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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/773,024	05/03/2011	7936245	REAP0577USA	5061

27765 7590 04/13/2011
NORTH AMERICA INTELLECTUAL PROPERTY CORPORATION
P.O. BOX 506
MERRIFIELD, VA 22116

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 0 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):

Kai-Yi Huang, Taipei City, TAIWAN;
Yuh-Sheng Jean, Yun-Lin Hsien, TAIWAN;
Ta-Hsun Yeh, Hsin-Chu City, TAIWAN;

PART B - FEE(S) TRANSMITTAL

**Complete and send this form, together with applicable fee(s), to: Mail Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (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.

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27765 7590 12/29/2010

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.

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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 facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

Stephanie Lai	(Depositor's name)
/Stephanie Lai/	(Signature)
03/24/2011	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/773,024	05/04/2010	Kai-Yi Huang	REAP0577USA	5061

TITLE OF INVENTION:

STACKED STRUCTURE OF A SPIRAL INDUCTOR

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	No	\$1510	\$300	\$1810	03/29/2011

EXAMINER	ART UNIT	CLASS-SUBCLASS
NGUYEN, TUYEN T	2832	336-200000

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 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

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

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

1 Winston Hsu

2 Scott Margio

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 has been filed for recordation as set forth in 37 CFR 3.111. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

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

Realtek Semiconductor Corp.

2 Innovation Rd. II, Science Park, HsinChu, Taiwan, R.O.C.

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

4a. The following fee(s) are enclosed:

☒ Issue Fee

☒ Publication Fee (No small entity discount permitted)

☐ Advance Order - # of Copies _____

4b. Payment of Fee(s):

☐ A check in the amount of the fee(s) is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☒ The Director is hereby authorized by charge the required fee(s), or credit any overpayment, to Deposit Account Number 50-3105.

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

☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27. ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

The Director of the USPTO is requested to apply the Issue Fee and Publication Fee (if any) or to re-apply any previously paid issue fee to the application identified above. NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant, a registered attorney or agent, or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature /Winston Hsu/ Date 03/23/2011

Typed or printed name Winston Hsu Registration No. 41,526

This collection of information 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 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, 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.

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Electronic Patent Application Fee Transmittal				
Application Number:		12773024		
Filing Date:		04-May-2010		
Title of Invention:		STACKED STRUCTURE OF A SPIRAL INDUCTOR		
First Named Inventor/Applicant Name:		Kai-Yi Huang		
Filer:		Winston Hsu/Stephanie Lai		
Attorney Docket Number:		REAP0577USA		
Filed as Large Entity				
Utility under 35 USC 111(a) Filing Fees				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Utility Appl issue fee	1501	1	1510	1510
Publ. Fee- early, voluntary, or normal	1504	1	300	300

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				1810

Electronic Acknowledgement Receipt	
EFS ID:	9717188
Application Number:	12773024
International Application Number:	
Confirmation Number:	5061
Title of Invention:	STACKED STRUCTURE OF A SPIRAL INDUCTOR
First Named Inventor/Applicant Name:	Kai-Yi Huang
Customer Number:	27765
Filer:	Winston Hsu/Stephanie Lai
Filer Authorized By:	Winston Hsu
Attorney Docket Number:	REAP0577USA
Receipt Date:	24-MAR-2011
Filing Date:	04-MAY-2010
Time Stamp:	03:05:40
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$1810
RAM confirmation Number	8121
Deposit Account	503105
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 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)	NP072-PTO.pdf	41814	no	1
			3e0e7448dbfc83ca2f97eb5e2b571d2575fa db72		

Warnings:

Information:

2	Fee Worksheet (PTO-875)	fee-info.pdf	31597	no	2
			07b089149e43003c3932809d352376cad18 b2c3b		

Warnings:

Information:

Total Files Size (in bytes): 73411

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.



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NOTICE OF ALLOWANCE AND FEE(S) DUE

27765 7590 12/29/2010

NORTH AMERICA INTELLECTUAL PROPERTY CORPORATION
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MERRIFIELD, VA 22116

EXAMINER

NGUYEN, TUYEN T

ART UNIT

PAPER NUMBER

2832

DATE MAILED: 12/29/2010

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/773,024	05/04/2010	Kai-Yi Huang	REAP0577USA	5061

TITLE OF INVENTION: STACKED STRUCTURE OF A SPIRAL INDUCTOR

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1510	\$300	\$0	\$1810	03/29/2011

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 SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

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If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

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: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

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

27765 7590 12/29/2010

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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 facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/773,024	05/04/2010	Kai-Yi Huang	REAP0577USA	5061

TITLE OF INVENTION: STACKED STRUCTURE OF A SPIRAL INDUCTOR

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1510	\$300	\$0	\$1810	03/29/2011

EXAMINER	ART UNIT	CLASS-SUBCLASS
NGUYEN, TUYEN T	2832	336-200000

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 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

- (1) the names of up to 3 registered patent attorneys or agents OR, alternatively, 1 _____
- (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 _____
- 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 has been filed for recordation as set forth in 37 CFR 3.11. 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. The following fee(s) are submitted:

- ☐ Issue Fee
- ☐ Publication Fee (No small entity discount permitted)
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- ☐ A check is enclosed.
- ☐ Payment by credit card. Form PTO-2038 is attached.
- ☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

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

- ☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27. ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____

Date _____

Typed or printed name _____

Registration No. _____

This collection of information 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 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, 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.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/773,024	05/04/2010	Kai-Yi Huang	REAP0577USA	5061
27765	7590	12/29/2010	EXAMINER	
NORTH AMERICA INTELLECTUAL PROPERTY CORPORATION P.O. BOX 506 MERRIFIELD, VA 22116			NGUYEN, TUYEN T	
			ART UNIT	PAPER NUMBER
			2832	
DATE MAILED: 12/29/2010				

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

The Patent Term Adjustment to date is 0 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 0 day(s).

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 Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

REASONS FOR ALLOWANCE

The following is an examiner's statement of reasons for allowance:

The prior art of record do not teach or suggest, in the claimed combination thereof, a structure of a spiral inductor, comprising: a first metal layer, including a first segment; a second segment; and a third segment, connected to the first segment, wherein a layout direction of the third segment is different from a layout direction of the first segment and a layout direction of the second segment; a second metal layer, being positioned under the first metal layer, the second metal layer including a fourth segment; a fifth segment; and a sixth segment, connected to the fifth segment, wherein a layout direction of the sixth segment is different from a layout direction of the fourth segment and a layout direction of the fifth segment; a first set of vias, for connecting the first segment with the fourth segment; and a second set of vias, for connecting the second segment with the fifth segment; wherein the first segment, the fourth segment and the first set of vias construct a first shunt winding; the second segment, the fifth segment and the second set of vias construct a second shunt winding; and the third segment and the sixth segment construct a crossover region.

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 TUYEN T. NGUYEN whose telephone number is (571)272-1996. The examiner can normally be reached on M-F 8:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, ELVIN ENAD can be reached on 571-272-1990. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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

/TUYEN T NGUYEN/
Primary Examiner, Art Unit 2832

Notice of References Cited	Application/Control No. 12/773,024	Applicant(s)/Patent Under Reexamination HUANG ET AL.	
	Examiner TUYEN T. NGUYEN	Art Unit 2832	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-4,816,784	03-1989	Rabjohn, Gordon G.	333/24R
*	B	US-7,656,264	02-2010	Hsu et al.	336/223
*	C	US-7,525,407	04-2009	Lee et al.	336/200
*	D	US-7,721,414	05-2010	Sia et al.	29/602.1
*	E	US-6,426,267	07-2002	Liou, Ping	438/319
*	F	US-6,355,535	03-2002	Liou, Ping	438/381
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

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

NON-PATENT DOCUMENTS

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

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



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BIB DATA SHEET

CONFIRMATION NO. 5061

SERIAL NUMBER 12/773,024	FILING or 371(c) DATE 05/04/2010 RULE	CLASS 336	GROUP ART UNIT 2832	ATTORNEY DOCKET NO. REAP0577USA		
APPLICANTS Kai-Yi Huang, Taipei City, TAIWAN; Yuh-Sheng Jean, Yun-Lin Hsien, TAIWAN; Ta-Hsun Yeh, Hsin-Chu City, TAIWAN; ** CONTINUING DATA ***** ** FOREIGN APPLICATIONS ***** TAIWAN 098116543 05/19/2009 ** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** 05/10/2010						
Foreign Priority claimed ☒ Yes ☐ No 35 USC 119(a-d) conditions met ☒ Yes ☐ No Verified and Acknowledged <u>/TUYEN T NGUYEN/</u> Examiner's Signature		☐ Met after Allowance <u>/TN/</u> Initials	STATE OR COUNTRY TAIWAN	SHEETS DRAWINGS 14	TOTAL CLAIMS 20	INDEPENDENT CLAIMS 2
ADDRESS NORTH AMERICA INTELLECTUAL PROPERTY CORPORATION P.O. BOX 506 MERRIFIELD, VA 22116 UNITED STATES						
TITLE STACKED STRUCTURE OF A SPIRAL INDUCTOR						
FILING FEE RECEIVED 1090	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:			☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit		

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	12773024
	Filing Date	2010-05-04
	First Named Inventor	Kai-Yi Huang
	Art Unit	2811
	Examiner Name	N/A
	Attorney Docket Number	REAP0577USA

U.S.PATENTS							
Examiner Initial*	Cite No	Patent Number	Kind Code	Issue Date	Name	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	
/TN/	1	6664882		2003-12-16	Andoh	all	
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/Tuyen Nguyen/

12/20/2010

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	12773024
	Filing Date	2010-05-04
	First Named Inventor	Kai-Yi Huang
	Art Unit	2811
	Examiner Name	N/A
	Attorney Docket Number	REAP0577USA

	1							
NON-PATENT LITERATURE DOCUMENTS								
Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.						
/TN/	1	DESIGN, SIMULATION AND APPLICATIONS OF INDUCTORS AND TRANSFORMERS FOR SI RF ICs, ALI M. NIKNEJAD AND ROBERT G. MEYER, 2000, P.22-24, Kluwer Academic Publishers, Distributors for North, Central and South America. no date						
EXAMINER SIGNATURE								
Examiner Signature	/Tuyen Nguyen/					Date Considered	12/20/2010	
*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.								

Issue Classification *1277302 4*	Application/Control No. 12/773,024	Applicant(s)/Patent under Reexamination HUANG ET AL.	
	Examiner TUYEN T. NGUYEN	Art Unit 2832	

ISSUE CLASSIFICATION									
ORIGINAL				CROSS REFERENCE(S)					
CLASS		SUBCLASS		CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)				
336		200							
INTERNATIONAL CLASSIFICATION									
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				/					
				/					
				/					
none (Assistant Examiner) (Date)				/Tuyen Nguyen/ Primary Examiner 12/17/2010 (Primary Examiner) (Date)			Total Claims Allowed: 20		
(Legal Instruments Examiner) (Date)							O.G. Print Claim(s) 1	O.G. Print Fig. 1-2	

☒ Claims renumbered in the same order as presented by applicant										☐ CPA		☐ T.D.		☐ R.1.47	
Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1		31		61		91		121		151		181		
	2		32		62		92		122		152		182		
	3		33		63		93		123		153		183		
	4		34		64		94		124		154		184		
	5		35		65		95		125		155		185		
	6		36		66		96		126		156		186		
	7		37		67		97		127		157		187		
	8		38		68		98		128		158		188		
	9		39		69		99		129		159		189		
	10		40		70		100		130		160		190		
	11		41		71		101		131		161		191		
	12		42		72		102		132		162		192		
	13		43		73		103		133		163		193		
	14		44		74		104		134		164		194		
	15		45		75		105		135		165		195		
	16		46		76		106		136		166		196		
	17		47		77		107		137		167		197		
	18		48		78		108		138		168		198		
	19		49		79		109		139		169		199		
	20		50		80		110		140		170		200		
	21		51		81		111		141		171		201		
	22		52		82		112		142		172		202		
	23		53		83		113		143		173		203		
	24		54		84		114		144		174		204		
	25		55		85		115		145		175		205		
	26		56		86		116		146		176		206		
	27		57		87		117		147		177		207		

	28		58		88		118		148		178		208
	29		59		89		119		149		179		209
	30		60		90		120		150		180		210

U.S. Patent and Trademark Office

Part of Paper No. 20101220

Search Notes *12773024*	Application/Control No. 12/773,024		Applicant(s)/Patent under Reexamination HUANG ET AL.	
	Examiner TUYEN T. NGUYEN		Art Unit 2832	

SEARCHED			
Class	Subclass	Date	Examiner
336	65, 200, 206-208, 232	12/17/2010	TN
336	192	12/17/2010	TN
257	531	12/17/2010	TN

INTERFERENCE SEARCHED			
Class	Subclass	Date	Examiner
same as above		12/17/2010	TN

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	DATE	EXMR



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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/773,024	05/04/2010	Kai-Yi Huang	REAP0577USA

CONFIRMATION NO. 5061

27765
NORTH AMERICA INTELLECTUAL PROPERTY CORPORATION
P.O. BOX 506
MERRIFIELD, VA 22116

PUBLICATION NOTICE



Title:STACKED STRUCTURE OF A SPIRAL INDUCTOR

Publication No.US-2010-0295648-A1

Publication Date:11/25/2010

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/>.

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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

KEA-577

USA

Priority Document for

USA Appl. No. 12/773,01

中華民國經濟部智慧財產局

INTELLECTUAL PROPERTY OFFICE
MINISTRY OF ECONOMIC AFFAIRS
REPUBLIC OF CHINA

茲證明所附文件，係本局存檔中原申請案的副本，正確無訛，
其申請資料如下：

This is to certify that annexed is a true copy from the records of this
Office of the application as originally filed which is identified hereunder:

請 日：西元 2009 年 05 月 19 日
Application Date May 19, 2009

請 案 號：098116543
Application No.

請 人：瑞昱半導體股份有限公司
Applicant(s)

發明人 / 創作人：黃凱易、簡育生、葉達勳
Inventor(s)

局 長
Director General

王美花

西元 2009 年 06 月 06 日
Jun 6, 2009

發明專利說明書

(本說明書格式、順序，請勿任意更動，※記號部分請勿填寫)

※申請案號：

※申請日：

※IPC 分類：

一、發明名稱：(中文/英文)

螺旋電感之堆疊結構/STACKED STRUCTURE OF A SPIRAL
INDUCTOR

二、中文發明摘要：

螺旋電感堆疊結構包含第一、第二金屬層及第一組、第二組介電窗。第一金屬層包含第一、第二、第三線段，第三線段之佈局方向不同於第一、第二線段之佈局方向。第二金屬層包含第四、第五、第六線段，第六線段連接第五線段且第六線段之佈局方向不同於第四、第五線段之佈局方向。第一組介電窗連接第一、第四線段，且三者係構成第一並聯繞線。第二組介電窗連接第二、第五線段，且三者係構成第二並聯繞線。第三、第六線段構成跨線區域。

三、英文發明摘要：

A stacked structure of a spiral inductor includes a first metal layer, a second metal layer, a first set of via, and a second set of via. The first metal layer includes a first segment, a second segment, and a third segment, wherein the layout direction of the third segment is different from the layout direction of the first and second segments. The second

metal layer includes a fourth segment, a fifth segment, and a sixth segment connected to the fifth segment, wherein the layout direction of the sixth segment is different from the layout direction of the fourth and fifth segments. The first set of via connects the first and fourth segments, and they construct a first shunt winding. The second set of via connects the second and fifth segments, and they construct a second shunt winding. The third and sixth segments construct a crossover region.

四、指定代表圖：

(一)本案指定代表圖為：第（ 1 ）圖。

(二)本代表圖之元件符號簡單說明：

100、200	螺旋電感
M11～M16、M21～M26	金屬層
110、210	第一組介電窗
120、220	第二組介電窗
S11～S16、S21～S26	線段
130、230	第一並聯繞線
140、240	第二並聯繞線
150、250	跨線區域

五、本案若有化學式時，請揭示最能顯示發明特徵的化學式：

無

六、發明說明：

【發明所屬之技術領域】

本發明有關一種螺旋電感之堆疊結構，尤指一種利用跨線區域的金屬層來當作並聯繞線以提升品質因數(quality factor)的堆疊結構。

【先前技術】

隨著 IC 製造朝系統單晶片 (system on chip, SoC) 方向發展，積體電感 (integrated inductor) 或積體變壓器 (integrated transformer) 等被動元件已被廣泛整合製作在高頻積體電路中。由於 IC 製造一般採用矽基底的結構，積體電感/積體變壓器的基底損耗 (substrate loss) 以及金屬損耗 (metal loss) 將決定其品質因數 (quality factor) 的好壞，尤其以金屬損耗為最直接影響電感特性的主因。

目前常見的積體電感包含對稱型螺旋電感以及非對稱型螺旋電感，多採用最上層 (或最上兩層) 金屬來作為電感的繞線，並使用下一層金屬以及介電窗 (via) 來作為跨線 (crossover)。此種電感的缺點是其寄生電阻將受限於此單層金屬、跨線的導電度、介電窗的數量以及介電窗的電阻值。若要提高電感的品質因數，勢必得增加繞線的線寬，但此作法將消耗更多的晶片面積。因此，有人提出利用多層金屬並聯的架構，使得電感在相同面積下，比傳統單層電感得到更低的串聯電阻，藉以提升品質因數，諸如前案美國專利第 20080074229 號、美國專利第 6664882 號所揭示者。然而，無論是

單層金屬架構或者是多層金屬並聯的架構，電感的跨線部份皆是使用到不同於電感繞線本身的金屬層，並無法使電感的品質因數達到最佳化。

【發明內容】

本發明的目的之一在於提供一種螺旋電感之堆疊結構，以解決先前技術中之問題。

本發明之實施例揭露了一種螺旋電感之堆疊結構，包含有一第一金屬層、一第二金屬層、一第一組介電窗以及一第二組介電窗。第一金屬層包含一第一線段、一第二線段以及一第三線段，第三線段連接至第一線段，且第三線段之佈局方向不同於該第一線段之佈局方向與該第二線段之佈局方向。第二金屬層佈局於第一金屬層之下，其包含有一第四線段、一第五線段以及一第六線段，第六線段連接至第五線段，且該第六線段之佈局方向不同於該第四線段之佈局方向與該第五線段之佈局方向。第一組介電窗連接第一線段以及第四線段。第二組介電窗連接第二線段以及第五線段。其中，第一線段、第四線段以及第一組介電窗係構成螺旋電感之一第一並聯繞線，第二線段、第五線段以及第二組介電窗係構成螺旋電感之一第二並聯繞線，以及第三線段與第六線段係構成一第一跨線區域。此螺旋電感係為一對稱型螺旋電感。

本發明之實施例另揭露了一種螺旋電感之堆疊結構，包含有一第

一金屬層、一第二金屬層、一第一組介電窗以及一第二組介電窗。第一金屬層包含一第一線段、一第二線段以及一第三線段，第三線段連接至第一線段與第二線段且佈局於第一線段以及第二線段之間。第二金屬層包含有一第四線段、一第五線段以及一第六線段，第六線段佈局於第四線段與第五線段之間。第一組介電窗連接第一線段以及第四線段。第二組介電窗連接第二線段以及第五線段。其中，第一線段與第四線段係構成螺旋電感之一第一並聯繞線，第二線段與第五線段係構成螺旋電感之一第二並聯繞線，以及第三線段與第六線段係構成一跨線區域。此螺旋電感係為一非對稱型螺旋電感。

【實施方式】

於以下實施例中，係針對對稱型（symmetric）螺旋電感（請參考第 1 圖至第 8 圖之實施例）以及非對稱型（asymmetric）螺旋電感（請參考第 9 圖至第 14 圖之實施例），提出至少三種多層金屬堆疊的螺旋電感之跨線結構，主要係分為 L 型跨線結構（L-shape Crossover）、指間交錯型跨線結構（Interdigitated Crossover）以及溝渠式跨線結構（Trench-shape Crossover），可使多層金屬堆疊的螺旋電感得到最佳化的品質因數。其中，「L 型跨線結構」、「指間交錯型跨線結構」以及「溝渠式跨線結構」等用語係本發明所定義之，僅作為名稱區隔之用。另外，本發明提出堆疊式防護環（stacked guard ring）來增加雜訊的阻隔能力。

