体の内面上に配置されるシート状のフレキシブル  
基材と、  
前記フレキシブル基材上に固定されて前記非接触型コイルアンテナを覆うシート状の軟磁  
性体電波吸収体と、  
を備えたことを特徴とする携帯通信端末。

## 【請求項2】

請求項1記載の携帯通信端末であって、  
前記筐体は、開口を有し前記電子機器が装着される内部空間を区画する本体と、前記本体  
に装着されて開口を塞ぐカバーと、を備え、  
前記フレキシブル基材は、前記カバーの内面上に固定されることを特徴とする携帯通信端  
末。

10

## 【発明の詳細な説明】

## 【0001】

## 【発明の属する技術分野】

本発明は、非接触型コイルアンテナを備えた携帯通信端末に関する。

## 【0002】

## 【従来の技術】

従来の非接触型ICカード読取／書込装置では、基板上にループ・アンテナが設けられた  
アンテナと、アンテナを制御する制御部材を搭載した制御基板との間に、電磁波吸収体を  
配置して、金属による電波の反射を図っている（例えば、特許文献1参照）。

20

## 【0003】

## 【特許文献1】

特開2002-63552号公報

## 【0004】

## 【発明が解決しようとする課題】

ところで、近年では、非接触型ICカードが様々なところで活用されている。例えば、定  
期券や、一部のコンビニエンスストアなどの店舗で使用可能なキャッシュレスカードなど  
でも採用されており、非接触という利便性が一般に広く認識されつつある。一方、携帯電  
話機などの携帯通信端末では、その機能の多様化が求められており、その一つとして、非  
接触型ICカード機能やICカードへのリーダライタ（R/W）機能がある。また、携帯  
通信端末には、その小型化や薄型化も要求されており、機能拡張による部品の増加を最小  
限に抑える必要がある。

30

## 【0005】

ICカード機能やR/W機能を搭載するには、専用のアンテナを設置する必要があり、携  
帯通信端末内の限られた空間にアンテナを配置するためのスペースを確保しなければなら  
ない。ところが、アンテナを、基板や金属部品やシールドケースなどに近接して配置した  
場合、アンテナの通信性能の劣化を招く恐れがある。例えば、R/W機能時には、アンテ  
ナから発生する磁界が携帯通信端末内の金属体で渦電流として発生してしまい、放射効率  
が悪化し、結果的に外部のICカードへの給電が困難となる。またICカード機能時には  
、外部のR/W装置から発生される磁界が誘電性のあるシールドケースなどで渦電流に変  
換されてしまい、ロスが生じてしまう。

40

## 【0006】

この点に関し、上記特許文献1は、携帯通信端末に比して大型である読取／書込装置であ  
り、アンテナと電磁波吸収体と制御基板とをスペーサを介して離間して配置するものであ  
る。すなわち、アンテナ及び電磁波吸収体には、離間配置に耐えうるだけの剛性を有する  
板体状であることが必要とされる。従って、上記特許文献1に記載の技術を携帯通信端末  
に適用すると、全体の大型化や厚肉化を招いてしまう。

50

## 【0007】

本発明は、このような実情に鑑みてなされたものであり、非接触型コイルアンテナの通信性能の向上と全体の小型化・薄型化とを両立して図ることが可能な携帯通信端末の提供を目的とする。

## 【0008】

## 【課題を解決するための手段】

本発明に係る携帯通信端末は、電子機器を有する筐体と、非接触型コイルアンテナを有し筐体の内面上に配置されるシート状のフレキシブル基材と、フレキシブル基材上に固定されて非接触型コイルアンテナを覆うシート状の軟磁性体電波吸収体と、を備えている。非接触型コイルアンテナは、携帯通信端末をいわゆるICカードと同等に機能させるためのICインターフェイス用であっても良く、外部のICカードに対する読取／書き装置として機能させるためのリーダーライター用であっても良い。

10

## 【0009】

上記構成では、電子部品を構成するシールドケースや金属部品や金属体や基板と非接触型コイルアンテナとの電磁結合を軟磁性体電波吸収体によって確実に防止することができる。従って、外部又は内部のコイルアンテナから放出される磁界が金属体やシールドケースで渦電流に変換されることが防止され、通信性能が向上する。また、軟磁性体電波吸収体の中波帯での特性上（高磁性率、低損失）、磁束が増加し、通信距離が増える。

## 【0010】

また、非接触型コイルアンテナを有するシート状のフレキシブル基材を筐体の内面上に配置し、そのフレキシブル基材上にシート状の軟磁性体電波吸収体を固定する構造であるため、筐体の内面からの突出量を極めて小さく抑えることができる。従って、携帯通信端末の小型化・薄型化を損なうことなく、非接触型コイルアンテナの通信性能の向上を図ることができる。

20

## 【0011】

筐体は、開口を有し電子機器が装着される内部空間を区画する本体と、本体に装着されて開口を塞ぐカバーと、を備えても良く、フレキシブル基材は、カバーの内面上に固定されても良い。

## 【0012】

上記構成では、カバーを開いた状態で電子機器及びフレキシブル基材が露出するので、製造時やメンテナンス時の作業性が向上する。

30

## 【0013】

## 【発明の実施の形態】

以下、本発明の実施形態について、図面を参照しながら詳細に説明する。

## 【0014】

図1は本発明が適用される折り畳み式の携帯端末装置としての携帯電話機（以下、端末と略称する）1を模式的に示す側断面図、図2は図1の端末1を開いた状態を示す平面図、図3は図2の端末1から軟磁性電波吸収体2を取り除いた状態を示す平面図、図4は図3の要部拡大図である。

40

## 【0015】

図1～図3に示すように、端末1は、上筐体3と下筐体4とヒンジ5とを有する。ヒンジ5は、上筐体3及び下筐体4の内面3a、4a同士が相対向する閉状態から、これら内面3a、4aが共に開放される開状態へ変更自在に、上筐体3の一端と下筐体4の一端とを連結している。端末1は、両筐体3、4を開いた開状態で使用され、上筐体3の内面3aには液晶ディスプレイ6が、下筐体4の内面4aには所定の入力キー（図示外）がそれぞれ配置されている。

## 【0016】

上筐体3は、本体7とカバー8とを有する。本体7は、上筐体3の外表面3bに配置された開口9を有する。カバー8は、本体7に装着されて開口9を塞ぎ、カバー8の外表面8bは、上筐体3の外表面3bの一部を構成する。本体7に区画される上筐体3の内部空間には、

50



様々な電子機器10が装着されている。また、上筐体3には、電話機としての通信を行うホイップアンテナ13が設けられている。

【0017】

電子機器10は、シールドケース14と主基板15と補基板16とを有する。主基板15及び補基板16には、所定の回路が形成される共に、所定の電子部品が固定される。主基板15及び補基板16の回路及び電子部品は、後述する非接触型コイルアンテナ11、12のために機能すると共に、端末1の本来的な目的（電話機機能）のための機能する。主基板15は、シールドケース14に覆われ、補基板16は、シールドケース14の外面上に開口9と対向して配置される。主基板15と補基板16とは、電気的に接続されている。

10

【0018】

図2に示すように、絶縁性樹脂からなるシート状のフレキシブル基材17は、環状部分17aと、環状部分17aから補基板16の近傍まで延びる連結部分17bとを有し、環状部分17aはカバー8の内面8a上に貼着により固定されている。

【0019】

フレキシブル基材17上には、端末1をいわゆるICカードと同等に機能させる際に外部リーダライタ18との間で通信を行うICインターフェイス用非接触型コイルアンテナ11（以下、ICカード用アンテナと称する）と、端末1を外部のICカード19に対するリーダライタとして機能させる際に外部のICカード19との間で通信を行うリーダライタ用非接触型コイルアンテナ（以下、R/W用アンテナと称する）12とが固定されている。ICカード用アンテナ11及びR/W用アンテナ12の中間部分は、共にフレキシブル基材17の環状部分17aに沿ってループパターンを形成し（図4に示す）、その両端は連結部分17bを通して補基板16に接続されている。環状部分17aでは、ICカード用アンテナ11の内側にR/W用アンテナ12が配置されている。

20

【0020】

フレキシブル基材17の外面上には、ICカード用アンテナ11及びR/W用アンテナ12を覆うシート状の軟磁性体電波吸収体2が貼着により固定されている。軟磁性体電波吸収体2としては、例えば株式会社トーキン製のバスタレイド（商品名）が使用される。

【0021】

端末1は、いわゆるICカードと同等に機能するICカードモードと、外部のICカード19に対するリーダライタとして機能するR/Wモードとに設定可能に構成されている。ICカードモードとR/Wモードとは、使用者からの入力キーの操作により適宜設定可能に構成しても良く、端末1に外部R/W18を近づけたときにはICカードモードに自動的に設定されるように構成しても良い。

30

【0022】

ICカードモードでは、ICカード用アンテナ11と外部R/W18との間で通信が行われ、補基板16のICチップに対する電力供給と情報の読取/書込とが行われる。なお、通信によってICチップに対する情報の読取/書込のみを行い、電力は端末1からICチップへ供給するように構成しても良い。

【0023】

R/Wモードでは、R/W用アンテナ12と外部のICカード19との間で通信が行われ、ICカード19内のICチップに対する電力供給と情報の読取/書込とが行われる。

40

【0024】

本実施形態によれば、ICカード用アンテナ11及びR/W用アンテナ12が軟磁性体電波吸収体2によって完全に覆われているので、電子機器10を構成するシールドケース14や主基板15や補基板16や金属部品や金属体などとICカード用アンテナ11及びR/W用アンテナ12との電磁結合を確実に防止することができる。従って、外部R/W18やR/W用アンテナ12から放出される磁界が金属体やシールドケース14で渦電流に変換されることが防止され、通信性能が向上する。また、通信周波数帯域において、高磁性率、低損失といった軟磁性体電波吸収体2の性質上、磁束の増加が見込め、通信性能が

50

向上する。

【0025】

図5は、軟磁性体電波吸収体2の有無以外の諸条件を同一として通信性能試験を行った結果を示す表であり、軟磁性体電波吸収体2によって通信性能が向上していることが分かる。

【0026】

具体的には、ICカードモードにおいて、端末1と強電界を形成するリーダライタ(R/W)との間で通信試験(ICへの電源供給あり)を行った場合、軟磁性体電波吸収体2を有するときの最大通信距離が101mmであるのに対し、軟磁性体電波吸収体2を有さないときの最大通信距離は97mmであった。同様に、ICカードモードにおいて、端末1と強電界を形成するリーダライタ(R/W)との間で通信試験(ICへの電源供給なし)を行った場合、軟磁性体電波吸収体2を有するときの最大通信距離が44mmであるのに対し、軟磁性体電波吸収体2を有さないときの最大通信距離は36mmであった。ICカードモードにおいて、端末1と弱電界を形成するリーダライタ(R/W)との間で通信試験を行った場合、軟磁性体電波吸収体2を有するときの最大通信距離が20mmであるのに対し、軟磁性体電波吸収体2を有さないときの最大通信距離は14mmであった。R/Wモードにおいて、端末1と共振周波数の小さいカードAとの間で通信試験を行った場合、軟磁性体電波吸収体2を有するときの最大通信距離が20mmであるのに対し、軟磁性体電波吸収体2を有さないときは通信不能であった。R/Wモードにおいて、端末1と共振周波数の大きいカードBとの間で通信試験を行った場合、軟磁性体電波吸収体2を有するときの最大通信距離が2mmであるのに対し、軟磁性体電波吸収体2を有さないときは通信不能であった。このように、軟磁性体電波吸収体2を有する方が有さないものに比して最大通信距離が増大している、すなわち通信性能が向上していることが分かる。

【0027】

また、ICカード用アンテナ11のループパターン間の結合が軟磁性体電波吸収体2によって確実に阻止されるので、コイルアンテナとしての機能が効率良く働く。このため、ICカードモードにおいて、外部R/W18のコイルアンテナとのトランス効果が最大限に得られ、この点においても通信性能が向上する。

【0028】

そして、ICカード用アンテナ11及びR/W用アンテナ12を有するシート状のフレキシブル基材17をカバー8の内面8a上に貼着すると共に、フレキシブル基材17上にシート状の軟磁性体電波吸収体2を貼着しているため、フレキシブル基材17及び軟磁性体電波吸収体2の内面8aからの突出量を極めて小さく抑えることができる。また、軟磁性体電波吸収体2を保持する手段を別個に設ける必要がない。従って、端末1の小型化・薄型化を損なうことなく、ICカード用アンテナ11及びR/W用アンテナ12の通信性能の向上を図ることができる。

【0029】

さらに、カバー8を開いた状態で電子機器10及びフレキシブル基材17が露出するので、製造時やメンテナンス時の作業性が向上する。

【0030】

本発明は、一例として説明した上述の実施形態に限定されることはない。例えば、上記実施形態では、折り畳み式携帯電話機を例に挙げて説明したが、いわゆるスティック型の携帯電話機や音声通信機能を持つPDA(Personal Digital Assistant)などの携帯通信端末に本発明を適用しても同様の作用効果を得ることができる。すなわち、上述の実施形態以外であっても、本発明に係る技術的思想を逸脱しない範囲であれば、設計等に応じて種々の変更が可能である。

【0031】

【発明の効果】

本発明によれば、携帯通信端末の小型化・薄型化を損なうことなく、非接触型コイルアンテナの通信性能の向上を図ることができる。

## 【図面の簡単な説明】

【図 1】本発明が適用される折り畳み式の携帯端末装置としての携帯電話機（以下、端末と略称する）1 を模式的に示す側断面図である。

【図 2】図 1 の端末 1 を開いた状態を示す平面図である。

【図 3】図 2 の端末 1 から軟磁性電波吸収体 2 を取り除いた状態を示す平面図である。

【図 4】図 3 の要部拡大図である。

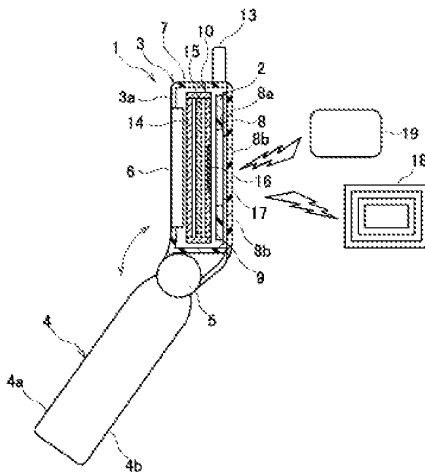
【図 5】通信性能試験の結果を示す表である。

## 【符号の説明】

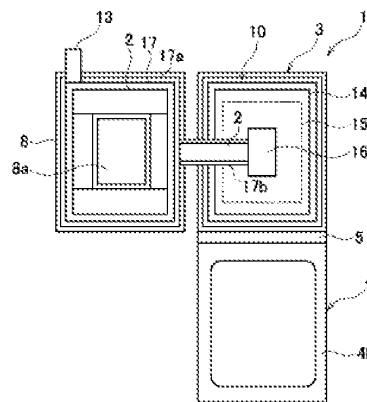
- 1 … 携帯電話機（携帯通信端末）
- 2 … 軟磁性体電波吸収体
- 3 … 上筐体
- 4 … 下筐体
- 7 … 本体
- 8 … カバー
- 9 … 開口
- 10 … 電子機器
- 11 … ICカード用アンテナ（非接触型コイルアンテナ）
- 12 … R/W用アンテナ（非接触型コイルアンテナ）
- 17 … フレキシブル基材

10

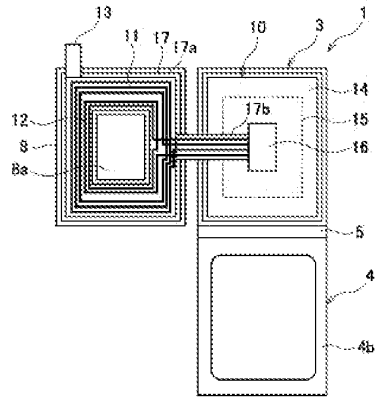
【図 1】



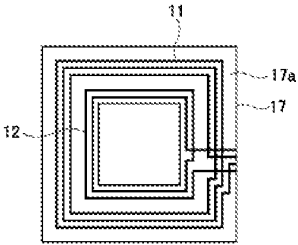
【図 2】



【図3】



【図4】



【図5】

誘導層下の機能	誘導対象	誘導距離(Max)(mm)	
		電磁波吸収シートあり	電磁波吸収シートなし
ICカード	誘電率R/W	10(*44)	5(*38)
ICカード	誘電率R/W	20	14
R/W	カーFA(10)	20	×
R/W	カーFB(10)	2	×

\*ICへの電源供給なし

---

フロントページの続き

(51)Int.Cl. <sup>7</sup>	F I	テーマコード (参考)
H 0 1 Q 17/00	H 0 1 Q 17/00	5 K 0 6 7
H 0 4 M 1/02	H 0 4 M 1/02	C
H 0 4 Q 7/32	H 0 4 B 7/26	V



Espacenet

**Bibliographic data: JPH11175676 (A) — 1999-07-02**

---

**NON-CONTACT IC CARD**

**Inventor(s):** FUKAO RYUZO ± (FUKAO RYUZO)

**Applicant(s):** HITACHI MAXELL ± (HITACHI MAXELL LTD)

**Classification:** - **international:** B42D15/10; G06K19/07; G06K19/077; H05K1/18;  
(IPC1-7): B42D15/10; G06K19/07; G06K19/077;  
H05K1/18

- **cooperative:**

**Application number:** JP19970343177 19971212

**Priority number (s):** JP19970343177 19971212

**Abstract of JPH11175676 (A)**

**PROBLEM TO BE SOLVED:** To provide a non-contact IC card low in cost and excellent in mass- productivity and versatility. **SOLUTION:** This non-contact IC card is constituted by using a circuit board 3 in which an antenna coil 2 is formed only on one surface of an insulating substrate. A land part 3a to draw the other end of the antenna coil 2 is formed on a part arranged closely to an inner peripheral end or an outer peripheral end of the antenna coil 2. An IC chip 1 is connected to the inner peripheral end or the outer peripheral end of the antenna coil placed closely to each other and the land part 3a. In addition, the other end of the antenna coil is connected to the land part 3a with a bridge member 10.

(19)日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11)特許出願公開番号

特開平11-175676

(43)公開日 平成11年(1999)7月2日

(51)Int.Cl. <sup>4</sup>	識別記号	F I	
G 0 6 K 19/07		G 0 6 K 19/00	H
B 4 2 D 15/10	5 2 1	B 4 2 D 15/10	5 2 1
G 0 6 K 19/077		H 0 5 K 1/18	J
H 0 5 K 1/18		G 0 6 K 19/00	K

審査請求 未請求 請求項の数2 O L (全 5 頁)

(21)出願番号	特願平9-343177
(22)出願日	平成9年(1997)12月12日

(71)出願人 000005810  
日立マクセル株式会社  
大阪府茨木市丑寅1丁目1番88号

(72)発明者 深尾 隆三  
大阪府茨木市丑寅1丁目1番88号 日立マクセル株式会社内

(74)代理人 弁理士 武 顕次郎

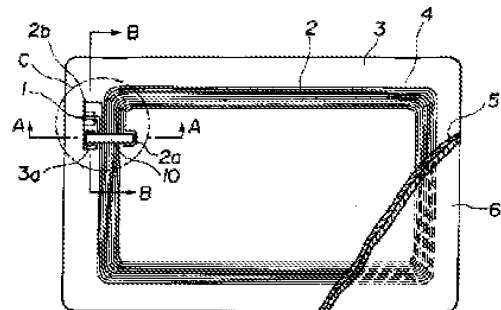
(54)【発明の名称】 非接触式ICカード

(57)【要約】

【課題】 安価で量産性及び汎用性に優れた非接触式ICカードを提供する。

【解決手段】 絶縁基板3bの片面にのみアンテナコイル2が形成された回路基板3を用いて非接触ICカードを構成する。アンテナコイルの内周端又は外周端と近接する部分に当該アンテナコイルの他端を引き出すためのランド部3aを形成する。互いに近接して配置されたアンテナコイルの内周端又は外周端と前記ランド部にICチップ1を接続する。また、アンテナコイルの他端と前記ランド部とをブリッジ部材10を介して接続する。

【図1】



## 【特許請求の範囲】

【請求項1】 アンテナコイルを含む所要の回路パターンが形成された回路基板と前記回路パターンに接続されたICチップとからなる回路モジュールを有し、前記アンテナコイルを介して外部機器からの電力の受給及び外部機器との間の情報の送受信を行う非接触式ICカードにおいて、前記回路基板を構成する絶縁基板の片面にのみ前記アンテナコイルを形成すると共に、当該アンテナコイルの内周端又は外周端と近接する部分に当該アンテナコイルの他端を引き出すためのランド部を形成し、互いに近接して配置された前記アンテナコイルの内周端又は外周端と前記ランド部とに前記ICチップを接続し、前記アンテナコイルの他端と前記ランド部とを前記ブリッジ部材を介して接続したことを特徴とする非接触式ICカード。

【請求項2】 請求項1に記載の非接触式ICカードにおいて、前記ブリッジ部材として、絶縁性テープの片面に導電性接着剤を用いて所要の導電パターンが形成され、前記アンテナコイルの他端及び前記ランド部と対応する部分に前記導電パターンが露出し、前記アンテナコイルの巻線部と対応する部分に絶縁部が形成されたものを用いたことを特徴とする非接触式ICカード。

## 【発明の詳細な説明】

## 【0001】

【発明の属する技術分野】本発明は、非接触式ICカードに係り、特に、回路基板に形成されるアンテナコイルを含む回路パターンの構成に関する。

## 【0002】

【従来の技術】非接触式ICカードは、定期券、運転免許証、テレホンカード、キャッシュカード等の代替品としての使用が検討されており、大量の使用が見込まれるところから、構成及び製造工程をいかに簡略化し、単価を下げるかが最も重要な技術的課題の1つになっている。

【0003】従来より、回路基板上に所要の回路パターンと非接触通信用のアンテナコイルとを形成し、当該回路基板上にICチップを実装してなる回路モジュールをプラスチックフィルム等からなるカード基体中に埋設した非接触式ICカードが知られている。この種の非接触式ICカードにおいては、アンテナコイルとICチップとの接続を容易にするため、回路基板上に形成されたアンテナコイルの一端を他端側に引き出すための手段を必要とする。従来においては、アンテナコイルの一端を他端側に引き出すための手段として、回路基板にスルーホールを形成し、回路基板の裏面側に形成された接続用配線を通じて当該アンテナコイルの一端を他端側に引き出すという方法が一般的にとられている。

【0004】また、アンテナコイルの一端を他端側に引き出すのではなく、アンテナコイルの両端部をその巻線部を介して対向に配置させ、ICチップを当該アンテナ

コイルの両端部にブリッジ接続するという方式も従来より提案されている。

## 【0005】

【発明が解決しようとする課題】然るに、回路基板に形成されたスルーホールを利用してアンテナコイルの一端を他端側に引き出すためには、絶縁基板にスルーホールを形成するための複雑な加工を施さなくてはならず、かつ回路モジュールをケーシングする際に必ず回路基板の両側に絶縁性のケーシング部材を配置しなくてはならないので、非接触式ICカードがコスト高になるという問題がある。また、回路基板の両側に絶縁性のケーシング部材を配置しなくてはならないことから、薄形の非接触式ICカードの製造が困難になるという問題もある。一方、相対向に配置されたアンテナコイルの両端部にICチップをブリッジ接続する場合には、かかる不都合は生じないが、その反面、IC端子の位置やアンテナコイルの線幅及び巻線数が極めて制限されるので、汎用性が低く実用性に乏しいという問題がある。

【0006】本発明は、かかる従来技術の不都合を解決するためになされたものであって、その課題とするところは、安価にして量産性及び汎用性に優れた非接触式ICカードを提供することにある。

## 【0007】

【課題を解決するための手段】本発明は、前記の課題を達成するため、アンテナコイルを含む所要の回路パターンが形成された回路基板と前記回路パターンに接続されたICチップとからなる回路モジュールを有し、前記アンテナコイルを介して外部機器からの電力の受給及び外部機器との間の情報の送受信を行う非接触式ICカードにおいて、前記回路基板を構成する絶縁基板の片面にのみ前記アンテナコイルを形成すると共に、当該アンテナコイルの内周端又は外周端と近接する部分に当該アンテナコイルの他端を引き出すためのランド部を形成し、互いに近接して配置された前記アンテナコイルの内周端又は外周端と前記ランド部とに前記ICチップを接続し、前記アンテナコイルの他端と前記ランド部とをブリッジ部材を介して接続するという構成にした。

【0008】前記ブリッジ部材としては、絶縁性テープの片面に導電性接着剤を用いて所要の導電パターンが形成され、前記アンテナコイルの他端及び前記ランド部と対応する部分に前記導電パターンが露出し、前記アンテナコイルの巻線部と対応する部分に絶縁部が形成されたものを用いることができる。

【0009】前記構成によると、絶縁基板にスルーホールを形成する必要がないので、非接触式ICカードを高効率かつ安価に製造することができる。また、アンテナコイルを含む回路パターンを絶縁基板の片面にのみ形成することから、カードケーシング時に当該回路パターンの形成面のみカード基体を設けるだけで非接触式ICカードを構成でき、この点からも非接触式ICカードの



製造コストを低減できると共に、非接触式ICカードの薄形化をも図ることができる。さらに、アンテナコイルの他端とランド部とを別途形成されたブリッジ部材を介して接続するので、IC端子の位置やアンテナコイルの線幅及び巻線数に制限がなく、汎用性に優れる。

#### 【0010】

【発明の実施の形態】以下、本発明に係る非接触式ICカードの一実施形態例を、図1～図5に基づいて説明する。図1は本実施形態例に係る非接触式ICカードの一部切断した平面図、図2は図1のA-A断面図、図3は図1のB-B断面図、図4は図1のC部詳細図、図5はブリッジ部材の斜視図である。

【0011】図1～図3に示すように、本例の非接触式ICカードは、片面に非接触通信用のアンテナコイル2を含む所要の回路パターン3aが形成された回路基板3を用い、当該回路基板3上にICチップ1を実装してなる回路モジュール4を、片面に接着剤層5を備えたラミネートフィルム6にてラミネートした構造になっている。

【0012】ICチップ1としては、製品である非接触式ICカードを薄形化するため、樹脂モールドを有しないベアチップが用いられる。当該ICチップ1の端子部には必要に応じて図3に示すようにパンプ1aが設けられる。

【0013】回路基板3は、例えばガラスエポキシ、セラミクス、ポリイミド樹脂、ポリエチレンテレフタレート(PET)などからなる絶縁基板3bの片面に、アンテナコイル2を含む所要の回路パターン3aを形成してなる。アンテナコイル2及びその他の回路パターン3aは、絶縁基板3bの片面に形成された金属層をエッチングすることによっても形成できるし、銀ペースト等の導電ペーストを印刷することによっても形成できる。なお、絶縁基板3bの表面に金属層を形成する方法としては、絶縁基板3bの表面に金属箔を接着する方法及び絶縁基板3bの表面に金属膜を真空蒸着する方法などがある。

【0014】図1及び図2から明らかなように、アンテナコイル2は回路基板3の片面にのみ形成されており、その両端に設けられたランド部2a、2bがアンテナコイル2の内周部及び外周部に夫々配置されている。また、図1及び図3から明らかなように、当該アンテナコイル2の外周部の内周ランド部2aと対向する部分には、ICチップ1とアンテナコイル2の内周ランド部2aとを接続するための第3のランド部(回路パターン3a)が形成されている。

【0015】内周ランド部2aと回路パターン3aとの接続は、ブリッジ部材によって行われる。ブリッジ部材としては、内周ランド部2aと回路パターン3aを導通可能なものであれば任意の構成のものを用いることもできるが、ブリッジ接続が容易であることから、図5に示

すように、絶縁性の基材テープ11の片面に導電性接着剤からなる導電部12と絶縁性接着剤からなるブリッジ部13とが設けられたブリッジ部材10を用いることが好ましい。ブリッジ部材10は、内周ランド部2aと回路パターン3aとを接続可能なサイズに形成されており、導電部12の両端の前記内周ランド部2a及び回路パターン3aに接続される部分には導電性接着剤が露出され、アンテナコイル2の巻線部に接着される部分には絶縁性のブリッジ部13が形成されている。

【0016】ブリッジ部材10を用いて内周ランド部2aと回路パターン3aとを接続する場合には、図2及び図4に示すように、ブリッジ部材10に形成された導電部12の両端部を夫々内周ランド部2aと回路パターン3aに接着し、かつブリッジ部13をアンテナコイル2の巻線部に接着することによって行われる。なお、導電部12を構成する導電性接着剤として、金属粒子又は表面に金属層が形成された樹脂粒子が分散されたものを用いる場合には、当該粒子と内周ランド部2a及び回路パターン3aとの密着性をより高いものにするため、加熱下で押圧力を負荷することがより好ましい。

【0017】ICチップ1は、図3及び図4に示すように、外周ランド部2bと回路パターン3aとにブリッジして接続される。ICチップ1と外周ランド部2b及び回路パターン3aとの接続は、例えばはんだ付けや導電性接着剤による接合など、公知に属する手段を用いて行うことができる。

【0018】ラミネートフィルム6としては、任意のプラスチックフィルムを用いることができるが、耐熱性及び耐薬品性に優れ、かつ焼却したときに塩素ガス等の有害ガスを発生せず環境性に優れることから、PET、PEN(ポリエチレンナフタレート)、PES(ポリエチレンスルホン)等のプラスチックフィルムを用いることが特に好ましい。

【0019】接着剤層5を構成する接着剤としては、所定の接着強度と硬化後の剛性とを有するものであれば、任意の接着剤を用いることができるが、ICチップ1を保護するため、プラスチックフィルムとの接着力が強く耐湿性及び耐水性に優れ、かつハロゲン元素、窒素、酸素などのICチップ1に悪影響を及ぼす元素を含まないか、仮にこれらの元素が含まれていたとしてもその含有率が極めて低く、実用上これらの元素が含まれていないとみなせる熱可塑性の接着剤、例えばポリエステル樹脂、スチレンブタジエンエラストマ、エチレンビニルアルコール(EVA)等を用いることが好ましい。

【0020】以下、本発明に係る非接触式ICカードのより具体的な実施例を示し、本発明の効果を明らかにする。

【0021】〈第1実施例〉厚さが25 $\mu$ mのPETフィルムに厚さが20 $\mu$ mのアルミニウム箔をラミネートし、エッチングによって図1に示した内周ランド部2a

及び外周ランド部2bを有するアンテナコイル2と所要の回路パターン3aとを形成した。

【0022】次いで、エチレンビニルアルコール(EVA)中に銀の微粒子を分散させた導電性接着剤にて導電部12が形成され、無添加のEVAにてブリッジ部13が形成された図5のブリッジ部材10を用いて、内周ランド部2aと回路パターン3aとの接続を行った。接続は、50℃～100℃の環境下で、ブリッジ部材10を回路基板であるPETフィルムに押圧することによって行った。

【0023】アンテナコイル2のブリッジ接続終了後、異方性導電フィルム(ACF)を用いて、ICチップ1と回路基板に形成された外周ランド部2b及び回路パターン3aとの接続を行った。ICチップ1としては、厚さが100 $\mu$ mのペアチップを用いた。

【0024】最後に、このようにして作製された回路モジュール4のICチップ実装面に厚さが50 $\mu$ mのPETフィルムの片面に熱可塑性接着剤5がコーティングされたラミネートフィルム6をラミネートした後、これを所定の形状に切断して、総厚が760 $\mu$ mの前記実施形態例に係る非接触式ICカードを得た。

【0025】〈第2実施例〉回路基板3として、厚さが100 $\mu$ mのPETシートの片面に、銀ペーストを用いて厚さが10 $\mu$ mのアンテナコイルパターンが印刷形成されたものを用いた。その他については、第1実施例に係る非接触式ICカードと同じにした。

【0026】〈第3実施例〉回路基板3として、厚さが25 $\mu$ mのポリイミドフィルムの片面に厚さが18 $\mu$ mの銅箔をラミネートし、当該銅箔をエッチングすることによってアンテナコイルパターンが形成されたものを用いた。その他については、第1実施例に係る非接触式ICカードと同じにした。

【0027】第1～第3実施例に係る非接触式ICカードについて、夫々100枚ずつ、各接続部の導通と非接触通信時の動作をチェックしたところ、いずれの非接触式ICカードにも異常は認められなかった。これらの試験結果より、アンテナコイルの両端部をブリッジ部材にて接続しても、信頼性に優れた非接触式ICカードを得られることが確認できた。

【0028】なお、前記実施形態例においては、ブリッジ部材10として基材テープ11に導電部12を1条のみ形成したが、接続の信頼性を高めるため、図6に示すように、基材テープ11に複数状の導電部12を平行に

形成することもできる。

【0029】

【発明の効果】以上説明したように、本発明によると、回路基板を構成する絶縁基板の片面にのみアンテナコイルと当該アンテナコイルの一端を引き出すためのランド部とを形成し、前記アンテナコイルの一端とランド部とをブリッジ部材を介して接続したので、絶縁基板にスルーホールを形成する必要がなく、非接触式ICカードを高効率かつ安価に製造することができる。また、アンテナコイルを含む回路パターンを絶縁基板の片面にのみ形成することから、カードケーシング時に当該回路パターンの形成面にのみカード基体を設けるだけで非接触式ICカードを構成でき、この点からも非接触式ICカードの製造コストを低減できると共に、非接触式ICカードの薄形化をも図ることができる。さらに、アンテナコイルの両端部を別途形成されたブリッジ部材を介して接続するので、IC端子の位置やアンテナコイルの線幅及び巻線数に制限がなく、汎用性に優れる。

【図面の簡単な説明】

【図1】実施形態例に係る非接触式ICカードの一部切断した平面図である。

【図2】図1のA-A断面図である。

【図3】図1のB-B断面図である。

【図4】図1のC部詳細図である。

【図5】ブリッジ部材の斜視図である。

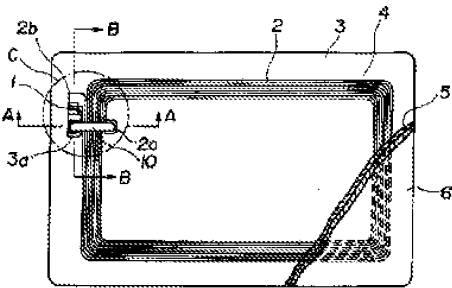
【図6】ブリッジ部材の他の例を示す斜視図である。

【符号の説明】

- 1 ICチップ
- 1a パンプ
- 2 アンテナコイル
- 3 回路基板
- 3a 回路パターン
- 3b 絶縁基板
- 4 回路モジュール
- 5 接着剤層
- 6 ラミネートフィルム
- 7 導電性接着剤
- 7a 金属粒子
- 10 ブリッジ部材
- 11 基材テープ
- 12 導電部
- 13 ブリッジ部

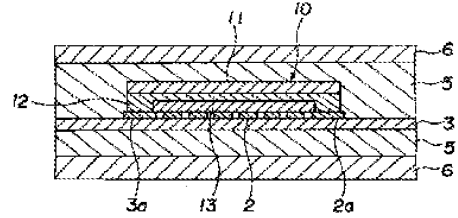
【図1】

【図1】



【図2】

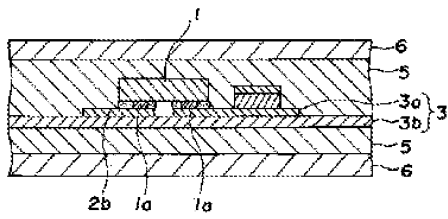
【図2】



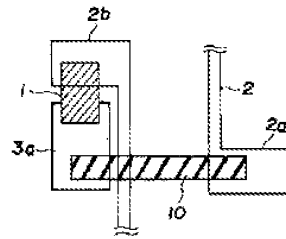
【図4】

【図3】

【図3】

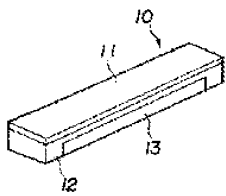


【図4】



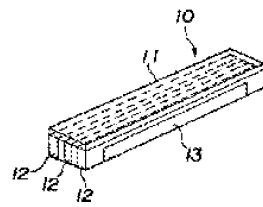
【図5】

【図5】



【図6】

【図6】





Espacenet

Bibliographic data: JP2007311407 (A) — 2007-11-29

---

IC CHIP, WAFER FINISHED WITH CIRCUIT FORMATION, AND NONCONTACT COMMUNICATION MEMBER

**Inventor(s):** SAKATA HIDETO; SUGURO KEIJI; KUDO HIROYUKI; FUKUOKA YOSHITAKA ± (SAKATA HIDETO, ; SUGURO KEIJI, ; KUDO HIROYUKI, ; FUKUOKA YOSHITAKA)

**Applicant(s):** DAINIPPON PRINTING CO LTD ± (DAINIPPON PRINTING CO LTD)

**Classification:** - international: G06K19/07; G06K19/077; H01L21/60; H01L23/12  
- cooperative: [H01L2224/16225](#); [H01L2224/32225](#);  
[H01L2224/73204](#) [more](#)

**Application number:** JP20060136574 20060516 [Global Dossier](#)

**Priority number (s):** JP20060136574 20060516

Abstract of JP2007311407 (A)

PROBLEM TO BE SOLVED: To provide an IC chip which can ensure good electrical connection with an external connection terminal. ;SOLUTION: An IC chip 30 is connected electrically with a pair of connection terminals 22a and 22b of a conductor 22. The IC chip comprises a chip body 32 having a circuit formation surface 33 of substantially rectangular plan view, and two bumps 34a and 34b projecting from the circuit formation surface and connected electrically with different connection terminals 22a and 22b. Assuming the length of the edge of the circuit formation surface is X [ $\mu$ m], and the separation length is Y [ $\mu$ m] between the connection terminals in the direction along the edge of the circuit formation surface when connected electrically with the bump; the length L [ $\mu$ m] of the edge of the circuit formation surface is represented by expression (1):  $(X-Y)/2-75 \leq L \leq (X-Y)/2-25$ . ;COPYRIGHT: (C) 2008,JPO&INPIT

(19) 日本国特許庁(JP)

(12) 公開特許公報(A)

(11) 特許出願公開番号

特開2007-311407

(P2007-311407A)

(43) 公開日 平成19年11月29日(2007.11.29)

(5) Int. Cl.		F 1	テーマコード (参考)
HO1L	23/12 (2006.01)	HO1L 23/12	5O1P
HO1L	21/60 (2006.01)	HO1L 21/92	6O2N
G06K	19/077 (2006.01)	HO1L 21/92	6O2P
G06K	19/07 (2006.01)	G06K 19/00	L
		G06K 19/00	H

審査請求 未請求 請求項の数 10 OL (全 15 頁)

(21) 出願番号	特願2006-136574 (P2006-136574)	(71) 出願人	000002897 大日本印刷株式会社 東京都新宿区市谷加賀町一丁目1番1号
(22) 出願日	平成18年5月16日 (2006.5.16)	(74) 代理人	100075812 弁理士 吉武 賢次
		(74) 代理人	100091982 弁理士 永井 浩之
		(74) 代理人	100096895 弁理士 岡田 淳平
		(74) 代理人	100117787 弁理士 勝沼 安仁
		(74) 代理人	100127465 弁理士 堀田 幸裕

最終頁に続く

(54) 【発明の名称】 ICチップ、回路形成済ウエハ、および非接触通信部材

(57) 【要約】

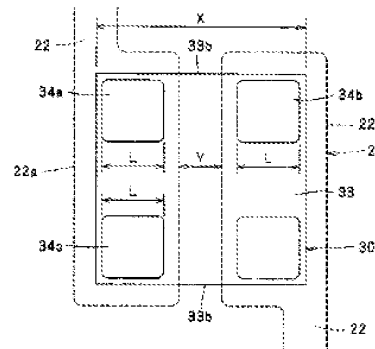
【課題】 外部の接続端子と良好な電気的接続を確保することができるICチップを提供する。