請參考第 1 圖，第 1 圖（包含有圖 1A 及圖 1B）為本發明一螺旋電感之堆疊結構之一實施例的示意圖。其中，圖 1A 係表示 L 型跨線結構，而圖 1B 係表示指間交錯型跨線結構。於本實施例中，圖 1A 所示之 L 型跨線結構以及圖 1B 所示之指間交錯型跨線結構皆係應用於一對稱型螺旋電感中。如圖 1A 所示，螺旋電感 100 之堆疊結構係包含六個金屬層 M16~M11、一第一組介電窗（via）110 以及一第二組介電窗 120。金屬層 M16~M14 包含線段 S11、S12 以及 S13，其中線段 S13 係連接至線段 S11 且佈局於線段 S11 以及線段 S12 之間。金屬層 M13~M11 係佈局於金屬層 M16~M14 之下，其包含線段 S14、S15 以及 S16，其中線段 S16 係連接至線段 S15 且佈局於線段 S14 與線段 S15 之間。第一組介電窗 110 係連接線段 S11 以及線段 S14，而第二組介電窗 120 係連接線段 S12 以及線段 S15。於本實施例中，金屬層 M16~M14 之線段 S11、金屬層 M13~M11 之線段 S14 以及第一組介電窗 110 係構成螺旋電感 100 之一第一並聯繞線（shunt winding）130，金屬層 M16~M14 之線段 S12、金屬層 M13~M11 之線段 S15 以及第二組介電窗 120 係構成螺旋電感 100 之一第二並聯繞線 140，且金屬層 M16~M14 之線段 S13 與金屬層 M13~M11 之線段 S16 係構成一跨線（crossover）區域 150。

如圖 1B 所示，螺旋電感 200 之堆疊結構係包含六個金屬層 M26~M21、一第一組介電窗 210 以及一第二組介電窗 220。金屬層 M26、M24、M22 包含線段 S21、S22 以及 S23，其中線段 S23 係連

接至線段 S21 且佈局於線段 S21 以及線段 S22 之間。金屬層 M25、M23、M21 包含線段 S24、S25 以及 S26，其中線段 S26 係連接至線段 S25 且佈局於線段 S24 與線段 S25 之間。第一組介電窗 210 係連接線段 S21 以及線段 S24，而第二組介電窗 220 係連接線段 S22 以及線段 S25。於本實施例中，金屬層 M26、M24、M22 之線段 S21、金屬層 M25、M23、M21 之線段 S24 以及第一組介電窗 210 係構成螺旋電感 200 之一第一並聯繞線 (shunt winding) 230，金屬層 M26、M24、M22 之線段 S22、金屬層 M25、M23、M21 之線段 S25 以及第二組介電窗 220 係構成螺旋電感 200 之一第二並聯繞線 240，且金屬層 M26、M24、M22 之線段 S23 與金屬層 M25、M23、M21 之線段 S26 係構成一跨線區域 250。

請注意，於上述之實施例中，係以六個金屬層為例，然此並非本發明之限制條件，金屬層的個數並不侷限。

請參考第 2 圖、第 3 圖以及第 4 圖，其中第 2 圖為一對稱型螺旋電感 300 之一範例的上視圖，第 3 圖為第 2 圖所示之對稱型螺旋電感 300 採用圖 1A 的堆疊結構之縱剖面圖，而第 4 圖為第 2 圖所示之對稱型螺旋電感 300 採用圖 1B 的堆疊結構之縱剖面圖。如第 2 圖所示，對稱型螺旋電感 300 包含一第一並聯繞線 330 以及一第二並聯繞線 340，而圖中標示 A1 的區域則代表跨線區域。第 3 圖係為對稱型螺旋電感 300 沿著第 2 圖中 YY' 虛線之縱剖面，其係採用 1A 的堆疊結構。如第 3 圖所示，對稱型螺旋電感 300 之堆疊結構係包

含五個金屬層 M36~M32、一第一組介電窗 310 以及一第二組介電窗 320。於本實施例中，金屬層 M36 之線段 S31、金屬層 M35~M32 之線段 S34 以及第一組介電窗 310 係構成螺旋電感 300 之第一並聯繞線 330，金屬層 M36 之線段 S32、金屬層 M35~M32 之線段 S35 以及第二組介電窗 320 係構成螺旋電感 300 之第二並聯繞線 340，且金屬層 M36 之線段 S33 與金屬層 M35~M32 之線段 S36 係構成一跨線區域 350（包含有第一部分 350A 以及第二部分 350B）。由第 2 圖與第 3 圖可得知，線段 S33（構成跨線區域 350 之第一部分 350A）的佈局方向係不同於線段 S31、線段 S32 的佈局方向，且線段 S36（構成跨線區域 350 之第二部分 350B）的佈局方向亦不同於線段 S34、線段 S35 的佈局方向。

另外，金屬層 M36 另包含第一防護環線段 S37，設置於線段 S31 及/或線段 S32 之外側；金屬層 M35~M32 另包含第二防護環線段 S38，設置於線段 S34 及/或線段 S35 之外側；且該堆疊結構另包含一第三組介電窗 360，連接第一防護環線段 S37 以及第二防護環線段 S38。其中，第一防護環線段 S37、第二防護環線段 S38 以及第三組介電窗 360 係構成一堆疊式防護環（stacked guard ring），來增加雜訊的阻隔能力。

請注意，於本實施例中，由於金屬層 M36 之厚度係大於金屬層 M35~M32 之厚度，所以跨線區域 350 的第一部分 350A 係採用單層金屬（亦即金屬層 M36 之線段 S33）來實現，而跨線區域 350 之

第二部分 350B 係採用多層堆疊金屬（亦即金屬層 M35～M32 之線段 S36）來實現，且金屬層 M35～M32 皆佈局於金屬層 M36 之下，以求電感的對稱性。

第 4 圖係為對稱型螺旋電感 300 沿著第 2 圖中 YY' 虛線之縱剖面，其係採用 1B 的堆疊結構。如第 4 圖所示，對稱型螺旋電感 300 之堆疊結構係包含六個金屬層 M46～M41、一第一組介電窗 410 以及一第二組介電窗 420。於本實施例中，金屬層 M46、M44、M42 之線段 S41、金屬層 M45、M43、M41 之線段 S44 以及第一組介電窗 410 係構成螺旋電感 300 之第一並聯繞線 330，金屬層 M46、M44、M42 之線段 S42、金屬層 M45、M43、M41 之線段 S45 以及第二組介電窗 420 係構成螺旋電感 300 之第二並聯繞線 340，且金屬層 M46、M44、M42 之線段 S43 與金屬層 M45、M43、M41 之線段 S46 係構成一跨線區域 450（包含有第一部分 450A 以及第二部分 450B）。由第 2 圖與第 4 圖可得知，線段 S43（構成跨線區域 450 之第一部分 450A）的佈局方向係不同於線段 S41、線段 S42 的佈局方向，且線段 S46（構成跨線區域 450 之第二部分 450B）的佈局方向係不同於線段 S44、線段 S45 的佈局方向。

另外，金屬層 M46、M44、M42 另包含一第一防護環線段 S47，設置於線段 S41 及/或線段 S42 之外側；金屬層 M45、M43、M41 另包含一第二防護環線段 S48，設置於線段 S44 及/或線段 S45 之外側；且該堆疊結構另包含一第三組介電窗 460，連接第一防護環線

段 S47 以及第二防護環線段 S48。其中，第一防護環線段 S47、第二防護環線段 S48 以及第三組介電窗 460 係構成一堆疊式防護環，來增加雜訊的阻隔能力。

請注意，於本實施例中，由於金屬層 M46、M44、M42 之厚度係等於金屬層 M45、M43、M41 之厚度，所以跨線區域 450 的第一部分 450A 係採用多層堆疊金屬（亦即金屬層 M46、M44、M42 之線段 S43）來實現，而跨線區域 450 之第二部分 450B 亦採用多層堆疊金屬（亦即金屬層 M45、M43、M41 之線段 S46）來實現，且金屬層 M46、M44、M42 與金屬層 M45、M43、M41 係相間設置（interlaced），以求電感的對稱性。

由上述第 3 圖及第 4 圖之相關說明可了解，本發明之螺旋電感之線路佈局方式可依據金屬層的厚度，來增加電感的對稱性。例如，當積體電路中之金屬層厚度有不同時，可採用「L 型跨線結構」（即圖 1A 或第 3 圖所示之跨線結構）進行線路的佈局，以獲得較佳之電感對稱性。另外，當積體電路中之每一金屬層的厚度皆相同時，可採用「指間交錯型跨線結構」（即圖 1B 或第 4 圖所示之跨線結構）進行線路的佈局，以獲得較佳之電感對稱性。

由上述之實施例可得知，本發明所揭露之螺旋電感的堆疊結構，其跨線區域的金屬層亦用來作為電感的繞線，以使電感的品質因數達到最佳化。如此一來，螺旋電感的寄生電阻將不再受限於跨線的

導電度、介電窗的數量以及介電窗的電阻值。

請參考第 5 圖至第 6 圖，第 5 圖為結合串聯繞線以及並聯繞線之一對稱型螺旋電感 500 之一範例的上視圖，第 6 圖（包含有圖 6A 以及圖 6B）為第 5 圖所示之對稱型螺旋電感 500 之第一電感 510（圖 6A）以及第二電感 610（圖 6B）的示意圖。對稱型螺旋電感 500 係為結合第一電感 510（亦即串聯繞線）以及第二電感 610（亦即並聯繞線）的多層堆疊螺旋電感，可在相同的面積下增加串聯電感值，使得晶片面積利用率增加。如圖 6A 所示，第一電感 510 係為傳統的單層對稱型螺旋電感，以金屬層 MT1 當作線圈繞線，以金屬層 MT2 當作跨線區域，其中第一串聯繞線 520 以及第二串聯繞線 530 的連接處 A、B 係為第一電感 510 的中心抽頭（center tap），將連接處 A、B 斷開，可往下連接至第二電感 610 的中心抽頭（亦即第一並聯繞線 620 以及第二並聯繞線 630 的連接處 A'、B'）。而圖 6B 之第二電感 610 則可採用圖 1A 的堆疊結構（亦即 L 型跨線結構）或者圖 1B 的堆疊結構（亦即指間交錯型跨線結構）來實現，其係以金屬層 MT3、MT4、MT5、MT6 來當作線圈繞線以及跨線區域，其中金屬層 MT1、MT2、MT3、MT4、MT5、MT6 係彼此上下平行。

請參考第 7 圖，第 7 圖為對稱型螺旋電感 500 沿著第 5 圖中 KK' 虛線之縱剖面，其係採用圖 1A 的堆疊結構。如第 7 圖所示，對稱型螺旋電感 500 包含第一電感 510 以及第二電感 610。於本實施例中，第一電感 510 係以金屬層 MT1 當作線圈繞線（包含第一串聯繞

線 520 以及第二串聯繞線 530)，以金屬層 MT2 當作跨線區域；而第二電感 610 則採用圖 1A 的 L 型跨線結構，其中金屬層 MT3、MT4 係可對應至圖 1A 的金屬層 M16～M14，而金屬層 MT5、MT6 係可對應至圖 1A 的金屬層 M13～M11。

請參考第 8 圖，第 8 圖對稱型螺旋電感 500 沿著第 5 圖中 KK' 虛線之縱剖面，其係採用圖 1B 的堆疊結構。如第 8 圖所示，對稱型螺旋電感 500 包含第一電感 510 以及第二電感 610。於本實施例中，第二電感 610 則採用圖 1B 的指間交錯型跨線結構，其中金屬層 MT3、MT5 係可對應至圖 1B 的金屬層 M26、M24、M22，而金屬層 MT4、MT6 係可對應至圖 1B 的金屬層 M25、M23、M21。

請參考第 9 圖，第 9 圖（包含有圖 9A、圖 9B、圖 9C 以及圖 9D）為本發明一螺旋電感之堆疊結構之另一實施例的示意圖。其中，圖 9A、9B 係表示溝渠式跨線結構，而圖 9C、9D 係表示指間交錯型跨線結構。於本實施例中，圖 9A、圖 9B、圖 9C 以及圖 9D 所示之跨線結構皆係應用於一非對稱型螺旋電感。如圖 9A 所示，螺旋電感 900A 之堆疊結構係包含六個金屬層 M96A～M91A、一第一組介電窗 910A 以及一第二組介電窗 920A。金屬層層 M96A～M94A 包含線段 S91A、S92A、S93A，其中線段 S93A 連接至線段 S91A 與線段 S92A 且佈局於線段 S91A 以及線段 S92A 之間。金屬層 M93A～M91A 包含線段 S94A、S95A、S96A，其中線段 S96A 佈局於線段 S94A 以及線段 S95A 之間。第一組介電窗 910A 係連接線段 S91A

以及線段 S94A，第二組介電窗 920A 係連接線段 S92A 以及線段 S95A。其中，金屬層 M96A~M94A 之線段 S91A 以及金屬層 M93A~M91A 之線段 S94A 係構成螺旋電感 900A 之一第一並聯繞線 930A，金屬層 M96A~M94A 之線段 S92A 以及金屬層 M93A~M91A 之線段 S95A 係構成螺旋電感 900A 之一第二並聯繞線 940A，以及線段 S93A 與線段 S96A 係構成一跨線區域 950A。而圖 9B 之螺旋電感 900B 之堆疊結構係與圖 9A 之螺旋電感 900A 之堆疊結構類似，兩者不同之處在於螺旋電感 900B 之堆疊結構係為螺旋電感 900A 之堆疊結構的倒置。換言之，於圖 9A 中，金屬層 M96A~M94A 係佈局於金屬層 M93A~M91A 之上方，而於圖 9B 中，金屬層 M93B~M91B 係佈局於金屬層 M96B~M94B 之下方。

如圖 9C 所示，螺旋電感 900C 之堆疊結構係包含六個金屬層 M96~M91C、一第一組介電窗 910C 以及一第二組介電窗 920C。金屬層層 M96C、M94C、M92C 包含線段 S91C、S92C、S93C，其中線段 S93C 連接至線段 S91C 與線段 S92C 且佈局於線段 S91C 以及線段 S92C 之間。金屬層層 M95C、M93C、M91C 包含線段 S94C、S95C、S96C，其中線段 S96C 佈局於線段 S94C 以及線段 S95C 之間。第一組介電窗 910C 係連接線段 S91C 以及線段 S94C，第二組介電窗 920C 係連接線段 S92C 以及線段 S95C。其中，金屬層 M96C、M94C、M92C 之線段 S91C 與金屬層 M95C、M93C、M91C 之線段 S94C 係構成螺旋電感 900C 之一第一並聯繞線 930C，金屬層金線段 S92C 與金屬層 M95C、M93C、M91C 之線段 S95C 係構成螺旋電感 900C

之一第二並聯繞線 940C，以及金屬層 M96C、M94C、M92C 之線段 S93C 與金屬層 M95C、M93C、M91C 之線段 S96C 係構成一跨線區域 950C。而圖 9D 之螺旋電感 900D 之堆疊結構係與圖 9C 之螺旋電感 900C 之堆疊結構類似，兩者不同之處在於螺旋電感 900D 之堆疊結構係為螺旋電感 900C 之堆疊結構的倒置。

請參考第 10 圖以及第 11 圖，第 10 圖為一非對稱型螺旋電感 1000 之一範例的上視圖，而第 11 圖（包含有圖 11A 以及圖 11B）則為第 10 圖所示之非對稱型螺旋電感 1000 之第一並聯繞線 1100（圖 11A）以及第二並聯繞線 1200（圖 11B）的示意圖。

請參考第 12 圖，第 12 圖為非對稱型螺旋電感 1000 沿著第 10 圖中 CC' 虛線之橫剖面，其係採用圖 9A 的堆疊結構。如第 12 圖所示，非對稱型螺旋電感 1000 之堆疊結構係包含五個金屬層 M126～M122、一第一組介電窗 1210 以及一第二組介電窗 1220。於本實施例中，金屬層 M126 之線段 S121、金屬層 M125～M122 之線段 S124 以及第一組介電窗 1210 係構成螺旋電感 1000 之第一並聯繞線 1100，金屬層 M126 之線段 S122、金屬層 M125～M122 之線段 S125 以及第二組介電窗 1220 係構成螺旋電感 1000 之第二並聯繞線 1200，且金屬層 M126 之線段 S123 與金屬層 M125～M122 之線段 S126 係構成一跨線區域 1250（包含有第一部分 1250A 以及第二部分 1250B）。

請注意，於本實施例中，由於金屬層 M126 之厚度係大於金屬層 M125～M122 之厚度，所以跨線區域 1250 的第一部分 1250A 係採用單層金屬（亦即金屬層 M126 之線段 S123）來實現，而跨線區域 1250 之第二部分 1250B 係採用多層堆疊金屬（亦即金屬層 M125～M122 之線段 S126）來實現，且金屬層 M125～M122 皆佈局於金屬層 M36 之下，以求電感的對稱性。

請參考第 13 圖，第 13 圖為非對稱型螺旋電感 1000 沿著第 10 圖中 CC' 虛線之橫剖面，其係採用圖 9B 的堆疊結構。第 13 圖與第 12 圖之堆疊結構類似，兩者不同之處在於第 13 圖之堆疊結構係為第 12 圖之堆疊結構的倒置。

請參考第 14 圖，第 14 圖為非對稱型螺旋電感 1000 沿著第 10 圖中 CC' 虛線之橫剖面，其係採用圖 9C 的堆疊結構。如第 14 圖所示，非對稱型螺旋電感 1000 之堆疊結構係包含六個金屬層 M146～M141、一第一組介電窗 1410 以及一第二組介電窗 1420。於本實施例中，金屬層 M146、M144、M142 之線段 S141、金屬層 M145、M143、M141 之線段 S144 以及第一組介電窗 1410 係構成非對稱型螺旋電感 1000 之第一並聯繞線 1100，金屬層 M146、M144、M142 之線段 S142、金屬層 M145、M143、M141 之線段 S145 以及第二組介電窗 1420 係構成螺旋電感 1000 之第二並聯繞線 1200，且金屬層 M146、M144、M142 之線段 S143 與金屬層 M145、M143、M141 之線段 S146 係構成一跨線區域 1450（包含有第一部分 1450A 以及

第二部分 1450B)。

請注意，於本實施例中，由於金屬層 M146、M144、M142 之厚度係等於金屬層 M145、M143、M141 之厚度，所以跨線區域 1450 的第一部分 1450A 係採用多層堆疊金屬(亦即金屬層 M146、M144、M142 之線段 S143) 來實現，而跨線區域 1450 之第二部分 1450B 亦採用多層堆疊金屬(亦即金屬層 M145、M143、M141 之線段 S146) 來實現，且金屬層 M146、M144、M142 與金屬層 M145、M143、M141 係相間設置，以求電感的對稱性。當然，亦可採用圖 9D 之堆疊結構來實現，由於其堆疊結構僅為第 14 圖之倒置，為簡潔起見，於此不再贅述。

當然，亦可採用前述之堆疊式防護環來增加雜訊的阻隔能力。此外，於上述之實施例中，第一並聯繞線與第二並聯繞線之形狀係以矩形以及八角形(octagon)為例，然此並非本發明之限制條件，本發明所揭露之螺旋電感之堆疊結構可適用於各種形狀。

以上所述的實施例僅用來說明本發明之技術特徵，並非用來侷限本發明之範疇。由上可知，本發明提供一種螺旋電感之堆疊結構，其係利用跨線區域的金屬層來當作並聯繞線，可使多層金屬堆疊的螺旋電感得到最佳化的品質因數。再者，本發明所揭露之螺旋電感之堆疊結構之應用範圍廣泛，其係可應用於對稱型螺旋電感以及非對稱型螺旋電感。且針對不同厚度的金屬層，亦提出不同的跨線結

構，以求電感的對稱性。另外，本發明提出堆疊式防護環（stacked guard ring）來增加雜訊的阻隔能力。

以上所述僅為本發明之較佳實施例，凡依本發明申請專利範圍所做之均等變化與修飾，皆應屬本發明之涵蓋範圍。

【圖式簡單說明】

第 1 圖（包含有圖 1A 及圖 1B）為本發明一螺旋電感之堆疊結構之一實施例的示意圖。

第 2 圖為一對稱型螺旋電感之一範例的上視圖。

第 3 圖為第 2 圖所示之對稱型螺旋電感採用圖 1A 的堆疊結構之縱剖面圖。

第 4 圖為第 2 圖所示之對稱型螺旋電感採用圖 1B 的堆疊結構之縱剖面圖。

第 5 圖為結合串聯繞線以及並聯繞線之一對稱型螺旋電感之一範例的上視圖。

第 6 圖（包含有圖 6A 以及圖 6B）為第 5 圖所示之對稱型螺旋電感之串聯繞線以及並聯繞線的示意圖。

第 7 圖為第 5 圖所示之對稱型螺旋電感採用圖 1A 的堆疊結構之橫剖面圖。

第 8 圖為第 5 圖所示之對稱型螺旋電感採用圖 1B 的堆疊結構之橫剖面圖。

第 9 圖（包含有圖 9A、圖 9B、圖 9C 以及圖 9D）為本發明一螺旋電感之堆疊結構之另一實施例的示意圖。

第 10 圖為一非對稱型螺旋電感之一範例的上視圖。

第 11 圖（包含有圖 11A 以及圖 11B）為第 10 圖所示之非對稱型螺旋電感之第一並聯繞線以及第二並聯繞線的示意圖。

第 12 圖為第 10 圖所示之非對稱型螺旋電感採用圖 9A 的堆疊結構之橫剖面圖。

第 13 圖為第 10 圖所示之非對稱型螺旋電感採用圖 9B 的堆疊結構之橫剖面圖。

第 14 圖為第 10 圖所示之非對稱型螺旋電感採用圖 9C 的堆疊結構之橫剖面圖。

【主要元件符號說明】

100、200、900A、900B、900C、900D	螺旋電感
M16~M11、M26~M21、M36~M32、M46~M41、 MT1~MT6、M96A~M91A、M96B~M91B、 M96C~M91C、M96D~M91D、M126~M122、 M136~M132、M146~M141	金屬層
110、210、310、410、910A、910B、 910C、910D、1210、1410	第一組介電窗
120、220、320、420、920A、920B、 920C、920D、1220、1420	第二組介電窗
360、460	第三組介電窗

S11~S16、S21~S26、S31~S36、S41~S46、	
S91A~S96A、S91B~S96B、S91C~S96C、	
S91D~S96D、S121~S126、S141~S146	線段
S37、S47	第一防護環線段
S38、S48	第二防護環線段
130、230、330、620、930A、	
930B、930C、930D、1100	第一並聯繞線
140、240、340、630、940A、	
940B、940C、940D、1200	第二並聯繞線
150、250、350、450、950A、950B、	
950C、950D、1250、1350、1450	跨線區域
A1	區域
350A、450A、1250A、1450A	第一部分
350B、450B、1250B、1450B	第二部分
300、500	對稱型螺旋電感
YY'、KK'、CC'	虛線
510	第一電感
610	第二電感
A、B、A'、B'	連接處
520	第一串聯繞線
530	第二串聯繞線
1000	非對稱型螺旋電感

七、申請專利範圍：

1. 一種螺旋電感之堆疊結構，包含有：

一第一金屬層，包含有：

一第一線段；

一第二線段；以及

一第三線段，連接至該第一線段，該第三線段之佈局方向不

同於該第一線段之佈局方向與該第二線段之佈局方向；

一第二金屬層，佈局於該第一金屬層之下，該第二金屬層包含有：

一第四線段；

一第五線段；以及

一第六線段，連接至該第五線段，該第六線段之佈局方向不

同於該第四線段之佈局方向與該第五線段之佈局方向；

一第一組介電窗 (via)，連接該第一線段以及該第四線段；以及

一第二組介電窗，連接該第二線段以及該第五線段；

其中，該第一線段、該第四線段以及該第一組介電窗係構成一第

一並聯繞線 (shunt winding)；該第二線段、該第五線段以及

該第二組介電窗係構成一第二並聯繞線；以及該第三線段與

該第六線段係構成一跨線 (crossover) 區域。

2. 如申請專利範圍第 1 項所述之螺旋電感之堆疊結構，其中該第三線段係佈局於該第一線段與該第二線段之間，以及該第六線段係佈局於該第四線段與該第五線段之間。

3. 如申請專利範圍第 1 項所述之螺旋電感之堆疊結構，其中該第一金屬層之厚度係大於該第二金屬層之厚度。
4. 如申請專利範圍第 3 項所述之螺旋電感之堆疊結構，其中該螺旋電感更包含一第三金屬層佈局於該第二金屬層下方，該第三金屬層之結構係與該第二金屬層之結構相同，且該第一金屬層之厚度係大於該第三金屬層之厚度。
5. 如申請專利範圍第 1 項所述之螺旋電感之堆疊結構，其中該第一金屬層之厚度係等於該第二金屬層之厚度。
6. 如申請專利範圍第 1 項所述之螺旋電感之堆疊結構，其中該螺旋電感更包含：
- 一第三金屬層佈局於該第二金屬層下方，且該第三金屬層之結構係與該第一金屬層之結構相同；以及
- 一第四金屬層佈局於該第三金屬層下方，且該第四金屬層之結構係與該第二金屬層之結構相同；
- 其中，該第三金屬層之一第七線段、該第四金屬層之一第八線段、該第三線段與該第六線段係構成該跨線區域；且該第三線段、該第六線段、該第七線段與該第八線段係構成一指間交錯型跨線結構。

7. 如申請專利範圍第 1 項所述之螺旋電感之堆疊結構，其中：
- 該第一金屬層另包含一第一防護環線段，設置於該第一線段或該第二線段之外側；
 - 該第二金屬層另包含一第二防護環線段，設置於該第四線段或該第五線段之外側；以及
 - 該堆疊結構另包含一第三組介電窗，連接該第一防護環線段以及該第二防護環線段，且該第一防護環線段、該第二防護環線段以及該第三組介電窗係構成一堆疊式防護環 (guard ring)。
8. 如申請專利範圍第 1 項所述之螺旋電感之堆疊結構，其中該螺旋電感係為一對稱型螺旋電感。
9. 如申請專利範圍第 1 項所述之螺旋電感之堆疊結構，其中該第一並聯繞線與該第二並聯繞線之形狀實質上為一矩形、一八角形 (octagon) 或者一圓形。
10. 一種螺旋電感之堆疊結構，包含有：
- 一第一金屬層，包含有：
 - 一第一線段；
 - 一第二線段；以及
 - 一第三線段，連接至該第一線段與該第二線段且佈局於該第一線段以及該第二線段之間；
 - 一第二金屬層，包含有：

一第四線段；

一第五線段；以及

一第六線段，佈局於該第四線段與該第五線段之間；

一第一組介電窗，連接該第一線段以及該第四線段；以及

一第二組介電窗，連接該第二線段以及該第五線段；

其中，該第一線段與該第四線段係構成一第一並聯繞線，該第二線段與該第五線段係構成該螺旋電感之一第二並聯繞線，以及該第三區段與該第六線段係構成一跨線區域。

11. 如申請專利範圍第 10 項所述之螺旋電感之堆疊結構，其中該第二金屬層係佈局於該第一金屬層之上方。
12. 如申請專利範圍第 10 項所述之螺旋電感之堆疊結構，其中該第一金屬層係佈局於該第二金屬層之上方。
13. 如申請專利範圍第 10 項所述之螺旋電感之堆疊結構，其中該第一金屬層之厚度係大於該第二金屬層之厚度。
14. 如申請專利範圍第 13 項所述之螺旋電感之堆疊結構，其中該螺旋電感佈局於更包含一第三金屬層，該第三金屬層之結構係與該第二金屬層之結構相同，該第三金屬層與該第二金屬層均佈局於該第一金屬層之上或之下，且該第一金屬層之厚度係大於該第三金屬層之厚度。

15. 如申請專利範圍第 10 項所述之螺旋電感之堆疊結構，其中該第一金屬層之厚度係等於該第二金屬層之厚度。

16. 如申請專利範圍第 10 項所述之螺旋電感之堆疊結構，其中該螺旋電感更包含：

一第三金屬層，且該第三金屬層之結構係與該第一金屬層之結構相同；以及

一第四金屬層，且該第四金屬層之結構係與該第二金屬層之結構相同；

其中，該第三金屬層之一第七線段、該第四金屬層之一第八線段、該第三線段與該第六線段係構成該跨線區域；且該第三線段、該第六線段、該第七線段與該第八線段係構成一指間交錯型跨線結構。

17. 如申請專利範圍第 16 項所述之螺旋電感之堆疊結構，其中該第二金屬層係佈局於該第一金屬層之下，該第三金屬層係佈局於該第二金屬層之下，以及該第四金屬層係佈局於該第三金屬層之下。

18. 如申請專利範圍第 16 項所述之螺旋電感之堆疊結構，其中該第一金屬層係佈局於該第二金屬層之下，該第四金屬層係佈局於該第一金屬層之下，以及該第三金屬層係佈局於該第四金屬層之

下。

19. 如申請專利範圍第 10 項所述之螺旋電感之堆疊結構，其中：

該第一金屬層另包含一第一防護環線段，設置於該第一線段或該第二線段之外側；

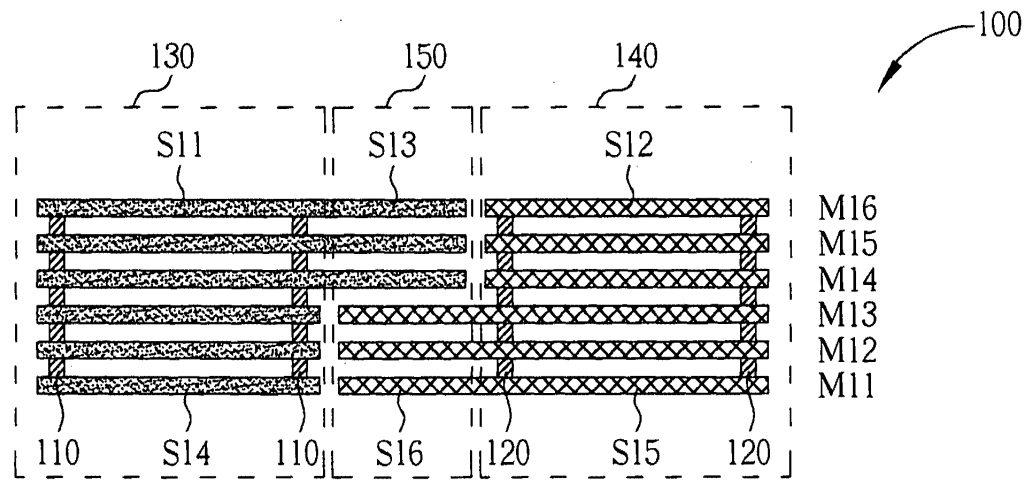
該第二金屬層另包含一第二防護環線段，設置於該第四線段或該第五線段之外側；以及

該堆疊結構另包含一第三組介電窗，連接該第一防護環線段以及該第二防護環線段，且該第一防護環線段、該第二防護環線段以及該第三組介電窗係構成一堆疊式防護環。

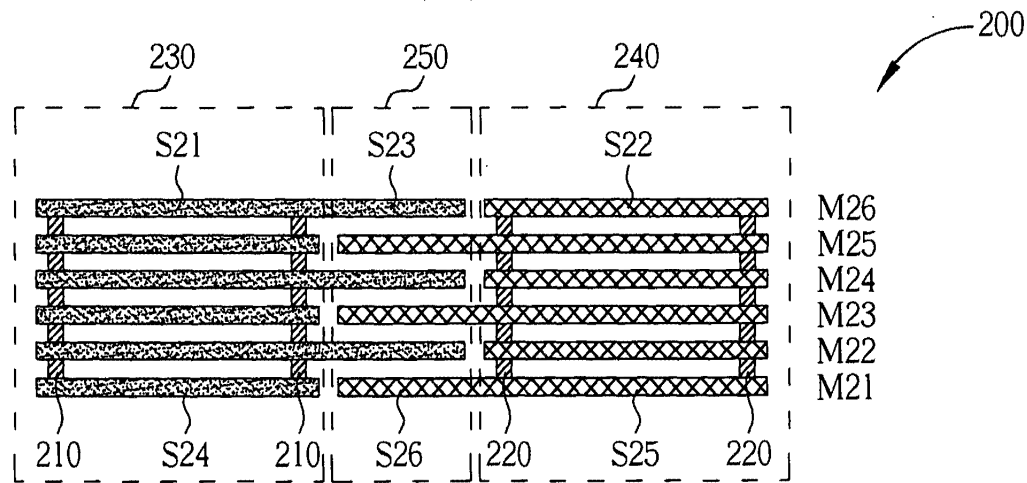
20. 如申請專利範圍第 10 項所述之螺旋電感之堆疊結構，其中該螺旋電感係為一非對稱型螺旋電感。

21. 如申請專利範圍第 10 項所述之螺旋電感之堆疊結構，其中該第一並聯繞線與該第二並聯繞線之形狀係為一矩形、一八角形或者一圓形。

八、圖式：



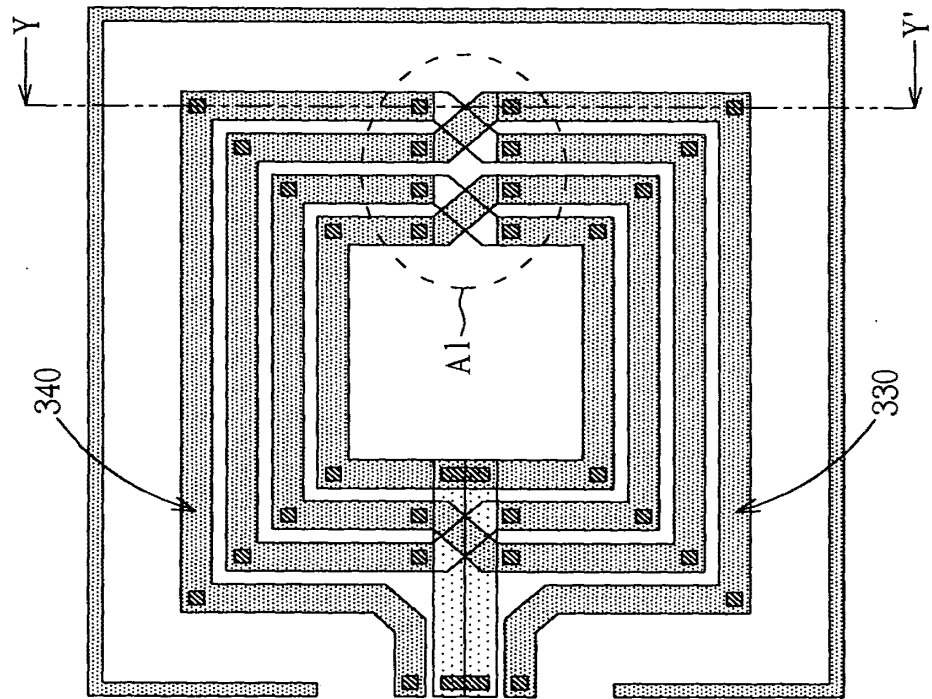
(1A)



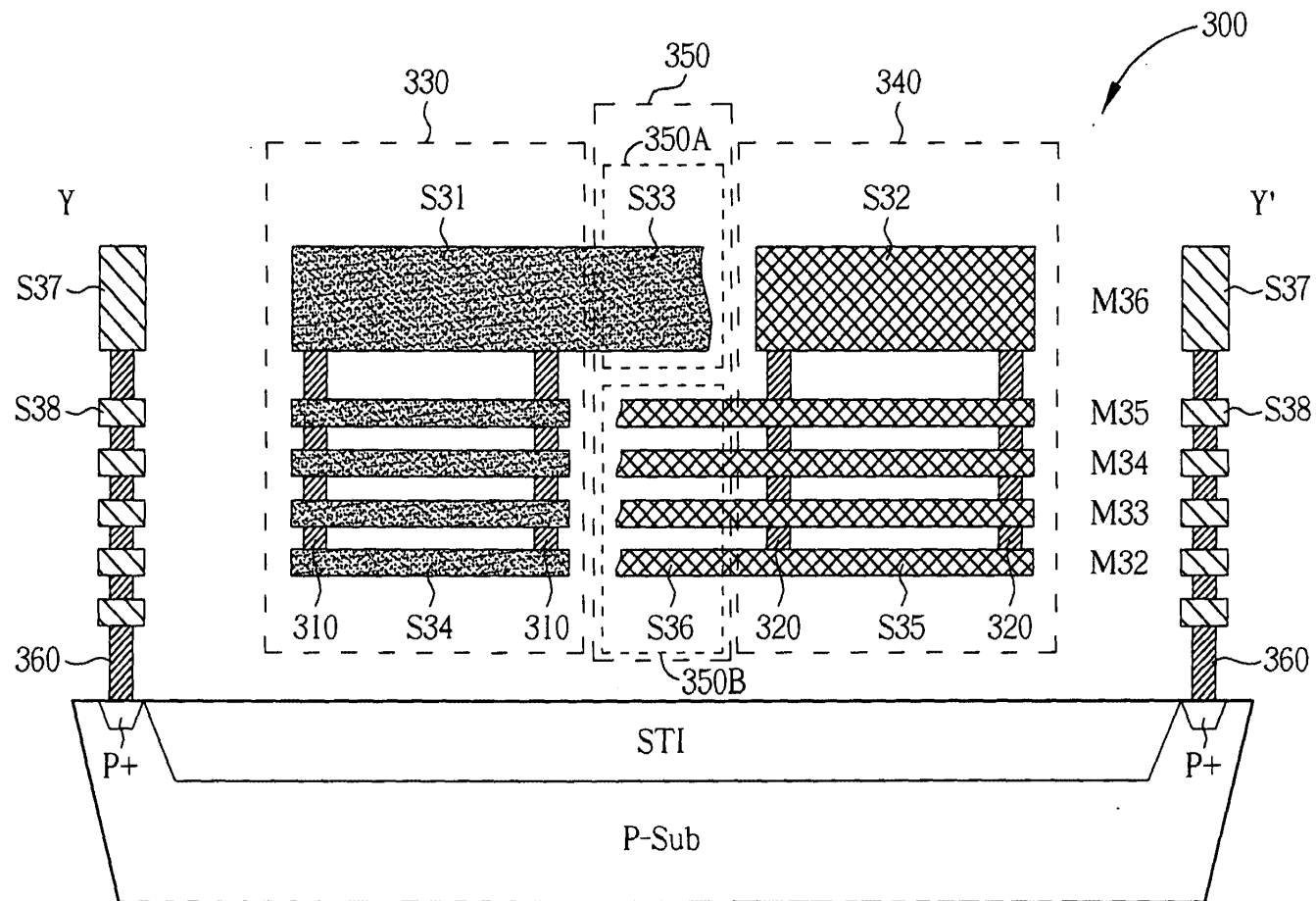
(1B)