【解決手段】 ICチップ30は導電体22の一对の接続端子22a、22bと電気的に接続され得る。ICチップは、平面視略矩形形状の回路形成面33を有するチップ本体32と、回路形成面から突出し、異なる接続端子22a、22bに電気的に接続されるようになる二つのバンプ34a、34bと、を備えている。回路形成面の一方の一对の端縁に沿ったバンプの長さLμmは、回路形成面の当該端縁の長さをXμmとし、バンプと電気的に接続された場合に回路形成面の当該端縁に沿うようになる方向での接続端子間の離間長さをYμmとすると、以下の式(1)が満たされる。

$$(X-Y)/2-75 \leq L \leq (X-Y)/2-25$$

・・・ 式(1)

【選択図】 図6



## 【特許請求の範囲】

## 【請求項1】

一対の接続端子と電気的に接続されるICチップであって、  
 平面視略矩形形状の回路形成面を有するチップ本体と、  
 前記回路形成面から突出し、異なる接続端子に電気的に接続されるようになる二つのバンパと、を備え、

前記回路形成面の一方の一対の端縁に沿った方向における前記バンパの長さ $L$   $\mu$ mは、前記回路形成面の当該端縁の長さを $X$   $\mu$ mとし、前記バンパと電気的に接続された場合に前記回路形成面の当該端縁に沿うようになる方向での前記一対の接続端子の離間長さを $Y$   $\mu$ mとすると、式(1)を満たすことを特徴とするICチップ。

$$(X-Y)/2-75 \leq L \leq (X-Y)/2-25 \quad \dots \text{式(1)}$$

## 【請求項2】

前記回路形成面から突出し、前記接続端子上に配置され前記二つのバンパとともにチップ本体を支持するようになる支持用バンパ、をさらに備え、

前記回路形成面の一方の一対の端縁に沿った方向における前記支持用バンパの長さ $L_s$   $\mu$ mは、式(2)を満たすことを特徴とする請求項1に記載のICチップ。

$$(X-Y)/2-75 \leq L_s \leq (X-Y)/2-25 \quad \dots \text{式(2)}$$

## 【請求項3】

前記二つのバンパは、前記回路形成面の一方の一対の端縁に沿った方向に離間し、対向して配置されていることを特徴とする請求項1または2に記載のICチップ。

## 【請求項4】

請求項1乃至3のいずれか一項に記載のICチップを含んだ回路形成済ウエハ。

## 【請求項5】

アンテナを有する非接触通信部材であって、

一対の接続端子を有する導電体と、

前記導電体と電気的に接続されたICチップと、を備え、

前記ICチップは、平面視略矩形形状の回路形成面を有するチップ本体と、前記回路形成面から突出し、前記導電体の異なる接続端子に電気的に接続された二つのバンパと、を有し、

前記回路形成面の一方の一対の端縁に沿った方向における前記バンパの長さ $L$   $\mu$ mは、前記回路形成面の当該端縁の長さを $X$   $\mu$ mとし、前記回路形成面の当該端縁に沿った方向における前記一対の接続端子の離間長さを $Y$   $\mu$ mとすると、式(3)を満たすことを特徴とする非接触通信部材。

$$(X-Y)/2-75 \leq L \leq (X-Y)/2-25 \quad \dots \text{式(3)}$$

## 【請求項6】

前記ICチップは、前記回路形成面から突出し、前記接続端子上に配置され前記二つのバンパとともにチップ本体を支持する支持用バンパ、をさらに備え、

前記回路形成面の一方の一対の端縁に沿った方向における前記支持用バンパの長さ $L_s$   $\mu$ mは、式(4)を満たすことを特徴とする請求項5に記載の非接触通信部材。

$$(X-Y)/2-75 \leq L_s \leq (X-Y)/2-25 \quad \dots \text{式(4)}$$

## 【請求項7】

前記導電体は、前記アンテナを構成することを特徴とする請求項5または6に記載の非接触通信部材。

## 【請求項8】

前記アンテナを構成するアンテナ用導電体をさらに備え、

前記導電体は、前記アンテナ用導電体と前記ICチップとを電気的に接続することを特徴とする請求項5または6に記載の非接触通信部材。

## 【請求項9】

前記二つのバンパは、前記回路形成面の一方の一対の端縁に沿った方向に離間し、対向

して配置されていることを特徴とする請求項5乃至8のいずれか一項に記載の非接触通信部材。

【請求項10】

前記一对の接続端子は、前記回路形成面の一方の一对の端縁に沿った方向に離間し、対向して配置されていることを特徴とする請求項5乃至9のいずれか一項に記載の非接触通信部材。

【発明の詳細な説明】

【技術分野】

【0001】

本発明は、接続用に用いられるバンパを有したICチップ、前記ICチップを含む回路形成済ウエハ、および前記ICチップを備えた非接触通信部材に係り、とりわけバンパの平面視における寸法が最適化されたICチップ、当該ICチップを含む回路形成済ウエハ、および当該ICチップを備えた非接触通信部材に関する。

【背景技術】

【0002】

従来、工業製品全般にICチップが用いられており、ICチップは、通常、外部の接続端子（接続部）との接続用に用いられる接続用のバンパを有している。

【0003】

このような工業製品のうち、昨今、需要が急激に拡大しつつあるものとして、非接触通信部材が挙げられる。ここで、非接触通信部材とは、リーダ・ライタ等の外部装置から発信される電磁波に対応し、当該外部装置と非接触で通信することができる部材（媒体）である。非接触通信部材は、通常、基材と、基材上に形成されたアンテナと、アンテナに接続されたICチップと、を有している（例えば、特許文献1）。このような非接触通信部材として、ICチップが情報の記録を可能にするメモリを含み、外部装置との間で情報の送受信を行うICタグやICカード等の情報保持部材が知られている。また、非接触通信部材として、情報を保持することはできないものの、外部装置との間で信号の送受信が可能である共振タグ（無線タグ）も知られている。

【特許文献1】特開2002-352206号公報

【発明の開示】

【発明が解決しようとする課題】

【0004】

ところで、ICタグに代表される非接触通信部材において、基材は柔軟性を有したPETフィルムや紙等から構成されることが多い。したがって、非接触通信部材の製造中や、その後の取り扱い中に基材が曲げられてしまうこと等があり、基材上でのICチップの配置は安定していない。このため、アンテナとICチップとの接続抵抗値が増大し、さらには、アンテナとICチップとの電気的な接続が損なわれてしまうこともある。

【0005】

また、このような問題は、ICチップの小型化にとまいない、非接触通信部材に限られず、ICチップを用いた製品全般に関連する問題となっている。

【0006】

本発明はこのような点を考慮してなされたものであって、接続端子との良好な電気的接続を確保することができるICチップ、当該ICチップを含む回路形成済ウエハ、および当該ICチップを備えた非接触通信部材に関する。

【課題を解決するための手段】

【0007】

本発明によるICチップは、一对の接続端子と電気的に接続されるICチップであって、平面視略矩形形状の回路形成面を有するチップ本体と、前記回路形成面から突出し、異なる接続端子に電気的に接続されるようになる二つのバンパと、を備え、前記回路形成面の一方の一对の端縁に沿った方向における前記バンパの長さ $L$   $\mu$ mは、前記回路形成面の当該端縁の長さを $X$   $\mu$ mとし、前記バンパと電気的に接続された場合に前記回路形成面の当該端縁に沿うようになる方向での前記一对の接続端子の離間長さを $Y$   $\mu$ mとすると、式（

1)を満たすことを特徴とする。

$$(X-Y)/2-75 \leq L \leq (X-Y)/2-25 \quad \dots \text{式(1)}$$

【0008】

このような本発明によるICチップによれば、バンパを接続端子が形成されている領域内に配置し得る。この場合、当該バンパと接続端子との接触面積を増大させてICチップおよび接続端子間の接続抵抗値を低減することができるとともに、ICチップおよび接続端子間の電気的接続が損なわれることを格段に抑制することもできる。

【0009】

本発明によるICチップは、前記回路形成面から突出し、前記接続端子上に配置され前記二つのバンパとともにチップ本体を支持するようになる支持用バンパ、をさらに備え、前記回路形成面の一方の一方の端縁に沿った方向における前記支持用バンパの長さ $L$   $\mu$ mが、式(2)を満たすようにしてもよい。

$$(X-Y)/2-75 \leq L \leq (X-Y)/2-25 \quad \dots \text{式(2)}$$

【0010】

このような本発明によるICチップによれば、支持用バンパを接続端子が形成されている領域内に配置し得る。この場合、当該支持用バンパと接続端子との間の固定が損なわれることを格段に抑制することができる。このため、接続端子上にICチップが安定して配置され得るようになり、結果として、ICチップおよび接続端子間の電気的接続が損なわれることを抑制し得る。

【0011】

本発明によるICチップにおいて、前記二つのバンパは、前記回路形成面の一方の一方の端縁に沿った方向に離間し、対向して配置されるようにしてもよい。

【0012】

本発明による回路形成済ウエハは、上述したいずれかのICチップを複数含んでいる。

【0013】

本発明による非接触通信部材は、アンテナを有する非接触通信部材であって、一方の接続端子を有する導電体と、前記導電体と電気的に接続されたICチップと、を備え、前記ICチップは、平面視略矩形形状の回路形成面を有するチップ本体と、前記回路形成面から突出し、前記導電体の異なる接続端子に電気的に接続された二つのバンパと、を有し、前記回路形成面の一方の一方の端縁に沿った方向における前記バンパの長さ $L$   $\mu$ mは、前記回路形成面の当該端縁の長さを $X$   $\mu$ mとし、前記回路形成面の当該端縁に沿った方向における前記一方の接続端子の離間長さを $Y$   $\mu$ mとすると、式(3)を満たすことを特徴とする。

$$(X-Y)/2-75 \leq L \leq (X-Y)/2-25 \quad \dots \text{式(3)}$$

【0014】

このような本発明による非接触通信部材によれば、ICチップのバンパを接続端子が形成されている領域内に配置し得る。この場合、当該導電用バンパと接続端子との接触面積を増大させてICチップおよび接続端子間の接続抵抗値を低減することができるとともに、ICチップおよび接続端子間の電気的接続が損なわれることを格段に抑制することもできる。

【0015】

本発明による非接触通信部材は、前記ICチップは、前記回路形成面から突出し、前記接続端子上に配置され前記二つのバンパとともにチップ本体を支持する支持用バンパ、をさらに備え、前記回路形成面の一方の一方の端縁に沿った方向における前記支持用バンパの長さ $L$   $\mu$ mが、式(4)を満たすようにしてもよい。

$$(X-Y)/2-75 \leq L \leq (X-Y)/2-25 \quad \dots \text{式(4)}$$

【0016】

このような本発明による非接触通信部材によれば、ICチップの支持用バンパを接続端子が形成されている領域内に配置し得る。この場合、当該支持用バンパと接続端子との間の固定が損なわれることを格段に抑制することができる。このため、接続端子上にICチ



ップが安定して配置され、結果として、ICチップおよび接続端子間の電気的接続が損なわれることを抑制し得る。

【0017】

本発明による非接触通信部材において、前記導電体は、前記アンテナを構成するアンテナ用導電体であるようにしてもよい。あるいは、本発明による非接触通信部材が、前記アンテナを構成するアンテナ用導電体をさらに備え、前記導電体は、前記アンテナ用導電体と前記ICチップとを電気的に接続する接続用導電体であるようにしてもよい。

【0018】

また、本発明による非接触通信部材において、前記二つのバンパは、前記回路形成面の一方の一对の端縁に沿った方向に離間し、対向して配置されるようにしてもよい。

【0019】

さらに、本発明による非接触通信部材において、前記一对の接続端子は、前記回路形成面の一方の一对の端縁に沿った方向に離間し、対向して配置されるようにしてもよい。

【発明の効果】

【0020】

本発明によれば、バンパの平面視における寸法を最適化することによって、ICチップと接続端子との良好な電気的な接続を確保および維持することができる。

【発明を実施するための最良の形態】

【0021】

以下、図面を参照して本発明の実施の形態について説明する。

【0022】

図1乃至図10は本発明によるICチップ、回路形成済ウエハ、および非接触通信部材の一実施の形態を示す図である。

【0023】

このうち図1はICチップを示す斜視図であり、図2は回路形成済ウエハを示す斜視図であり、図3は非接触通信部材を示す上面図であり、図4は図3のIV-V線に沿った断面図であり、図5は図3のV-V線に沿った断面図であり、図6乃至図10はICチップのバンパの設計方法を説明するための図である。

【0024】

図3乃至図5に示すように、本実施の形態における非接触通信部材10は、非導電性のシート状の基材12と、基材12上に形成されたアンテナ20と、基材12上に設けられ、アンテナ20に接続されたICチップ30と、を備えている。

【0025】

このような非接触通信部材10は、外部装置（リーダ・ライタ等）と非接触状態で通信することができ、例えば、ICタグ、ICカード、共振タグ等として使用される。ICタグやICカードとして使用される場合、ICチップ30は情報を記録するためのメモリを含み、外部装置（リーダ・ライタ等）により、アンテナ20を介してICチップ30に記録された情報を読み出したり、アンテナ20を介してICチップ30に新たな情報を書き込んだりすることができるようになっている。そして、非接触通信部材10のこのような機能を発現するための回路配線33aがICチップ30に書き込まれている。

【0026】

図1に示すようにICチップ30は、平坦な略直方体からなるICチップ本体32と、ICチップ本体32から突出するバンパ（接続電極）34a、34b、34cと、を備えている。ICチップ本体32は、略矩形形状、さらに詳しくは略正方形形状からなり、対向して配置された一对の主面を有している。この主面のうちの一方は、上述した非接触通信部材10としての機能を発現するための回路33aが記録された回路形成面33をなしている。なお、本願において、ICチップ30に関しての平面視とは、この主面（回路形成面33）に直交する方向からこの主面を眺める視野を指すものとする。

【0027】

本実施の形態において、ICチップ30には3つのバンパ34a、34b、34cが形

成されている。3つのバンク34a、34b、34cは、回路形成面33から略同一長さだけICチップ本体32の外方に突出している。このうち2つのバンク34a、34bは、回路33aに電氣的に接続され、アンテナ20を介しての外部装置との通信に用いられる導電用バンクである。残りのバンク34cは、アンテナ20上でICチップ30が安定して配置されるよう、導電用バンク34a、34bとともに、ICチップ本体32をアンテナ20側から支持するための支持用バンクである。すなわち、本実施の形態においては、二つの導電バンク34a、34bと、一つの支持用バンク34cとの合計三つのバンクによって、ICチップ本体32をぐらつかせることなくアンテナ20上で支持するようになっている。なお、導電用バンク34a、34bおよび支持用バンク34cの寸法の設計方法については、図6乃至図10を用いて後に詳述する。

【0028】

このようなICチップ30は、半導体ウエハに多数の回路33aを書き込んで回路形成済ウエハ1（図2参照）を作製し、この回路形成済ウエハ1を回路毎に切断（ダイシング）することによって、得られ得る。なお、このような回路形成済ウエハ1も、本件の対象である。

【0029】

次に、図3乃至図5に戻って、基材12上に形成されたアンテナ20について詳述する。なお、アンテナ20を支持する基材12は、PETフィルムや紙等から構成され得る。

【0030】

本実施の形態において、基材12上に形成されたアンテナ20は、図3に示すように、コイル状アンテナとして形成されている。アンテナ20は、基材12上に配置され、略コイル状からなるアンテナ用導電体22と、アンテナ用導電体22の所定の部分間を短絡させる（導通させる）ブリッジ部材25のブリッジ用導電体25aと、から構成されている。

【0031】

図3に示すように、アンテナ用導電体22は、ICチップ30のバンク34a、34bとの電氣的な接続の実現に用いられる一対の接続端子22a、22bを有している。図4に示すように、この接続端子22a、22bが異なる導通用バンク34a、34bとそれぞれ接触するようにして、ICチップ30がアンテナ20上に配置されている。また、図4に示されているように、アンテナ用導電体22とICチップ30との間に非導電性の接着剤38が設けられており、この接着剤38によって、ICチップ30がアンテナ20を介して基材12上に固定されている。このような構成によって、ICチップ30がアンテナ20に電氣的に接続されるとともに基材12に固定されている。

【0032】

なお、ICチップ30とアンテナ20との間の電氣的接続は、このような方法に限定されず種々の方法によって実現することができる。例えば、超音波接合による電氣的接続であってもよく、あるいは導電性または異方性導電性接着剤を介した電氣的接続であってもよい。

【0033】

また、図3に示すように、アンテナ用導電体22は、ブリッジ部材25によって短絡される最内周端部22cと最外周端部22dとを有している。図5に示すように、本実施の形態におけるブリッジ部材25は、非導電性の支持シート（ブリッジ支持シート）25bと、支持シート25b上に配置され、アンテナ用導電体22と電氣的に接続されるブリッジ用導電体25aと、を有している。ブリッジ部材25の支持シート25bは、基材12と同様に、例えばPETや紙等からなる。また、ブリッジ用導電体25aは、銅やアルミニウム等から構成される。

【0034】

図5に示すように、ブリッジ用導電体25aの両端部がそれぞれアンテナ用導電体22の最内周端部22cまたは最外周端部22dに接触するようにして、ブリッジ部材25がアンテナ20上に配置されている。また、ブリッジ部材25とアンテナ20および基材1

2との間には非導電性の接着剤28が塗布されている。アンテナ用導電体22の最内周端部22bおよび最外周端部22c以外の部分は、この非導電性の接着剤28によって短絡されることが防止されている。このようにして、本実施の形態において、ブリッジ用導電体25aを介してアンテナ用導電体22の最内周端部22bと最外周端部22cとが電氣的に接続されている(短絡されている)。

【0035】

なお、このようなブリッジ部材25の構成は、アンテナ用導電体22への接続方法も含め、単なる例示に過ぎず、既知である種々のブリッジ部材の構成およびアンテナ用導電体22への接続方法を採用することができる。

【0036】

ところで、上述したアンテナ用導電体22は、例えば、スクリーン印刷機を用いて導電性インキを基材12上に塗布することにより、あるいは基材12上に銅やアルミニウム等からなる導電性箔を転写することにより、あるいは基材12上に積層された銅やアルミニウム等からなる導電性箔にエッチングを施して所望の形状にパターニングすること等により、基材12上に形成され得る。このようにして形成されたアンテナ用導電体22上に接着剤28、38を介してICチップ30およびブリッジ部材25を配置固定することによって、非接触通信部材10が得られる。なお、ブリッジ部材25のブリッジ用導電体25aは、アンテナ用導電体22を基材12上に形成する方法と同様にして、支持シート25b上に形成することができる。

【0037】

次に、図6乃至図10を用い、ICチップ30の bumps 34a、34bに関する好適な設計方法について詳述する。ここで、図6および図8乃至図10は、ICチップ30の bumps 34a、34bとアンテナ用導電体22の接続端子22a、22bとの位置関係を説明するためのICチップ30の上面図である。また、図7は、図4に対応する非接触通信部材の断面図である。

【0038】

本件発明者は、鋭意研究を重ねたところ、接続端子22a、22bが形成された領域内にICチップ30の導電用 bumps 34a、34bが配置されている場合に、ICチップ30および接続端子22a、22b間の接続抵抗値を低く抑えるだけでなく、ICチップ30および接続端子22a、22b間の電氣的接続を維持する上においても有効であることを見出した。以下に説明する、ICチップ30の bumps 34a、34bの設計方法はこのような知見に基づくものである。

【0039】

すなわち、図6に示すように、接続端子22a、22bが形成される領域をいくら大きくしたとしても(つまり、接続端子22a、22bをいくら大きくしたとしても)、導電用 bumps 34a、34b間には一対の接続端子22a、22b間の隙間が形成されてしまう。そして、図7に示すように、この隙間上に導電用 bumps 34bが配置されると、当該導電用 bumps 34bと接続端子22bとの接触面積が減少してICチップ30および接続端子22a、22b間の接続抵抗値が高まるだけでなく、この部分Aを起点としてICチップ30および接続端子22a、22b間の電氣的接続が著しく損なわれやすくなる。そして、本発明による導電用 bumps の設計方法は、当該導電用 bumps 34a、34b間に生じてしまう一対の接続端子22a、22b間の隙間の大きさと、導電用 bumps 34a、34bの寸法ばらつきと、ICチップ30の接続端子22a、22b上への配置位置のずれと、を考慮してICチップ30の平面視における導電用 bumps 34a、34bの寸法を最適化するものである。以下にこのような導電用 bumps 34a、34bの設計方法を詳述する。

【0040】

図6に示すように、本実施の形態において、対向して配置されたアンテナ用導電体22の接続端子22a、22bが離間する方向と、ICチップ30の対向して配置された導電用 bumps 34a、34bが離間する方向とは並行であり、回路形成面33の一方の一対の

端縁33bに沿った方向(図6の紙面における左右方向)と一致している。ここで、図6に示すように、回路形成面33の当該端縁33bの長さをX( $\mu\text{m}$ )とし、当該端縁33bに沿った一対の接続端子34a、34bの離間長さをY( $\mu\text{m}$ )とし、接続端子22a、22bが十分大きく形成されているとすれば、導電用バンク34a、34bの当該端縁に沿った長さLは、少なくとも、以下の式(5)を満たすようになる。

$$L \leq (X - Y) / 2 \quad \dots \text{式(5)}$$

【0041】

ところで、通常、非接触通信部材10は、まず、接続端子22a、22bを含むアンテナ用導電体22を基材12上に形成し、次に、接続端子22a、22b上にICチップ30を配置することによって、作製される。このとき、アンテナ用導電体22の接続端子22a、22bに対するICチップ30の配置位置はずれてしまうことがある。このような例を図8および図9に示す。図8および図9において、点線で示すICチップ30'は接続端子上22a、22bにおけるICチップの配置目標位置である。そして、図8に示す例において、ICチップ30は目標位置に対し、図8の紙面における左上へずれた位置に配置されている。一方、図9に示す例において、ICチップ30は目標位置に対し、図9の紙面における右下へずれた位置に配置されている。

【0042】

すなわち、ICチップ30の配置位置は、回路形成面33の前記一方の一対の端縁33bに沿った方向、および、この端縁に直交33bする方向のいずれにもずれ得る。そして、本件発明者は、鋭意研究を重ねたところ、ICチップ30の配置位置は任意の一方に沿って50 $\mu\text{m}$ だけずれ得ることを知見した。すなわち、ICチップの各導電用バンク34a、34bは、回路形成面33の前記一方の一対の端縁33bに沿い、接続端子22a、22b間の隙間に向けた向き(例えば、図6における左側に配置された導電用バンク34aは図6右向き)へ、50 $\mu\text{m}$ の半分、すなわち、25 $\mu\text{m}$ だけずれ得る。

【0043】

このような25 $\mu\text{m}$ の配置位置ずれを考慮して、上述の式(5)を書き換えると、導電用バンク34a、34bの当該端縁に沿った長さLは、以下の式(6)を満たさなければならない。

$$L \leq (X - Y) / 2 - 25 \quad \dots \text{式(6)}$$

【0044】

さらに、ICチップ30のバンク34a、34b、34cを電界めつき等の公知の方法により作製すると、バンク34a、34b、34cの寸法ばらつきが生じてしまう。図10に、回路形成面33の当該図面において右上に配置された導電用バンク34bの寸法ばらつきの例を示す。図10において、実線で示す導電用バンク34bの輪郭が目標とする導電用バンク34a、34bの大きさである。このような目標とする大きさの導電用バンク34bに対し、実際に作製される導電用バンクの大きさは、大きくなったり小さくなったりする。

【0045】

そして、本件発明者は、鋭意研究を重ねたところ、公知な方法によって任意の寸法のバンクを作製すると、当該バンクの平面視における寸法は、最も大きく形成されるバンク34b<sub>MAX</sub>と最も小さく形成されるバンク34b<sub>MIN</sub>との間で、任意の一方(例えば、L<sub>MAX</sub> - L<sub>MIN</sub>)に沿って50 $\mu\text{m}$ だけばらつき得ることを知見した。すなわち、ICチップ30の各導電用バンク34a、34bの平面視における寸法は、回路形成面33の前記一方の一対の端縁33bに沿い、50 $\mu\text{m}$ だけばらつき得る。したがって、回路形成面33の前記一方の一対の端縁33bに沿った導電用バンク34a、34bの目標長さを、上記式(6)で算出される上限値よりも、50 $\mu\text{m}$ の半分、すなわち、25 $\mu\text{m}$ だけ短く設定しておくことが好ましい。このように回路形成面33の前記一方の一対の端縁33bに沿った導電用バンク34a、34bの目標長さを設定した場合、結果として得られる導電用バンク34a、34bの当該端縁33bに沿った長さLは、以下の式(7)を満たすようになる。

$$(X-Y)/2-75 \leq L \leq (X-Y)/2-25 \quad \dots \text{式(7)}$$

## 【0046】

次に、支持用バンパ34cについて説明する。図6に示すように、本実施の形態において、支持用バンパ34cは、一方の導電用バンパ34aとともに一方のアンテナ用導電体22a上に配置されている。この支持用バンパ34cも、一方の導電用バンパ34aと同様に接着剤38を介してアンテナ用導電体22の接続端子22aに接着固定されている（図4参照）。そして、ICチップ30を安定してアンテナ用導電体22上に配置しておくには、導電用バンパ34a、34bと同様に、支持用バンパ34cも接続端子22aが形成された領域内に配置しておくことが好ましい。このような理由から、本実施の形態において、支持用バンパ34cは、前記回路形成面33の一方の一对の端縁33bに沿った方向において、一方の導電用バンパ34aと略同一な位置に配置されている（図6参照）。また、支持用バンパ34cの前記回路形成面33の一方の一对の端縁33bに沿った長さLsは、以下の式（8）を満たすようになっている。

$$(X-Y)/2-75 \leq Ls \leq (X-Y)/2-25 \quad \dots \text{式(8)}$$

## 【0047】

以上のように本実施の形態によれば、ICチップ30の導電用バンパ34a、34bの平面視における寸法が、当該導電用バンパ34a、34b間に生じてしまう一对の接続端子22a、22b間の隙間の大きさと、導電用バンパ34a、34bの寸法ばらつきと、ICチップ30の接続端子22a、22b上への配置位置のずれと、を考慮して最適化されている。具体的には、回路形成面33の一方の一对の端縁33bに沿った方向における導電用バンパ34a、34bの長さLμmが、回路形成面33の当該端縁33bの長さをXμmとし、回路形成面33の端縁33bに沿った方向における一对の接続端子22a、22bの離間長さをYμmとすると、

$$(X-Y)/2-75 \leq L \leq (X-Y)/2-25$$

となっている。このように回路形成面33の一方の一对の端縁33bに沿った方向における導電用バンパ34a、34bの長さLμmを設定することにより、当該導電用バンパ34a、34bを接続端子22a、22bが形成されている領域内に配置することができるようになる。この場合、当該導電用バンパ34a、34bと接続端子22a、22bとの接触面積を増大させてICチップ30および接続端子22a、22b間の接続抵抗値を低減することができるだけでなく、ICチップ30および接続端子22a、22b間の電氣的接続が損なわれることを格段に抑制することができる。

## 【0048】

また、本実施の形態によれば、回路形成面33に支持用バンパ34cが設けられている。そして、回路形成面33の一方の一对の端縁33bに沿った方向における支持用バンパ34cの長さLsμmが、

$$(X-Y)/2-75 \leq Ls \leq (X-Y)/2-25$$

となっている。このように回路形成面33の一方の一对の端縁33bに沿った方向における支持用バンパ34cの長さLsμmを設定することにより、当該支持用バンパ34cを接続端子22aが形成されている領域内に配置することができるようになる。この場合、当該支持用バンパ34cと接続端子22aとの間の固定が損なわれることを格段に抑制することができる。このため、アンテナ20上にICチップ30が安定して配置されるようになり、結果として、ICチップ30および接続端子22a、22b間の電氣的接続が損なわれることが抑制される。

## 【0049】

なお、上述した実施の形態に関し、本発明の要旨の範囲内で種々の変更が可能である。以下、変形例の一例について説明する。

## 【0050】

例えば、上述した実施の形態において、ICチップ30が、二つの導電用バンパ34a、34bと、一つの支持用バンパ34cと、を有する例を示したが、これに限られない。支持用バンパの数量は、ICチップ30がアンテナ20上に安定して配置される限りにお

いて、特に限定されない。例えば、支持用バンパが全く設けられていなくてもよいし、二つ以上の支持用バンパが設けられていてもよい。二つの支持用バンパを設ける場合には、さらなる支持用バンパを、例えば図6の二点鎖線で示す位置に配置するようにしてもよい。

【0051】

また、上述した実施の形態において、コイル状のアンテナ20の接続端子22a、22bに対してICチップ30の導電用バンパ34a、34bが電氣的に接続される例を示したが、これに限られない。外部装置との通信に用いられる電磁波の周波数等に依存して、非接触通信部材10のアンテナ20の形状は種々変更され、例えばダイポールアンテナとして機能する一対の棒状からなるアンテナ用導電体によって、アンテナ20が形成されることもある。このような種々の形状のアンテナに対しても、上述したICチップ30を適用することができる。

【0052】

さらに、上述した実施の形態において、ICチップ30の導電用バンパ34a、34bがアンテナ20を構成するアンテナ用導電体22と電氣的に接続される例を示したが、これに限られない。例えば、図11乃至図13に示すように、ICチップ30がインターホーザ40に組み込まれ、ICチップ30がアンテナ用導電体22と間接的に接続されるようにしてもよい。

【0053】

ここで、図11乃至図13を用い、このような例についての詳細を説明しておく。なお、図11乃至図13に示す変形例において、上述した実施の形態と同一部分については同一符号を付して、重複する詳細な説明は省略する。

【0054】

図示された本例において、インターホーザ40は、非導電性の支持シート（インターホーザ支持シート）42と、支持シート42上に配置された一対の棒状の接続用導電体44、44と、一対の接続用導電体44、44に電氣的に接続（導通）されたICチップ30と、を備えている。インターホーザ40の断面を示す図13から理解できるように、本例において、ICチップ30の導電用バンパ34a、34bと電氣的に接続される接続端子44a、44bは、一対の接続用導電体44、44の各内方端部部分によって形成される。そして、ICチップ30は、各接続端子44a、44bに異なる導電用バンパ34a、34bが接触するようにして、接着剤59を介して接続用導電体44上に接着固定されている。

【0055】

なお、インターホーザ40の支持シート42は、PETや紙等からなっている。一方、接続用導電体44は銅やアルミニウムの箔等から構成される。接続用導電体44は、例えば、上述した実施の形態において説明したブリッジ用導電体25aと同様にして支持シート42上に形成され得る。

【0056】

図13に示すように、インターホーザ40は、基材12上に形成されたアンテナ用導電体22の最内周端部22cおよび最外周端部22dに異なる接続用導電体44が電氣的に接続した状態で、アンテナ20上に接着剤29を介して接着固定されている。この結果、ICチップ30の各導電用バンパ34a、34bは、異なる接続用導電体44の接続端子44a、44bとそれぞれ電氣的に接続（導通）し、当該接続用導電体44a、44bを介してアンテナ用導電体22の最内周端部22cまたは最外周端部22dと電氣的に接続（導通）している。したがって、ICチップ30をコイル状回路（さらに詳しくは、アンテナ用導電体22）内に直接電氣的に接続させるための上述した接続端子22a、22bは、本例のアンテナ用導電体22に設けられていない。

【0057】

このような例においても、上述した実施形態と同様にして、ICチップ30の回路形成面33の一方の一対の端縁33bに沿った方向における導電用バンパ34a、34bの長

さし $\mu\text{m}$ 、並びに、ICチップ30の回路形成面33の一方の一对の端縁33bに沿った方向における支持用バンパ34cの長さ $L_s\mu\text{m}$ を、一对の接続端子44a、44b間の隙間の大きさと、バンパ34a、34b、34cの寸法ばらつきと、ICチップ30の接続端子44a、44b上への配置位置のずれと、を考慮して最適化することができる。この場合、上述した実施の形態と同様にして、バンパ34a、34b、34cを接続端子44a、44bが形成されている領域内に配置することができるようになる。このため、当該導電用バンパ34a、34bと接続端子44a、44bとの接触面積を増大させてICチップ30および接続端子44a、44b間の接続抵抗値を低減することができるだけでなく、ICチップ30が接続用導電体44上において安定して配置され得るとともに、ICチップ30および接続端子44a、44b間の電氣的接続が損なわれることを格段に抑制し得る。

【0058】

さらに、図1乃至図10に示す実施の形態において、ICチップ30が非接触通信部材10に適用される例を説明したが、これに限られない。上述した実施の形態におけるICチップ30によれば、ICチップ30と電氣的に接続されるべき接続端子との間での接続抵抗値を低減することができるとともに、ICチップ30および接続端子間の電氣的接続が損なわれてしまうことを格段に抑制することができる。このような効果は、従来ICチップが用いられてきた分野全般において有用であることから、従来ICチップが用いられてきた分野全般に対して上述したICチップを適用することができる。

【図面の簡単な説明】

【0059】

【図1】図1は、本発明によるICチップの一実施の形態を示す斜視図である。

【図2】図2は、本発明による回路形成済ウエハの一実施の形態を示す斜視図である。

【図3】図3は、本発明による非接触通信部材の一実施の形態を示す上面図である。

【図4】図4は、図3のIV-IV線に沿った断面図である。

【図5】図5は、図3のV-V線に沿った断面図である。

【図6】図6は、ICチップのバンパの設計方法を説明するための図であり、接続端子とともに回路形成面を示すICチップの上面図である。

【図7】図7は、図4に対応する図であって、ICチップのバンパの設計方法を説明するため接続端子とバンパとの位置関係を示す図である。

【図8】図8は、ICチップのバンパの設計方法を説明するための図であり、接続端子に対するバンパの位置ずれを示すICチップの上面図である。

【図9】図9は、ICチップのバンパの設計方法を説明するための図であり、接続端子に対するバンパの位置ずれを示すICチップの上面図である。

【図10】図10は、ICチップのバンパの設計方法を説明するための図であり、バンパの寸法変動を示すICチップの上面図である。

【図11】図11は、ICチップをインターポーザに適用した例を説明するためのインターポーザの上面図である。

【図12】図12は、非接触通信部材の一変形例として、図11に示すインターポーザを用いた非接触通信部材を示す上面図である。

【図13】図13は、図12のXIII-XIII線に沿った断面図である。

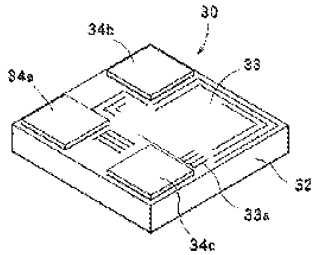
【符号の説明】

【0060】

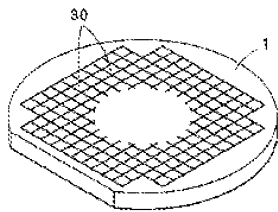
- 1 回路形成済ウエハ
- 10 非接触通信部材
- 12 基材
- 20 アンテナ
- 22 アンテナ用導電体
- 22a、22b 接続端子
- 30 ICチップ

- 32 チップ本体
- 33 回路形成面
- 33a 回路配線
- 33b 端縁
- 34a, 34b パンプ(導通用パンプ)
- 34c 支持用パンプ
- 40 インターポーザ
- 44 接続用導電体
- 44a, 44b 接続端子
- X 端縁の長さ
- Y 端縁に沿った接続端子間の離間長さ
- L 端縁に沿ったパンプの長さ

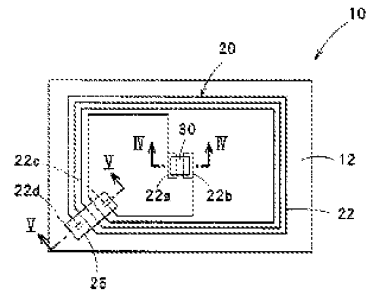
【図1】



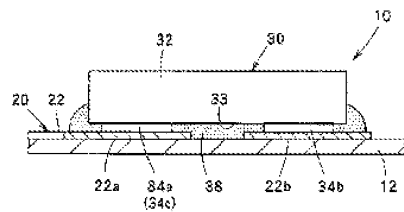
【図2】



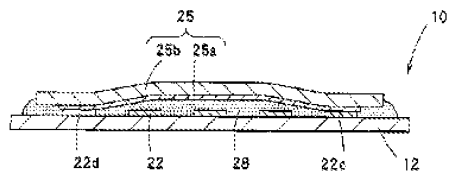
【図3】



【図4】

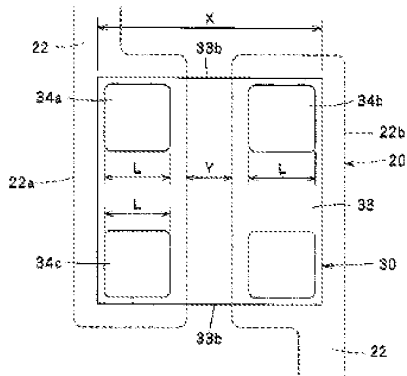


【図5】

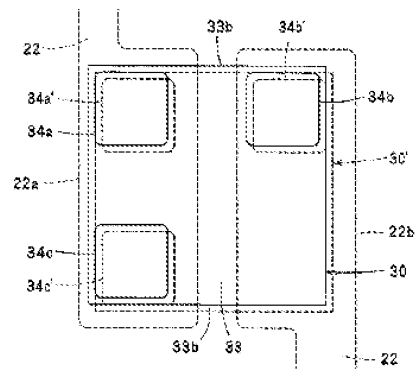




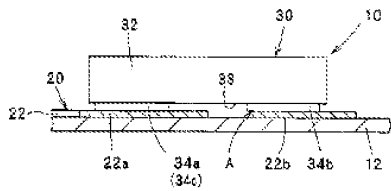
【図6】



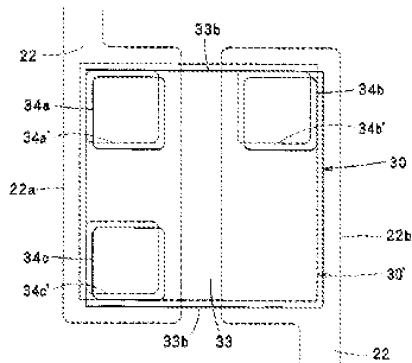
【図8】



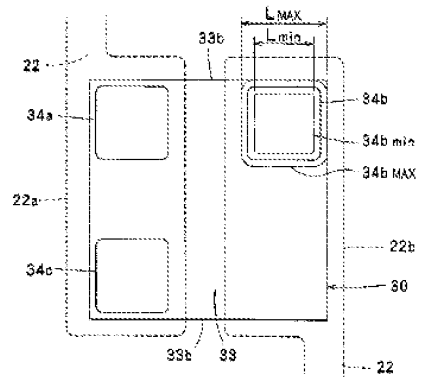
【図7】



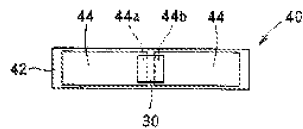
【図9】



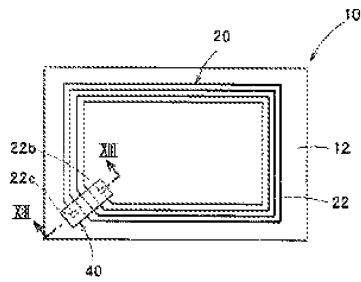
【図10】



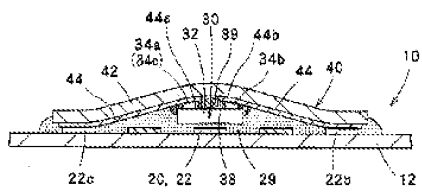
【図11】



【圖12】



【圖13】



- (72)発明者 坂 田 英 人  
東京都新宿区市谷加賀町一丁目1番1号 大日本印刷株式会社内
- (72)発明者 勝 呂 啓 志  
東京都新宿区市谷加賀町一丁目1番1号 大日本印刷株式会社内
- (72)発明者 工 藤 寛 之  
東京都新宿区市谷加賀町一丁目1番1号 大日本印刷株式会社内
- (72)発明者 福 岡 義 孝  
東京都新宿区市谷加賀町一丁目1番1号 大日本印刷株式会社内
- Fターム(参考) 5B035 AA08 BA03 BB09 CA03 CA08 CA23



Espacenet

**Bibliographic data: JP2012008857 (A) — 2012-01-12**
**ANTENNA CIRCUIT CONFIGURING BODY FOR IC CARD/TAG, AND METHOD FOR MANUFACTURING THE SAME**
**Inventor(s):** HIGASHIYAMA DAIKI ± (HIGASHIYAMA DAIKI)

**Applicant(s):** TOYO ALUMINIUM KK ± (TOYO ALUMINIUM KK)

**Classification:** - international: G06K19/07; G06K19/077  
 - cooperative: G06K19/07718; G06K19/07773; G06K19/07775;  
G06K19/07783; H01Q1/2225; H01Q1/38; H01Q7/00;  
H05K3/4685
**Application number:** JP20100145078 20100625 [Global Dossier](#)
**Priority number(s):** JP20100145078 20100625

**Also published as:** [CN102971752 \(A\)](#) [CN102971752 \(B\)](#) [EP2587413 \(A1\)](#) [EP2587413 \(A4\)](#) [EP2587413 \(B1\)](#) [more](#)
**Abstract of JP2012008857 (A)**

**PROBLEM TO BE SOLVED:** To provide an antenna circuit configuring body for IC cards/tags capable of reducing a load applied to environment and improving the reliability of a joining portion of both ends of antenna circuit pattern layers in a manufacturing process for joining the both ends of the antenna circuit pattern layers, and to provide a method for manufacturing the same. **SOLUTION:** In the antenna circuit configuring body for IC cards/tags, an insulating layer 107 is formed so as to extend from the upper part of a first circuit pattern layer 103 to the upper part of a second circuit pattern layer via the upper part of an antenna coil 101. A conductive layer 108 is formed on the insulating layer 107 to establish electrical conductivity between the first circuit pattern layer 103 and the second circuit pattern layer. The insulating layer 107 has a plurality of slope end faces on the respective upper parts of the first circuit pattern layer 103 and the second circuit pattern layer.