第1圖

300

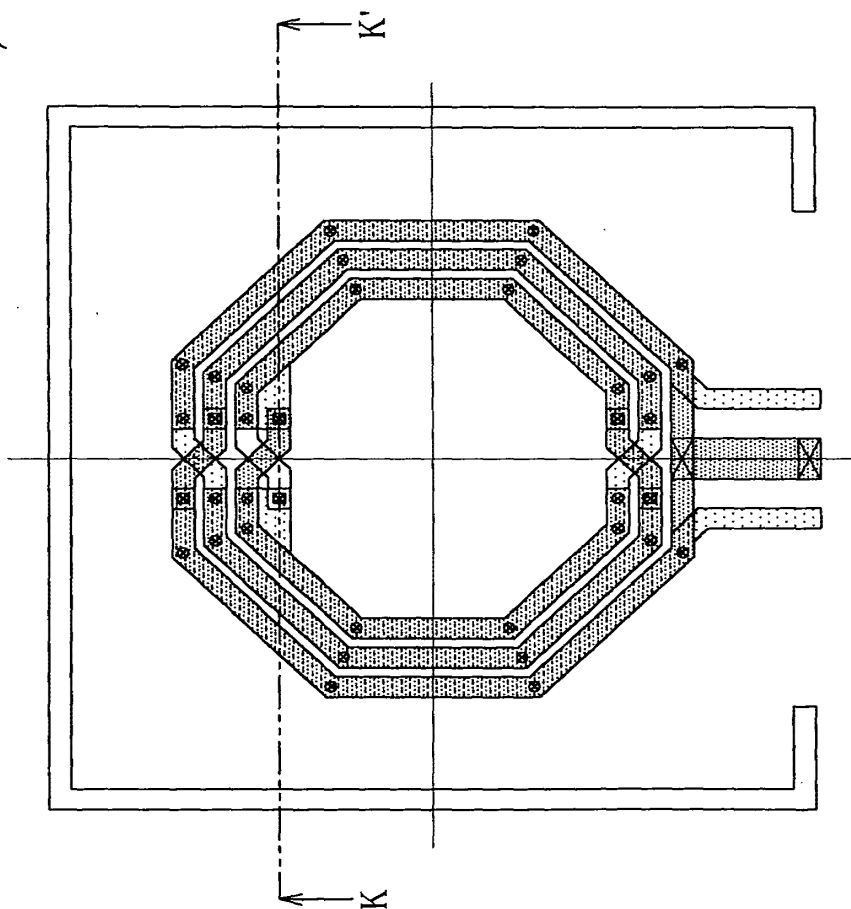


第2圖

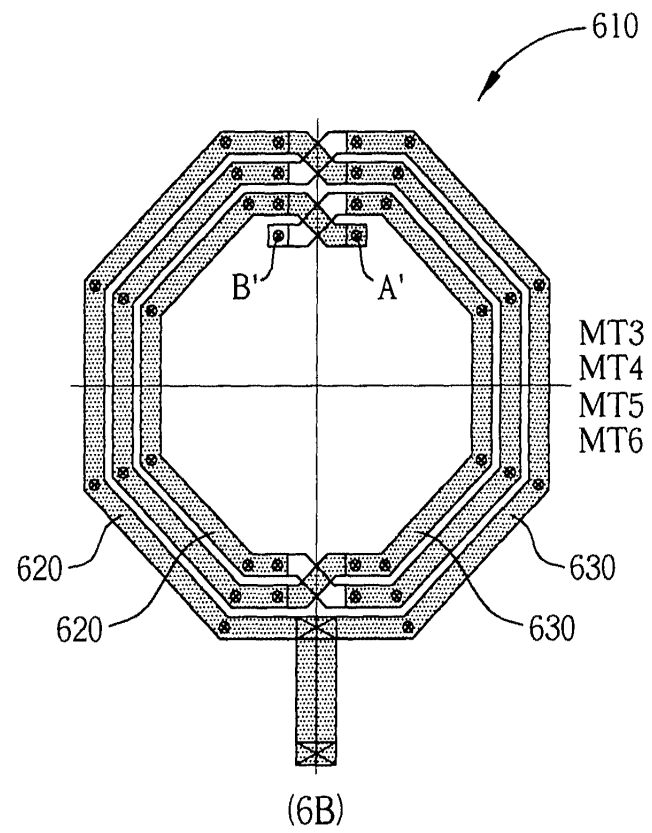
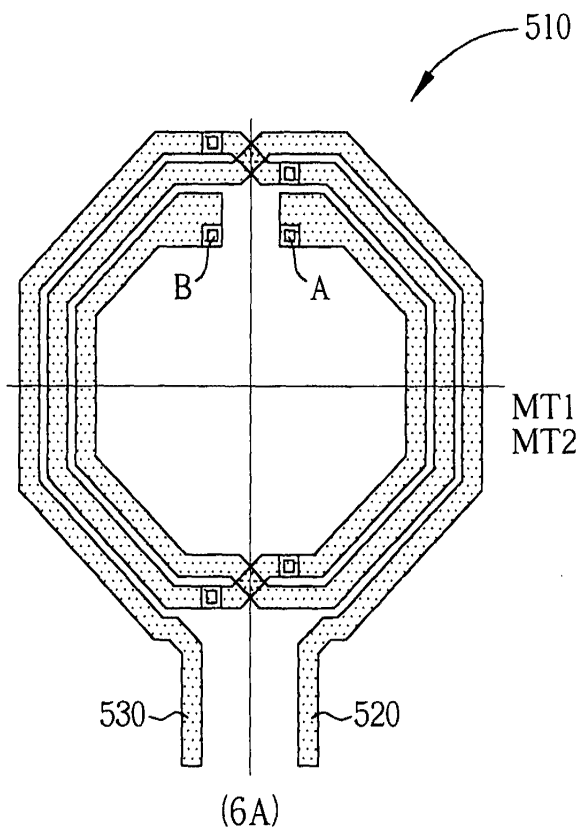


第3圖

500

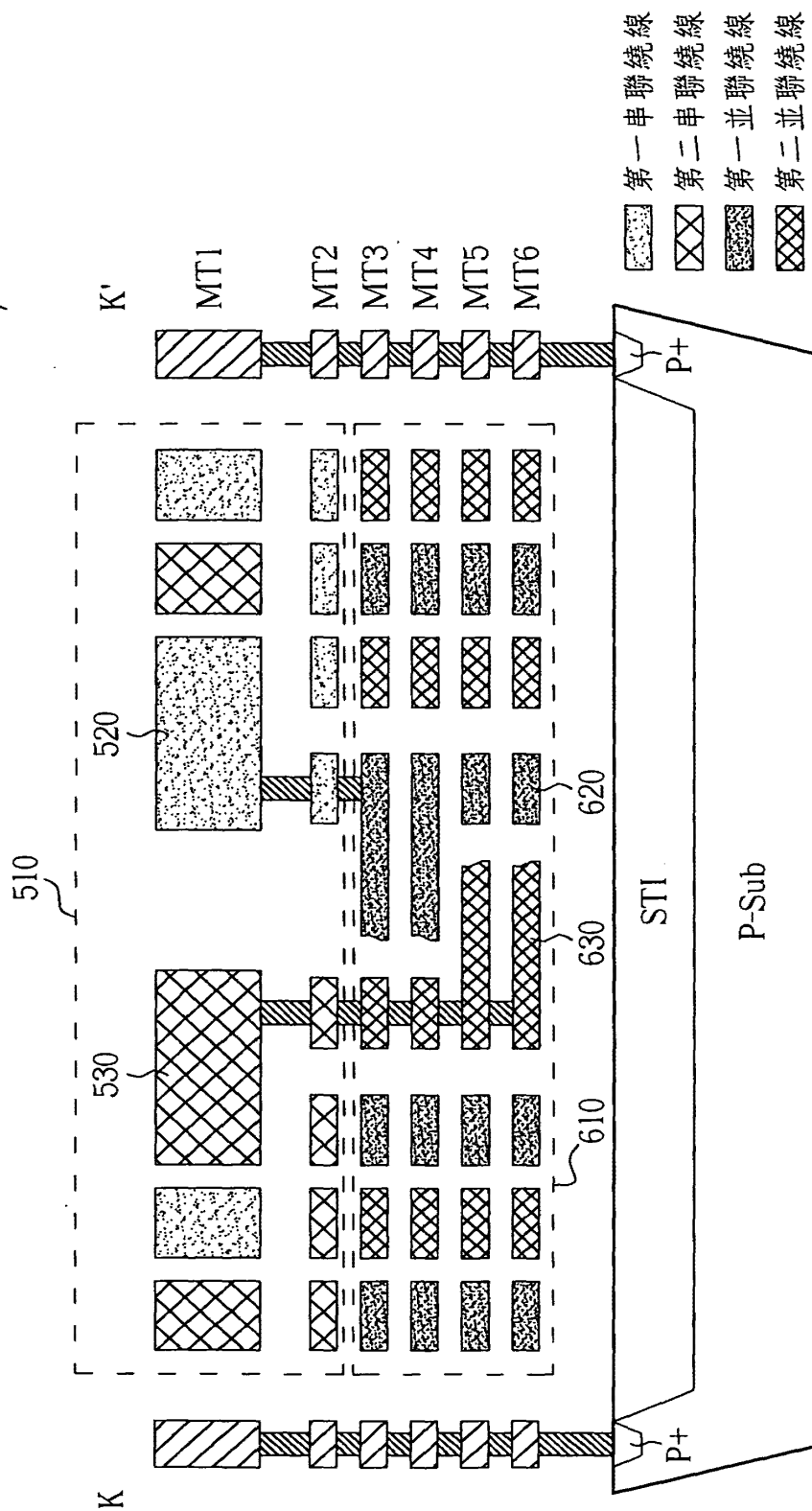


第5圖



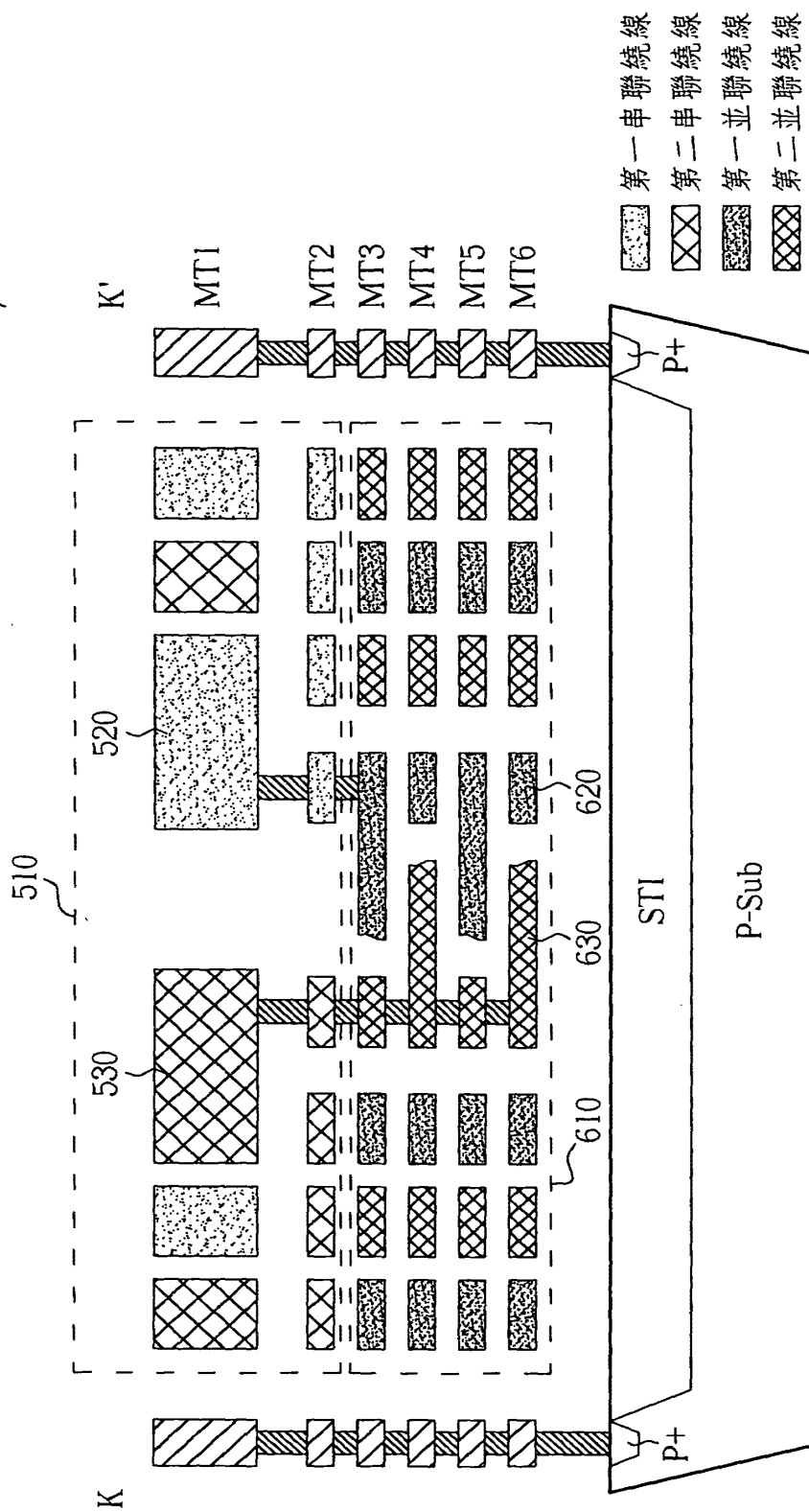
第6圖

500

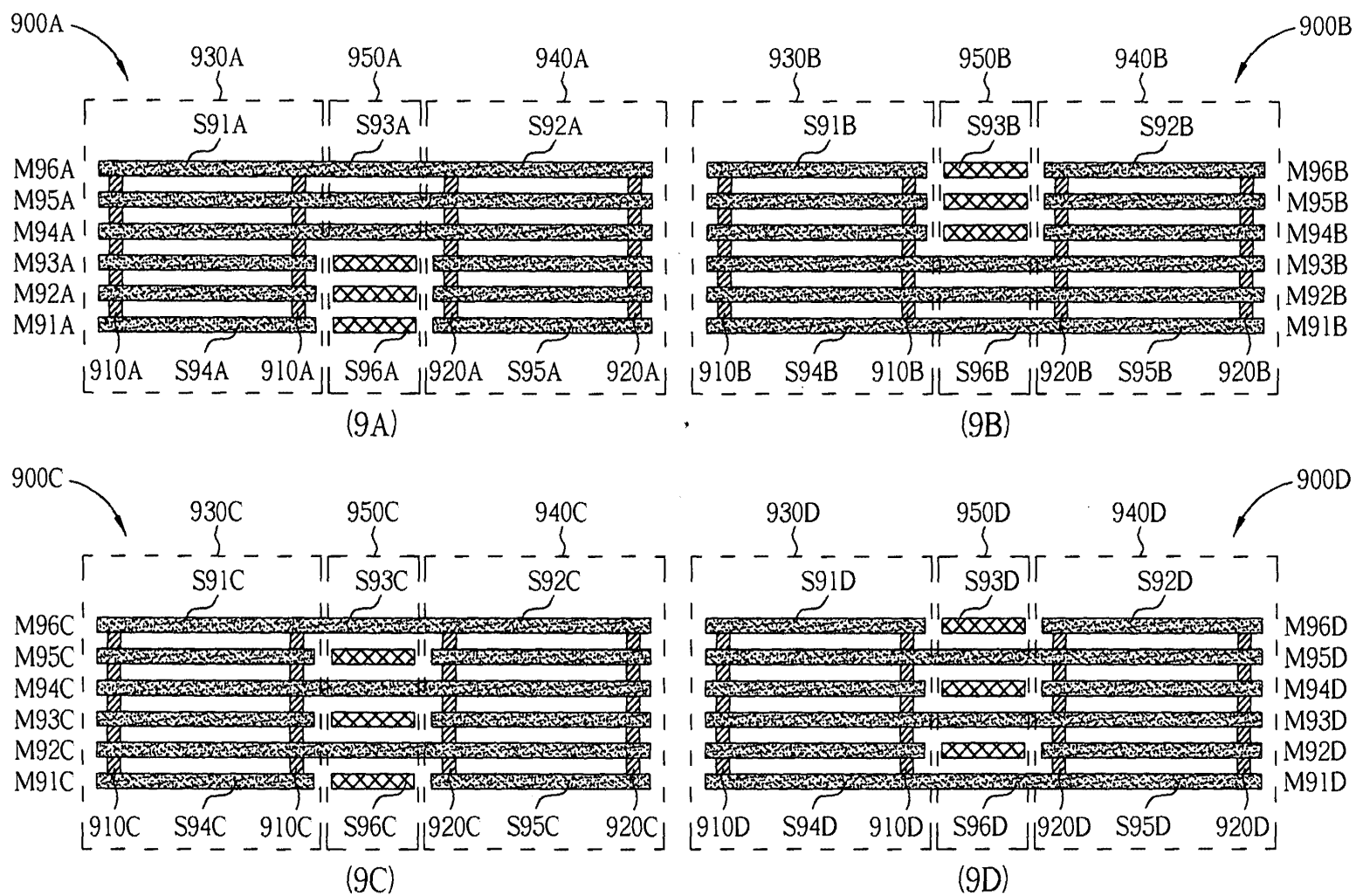


第7圖

500

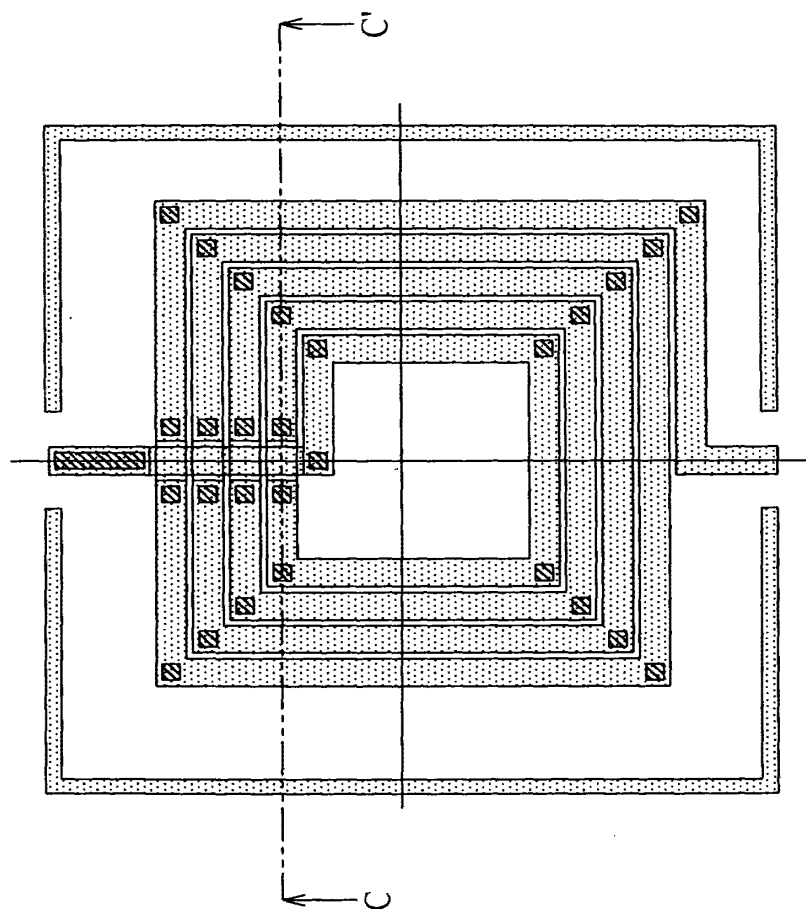


第8圖



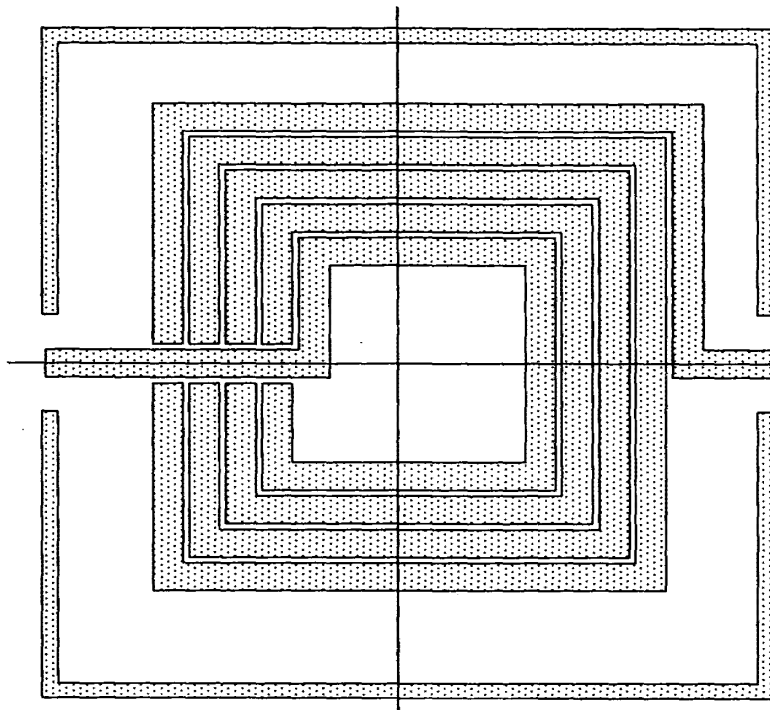
第9圖

1000



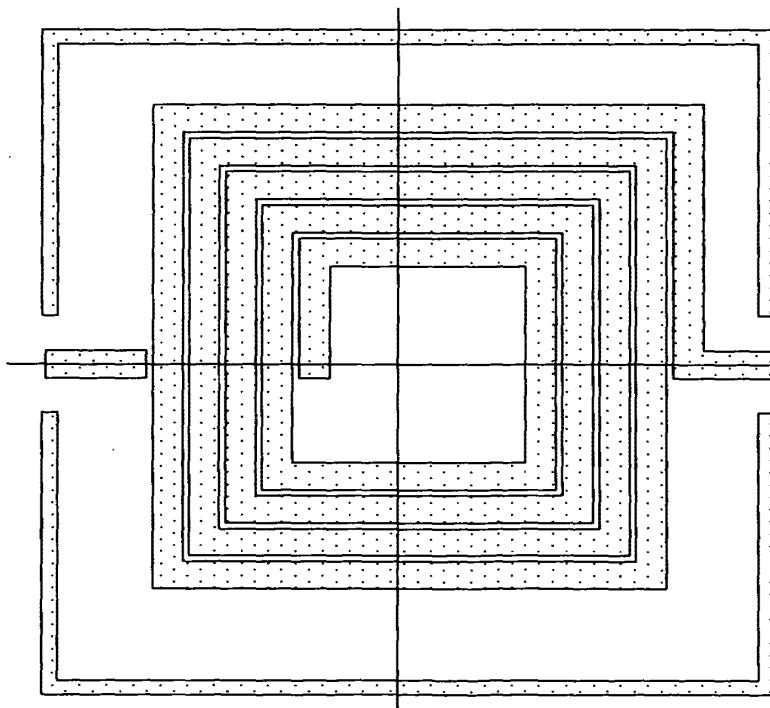
第10圖

1200



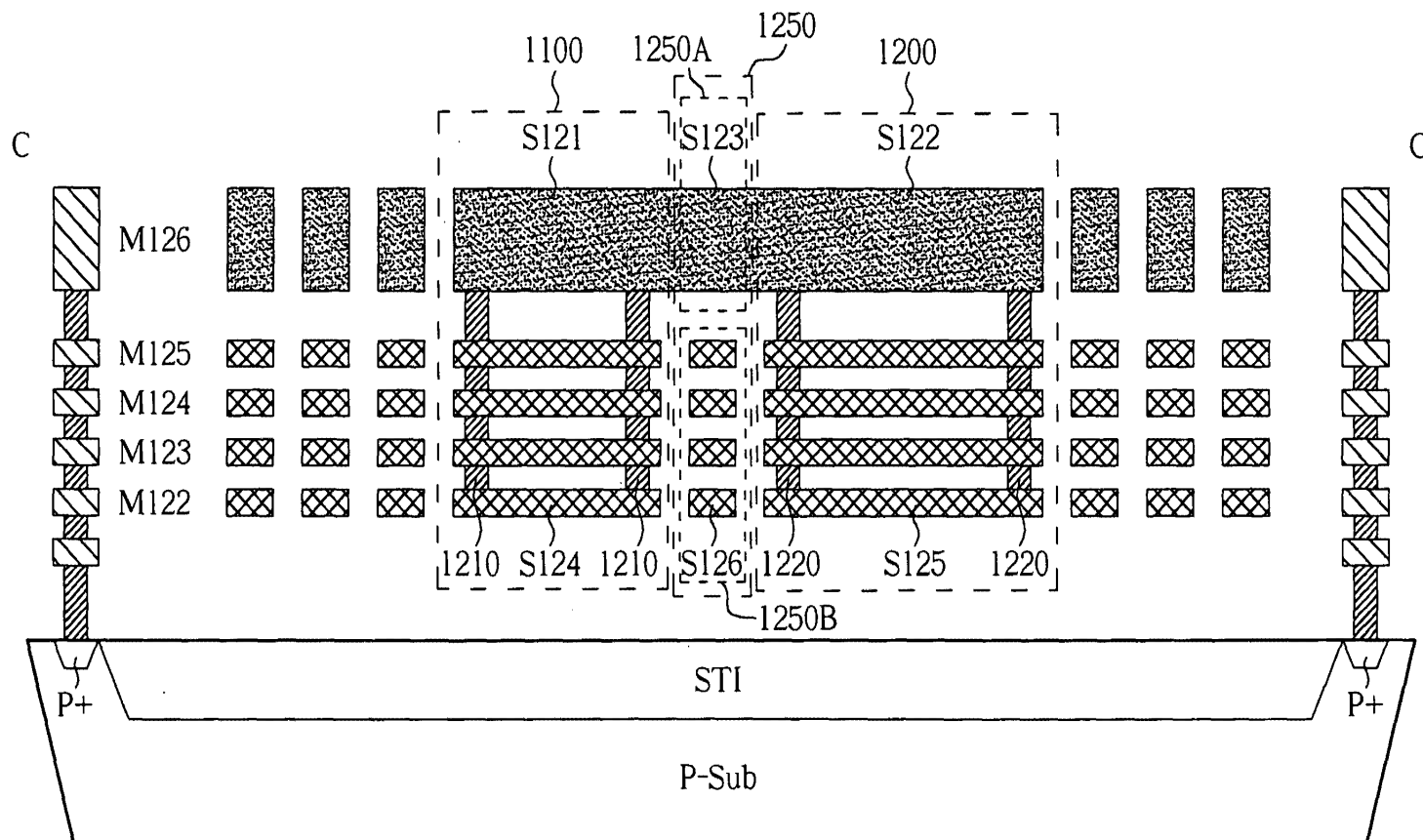
(11B)

1100

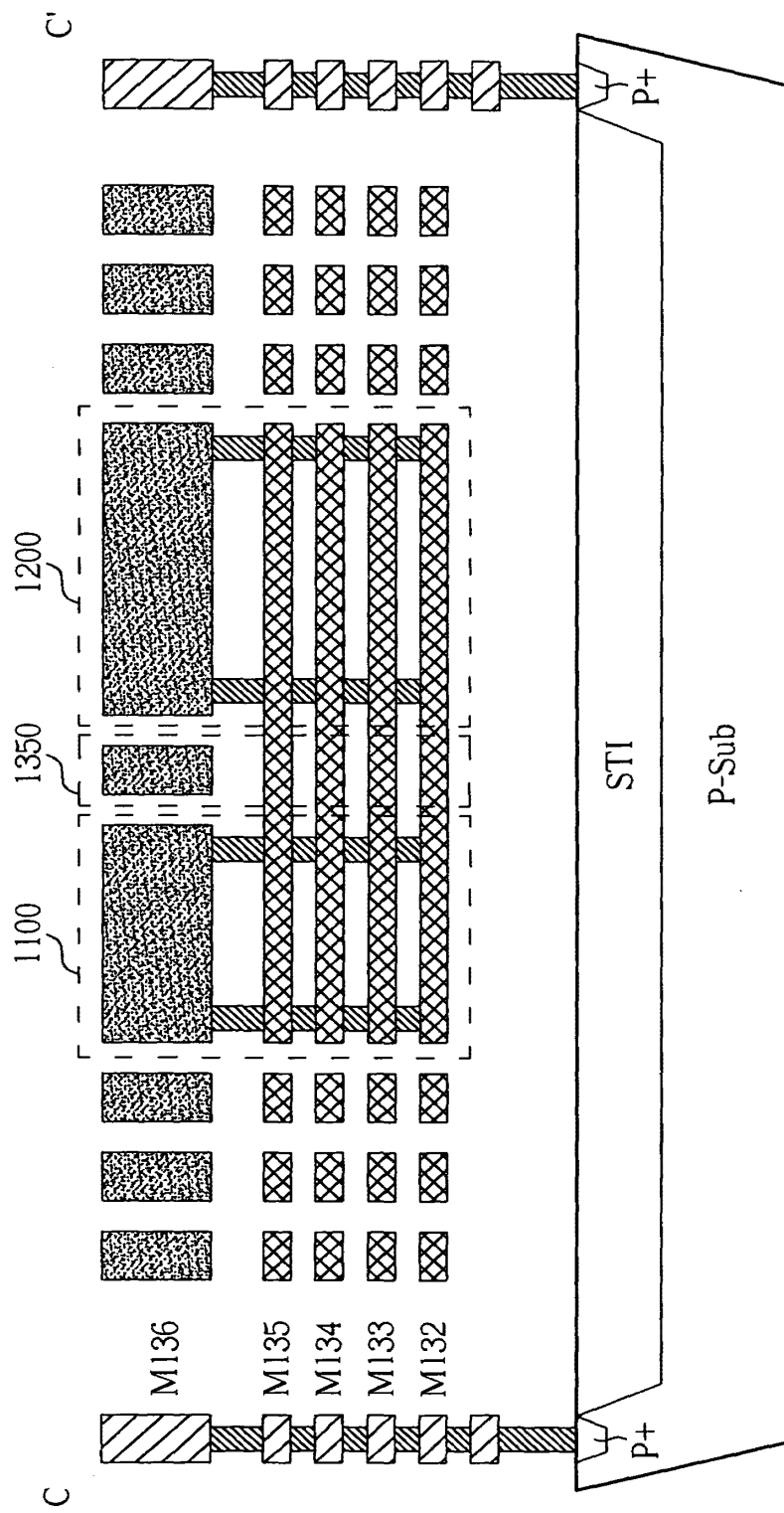


(11A)

第11圖



第12圖



第13圖



TSW

PTO/SB/21 (12-08)

Approved for use through 01/31/2009. OMB 0651-0031

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

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	First Named Inventor	Kai-Yi Huang
	Art Unit	N/A
	Examiner Name	N/A
	Attorney Docket Number	REAP0577USA
Total Number of Pages in This Submission		3

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Date	05/27/2010	Reg. No.	41,526

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 PTO/SB/17 (10-08)
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FEE TRANSMITTAL For FY 2009		Complete if Known	
☐ Applicant claims small entity status. See 37 CFR 1.27		Application Number: 12/773,024 Filing Date: 05/04/2010 First Named Inventor: Kai-Yi Huang Examiner Name: N/A Art Unit: N/A Attorney Docket No.: REAP0577USA	
TOTAL AMOUNT OF PAYMENT (\$) 0.00			

METHOD OF PAYMENT (check all that apply)

☐ Check
 ☐ Credit Card
 ☐ Money Order
 ☐ None
 ☐ Other (please identify): _____

☒ Deposit Account
 Deposit Account Number: 50-3105
 Deposit Account Name: North America Intellectual Property Corporation

For the above-identified deposit account, the Director is hereby authorized to: (check all that apply)

☒ Charge fee(s) indicated below
 ☐ Charge fee(s) indicated below, except for the filing fee
☒ Charge any additional fee(s) or underpayments of fee(s) under 37 CFR 1.16 and 1.17
 ☒ Credit any overpayments

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FEE CALCULATION

1. BASIC FILING, SEARCH, AND EXAMINATION FEES

Application Type	FILING FEES		SEARCH FEES		EXAMINATION FEES		Fees Paid (\$)
	Fee (\$)	Small Entity Fee (\$)	Fee (\$)	Small Entity Fee (\$)	Fee (\$)	Small Entity Fee (\$)	
Utility	330	165	540	270	220	110	
Design	220	110	100	50	140	70	
Plant	220	110	330	165	170	85	
Reissue	330	165	540	270	650	325	
Provisional	220	110	0	0	0	0	

2. EXCESS CLAIM FEES

Fee Description	Fee (\$)	Small Entity Fee (\$)
Each claim over 20 (including Reissues)	52	26
Each independent claim over 3 (including Reissues)	220	110
Multiple dependent claims	390	195

Total Claims **Extra Claims** **Fee (\$)** **Fee Paid (\$)**
 - 20 or HP = _____ x _____ = _____
 HP = highest number of total claims paid for, if greater than 20.

Indep. Claims **Extra Claims** **Fee (\$)** **Fee Paid (\$)**
 - 3 or HP = _____ x _____ = _____
 HP = highest number of independent claims paid for, if greater than 3.

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is \$270 (\$135 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).

Total Sheets	Extra Sheets	Number of each additional 50 or fraction thereof	Fee (\$)	Fee Paid (\$)
_____	_____	_____ / 50 = _____ (round up to a whole number)	_____ x _____ = _____	

4. OTHER FEE(S)

Non-English Specification, \$130 fee (no small entity discount)

Other (e.g., late filing surcharge): _____

SUBMITTED BY			
Signature	/WINSTON HSU/	Registration No. (Attorney/Agent) 41,526	Telephone 3027291562
Name (Print/Type)	Winston Hsu	Date 05/27/2010	

This collection of information is required by 37 CFR 1.136. 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, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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PTO/SB/028 (07-07)
Approved for use through 06/30/2010. OMB 0651-0032
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DECLARATION – Supplemental Priority Data Sheet

Foreign applications:					
Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached?	
				YES	NO
098116543	TW	05/19/2009	☐	☒	☐
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐
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			☐	☐	☐
			☐	☐	☐
			☐	☐	☐

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. 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 21 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.**

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
12/773,024	05/04/2010	2811	1090	REAP0577USA	20	2

CONFIRMATION NO. 5061

27765
NORTH AMERICA INTELLECTUAL PROPERTY CORPORATION
P.O. BOX 506
MERRIFIELD, VA 22116

FILING RECEIPT



OC000000041549482

Date Mailed: 05/13/2010

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**

Applicant(s)

Kai-Yi Huang, Taipei City, TAIWAN;
Yuh-Sheng Jean, Yun-Lin Hsien, TAIWAN;
Ta-Hsun Yeh, Hsin-Chu City, TAIWAN;

Power of Attorney: The patent practitioners associated with Customer Number 27765

Domestic Priority data as claimed by applicant

Foreign Applications

TAIWAN 098116543 05/19/2009

Permission to Access - A proper **Authorization to Permit Access to Application by Participating Offices** (PTO/SB/39 or its equivalent) has been received by the USPTO.

If Required, Foreign Filing License Granted: 05/10/2010

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 12/773,024**

Projected Publication Date: 11/25/2010

Non-Publication Request: No

Early Publication Request: No

Title

STACKED STRUCTURE OF A SPIRAL INDUCTOR

Preliminary Class

257

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

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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.

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page 2 of 3

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/773,024	05/04/2010	Kai-Yi Huang	REAP0577USA

CONFIRMATION NO. 5061

POA ACCEPTANCE LETTER

27765
NORTH AMERICA INTELLECTUAL PROPERTY CORPORATION
P.O. BOX 506
MERRIFIELD, VA 22116



Date Mailed: 05/13/2010

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 05/04/2010.

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.

/dnguyen/

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

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	12773024
	Filing Date	2010-05-04
	First Named Inventor	Kai-Yi Huang
	Art Unit	2811
	Examiner Name	N/A
	Attorney Docket Number	REAP0577USA

U.S.PATENTS						
Examiner Initial*	Cite No	Patent Number	Kind Code	Issue Date	Name	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6664882		2003-12-16	Andoh	all
	2	7039381	B2	2006-05-02	Yang	
	3	6967555	B2	2005-11-22	Yu	
	4	7091814	B2	2006-08-15	Kyriazidou	

U.S.PATENT APPLICATION PUBLICATIONS						
Examiner Initial*	Cite No	Publication Number	Kind Code	Publication Date	Name	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20080074229		2008-03-27	Moinian	all

FOREIGN PATENT DOCUMENTS							
Examiner Initial*	Cite No	Foreign Document Number	Country Code	Kind Code	Publication Date	Name	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	12773024
	Filing Date	2010-05-04
	First Named Inventor	Kai-Yi Huang
	Art Unit	2811
	Examiner Name	N/A
	Attorney Docket Number	REAP0577USA

	1							
NON-PATENT LITERATURE DOCUMENTS								
Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.						
	1	DESIGN, SIMULATION AND APPLICATIONS OF INDUCTORS AND TRANSFORMERS FOR SI RF ICS, ALI M. NIKNEJAD AND ROBERT G. MEYER, 2000, P.22-24, Kluwer Academic Publishers, Distributors for North, Central and South America.						
EXAMINER SIGNATURE								
Examiner Signature						Date Considered		
*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.								

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

Application Number	12773024
Filing Date	2010-05-04
First Named Inventor	Kai-Yi Huang
Art Unit	2811
Examiner Name	N/A
Attorney Docket Number	REAP0577USA

CERTIFICATION STATEMENT

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

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

OR

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

- ☐ See attached certification statement.
- ☐ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.
- ☒ None

SIGNATURE

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

Signature	/WINSTON HSU/	Date (YYYY-MM-DD)	2010-05-10
Name/Print	WINSTON HSU	Registration Number	41526

Electronic Acknowledgement Receipt	
EFS ID:	7576485
Application Number:	12773024
International Application Number:	
Confirmation Number:	5061
Title of Invention:	STACKED STRUCTURE OF A SPIRAL INDUCTOR
First Named Inventor/Applicant Name:	Kai-Yi Huang
Customer Number:	27765
Filer:	Winston Hsu/Karen Chen
Filer Authorized By:	Winston Hsu
Attorney Docket Number:	REAP0577USA
Receipt Date:	10-MAY-2010
Filing Date:	
Time Stamp:	05:43:46
Application Type:	Utility under 35 USC 111(a)

Payment information:

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

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	NPL Documents	NPL-1.pdf	885524	no	5
			422f765e365135efb2fde411eab1ef77fb6a6029		

Warnings:

Information:

2	Information Disclosure Statement (IDS) Filed (SB/08)	840517.PDF	27944 fe765cf3bcbef673303dcd512cb8375b973372c5	no	3
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
Total Files Size (in bytes):			913468		
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. <u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application. <u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course. <u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.					

**POWER OF ATTORNEY
and
CORRESPONDENCE ADDRESS INDICATION FORM**

Attorney Docket Number: REAP0577USA

Invention title: STACKED STRUCTURE OF A SPIRAL
INDUCTOR

I hereby revoke all previous powers of attorney
given in the above-identified application.

I hereby appoint the practitioners associated with
the Customer Number: 27765 as my/our attorney(s) or
agent(s) to prosecute the application identified above,
and to transact all business in the United States Patent
and Trademark Office connected therewith.