(19) 日本国特許庁(JP)

(12) 公開特許公報(A)

(11) 特許出願公開番号

特開2012-8857

(P2012-8857A)

(43) 公開日 平成24年1月12日(2012.1.12)

(51) Int. Cl.	F I	テーマコード (参考)
G06K 19/07 (2006.01)	G06K 19/00 K	5B035
G06K 19/07 (2006.01)	G06K 19/00 H	

審査請求 未請求 請求項の数 6 O L (全 16 頁)

(21) 出願番号	特願2010-145078 (P2010-145078)	(71) 出願人	399054321 東洋アルミニウム株式会社 大阪府大阪市中央区久太郎町三丁目6番8号
(22) 出願日	平成22年6月25日 (2010. 6. 25)	(74) 代理人	100099922 弁理士 甲田 一幸
		(72) 発明者	東山 大樹 大阪府大阪市中央区久太郎町三丁目6番8号 東洋アルミニウム株式会社内
		Fターム(参考)	5B035 AA04 BA03 BB09 CA08 CA23

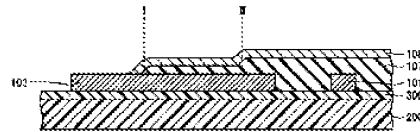
(54) 【発明の名称】 ICカード・タグ用アンテナ回路構成体とその製造方法

(57) 【要約】 (修正有)

【課題】 アンテナ回路パターン層の両端部を接合するための製造工程において環境に与える負荷を低減させ、アンテナ回路パターン層の両端部の接合箇所の信頼性を高めることが可能なICカード・タグ用アンテナ回路構成体とその製造方法を提供する。

【解決手段】 ICカード・タグ用アンテナ回路構成体は、絶縁層107が第1の回路パターン層部分103の上からアンテナコイル部101の上を経て第2の回路パターン層部分の上まで延びるように形成されている。導電層108が第1の回路パターン層部分103と第2の回路パターン層部分とを導通させるように絶縁層107の上に形成されている。絶縁層107が第1の回路パターン層部分103と第2の回路パターン層部分のそれぞれの上において複数の傾斜端面を有する。

【選択図】 図11



## 【特許請求の範囲】

## 【請求項 1】

樹脂フィルムからなる基材と、  
前記基材の一方表面の上に形成された、主成分として金属を含む導電体からなるアンテナ回路パターン層と、を備え、

前記アンテナ回路パターン層は、電氣的に接続される第 1 の回路パターン層部分と第 2 の回路パターン層部分と、前記第 1 と第 2 の回路パターン層部分の間の前記基材の領域の一方表面の上に形成された第 3 の回路パターン層部分と、を含み、さらに、

前記第 1 の回路パターン層部分の上から前記第 3 の回路パターン層部分の上を経て前記第 2 の回路パターン層部分の上まで延びるように形成された絶縁層と、

前記第 1 の回路パターン層部分と前記第 2 の回路パターン層部分とを導通させるように前記絶縁層の上に形成された導電層と、を備え、

前記絶縁層が、前記第 1 の回路パターン層部分と前記第 2 の回路パターン層部分のそれぞれの上において複数の傾斜端面を有する、IC カード・タグ用アンテナ回路構成体。

## 【請求項 2】

前記絶縁層が、前記第 1 の回路パターン層部分と前記第 2 の回路パターン層部分のそれぞれの上において段差部分を有する、請求項 1 に記載の IC カード・タグ用アンテナ回路構成体。

## 【請求項 3】

前記絶縁層が、前記第 3 の回路パターン層部分の上に形成された相対的に厚みの大きい中央部分と、前記第 1 の回路パターン層部分と前記第 2 の回路パターン層部分のそれぞれの上に形成された相対的に厚みの小さい両端部分とを含む、請求項 1 または請求項 2 に記載の IC カード・タグ用アンテナ回路構成体。

## 【請求項 4】

前記絶縁層がポリエステル樹脂からなる、請求項 1 から請求項 3 までのいずれか 1 項に記載の IC カード・タグ用アンテナ回路構成体。

## 【請求項 5】

前記アンテナ回路パターン層は銅箔からなり、前記アンテナ回路パターン層と前記基材は接着剤層を介して熱接着されており、前記導電層は銀を含む、請求項 1 から請求項 4 までのいずれか 1 項に記載の IC カード・タグ用アンテナ回路構成体。

## 【請求項 6】

樹脂フィルムからなる基材の一方表面の上に金属箔を固着する工程と、  
前記金属箔の上に所定のパターンを有するレジストインク層を印刷する工程と、  
前記レジストインク層をマスクとして用いて前記金属箔をエッチングすることによって、前記基材の一方表面の上に、電氣的に接続される第 1 の回路パターン層部分と第 2 の回路パターン層部分と、前記第 1 と第 2 の回路パターン層部分の間の前記基材の領域の一方表面の上に形成された第 3 の回路パターン層部分とを含むアンテナ回路パターン層を形成する工程と、

前記第 1 の回路パターン層部分の上から前記第 3 の回路パターン層部分の上を経て前記第 2 の回路パターン層部分の上まで延びるように第 1 の絶縁層部分を形成する工程と、

前記第 1 の回路パターン層部分と前記第 2 の回路パターン層部分のそれぞれの上形成された前記第 1 の絶縁層部分の一部表面を露出するように前記第 1 の絶縁層部分の上に第 2 の絶縁層部分を形成する工程と、

前記第 1 の回路パターン層部分と前記第 2 の回路パターン層部分とを導通させる導電層を前記第 1 と第 2 の絶縁層部分の上に形成する工程と、  
を備えた、IC カード・タグ用アンテナ回路構成体の製造方法。

## 【発明の詳細な説明】

## 【技術分野】

【0001】

10

20

30

40

50

本発明は、一般的には、ICカード・タグ用アンテナ回路構成体とその製造方法に関し、特定的には、非接触ICカード、万引き防止センサ等に代表されるRFID (Radio Frequency Identification) のためのアンテナ回路を備えたICカード・タグ用アンテナ回路構成体とその製造方法に関するものである。

【背景技術】

【0002】

近年、ICタグ、ICカード等の機能カードは、目覚しい発展を遂げ、盗難防止用タグ、出人者チェック用タグ、テレホンカード、クレジットカード、プリペイドカード、キャッシュカード、IDカード、カードキー、各種会員カード、図書券、診察券、定期券等に使用され始めている。これらの機能カード用アンテナ回路構成体は、ポリプロピレン (PP) フィルム、ポリエチレンテレフタレート (PET) フィルム等の樹脂フィルムからなる基材と、基材の表面上に形成されたアルミニウム箔または銅箔の金属箔からなるアンテナ回路パターン層とから構成される。アンテナ回路パターン層は、基材の片面または両面に接着剤を介在して金属箔をドライラミネート法等によって接着した後、その金属箔にエッチング処理を施すことにより、基材の表面上に形成される。

10

【0003】

上記のような構成の従来のアンテナ回路構成体とその製造方法は、特開2002-7990号公報 (特許文献1)、特開2004-140587号公報 (特許文献2) に記載されている。

【0004】

従来のRFID用アンテナ回路構成体では、一般的に、樹脂フィルムからなる基材の両面に回路のパターン層が形成されている。基材の一方の面にはコイル状のアンテナ回路のパターン層が形成されている。このアンテナ回路のパターン層が、電子回路のコイルに相当し、同時に電磁波を受け取るアンテナの役割を果たし、いわゆるコイルパターンと呼ばれる。基材の反対側の他方の面には、上記のアンテナ回路のジャンパーの役割を果たす回路のパターン層が形成されている。この回路のパターン層は、いわゆるブリッジ回路パターン層と呼ばれる。

20

【0005】

このようなアンテナ回路構成体において、基材の一方面側に形成されたアンテナ回路パターン層と、基材の他方面側に形成されたブリッジ回路パターン層との電氣的接続方法としては、以下の方法がある。

30

【0006】

(1) アンテナ回路パターン層が形成された基材の一方面側と反対側の他方面側にブリッジ回路パターン層を形成し、接合されるべきアンテナ回路パターン層の両端部とブリッジ回路パターン層の両端部のそれぞれの箇所にて基材を貫通するスルーホールを形成する。メッキまたは銀塗料でスルーホールを充填することによって、基材の一方面側に形成されたアンテナ回路パターン層の両端部と基材の他方面側に形成されたブリッジ回路パターン層の両端部とを接続する。

【0007】

(2) 特開2002-7990号公報 (特許文献1)、特開2004-140587号公報 (特許文献2) に開示されているように、アンテナ回路パターン層が形成された基材の一方面側と反対側の他方面側にブリッジ回路パターン層を形成し、クレンジング加工によって、基材の一方面側に形成されたアンテナ回路パターン層の両端部と基材の他方面側に形成されたブリッジ回路パターン層の両端部のそれぞれの箇所を接続する。ここで、クレンジング加工とは、たとえば、超音波等により、基材の両面に接着剤を介在して形成された回路パターン層の少なくとも一部同士を押圧することによって、接着剤、基材等を構成する樹脂を部分的に破壊し、両側の回路パターン層の一部同士を物理的に接触させることをいう。

40

【0008】

(3) 特開2008-269161号公報 (特許文献3) に開示されているように、ア

50

アンテナ回路パターン層が形成された基材の一方面側と反対側の他方面側にブリッジ回路パターン層を形成し、抵抗溶接によって、基材の一方面側に形成されたアンテナ回路パターン層と基材の他方面側に形成されたブリッジ回路パターン層とを接続する。この場合、溶接電極を回路パターン層の表側と裏側に接触させて圧力を加えた状態で、溶接電極に所定の電流を流すことによって加熱することにより、表側と裏側の回路パターン層の間に介在する基材の一部を溶融させるとともに、互いに対向する表側と裏側の回路パターン層の一部を接触させる。接触させられた表側と裏側の回路パターン層の一部に所定の溶接電流を流すことにより、互いに対向する表側と裏側の回路パターン層の一部を接合する。

【0009】

なお、アンテナ回路構成体において、基材の他方面側にブリッジ回路パターン層を形成しないで、基材の一方面側に形成されたアンテナ回路パターン層の両端部を電気的に接続する方法としては、以下の方法がある。

【0010】

(4) 特開2001-92936号公報(特許文献4)、特開2005-109505号公報(特許文献5)に開示されているように、基材の一方表面にアンテナ回路パターン層を形成し、ジャンパー回路パターン層と交差するアンテナ回路パターン層の一部分の上に絶縁性樹脂を塗布して絶縁層を形成し、アンテナ回路パターン層の両端部において接合される箇所同士を電気的に接続するように、絶縁層の上に銀ペースト等の導電性物質を塗布することにより、ジャンパー回路パターン層を形成する。

【0011】

(5) 特開2010-28706号公報(特許文献6)に開示されているように、基材と基材の一方表面に形成されたアンテナ回路パターン層とを貫通するように、導電性の線状体の一方端部と他方端部のそれぞれの先端縁を、基材の他方表面から、電気的に接続されるべきアンテナ回路パターン層の両端部のそれぞれに突き刺すことによって、基材の他方表面の上に線状体の中央部を延在させ、線状体の一方端部をアンテナ回路パターン層の一方端部の表面上に配置し、線状体の他方端部をアンテナ回路パターン層の他方端部の表面上に配置する。

【先行技術文献】

【特許文献】

【0012】

【特許文献1】 特開2002-7990号公報

【特許文献2】 特開2004-140587号公報

【特許文献3】 特開2008-269161号公報

【特許文献4】 特開2001-92936号公報

【特許文献5】 特開2005-109505号公報

【特許文献6】 特開2010-28706号公報

【発明の概要】

【発明が解決しようとする課題】

【0013】

(1)、(2)および(3)の方法では、アンテナ回路パターン層の両端部を電気的に接続するために、基材の他方面側にブリッジ回路パターン層を形成する。ブリッジ回路パターン層は、基材の他方面側に接着剤で固着された金属箔をエッチングすることにより、形成される。このとき、基材の表面上に接着された金属箔の大部分をエッチング処理によって除去している。このため、金属箔の無駄が多いので製造コストが高くなるだけでなく、金属箔の大部分をエッチング処理によって除去するので生産性が低いという問題がある。また、ブリッジ回路パターン層を形成する目的だけのために基材の他方面側に金属箔を別に固着する必要があるだけでなく、その金属箔をエッチング加工する必要があるため、余分にエッチング液が必要になり、さらに、エッチング加工によって金属イオンを含む廃液が多く発生することになるという問題がある。その結果、環境に与える負荷が高くなるという問題がある。

10

20

30

40

50



## 【0014】

(4)の方法では、上記(1)、(2)および(3)の方法のようにブリッジ回路パターン層を形成する目的だけのために基材の他方面側に別に固着した金属箔をエッチング加工する必要がないので、環境に与える負荷を低減することができる。しかし、アンテナ回路パターン層の厚みが厚くなると、絶縁性を確保するために絶縁層の厚みが増える。このため、ジャンパー回路パターン層の高低差が増える。これにより、ジャンパー回路パターン層を形成した後にアンテナ回路構成体を搬送する際にジャンパー回路パターン層にクラックが生じて断線するという問題がある。その結果、信頼性の点で問題がある。

## 【0015】

また、(5)の方法では、上記(1)、(2)および(3)の方法のようにブリッジ回路パターン層を形成する目的だけのために基材の他方面側に別に固着した金属箔をエッチング加工する必要がないので、環境に与える負荷を低減することができる。しかし、導電性の線状体の先端縁が柔軟性に欠けること、加工後にアンテナ回路構成体を搬送するときに線状体の先端縁が移動してアンテナ回路パターン層を破損させること等の問題がある。その結果、信頼性の点で問題がある。

## 【0016】

そこで、本発明の目的は、アンテナ回路パターン層の両端部を接合するための製造工程において環境に与える負荷を低減させることができるとともに、アンテナ回路パターン層の両端部の接合箇所の信頼性を高めることが可能なICカード・タグ用アンテナ回路構成体とその製造方法を提供することである。

## 【課題を解決するための手段】

## 【0017】

本発明にしたがったICカード・タグ用アンテナ回路構成体は、樹脂フィルムからなる基材と、この基材の一方表面の上に形成された、主成分として金属を含む導電体からなるアンテナ回路パターン層と、を備える。アンテナ回路パターン層は、電気的に接続される第1の回路パターン層部分と第2の回路パターン層部分と、第1と第2の回路パターン層部分の間の基材の領域の一方表面の上に形成された第3の回路パターン層部分と、を含む。さらに、本発明のICカード・タグ用アンテナ回路構成体は、第1の回路パターン層部分の上から第3の回路パターン層部分の上を経て第2の回路パターン層部分の上まで延びるように形成された絶縁層と、第1の回路パターン層部分と第2の回路パターン層部分とを導通させるように絶縁層の上に形成された導電層と、を備える。絶縁層が、第1の回路パターン層部分と第2の回路パターン層部分のそれぞれの上において複数の傾斜端面を有する。

## 【0018】

本発明のICカード・タグ用アンテナ回路構成体においては、ブリッジ回路パターン層としての導電層を形成する目的だけのために基材の他方表面側に別に固着した金属箔をエッチング加工する必要がないので、環境に与える負荷を低減することができる。

## 【0019】

また、絶縁層が第1の回路パターン層部分と第2の回路パターン層部分のそれぞれの上において複数の傾斜端面を有するので、絶縁層端部の傾斜を緩やかにすることができる。これにより、導電層を形成した後にアンテナ回路構成体を搬送する際に導電層にクラックが生じて断線するという問題を解消することができる。その結果、アンテナ回路パターン層の両端部の接合箇所の信頼性を高めることが可能になる。

## 【0020】

本発明のICカード・タグ用アンテナ回路構成体において、絶縁層が、第1の回路パターン層部分と第2の回路パターン層部分のそれぞれの上において段差部分を有することが好ましい。

## 【0021】

また、本発明のICカード・タグ用アンテナ回路構成体において、絶縁層が、第3の回路パターン層部分の上に形成された相対的に厚みの大きい中央部分と、第1の回路パター

10

20

30

40

50

ン層部分と第2の回路パターン層部分のそれぞれの上に形成された相対的に厚みの小さい両端部分とを含むことが好ましい。

【0022】

さらに、本発明のICカード・タグ用アンテナ回路構成体において、絶縁層がポリエステル樹脂からなることが好ましい。

【0023】

本発明のICカード・タグ用アンテナ回路構成体において、アンテナ回路パターン層は銅箔からなり、アンテナ回路パターン層と基材は接着剤層を介して熱接着されており、導電層は銀を含むことが好ましい。

【0024】

本発明に従ったICカード・タグ用アンテナ回路構成体の製造方法は、次の工程を備える。

【0025】

(a) 樹脂フィルムからなる基材の一方表面の上に金属箔を固着する工程

【0026】

(b) 金属箔の上に所定のパターンを有するレジストインク層を印刷する工程

【0027】

(c) レジストインク層をマスクとして用いて金属箔をエッチングすることによって、基材の一方表面の上に、電氣的に接続される第1の回路パターン層部分と第2の回路パターン層部分と、第1と第2の回路パターン層部分の間の基材の領域の一方表面の上に形成された第3の回路パターン層部分とを含むアンテナ回路パターン層を形成する工程

【0028】

(d) 第1の回路パターン層部分の上から第3の回路パターン層部分の上を経て第2の回路パターン層部分の上まで延びるように第1の絶縁層部分を形成する工程

【0029】

(e) 第1の回路パターン層部分と第2の回路パターン層部分のそれぞれの上に形成された第1の絶縁層部分の一部表面を露出するように第1の絶縁層部分の上に第2の絶縁層部分を形成する工程

【0030】

(f) 第1の回路パターン層部分と第2の回路パターン層部分とを導通させる導電層を第1と第2の絶縁層部分の上に形成する工程

【発明の効果】

【0031】

以上のように本発明によれば、アンテナ回路パターン層の両端部を接合するための製造工程において環境に与える負荷を低減させることができるとともに、アンテナ回路パターン層の両端部の接合箇所の信頼性を高めることが可能になる。

【図面の簡単な説明】

【0032】

【図1】本発明の一つの実施の形態に従ったICカード・タグ用アンテナ回路構成体を示す平面図である。

【図2】図1の一部分を拡大して示す部分拡大平面図である。

【図3】図1と図2のI-I-I-I-I線方向から見た模式的な部分断面図である。

【図4】本発明の一つの実施の形態に従ったICカード・タグ用アンテナ回路構成体の第1の製造工程を示す模式的な部分断面図である。

【図5】本発明の一つの実施の形態に従ったICカード・タグ用アンテナ回路構成体の第2の製造工程を示す模式的な部分断面図である。

【図6】本発明の一つの実施の形態に従ったICカード・タグ用アンテナ回路構成体の第3の製造工程を示す模式的な部分断面図である。

【図7】本発明の一つの実施の形態に従ったICカード・タグ用アンテナ回路構成体の第4の製造工程を示す模式的な部分断面図である。

10

20

30

40

50

【図 8】本発明の一つの実施の形態に従った IC カード・タグ用アンテナ回路構成体の第 5 の製造工程を示す模式的な部分断面図である。

【図 9】本発明の一つの実施の形態に従った IC カード・タグ用アンテナ回路構成体の製造方法において絶縁層を形成するための第 1 の塗布工程を示す部分拡大断面図である。

【図 10】本発明の一つの実施の形態に従った IC カード・タグ用アンテナ回路構成体の製造方法において絶縁層を形成するための第 2 の塗布工程を示す部分拡大断面図である。

【図 11】本発明の一つの実施の形態に従った IC カード・タグ用アンテナ回路構成体の製造方法において導電層を形成するための塗布工程を示す部分拡大断面図である。

【図 12】従来の IC カード・タグ用アンテナ回路構成体の製造方法において絶縁層を形成するための塗布工程を示す部分拡大断面図である。

10

【図 13】従来の IC カード・タグ用アンテナ回路構成体の製造方法において導電層を形成するための塗布工程を示す部分拡大断面図である。

【図 14】帯状の樹脂フィルム基材の表面上に作製された複数のアンテナ回路構成体の配列を示す平面図である。

【図 15】帯状の樹脂フィルム基材の表面上に作製された複数のアンテナ回路構成体の一部を切り出した試料シートを示す平面図である。

【図 16】本発明の実施例と比較例において作製された試料シートの評価試験の方法を説明するための図である。

【発明を実施するための形態】

【0033】

20

以下、本発明の実施の形態を図面に基づいて説明する。

【0034】

図 1～図 3 に示すように、IC カード・タグ用アンテナ回路構成体は、樹脂を含む樹脂フィルムからなる基材 200 と、基材 200 の一方表面上に接着剤層 300 を介在させて所定のパターンに従って形成された、主成分として銅を含む銅箔からなるアンテナ回路パターン層 100 とから構成されている。

【0035】

図 1 に示されるように、アンテナ回路パターン層 100 は、基材の一方表面上に渦巻状のパターンで形成されたアンテナコイル部 101 と、IC チップ搭載部 102 と、アンテナコイル部 101 の端部に接続するように形成された第 1 の回路パターン層部分 103 および第 2 の回路パターン層部分 104 と、スリットラインマーク部 105 と、センサマーク部 106 とから構成される。アンテナコイル部 101 の内周側の端部には IC チップ（図示せず）に配線を接続するための領域が形成され、その端部付近には IC チップ搭載部 102 が形成されている。第 1 の回路パターン層部分 103 は、IC チップ搭載部 102 の上に IC チップが搭載されることにより、アンテナコイル部 101 の内周側の端部に電氣的に接続される。第 2 の回路パターン層部分 104 は、アンテナコイル部 101 の外周側の端部に電氣的に接続されている。アンテナコイル部 101 の外側で、隣り合う別の回路パターン層（図 1 には示されていない）との間の領域には、各アンテナコイル構成体を分離切断するための位置を示すためにスリットラインマーク部 105 が、アンテナ回路パターン層 100 と同様にして銅箔からなる線状パターンで形成されている。アンテナコイル部 101 の内側には、センサ位置を確認するためのセンサマーク部 106 が、アンテナ回路パターン層 100 と同様にして銅箔からなる島状パターンで形成されている。

30

40

【0036】

図 2 と図 3 に示すように、第 1 の回路パターン層部分 103 と第 2 の回路パターン層部分 104 の間の基材 200 の領域には、アンテナコイル部 101 を構成する複数の線状パターン層の一部分として第 3 の回路パターン層部分が配置されている。絶縁層 107 が、第 1 の回路パターン層部分 103 の上から第 3 の回路パターン層部分（アンテナコイル部 101 を構成する複数の線状パターン層の一部分）の上を経て第 2 の回路パターン層部分 104 の上まで延びるように形成されている。すなわち、絶縁層 107 は、第 3 の回路パターン層部分（アンテナコイル部 101 を構成する複数の線状パターン層の一部分）の上

50

を跨るように形成され、第1の回路パターン層部分103と第2の回路パターン層部分104の一部の上に形成されている。また、絶縁層107は、アンテナコイル部101を構成する線状パターン層部分の間隙を充填するように形成されている。第1の回路パターン層部分103と第2の回路パターン層部分104とを導通させるように導電層108が絶縁層107の上に形成されている。なお、絶縁層107は、図3では模式的に示されているが、具体的な形状については後述する。

#### 【0037】

アンテナ回路パターン層100を形成するために使用される銅箔は、厚みが $9\mu\text{m}$ 以上 $50\mu\text{m}$ 以下であることが好ましい。銅箔の厚みが $9\mu\text{m}$ 未満の場合には、ピンホールが多く発生するとともに製造工程において破断するおそれがある。一方、銅箔の厚みが $50\mu\text{m}$ を超える場合には、アンテナ回路パターン層100を形成するためのエッチング処理に時間がかかるとともに、材料コストの上昇を招く。なお、銅箔は、圧延または電解のいずれで製造されたものでもよい。アンテナ回路パターン層100を形成するために銅箔以外の金属箔を用いてもよい。

#### 【0038】

本発明のICカード・タグ用アンテナ回路構成体の基材200として用いられる樹脂フィルムは、ポリエチレンテレフタレート（PET）フィルム、ポリエチレンナフタレート（PEN）フィルム等から選ばれる少なくとも1種であるのが好ましい。この樹脂フィルムの厚みは $15\mu\text{m}$ 以上 $50\mu\text{m}$ 以下の範囲内であることが好ましく、より好ましくは $20\mu\text{m}$ 以上 $40\mu\text{m}$ 以下の範囲内である。基材200の厚みが $15\mu\text{m}$ 未満では、アンテナ回路パターン層を形成する銅箔との積層体の剛性が不足するため、各製造工程での作業性に問題が生じる。一方、基材の厚みが $50\mu\text{m}$ を超える場合には、ICカード・タグの厚みや重量が過大になるおそれがある。

#### 【0039】

アンテナ回路パターン層100を形成するための銅箔と、基材200としての樹脂フィルムとの間の接着は、エポキシ樹脂を含有するポリウレタン（PU）系接着剤を用いたドライラミネーションによるのが好ましい。エポキシ樹脂を含有するポリウレタン系接着剤としては東洋モートン社製AD506、AD503、AD76-P1等を採用することができ、硬化剤としては同社製CAT-10を接着剤：硬化剤＝2～12：1の比率で配合して使用すればよい。通常のエポキシ樹脂を含有しないポリウレタン系接着剤を用いた場合には、回路パターン層を形成するためのエッチング処理中に、または、ICチップを実装するときに、デラミネーション（剥離）が生じやすくなる。これは、エポキシ樹脂を含有しないポリウレタン系接着剤が耐薬品性や耐熱性に劣るからである。

#### 【0040】

基材200としての樹脂フィルムの上にアンテナ回路パターン層100を形成するために用いられる銅箔110を接着させるためには、エポキシ樹脂を含有するポリウレタン系接着剤を乾燥後において重量で $1\sim 15\text{g}/\text{m}^2$ 程度塗布するのが好ましい。この塗布量が $1\text{g}/\text{m}^2$ 未満では、銅箔の接着力が不足し、 $15\text{g}/\text{m}^2$ を超える場合には、製造コストの上昇を招く。

#### 【0041】

絶縁層107としては、ポリアミド樹脂、エポキシ樹脂、ポリエステル樹脂、フェノール樹脂、ウレタン樹脂、アクリル樹脂等の、樹脂フィルムと接着剤の特性が損なわれない程度の加熱で硬化するものを使用することができる。ポリエステル樹脂が好ましい。

#### 【0042】

絶縁層107の厚み（第1の回路パターン層部分103と第2の回路パターン層部分104の上に形成される絶縁層107の厚み）は、 $10\mu\text{m}$ 以上 $100\mu\text{m}$ 以下の範囲内であることが好ましい。絶縁層107の厚みが $10\mu\text{m}$ 未満では、絶縁効果が十分でない。一方、絶縁層107の厚みが $100\mu\text{m}$ を超えると、絶縁層107の形成が困難である上に、導電層108の形成に支障をきたす恐れがある。

#### 【0043】

導電層 108 の材料としては、金ペースト、銀ペースト、銅ペースト、アルミペースト、ニッケルペースト、導電性高分子等が挙げられ、導電性に優れる銀ペーストが好適に使用される。

【0044】

導電層 108 の厚みは、 $1\ \mu\text{m}$  以上  $50\ \mu\text{m}$  以下の範囲内であることが好ましい。導電層 108 の厚みが  $1\ \mu\text{m}$  未満では、導電効果が十分でない。一方、導電層 108 の厚みが  $50\ \mu\text{m}$  を超えると、屈曲性が低下し、導電層 108 が剥がれ落ちる、または、クラック断線が発生する恐れがある。

【0045】

次に、本発明の IC カード・タグ用アンテナ回路構成体の製造方法の一つの実施の形態について説明する。なお、図 4～図 8 は、図 1 と図 2 の III-III 線 の方向から見た部分断面を示している。

10

【0046】

図 4 に示すように、樹脂フィルムからなる基材 200 の一方表面に接着剤層 300 を形成し、この接着剤層 300 によって基材 200 の一方表面に銅箔 110 を固着する。このようにして、銅箔 110 と基材 200 との積層体を準備する。

【0047】

図 5 に示すように、アンテナコイルの仕様に従った所定の渦巻状パターンを有するようにレジストインク層 400 を銅箔 110 の表面上に印刷する。印刷後、レジストインク層 400 の硬化処理を行なう。

20

【0048】

レジストインク層 400 をマスクとして用いて銅箔 110 をエッチングすることにより、アンテナ回路パターン層 100 (図 1) を形成する。図 6 に示す断面では、アンテナコイル部 101、第 1 の回路パターン層部分 103 および第 2 の回路パターン層部分 104 が形成される。

【0049】

そして、図 7 に示すように、図 6 のレジストインク層 401、403、404 を剥離する。

【0050】

その後、図 8 に示すように、第 1 の回路パターン層部分 103 の一部表面の上から、アンテナコイル部 101 を構成する複数の線状パターン層の一部を交差して跨るようにして、第 2 の回路パターン層部分 104 の一部表面の上まで延びるように絶縁層 107 を形成する。さらに、図 3 に示すように、第 1 の回路パターン層部分 103 と第 2 の回路パターン層部分 104 とを導通させるように導電層 108 を絶縁層 107 の上に形成する。このようにして本発明の IC カード・タグ用アンテナ回路構成体が完成する。

30

【0051】

図 8 に示す絶縁層形成工程と図 3 に示す導電層形成工程とについて、図 9～図 11 を用いて具体的に説明する。なお、図 9～図 11 は、図 8 と図 3 の左側の部分を拡大して示す部分拡大断面図である。

【0052】

図 8 に示す絶縁層形成工程では、まず、図 9 に示すように、第 1 の回路パターン層部分 103 の上の箇所 I から矢印 R の方向に樹脂ペーストをスクリーン印刷法により塗布して第 1 の絶縁層部分 107 a を形成する。その後、図 10 に示すように、第 1 の回路パターン層部分 103 の上の箇所 II まで矢印 S の方向に樹脂ペーストをスクリーン印刷法により第 1 の絶縁層部分 107 a の上に塗布して第 2 の絶縁層部分 107 b を形成する。このとき、第 2 の絶縁層部分 107 b は、第 1 の回路パターン層部分 103 と第 2 の回路パターン層部分 104 のそれぞれの上に形成された第 1 の絶縁層部分 107 a の一部表面 (a の部分) を露出するように第 1 の絶縁層部分 107 a の上に形成される。そして、樹脂ペーストを加熱乾燥させることにより、第 1 の絶縁層部分 107 a と第 2 の絶縁層部分 107 b とを含む絶縁層 107 を形成する。このようにして樹脂ペーストを 2 回に分けて塗布

40

50

することによって絶縁層107を形成する。なお、箇所11には、塗布直後では階段状の段差部が形成されるが、加熱乾燥後に滑らかな傾斜面を有する段差部が形成される。

【0053】

本発明では、上述したように絶縁層107が形成されるので、絶縁層107は、第1の回路パターン層部分103の上において複数の傾斜端面、具体的には、箇所1における傾斜端面と箇所11における傾斜端面とを有する。同様に、絶縁層107は、第2の回路パターン層部分104の上において複数の傾斜端面を有する。

【0054】

樹脂ペーストの2回塗布の方法は、次のようにして行ってもよい。まず、図9に示すように、第1の回路パターン層部分103の上の箇所1まで矢印Sの方向に樹脂ペーストをスクリーン印刷法により塗布して第1の絶縁層部分107aを形成する。その後、図10に示すように、第1の回路パターン層部分103の上の箇所11から矢印Rの方向に樹脂ペーストをスクリーン印刷法により第1の絶縁層部分107aの上に塗布して第2の絶縁層部分107bを形成する。

【0055】

図3に示す導電層形成工程では、図11に示すように、銀ペーストをスクリーン印刷法により絶縁層107の上に塗布した後に加熱乾燥することによって、導電層108を形成する。

【0056】

本発明のICカード・タグ用アンテナ回路構成体においては、ブリッジ回路パターン層としての導電層を形成する目的だけのために基材200の他方表面側に別に固着した金属箔をエッチング加工する必要がないので、環境に与える負荷を低減することができる。

【0057】

また、絶縁層107が第1の回路パターン層部分103と第2の回路パターン層部分104のそれぞれの上において複数の傾斜端面を有するので、絶縁層107の端部の傾斜を緩やかにすることができる。これにより、導電層108を形成した後にアンテナ回路構成体を搬送する際に導電層108にクラックが生じて断線するという問題を解消することができる。その結果、アンテナ回路パターン層100の両端部の接合箇所の信頼性を高めることが可能になる。

【0058】

本発明のICカード・タグ用アンテナ回路構成体において、絶縁層107が、第1の回路パターン層部分103と第2の回路パターン層部分104のそれぞれの上において段差部分、具体的には箇所11における段差部分を有することが好ましい。

【0059】

また、本発明のICカード・タグ用アンテナ回路構成体において、絶縁層107が、第3の回路パターン層部分（アンテナコイル部101を構成する複数の線状パターン層の一部）の上に形成された相対的に厚みの大きい中央部分（第1の絶縁層部分107aと第2の絶縁層部分107bとから構成される部分）と、第1の回路パターン層部分103と第2の回路パターン層部分104のそれぞれの上に形成された相対的に厚みの小さい両端部分（第1の絶縁層部分107aのみから構成される部分）とを含むことが好ましい。

【0060】

これに対して、従来の絶縁層形成工程と導電層形成工程では、まず、図12に示すように、第1の回路パターン層部分103の上の箇所1から矢印Rの方向に、あるいは、箇所1まで矢印Sの方向に、樹脂ペーストをスクリーン印刷法により1回で塗布した後に加熱乾燥することによって、絶縁層107を形成する。上記の樹脂ペーストの塗布は、2回に分けて行ってもよい。次に、図13に示すように、銀ペーストをスクリーン印刷法により絶縁層107の上に塗布した後に加熱乾燥することによって、導電層108を形成する。

【0061】

従来の絶縁層形成工程では、絶縁層107が第1の回路パターン層部分103と第2の回路パターン層部分104のそれぞれの上（箇所1）において、単一の傾斜端面を有する

10

20

30

40

50

ので、絶縁層107の端部の傾斜が急である。これにより、導電層108を形成した後にアンテナ回路構成体を搬送する際に導電層108にクラックが生じて断線するという問題がある。その結果、信頼性の点で問題がある。

#### 【0062】

本発明の絶縁層107の形成方法としては、スクリーン印刷法、インクジェット印刷法等が挙げられる。スクリーン印刷法は、絶縁に必要な厚みを形成することが容易であり、また、任意形状を形成しやすいので、好適に使用される。

#### 【0063】

図10に示す絶縁層107の相対的に厚みの小さい両端部分(第1の絶縁層部分107aのみから構成される部分)において(a)と(t)の好ましい関係は、 $\tan \theta = t/a$ と表すと、 $\pi/90 (2^\circ) \leq \theta \leq \pi/3 (60^\circ)$ である。特に $\theta$ は、 $\pi/60 (3^\circ) \leq \theta \leq \pi/4 (45^\circ)$ である範囲内であることがより好ましい。絶縁が必要な導電部(アンテナコイル部101)から絶縁層107の相対的に厚みの小さい両端部分(第1の絶縁層部分107aのみから構成される部分)までの最短距離(b)は、0.5mm以上離れていることが好ましい。

#### 【0064】

導電層108の形成方法としては、スクリーン印刷法、インクジェット法、フレキシ印刷法等が挙げられるが、スクリーン印刷が導電体の厚みを形成することが容易であり、かつ、任意形状を形成しやすいために、好適に使用される。

#### 【0065】

本発明の製造方法において用いられるレジストインクは特に限定されないが、分子中に少なくとも1個のカルボキシル基を有するアクリルモノマーとアルカリ可溶性樹脂とを主成分とする紫外線硬化型レジストインクを用いるのが好ましい。このレジストインクは、グラビア印刷が可能であり、耐酸性を有し、かつアルカリによって容易に剥離除去することが可能であるので、連続大量生産に適している。このレジストインクを用いて、アルミニウム箔または銅箔に所定の回路パターンでグラビア印刷を施し、紫外線を照射して硬化させた後、通常の方法に従って、たとえば塩化第二鉄等によるアルミニウム箔または銅箔の酸エッチング、水酸化ナトリウム等のアルカリによるレジストインク層の剥離除去を行なうことによって、アンテナ回路パターン層を形成することができる。

#### 【0066】

分子中に少なくとも1個のカルボキシル基を有するアクリルモノマーとしては、たとえば、2-アクリロイルオキシエチルフタル酸、2-アクリロイルオキシエチルコハク酸、2-アクリロイルオキシエチルヘキサヒドロフタル酸、2-アクリロイルオキシプロピルフタル酸、2-アクリロイルオキシプロピルテトラヒドロフタル酸、2-アクリロイルオキシプロピルヘキサヒドロフタル酸等が挙げられ、これらのうち、単独のアクリルモノマー、またはいくつかのアクリルモノマーを混合したものを使用することができる。上記のアルカリ可溶性樹脂としては、たとえば、スチレン-マレイン酸樹脂、スチレン-アクリル樹脂、ロジン-マレイン酸樹脂等が挙げられる。

#### 【0067】

レジストインクには、上記の成分の他に、アルカリ剥離性を阻害しない程度に通常の単官能アクリルモノマー、多官能アクリルモノマー、プレポリマーを添加することができ、光重合開始剤、顔料、添加剤、溶剤等を適宜添加して作製することができる。光重合開始剤としては、ベンゾフェノンおよびその誘導体、ベンジル、ベンゾイン、およびそのアルキルエーテル、チオキサントンおよびその誘導体、ルシリンPTO、チバスベシャルティケミカルズ製イルガキュア、フラツテリ・ランベルティ製エサキュア等が挙げられる。顔料としては、パターンが見やすいように着色顔料を添加する他、シリカ、タルク、クレー、硫酸バリウム、炭酸カルシウム等の体質顔料を併用することができる。特にシリカは、紫外線硬化型レジストインクを付けたまま、銅箔を巻き取る場合には、ブロッキング防止に効果がある。添加剤としては、2-ターシャリーブチルヒドロキノン等の重合禁止剤、シリコン、フッ素化合物、アクリル重合物等の消泡剤、レベリング剤があり、必要に応

10

20

30

40

50

じて適宜添加する。溶剤としては酢酸エチル、エタノール、変性アルコール、イソプロピルアルコール、トルエン、MEK等が挙げられ、これらのうち、溶剤を単独、または混合して用いることができる。溶剤は、グラビア印刷の後、熱風乾燥等でレジストインク層から蒸発させることが好ましい。

【実施例】

【0068】

以下に説明するように本発明の実施例と従来例のアンテナ回路構成体の試料を作製した。

【0069】

(実施例)