Please recognize or change the correspondence
address for the above-identified application to the
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**POWER OF ATTORNEY
and
CORRESPONDENCE ADDRESS INDICATION FORM**

Inventor(s):

Kai-Yi Huang
Kai-Yi Huang
Citizen of: TWN

Date: APR 30 2010

Yuh-Sheng Jean
Yuh-Sheng Jean
Citizen of: TWN

Date: APR 30 2010

Ta-Hsun Yeh
Ta-Hsun Yeh
Citizen of: TWN

Date: APR 30 2010

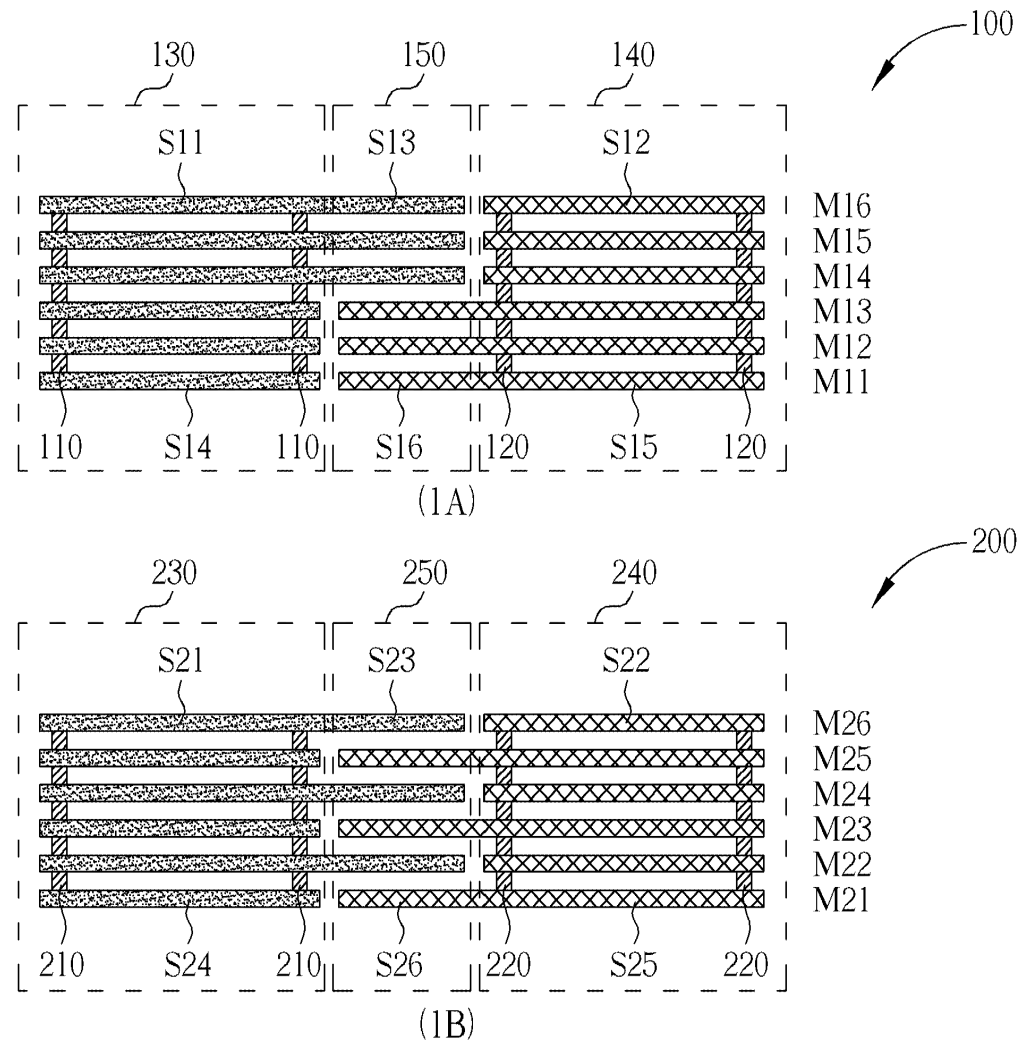


FIG. 1

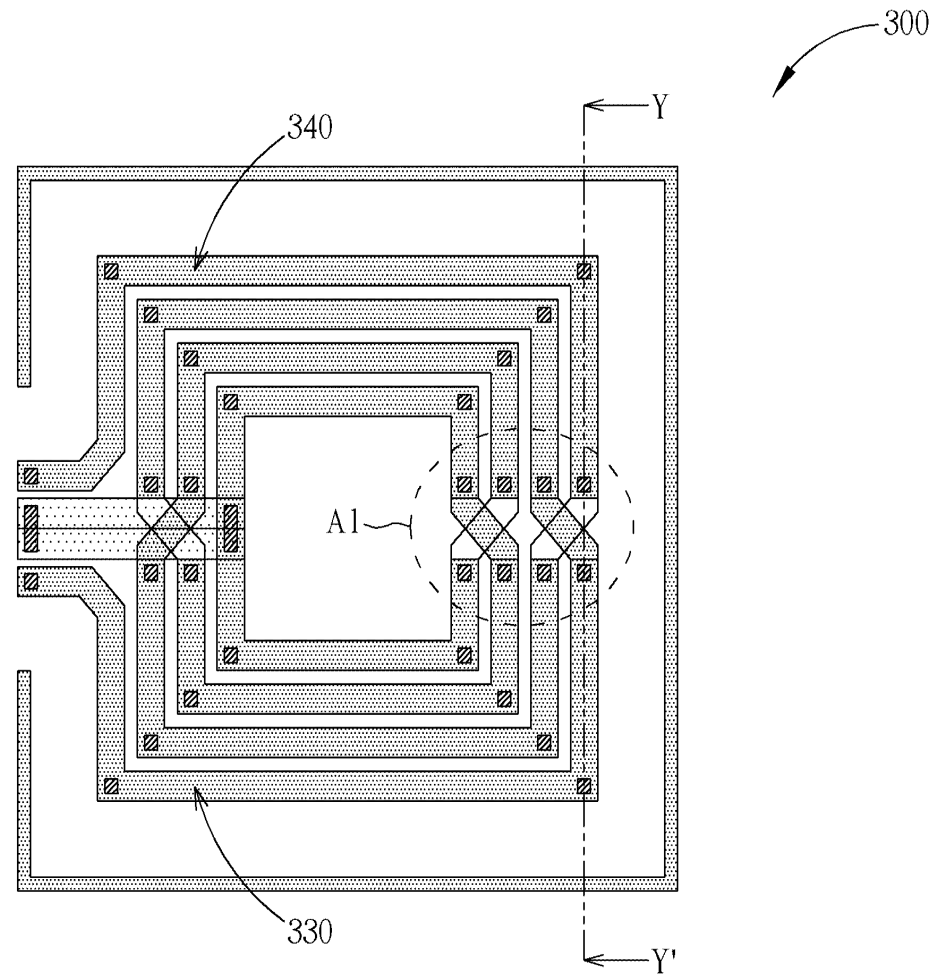


FIG. 2

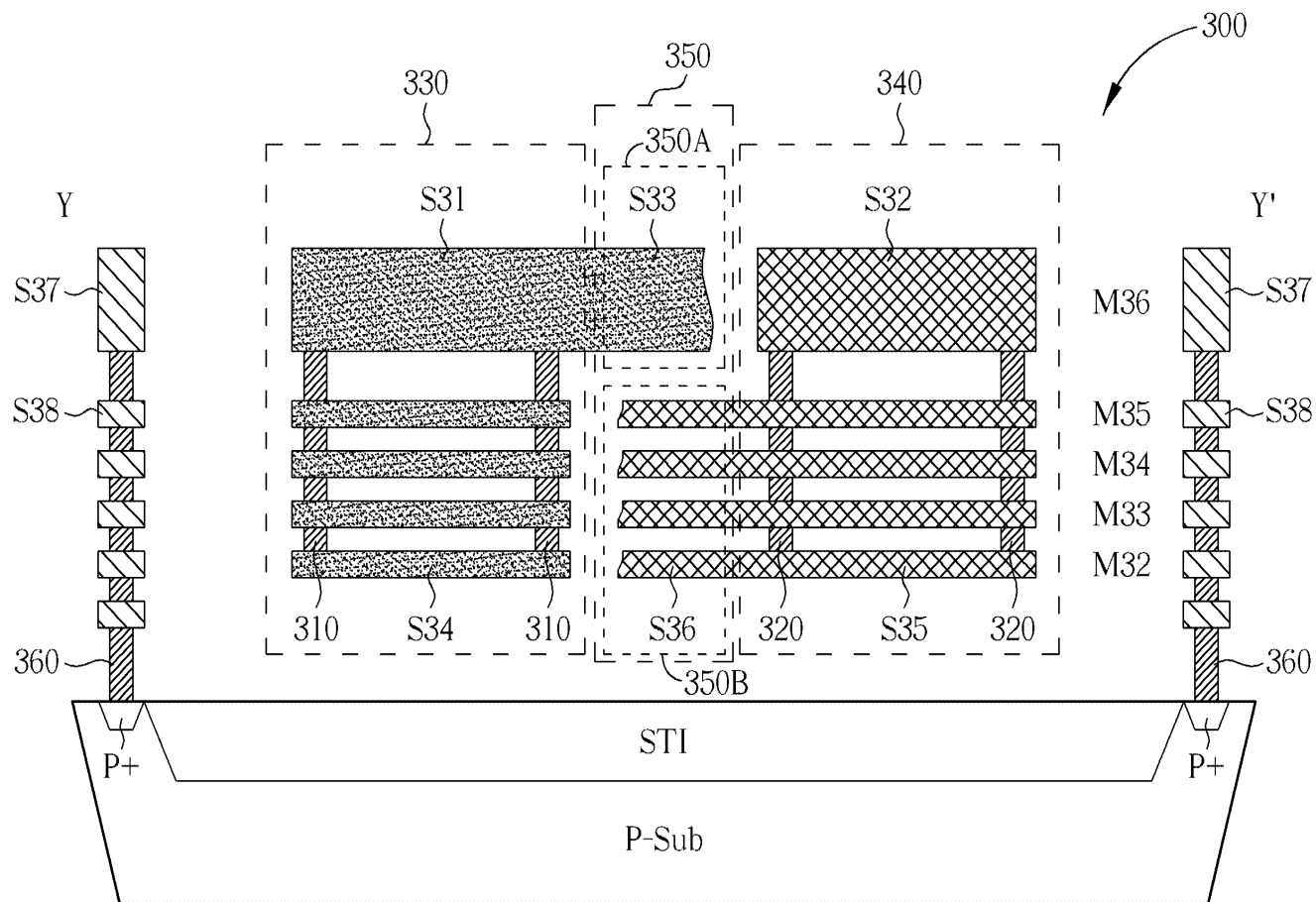


FIG. 3

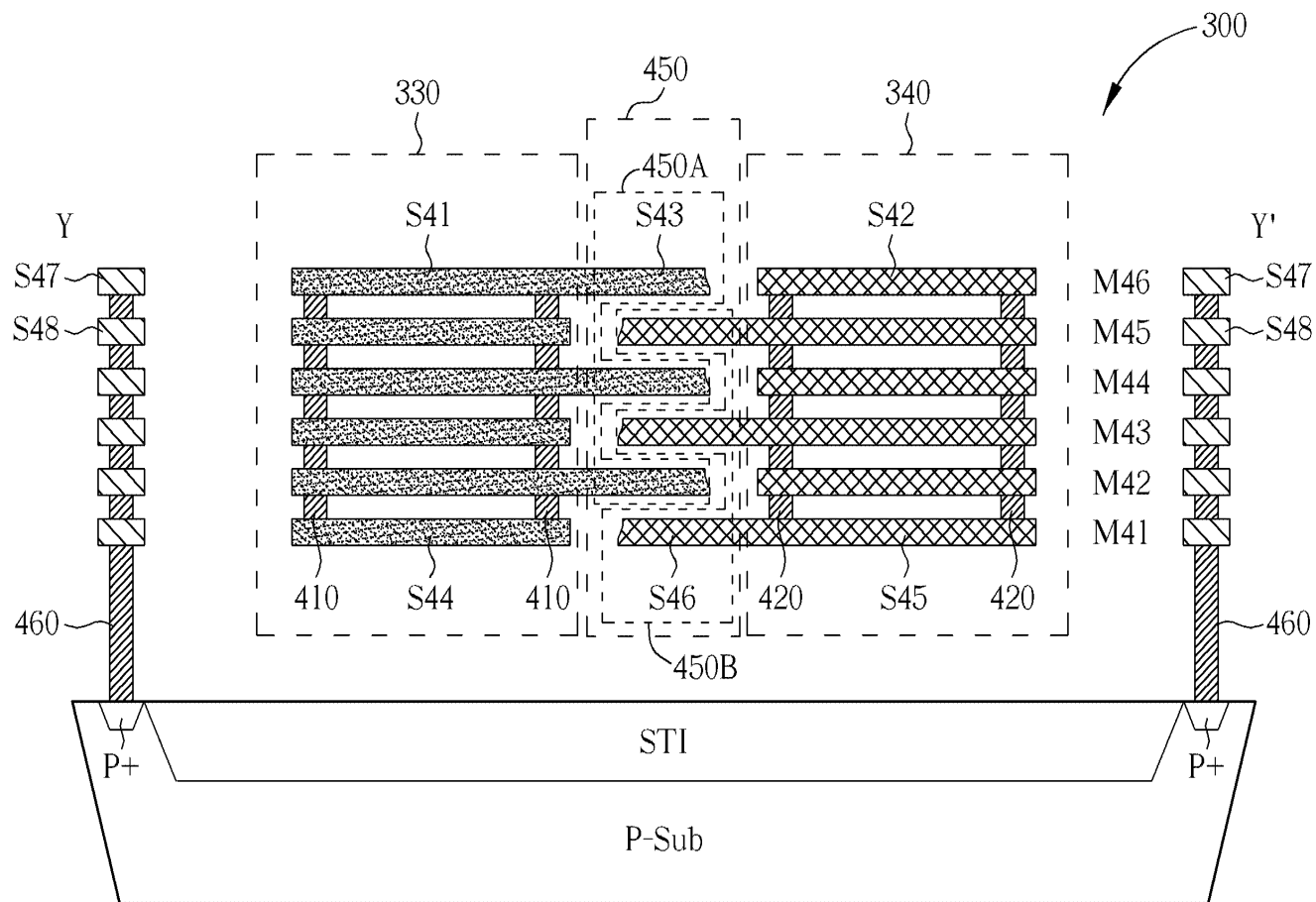


FIG. 4

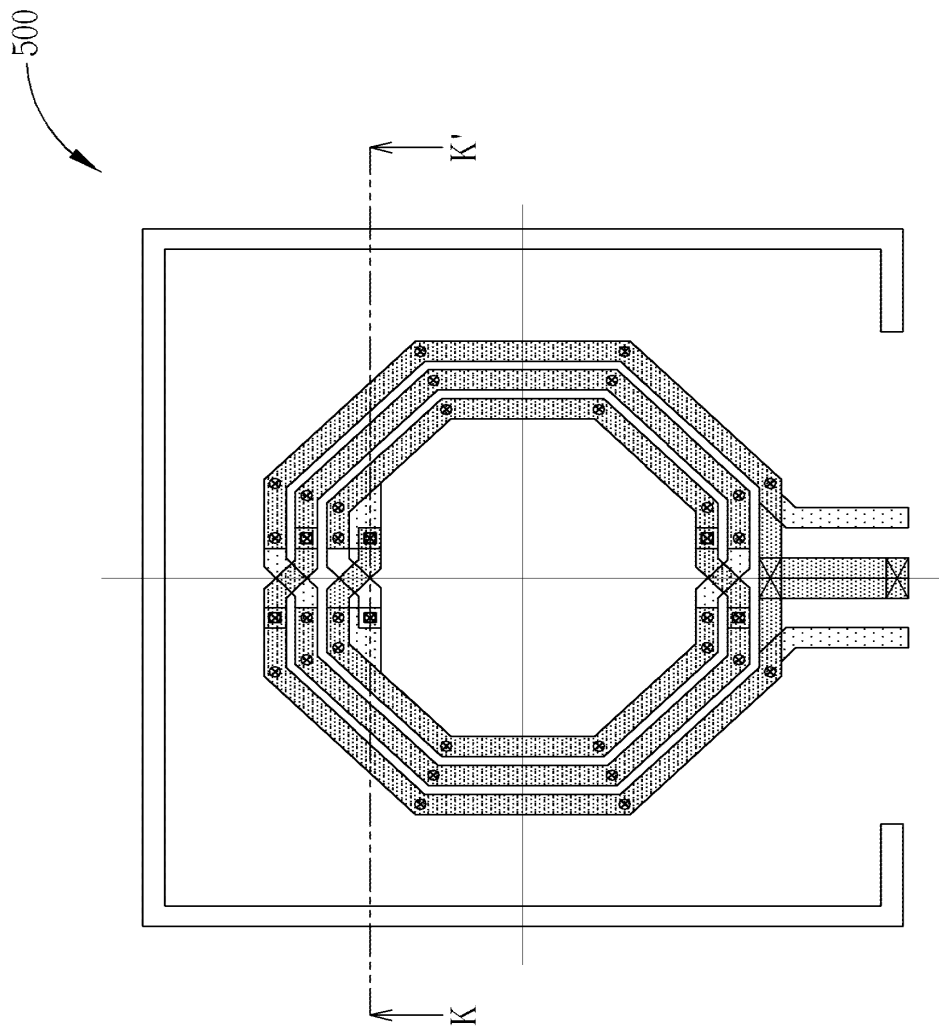


FIG. 5

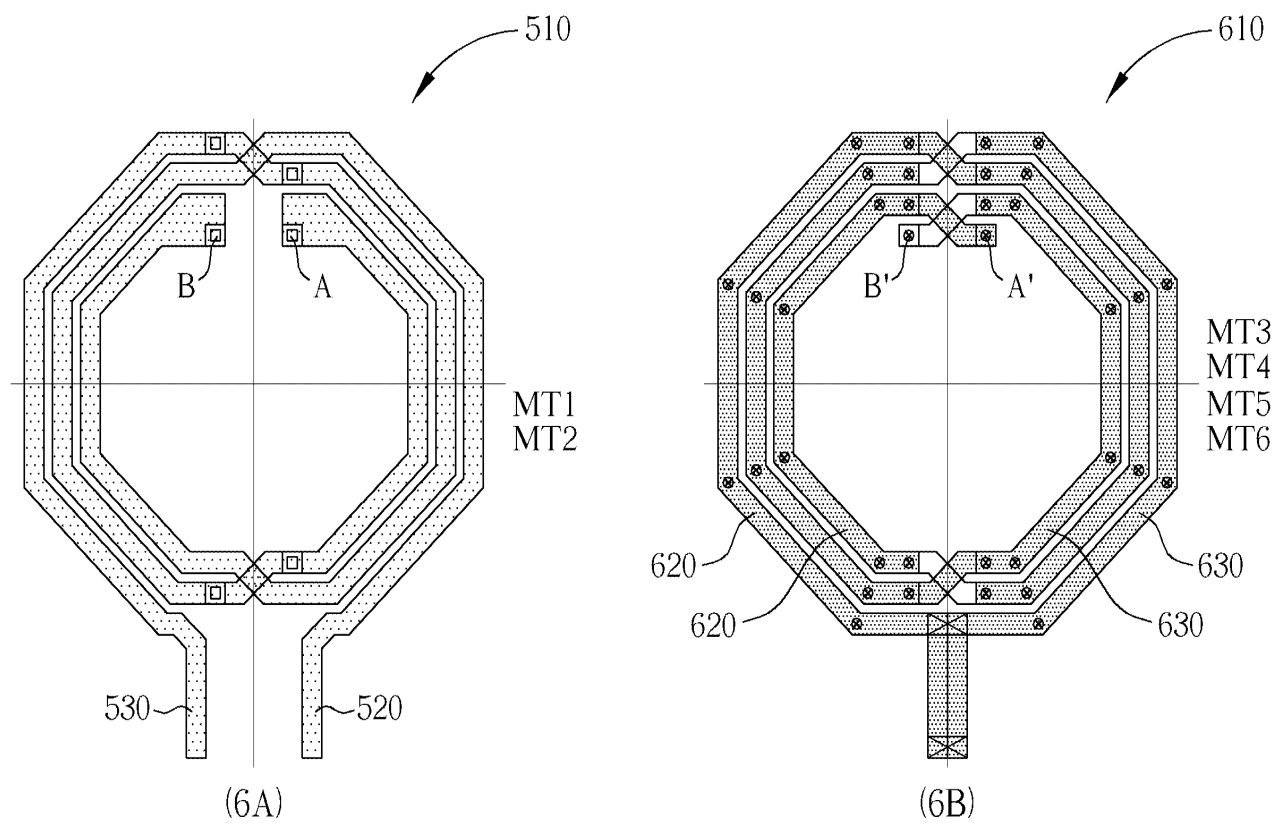


FIG. 6

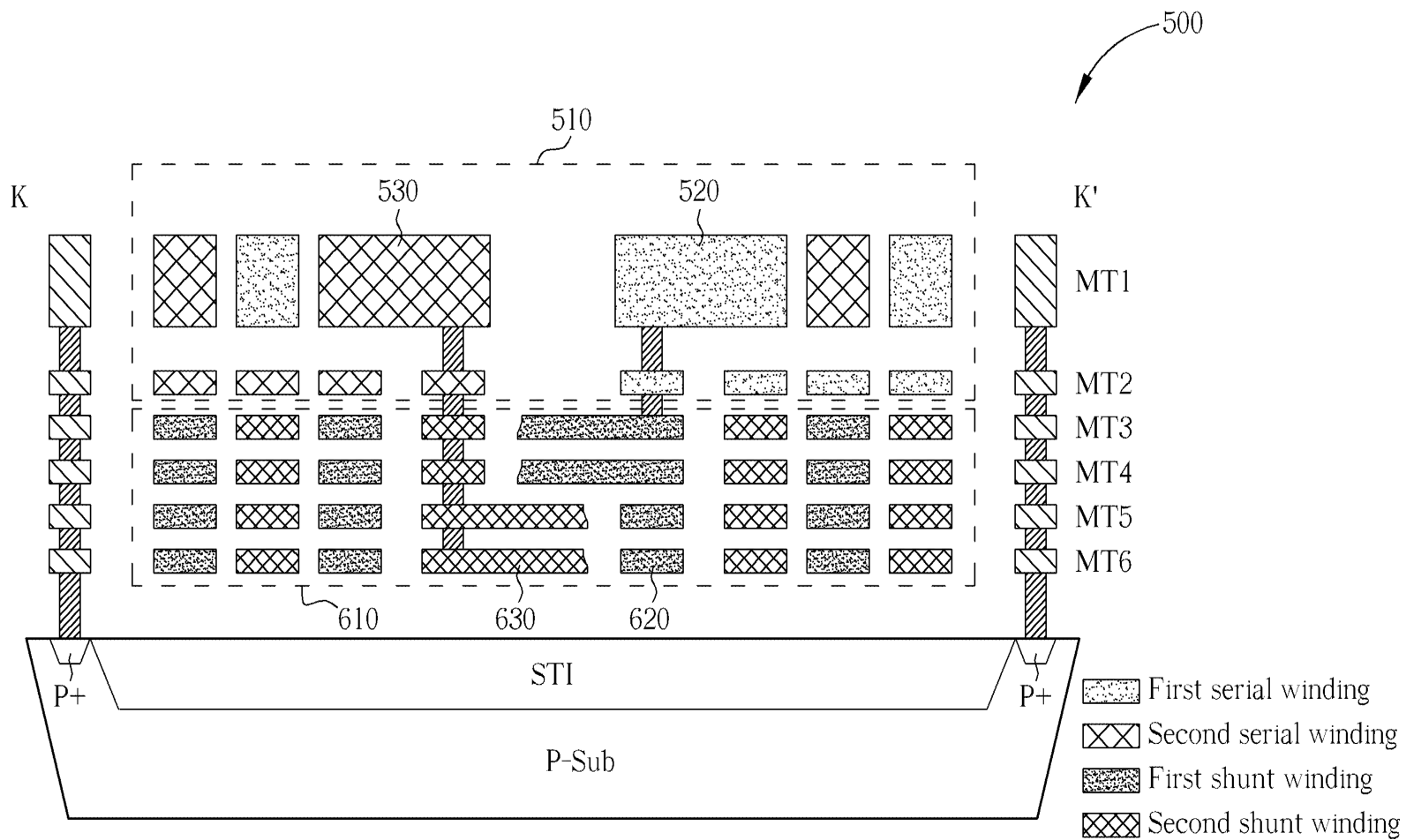


FIG. 7



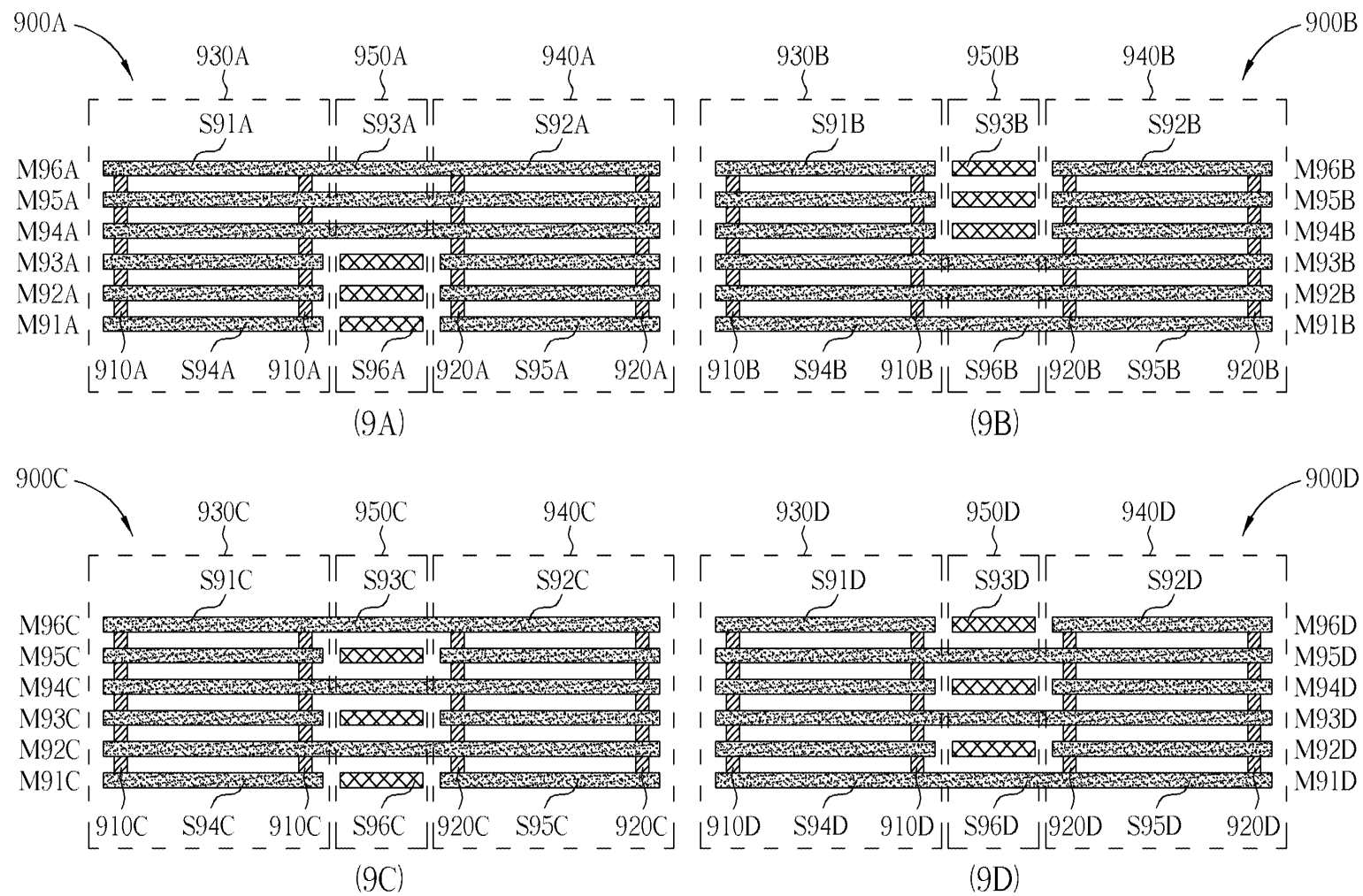


FIG. 9

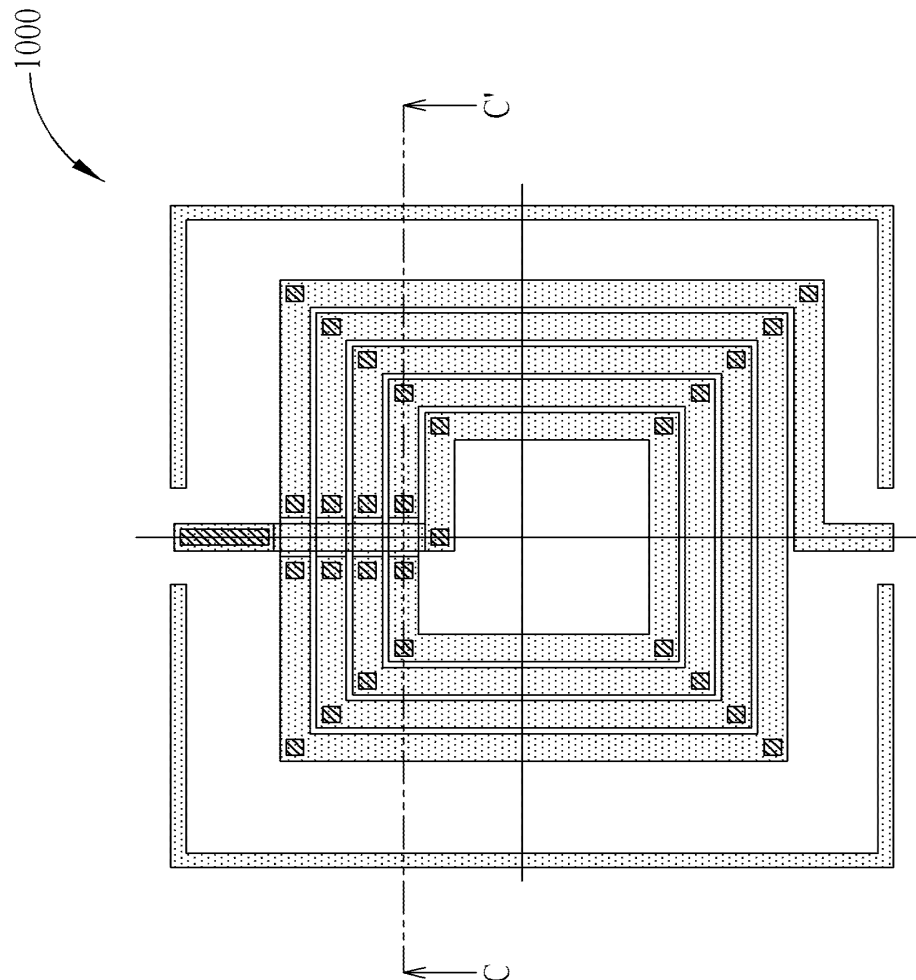
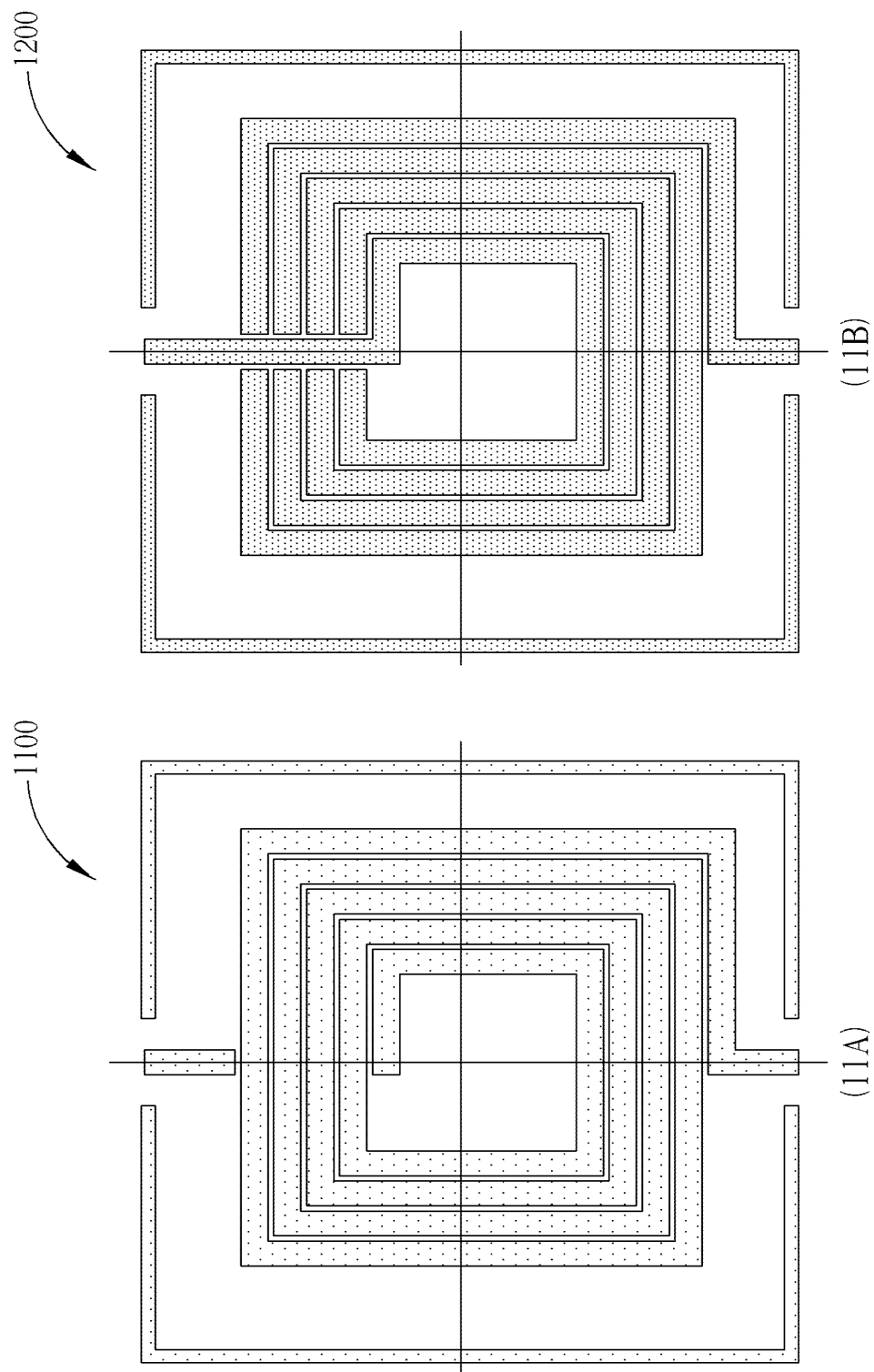


FIG. 10



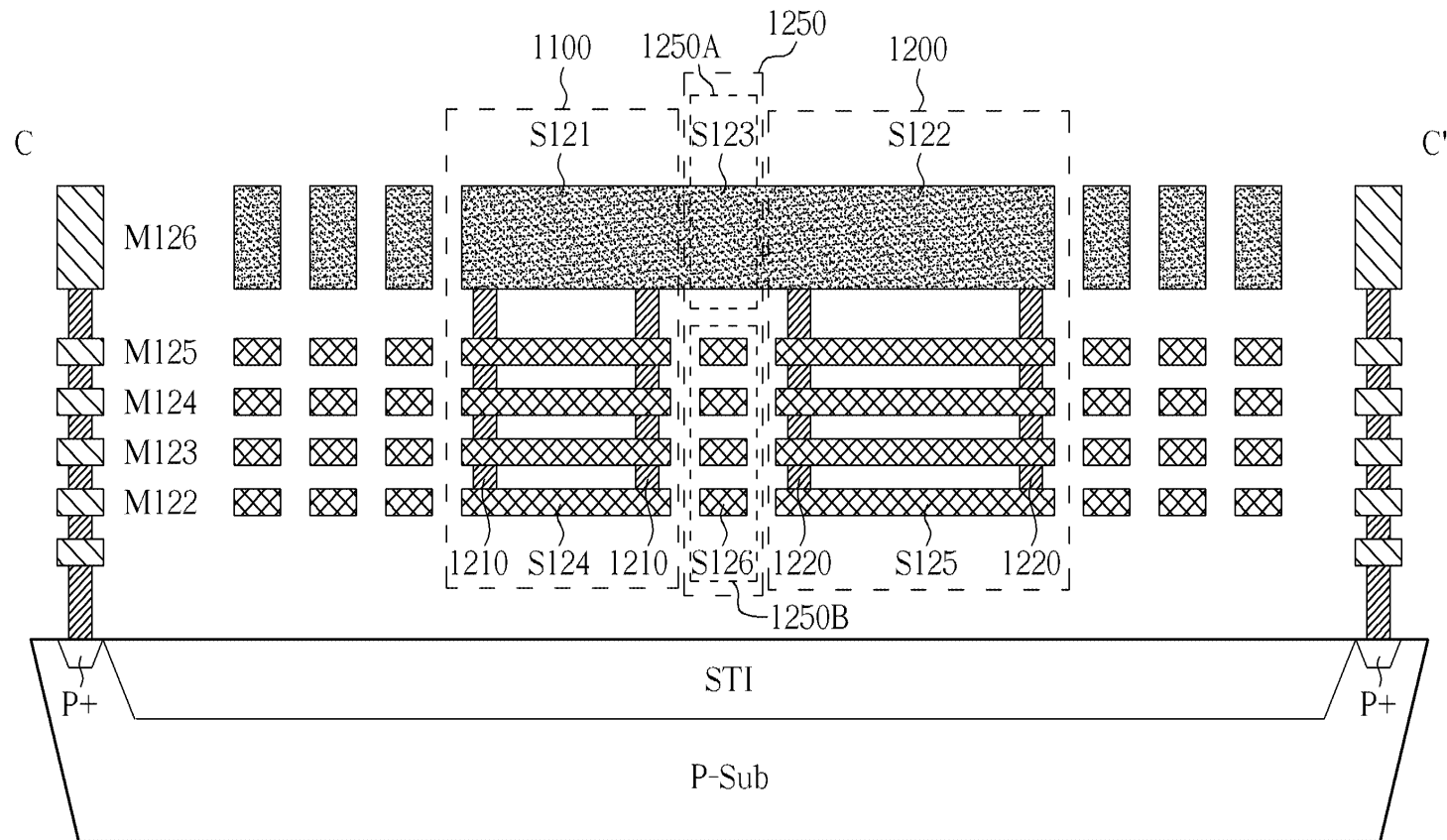