【0070】

図4に示すように厚みが38 $\mu\text{m}$ のPETフィルムからなる基材200の一方表面には厚みが35 $\mu\text{m}$ の圧延された銅箔110を、エポキシ樹脂を含有するポリウレタン系接着剤を用いてドライラミネーション法により接着して積層体を作製した。このようにして得られた積層体の銅箔110上に、以下に示す組成のレジストインクとヘリオクリッシュグラビア版を用いて、図1に示すようなアンテナ回路パターン層100の印刷パターンを印刷した。印刷後、照射線量が480W/cm<sup>2</sup>の紫外線ランプで15秒間照射し、レジストインクを硬化させることにより、図5に示すようにレジストインク層400を形成した。

【0071】

インクの組成は以下のとおりである。

【0072】

ベッカサイトJ-896(大日本インキ化学工業社製ロジナーマレイン酸樹脂):21重量部、2-アクリロイロヘキシエチルヘキサヒドロフタル酸:25重量部、ユニディックV-5510(大日本インキ化学工業社製プレポリマー、モノマーの混合物):8重量部、イルガキュア184:3重量部、酢酸エチル:28重量部、変性アルコール:12重量部、フタロシアニブルー:1重量部、シリカ:2重量部

【0073】

上記のようにしてレジストインク層400が形成された積層体を42ボーマの塩化第二鉄水溶液に温度45℃で5分間浸漬することにより、銅箔110のエッチングを行ない、所定のパターンに従ったアンテナ回路パターン層100を形成した。その後、その積層体を1%の水酸化ナトリウム水溶液に温度20℃で10秒間浸漬することにより、図7に示すようにレジストインク層400を剥離した。そして、温度70℃の温風で積層体を乾燥させた。

【0074】

このようにして得られた積層体の所定の位置で、具体的には図2に示す第1の回路パターン層部分103と第2の回路パターン層部分104との間において、図8と図3に示すように絶縁層107と導電層108を形成することにより、第1の回路パターン層部分103と第2の回路パターン層部分104とを導通させた。

【0075】

絶縁層107は、150メッシュテロン版を用いてポリエステル系絶縁インキ(十條ケミカル株式会社製 品番AC3G)を印刷した後、150℃の温度で30分間加熱することにより形成した。ポリエステル系絶縁インキの印刷は、図9~図10に示すようにスクリーン印刷法により17 $\mu\text{m}$ の厚みで2回塗布することによって行った。図10において $\tan\theta = t/a$ と表すと、 $t/a$ の角度は7.5°であった。

【0076】

導電層108は、150メッシュテロン版を用いて銀ペースト(Dupont社製 品番5029)を印刷した後、150℃の温度で30分間加熱することにより形成した。銀ペーストの印刷は、図11に示すようにスクリーン印刷法により17 $\mu\text{m}$ の厚みで1回塗布することによって行った。

10

20

30

40

50



【0077】

このようにして、銅箔を用いた本発明のICカード・タグ用アンテナ回路構成体を作製した。

【0078】

(従来例)

【0079】

図12に示すように絶縁層107を形成するためのポリエステル系絶縁インキの印刷を、スクリーン印刷法により $34\mu\text{m}$ の厚みで1回塗布することによって行ったこと以外は、実施例と同様にして、従来のICカード・タグ用アンテナ回路構成体を作製した。

【0080】

なお、本発明の実施例と従来例のアンテナ回路構成体は、図14に示すように帯状の基材の表面上に多数個のアンテナ回路パターン層100を所定の間隔で縦横に連続的に配列させて形成したものである。得られたアンテナ回路パターン層100の各々は、図14に示すように幅Wが約 $4.5\text{cm}$ 、長さLが約 $7.5\text{cm}$ であった。

【0081】

(評価方法)

【0082】

図14に示すように多数個のアンテナ回路パターン層100が形成された帯状体から、図15に示すようにアンテナ回路パターン層100が縦1列に9個並ぶように試料シート1000を切り出した。この試料シート1000を用いて導電層108の評価を行った。

【0083】

図16に示すように直径が $20\text{mm}$ の回転ロール500の周囲に矢印T(図15)の方向に伸びるように試料シート1000をセットし、試料シート1000の両端に $300\text{g}$ の荷重Wをかけ、試料シート1000が回転ロール500上を100往復するように手で移動させた。

【0084】

その後、実施例と従来例のそれぞれ4枚の上記の試験を行った試料シート1000について、図15に示すように中央部に位置する5個のアンテナ回路パターン層100(ハッチングが施されたもの)中にて導電層108の部分を目視で観察し、クラック断線を目視で確認した。確認した試料数は実施例と従来例のそれぞれで20個である。

【0085】

その結果、実施例では、導電層108にクラック断線が認められた試料はなかった。従来例では、8個の試料の導電層108にクラック断線が認められた。本発明の実施例によれば、導電層108の信頼性を高めることが可能になることがわかる。

【0086】

そして、クラック断線が認められなかった実施例の20個の試料と従来例の12個の試料において、図2に示す箇所PとQとの間の電気抵抗を測定し、その平均値を求めた。この方法によれば、図1に示すアンテナ回路パターン層100のICチップ搭載部102にはICチップが搭載されていないので、導電層108の接触部分の電気抵抗を評価することができる。

【0087】

その結果、実施例では $150\text{m}\Omega$ 、比較例では $2000\text{m}\Omega$ であった。本発明の実施例によれば、導電層108の接触部分の電気抵抗を低減することができることがわかる。

【0088】

今回開示された実施の形態と実施例はすべての点で例示であって制限的なものではないと考慮されるべきである。本発明の範囲は以上の実施の形態と実施例ではなく、特許請求の範囲によって示され、特許請求の範囲と均等の意味および範囲内でのすべての修正と変形を含むものであることが意図される。

【符号の説明】

【0089】

10

20

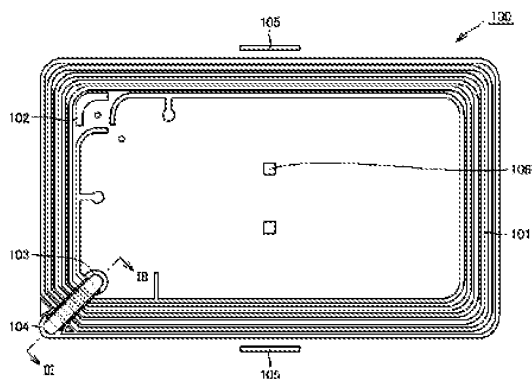
30

40

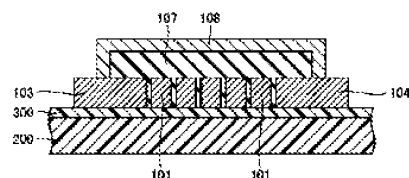
50

100：アンテナ回路パターン層、101：アンテナコイル部、103：第1の回路パターン層部分、104：第2の回路パターン層部分、107：絶縁層、107a：第1の絶縁層部分、107b：第2の絶縁層部分、108：導電層、200：基材、300：接着剤層、400：レジストインク層、110：銅箔。

【図1】



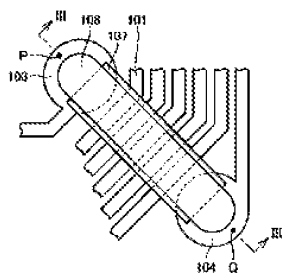
【図3】



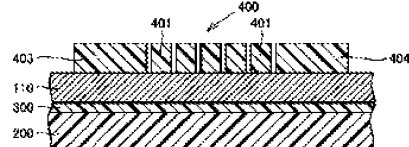
【図4】



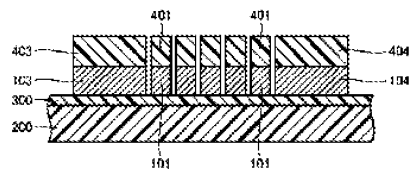
【図2】



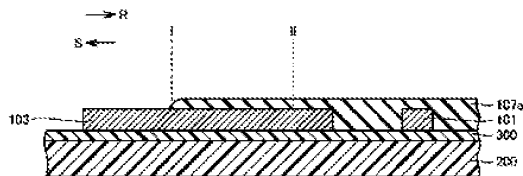
【図5】



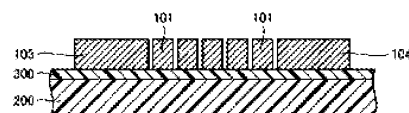
【図6】



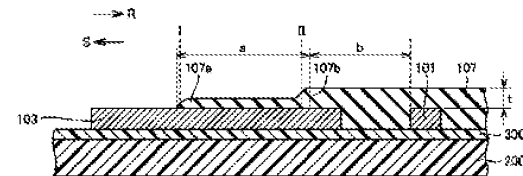
【図9】



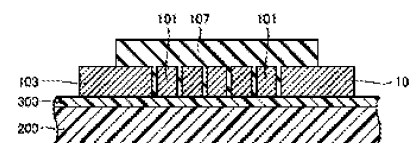
【図7】



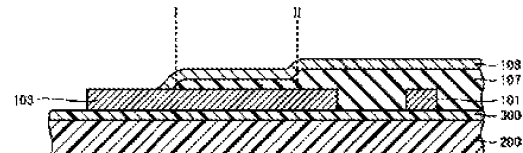
【図10】



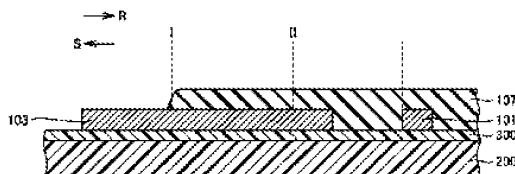
【図8】



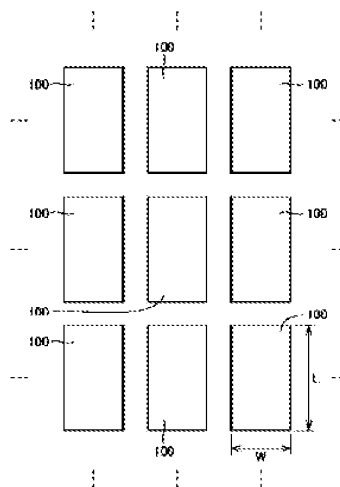
【図11】



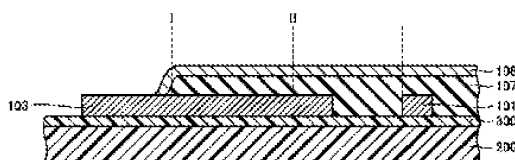
【図12】



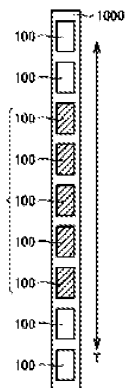
【図14】



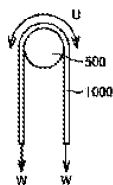
【図13】



【図15】



【図16】



## Electronic Acknowledgement Receipt

<b>EFS ID:</b>	35845678
<b>Application Number:</b>	16264360
<b>International Application Number:</b>	
<b>Confirmation Number:</b>	7253
<b>Title of Invention:</b>	Wireless Power Receiver and Method of Manufacturing the Same
<b>First Named Inventor/Applicant Name:</b>	JEONG WOOK AN
<b>Customer Number:</b>	23557
<b>Filer:</b>	Jeff Lloyd/Megan Kuchenthal
<b>Filer Authorized By:</b>	Jeff Lloyd
<b>Attorney Docket Number:</b>	SUN.LGI.420D3
<b>Receipt Date:</b>	26-APR-2019
<b>Filing Date:</b>	31-JAN-2019
<b>Time Stamp:</b>	14:53:28
<b>Application Type:</b>	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		SIDS.pdf	215800 817167bd1504d79685af0734fe7bad39637731e	yes	3

	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Transmittal Letter		1	2	
	Information Disclosure Statement (IDS) Form (SB08)		3	3	
<b>Warnings:</b>					
<b>Information:</b>					
2	Foreign Reference	F1.pdf	3983121	no	44
			f9b547ad84b09c9e6e97c6139674962813e d70f5		
<b>Warnings:</b>					
<b>Information:</b>					
3	Foreign Reference	F2.pdf	3079922	no	9
			e67650d712dd236ac9dd08a50495311274 e44888		
<b>Warnings:</b>					
<b>Information:</b>					
4	Foreign Reference	F3.pdf	724545	no	6
			65f52cab99016125615505339e9a84fb42cd 53ee		
<b>Warnings:</b>					
<b>Information:</b>					
5	Foreign Reference	F4.pdf	1355953	no	16
			7608dcd1c2dda054f8a4f3589140b289c5b 11a92		
<b>Warnings:</b>					
<b>Information:</b>					
6	Foreign Reference	F5.pdf	1485887	no	17
			4c55222794062be93ef74ab6d382638c8e4f 58c2		
<b>Warnings:</b>					
<b>Information:</b>					
7	Other Reference-Patent/App/Search documents	R1.pdf	1208669	no	12
			ce0771e8aaaddb54df5f46e1b0fd30aa6cad c66a		
<b>Warnings:</b>					

Information:					
8	Other Reference-Patent/App/Search documents	R2.pdf	780311	no	3
			6c5b1c06b9c9acb1ea6315eb758eff2a6aff8db6		
Warnings:					
Information:					
Total Files Size (in bytes):				12834208	
<p><b>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.</b></p> <p><b><u>New Applications Under 35 U.S.C. 111</u></b>  <b>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.</b></p> <p><b><u>National Stage of an International Application under 35 U.S.C. 371</u></b>  <b>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.</b></p> <p><b><u>New International Application Filed with the USPTO as a Receiving Office</u></b>  <b>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.</b></p>					

I hereby certify that this correspondence is being electronically filed in the United States Patent and Trademark Office on April 26, 2019.

  
\_\_\_\_\_  
Jeff Lloyd, Patent Attorney, Reg. No. 35,589

SUPPLEMENTAL INFORMATION  
DISCLOSURE STATEMENT  
UNDER 37 C.F.R §§ 1.97 AND 1.98  
Examining Group 2836  
Patent Application  
Docket No. SUN.LGI.420D3  
Serial No. 16/264,360

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Art Unit : 2836  
Applicants : Jeong Wook An, Jung Oh Lee, Sung Hyun Leem, Yang Hyun Kim  
Serial No. : 16/264,360  
Filed : January 31, 2019  
Conf. No. : 7253  
For : WIRELESS POWER RECEIVER AND METHOD OF  
MANUFACTURING THE SAME

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

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT  
UNDER 37 C.F.R. §§ 1.97 AND 1.98

Sir:

In accordance with 37 C.F.R. § 1.56, the references listed on the attached form PTO/SB/08 are being brought to the attention of the Examiner for consideration in connection with the examination of the patent application identified above. Copies of the cited references are attached. However, Applicants have not submitted copies of the U.S. Patents cited on attached Form PTO/SB/08 pursuant to 37 CFR 1.98(a)(2)(ii).

The undersigned hereby certifies that each item of information contained in this Supplemental Information Disclosure Statement was first cited in communications from foreign patent offices in counterpart foreign applications not more than three months prior to the filing of this Supplemental Information Disclosure Statement. Applicants are attaching copies of the Chinese Office Action and Japanese Office Action.



It is respectfully requested that the Examiner indicate consideration of the cited references by returning a copy of the attached form PTO/SB/08 with initials or other appropriate marks.

Applicants respectfully assert that the substantive provisions of 37 C.F.R. §§ 1.56, 1.97, and 1.98 are met by the foregoing statements.

The Commissioner is hereby authorized to charge any fees under 37 C.F.R. §§ 1.16 or 1.17 as required by this paper to Deposit Account 19-0065.

Respectfully submitted,



Jeff Lloyd  
Patent Attorney

Registration No. 35,589

Phone No.: 352-375-8100

Fax No.: 352-372-5800

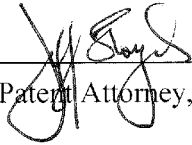
Address: Saliwanchik, Lloyd & Eisenschenk  
A Professional Association  
P.O. Box 142950  
Gainesville, FL 32614-2950

JL/mrk

Attachments: Form PTO/SB/08; copies of references cited.

I hereby certify that this correspondence is being electronically transmitted via EFS to the United States Patent and Trademark Office on the date shown below:

14 March 2019



Jeff Lloyd, Patent Attorney, Reg. No. 35,589

PRELIMINARY AMENDMENT  
Examining Group 2649  
Patent Application  
Docket No. SUN.LGI.420D3  
Serial No. 16/264,360

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Art Unit : 2836  
Applicants : Jeong Wook An, Jung Oh Lee, Sung Hyun Leem, Yang Hyun Kim  
Serial No. : 16/264,360  
Filed : January 31, 2019  
Confirm. No. : 7253  
For : Wireless Power Receiver and Method of Manufacturing the Same

Mail Stop **Amendment**  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

PRELIMINARY AMENDMENT

Sir:

Prior to examination, Applicants respectfully request that the application identified above be amended as follows:

In the Claims

This listing of claims will replace all prior versions and listings of claims in the application.

1. (Original) A wireless power receiver, comprising:
  - a magnetic substrate comprising a first receiving space and a second receiving space;
  - a coil on the magnetic substrate;
  - a first connection terminal connected to an inner end of the coil;
  - a second connection terminal connected to an outer end of the coil; and
  - a connecting unit comprising:
    - a circuit board;
    - a third connection terminal connected to the first connection terminal; and
    - a fourth connection terminal connected to the second connection terminal,wherein the first receiving space overlaps the third connection terminal in a vertical direction perpendicular to the magnetic substrate,
  - wherein the second receiving space overlaps the fourth connection terminal in the vertical direction,
  - wherein the circuit board comprises:
    - a first portion that overlaps the first receiving space in the vertical direction; and
    - a second portion that overlaps the second receiving space in the vertical direction,wherein the third connection terminal is disposed on the first portion of the circuit board, and
  - wherein the fourth connection terminal is disposed on the second portion of the circuit board.
2. (Original) The wireless power receiver of claim 1, wherein the circuit board comprises a third portion connecting the first portion and the second portion.
3. (Original) The wireless power receiver of claim 2, wherein the third portion of the circuit board overlaps the coil in the vertical direction.

4. (Original) The wireless power receiver of claim 1, wherein the first portion of the circuit board overlaps the first connection terminal in the vertical direction.

5. (Original) The wireless power receiver of claim 1, wherein the second portion of the circuit board overlaps the second connection terminal in the vertical direction.

6. (Currently Amended) The wireless power receiver of claim 1, wherein the first receiving space ~~comprises a recess passing~~passes through the magnetic sheet ~~substrate~~ in the vertical direction.

7. (Currently Amended) The wireless power receiver of claim 1, wherein the second receiving space ~~comprises a recess passing~~passes through the magnetic sheet ~~substrate~~ in the vertical direction.

8. (Original) The wireless power receiver of claim 1, comprising an adhesive layer disposed on at least one surface of the magnetic substrate,  
wherein the adhesive layer comprises a third receiving space and a fourth receiving space.

9. (Original) The wireless power receiver of claim 8, wherein the third receiving space overlaps the first portion of the circuit substrate in the vertical direction, and  
wherein the fourth receiving space overlaps the second portion of the circuit substrate in the vertical direction.

10. (Original) The wireless power receiver of claim 9, wherein the adhesive layer comprises a fifth receiving space that overlaps the third portion of the circuit substrate in the vertical direction.

11. (Original) The wireless power receiver of claim 1, wherein the circuit board comprises a fourth portion that does not overlap the magnetic substrate in the vertical direction.

12. (Original) The wireless power receiver of claim 11, wherein the fourth portion of the circuit board is disposed outside of the magnetic substrate.

13. (Original) The wireless power receiver of claim 1, wherein the first receiving space is disposed inside the coil.

14. (Original) The wireless power receiver of claim 1, wherein the second receiving space is disposed outside the coil.

15. (Original) A wireless power receiver, comprising:  
an adhesive layer comprising a first receiving space and a second receiving space;  
a coil on the adhesive layer;  
a first connection terminal connected to an inner end of the coil;  
a second connection terminal connected to an outer end of the coil; and  
a connecting unit comprising:  
    a circuit board;  
    a third connection terminal connected to the first connection terminal; and  
    a fourth connection terminal connected to the second connection terminal,  
wherein the first receiving space overlaps the third connection terminal in a vertical direction perpendicular to the adhesive layer,  
wherein the second receiving space overlaps the fourth connection terminal in the vertical direction,  
wherein the circuit board comprises:  
    a first portion that overlaps the first space in the vertical direction; and  
    a second portion that overlaps the second space in the vertical direction,  
wherein the third connection terminal is disposed on the first portion of the circuit board, and  
wherein the fourth connection terminal is disposed on the second portion of the circuit board.

16. (Original) The wireless power receiver of claim 15, wherein the circuit board comprises a third portion connecting the first portion and the second portion.

17. (Original) The wireless power receiver of claim 16, wherein the third portion of the circuit board overlaps the coil in the vertical direction.

18. (Currently Amended) The wireless power receiver of claim 15, wherein the first receiving space ~~comprises a first recess~~ passing through the adhesive layer in the vertical direction, and wherein the second receiving space ~~comprises a second recess~~ passing through the adhesive layer in the vertical direction.

19. (Original) The wireless power receiver of claim 16, wherein the adhesive layer comprises a third receiving space that overlaps the third portion of the circuit board in the vertical direction.

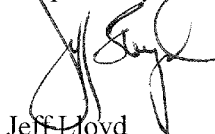
20. (Original) The wireless power receiver of claim 1, wherein the circuit board comprises a fourth portion that does not overlap the adhesive layer in the vertical direction, and wherein the fourth portion is disposed outside of the adhesive layer.

Remarks

Claims 1-20 are pending in the subject application. Claims 6, 7, and 18 are amended. No new matter is introduced by these amendments. Upon entry of these amendments, claims 1-20 will be before the Examiner. Favorable consideration of the pending claims is respectfully requested.

The Commissioner is hereby authorized to charge any fees under 37 C.F.R. §§ 1.16 or 1.17 as required by this paper to Deposit Account 19-0065.

Respectfully submitted,



Jeff Lloyd

Patent Attorney

Registration No. 35,589

Phone No.: 352-375-8100

Fax No.: 352-372-5800

Address: Saliwanchik, Lloyd & Eisenschenk  
A Professional Association  
P.O. Box 142950  
Gainesville, FL 32614-2950

JL/mrk

## Electronic Acknowledgement Receipt

<b>EFS ID:</b>	35423238
<b>Application Number:</b>	16264360
<b>International Application Number:</b>	
<b>Confirmation Number:</b>	7253
<b>Title of Invention:</b>	Wireless Power Receiver and Method of Manufacturing the Same
<b>First Named Inventor/Applicant Name:</b>	JEONG WOOK AN
<b>Customer Number:</b>	23557
<b>Filer:</b>	Jeff Lloyd/Megan Kuchenthal
<b>Filer Authorized By:</b>	Jeff Lloyd
<b>Attorney Docket Number:</b>	SUN.LGI.420D3
<b>Receipt Date:</b>	14-MAR-2019
<b>Filing Date:</b>	31-JAN-2019
<b>Time Stamp:</b>	13:44:58
<b>Application Type:</b>	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		PreAmd-AF.pdf	278230  1b2edd6af7cdf6708fed0045a56643fc53f2e8e0	yes	6



<b>Multipart Description/PDF files in .zip description</b>			
<b>Document Description</b>		<b>Start</b>	<b>End</b>
Preliminary Amendment		1	1
Claims		2	5
Applicant Arguments/Remarks Made in an Amendment		6	6
<b>Warnings:</b>			
<b>Information:</b>			
<b>Total Files Size (in bytes):</b>		278230	
<p><b>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.</b></p> <p><b><u>New Applications Under 35 U.S.C. 111</u></b>  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><b><u>National Stage of an International Application under 35 U.S.C. 371</u></b>  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><b><u>New International Application Filed with the USPTO as a Receiving Office</u></b>  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>			

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.

<b>PATENT APPLICATION FEE DETERMINATION RECORD</b> Substitute for Form PTO-875	Application or Docket Number 16/264,360	Filing Date 01/31/2019	<input type="checkbox"/> To be Mailed
---	--	---------------------------	---------------------------------------

ENTITY:  LARGE  SMALL  MICRO

**APPLICATION AS FILED - PART I**

	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE (\$)	FEE (\$)
<input type="checkbox"/> BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
<input type="checkbox"/> SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A	
<input type="checkbox"/> EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 = *		x \$100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 = *		x \$460 =	
<input type="checkbox"/> 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).			
<input type="checkbox"/> MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

**APPLICATION AS AMENDED - PART II**

	(Column 1)		(Column 2)	(Column 3)	RATE (\$)	ADDITIONAL FEE (\$)
<b>AMENDMENT</b>	03/14/2019	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		
	Total (37 CFR 1.16(i))	* 20	Minus ** 20	= 0	x \$100 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus *** 3	= 0	x \$460 =	0
	<input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))					
<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	0
<b>AMENDMENT</b>		CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		
	Total (37 CFR 1.16(i))	*	Minus **	=	x \$0 =	
	Independent (37 CFR 1.16(h))	*	Minus ***	=	x \$0 =	
	<input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))					
<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.					SLIE	
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".					/DEIDRE C KING-WOODWARD/	
*** 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 number found in the appropriate box in column 1.						

This collection of information is required by 37 CFR 1.16. 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 12 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.*

<b>PATENT APPLICATION FEE DETERMINATION RECORD</b>						Application or Docket Number 16/264,360				
Substitute for Form PTO-875										
<b>APPLICATION AS FILED - PART I</b>										
		(Column 1)	(Column 2)		<b>SMALL ENTITY</b>		OR	<b>OTHER THAN SMALL ENTITY</b>		
FOR	NUMBER FILED	NUMBER EXTRA	RATE(\$)	FEE(\$)	RATE(\$)	FEE(\$)		RATE(\$)	FEE(\$)	
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A		N/A	300		N/A	660	
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A		N/A	760		N/A	760	
EXAMINATION FEE (37 CFR 1.16(e), (p), or (q))	N/A	N/A	N/A		N/A	0.00	OR	x 100 =	0.00	
TOTAL CLAIMS (37 CFR 1.16(i))	20	minus 20 = *						x 460 =	0.00	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2	minus 3 = *							0.00	
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).								0.00	
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))									0.00	
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL		TOTAL	1720				
<b>APPLICATION AS AMENDED - PART II</b>										
		(Column 1)	(Column 2)	(Column 3)	<b>SMALL ENTITY</b>		OR	<b>OTHER THAN SMALL ENTITY</b>		
<b>AMENDMENT A</b>	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)	
	Total (37 CFR 1.16(i))	*	Minus **	**	x =		OR	x =		
	Independent (37 CFR 1.16(h))	*	Minus ***	***	x =		OR	x =		
	Application Size Fee (37 CFR 1.16(s))						OR			
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						OR			
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE		
<b>AMENDMENT B</b>	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)	
	Total (37 CFR 1.16(i))	*	Minus **	**	x =		OR	x =		
	Independent (37 CFR 1.16(h))	*	Minus ***	***	x =		OR	x =		
	Application Size Fee (37 CFR 1.16(s))						OR			
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						OR			
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE		
<p>* 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.</p>										



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

Table with 7 columns: APPLICATION NUMBER, FILING or 371(c) DATE, GRP ART UNIT, FIL FEE REC'D, ATTY. DOCKET NO, TOT CLAIMS, IND CLAIMS. Row 1: 16/264,360, 01/31/2019, 2649, 1720, SUN.LGI.420D3, 20, 2

CONFIRMATION NO. 7253

FILING RECEIPT

23557
SALIWANCIK, LLOYD & EISENSCHENK
A PROFESSIONAL ASSOCIATION
PO Box 142950
GAINESVILLE, FL 32614



Date Mailed: 02/22/2019

Receipt is acknowledged of this non-provisional 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 APPLICANT, 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 Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections 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

Inventor(s)

JEONG WOOK AN, Seoul, KOREA, REPUBLIC OF;
JUNG OH LEE, Seoul, KOREA, REPUBLIC OF;
SUNG HYUN LEEM, Seoul, KOREA, REPUBLIC OF;
YANG HYUN KIM, Seoul, KOREA, REPUBLIC OF;

Applicant(s)

LG INNOTEK CO., LTD., Seoul, KOREA, REPUBLIC OF;

Power of Attorney: The patent practitioners associated with Customer Number 23557

Domestic Priority data as claimed by applicant

This application is a CON of 15/430,173 02/10/2017
which is a CON of 15/360,425 11/23/2016
which is a CON of 13/663,012 10/29/2012 PAT 9806565

Foreign Applications (You may be eligible to benefit from the Patent Prosecution Highway program at the USPTO. Please see http://www.uspto.gov for more information.)

REPUBLIC OF KOREA 10-2012-0029987 03/23/2012 No Access Code Provided
REPUBLIC OF KOREA 10-2012-0079004 07/19/2012 No Access Code Provided

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:** 02/21/2019

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/264,360**

**Projected Publication Date:** 05/30/2019

**Non-Publication Request:** No

**Early Publication Request:** No  
**Title**

Wireless Power Receiver and Method of Manufacturing the Same

**Preliminary Class**

455

**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).

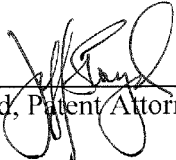
---

***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.

I hereby certify that this correspondence is being electronically transmitted via EFS to the United States Patent and Trademark Office on January 31, 2019.

CLAIM OF PRIORITY UNDER 35 USC §119  
Patent Application  
Docket No. SUN.LGI.420D3

  
\_\_\_\_\_  
Jeff Lloyd, Patent Attorney, Reg. No. 35,589

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants : Jeong Wook An, Jung Oh Lee, Sung Hyun Leem, Yang Hyun Kim  
Filed : January 31, 2019  
For : Wireless Power Receiver and Method of Manufacturing the Same

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

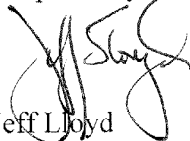
CLAIM OF PRIORITY UNDER 35 USC §119

Sir:

Applicants in the patent application identified above hereby reaffirm their claim to the right of priority granted pursuant to 35 USC §119 based upon Korean Application Nos. 10-2012-0029987, filed March 23, 2012, and 10-2012-0079004, filed July 19, 2012.

Certified copies of the above Korean applications can be found in the parent application, U.S. Application No. 15/430,173 or in ancestral application U.S. Application No. 13/663,012 (now U.S. Patent No. 9,806,565). Applicants respectfully request that certified copies of the foreign priority applications be made of record in the subject application pursuant to MPEP 201.14(b).

Respectfully submitted,



Jeff Lloyd  
Patent Attorney  
Registration No. 35,589  
Phone No.: 352-375-8100  
Fax No.: 352-372-5800  
Address: P.O. Box 142950  
Gainesville, FL 32614-2950

JL/lem

2012/10/29 어정오  
LG이노텍/x.x.x.112.미정오

**COMBINED DECLARATION (37 C.F.R. § 1.63) AND ASSIGNMENT**

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

I believe I am the original inventor or an original joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled

Insert Title:

**WIRELESS POWER RECEIVER AND METHOD OF MANUFACTURING THE SAME**

the specification for which

- is attached hereto.
- was filed \_\_\_\_\_, Serial No. \_\_\_\_\_.

The above-identified application was made or authorized to be made by me.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability of this application in accordance with Title 37, Code of Federal Regulations, § 1.56.

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**

WHEREAS, the undersigned has invented certain new and useful improvements described in the application identified above.

WHEREAS,

Insert Assignee(s)

**LG INNOTEK CO., LTD.,**

Name/Address:

a corporation of the country of the Seoul Square, 541, Namdaemunno 5-ga, Jung-gu, Seoul, 100-714, Republic of Korea

(hereinafter ASSIGNEE), is desirous of acquiring the entire right, title, and interest in and to said invention and in and to any Letters Patent which may be granted therefor in the United States and in any and all foreign countries;



2012/10/29 이경오  
LGI인도텍/x

NOW, THEREFORE, in view of valuable consideration, receipt of which is hereby acknowledged, I/we, the undersigned, have sold, assigned, and transferred, and by these presents do sell, assign, and transfer, unto said ASSIGNEE, its successors and assigns, the full and exclusive right to the said invention in the United States and its territorial possessions and in all foreign countries and the entire right, title, and interest in and to any and all Letters Patent which may be granted therefor in the United States and its territorial possessions and in any and all foreign countries and in and to any and all divisions, reissues, continuations, and extensions thereof.

I/we hereby authorize and request the Patent Office Officials in the United States and in any and all foreign countries to issue any and all of said Letters Patent, when granted, to ASSIGNEE, as the assignee of the entire right, title, and interest in and to the same, for the sole use and behoof of said ASSIGNEE, its successors and assigns.

FURTHER, I/we agree that we will communicate to said ASSIGNEE, or its representatives, any facts known to me respecting said invention; testify in any legal proceedings; sign all lawful papers; execute all divisional, continuation, substitution, renewal, and reissue applications; execute all necessary assignment papers to cause any and all of said Letters Patent to be issued to said ASSIGNEE; make all rightful oaths; and generally do everything possible to aid the said ASSIGNEE, its successors and assigns, to obtain and enforce proper protection for said invention in the United States and in any and all foreign countries.

In witness whereof, executed by the undersigned on the date opposite the undersigned name.

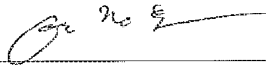
Legal Name  
of inventor

AN, Jeong Wook

Date:

29 / Oct / 2012

Inventor's  
Signature



Additional inventors are being named on the 1 supplemental sheet(s) attached hereto.

Docket No. SUN.LGI.420D2

Docket No. P2012-Z0451US

2012/10/29 이정오  
LG이노텍/x.x.x.117 이정오

**SUPPLEMENTAL SHEET FOR  
DECLARATION AND ASSIGNMENT**

**ADDITIONAL INVENTOR(S)**  
Supplemental Sheet Page 1 of 1

LEGAL NAME OF JOINT INVENTOR, IF ANY:

Legal Name  
of inventor

LEE, Jung Oh

Date:

29 oct. 2012

Inventor's  
Signature



LEGAL NAME OF JOINT INVENTOR, IF ANY:

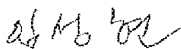
Legal Name  
of inventor

LEEM, Sung Hyun

Date:

29. oct. 2012

Inventor's  
Signature



LEGAL NAME OF JOINT INVENTOR, IF ANY:

Legal Name  
of inventor

KIM, Yang Hyun

Date:

Inventor's  
Signature

LEGAL NAME OF JOINT INVENTOR, IF ANY:

Legal Name  
of inventor

Date:

Inventor's  
Signature

LEGAL NAME OF JOINT INVENTOR, IF ANY:

Legal Name  
of inventor

Date:

Inventor's  
Signature

2012/10/29 김양현  
LGI노태/x.x.x.197 김양현

**SUPPLEMENTAL SHEET FOR  
DECLARATION AND ASSIGNMENT**

**ADDITIONAL INVENTOR(S)**  
Supplemental Sheet Page 1 of 1

LEGAL NAME OF JOINT INVENTOR, IF ANY:

Legal Name  
of inventor

LEE, Jung Oh

Date:

Inventor's  
Signature

LEGAL NAME OF JOINT INVENTOR, IF ANY:

Legal Name  
of inventor

LEEM, Sung Hyun

Date:

Inventor's  
Signature

LEGAL NAME OF JOINT INVENTOR, IF ANY:

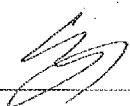
Legal Name  
of inventor

KIM, Yang Hyun

Date:

2012.10.30

Inventor's  
Signature



LEGAL NAME OF JOINT INVENTOR, IF ANY:

Legal Name  
of inventor

Date:

Inventor's  
Signature

LEGAL NAME OF JOINT INVENTOR, IF ANY:

Legal Name  
of inventor

Date:

Inventor's  
Signature

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.

## POWER OF ATTORNEY BY APPLICANT

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

- I hereby appoint 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 equivalent):

23557

OR

- I hereby appoint Practitioner(s) named below 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 equivalent):

Name	Registration Number	Name	Registration Number

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

- The address associated with the above-mentioned Customer Number.

OR

- The address associated with Customer Number:

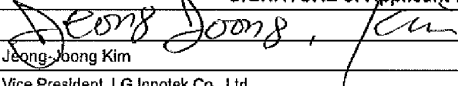
OR

<input type="checkbox"/> Firm or Individual Name			
Address			
City	State	Zip	
Country			
Telephone	Email		

I am the Applicant:

- Inventor or Joint Inventor
- Legal Representative of a Deceased or Legally Incapacitated Inventor
- Assignee or Person to Whom the Inventor is Under an Obligation to Assign
- 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)

### SIGNATURE of Applicant for Patent

Signature		Date	October 5, 2012
Name	Jeong Joong Kim	Telephone	+82-31-436-7890
Title and Company	Vice President, LG Innotek Co., Ltd.		

**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. Submit multiple forms for more than one signature, see below \*.

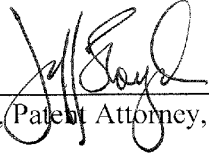
- \*Total of \_\_\_\_\_ forms are submitted.

This collection of information is required by 37 CFR 1.31, 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 this 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 1460, Alexandria, VA 22313-1460. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1460, Alexandria, VA 22313-1460.

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

I hereby certify that this correspondence is being electronically transmitted via EFS to the United States Patent and Trademark Office on January 31, 2019.

INFORMATION DISCLOSURE  
STATEMENT  
Patent Application  
Docket No. SUN.LGI.420D3



Jeff Lloyd, Patent Attorney, Reg. No. 35,589

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants : Jeong Wook An, Jung Oh Lee, Sung Hyun Leem, Yang Hyun Kim  
Filed : January 31, 2019  
For : Wireless Power Receiver and Method of Manufacturing the Same

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

INFORMATION DISCLOSURE STATEMENT  
UNDER 37 CFR §§1.97 AND 1.98

Sir:

In accordance with 37 CFR §1.97 and §1.98, Applicants would like to bring to the attention of the Examiner the references cited in the following patent applications:

U.S. Serial No. 15/430,173, filed February 10, 2017;

U.S. Serial No. 15/360,425, filed November 23, 2016; and

U.S. Serial No. 13/663,012, filed October 29, 2012, now U.S. Patent No. 9,806,565, issued October 31, 2017.

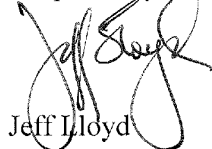
The subject application claims the benefit under 35 USC §120 of the filing date of patent application Serial Nos. 15/430,173; 15/360,425; and 13/633,012. In accordance with 37 CFR §1.98(d), Applicants respectfully request that the copies of references supplied in the Information Disclosure Statements of the 15/430,173; 15/360,425; and 13/633,012 applications as well as references cited during the prosecution thereof be made of record in the subject application. As copies of the references filed in the 15/430,173; 15/360,425; and 13/633,012 applications and cited on the attached form PTO/SB/08 can be found in the 15/430,173; 15/360,425; and 13/633,012 casefiles, copies of those references are not provided herewith.

It is respectfully requested that the references cited in the 15/430,173; 15/360,425; and 13/633,012 applications be considered in the examination of the subject application and that their consideration be made of record.

Applicants respectfully assert that the substantive provisions of 37 CFR §§1.97 and 1.98 are met by the foregoing statements.

The Commissioner is hereby authorized to charge any fees under 37 CFR §§1.16 or 1.17 as required by this paper to Deposit Account No. 19-0065.