FIG. 12

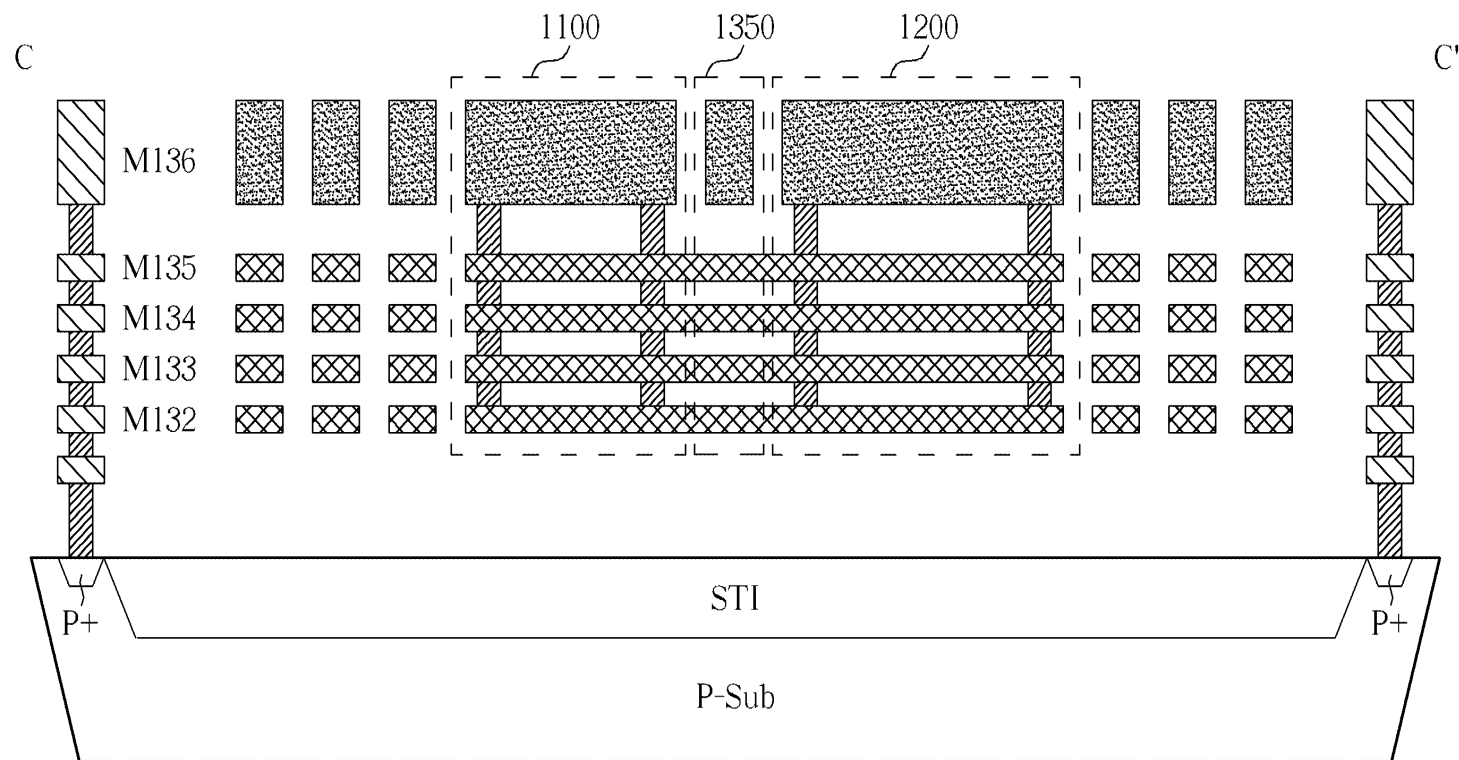


FIG. 13



Abstract of Disclosure

A stacked structure of a spiral inductor includes a first metal layer, a second metal layer, a first set of vias, and a second set of vias. The first metal layer includes a first segment, a second segment, and a third segment, wherein the layout direction of the third segment is different from the layout direction of the first and second segments. The second metal layer includes a fourth segment, a fifth segment, and a sixth segment connected to the fifth segment, wherein the layout direction of the sixth segment is different from the layout direction of the fourth and fifth segments. The first set of vias connects the first and fourth segments, and they construct a first shunt winding. The second set of vias connects the second and fifth segments, and they construct a second shunt winding. The third and sixth segments construct a crossover region.