Respectfully submitted,



Jeff Lloyd  
Patent Attorney

Registration No. 35,589

Phone No.: 352-375-8100

Fax No.: 352-372-5800

Address: P.O. Box 142950

Gainesville, FL 32614-2950

JL/lem

Attachment: Form PTO/SB/08

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 1449A/PTO			<b>Complete if Known</b>	
<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  <i>(use as many sheets as necessary)</i>			<b>Application Number</b>	
			<b>Filing Date</b> January 31, 2019	
			<b>First Named Inventor</b> Jeong Wook AN	
			<b>Art Unit</b>	
			<b>Examiner Name</b>	
			<b>Attorney Docket Number</b> SUN.LGI.420D3	
Sheet	1	of	15	

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. <sup>1</sup>	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number - Kind Code <sup>2</sup> (if known)			
	U1	2003/0141590-A1	07-31-2003	Kamiya <i>et al.</i>	ALL
	U2	2005/0046573-A1	03-03-2005	De Velasco <i>et al.</i>	ALL
	U3	2005/0072595-A1	04-07-2005	Se-hoon Cho	ALL
	U4	2005/0079820-A1	04-14-2005	Yamashita	ALL
	U5	2005/0116874-A1	06-02-2005	El-Mahdawy <i>et al.</i>	ALL
	U6	2005/0275497-A1	12-15-2005	Ramadan <i>et al.</i>	ALL
	U7	2006/0166506-A1	07-27-2006	Okawa <i>et al.</i>	ALL
	U8	2007/0001921-A1	01-04-2007	Takahashi <i>et al.</i>	ALL
	U9	2007/0007661-A1	01-11-2007	Burgess <i>et al.</i>	ALL
	U10	2007/0020932-A1	01-25-2007	Maruyama <i>et al.</i>	ALL
	U11	2007/0069961-A1	03-29-2007	Akiho <i>et al.</i>	ALL
	U12	2007/0095913-A1	05-03-2007	Takahashi <i>et al.</i>	ALL
	U13	2007/0254432-A1	11-01-2007	Yamazaki <i>et al.</i>	ALL
	U14	2007/0279002-A1	12-06-2007	Afshin Partovi	ALL
	U15	2008/0055046-A1	03-06-2008	Shimizu	ALL
	U16	2008/0129439-A1	06-05-2008	Nishikawa <i>et al.</i>	ALL
	U17	2008/0164840-A1	07-10-2008	Kato <i>et al.</i>	ALL
	U18	2008/0197957-A1	08-21-2008	Kondo Yoichiro <i>et al.</i>	ALL
	U19	2008/0200210-A1	08-21-2008	Lim <i>et al.</i>	ALL
	U20	2008/0246664-A1	10-09-2008	Ikemoto <i>et al.</i>	ALL
	U21	2008/0266748-A1	10-30-2008	Hyung-Joo Lee	ALL

Examiner Signature	Date Considered
--------------------	-----------------

\*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. <sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> See Kind Codes of USPTO Patent Documents at [www.uspto.gov](http://www.uspto.gov) or MPEP901.04. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached.

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 2 hours 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, 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 (1-800-786-9199) and select option 2.

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 1449A/PTO			<b>Complete if Known</b>	
<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  <i>(use as many sheets as necessary)</i>			<b>Application Number</b>	
			<b>Filing Date</b> January 31, 2019	
			<b>First Named Inventor</b> Jeong Wook AN	
			<b>Art Unit</b>	
			<b>Examiner Name</b>	
			<b>Attorney Docket Number</b> SUN.LGI.420D3	
Sheet	2	of	15	

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. <sup>1</sup>	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number - Kind Code <sup>2</sup> (if known)			
	U22	2008/0122570-A1	05-29-2008	Takaishi Konomu	ALL
	U23	2008/0154178-A1	06-26-2008	Carter Darrick <i>et al.</i>	ALL
	U24	2008/0303735-A1	12-11-2008	Fujimoto <i>et al.</i>	ALL
	U25	2009/0029185-A1	01-29-2009	Lee <i>et al.</i>	ALL
	U26	2009/0058737-A1	03-05-2009	TSUJIMURA <i>et al.</i>	ALL
	U27	2009/0108974-A1	04-30-2009	Raggam <i>et al.</i>	ALL
	U28	2009/0115681-A1	05-07-2009	Lai <i>et al.</i>	ALL
	U29	2009/0314842-A1	12-24-2009	Charrin	ALL
	U30	2009/0315680-A1	12-24-2009	Arimura	ALL
	U31	2009/0058358-A1	03-05-2009	Inoue Tetsuo <i>et al.</i>	ALL
	U32	2010/0156735-A1	06-24-2010	Nakamura <i>et al.</i>	ALL
	U33	2010/0265041-A1	10-21-2010	ALMOG <i>et al.</i>	ALL
	U34	2010/0277004-A1	11-04-2010	Suzuki <i>et al.</i>	ALL
	U35	2010/0289341-A1	11-18-2010	Ozaki <i>et al.</i>	ALL
	U36	2010/0295682-A1	11-25-2010	August <i>et al.</i>	ALL
	U37	2010/0308187-A1	12-09-2010	Pi-Fen Lin	ALL
	U38	2011/0032685-A1	02-10-2011	Akiba <i>et al.</i>	ALL
	U39	2011/0127070-A1	06-02-2011	Ahn <i>et al.</i>	ALL
	U40	2011/0267248-A1	11-03-2011	Remski <i>et al.</i>	ALL

Examiner Signature		Date Considered	
-----------------------	--	--------------------	--

\*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. <sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> See Kind Codes of USPTO Patent Documents at [www.uspto.gov](http://www.uspto.gov) or MPEP901.04. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached.

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 2 hours 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, 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 (1-800-786-9199) and select option 2.



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 1449A/PTO  <b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  <i>(use as many sheets as necessary)</i>		<b>Complete if Known</b>	
		Application Number	
		Filing Date	January 31, 2019
		First Named Inventor	Jeong Wook AN
		Art Unit	
		Examiner Name	
Sheet	3	of	15
		Attorney Docket Number	SUN.LGI.420D3

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. <sup>1</sup>	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number - Kind Code <sup>2</sup> (if known)			
	U41	2011/0285494-A1	11-24-2011	Jeong <i>et al.</i>	ALL
	U42	2011/0302770-A1	12-15-2011	Radenne <i>et al.</i>	ALL
	U43	2011/0312382-A1	12-22-2011	Itay <i>et al.</i>	ALL
	U44	2011/0050164-A1	03-03-2011	Partovi <i>et al.</i>	ALL
	U45	2012/0001701-A1	01-05-2012	Taniguchi <i>et al.</i>	ALL
	U46	2012/0019075-A1	01-26-2012	In-Kui Cho <i>et al.</i>	ALL
	U47	2012/0044114-A1	02-23-2012	Eom <i>et al.</i>	ALL
	U48	2012/0049986-A1	03-01-2012	In-Kui Cho <i>et al.</i>	ALL
	U49	2012/0057322-A1	03-08-2012	Waffenschmidt Eberhard	ALL
	U50	2012/0058722-A1	03-08-2012	LO <i>et al.</i>	ALL
	U51	2012/0092222-A1	04-19-2012	KATO <i>et al.</i>	ALL
	U52	2012/0187767-A1	07-26-2012	Kanno <i>et al.</i>	ALL
	U53	2012/0248981-A1	10-04-2012	Karalis <i>et al.</i>	ALL
	U54	2012/0249276-A1	10-04-2012	FONTANA <i>et al.</i>	ALL
	U55	2012/0274148-A1	11-01-2012	Sung <i>et al.</i>	ALL
	U56	2013/0038278-A1	02-14-2013	Park <i>et al.</i>	ALL
	U57	2013/0038497-A1	02-14-2013	Chae <i>et al.</i>	ALL
	U58	2013/0069444-A1	03-21-2013	Waffenschmidt <i>et al.</i>	ALL
	U59	2013/0106198-A1	05-02-2013	Kuk <i>et al.</i>	ALL
	U60	2013/0113422-A1	05-09-2013	LEE <i>et al.</i>	ALL

Examiner Signature	Date Considered
--------------------	-----------------

\*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. <sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> See Kind Codes of USPTO Patent Documents at [www.uspto.gov](http://www.uspto.gov) or MPEP901.04. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached.

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 2 hours 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, 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 (1-800-786-9199) and select option 2.

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 1449A/PTO <b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b> <i>(use as many sheets as necessary)</i>				<b>Complete if Known</b>			
				Application Number			
				Filing Date		January 31, 2019	
				First Named Inventor		Jeong Wook AN	
				Art Unit			
				Examiner Name			
Sheet	4	of	15	Attorney Docket Number	SUN.LGI.420D3		

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. <sup>1</sup>	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number - Kind Code <sup>2</sup> (if known)			
	U61	2013/0176179-A1	07-11-2013	Park	ALL
	U62	2013/0200716-A1	08-08-2013	Kesler <i>et al.</i>	ALL
	U63	2013/0249302-A1	09-26-2013	AN <i>et al.</i>	ALL
	U64	2013/0267170-A1	10-10-2013	CHONG <i>et al.</i>	ALL
	U65	2013/0271328-A1	10-17-2013	Nickel <i>et al.</i>	ALL
	U66	2013/0285783-A1	10-31-2013	YUSSOF <i>et al.</i>	ALL
	U67	2013/0308256-A1	11-21-2013	Lehr <i>et al.</i>	ALL
	U68	2014/0062827-A1	03-06-2014	KATO	ALL
	U69	2014/0091640-A1	04-03-2014	Scholz <i>et al.</i>	ALL
	U70	2014/0091758-A1	04-03-2014	Hidaka <i>et al.</i>	ALL
	U71	2014/0145906-A1	05-29-2014	KATO <i>et al.</i>	ALL
	U72	2014/0168019-A1	06-19-2014	Hirobe <i>et al.</i>	ALL
	U73	2014/0168026-A1	06-19-2014	Nakamura <i>et al.</i>	ALL
	U74	2014/0176384-A1	07-26-2014	YOSUI <i>et al.</i>	ALL
	U75	2014/0184462-A1	07-03-2014	YOSUI	ALL
	U76	2014/0210406-A1	07-31-2014	Na <i>et al.</i>	ALL
	U77	2014/0226293-A1	08-14-2014	SATO	ALL
	U78	2014/0266030-A1	09-18-2014	PARK <i>et al.</i>	ALL
	U79	2015/0054455-A1	02-26-2015	Kim <i>et al.</i>	ALL
	U80	2015/0054457-A1	02-26-2015	Kim	ALL
	U81	2015/0061400-A1	03-05-2015	PARK <i>et al.</i>	ALL

Examiner Signature		Date Considered	
--------------------	--	-----------------	--

\*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. <sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> See Kind Codes of USPTO Patent Documents at [www.uspto.gov](http://www.uspto.gov) or MPEP901.04. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached.

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 2 hours 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, 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 (1-800-786-9199) and select option 2.

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 1449A/PTO				<b>Complete if Known</b>	
				<b>Application Number</b>	
<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  (use as many sheets as necessary)				<b>Filing Date</b>	January 31, 2019
				<b>First Named Inventor</b>	Jeong Wook AN
				<b>Art Unit</b>	
				<b>Examiner Name</b>	
				<b>Attorney Docket Number</b>	SUN.LGI.420D3
Sheet	5	of	15		

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. <sup>1</sup>	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number - Kind Code <sup>2</sup> (if known)			
	U82	2015/0077296-A1	03-19-2015	An <i>et al.</i>	ALL
	U83	2015/0116178-A1	04-30-2015	Kim <i>et al.</i>	ALL
	U84	2015/0123604-A1	05-07-2015	Lee <i>et al.</i>	ALL
	U85	2015/0145635-A1	05-28-2015	Kurz <i>et al.</i>	ALL
	U86	2015/0171519-A1	06-18-2015	Han <i>et al.</i>	ALL
	U87	2015/0207207-A1	07-23-2015	Park <i>et al.</i>	ALL
	U88	2015/0222017-A1	08-06-2015	KUMURA <i>et al.</i>	ALL
	U89	2015/0281873-A1	10-01-2015	OJALA	ALL
	U90	2016/0064814-A1	03-03-2016	Jang <i>et al.</i>	ALL
	U91	2016/0118711-A1	04-28-2016	Finn <i>et al.</i>	ALL
	U92	2016/0126002-A1	05-05-2016	CHIEN <i>et al.</i>	ALL
	U93	2016/0188926-A1	06-30-2016	Pachler <i>et al.</i>	ALL
	U94	2016/0204836-A1	07-14-2016	LEE <i>et al.</i>	ALL
	U95	2016/0224975-A1	08-04-2016	NA <i>et al.</i>	ALL
	U96	2016/0315497-A1	10-27-2016	KIM <i>et al.</i>	ALL
	U97	2016/0345125-A1	11-24-2016	Kim <i>et al.</i>	ALL
	U98	2017/0040696-A1	02-09-2017	Peralta <i>et al.</i>	ALL
	U99	2017/0054213-A1	02-23-2017	Singh <i>et al.</i>	ALL
	U100	2017/0213644-A1	07-27-2017	Lee <i>et al.</i>	ALL
	U101	2017/0317519-A1	11-02-2017	YEOM <i>et al.</i>	ALL
	U102	2017/0338562-A1	11-23-2017	Ozenne <i>et al.</i>	ALL

Examiner Signature	Date Considered
--------------------	-----------------

\*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. <sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> See Kind Codes of USPTO Patent Documents at [www.uspto.gov](http://www.uspto.gov) or MPEP901.04. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached.

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 2 hours 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, 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 (1-800-786-9199) and select option 2.

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 1449A/PTO				<b>Complete if Known</b>			
				<b>Application Number</b>			
<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  (use as many sheets as necessary)				<b>Filing Date</b>		January 31, 2019	
				<b>First Named Inventor</b>		Jeong Wook AN	
				<b>Art Unit</b>			
				<b>Examiner Name</b>			
				<b>Attorney Docket Number</b>		SUN.LGI.420D3	
Sheet	6	of	15				

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. <sup>1</sup>	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number - Kind Code <sup>2</sup> (if known)			
	U103	2017/0345535-A1	11-30-2017	KIM <i>et al.</i>	ALL
	U104	2018/0076650-A1	03-15-2018	Yamaguchi <i>et al.</i>	ALL
	U105	2018/0189627-A1	07-05-2018	Kwon <i>et al.</i>	ALL
	U106	2018/0248255-A1	08-30-2018	NOH <i>et al.</i>	ALL
	U107	2018/0287243-A1	10-04-2018	KO <i>et al.</i>	ALL
	U108	4,947,180-A	08-07-1990	Scholz	ALL
	U109	5,574,470-A	11-12-1996	de Vall	ALL
	U110	6,008,622-A	12-28-1999	Nakawatase Norio	ALL
	U111	6,575,374-B1	06-10-2003	Boyadjian <i>et al.</i>	ALL
	U112	6,950,023-B1	09-27-2005	Martin	ALL
	U113	7,113,137-B2	09-26-2006	Bisig	ALL
	U114	7,259,672-B2	08-21-2007	Takei	ALL
	U115	7,712,672-B2	05-11-2010	Takahashi <i>et al.</i>	ALL
	U116	7,971,339-B2	07-05-2011	Finn	ALL
	U117	8,159,182-B2	04-17-2012	Kato <i>et al.</i>	ALL
	U118	8,514,135-B2	08-20-2013	Jang <i>et al.</i>	ALL
	U119	8,792,837-B2	07-29-2014	Deguchi <i>et al.</i>	ALL
	U120	8,947,189-B2	02-03-2015	Maruyama <i>et al.</i>	ALL
	U121	9,105,967-B2	08-11-2015	Park	ALL

Examiner Signature		Date Considered	
--------------------	--	-----------------	--

\*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. <sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> See Kind Codes of USPTO Patent Documents at [www.uspto.gov](http://www.uspto.gov) or MPEP901.04. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached.

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 2 hours 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, 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 (1-800-786-9199) and select option 2.

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 1449A/PTO				<b>Complete if Known</b>	
				<b>Application Number</b>	
<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  (use as many sheets as necessary)				<b>Filing Date</b>	January 31, 2019
				<b>First Named Inventor</b>	Jeong Wook AN
				<b>Art Unit</b>	
				<b>Examiner Name</b>	
				<b>Attorney Docket Number</b>	SUN.LGI.420D3
Sheet	7	of	15		

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. <sup>1</sup>	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number - Kind Code <sup>2</sup> (if known)			
	U122	9,165,708-B2	10-20-2015	Lim <i>et al.</i>	ALL
	U123	9,276,642-B2	03-01-2016	Shostak	ALL
	U124	9,450,303-B2	09-20-2016	Su <i>et al.</i>	ALL
	U125	9,460,847-B2	10-04-2016	Lee <i>et al.</i>	ALL
	U126	9,484,768-B2	11-01-2016	Park <i>et al.</i>	ALL
	U127	9,515,513-B2	12-06-2016	Suzuki <i>et al.</i>	ALL
	U128	9,543,653-B2	01-10-2017	Han <i>et al.</i>	ALL
	U129	9,553,476-B2	01-24-2017	An <i>et al.</i>	ALL
	U130	9,607,757-B2	03-28-2017	Hirobe <i>et al.</i>	ALL
	U131	9,673,509-B2	06-06-2017	Park <i>et al.</i>	ALL
	U132	9,674,646-B2	06-06-2017	Jang <i>et al.</i>	ALL
	U133	9,761,928-B2	09-12-2017	Han <i>et al.</i>	ALL
	U134	9,825,484-B2	11-21-2017	Van Bosch <i>et al.</i>	ALL
	U135	9,843,215-B2	12-12-2017	Yeom <i>et al.</i>	ALL
	U136	9,941,576-B2	04-10-2018	Ito <i>et al.</i>	ALL
	U137	9,941,729-B2	04-10-2018	Peralta <i>et al.</i>	ALL
	U138	9,941,743-B2	04-10-2018	Peralta <i>et al.</i>	ALL
	U139	9,948,129-B2	04-17-2018	Singh <i>et al.</i>	ALL
	U140	9,960,629-B2	05-01-2018	Rajagopalan <i>et al.</i>	ALL
	U141	9,991,735-B1	06-05-2018	Yamaguchi <i>et al.</i>	ALL

Examiner Signature		Date Considered	
--------------------	--	-----------------	--

\*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. <sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> See Kind Codes of USPTO Patent Documents at [www.uspto.gov](http://www.uspto.gov) or MPEP901.04. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached.

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 2 hours 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, 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 (1-800-786-9199) and select option 2.

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 1449A/PTO <b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b> <i>(use as many sheets as necessary)</i>				<b>Complete if Known</b>			
				Application Number			
				Filing Date		January 31, 2019	
				First Named Inventor		Jeong Wook AN	
				Art Unit			
				Examiner Name			
Sheet	8	of	15	Attorney Docket Number	SUN.LGI.420D3		

U.S. PATENT DOCUMENTS					
Examiner Initials*	Cite No. <sup>1</sup>	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number - Kind Code <sup>2</sup> (if known)			
	U142	9,991,744-B2	06-05-2018	Lee <i>et al.</i>	ALL
	U143	10,003,120-B2	06-19-2018	Kang <i>et al.</i>	ALL
	U144	10,063,100-B2	08-28-2018	Singh <i>et al.</i>	ALL
	U145	10,014,577-B2	07-03-2018	Cao	ALL
	U146	10,110,052-B2	10-23-2018	YEOM <i>et al.</i>	ALL
	U147	2013/0169398-A1	07-04-2013	Sugita <i>et al.</i>	ALL

FOREIGN PATENT DOCUMENTS							
Examiner Initials*	Cite No. <sup>1</sup>	Foreign Patent Document		Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T <sup>6</sup>
		Country Code <sup>3</sup>	Number <sup>4</sup> - Kind Code <sup>5</sup> (if known)				
	F1		CN-101256876-A (With English Abstract)	09-03-2008	TDK Corp.	ALL	
	F2		CN-101924398-A (With English Abstract)	12-22-2010	Zhongyou <i>et al.</i>	ALL	
	F3		CN-102083280-A (With English Abstract)	06-01-2011	LG Innotek Co., Ltd.	ALL	
	F4		CN-102360718-A (With English Abstract)	02-22-2012	Samsung Electro Mechanics K.K.	ALL	
	F5		CN-1784510-A (With English Abstract)	06-07-2006	TDK Corp.	ALL	
	F6		EP-02642632-A2 (Equivalent to US 2013/0249302-A1)	09-25-2013	LG Innoteck Co., Ltd.	ALL	
	F7		EP-02752943-A1 (Equivalent to US 9,460,847-B2)	07-09-2014	LG Innoteck Co., Ltd.	ALL	

Examiner Signature		Date Considered	
--------------------	--	-----------------	--

\*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. <sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> See Kind Codes of USPTO Patent Documents at [www.uspto.gov](http://www.uspto.gov) or MPEP901.04. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached.

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 2 hours 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, 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 (1-800-786-9199) and select option 2.

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 1449A/PTO  <b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  <i>(use as many sheets as necessary)</i>			<i>Complete if Known</i>		
			Application Number		
			Filing Date		January 31, 2019
			First Named Inventor		Jeong Wook AN
			Art Unit		
			Examiner Name		
Sheet	9	of	15	Attorney Docket Number	SUN.LGI.420D3

FOREIGN PATENT DOCUMENTS							
Examiner Initials*	Cite No. <sup>1</sup>	Foreign Patent Document		Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T <sup>6</sup>
		Country Code <sup>3</sup>	Number <sup>4</sup> - Kind Code <sup>5</sup> (if known)				
	F8		JP-2004110854-A (With English Abstract)	04-08-2004	Toshiba Corp. <i>et al.</i>	ALL	
	F9		JP-2004364199-A (With English Abstract)	12-24-2004	Sony Corp.	ALL	
	F10		JP-2006-042519-A (With English Abstract)	02-09-2006	Seiko Epson Corp.	ALL	
	F11		JP-2008-027015-A (With English Abstract)	02-07-2008	Dainippon Printing Co., Ltd.	ALL	
	F12		JP-2008-172872-A (With English Abstract)	07-24-2008	Sony Ericsson Mobile Comm, et al.	ALL	
	F13		JP-2008-205215-A (With English Abstract)	09-04-2008	Seiko Epson Corp.	ALL	
	F14		JP-2008-210861-A (With English Abstract)	09-11-2008	Yonezawa Densen <i>et al.</i>	ALL	
	F15		JP-2009033106-A (With English Abstract)	02-12-2009	Taida Electronic Ind. Co. Ltd.	ALL	
	F16		JP-2011-097534-A (With English Abstract)	05-12-2011	Tokai Rika Co., Ltd.	ALL	
	F17		JP-2012-010533-A (With English Abstract)	01-12-2012	Murata MFG Co., Ltd.	ALL	
	F18		JP-2012-0191134-A (With English Abstract)	10-04-2012	Murata Manufacturing Co.	ALL	
	F19		JP-2012019302-A (With English Abstract)	01-26-2012	Nec Tokin Corp.	ALL	
	F20		JP-2012-178959-A (With English Abstract)	09-13-2012	Equos Res. Co. Ltd.	ALL	
	F21		JP-H04-51115-U (With English Abstract)	04-30-1992	Hitachi Ferrite, Ltd.	ALL	

Examiner Signature		Date Considered	
--------------------	--	-----------------	--

\*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. <sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> See Kind Codes of USPTO Patent Documents at [www.uspto.gov](http://www.uspto.gov) or MPEP901.04. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached.

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 2 hours 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, 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 (1-800-786-9199) and select option 2.

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 1449A/PTO				<b>Complete if Known</b>	
<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  (use as many sheets as necessary)				<b>Application Number</b>	
				<b>Filing Date</b> January 31, 2019	
				<b>First Named Inventor</b> Jeong Wook AN	
				<b>Art Unit</b>	
				<b>Examiner Name</b>	
<b>Sheet</b>	10	of	15	<b>Attorney Docket Number</b>	SUN.LGI.420D3

FOREIGN PATENT DOCUMENTS							
Examiner Initials*	Cite No. <sup>1</sup>	Foreign Patent Document		Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T <sup>6</sup>
		Country Code <sup>3</sup>	Number <sup>4</sup> - Kind Code <sup>5</sup> (if known)				
	F22	JP-H06-267746-A (With English Abstract)		09-22-1994	Murata MFG Co., Ltd.	ALL	
	F23	JP-H07-074038-A (With English Abstract)		03-17-1995	TDK Corp.	ALL	
	F24	JP-H08-79976-A (With English Abstract)		03-22-1996	TDK Corp.	ALL	
	F25	JP-H10282232-A (With English Abstract)		10-23-1998	Toshiba Corp.	ALL	
	F26	JP-S56-78415-U (With English Abstract)		06-25-1981	Omron Corporation	ALL	
	F27	JP-S61-69811-U (With English Abstract)		05-13-1986	Fui Denki Kagaku Kabushiki Kaisha	ALL	
	F28	KR-10-1177302-B1 (With English Abstract)		08-30-2012	Nanomag Co., Ltd.	ALL	
	F29	KR-1020040063286-A (With English Abstract)		07-14-2004	Flex-Tech Co., Ltd.	ALL	
	F30	KR-10-2005-0120481-A (With English Abstract)		12-22-2005	Samsung Techwin Co., Ltd.	ALL	
	F31	KR-10-2006-0008332-A (With English Abstract)		01-26-2006	Sony Corp.	ALL	
	F32	KR-10-2008-0074640-A (With English Abstract)		08-13-2008	Anyquitous Co., Ltd.	ALL	
	F33	KR-10-2010-0130480-A (With English Abstract)		12-13-2010	UK Tech. Co. Ltd., et al.	ALL	
	F34	KR-10-2012-0016778-A (With English Abstract)		02-27-2012	Samsung Electronics Co., Ltd.	ALL	
	F35	KR-10-2012-0123375-A (With English Abstract)		11-08-2012	Asahi Glass Co., Ltd.	ALL	

<b>Examiner Signature</b>		<b>Date Considered</b>	
---------------------------	--	------------------------	--

\*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. <sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> See Kind Codes of USPTO Patent Documents at [www.uspto.gov](http://www.uspto.gov) or MPEP901.04. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached.

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 2 hours 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, 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 (1-800-786-9199) and select option 2.



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 1449A/PTO				<b>Complete if Known</b>			
<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  (use as many sheets as necessary)				<b>Application Number</b>			
				<b>Filing Date</b>		January 31, 2019	
				<b>First Named Inventor</b>		Jeong Wook AN	
				<b>Art Unit</b>			
				<b>Examiner Name</b>			
<b>Sheet</b>	11	<b>of</b>	15	<b>Attorney Docket Number</b>	SUN.LGI.420D3		

FOREIGN PATENT DOCUMENTS							
Examiner Initials*	Cite No. <sup>1</sup>	Foreign Patent Document		Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T <sup>6</sup>
		Country Code <sup>3</sup>	Number <sup>4</sup> - Kind Code <sup>5</sup> (if known)				
	F36		KR-1020130015618-A (With English Abstract)	02-14-2013	EMW Co., Ltd.	ALL	
	F37		KR-10-2013-0028301-A (With English Abstract)	03-19-2013	Se Gi Synthetic Environment Co., Ltd.	ALL	
	F38		KR-10-2013-0028302-A (With English Abstract)	03-19-2013	Osung Mega Power Co., Ltd.	ALL	
	F39		KR-10-2014-0113205-A (With English Abstract)	09-24-2014	LG INNOTEK CO., LTD	ALL	
	F40		TW-M424550-U1 (With English Abstract)	03-11-2012	TDK Taiwan Corp.	ALL	
	F41		WO-2012008693-A2 (With English Abstract)	01-19-2012	Hanrim Postech. Co. Ltd. <i>et al.</i>	ALL	
	F42		WO-2012150293-A1 (With English Abstract)	11-08-2012	Scholz <i>et al.</i>	ALL	
	F43		CN-1816945-A (With English Abstract) (Equivalent to US 2007/0095913)	08-09-2006	SONY CORP	ALL	
	F44		CN-2888666-Y (With English Abstract)	04-11-2007	BEIJING WATCH DATA SYSTEM CO., LTD	ALL	
	F45		CN-1592986-A (With English Abstract) (Equivalent to US 7,113,137-B2)	03-09-2005	ETA SA MANUFACTURE HORLOGERE S	ALL	
	F46		CN-202120299-U (With English Abstract)	01-18-2012	SMART APPROACH TECHNOLOGY CO., LTD	ALL	
	F47		CN-1462413-A (With English Abstract) (Equivalent to US 6,950,023)	12-17-2003	GEMPLUS	ALL	

Examiner Signature		Date Considered	
--------------------	--	-----------------	--

\*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.<sup>1</sup> Applicant's unique citation designation number (optional).<sup>2</sup> See Kind Codes of USPTO Patent Documents at [www.uspto.gov](http://www.uspto.gov) or MPEP901.04. <sup>3</sup> Enter Office that issued the document, by the two-letter code (WIPO Standard T.3). <sup>4</sup> For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. <sup>5</sup> Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. <sup>6</sup> Applicant is to place a check mark here if English language Translation is attached.

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 2 hours 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, 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 (1-800-786-9199) and select option 2.

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 1449A/PTO				<b>Complete if Known</b>	
<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  (use as many sheets as necessary)				Application Number	
				Filing Date	January 31, 2019
				First Named Inventor	Jeong Wook AN
				Art Unit	
				Examiner Name	
Sheet	12	of	15	Attorney Docket Number	SUN.LGI.420D3

FOREIGN PATENT DOCUMENTS							
Examiner Initials*	Cite No. <sup>1</sup>	Foreign Patent Document		Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T <sup>6</sup>
		Country Code <sup>3</sup>	Number <sup>4</sup> - Kind Code <sup>5</sup> (if known)				
	F48	JP-2001-027687-A (With English Abstract)		01-30-2001	ISHIKAWAJIMA HARIMA HEAVY IND CO LTD	ALL	
	F49	JP-2002-299138-A (With English Abstract)		10-11-2002	Kawasaki Steel Corp.	ALL	
	F50	CN-101573716-A (With English Abstract) (Equivalent to US 7,971,339)		11-04-2009	ASSA ABLOY IDENTIFICATION TECH <i>et al.</i>	ALL	

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No. <sup>1</sup>	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 <sup>2</sup>
	R1	Dainippon Printing (JP 2008-027015) Translation F5; February 2008.	
	R2	European Patent Communication dated October 19, 2017, in European Application No. 13763524.9-1806.	
	R3	European Search Report dated August 29, 2017 in European Application No. 17157643.2.	
	R4	European Search Report dated August 8, 2017 in European Application No. 16206292.1.	
	R5	European Search Report dated February 4, 2016 in European Application No. 13763524.9.	
	R6	European Search Report dated July 1, 2014 in European Application No. 12190583.0.	

Examiner Signature		Date Considered	
--------------------	--	-----------------	--

\*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.

<sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> Applicant is to place a check mark here if English language Translation is attached. This collection of information is required by 37 CFR 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 2 hours 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, 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 (1-800-786-9199) and select option 2.

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 1449A/PTO <b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b> <i>(use as many sheets as necessary)</i>				<b>Complete if Known</b>			
				Application Number			
				Filing Date		January 31, 2019	
				First Named Inventor		Jeong Wook AN	
				Art Unit			
				Examiner Name			
Sheet	13	of	15	Attorney Docket Number	SUN.LGI.420D3		

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No. <sup>1</sup>	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 <sup>2</sup>
	R7	International Search Report dated July 25, 2013 in International Application No. PCT/KR2013/002406.	
	R8	International Search Report dated July 26, 2013 in International Application No. PCT/KR2013/002412.	
	R9	International Search Report in International Application No. PCT/KR2013/002412, filed March 22, 2013.	
	R10	Murata (JP 2012-191134) - Translated patent; October 2012.	
	R11	Office Action dated August 10, 2016 in Japanese Application No. 2015-172306.	
	R12	Office Action dated August 24, 2015 in US Application No.13/663,012.	
	R13	Office Action dated August 24, 2016 in Taiwanese Application No. 103130766.	
	R14	Office Action dated December 21, 2015 in Chinese Application No. 201380026460.5.	
	R15	Office Action dated February 13, 2015 in US Application No.13/663,012.	
	R16	Office Action dated February 14, 2017 in Japanese Application No. 2015501586.	
	R17	Office Action dated February 24, 2014 in Korean Application No. 10-2013-0028301.	

Examiner Signature		Date Considered	
--------------------	--	-----------------	--

\*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.

<sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> Applicant is to place a check mark here if English language Translation is attached.

This collection of information is required by 37 CFR 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 2 hours 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, 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 (1-800-786-9199) and select option 2.

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 1449A/PTO				<b>Complete if Known</b>	
<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  (use as many sheets as necessary)				<b>Application Number</b>	
				<b>Filing Date</b> January 31, 2019	
				<b>First Named Inventor</b> Jeong Wook AN	
				<b>Art Unit</b>	
				<b>Examiner Name</b>	
<b>Sheet</b>	14	of	15	<b>Attorney Docket Number</b> SUN.LGI.420D3	

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No. <sup>1</sup>	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 <sup>2</sup>
	R18	Office Action dated February 24, 2014 in Korean Application No. 10-2013-0028302.	
	R19	Office Action dated July 1, 2014 in European Application No.12190583.0.	
	R20	Office Action dated June 2, 2016 in U.S. Application No. 14/387,521.	
	R21	Office Action dated June 29, 2016 in Chinese Application No. 201510084340.1.	
	R22	Office Action dated November 11, 2013 in Korean Application No. 10-2012-0123375.	
	R23	Office Action dated November 12, 2013 in Japanese Application No.2012-238615.	
	R24	Office Action dated October 7, 2014 in Japanese Application No.2012-238615.	
	R25	Office Action dated September 28, 2016 in Korean Application No. 1020130028300.	
	R26	Office Action dated November 27, 2017 in U.S. Application No. 15/362,367.	
	R27	Office Action dated May 2, 2018 in Chinese Application No. 201610391052.5.	
	R28	Office Action dated April 30, 2018 in U.S. Application No. 15/362,367.	

<b>Examiner Signature</b>	<b>Date Considered</b>
-------------------------------	----------------------------

\*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.

<sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> Applicant is to place a check mark here if English language Translation is attached.

This collection of information is required by 37 CFR 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 2 hours 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, 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 (1-800-786-9199) and select option 2.

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 1449A/PTO				<b>Complete if Known</b>	
<b>INFORMATION DISCLOSURE STATEMENT BY APPLICANT</b>  (use as many sheets as necessary)				Application Number	
				Filing Date	January 31, 2019
				First Named Inventor	Jeong Wook AN
				Art Unit	
				Examiner Name	
Sheet	15	of	15	Attorney Docket Number	SUN.LGI.420D3

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No. <sup>1</sup>	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 <sup>2</sup>
	R29	Office Action dated June 15, 2018 in U.S. Application No. 15/360,425.	
	R30	Office Action dated July 10, 2018 in U.S. Application No. 15/430,173.	

Examiner Signature	Date Considered	
-----------------------	--------------------	--

\*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.

<sup>1</sup> Applicant's unique citation designation number (optional). <sup>2</sup> Applicant is to place a check mark here if English language Translation is attached.

This collection of information is required by 37 CFR 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 2 hours 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, 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 (1-800-786-9199) and select option 2.

## Electronic Patent Application Fee Transmittal

<b>Application Number:</b>				
<b>Filing Date:</b>				
<b>Title of Invention:</b>	Wireless Power Receiver and Method of Manufacturing the Same			
<b>First Named Inventor/Applicant Name:</b>	JEONG WOOK AN			
<b>Filer:</b>	Jeff Lloyd/Larann Massey			
<b>Attorney Docket Number:</b>	SUN.LGI.420D3			
Filed as Large Entity				
<b>Filing Fees for Utility under 35 USC 111(a)</b>				
<b>Description</b>	<b>Fee Code</b>	<b>Quantity</b>	<b>Amount</b>	<b>Sub-Total in USD(\$)</b>
<b>Basic Filing:</b>				
UTILITY APPLICATION FILING	1011	1	300	300
UTILITY SEARCH FEE	1111	1	660	660
UTILITY EXAMINATION FEE	1311	1	760	760
<b>Pages:</b>				
<b>Claims:</b>				
<b>Miscellaneous-Filing:</b>				
<b>Petition:</b>				
<b>Patent-Appeals-and-Interference:</b>				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
<b>Post-Allowance-and-Post-Issuance:</b>				
<b>Extension-of-Time:</b>				
<b>Miscellaneous:</b>				
<b>Total in USD (\$)</b>				<b>1720</b>

## Electronic Acknowledgement Receipt

<b>EFS ID:</b>	35026612
<b>Application Number:</b>	16264360
<b>International Application Number:</b>	
<b>Confirmation Number:</b>	7253
<b>Title of Invention:</b>	Wireless Power Receiver and Method of Manufacturing the Same
<b>First Named Inventor/Applicant Name:</b>	JEONG WOOK AN
<b>Customer Number:</b>	23557
<b>Filer:</b>	Jeff Lloyd/Larann Massey
<b>Filer Authorized By:</b>	Jeff Lloyd
<b>Attorney Docket Number:</b>	SUN.LGI.420D3
<b>Receipt Date:</b>	31-JAN-2019
<b>Filing Date:</b>	
<b>Time Stamp:</b>	18:54:13
<b>Application Type:</b>	Utility under 35 USC 111(a)

### Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	\$1720
RAM confirmation Number	020119INTEFSW00006107190065
Deposit Account	190065
Authorized User	Larann Massey

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)



37 CFR 1.19 (Document supply fees)  
 37 CFR 1.20 (Post Issuance fees)  
 37 CFR 1.21 (Miscellaneous fees and charges)

**File Listing:**

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	aia0014_ADS.PDF	1256485	no	10
			e8d2749e767e1df24381d995f3615af3f5b0c2a		

**Warnings:**

**Information:**

2		SUN-LGI-420D3-Application-AF.pdf	168224	yes	33
			0ea39cf7599fe51355c5601580bf2f924c853bd5		

**Multipart Description/PDF files in .zip description**

	Document Description	Start	End
	Specification	1	28
	Claims	29	32
	Abstract	33	33

**Warnings:**

**Information:**

3	Drawings-other than black and white line drawings	SUN-LGI-420D3-Figures-AF.pdf	439100	no	21
			638c74032199e68440eaf996b212ceb5e89e64f8		

**Warnings:**

**Information:**

4	Request for USPTO to retrieve priority docs	SUN-LGI-420D3-ClaimofPriority.pdf	64172	no	1
			7adff472ecd3c9c04ea06856ce1e116d53dfb73		

**Warnings:**

**Information:**

5	Oath or Declaration filed	Exec-Dec.pdf	138333	no	4
			7452d4696a53a4d1514c068ebf03ff045bed7fa		

<b>Warnings:</b>					
<b>Information:</b>					
6	Power of Attorney	POA.pdf	60076 661ed07583d3c7a5f7ced369520c4586f09d ed99	no	1
<b>Warnings:</b>					
<b>Information:</b>					
7		SUN-LGI-420D3-IDS.pdf	1860721 63d1dc550b194381a34f7b595d38a2fb9ff6 dd5b	yes	17
	<b>Multipart Description/PDF files in .zip description</b>				
	<b>Document Description</b>		<b>Start</b>	<b>End</b>	
	Transmittal Letter		1	2	
	Information Disclosure Statement (IDS) Form (SB08)		3	17	
<b>Warnings:</b>					
<b>Information:</b>					
8	Fee Worksheet (SB06)	fee-info.pdf	35069 61eda2a44ede36903d5efaa1b2a5fe6b4d2 8282	no	2
<b>Warnings:</b>					
<b>Information:</b>					
<b>Total Files Size (in bytes):</b>			4022180		
<p><b>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.</b></p> <p><b><u>New Applications Under 35 U.S.C. 111</u></b>  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><b><u>National Stage of an International Application under 35 U.S.C. 371</u></b>  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><b><u>New International Application Filed with the USPTO as a Receiving Office</u></b>  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>					

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.

<b>Application Data Sheet 37 CFR 1.76</b>		Attorney Docket Number	SUN.LGI.420D3
		Application Number	
Title of Invention	Wireless Power Receiver and Method of Manufacturing the Same		
<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. 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:**

<input type="checkbox"/>	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	
	JEONG WOOK		AN		
Residence Information (Select One)    US Residency    ● Non US Residency    Active US Military Service					
City	Seoul	Country of Residence <sup>i</sup>	KR		
Mailing Address of Inventor:					
Address 1	98, Huam-ro, Jung-gu				
Address 2					
City	Seoul	State/Province			
Postal Code	04637	Country <sup>i</sup>	KR		
Inventor	2				Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	JUNG OH		EE		
Residence Information (Select One)    US Residency    ● Non US Residency    Active US Military Service					
City	Seoul	Country of Residence <sup>i</sup>	KR		
Mailing Address of Inventor:					
Address 1	98, Huam-ro, Jung-gu				
Address 2					
City	Seoul	State/Province			
Postal Code	04637	Country <sup>i</sup>	KR		
Inventor	3				Remove
Legal Name					

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.

<b>Application Data Sheet 37 CFR 1.76</b>		Attorney Docket Number	SUN.LGI.420D3
		Application Number	
Title of Invention	Wireless Power Receiver and Method of Manufacturing the Same		

Prefix	Given Name	Middle Name	Family Name	Suffix
	SUNG HYUN		LEEM	

<b>Residence Information (Select One)</b>	US Residency	<input checked="" type="radio"/> Non US Residency	Active US Military Service
City	Seoul	Country of Residence <sup>i</sup>	KR

**Mailing Address of Inventor:**

Address 1	98, Huam-ro, Jung-gu		
Address 2			
City	Seoul	State/Province	
Postal Code	04637	Country <sup>i</sup>	KR
Inventor	4	<input type="button" value="Remove"/>	

**Legal Name**

Prefix	Given Name	Middle Name	Family Name	Suffix
	YANG HYUN		KIM	

<b>Residence Information (Select One)</b>	US Residency	<input checked="" type="radio"/> Non US Residency	Active US Military Service
City	Seoul	Country of Residence <sup>i</sup>	KR

**Mailing Address of Inventor:**

Address 1	98, Huam-ro, Jung-gu		
Address 2			
City	Seoul	State/Province	
Postal Code	04637	Country <sup>i</sup>	KR

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button.

**Correspondence Information:**

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).	
<input type="checkbox"/> An Address is being provided for the correspondence information of this application.	
Customer Number	23557
Email Address	JL@SLEPATENTS.COM <input type="button" value="Add Email"/> <input type="button" value="Remove Email"/>

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.

<b>Application Data Sheet 37 CFR 1.76</b>		Attorney Docket Number	SUN.LGI.420D3
		Application Number	
Title of Invention	Wireless Power Receiver and Method of Manufacturing the Same		

**Application Information:**

Title of the Invention	Wireless Power Receiver and Method of Manufacturing the Same		
Attorney Docket Number	SUN.LGI.420D3	Small Entity Status Claimed	<input type="checkbox"/>
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	21	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

**Publication Information:**

<input type="checkbox"/> Request Early Publication (Fee required at time of Request 37 CFR 1.219)
<input type="checkbox"/> <b>Request Not to Publish.</b> 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 <b>has not and will not</b> 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:	<input checked="" type="radio"/> Customer Number	<input type="radio"/> US Patent Practitioner	<input type="radio"/> Limited Recognition (37 CFR 11.9)
Customer Number	23557		

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.

<b>Application Data Sheet 37 CFR 1.76</b>		Attorney Docket Number	SUN.LGI.420D3
		Application Number	
Title of Invention	Wireless Power Receiver and Method of Manufacturing the Same		

### 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	15430173	2017-02-10			
Prior Application Status	Pending					Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)			
15430173	Continuation of	15360425	2016-11-23			
Prior Application Status	Patented					Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)	
15360425	Continuation of	13663012	2012-10-29	9806565	2017-10-31	
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.						Add

### 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)<sup>i</sup> 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).

Application Number	Country <sup>i</sup>	Filing Date (YYYY-MM-DD)	Access Code <sup>j</sup> (if applicable)	Remove
10-2012-0029987	KR	2012-03-23		
Application Number	Country <sup>i</sup>	Filing Date (YYYY-MM-DD)	Access Code <sup>j</sup> (if applicable)	Remove
10-2012-0079004	KR	2012-07-19		
Additional Foreign Priority Data may be generated within this form by selecting the Add button.				
Add				

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.

<b>Application Data Sheet 37 CFR 1.76</b>		Attorney Docket Number	SUN.LGI.420D3
		Application Number	
Title of Invention	Wireless Power Receiver and Method of Manufacturing the Same		

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

<p>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.</p> <p><input type="checkbox"/> 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.</p>
--

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.

<b>Application Data Sheet 37 CFR 1.76</b>		Attorney Docket Number	SUN.LGI.420D3
		Application Number	
Title of Invention	Wireless Power Receiver and Method of Manufacturing the Same		

## 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)

A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

**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.



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.

<b>Application Data Sheet 37 CFR 1.76</b>		Attorney Docket Number	SUN.LGI.420D3
		Application Number	
Title of Invention	Wireless Power Receiver and Method of Manufacturing the Same		

## 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.

<b>Applicant</b> 1	<input type="button" value="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>		
<input type="button" value="Clear"/>		
<input type="radio"/> Assignee	<input type="radio"/> Legal Representative under 35 U.S.C. 117	<input type="radio"/> Joint Inventor
<input type="radio"/> Person to whom the inventor is obligated to assign.	<input type="radio"/> Person who shows sufficient proprietary interest	
If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:		
<input type="text"/>		
Name of the Deceased or Legally Incapacitated Inventor: <input type="text"/>		
If the Applicant is an Organization check here. <input checked="" type="checkbox"/>		
Organization Name	<input type="text" value="LG INNOTEK CO., LTD."/>	
<b>Mailing Address Information For Applicant:</b>		
Address 1	<input type="text" value="98, Huam-ro, Jung-gu"/>	
Address 2	<input type="text"/>	
City	<input type="text" value="Seoul"/>	State/Province <input type="text"/>
Country	<input type="text" value="KR"/>	Postal Code <input type="text" value="04637"/>
Phone Number	<input type="text"/>	Fax Number <input type="text"/>
Email Address	<input type="text"/>	
Additional Applicant Data may be generated within this form by selecting the Add button. <input type="button" value="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.

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.

<b>Application Data Sheet 37 CFR 1.76</b>		Attorney Docket Number	SUN.LGI.420D3
		Application Number	
Title of Invention	Wireless Power Receiver and Method of Manufacturing the Same		

<b>Assignee</b>	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. <input type="checkbox"/>				
Prefix	Given Name	Middle Name	Family Name	Suffix
<b>Mailing Address Information For Assignee including Non-Applicant Assignee:</b>				
Address 1				
Address 2				
City		State/Province		
Country <sup>i</sup>		Postal Code		
Phone Number		Fax Number		
Email Address				
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.

<b>Signature</b>	/JEFF LLOYD/		Date (YYYY-MM-DD)	2019-01-31
First Name	JEFF	Last Name	LLOYD	Registration Number
Additional Signature may be generated within this form by selecting the Add button.				<input type="button" value="Add"/>

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.

<b>Application Data Sheet 37 CFR 1.76</b>		Attorney Docket Number	SUN.LGI.420D3
		Application Number	
Title of Invention	Wireless Power Receiver and Method of Manufacturing the Same		

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.**

## 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.

## WIRELESS POWER RECEIVER AND METHOD OF MANUFACTURING THE SAME

### CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. Application No. 15/430,173, filed February 10, 2017; which is a continuation of U.S. Application No. 15/360,425, filed November 23, 2016; which is a continuation of U.S. Application No. 13/663,012, filed October 29, 2012, now U.S. Patent No. 9,806,565, issued October 31, 2017; which claims the benefit under 35 U.S.C §119 of Korean Patent Application Nos. 10-2012-0029987, filed March 23, 2012, and 10-2012-0079004, filed July 19, 2012; which are hereby incorporated by reference in their entirety.

### BACKGROUND

The embodiment relates to a wireless power receiver and a method of manufacturing the same. In more particular, the embodiment relates to a wireless power receiver used for wireless power transmission or an antenna to reduce a thickness of the wireless power receiver and to simplify the manufacturing process thereof and a method of manufacturing the same.

A wireless power transmission or a wireless energy transfer refers to a technology of wirelessly transferring electric energy to desired devices. In the 1800's, an electric motor or a transformer employing the principle of electromagnetic induction has been extensively used and then a method of transmitting electrical energy by irradiating electromagnetic waves, such as radio waves or lasers, has been suggested. Actually, electrical toothbrushes or electrical razors, which are frequently used in daily life, are charged based on the principle of electromagnetic induction. The electromagnetic induction refers to the generation of an electric current through induction of a voltage when a magnetic field is changed around a conductor. The electromagnetic induction scheme has been successfully commercialized for electronic appliances having small sizes, but represents a problem in that the transmission distance of power is too short.

Besides the electromagnetic induction scheme, the long-distance transmission using the resonance and the short-wavelength radio frequency has been suggested as the wireless energy transfer scheme.

However, in general, a wireless power receiver disposed in a terminal has a thick thickness and the manufacturing process thereof is complicated.

#### BRIEF SUMMARY

5 An embodiment provides a method capable of remarkably reducing a thickness of a wireless power receiver by directly disposing a coil unit on a top surface of a magnetic substrate.

An embodiment provides a method capable of ensuring high power transmission efficiency and enabling communication with external devices by directly disposing a coil unit and a near field communication antenna on a top surface of a magnetic substrate.

10 An embodiment provides a method capable of simplifying the manufacturing process for a wireless power receiver by directly disposing a coil unit on a magnetic substrate.

An embodiment provides a method capable of remarkably reducing a thickness of a wireless power receiver by disposing a coil unit inside a magnetic substrate.

15 An embodiment provides a method capable of ensuring high power transmission efficiency and enabling communication with external devices by disposing a coil unit inside a magnetic substrate and a near field communication antenna on a magnetic substrate.

An embodiment provides a method capable of simplifying the manufacturing process for a wireless power receiver by disposing a coil unit inside a magnetic substrate.

20 A wireless power receiver according to one embodiment includes a magnetic substrate and a coil configured to wirelessly receive power, wherein the coil is formed as a conductive layer on the magnetic substrate.

25 A wireless power receiver according to one embodiment includes a magnetic substrate and a coil a coil configured to wirelessly receive power, wherein the coil is formed as a conductive layer at the magnetic substrate, wherein a part of the coil is disposed inside the magnetic substrate.

30 A method of manufacturing a wireless power receiver for wirelessly receiving power according to one embodiment includes forming a conductor on a protective film, forming a conductive pattern by etching the conductor, connecting a connecting unit to be connected to an external circuit to a connection terminal of the conductive pattern, obtaining a magnetic substrate having a receiving space of a predetermined shape corresponding to the connecting unit and

disposing the magnetic substrate on the conductive pattern while positioning the connecting unit in the receiving space.

According to one embodiment, the thickness of the wireless power receiver can be remarkably reduced by directly disposing the coil unit on a top surface of the magnetic substrate.

5 According to one embodiment, the high power transmission efficiency can be ensured and communication with external devices can be enabled by directly disposing the coil unit and the near field communication antenna on the top surface of the magnetic substrate.

10 According to one embodiment, the manufacturing process for the wireless power receiver can be simplified by directly disposing the coil unit on the magnetic substrate only through laminating and etching processes.

According to one embodiment, the thickness of the wireless power receiver can be remarkably reduced by forming the conductive pattern inside the magnetic substrate.

15 According to one embodiment, the high power transmission efficiency can be ensured by forming the conductive pattern inside the magnetic substrate and the communication with external devices can be enabled by using the near field communication antenna.

According to one embodiment, the connecting unit is disposed in the receiving space of the magnetic substrate so that the thickness of the wireless power receiver can be remarkably reduced as much as the thickness of the connecting unit.

20 According to one embodiment, a tape substrate is used as the connecting unit so that the overall size of the wireless power receiver can be reduced.

According to one embodiment, a lead frame is used as the connecting unit, so the wiring layer included in the connecting unit can be protected from the heat, external moisture or impact and the mass production can be realized.

25 According to one embodiment, the magnetic field directed to the outside can be changed into the coil unit due to the conductive pattern formed in the magnetic substrate, so the power transmission efficiency can be improved, at the same time, the amount of the magnetic field leaked to the outside can be reduced so that the bad influence of the magnetic field exerted to the human body can be diminished.

According to one embodiment, the wireless power receiver can be manufactured only through the processes of forming the pattern groove and inserting the coil unit, so that the manufacturing process can be simplified.

5 Other various effects of the embodiments will be disclosed directly or indirectly in the detailed description of the embodiments.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view illustrating a wireless power receiver **1000** according to the first embodiment;

10 FIG. 2 is a plan view illustrating a wireless power receiver **1000** according to the first embodiment;

FIG. 3 is a sectional view taken along line A-A' of a connecting unit **300** of a wireless power receiver **1000** shown in FIG. 2;

15 FIGS. 4 to 8 are views for explaining a method of manufacturing a wireless power receiver **1000** according to one embodiment;

FIG. 9 is a sectional view taken along line A-A' of a connecting unit **300** of a wireless power receiver **1000** shown in FIG. 2 according to the second embodiment;

FIG. 10 is a plan view illustrating a wireless power receiver **1000** according to the third embodiment;

20 FIG. 11 is a perspective view illustrating a wireless power receiver **1000** according to the fourth embodiment;

FIG. 12 is a plan view illustrating a wireless power receiver **1000** according to the fourth embodiment;

25 FIG. 13 is a sectional view taken along line B-B' of a connecting unit **300** of a wireless power receiver **1000** shown in FIG. 12 according to the fourth embodiment;

FIG. 14 is a perspective view illustrating a wireless power receiver **1000** according to the fifth embodiment;

FIG. 15 is a plan view illustrating a wireless power receiver **1000** according to the fifth embodiment;



FIG. 16 is a sectional view taken along line C-C' of a wireless power receiver **1000** according to the fifth embodiment;

FIGS. 17 to 21 are views for explaining a method of manufacturing a wireless power receiver **1000** according to the fifth embodiment;

5 FIG. 22 is a view for explaining variation of inductance, resistance and **Q** values of a coil unit **200** as a function of a usable frequency when the coil unit **200** is disposed on a top surface of a magnetic substrate according to the first embodiment;

FIG. 23 is a view for explaining variation of inductance, resistance and **Q** values of a coil unit **200** as a function of a usable frequency when the coil unit **200** is disposed in a pattern groove formed in a magnetic substrate according to the fifth embodiment;

FIG. 24 is an H-field for illustrating a radiation pattern of a magnetic field when a coil unit is disposed on a top surface of a magnetic substrate according to the first embodiment;

FIG. 25 is an H-field for illustrating a radiation pattern of a magnetic field when a coil unit is disposed in a pattern groove formed in a magnetic substrate according to the fifth embodiment;

FIG. 26 is an exploded perspective view of a wireless power receiver **1000** according to still another embodiment;

FIG. 27 is a perspective view of a wireless power receiver **1000** according to still another embodiment;

20 FIG. 28 is a sectional view of a wireless power receiver **1000** according to still another embodiment; and

FIGS. 29 to 37 are views for explaining a method of manufacturing a wireless power receiver according to still another embodiment.

## 25 DETAILED DESCRIPTION

Hereinafter, exemplary embodiments will be described in detail with reference to accompanying drawings so that those skilled in the art can easily work with the embodiments.

Hereinafter, “conductive pattern” refers to the shape of a conductive layer and may be used to refer to a structure formed by a patterning process. “conductive layer” may be used

interchangeably with “conductive pattern” and refers to a structure formed by methods including patterning, etching, depositing, selective plating, and the like.

FIG. 1 is a perspective view illustrating a wireless power receiver **1000** according to the first embodiment, FIG. 2 is a plan view illustrating the wireless power receiver **1000** according to the first embodiment and FIG. 3 is a sectional view taken along line A-A’ of a connecting unit **300** of the wireless power receiver **1000** shown in FIG. 2.

Referring to FIGS. 1 to 3, the wireless power receiver **1000** may include a magnetic substrate **100**, a coil unit **200** and a connecting unit **300**.

The wireless power receiver **1000** may wirelessly receive power from a transmission side. According to one embodiment, the wireless power receiver **1000** may wirelessly receive the power using electromagnetic induction. According to one embodiment, the wireless power receiver **1000** may wirelessly receive the power using resonance.

The electromagnetic induction and resonance may be used when transmitting the power using the magnetic field.

The magnetic substrate **100** may change the direction of the magnetic field received from the transmission side.

The magnetic substrate **100** can reduce the amount of the magnetic field to be leaked to the outside by changing the direction of the magnetic field received from the transmission side.

In detail, the magnetic substrate **100** changes the direction of the magnetic field transferred from the transmission side in the lateral direction such that the magnetic field can be more concentrated onto the coil unit **200**.

The magnetic substrate **100** can absorb some of the magnetic field received from the transmission side and leaked to the outside to dissipate the magnetic field as heat. If the amount of the magnetic field leaked to the outside is reduced, the bad influence of the magnetic field exerted on the human body can be reduced.

Referring to FIG. 3, the magnetic substrate **100** may include a magnet **110** and a support **120**.

The magnet **110** may include a particle or a ceramic.

The support **120** may include thermosetting resin or thermoplastic resin.

The magnetic substrate **100** may be prepared in the form of a sheet and may have a flexible property.

Referring again to FIG. 1, the coil unit **200** may include a first connection terminal **210**, a second connection terminal **220** and a coil **230**. The coil **230** may be formed as a conductive layer or a conductive pattern.

The first connection terminal **210** is located at one end of the coil **230** and the second connection terminal **220** is provided at the other end of the coil **230**.

The first and second connection terminals **210** and **220** are necessary for connection with the connecting unit **300**.

The coil **230** may be formed as a conductive pattern which is obtained by winding a conductive line several times. According to one embodiment, when viewed from the top, the coil pattern may have a spiral shape. However, the embodiment is not limited thereto, and various patterns may be formed.

The coil unit **200** can be directly disposed on the top surface of the magnetic substrate **100**. According to one embodiment, an adhesive layer (not shown) may be disposed between the coil unit **200** and the magnetic substrate **100**.

The coil unit **200** may include a conductor. The conductor may include a metal or an alloy. According to one embodiment, the metal may include silver or copper, but the embodiment is not limited thereto.

The coil unit **200** may transfer the power, which is wirelessly received from the transmission side, to the connecting unit **300**. The coil unit **200** can receive the power from the transmission side using the electromagnetic induction or resonance.

The connecting unit **300** may include a first connection terminal **310**, a second connection terminal **320** and a printed circuit board **330**.

The first connection terminal **310** of the connecting unit **300** may be connected to the first connection terminal **210** of the coil unit **200** and the second connection terminal **320** of the connecting unit **300** may be connected to the second connection terminal **220** of the coil unit **200**.

The printed circuit board **330** may include a wiring layer and a receiver circuit, which will be described later, may be disposed on the wiring layer.

The connecting unit **300** connects the wireless power receiving circuit (not shown) with the coil unit **200** to transfer the power received from the coil unit **200** to a load (not shown) through the wireless power receiving circuit. The wireless power receiving circuit may include a rectifier circuit for converting AC power into DC power and a smoothing circuit for transferring the DC power to the load after removing ripple components from the DC power.

FIGS. 2 and 3 are views for explaining the structure of the wireless power receiver **1000** according to the first embodiment in detail when the coil unit **200** is connected with the connecting unit **300**.

FIG. 2 is a plan view illustrating the wireless power receiver **1000** according to the first embodiment.

FIG. 2 shows the coil unit **200** connected with the connecting unit **300**.

According to one embodiment, the connection between the coil unit **200** and the connecting unit **300** may be achieved by a solder. In detail, the first connection terminal **210** of the coil unit **200** may be connected to the first connection terminal **310** of the connecting unit **300** through a first solder **10** and the second connection terminal **220** of the coil unit **200** may be connected to the second connection terminal **320** of the connecting unit **300** through a second solder **20**. In more detail, the first connection terminal **210** of the coil unit **200** may be connected to the first connection terminal **310** of the connecting unit **300** through a via hole of the first solder **10** and the second connection terminal **220** of the coil unit **200** may be connected to the second connection terminal **320** of the connecting unit **300** through a via hole of the second solder **20**.

The wireless power receiver **1000** shown in FIG. 2 may be equipped in an electronic appliance, such as a terminal.

The terminal may include a typical mobile phone, such as a cellular phone, a PCS (personal communication service) phone, a GSM phone, a CDMA-2000 phone, or a WCDMA phone, a PMP (portable multimedia player), a PDA (personal digital assistant), a smart phone, or an MBS (mobile broadcast system) phone, but the embodiment is not limited thereto. Various devices can be used as the terminal if they can wirelessly receive the power.

A section taken along line A-A' of the connecting unit **300** shown in FIG. 2 will be explained with reference to FIG. 3.

FIG. 3 is a sectional view taken along line A-A' of the connecting unit **300** of the wireless power receiver **1000** shown in FIG. 2.

Referring to FIG. 3, the first connection terminal **210**, the second connection terminal **220** and the coil **230** constituting the coil unit **200** are disposed on the top surface of the magnetic substrate **100**.

In the wireless power receiver **1000** according to the first embodiment, the coil unit **200** is directly disposed on the top surface of the magnetic substrate **100**, so the overall thickness can be remarkably reduced when comparing with the case in which the coil pattern is formed on an FPCB.

Preferably, the magnetic substrate **100** has a thickness of 0.43 mm and the coil unit **200** has a thickness of 0.1 mm, so the overall thickness is 0.53 mm. However, this numerical value is illustrative purpose only.

That is, the thickness of the wireless power receiver **1000** can be reduced by preparing the coil unit **200** in the form of a conductor, a conductive pattern or a thin film. Since the current trend has tended toward the slimness, if the wireless power receiver **1000** is applied to the electronic device, such as the portable terminal, the overall thickness of the portable terminal can be reduced and the power can be effectively received from the transmission side.

The connecting unit **300** is directly disposed on the coil unit **200**. Since the connecting unit **300** is directly disposed on the coil unit **200**, the coil unit **200** can be readily connected with the connecting unit **300**.

The first connection terminal **210** of the coil unit **200** is connected to the first connection terminal **310** of the connecting unit **300** through the solder **10**.

The second connection terminal **220** of the coil unit **200** is connected to the second connection terminal **320** of the connecting unit **300** through the solder **20**.

The coil **230** may be designed to have a predetermined width **W** and a predetermined thickness **T**. In addition, the coil **230** can be designed to have a predetermined winding interval.

FIGS. 4 to 8 are views for explaining a method of manufacturing the wireless power receiver **1000** according to one embodiment.

The structure of the wireless power receiver **1000** may be essentially identical to the structure of the wireless power receiver **1000** described with reference to FIGS. 1 to 3.

First, referring to FIG. 4, the magnetic substrate **100** is prepared.

Then, referring to FIG. 5, a conductor **201** is directly laminated on the top surface of the magnetic substrate **100**. According to one embodiment, the conductor **201** may be laminated after the adhesive layer has been laminated on the top surface of the magnetic substrate **100**.

5 According to one embodiment, a laminating process can be used to form the conductor **201** on the top surface of the magnetic substrate **100**. According to the laminating process, the conductor **201** is heated at the predetermined temperature and then predetermined pressure is applied to the conductor **201**. The laminating process refers to a process of forming heterogeneous materials, such as a metal foil and a paper, by using heat and pressure.

10 Then, referring to FIG. 6, a mask **500** is laminated on the top surface of the conductor **201**. The mask **500** may be selectively formed on the top surface of the conductor **201** corresponding to positions of the first connection terminal **210**, the second connection terminal **220** and the coil **230** of the coil unit **200**.

15 After that, referring to FIG. 7, the structure shown in FIG. 6 is immersed in an etchant so that portions of the conductor **201** where the mask **500** is not positioned may be etched. Thus, the conductor **201** may have a predetermined conductive pattern.

Then, the coil unit **200** of the wireless power receiver **1000** is formed by removing the mask **500**.

20 Thereafter, referring to FIG. 8, the soldering work is performed to connect the coil unit **200** with the connecting unit **300**.

That is, the first connection terminal **210** of the coil unit **200** may be connected to the first connection terminal **310** of the connecting unit **300** through the first solder **10** and the second connection terminal **220** of the coil unit **200** may be connected to the second connection terminal **320** of the connecting unit **300** through the second solder **20**.

25 As described above, since the coil unit **200** is directly disposed on the top surface of the magnetic substrate **100**, the overall thickness of the wireless power receiver **1000** can be remarkably reduced. In addition, since the wireless power receiver **1000** can be manufactured only through the laminating and etching processes, the manufacturing process may be simplified. FIG. 9 is a sectional view taken along line A-A' of the connecting unit **300** of the wireless power receiver **1000** shown in FIG. 2 according to the second embodiment.

30

Referring to FIG. 9, the wireless power receiver **1000** may include a magnetic substrate **100**, a coil unit **200**, a connecting unit **300** and an adhesive layer **700**.

The magnetic substrate **100**, the coil unit **200**, and the connecting unit **300** are identical to those described with reference to FIG. 1.

5 The adhesive layer **700** is interposed between the magnetic substrate **100** and the coil unit **200** to bond the magnetic substrate **100** to the coil unit **200**.

FIG. 10 is a plan view illustrating a wireless power receiver **1000** according to the third embodiment.

10 Referring to FIG. 10, the wireless power receiver **1000** may include a magnetic substrate **100**, a coil unit **200**, a connecting unit **300** and a short-range communication antenna **600**.

The magnetic substrate **100**, the coil unit **200** and the connecting unit **300** are identical to those described with reference to FIGS. 1 to 3.

The short-range communication antenna **600** includes a first connection terminal **610**, a second connection terminal **620** and an outer peripheral coil **630**.

15 The first connection terminal **610** and the second connection terminal **620** of the short-range communication antenna **600** are connected to the connecting unit **300**.

The short-range communication antenna **600** can make near field communication with a reader. The short-range communication antenna **600** may serve as an antenna that transceives information in cooperation with the reader.

20 According to one embodiment, the short-range communication antenna **600** may be arranged at an outer peripheral portion of the coil unit **200**. According to one embodiment, when the coil unit **200** is disposed at the center of the magnetic substrate **100**, the short-range communication antenna **600** may be arranged along the outer peripheral portion of the magnetic substrate **100** to surround the coil unit **200**. The short-range communication antenna **600** may have a rectangular configuration by winding one conductive line several times, but the embodiment is not limited thereto.

25 Similar to the coil unit **200**, the short-range communication antenna **600** may be formed as a conductive pattern or a conductive layer.

Various short-range communication technologies can be applied to the short-range communication antenna **600**, and the NFC technology is preferable. The NFC technology has the band of 12.56 MHz and is used for wireless communication in a short distance.

5 The short-range communication antenna **600** can be directly disposed on the top surface of the magnetic substrate **100**.

The method of forming the short-range communication antenna **600** on the magnetic substrate **100** may be identical to the method described with reference to FIG. 4.

Hereinafter, a wireless power receiver **1000** according to the fourth embodiment will be described with reference to FIGS. 11 to 13.

10 FIG. 11 is a perspective view illustrating the wireless power receiver **1000** according to the fourth embodiment.

Referring to FIG. 11, the wireless power receiver **1000** includes a magnetic substrate **100**, a coil unit **200** and a connecting unit **300**.

15 The magnetic substrate **100** and the coil unit **200** are identical to those described with reference to FIG. 1. However, the magnetic substrate **100** is slightly different from the magnetic substrate **100** described with reference to FIG. 1, so the following description will be made while focusing the difference of the magnetic substrate **100**.

20 Referring to FIG. 11, the magnet substrate **100** is formed with a receiving space **130** having a structure the same as that of the connecting unit **300**. That is, referring to FIG. 1, the coil unit **200** is disposed on the top surface of the magnetic substrate **100** and the connecting unit **300** is disposed on the coil unit **200**. However, referring to FIG. 11, the receiving space **130** having the structure the same as that of the connecting unit **300** is formed in the magnetic substrate **100**, so that the connecting unit **300** may be disposed under the coil unit **200**.

25 FIG. 12 is a plan view illustrating a wireless power receiver **1000** according to the fourth embodiment.

FIG. 12 shows the state in which the coil unit **200** and the connecting unit **300** are interconnected with each other.

30 The connecting unit **300** has a thickness equal to or smaller than a thickness of the magnetic substrate **100**. The connecting unit **300** may be implemented as a flexible printed circuit board (FPCB).



The connecting unit **300** may be disposed in the receiving space **130** of the magnetic substrate **100**.

If the thickness of the connecting unit **300** is equal to or smaller than the thickness of the magnetic substrate **100**, different from the embodiment shown in FIG. 3, the overall thickness of the wireless power receiver **1000** can be reduced as much as the thickness of the connecting unit **300**. In addition, since the usage of the magnet **110** and the support **120** can be reduced due to the receiving space **130**, it is advantageous in terms of cost effectiveness.

FIG. 13 is a sectional view taken along line B-B' of the connecting unit **300** of the wireless power receiver **1000** shown in FIG. 12 according to the fourth embodiment.

The following description will be made on the assumption that the connecting unit **300** has a thickness smaller than that of the magnetic substrate **100**.

Referring to FIG. 13, the first connection terminal **210**, the second connection terminal **220** and the coil **230** constituting the coil unit **200** are disposed on the top surface of the connecting unit **300**.

The connecting unit **300** is disposed under the coil unit **200**.

The first connection terminal **210** of the coil unit **200** is connected to the first connection terminal **310** of the connecting unit **300** by the solder **10**.

The second connection terminal **220** of the coil unit **200** is connected to the second connection terminal **320** of the connecting unit **300** by the solder **20**.

The coil **230** may be designed to have a predetermined width **W** and a predetermined thickness **T**. In addition, the coil **230** can be designed to have a predetermined winding interval.

Referring to FIG. 12, different from the embodiment shown in FIG. 3, the thickness of the connecting unit **300** is smaller than the thickness of the magnetic substrate **100**, so the overall thickness of the wireless power receiver **1000** can be reduced as much as the thickness of the connecting unit **300**. In addition, since the usage of the magnet **110** and the support **120** can be reduced due to the receiving space **130**, it is advantageous in terms of cost effectiveness.

Hereinafter, a wireless power receiver **1000** according to the fifth embodiment will be described in detail with reference to FIGS. 14 to 20.

FIG. 14 is a perspective view illustrating the wireless power receiver **1000** according to the fifth embodiment, FIG. 15 is a plan view illustrating the wireless power receiver **1000**

according to the fourth embodiment, FIG. 16 is a sectional view taken along line C-C' of the wireless power receiver **1000** according to the fifth embodiment, and FIGS. 17 to 21 are views for explaining a method of manufacturing the wireless power receiver **1000** according to the fifth embodiment.

5 First, referring to FIG. 14, the wireless power receiver **1000** according to the fifth embodiment may include a magnetic substrate **100**, a coil unit **200** and a connecting unit **300**.

According to one embodiment, the wireless power receiver **1000** can wirelessly receive power from the transmission side using electromagnetic induction. In this case, the coil **230** of the coil unit **200** can wirelessly receive power through the electromagnetic induction with a coil  
10 of the transmission side.

According to one embodiment, the wireless power receiver **1000** can wirelessly receive power from the transmission side using resonance.

The magnetic substrate **100** may change the direction of the magnetic field received from the transmission side.

15 The magnetic substrate **100** can reduce the amount of the magnetic field leaked to the outside by changing the direction of the magnetic field received from the transmission side.

The magnetic substrate **100** can change the direction of the magnetic field received from the transmission side in the lateral direction such that the magnetic field can be more concentrated onto the coil unit **200**.

20 The magnetic substrate **100** can absorb some of the magnetic field received from the transmission side and leaked to the outside to dissipate the magnetic field as heat. If the amount of the magnetic field leaked to the outside is reduced, the bad influence of the magnetic field exerted on the human body can be reduced.

Referring to FIG. 16, the magnetic substrate **100** may include a magnet **110** and a support  
25 **120**.

The magnet **110** may include a particle or a ceramic. According to one embodiment, the magnet **110** may be one of a spinel type magnet, a hexa type magnet, a sendust type magnet and a permalloy type magnet.

30 The support **120** may include thermosetting resin or thermoplastic resin and support the magnetic substrate **100**.

The magnetic substrate **100** may be prepared in the form of a sheet and may have a flexible property.

Referring again to FIG. 14, the coil unit **200** may include a first connection terminal **210**, a second connection terminal **220** and a coil **230**. The coil **230** may formed as a conductive layer or a conductive pattern.

The coil unit **200** may be disposed inside the magnetic substrate **100**. In detail, the coil unit **200** may be buried inside the magnetic substrate **100**. In more detail, the magnetic substrate **100** may include a pattern groove and the coil unit **200** may be disposed in the pattern groove. The pattern groove may be formed as a conductive pattern or a conductive layer similar to the coil unit **200**.

The coil unit **200** has a thickness smaller than that of the magnetic substrate **100** and an upper portion of the coil unit **200** may be exposed out of the magnetic substrate **100**.

A process for manufacturing the wireless power receiver **1000** by disposing the coil unit **200** and the connecting unit **300** in the magnetic substrate **100** will be described later with reference to FIGS. 17 to 21.

The first connection terminal **210** of the coil unit **200** is located at one end of the coil **230** and the second connection terminal **220** of the coil unit **200** is located at the other end of the coil **230**.

The first and second connection terminals **210** and **220** of the coil unit **200** are necessary for connection with the connecting unit **300**.

The coil **230** may be formed as a coil pattern which is obtained by winding a conductive line several times. According to one embodiment, when viewed from the top, the coil pattern may have a spiral shape. However, the embodiment is not limited thereto, and various patterns may be formed.

The coil unit **200** may transfer the power wirelessly received from the transmission side to the connecting unit **300**. The coil unit **200** may transfer the power wirelessly received from the transmission side using the electromagnetic induction or resonance to the connecting unit **300**.

The connecting unit **300** may include a first connection terminal **310**, a second connection terminal **320** and a printed circuit board **330**.

The first connection terminal **310** of the connecting unit **300** may be connected to the first connection terminal **210** of the coil unit **200** and the second connection terminal **320** of the connecting unit **300** may be connected to the second connection terminal **220** of the coil unit **200**.

5 The printed circuit board **330** may include a wiring layer and the wiring layer may include a wireless power receiving circuit, which will be described later.

The connecting unit **300** connects the wireless power receiving circuit (not shown) with the coil unit **200** to transfer the power received from the coil unit **200** to a load (not shown) through the wireless power receiver circuit. The wireless power receiver circuit may include a rectifier circuit (not shown) for converting AC power into DC power and a smoothing circuit for transferring the DC power to the load after removing ripple components from the DC power.

10 FIGS. 15 and 16 show the detailed structure of the wireless power receiver **1000** according to the fifth embodiment when the coil unit **200** is connected to the connecting unit **300**.

15 FIG. 15 shows the coil unit **200** and the connecting unit **300** interconnected with each other.

The coil unit **200** can be connected to the connecting unit **300** by a solder.

Referring to FIG. 16, the first connection terminal **210** of the coil unit **200** may be connected to the first connection terminal **310** of the connecting unit **300** through a first solder **10** and the second connection terminal **220** of the coil unit **200** may be connected to the second connection terminal **320** of the connecting unit **300** through a second solder **20**. In detail, the first connection terminal **210** of the coil unit **200** may be connected to the first connection terminal **310** of the connecting unit **300** through a via hole of the first solder **10** and the second connection terminal **220** of the coil unit **200** may be connected to the second connection terminal **320** of the connecting unit **300** through a via hole of the second solder **20**.

25 According to one embodiment, the via hole can be formed by using a laser. The laser may include a UV laser or a CO2 laser.

FIG. 16 is a sectional view of the wireless power receiver **1000** in which the magnetic substrate **100** and the coil unit **200** are connected to the connecting unit **300**.

That is, the first connection terminal **210**, the second connection terminal **220** and the coil **230** constituting the coil unit **200** may be disposed in a pattern groove **140** of the magnetic substrate **100**.

5 In addition, the magnetic substrate **100** and the coil unit **200** are connected to the connecting unit **300**.

The coil **230** may be designed to have a predetermined width **W** and a predetermined thickness **T** and the magnetic substrate **100** may be designed to have a predetermined thickness **T1**. According to one embodiment, the coil **230** has a thickness of 0.1mm and the magnetic substrate **100** has a thickness of 0.43 mm, but these numerical values are illustrative purposes  
10 only. According to one embodiment, the thickness **T** of the coil **230** may be smaller than the thickness **T1** of the magnetic substrate **100**.

In the wireless power receiver **1000** according to the fifth embodiment, the coil unit **200** is directly disposed in the pattern groove **140** of the magnetic substrate **100**, so the overall thickness of an electronic appliance equipped with the wireless power receiver **1000** can be  
15 reduced as much as the thickness of the coil unit **200**. Thus, if the wireless power receiver **1000** according to the fifth embodiment is applied to the electronic device, such as the portable terminal, the overall thickness of the portable terminal can be reduced suitably for the current trend of slimness

In addition, in the wireless power receiver **1000** according to the fifth embodiment, the  
20 coil unit **200** is disposed in the pattern groove **140** of the magnetic substrate **100**. Thus, different from the electronic appliance in which a coil pattern is formed on an FPCB, the overall size of the electronic device equipped with the wireless power receiver **1000** can be reduced.

FIGS. 17 to 21 are views for explaining a method of manufacturing the wireless power receiver **1000** according to the fifth embodiment.

25 Hereinafter, the method of manufacturing the wireless power receiver **1000** according to the fifth embodiment will be described with reference to FIGS. 17 to 21 as well as FIGS. 14 to 16.

First, referring to FIG. 17, the magnetic substrate **100** is prepared. According to one embodiment, the magnetic substrate **100** may be produced by coating metal powder of sendust

alloys, such as Al, Fe and SiO<sub>2</sub>, on polyethylene rubber and then forming an oxide layer on a surface of the polyethylene rubber.

Then, referring to FIG. 18, heat and pressure are applied using a mold **1** to form the pattern groove in the magnetic substrate **100** for receiving the coil unit **200**. The mold **1** may have the shape corresponding to the shape of the coil unit **200**. According to one embodiment, the mold **1** can be manufactured by using an aluminum alloy, a copper alloy or a cast iron.

The mold **1** may be provided with a protrusion at a region corresponding to the coil unit **200** for wirelessly receiving the power.

When the heat is applied by using the mold **1**, the heat having the specific temperature is applied by taking the property of the metal powder of the sendust alloy constituting the magnetic substrate **100** into consideration. According to one embodiment, if the magnetic substrate **100** is produced by coating the metal powder of sendust alloy on the polyethylene rubber, when the heat and pressure are applied by using the mold **1**, high-pressure is applied at the temperature in the range of 100°C to 180°C, and then the mold **100** is cooled to the temperature of 100°C or below. After that, the mold **1** is separated from the magnetic substrate **100**. If the mold **1** is separated just after the pressure has been applied to the magnetic substrate **100**, the desired pattern groove **140** may not be formed due to residual heat in the pattern groove **140**. For this reason, the mold **1** is separated from the magnetic substrate **100** after cooling the mold **100** to the temperature of 100°C or below.

If the magnetic substrate **100** is prepared by using the metal powder of sendust alloy, the heat temperature and pressure may vary depending on the distribution and concentration of the metal powder. That is, if the distribution of the metal powder is not uniform, the higher temperature and pressure may be applied. In contrast, if the distribution of the metal powder is uniform, the lower temperature and pressure may be applied. In addition, if the concentration of the metal powder is low, the lower temperature and pressure may be applied as compared with the case in which the concentration of the metal powder is high. Further, the heat temperature and pressure may vary depending on the composition of the metal powder, that is, depending on the alloy constituting the metal powder.

In this manner, the temperature applied to the mold **1** may vary depending on the distribution, concentration and composition of the powder.

According to one embodiment, laser may be irradiated, instead of applying heat and pressure using the mold **1**, to form the pattern groove in the magnetic substrate **100** to receive the coil unit **200**. In this case, the pattern groove can be formed by using an excimer laser that irradiates the laser beam having a wavelength band of ultraviolet ray. The excimer laser may include a KrF excimer laser (central wavelength 248 nm) or an ArF excimer laser (central wavelength 193 nm).

Next, referring to FIG. 19, the mold **1** is separated from the magnetic substrate **100** so that the magnetic substrate **100** is formed with the pattern groove **140**.

Then, referring to FIG. 20, the coil unit **200** is inserted into the pattern groove **140** formed in the magnetic substrate **100**. As the coil unit **200** is inserted into the pattern groove **140**, a predetermined conductive pattern is formed in the pattern groove **140** of the magnetic substrate **100**.

According to one embodiment, a process for forming the coil unit **200** in the pattern groove **140** of the magnetic substrate **100** may include a plating process or a process for inserting a metal which has been etched to have the conductive pattern formed by the coil unit **200**.

In detail, according to the plating process, the metallic material is filled in the pattern groove **140** to form the coil unit **200**. At this time, the metallic material may include one selected from Cu, Ag, Sn, Au, Ni and Pd and the filling of the metallic metal can be performed through one of electroless plating, screen printing, sputtering, evaporation, ink-jetting and dispensing or a combination thereof.

Then, referring to FIG. 21, the soldering process is performed to connect the coil unit **200** with the connecting unit **300**.

That is, the first connection terminal **210** of the coil unit **200** is connected to the first connection terminal **310** of the connecting unit **300** through the solder **10** and the second connection terminal **220** of the coil unit **200** is connected to the second connection terminal **320** of the connecting unit **300** through the solder **20**.

As described above, according to the method of manufacturing the wireless power receiver **1000** of the fifth embodiment, the pattern groove is formed in the magnetic substrate **100** and the coil unit **200** is disposed in the pattern groove, so that the overall thickness of the wireless power receiver **1000** can be reduced. In addition, the wireless power receiver **1000** can

be manufactured by simply forming the pattern groove and then inserting the coil unit into the pattern groove, so that the manufacturing process can be simplified.

FIG. 22 is a view for explaining variation of inductance, resistance and Q values of the coil unit **200** as a function of a usable frequency when the coil unit **200** is disposed on a top surface of the magnetic substrate according to the first embodiment, and FIG. 23 is a view for explaining variation of inductance, resistance and Q values of the coil unit **200** as a function of a usable frequency when the coil unit **200** is disposed in the pattern groove formed in the magnetic substrate according to the fifth embodiment.

The inductance, resistance and Q values of the coil unit **200** can be expressed as following equation 1.

[Equation 1]

$$Q=W*L/R$$

In equation 1, w is a frequency used when transmitting power, L is inductance of the coil unit **200** and R is resistance of the coil unit **200**.

As can be understood from equation 1, the Q value becomes high as the inductance of the coil unit **200** is increased. If the Q value is increased, the power transmission efficiency can be improved. The resistance of the coil unit **200** is a numerical value of power loss occurring in the coil unit **200** and the Q value becomes high as the resistance value is decreased.

Referring to FIGS. 22 and 23, when comparing the fifth embodiment, in which the coil unit **200** is disposed in the pattern groove **140** of the magnetic substrate **100**, with the first embodiment, in which the coil unit **200** is disposed on the top surface of the magnetic substrate **100**, when the usable frequency is 150 kHz, the inductance of the coil unit **200** is increased by 352.42  $\mu\text{m}$  from about 9986.92  $\mu\text{m}$  to about 10339.34  $\mu\text{m}$  and the resistance of the coil unit **200** is reduced by 0.057  $\Omega$  from 0.910  $\Omega$  to 0.853  $\Omega$ . That is, the Q value is increased corresponding to the increment of the inductance and the reduction of the resistance.

Therefore, the wireless power receiver **1000** according to the fifth embodiment can increase the Q value by disposing the coil unit **200** in the pattern groove of the magnetic substrate **100**.

FIG. 24 is an H-field for illustrating a radiation pattern of a magnetic field when the coil unit is disposed on a top surface of the magnetic substrate according to the first embodiment, and



FIG. 25 is an H-field for illustrating a radiation pattern of a magnetic field when the coil unit is disposed in the pattern groove formed in the magnetic substrate according to the fifth embodiment.

Referring to FIGS. 24 and 25, a greater amount of magnetic fields is radiated from the outer peripheral portion of the coil unit **200** when the coil unit **200** is disposed in the pattern groove formed in the magnetic substrate **100** as compared with the case in which the coil unit **200** is disposed on the top surface of the magnetic substrate **100**. This is because the magnetic field directed to the outside is changed in the lateral direction of the coil unit **200** due to the coil unit **200** buried in the magnetic substrate **100**.

In addition, a greater amount of magnetic fields is radiated at the inner portion of the coil unit **200** when the coil unit **200** is disposed in the pattern groove formed in the magnetic substrate **100** as compared with the case in which the coil unit **200** is disposed on the top surface of the magnetic substrate **100**. This is also because the magnetic field directed to the outside is changed in the lateral direction of the coil unit **200** due to the coil unit **200** buried in the magnetic substrate **100**.

Referring to FIGS. 24 and 25, the wireless power receiver **1000** may further include a short-range communication antenna **600**.

The short-range communication antenna **600** can make near field communication with a reader. The short-range communication antenna **600** may serve as an antenna that transceives information in cooperation with the reader.

According to one embodiment, the short-range communication antenna **600** may be arranged at an outer peripheral portion of the coil unit **200**. According to one embodiment, when the coil unit **200** is disposed at the center of the magnetic substrate **100**, the short-range communication antenna **600** may be arranged along the outer peripheral portion of the magnetic substrate **100** to surround the coil unit **200**. The short-range communication antenna **600** may have a rectangular configuration by winding one conductive line several times, but the embodiment is not limited thereto.

Similar to the coil unit **200**, the short-range communication antenna **600** may be formed as a conductive pattern or a conductive layer.

Various short-range communication technologies can be applied to the short-range communication antenna **600** and the NFC technology is preferable.

Hereinafter, a wireless power receiver according to another embodiment will be described with reference to FIGS. 26 to 37.

5 FIG. 26 is an exploded perspective view of the wireless power receiver **1000** according to still another embodiment, FIG. 27 is a perspective view of the wireless power receiver **1000** according to still another embodiment, and FIG. 28 is a sectional view of the wireless power receiver **1000** according to still another embodiment.

10 Meanwhile, FIG. 27 is a perspective view showing the assembled state of the elements of the wireless power receiver **1000** shown in FIG. 26, in which some elements are omitted.

The wireless power receiver **1000** according to still another embodiment may be disposed in an electronic device, such as a portable terminal.

15 Referring to FIGS. 26 to 28, the wireless power receiver **1000** may include a magnetic substrate **100**, a coil unit **200**, a connecting unit **300**, a short-range communication antenna **600**, an adhesive layer **700**, a first dual-side adhesive layer **710**, a second dual-side adhesive layer **720**, a protective film **800** and a release paper layer **730**.

Referring to FIG. 26, the magnetic substrate **100** can change the direction of the magnetic field transferred from the transmission side.

20 The magnetic substrate **100** changes the direction of the magnetic field transferred to the coil unit **200** from the transmission side to reduce the amount of the magnetic field leaked to the outside. Thus, the magnetic substrate **100** may have the electromagnetic wave shielding effect.

In detail, the magnetic substrate **100** changes the direction of the magnetic field transferred from the transmission side in the lateral direction such that the magnetic field can be more concentrated onto the coil unit **200**.

25 The magnetic substrate **100** can absorb some of the magnetic field transferred to the coil unit **200** from the transmission side and leaked to the outside to dissipate the magnetic field as heat. If the amount of the magnetic field leaked to the outside is reduced, the bad influence of the magnetic field exerted on the human body can be reduced.

30 Referring to FIG. 28, the magnetic substrate **100** may include a magnet **110** and a support **120**.

According to one embodiment, the magnet **110** may be one of a spinel type magnet, a hexa type magnet, a sendust type magnet and a permalloy type magnet.

The support **120** may include thermosetting resin or thermoplastic resin and support the magnetic substrate **100**.

5 Referring again to FIG. 26, the magnetic substrate **100** may be prepared in the form of a sheet and may have a flexible property.

A receiving space **130** is formed at a predetermined area of the magnet substrate **100**. The receiving space **130** has a structure the same as that of the connecting unit **300**. The connecting unit **300** is disposed in the receiving space **130** and connected to the coil unit **200**.

10 The coil unit **200** can receive the power from the transmission side using the electromagnetic induction or resonance. Similar to the coil unit **200** illustrated in FIG. 1, the coil unit **200** may include a first connection terminal **210**, a second connection terminal **220** and a coil **230**. The coil **230** may be formed as a conductive layer or a conductive pattern.

The connecting unit **300** connects a receiver circuit (not shown) with the coil unit **200** to transfer the power received from the coil unit **200** to a load (not shown) through the receiver circuit.

The connecting unit **300** may include a wiring layer and the wiring layer may include the wireless power receiving circuit. The wireless power receiving circuit may include a rectifier circuit for rectifying the power received from the coil unit **200**, a smoothing circuit for removing noise signals, and a main IC chip for performing the operation to wirelessly receive the power.

In addition, the receiver circuit can transfer the signal received from the short-range communication antenna **600** to a short-range communication signal processing unit (not shown).

The connecting unit **300** is disposed in the receiving space **130** of the magnetic substrate **100** and connected to the coil unit **200**. FIG. 27 shows the connecting unit **300** disposed in the receiving space **130** of the magnetic substrate **100**.

The connecting unit **300** may include a first connection terminal **310**, a second connection terminal **320**, a third connection terminal **340** and a fourth connection terminal **350**. The first connection terminal **310** of the connecting unit **300** is connected to the first connection terminal **210** of the coil unit **200**, the second connection terminal **320** of the connecting unit **300** is connected to the second connection terminal **220** of the coil unit **200**, the third connection

terminal **340** of the connecting unit **300** is connected to a first connection terminal **610** of the short-range communication antenna **600** and the fourth connection terminal **350** of the connecting unit **300** is connected to a second connection terminal **620** of the short-range communication antenna **600**.

5           The connecting unit **300** may have the shape corresponding to the shape of the receiving space **130** and may be disposed in the receiving space **130**. Since the connecting unit **300** is disposed in the receiving space **130** of the magnetic substrate **100**, the thickness of the wireless power receiver **1000** can be remarkably reduced as much as the thickness of the connecting unit **300**. Thus, the thickness of the electronic device, such as a portable terminal, equipped with the  
10           wireless power receiver **1000** can be remarkably reduced.

          According to one embodiment, the connecting unit **300** may include a flexible printed circuit board (FPCB), a tape substrate (TS) or a lead frame (LF). If the tape substrate is used as the connecting unit **300**, the thickness of the connecting unit **300** can be reduced, so that the overall size of the wireless power receiver **1000** can be reduced.

15           If the lead frame is used as the connecting unit **300**, the wiring layer included in the connecting unit **300** can be protected from the heat, external moisture or impact and the mass production can be realized.

          Referring again to FIG. 26, the short-range communication antenna **600** can make near field communication with a reader. The short-range communication antenna **600** may serve as an  
20           antenna that transceives information in cooperation with the reader.

          According to one embodiment, the NFC signal processing unit (not shown) can process the signal transferred to the short-range communication antenna **600** through the connecting unit **300**.

25           Various short-range communication technologies can be applied to the short-range communication antenna **600** and the NFC technology is preferable.

          According to one embodiment, the short-range communication antenna **600** may be arranged at an outer peripheral portion of the coil unit **200**. Referring to FIG. 27, when the coil unit **200** is disposed at the magnetic substrate **100**, the short-range communication antenna **600** may be arranged along the outer peripheral portion of the magnetic substrate **100** to surround the

coil unit **200**. The short-range communication antenna **600** may have a rectangular configuration by winding one conductive line several times, but the embodiment is not limited thereto.

Referring again to FIG. 26, the adhesive layer (not shown) may be disposed under the protective film **800** to form the protective film **800** on the coil unit **200** and the short-range communication antenna **600**, which will be described later in detail.

The first dual-side adhesive layer **710** is interposed between the magnetic substrate **100** and the coil unit **200**/short-range communication antenna **600** to adhere the coil unit **200** to the magnetic substrate **100**, which will be described later in detail. Similar to the magnetic substrate **100**, a receiving space having the shape identical to the shape of the connecting unit **300** may be formed in the first dual-side adhesive layer **710**.

Referring again to FIG. 28, the second dual-side adhesive layer **720** adheres the protective film **800** to the release paper layer **730**, which will be described later in detail.

The coil unit **200** may be disposed on the magnetic substrate **100** and may have a spiral structure, but the embodiment is not limited thereto.

Hereinafter, the method of manufacturing the wireless power receiver **1000** according to still another embodiment will be described with reference to FIGS. 29 to 37.

When the manufacturing process starts, as shown in FIG. 29, the conductor **201**, the adhesive layer **700** and the protective film **800** are prepared.

According to one embodiment, the conductor **201** may be formed by using an alloy including copper. The copper is in the form of roll annealed copper or electrodeposited copper. The conductor **201** may have various thicknesses depending on the specification of a product. According to one embodiment, the conductor **201** may have the thickness of 100 $\mu$ m, but the embodiment is not limited thereto.

The adhesive layer **700** is used to reinforce the adhesive strength between the conductor **201** and the protective film **800**. The adhesive layer **700** may include thermosetting resin, but the embodiment is not limited thereto. The adhesive layer may have the thickness of 17 $\mu$ m, but the embodiment is not limited thereto.

The protective film **800** protects the conductor **201** when a predetermined conductive pattern is formed in the conductor **201**. In detail, the protective film **800** supports the conductor

**201** in the etching process, which will be described later, to protect the conductor **201** such that the predetermined conductive pattern can be formed in the conductor **201**.

According to one embodiment, the protective film **800** may include polyimide film (PI film), but the embodiment is not limited thereto.

5 Then, as shown in FIG. 30, the conductor **201** is formed on the protective film **800** by the adhesive layer **700**. The laminating process can be used to form the conductor **201** on the protective film **800**. The laminating process refers to the process to bond heterogeneous materials with each other by applying predetermined heat and pressure.

10 Then, as shown in FIG. 31, a photoresist film **900** is attached onto the top surface of the conductor **201**. The photoresist film **900** is used for etching the conductor **201** to form a predetermined conductive pattern in the conductor **201**. A UV exposure type film or an LDI exposure type film may be used as the photoresist film **900**. According to another embodiment, a photoresist coating solution can be coated on the top surface of the conductor **201** without using the photoresist film **900**.

15 After that, as shown in FIG. 32, the photoresist film **900** is subject to the exposure and development processes to form a mask pattern **910**.

The mask pattern **910** may be formed on the top surface of the conductor **201** corresponding to the position of the conductive pattern.

20 The exposure process refers to the process for selectively irradiating light onto the photoresist film **900** corresponding to the conductive pattern. In detail, in the exposure process, the light is irradiated onto regions of the conductor **201** where the conductive pattern is not formed. The development process refers to the process for removing the regions to which the light is irradiated through the exposure process.

25 Due to the exposure and development processes, the mask pattern **910** may be formed in the regions corresponding to the coil unit **200** and the short-range communication antenna **600**. The conductor **201** exposed through the mask pattern **910** may be etched.

30 Then, as shown in FIG. 33, a predetermined portion of the conductor **201** where the mask pattern **910** is not formed may be removed through the etching process. The etching process refers to the process of removing the predetermined portion of the conductor **201** where the mask pattern **910** is not formed by using a chemical reacting with the predetermined portion of the

conductor **201**. According to one embodiment, the conductor **201** may be patterned through the wet etching or dry etching.

After that, as shown in FIG. 34, the mask pattern **910** is removed so that the first and second connection terminals **210** and **220** of the coil unit **200**, the first and second connection terminals **610** and **620** of the short-range communication antenna **600**, the coil **230** having a predetermined conductive pattern and the short-range communication antenna **600** having a predetermined conductive pattern may be formed.

Then, as shown in FIG. 35, the soldering process is performed to connect the coil unit **200** and the short-range communication antenna **600** to the connecting unit **300**. According to one embodiment, the soldering process includes the reflow process, but the embodiment is not limited thereto. The reflow process refers to the process for bonding the coil unit **230** and the short-range communication antenna **600** with the connecting unit **300** by melting solder cream using high-temperature heat to ensure the stable electrical connection between the connecting unit **300** and the coil unit **230**/NFC antenna **600**.

The first connection terminal **310** of the connecting unit **300** may be connected to the first connection terminal **210** of the coil unit **200** by a solder **30**, the second connection terminal **320** of the connecting unit **300** may be connected to the second connection terminal **220** of the coil unit **200** by the solder **30**, the third connection terminal **340** of the connecting unit **300** may be connected to the first connection terminal **610** of the short-range communication antenna **600** by the solder **30** and the fourth connection terminal **350** of the connecting unit **300** may be connected to the second connection terminal **620** of the short-range communication antenna **600**.

Then, as shown in FIG. 36, the magnetic substrate **100** is laminated on a predetermined portion of the conductive pattern where the connecting unit **300** is not present. In detail, the magnetic substrate **100** may be laminated on the top surfaces of the coil **230** and the short-range communication antenna **600**.

Prior to the above, the receiving space corresponding to the connecting unit **300** can be formed at the magnetic substrate **100**. The receiving space of the magnetic substrate **100** may have the shape identical to the shape of the connecting unit **300**.

As described above with reference to FIG. 26, since the connecting unit **300** is disposed in the receiving space **130** of the magnetic substrate **100**, the thickness of the wireless power

receiver **1000** can be remarkably reduced as much as the thickness of the connecting unit **300**. Thus, the thickness of the electronic device, such as a portable terminal, equipped with the wireless power receiver **1000** can be remarkably reduced.

5 The coil **230**/short-range communication antenna **600** and the magnetic substrate **100** may be adhered with each other by the first dual-side adhesive layer **710**. According to one embodiment, the magnetic substrate **100** may have the thickness in the range of 100 $\mu$ m to 800 $\mu$ m, but the embodiment is not limited thereto. According to one embodiment, the first dual-side adhesive layer **710** may have the thickness in the range of 10 $\mu$ m to 50 $\mu$ m, but the embodiment is not limited thereto.

10 After that, as shown in FIG. 37, the release paper layer **730** is attached to one side of the protective film **800** by interposing the second dual-size adhesive layer **720** therebetween. The release paper layer **730** is a paper layer for protecting the second dual-size adhesive layer **720** and may be removed when the wireless power receiver is disposed in a case of an electronic device, such as a portable terminal.

15 Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this disclosure. More particularly, various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement  
20 within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.



## CLAIMS

What is claimed is:

1. A wireless power receiver, comprising:
  - a magnetic substrate comprising a first receiving space and a second receiving space;
  - a coil on the magnetic substrate;
  - a first connection terminal connected to an inner end of the coil;
  - a second connection terminal connected to an outer end of the coil; and
  - a connecting unit comprising:
    - a circuit board;
    - a third connection terminal connected to the first connection terminal; and
    - a fourth connection terminal connected to the second connection terminal,wherein the first receiving space overlaps the third connection terminal in a vertical direction perpendicular to the magnetic substrate,
  - wherein the second receiving space overlaps the fourth connection terminal in the vertical direction,
  - wherein the circuit board comprises:
    - a first portion that overlaps the first receiving space in the vertical direction; and
    - a second portion that overlaps the second receiving space in the vertical direction,wherein the third connection terminal is disposed on the first portion of the circuit board,
  - and
  - wherein the fourth connection terminal is disposed on the second portion of the circuit board.
2. The wireless power receiver of claim 1, wherein the circuit board comprises a third portion connecting the first portion and the second portion.
3. The wireless power receiver of claim 2, wherein the third portion of the circuit board overlaps the coil in the vertical direction.

4. The wireless power receiver of claim 1, wherein the first portion of the circuit board overlaps the first connection terminal in the vertical direction.

5. The wireless power receiver of claim 1, wherein the second portion of the circuit board overlaps the second connection terminal in the vertical direction.

6. The wireless power receiver of claim 1, wherein the first receiving space comprises a recess passing through the magnetic sheet in the vertical direction.

7. The wireless power receiver of claim 1, wherein the second receiving space comprises a recess passing through the magnetic sheet in the vertical direction.

8. The wireless power receiver of claim 1, comprising an adhesive layer disposed on at least one surface of the magnetic substrate,  
wherein the adhesive layer comprises a third receiving space and a fourth receiving space.

9. The wireless power receiver of claim 8, wherein the third receiving space overlaps the first portion of the circuit substrate in the vertical direction, and  
wherein the fourth receiving space overlaps the second portion of the circuit substrate in the vertical direction.

10. The wireless power receiver of claim 9, wherein the adhesive layer comprises a fifth receiving space that overlaps the third portion of the circuit substrate in the vertical direction.

11. The wireless power receiver of claim 1, wherein the circuit board comprises a fourth portion that does not overlap the magnetic substrate in the vertical direction.

12. The wireless power receiver of claim 11, wherein the fourth portion of the circuit board is disposed outside of the magnetic substrate.

13. The wireless power receiver of claim 1, wherein the first receiving space is disposed inside the coil.

14. The wireless power receiver of claim 1, wherein the second receiving space is disposed outside the coil.

15. A wireless power receiver, comprising:  
an adhesive layer comprising a first receiving space and a second receiving space;  
a coil on the adhesive layer;  
a first connection terminal connected to an inner end of the coil;  
a second connection terminal connected to an outer end of the coil; and  
a connecting unit comprising:  
a circuit board;  
a third connection terminal connected to the first connection terminal; and  
a fourth connection terminal connected to the second connection terminal,  
wherein the first receiving space overlaps the third connection terminal in a vertical direction perpendicular to the adhesive layer,  
wherein the second receiving space overlaps the fourth connection terminal in the vertical direction,  
wherein the circuit board comprises:  
a first portion that overlaps the first space in the vertical direction; and  
a second portion that overlaps the second space in the vertical direction,  
wherein the third connection terminal is disposed on the first portion of the circuit board,  
and  
wherein the fourth connection terminal is disposed on the second portion of the circuit board.

16. The wireless power receiver of claim 15, wherein the circuit board comprises a third portion connecting the first portion and the second portion.

17. The wireless power receiver of claim 16, wherein the third portion of the circuit board overlaps the coil in the vertical direction.

18. The wireless power receiver of claim 15, wherein the first receiving space comprises a first recess passing through the adhesive layer in the vertical direction, and wherein the second receiving space comprises a second recess passing through the adhesive layer in the vertical direction.

19. The wireless power receiver of claim 16, wherein the adhesive layer comprises a third receiving space that overlaps the third portion of the circuit board in the vertical direction.

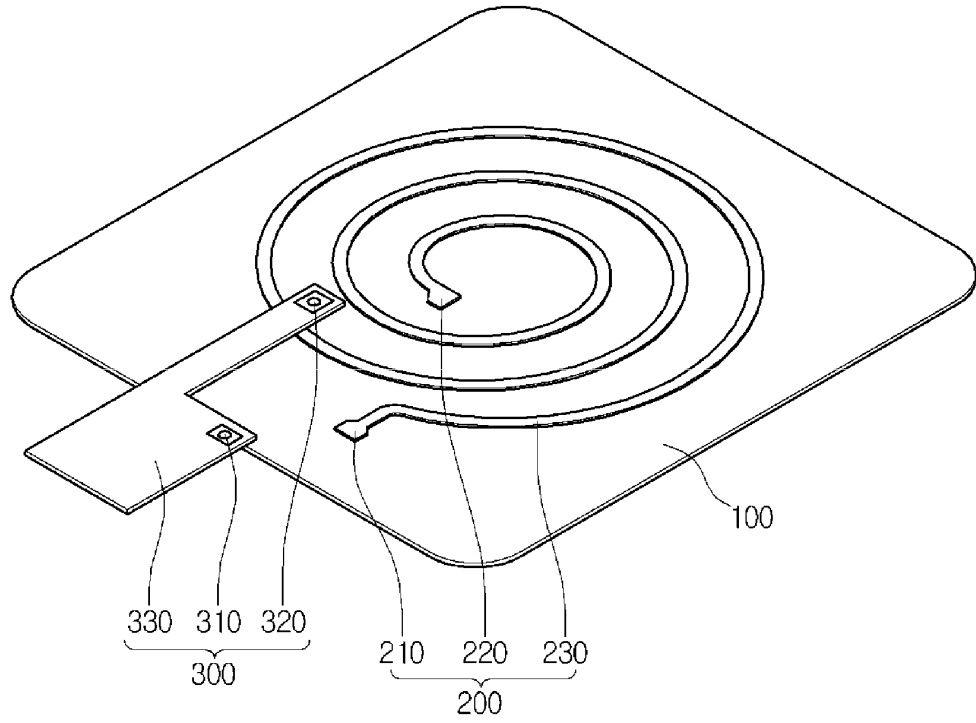
20. The wireless power receiver of claim 1, wherein the circuit board comprises a fourth portion that does not overlap the adhesive layer in the vertical direction, and wherein the fourth portion is disposed outside of the adhesive layer.

## ABSTRACT

A wireless power receiver can include a magnetic substrate and a coil configured to wirelessly receive power. The coil can be formed as a conductive layer on the magnetic substrate. A connecting unit can be disposed in a receiving space of the magnetic substrate and can be connected to the coil unit.

5

1000



**FIG. 1**

1000

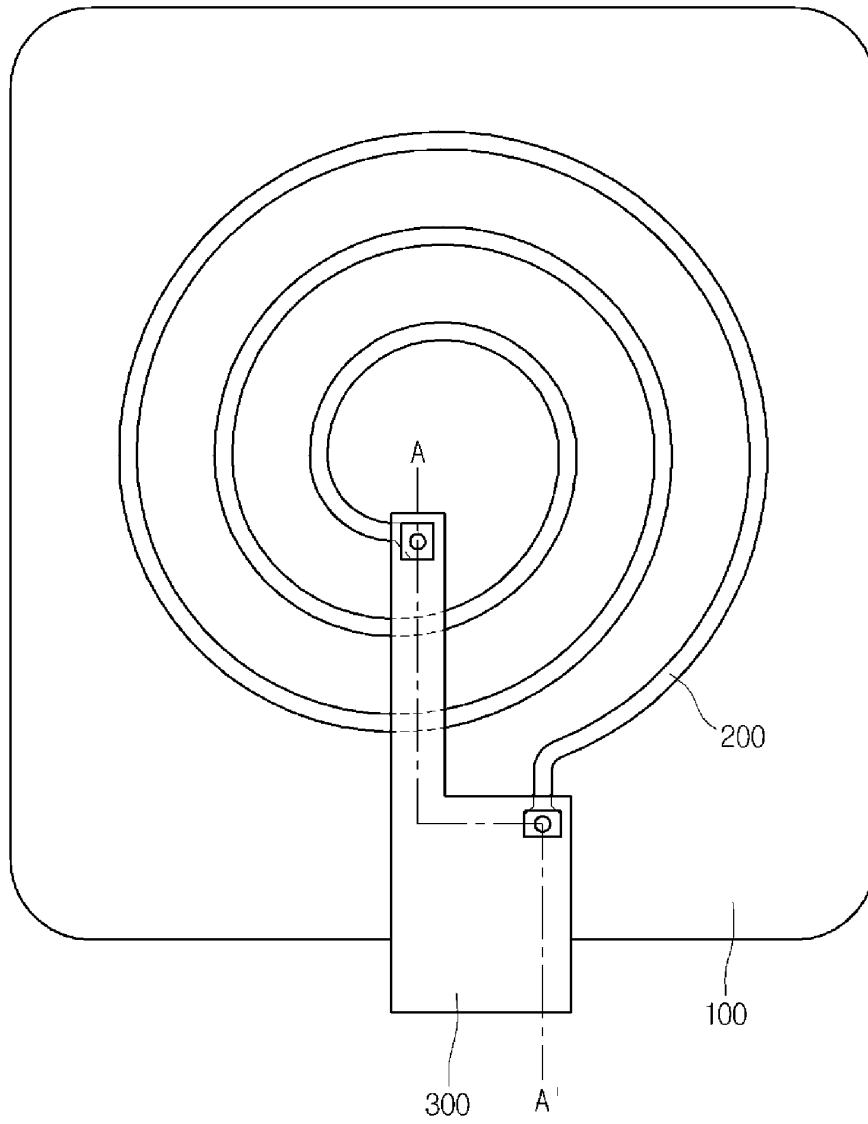


FIG.2





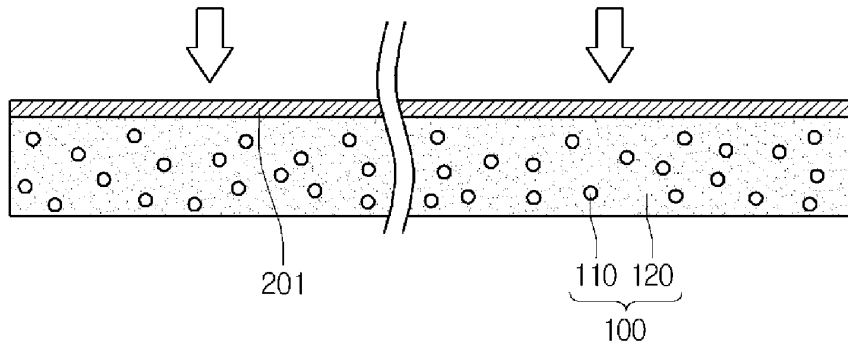


FIG. 5

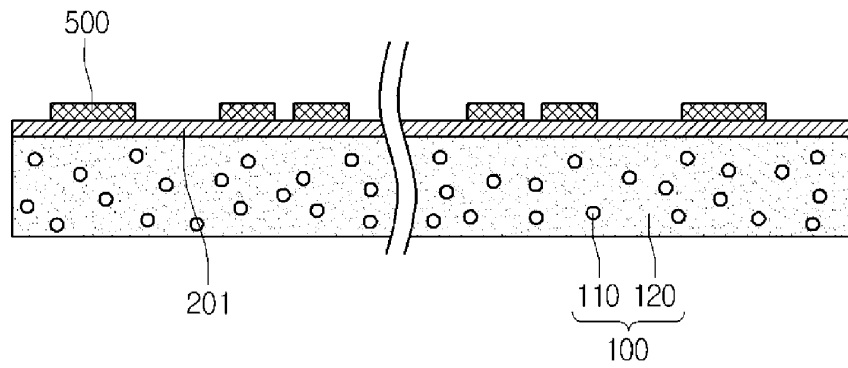


FIG. 6

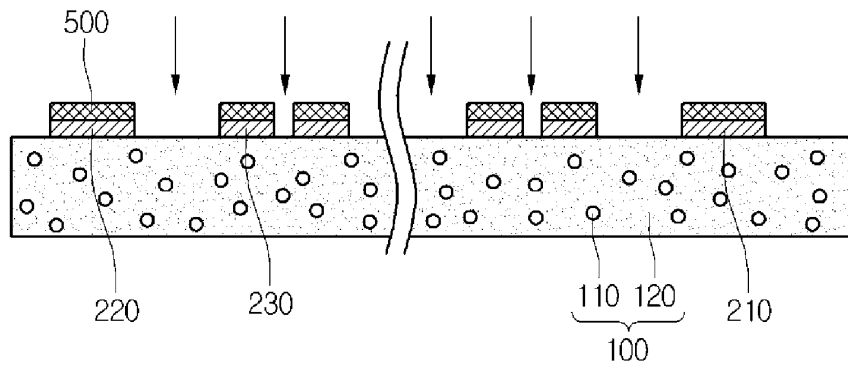


FIG. 7

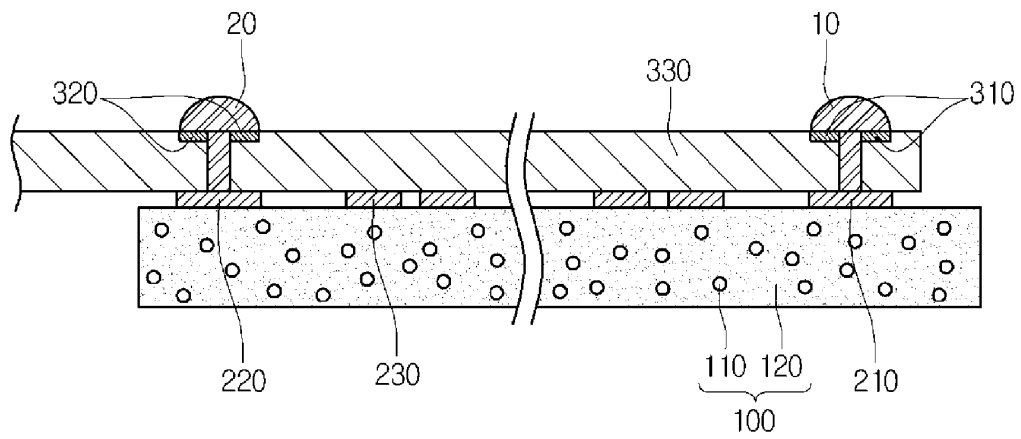


FIG. 8

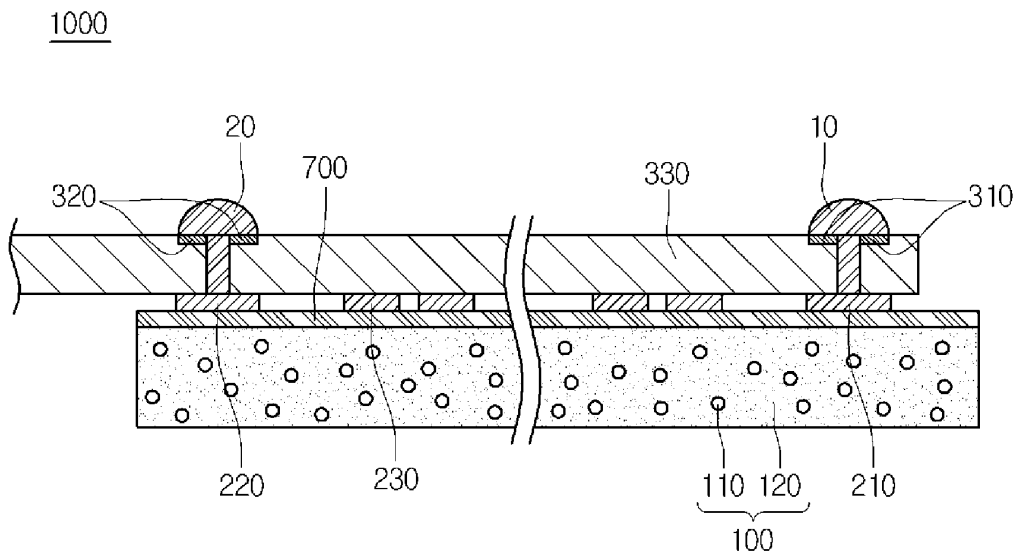


FIG. 9

1000

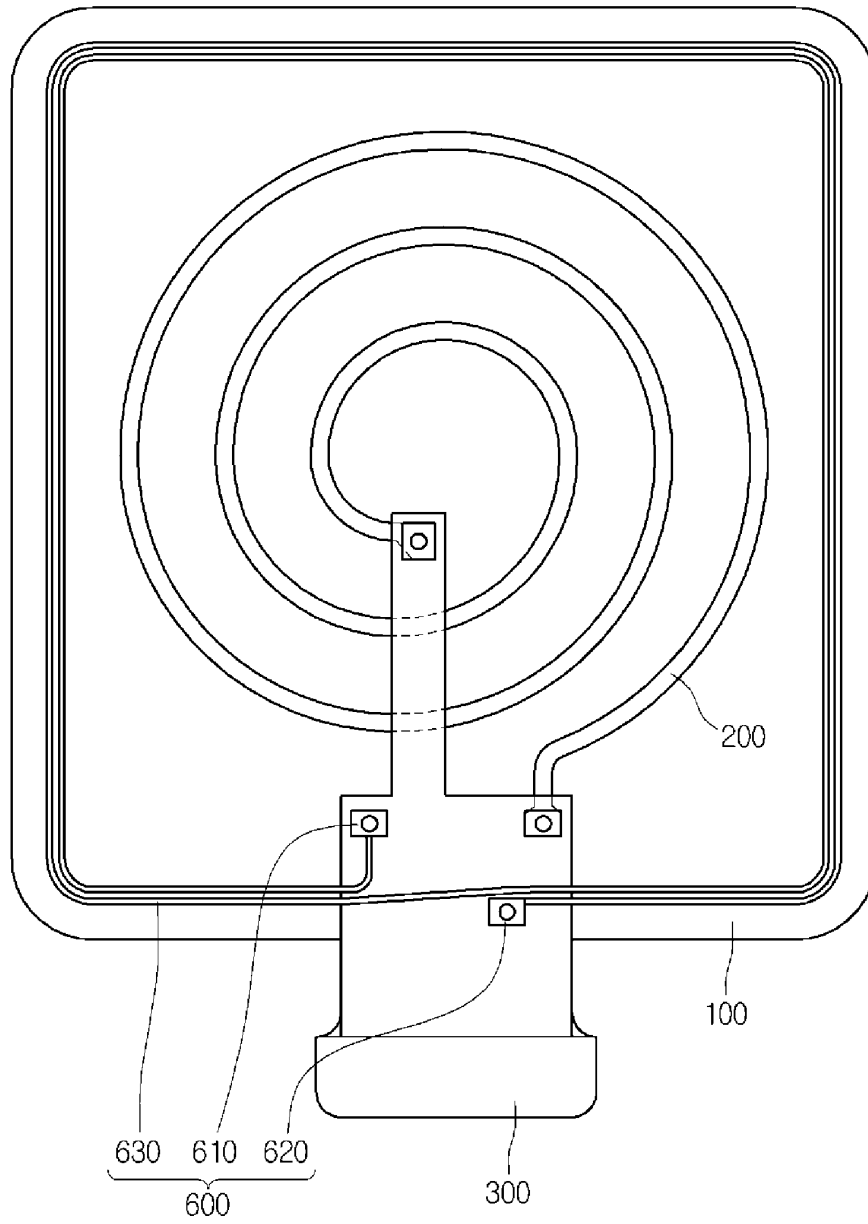
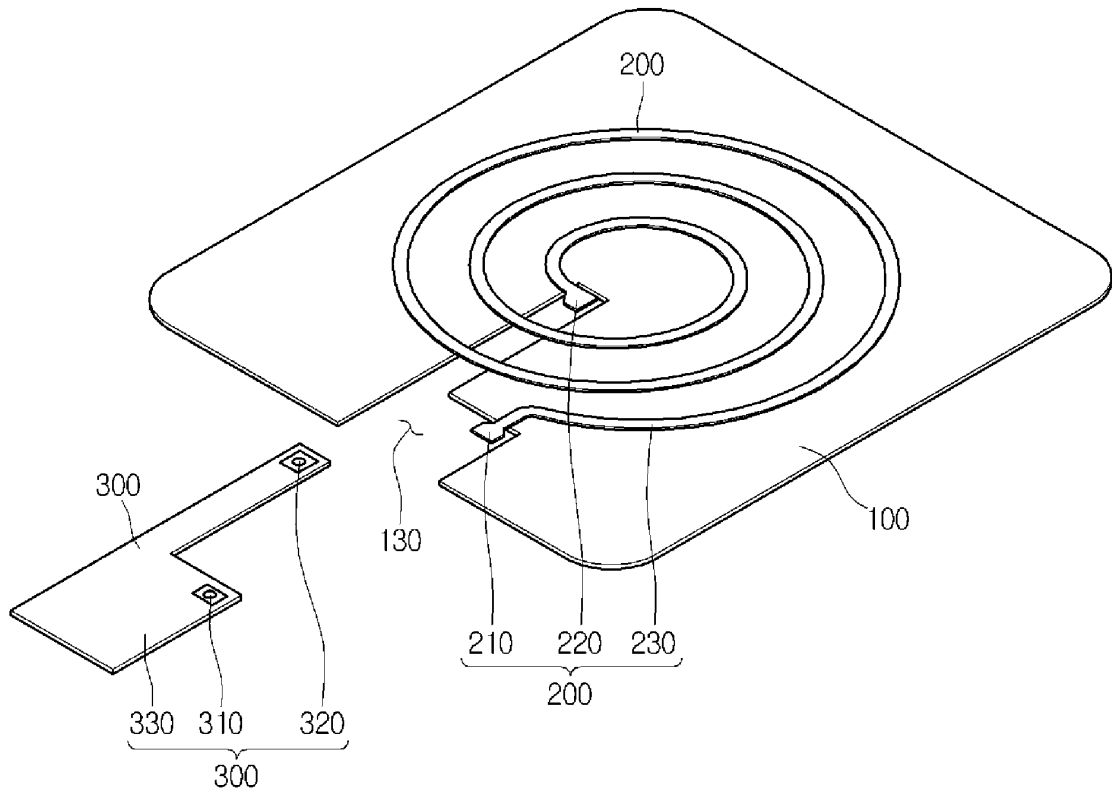


FIG.10

1000



**FIG.11**

1000

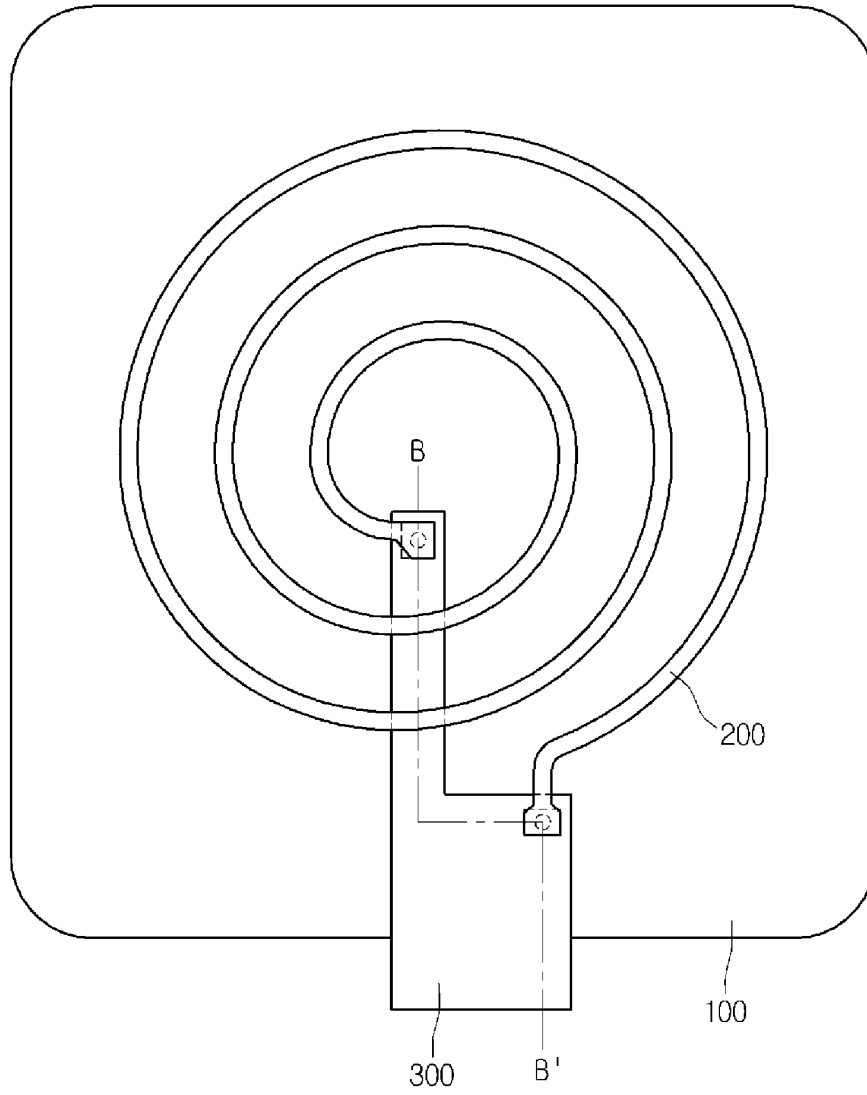


FIG.12

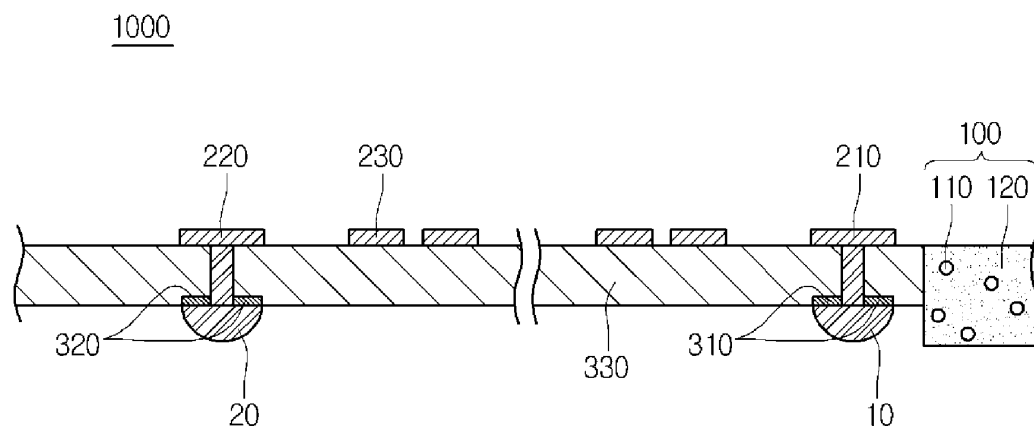


FIG.13

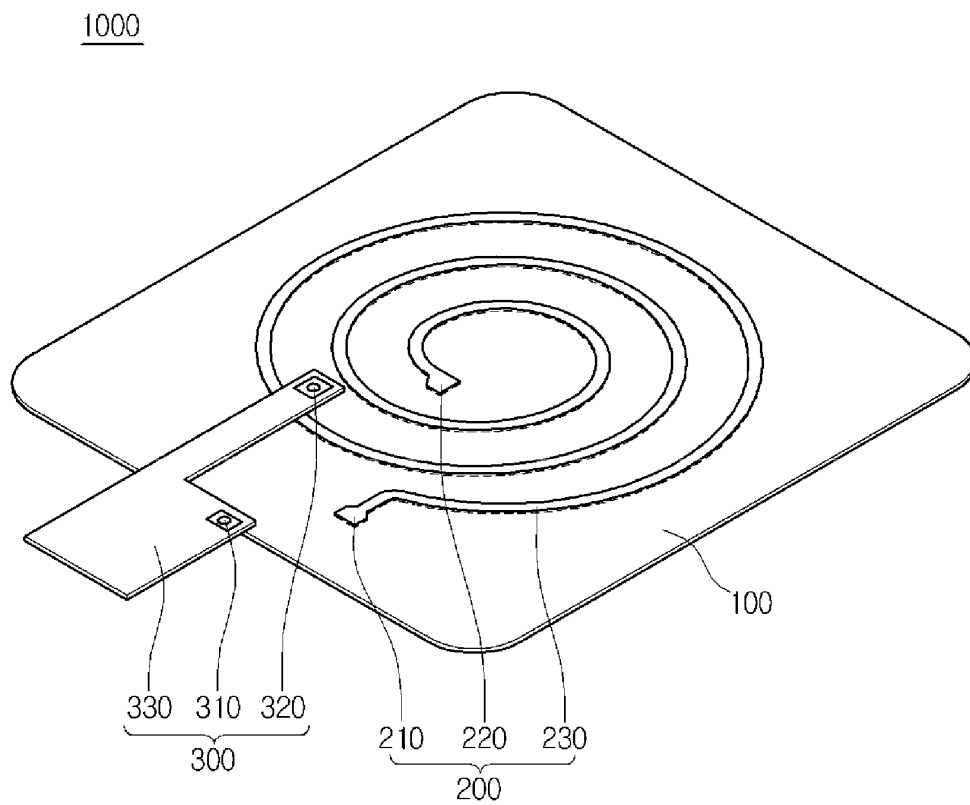
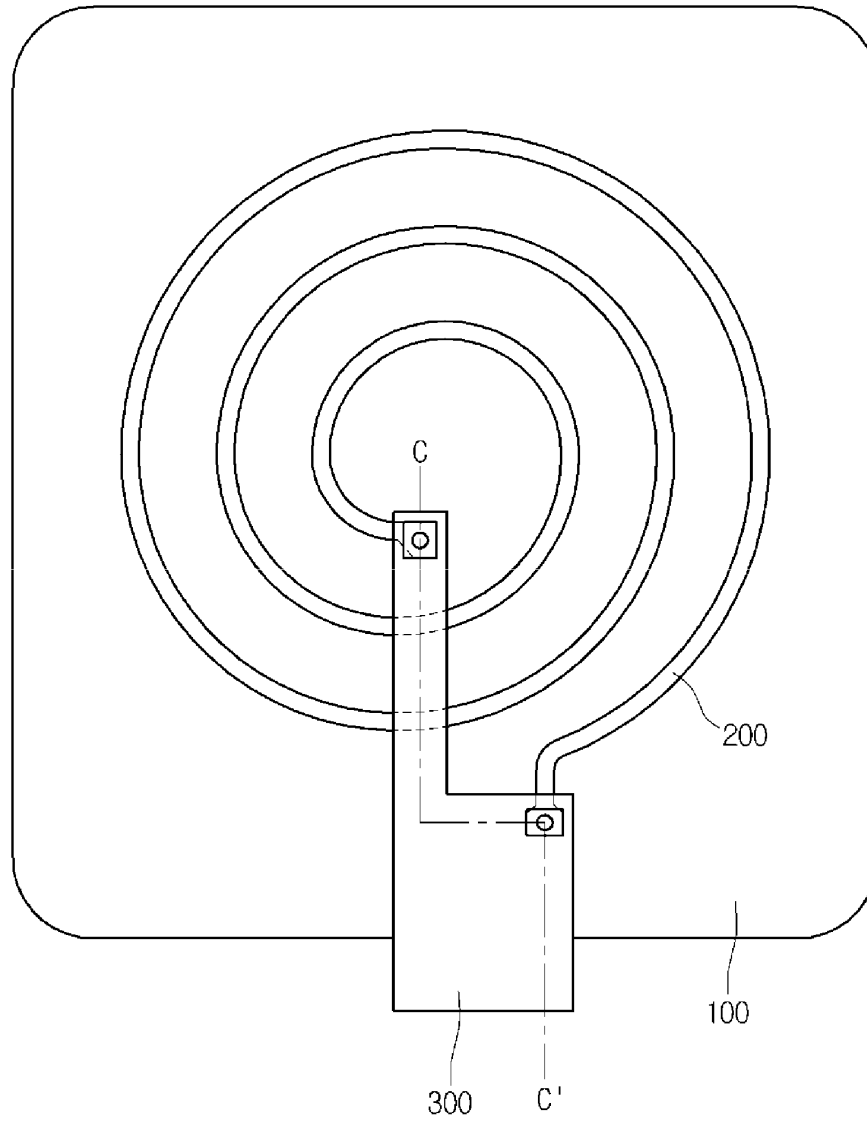


FIG.14

1000



**FIG.15**

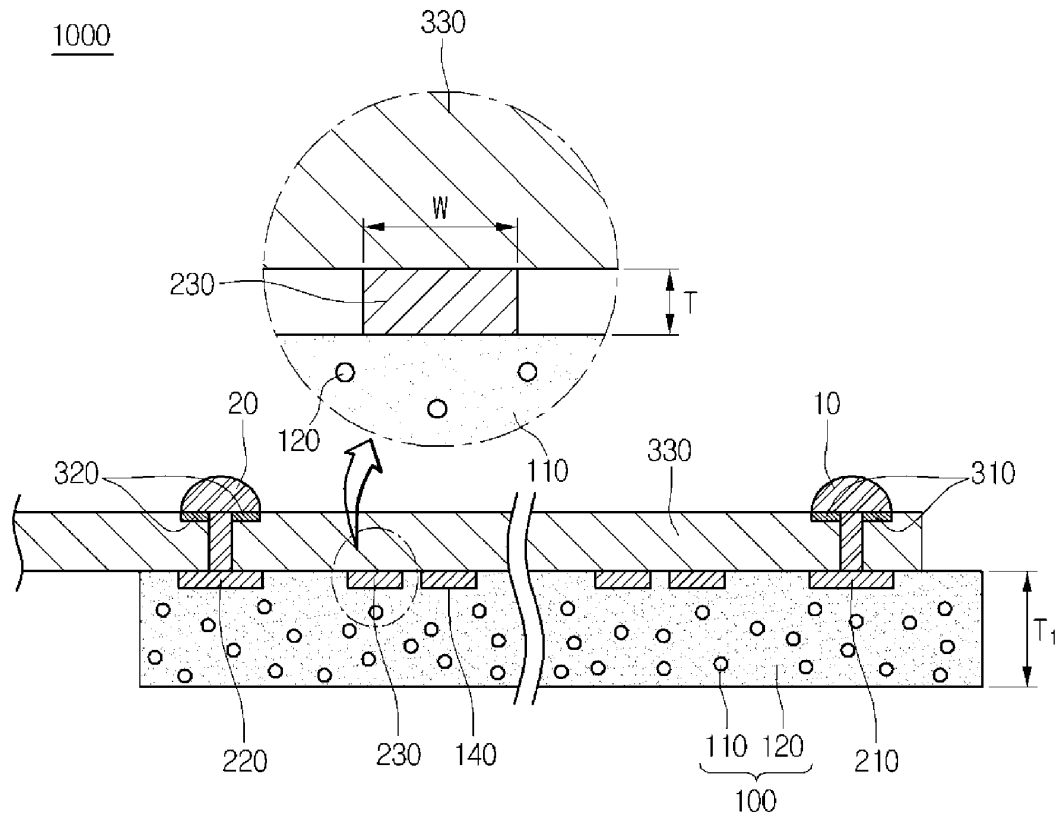


FIG. 16

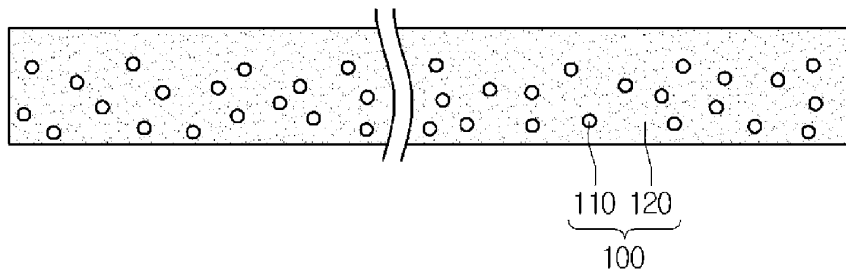


FIG. 17



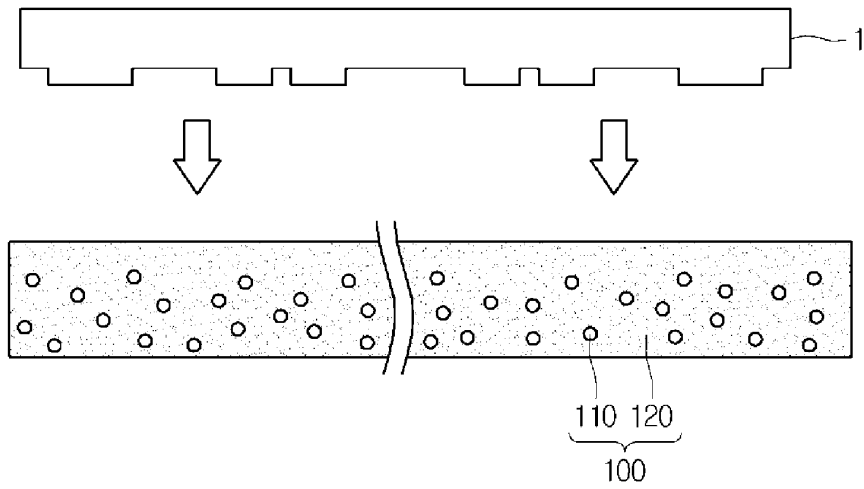


FIG. 18

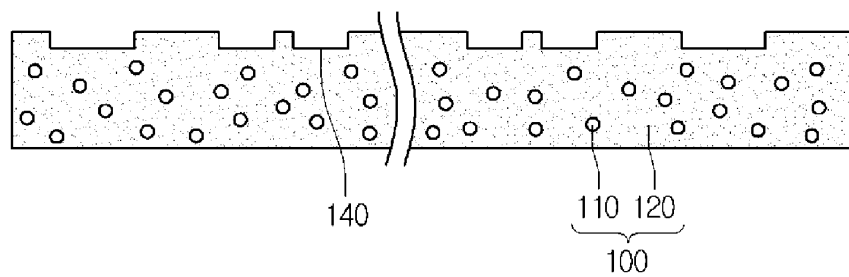


FIG. 19

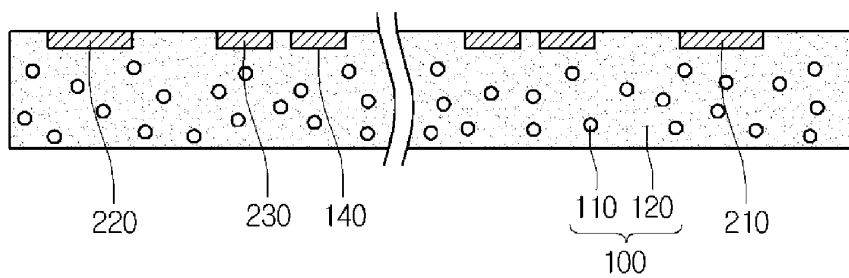


FIG. 20

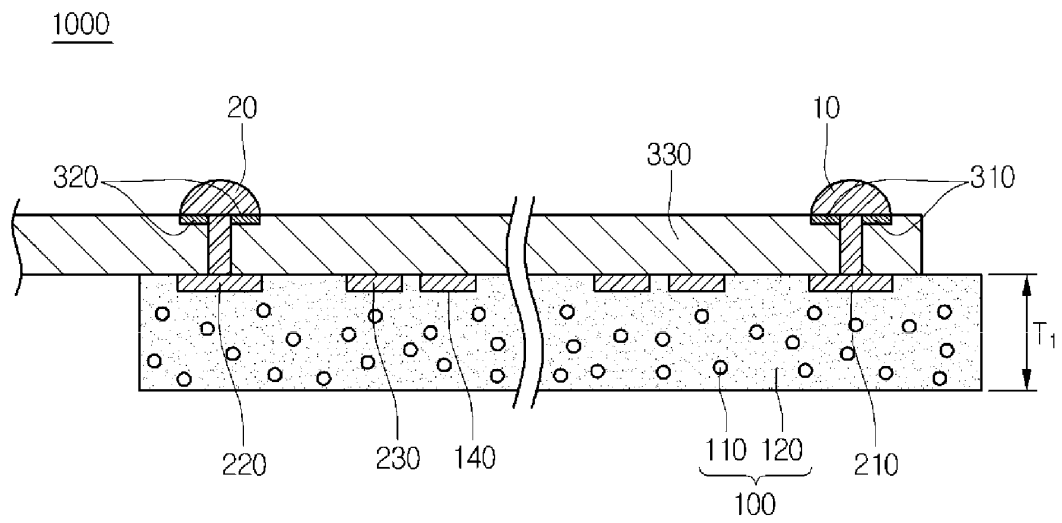


FIG.21

Freq[kHz]	Inductance Setup1 : Sweep	Resistance Setup1 : Sweep	Q Setup1 : Sweep
130.000000	10023.448082	0.809633	10.012480
131.000000	10021.543951	0.814464	10.028048
132.000000	10019.649417	0.819320	10.043115
133.000000	10017.764376	0.824199	10.057691
134.000000	10015.888496	0.829101	10.071784
135.000000	10014.021426	0.834027	10.085405
136.000000	10012.163025	0.838976	10.098561
137.000000	10010.312867	0.843948	10.111262
138.000000	10008.470902	0.848942	10.123517
139.000000	10006.636764	0.853960	10.135333
140.000000	10004.810399	0.859000	10.146721
141.000000	10002.991358	0.864062	10.157687
142.000000	10001.179585	0.869147	10.168241
143.000000	9999.374809	0.874254	10.178391
144.000000	9997.577015	0.879383	10.188142
145.000000	9995.785687	0.884534	10.197506
146.000000	9994.000944	0.889706	10.206488
147.000000	9992.222542	0.894900	10.215097
148.000000	9990.450319	0.900116	10.223339
149.000000	9988.684063	0.905352	10.231223
150.000000	9986.923648	0.910610	10.238756
151.000000	9985.169040	0.915889	10.245944
152.000000	9983.419964	0.921189	10.252794
153.000000	9981.676290	0.926509	10.259313
154.000000	9979.937950	0.931850	10.265510
155.000000	9978.204783	0.937212	10.271388
156.000000	9976.476722	0.942594	10.276956
157.000000	9974.753596	0.947996	10.282220
158.000000	9973.035485	0.953418	10.287185
159.000000	9971.321833	0.958860	10.291859
160.000000	9969.613051	0.964321	10.296247

FIG.22

Freq[kHz]	Inductance Setup1 : Sweep	Resistance Setup1 : Sweep	Q Setup1 : Sweep
130.000000	10375.469101	0.760491	11.053420
131.000000	10373.611592	0.764922	11.072242
132.000000	10371.760893	0.769376	11.090493
133.000000	10369.916781	0.773853	11.108182
134.000000	10368.078898	0.778351	11.125322
135.000000	10366.247102	0.782872	11.141920
136.000000	10364.421100	0.787415	11.157989
137.000000	10362.600644	0.791979	11.173537
138.000000	10360.785303	0.796565	11.188574
139.000000	10358.975165	0.801173	11.203109
140.000000	10357.169752	0.805802	11.217153
141.000000	10355.369156	0.810452	11.230713
142.000000	10353.572957	0.815124	11.243801
143.000000	10351.780892	0.819816	11.256422
144.000000	10349.993078	0.824529	11.268591
145.000000	10348.209063	0.829263	11.280309
146.000000	10346.428853	0.834018	11.291589
147.000000	10344.652133	0.838792	11.302441
148.000000	10342.878918	0.843587	11.312871
149.000000	10341.108850	0.848402	11.322886
150.000000	10339.342085	0.853237	11.332499
151.000000	10337.578231	0.858092	11.341712
152.000000	10335.817245	0.862967	11.350536
153.000000	10334.058946	0.867867	11.358980
154.000000	10332.303299	0.872774	11.367050
155.000000	10330.550019	0.877706	11.374754
156.000000	10328.799305	0.882658	11.382099
157.000000	10327.050748	0.887629	11.389091
158.000000	10325.304351	0.892618	11.395741
159.000000	10323.560143	0.897626	11.402053
160.000000	10321.817935	0.902653	11.408035

**FIG.23**

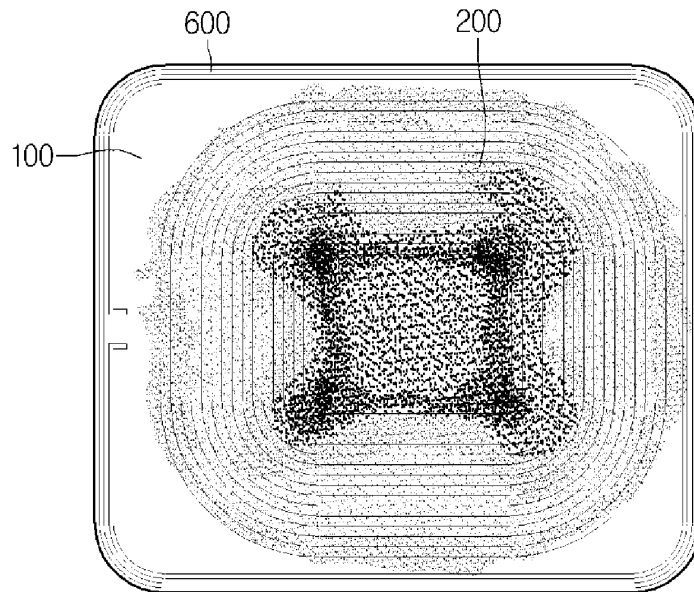


FIG. 24

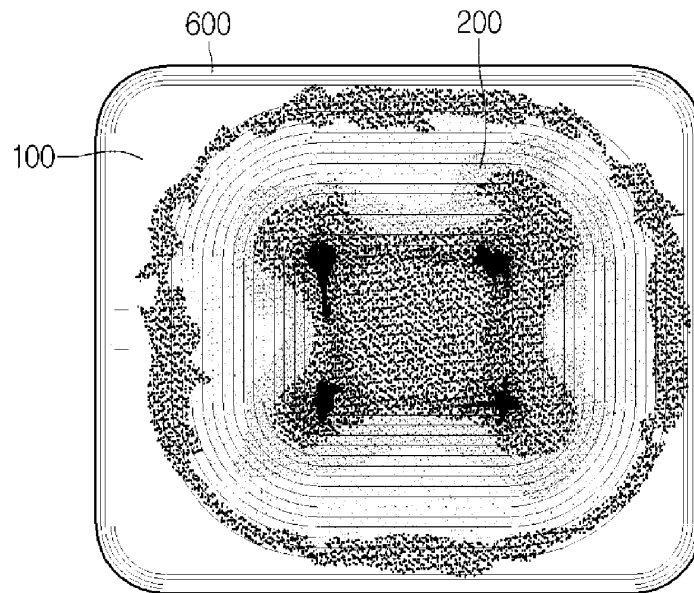


FIG. 25

1000

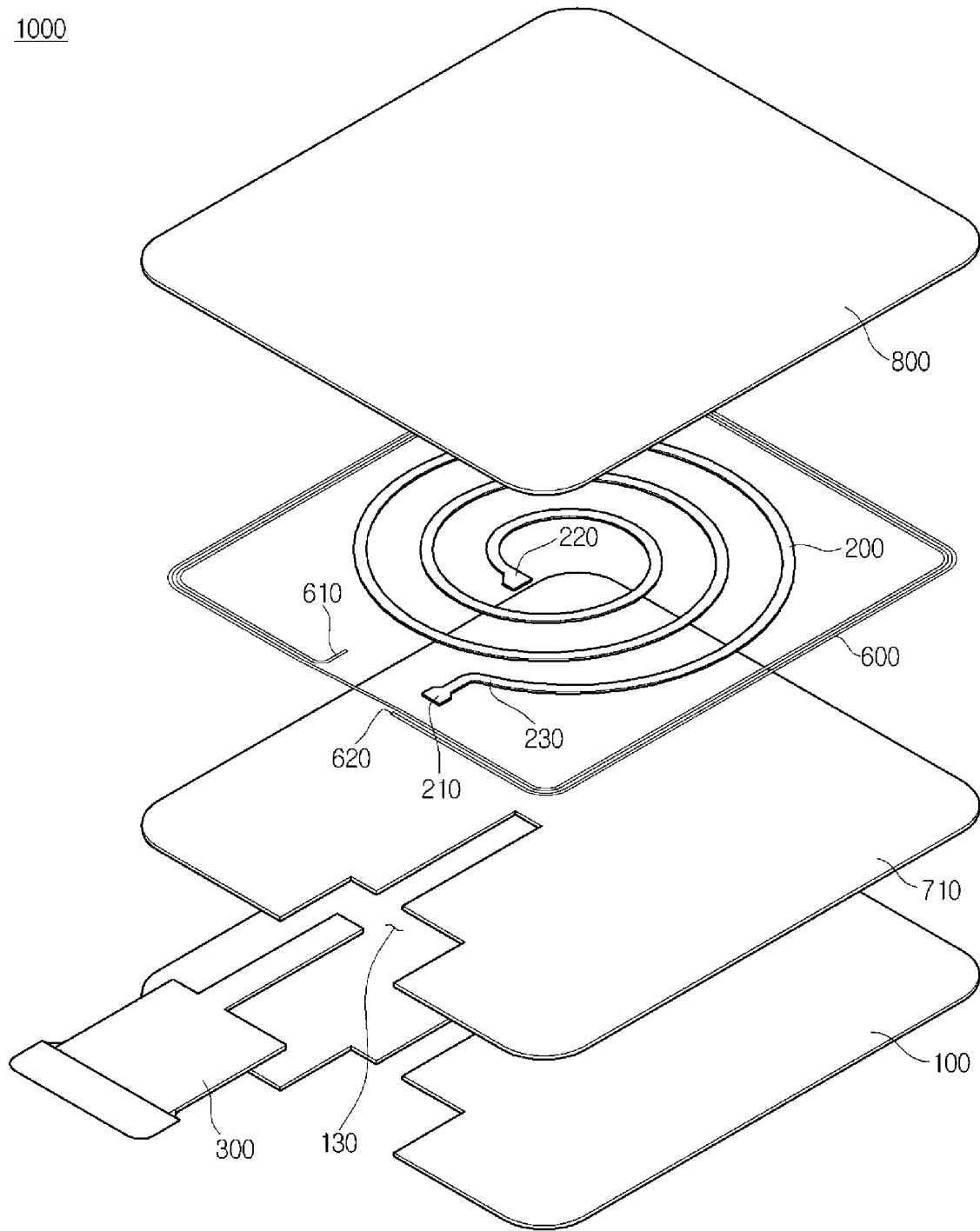


FIG.26

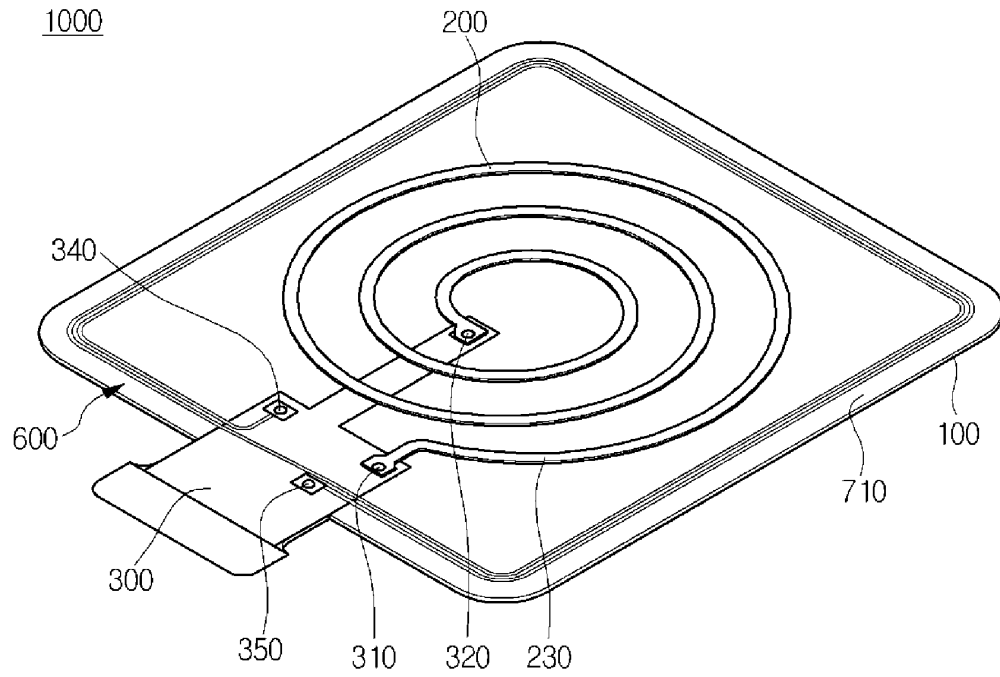


FIG. 27

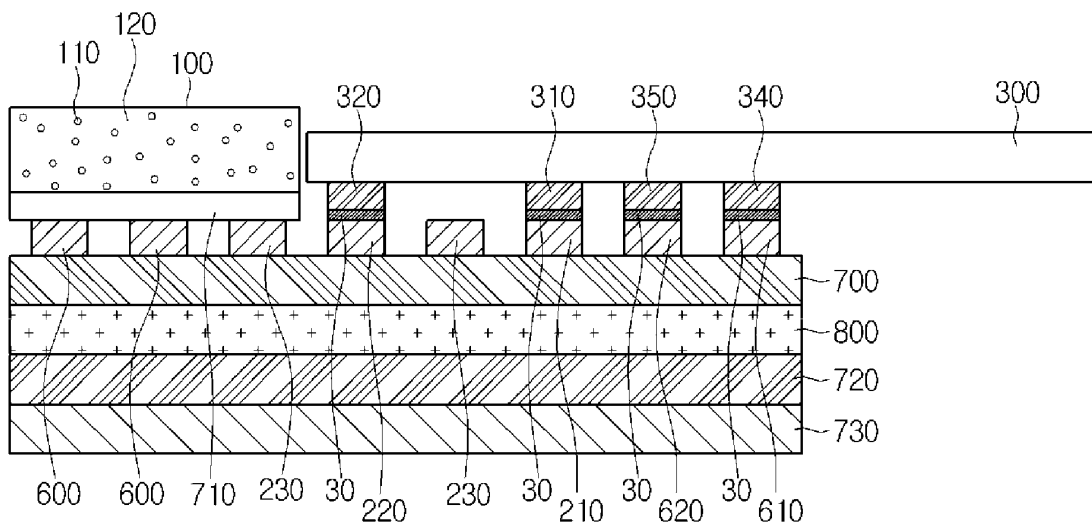


FIG. 28

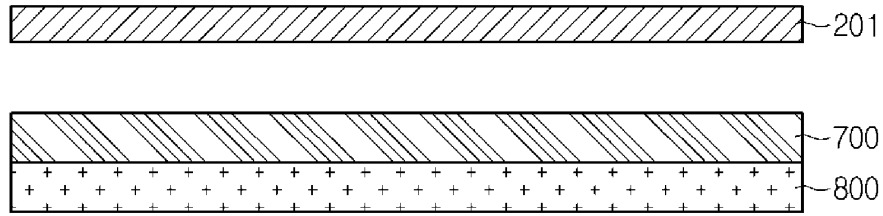


FIG.29

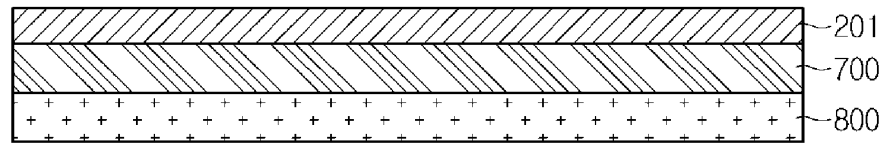


FIG.30

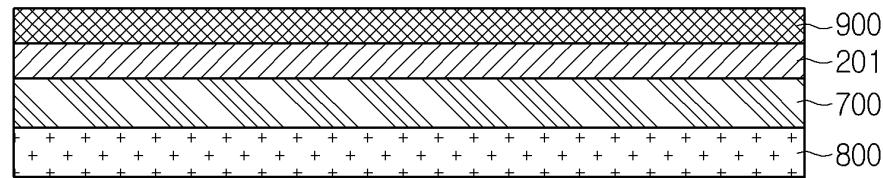


FIG.31

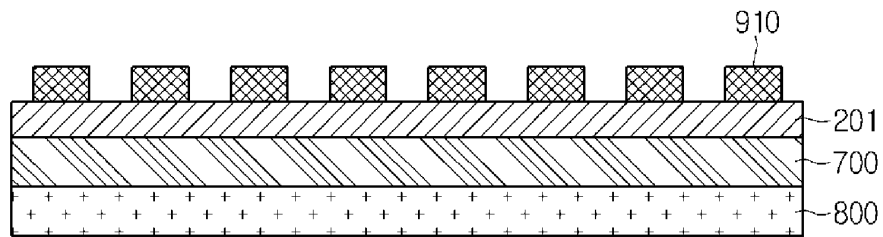


FIG.32



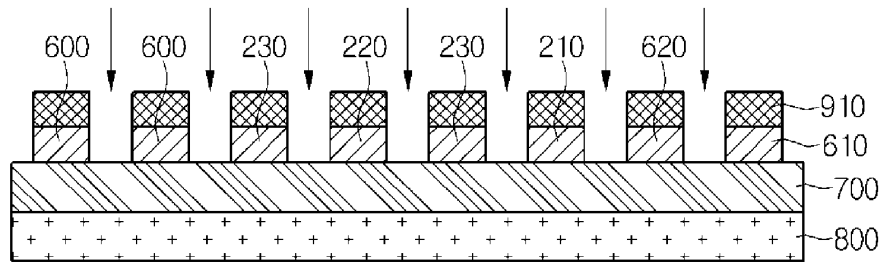


FIG.33

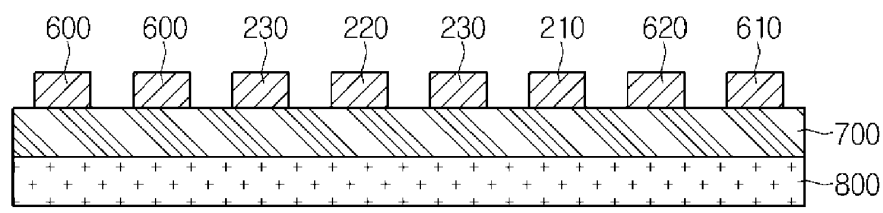


FIG.34

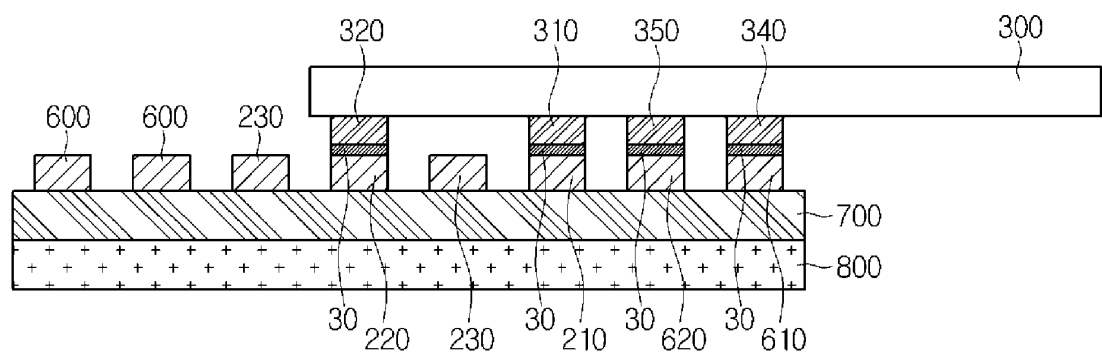


FIG.35

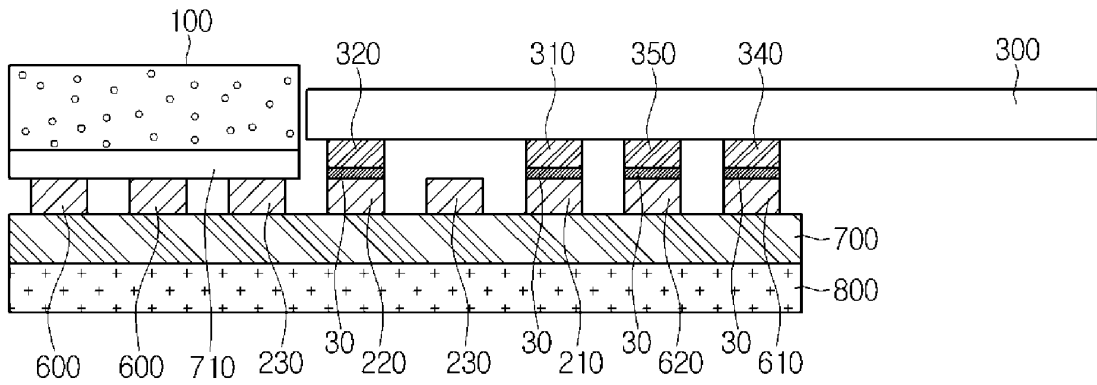


FIG.36

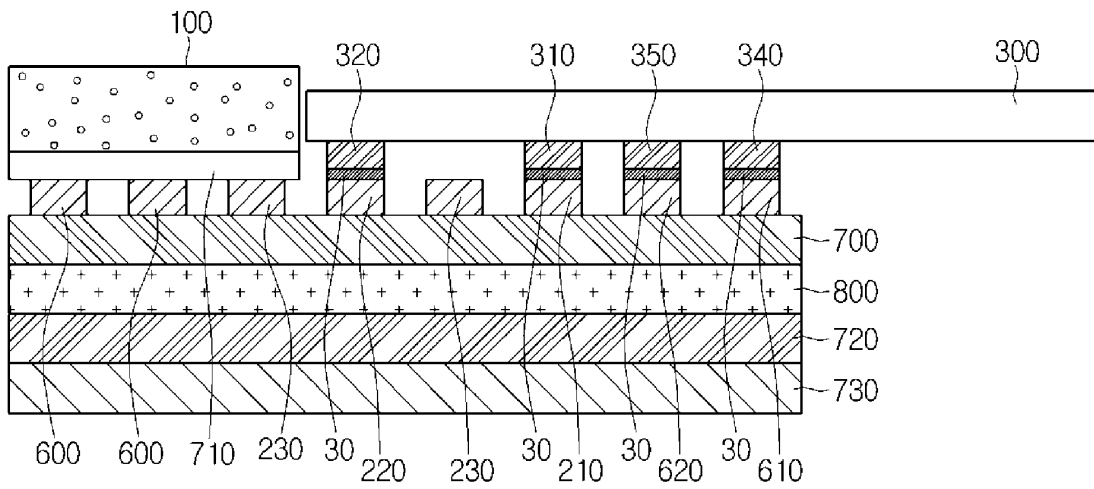


FIG.37

## SCORE Placeholder Sheet for IFW Content

Application Number: 16264360

Document Date: 01/31/2019

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 eDAN using the Supplemental Content tab, or via the SCORE web page.
- External customers may access SCORE content via PAIR using the Supplemental Content tab.