Claims

What is claimed is:

1. A structure of a spiral inductor, comprising:
 - a first metal layer, comprising:
 - a first segment;
 - a second segment; and
 - a third segment, connected to the first segment, wherein a layout direction of the third segment is different from a layout direction of the first segment and a layout direction of the second segment;
 - a second metal layer, being positioned under the first metal layer, the second metal layer comprising:
 - a fourth segment;
 - a fifth segment; and
 - a sixth segment, connected to the fifth segment, wherein a layout direction of the sixth segment is different from a layout direction of the fourth segment and a layout direction of the fifth segment;
 - a first set of vias, for connecting the first segment with the fourth segment; and
 - a second set of vias, for connecting the second segment with the fifth segment;wherein the first segment, the fourth segment and the first set of vias construct a first shunt winding; the second segment, the fifth segment and the second set of vias construct a second shunt winding; and the third segment and the sixth segment construct a crossover region.
2. The structure of the spiral inductor of claim 1, wherein the third segment is positioned between the first segment and the second segment; and the sixth segment is positioned between the fourth segment and the fifth segment.
3. The structure of the spiral inductor of claim 1, wherein a first thickness of the first metal layer is greater than a second

thickness of the second metal layer.

4. The structure of the spiral inductor of claim 3, wherein the spiral inductor further comprises a third metal layer being positioned under the second metal layer, a structure of the third metal layer is the same as a structure of the second metal layer, and the first thickness of the first metal layer is greater than a third thickness of the third metal layer.
5. The structure of the spiral inductor of claim 1, wherein a first thickness of the first metal layer is equal to a second thickness of the second metal layer.
6. The structure of the spiral inductor of claim 1, wherein the spiral inductor further comprises:
 - a third metal layer, being positioned under the second metal layer, and a structure of the third metal layer is the same as a structure of the first metal layer; and
 - a fourth metal layer, being positioned under the third metal layer, and a structure of the fourth metal layer is the same as a structure of the second metal layer;wherein a seventh segment of the third metal layer, an eighth segment of the fourth metal layer, the third segment, and the sixth segment construct the crossover region; and the third segment, the sixth segment, the seventh segment, and the eighth segment construct an interdigitated crossover structure.
7. The structure of the spiral inductor of claim 1, wherein:
 - the first metal layer further comprises a first guard ring segment, disposed at the outer side of the first segment or the outer side of the second segment;
 - the second metal layer further comprises a second guard ring segment, disposed at the outer side of the fourth segment or the outer side of the fifth segment; and
 - the stacked structure further comprises a third set of vias, for

connecting the first guard ring segment with the second guard ring segment; wherein the first guard ring segment, the second guard ring segment, and the third set of vias construct a stacked guard ring.

8. The structure of the spiral inductor of claim 1, wherein the spiral inductor is a symmetric spiral inductor.
9. The structure of the spiral inductor of claim 1, wherein a shape of the first shunt winding and the second shunt winding is substantially a rectangle, an octagon, or a circle.
10. A structure of a spiral inductor, comprising:
 - a first metal layer, comprising:
 - a first segment;
 - a second segment; and
 - a third segment, being connected to the first segment and the second segment, and being positioned between the first segment and the second segment;
 - a second metal layer, comprising:
 - a fourth segment;
 - a fifth segment; and
 - a sixth segment, being positioned between the fourth segment and the fifth segment;
 - a first set of vias, for connecting the first segment with the fourth segment; and
 - a second set of vias, for connecting the second segment and the fifth segment;
 - wherein the first segment and the fourth segment construct a first shunt winding; the second segment and the fifth segment construct a second shunt winding; and the third segment and the sixth segment construct a crossover region.
11. The structure of the spiral inductor of claim 10, wherein the second metal layer is positioned above the first metal layer.

12. The structure of the spiral inductor of claim 10, wherein the first metal layer is positioned above the second metal layer.
13. The structure of the spiral inductor of claim 10, wherein a first thickness of the first metal layer is greater than a second thickness of the second metal layer.
14. The structure of the spiral inductor of claim 13, wherein the spiral inductor further comprises a third metal layer; a structure of the third metal layer is the same as a structure of the second metal layer; both the third metal layer and the second metal layer are positioned above or under the first metal layer; and the first thickness of the first metal layer is greater than a third thickness of the third metal layer.
15. The structure of the spiral inductor of claim 10, wherein a first thickness of the first metal layer is equal to a second thickness of the second metal layer.
16. The structure of the spiral inductor of claim 10, wherein the spiral inductor further comprises:
a third metal layer, and a structure of the third metal layer is the same as a structure of the first metal layer; and
a fourth metal layer, and a structure of the fourth metal layer is the same as a structure of the second metal layer;
wherein a seventh segment of the third metal layer, an eighth segment of the fourth metal layer, the third segment, and the sixth segment construct the crossover region; and the third segment, the sixth segment, the seventh segment, and the eighth segment construct an interdigitated crossover structure.
17. The structure of the spiral inductor of claim 10, wherein the second metal layer is positioned under the first metal layer; the third metal layer is positioned under the second metal layer; and

the fourth metal layer is positioned under the third metal layer.

18. The structure of the spiral inductor of claim 16, wherein the first metal layer is positioned under the second metal layer; the fourth metal layer is positioned under the first metal layer; and the third metal layer is positioned under the fourth metal layer.
19. The structure of the spiral inductor of claim 10, wherein:
the first metal layer further comprises a first guard ring segment,
disposed at the outer side of the first segment or the outer side of the second segment;
the second metal layer further comprises a second guard ring segment, disposed at the outer side of the fourth segment or the outer side of the fifth segment; and
the stacked structure further comprises a third set of vias, for connecting the first guard ring segment with the second guard ring segment; wherein the first guard ring segment, the second guard ring segment, and the third set of vias construct a stacked guard ring.
20. The structure of the spiral inductor of claim 10, wherein the spiral inductor is a non-symmetric spiral inductor.

Title

STACKED STRUCTURE OF A SPIRAL INDUCTOR

Background of the Invention

1. Field of the Invention

[0001] The present invention relates to a stacked structure of a spiral inductor, and more particularly, to a stacked structure for improving quality factor by making use of metal layers of a crossover region as shunt windings.

2. Description of the Prior Art

[0002] As IC manufacturing processes are developing with a trend for system on chip (SOC) design, passive elements such as integrated inductors or integrated transformers have been widely integrated in high-frequency integrated circuits. Since IC manufacturing processes usually adopt a structure with Silicon-based substrates, substrate loss and metal loss of the integrated inductors/integrated transformers will affect their quality factor. And more particularly, metal loss is the main cause that most immediately affects the inductor properties.

[0003] Recently common integrated inductors consist of symmetric inductors and non-symmetric inductors. Most of them adopt the top metal layer (or the top two metal layers) as a winding of the inductor, and use the next metal layer as well as vias as a crossover region. Such inductor has the following disadvantages, that is: its parasitic resistor will be restricted by the single metal layer, a conductivity of the crossover region, a number of the vias, and the resistance of the vias. In order to improve the quality factor of the inductor, increasing widths of the winding is required. However, this approach will occupy more chip area. Hence, a structure with multiple metal layers in parallel is proposed, such as in the US patent with patent No. 2008/0074229 and the US patent with patent No. 6,664,882 proposed in the prior art, such that the inductor can have a lower series resistance than a traditional single-layer inductor so as to improve

its quality factor. However, no matter the structure with a single metal layer or the structure with multiple metal layers in parallel are concerned, the metal layers of their crossover regions of the inductor are different from the metal layers of the windings. For this reason, the quality factor of the inductor cannot be optimized.

Summary of the Invention

[0004] It is one of the objectives of the present invention to provide a stacked structure of a spiral inductor to solve the abovementioned problems.

[0005] According to an embodiment of the present invention, a stacked structure of a spiral inductor is provided. The stacked structure of the spiral inductor includes a first metal layer, a second metal layer, a first set of vias, and a second set of vias. The first metal layer includes a first segment, a second segment, and a third segment being connected to the first segment, wherein a layout direction of the third segment is different from a layout direction of the first segment and a layout direction of the second segment. The second metal layer is positioned under the first metal layer. The second metal layer includes a fourth segment, a fifth segment, and a sixth segment being connected to the fifth segment, wherein a layout direction of the sixth segment is different from a layout direction of the fourth segment and a layout direction of the fifth segment. The first set of vias connects the first segment with the fourth segment. The second set of vias connects the second segment with the fifth segment. Herein the first segment, the fourth segment, and the first set of vias construct a first shunt winding; the second segment, the fifth segment, and the second set of vias construct a second shunt winding; and the third segment and the sixth segment construct a crossover region. The spiral inductor may be a symmetric spiral inductor.

[0006] According to another embodiment of the present invention, a stacked structure of a spiral inductor is provided. The stacked structure of the spiral inductor includes a first metal layer, a second

metal layer, a first set of vias, and a second set of vias. The first metal layer includes a first segment, a second segment, and a third segment, wherein the third segment is connected to the first segment and the second segment, and is positioned between the first segment and the second segment. The second metal layer includes a fourth segment, a fifth segment, and a sixth segment, wherein the sixth segment is positioned between the fourth segment and the fifth segment. The first set of vias connects the first segment with the fourth segment. The second set of vias connects the second segment and the fifth segment. Herein the first segment and the fourth segment construct a first shunt winding; the second segment and the fifth segment construct a second shunt winding; and the third segment and the sixth segment construct a crossover region. The spiral inductor may be a non-symmetric spiral inductor.

[0007] These and other objectives of the present invention will no doubt become obvious to those of ordinary skill in the art after reading the following detailed description of the preferred embodiment that is illustrated in the various figures and drawings.

Brief Description of the Drawings

[0008] FIG.1 (including 1A and 1B) is a diagram of stacked structures of a spiral inductor according to an embodiment of the present invention.

[0009] FIG.2 is a top view diagram showing an exemplary embodiment of a symmetric spiral inductor.

[0010] FIG.3 is a longitudinal section view of the symmetric spiral inductor shown in FIG.2 adopting the first stacked structure of 1A.

[0011] FIG.4 is a longitudinal section view of the symmetric spiral inductor shown in FIG.2 adopting the second stacked structure of 1B.

[0012] FIG.5 is a top view diagram showing an exemplary embodiment of a symmetric spiral inductor combining a serial winding with a shunt

winding.

[0013] FIG.6 (including 6A and 6B) is a diagram illustrating the serial winding and the shunt winding of the symmetric spiral inductor shown in FIG.5.

[0014] FIG.7 is a transverse section view of the symmetric spiral inductor shown in FIG.5 adopting the first stacked structure of 1A.

[0015] FIG.8 is a transverse section view of the symmetric spiral inductor shown in FIG.5 adopting the second stacked structure of 1B.

[0016] FIG.9 (including 9A, 9B, 9C and 9D) is a diagram of stacked structures of a spiral inductor according to another embodiment of the present invention.

[0017] FIG.10 is a top view diagram showing an exemplary embodiment of a non-symmetric spiral inductor.

[0018] FIG.11 (including 11A and 11B) is a diagram illustrating the first shunt winding and the second shunt winding of the non-symmetric spiral inductor shown in FIG.10.

[0019] FIG.12 is a transverse section view of the non-symmetric spiral inductor shown in FIG.10 adopting the first stacked structure of 9A.

[0020] FIG.13 is a transverse section view of the non-symmetric spiral inductor shown in FIG.10 adopting the second stacked structure of 9B.

[0021] FIG.14 is a transverse section view of the non-symmetric spiral inductor shown in FIG.10 adopting the third stacked structure of 9C.

Detailed Description

[0022] In the following embodiment, three kinds of stacked structures

of spiral inductors with multiple stacked metal layers are provided in the light of symmetric spiral inductors (as is referenced by the embodiments shown in FIG.1~FIG.8) and non-symmetric spiral inductors (as is referenced by the embodiments shown in FIG.9~FIG.14). These stacked structures are mainly divided into an L-shape crossover structure, an interdigitated crossover structure, and a trench-shape crossover structure, such that the spiral inductor with multiple stacked metal layers can obtain an optimum quality factor. Herein the terms like "the L-shape crossover structure", "the interdigitated crossover structure", and "the trench-shape crossover structure" defined in the present invention are used for distinguishing names only. What's more, a stacked guard ring is proposed in the present invention in order to improve the noise-blocking ability.

[0023] Please refer to FIG.1. FIG.1 (including 1A and 1B) is a diagram of stacked structures of a spiral inductor according to an embodiment of the present invention. Herein 1A represents an L-shape crossover structure, and 1B represents an interdigitated crossover structure. In this embodiment, both of the L-shape crossover structure shown in 1A and the interdigitated crossover structure shown in 1B are applied to a symmetric spiral inductor. As shown in 1A, the stacked structure of a spiral inductor 100 consists of six metal layers M16~M11, a first set of vias 110, and a second set of vias 120. The metal layers M16~M14 respectively have segments S11, S12, and S13, wherein the segment S13 is connected to the segment S11 and is positioned between the segment S11 and the segment S12. The metal layers M13~M11 are positioned under the metal layers M16~M14. The metal layers M13~M11 respectively have segments S14, S15, and S16, wherein the segment S16 is connected to the segment S15 and is positioned between the segment S14 and the segment S15. Moreover, the first set of vias 110 connects the segment S11 with the segment S14, while the second set of vias 120 connects the segment S12 with the segment S15. Be noted that in this embodiment, the segment S11 of the metal layers M16~M14, the segment S14 of the metal layers M13~M11, together with

the first set of vias 110 construct a first shunt winding 130 of the spiral inductor 100; the segment S12 of the metal layers M16~M14, the segment S15 of the metal layers M13~M11, together with the second set of vias 120 construct a second shunt winding 140 of the spiral inductor 100; and the segment S13 of the metal layers M16~M14 together with the segment S16 of the metal layers M13~M11 construct a crossover region 150.

[0024] As shown in 1B, the stacked structure of a spiral inductor 200 consists of six metal layers M26~M21, a first set of vias 210, and a second set of vias 220. The metal layers M26, M24, and M22 respectively have segments S21, S22, and S23, wherein the segment S23 is connected to the segment S21 and is positioned between the segment S21 and the segment S22. The metal layers M25, M23, and M21 respectively have segments S24, S25, and S26, wherein the segment S26 is connected to the segment S25 and is positioned between the segment S24 and the segment S25. Moreover, the first set of vias 210 connects the segment S21 with the segment S24, while the second set of vias 220 connects the segment S22 with the segment S25. Be noted that in this embodiment, the segment S21 of the metal layers M26, M24, and M22, the segment S24 of the metal layers M25, M23, and M21, together with the first set of vias 210 construct a first shunt winding 230 of the spiral inductor 200; the segment S22 of the metal layers M26, M24, and M22, the segment S25 of the metal layers M25, M23, and M21, together with the second set of vias 220 construct a second shunt winding 240 of the spiral inductor 200; and the segment S23 of the metal layers M26, M24, and M22 together with the segment S26 of the metal layers M25, M23, and M21 construct a crossover region 250.

[0025] Please note that in the abovementioned embodiment, six metal layers are cited as an example for illustration. However, this is not meant to be limitations of the scope of the present invention, and the number of the metal layers is not limited.

[0026] Please refer to FIG.2, FIG.3, together with FIG.4. FIG.2 is

a top view diagram showing an exemplary embodiment of a symmetric spiral inductor 300; FIG.3 is a longitudinal section view of the symmetric spiral inductor 300 shown in FIG.2 adopting the first stacked structure of 1A; and FIG.4 is a longitudinal section view of the symmetric spiral inductor 300 shown in FIG.2 adopting the second stacked structure of 1B. From FIG.2, we can see that the symmetric spiral inductor 300 consists of a first shunt winding 330 and a second shunt winding 340, and an area marked with A1 represents a crossover region. In addition, FIG.3 shows a longitudinal section view of the symmetric spiral inductor 300 along the dotted line YY' shown in FIG.2, which adopts the first stacked structure of 1A. As FIG.3 depicts, the stacked structure of the symmetric inductor 300 includes five metal layers M36~M32, a first set of vias 310, and a second set of vias 320. Be noted that in this embodiment, a segment S31 of the metal layer M36, a segment S34 of the metal layers M35~M32, together with the first set of vias 310 construct the first shunt winding 330 of the symmetric spiral inductor 300; a segment S32 of the metal layer M36, a segment S35 of the metal layers M35~M32, together with the second set of vias 320 construct the second shunt winding 340 of the spiral inductor 300; and a segment S33 of the metal layer M36 together with a segment S36 of the metal layers M35~M32 construct a crossover region 350 (including a first portion 350A and a second portion 350B). As can be known from FIG.2 and FIG.3, a layout direction of the segment S33 (used for constructing the first portion 350A of the crossover region 350) is different from a layout direction of the segment S31 and a layout direction of the segment S32; and a layout direction of the segment S36 (used for constructing the second portion 350B of the crossover region 350) is different from a layout direction of the segment S34 and a layout direction of the segment S35 as well.

[0027] What is more, the metal layer M36 further includes a first guard ring segment S37 disposed at the outer side of the segment S31 and/or the outer side of the segment S32; the metal layers M35~M32 further includes a second guard ring segment S38 disposed at the outer side of the segment S34 and/or the outer side of the segment S35; and the

stacked structure further includes a third set of vias 360 for connecting the first guard ring segment S37 with the second guard ring segment S38. Herein the first guard ring segment S37, the second guard ring segment S38, together with the third set of vias 360 construct a stacked guard ring, such that noise-blocking ability can be improved.

[0028] Please note that in this embodiment, since a thickness of the metal layer M36 is greater than a thickness of the metal layers M35 ~ M32, the first portion 350A of the crossover region 350 is implemented by adopting a single metal layer (namely, the segment S33 of the metal layer M36), and the second portion 350B of the crossover region 350 is implemented by adopting multiple stacked metal layers (namely, the segment S36 of the metal layers M35 ~ M32). Furthermore, all of the metal layers M35 ~ M32 are positioned under the metal layer M36 with a view to the inductor symmetry.

[0029] FIG.4 shows a longitudinal section view of the symmetric spiral inductor 300 along the dotted line YY' shown in FIG.2, which adopts the second stacked structure of 1B. As FIG.4 depicts, the stacked structure of the symmetric inductor 300 includes six metal layers M46 ~ M41, a first set of vias 410, and a second set of vias 420. Be noted that in this embodiment, a segment S41 of the metal layers M46, M44, and M42, a segment S44 of the metal layers M45, M43, and M41, together with the first set of vias 410 construct the first shunt winding 330 of the symmetric spiral inductor 300; a segment S42 of the metal layers M46, M44, and M42, a segment S45 of the metal layers M45, M43, and M41, together with the second set of vias 420 construct the second shunt winding 340 of the spiral inductor 300; and a segment S43 of the metal layers M46, M44, and M42 together with a segment S46 of the metal layers M45, M43, and M41 construct a crossover region 450 (including a first portion 450A and a second portion 450B). As can be known from FIG.2 and FIG.4, a layout direction of the segment S43 (used for constructing the first portion 450A of the crossover region 450) is different from a layout direction of the segment S41

and a layout direction of the segment S42; and a layout direction of the segment S46 (used for constructing the second portion 450B of the crossover region 450) is different from a layout direction of the segment S44 and a layout direction of the segment S45 as well.

[0030] What's more, the metal layers M46, M44, and M42 further include a first guard ring segment S47 disposed at the outer side of the segment S41 and/or the outer side of the segment S42; the metal layers M45, M43, and M41 further include a second guard ring segment S48 disposed at the outer side of the segment S44 and/or the outer side of the segment S45; and the stacked structure further includes a third set of vias 460 for connecting the first guard ring segment S47 with the second guard ring segment S48. Herein the first guard ring segment S47, the second guard ring segment S48, together with the third set of vias 460 construct a stacked guard ring, such that noise-blocking ability can be improved.

[0031] Please note that in this embodiment, since a thickness of the metal layer M46/M44/M42 is equal to a thickness of the metal layer M45/M43/M41, the first portion 450A of the crossover region 450 is implemented by adopting multiple stacked metal layers (namely, the segment S43 of the metal layers M46, M44, and M42), and the second portion 450B of the crossover region 450 is implemented by adopting multiple stacked metal layers (namely, the segment S46 of the metal layers M45, M43, and M41) as well. Furthermore, the metal layers M46, M44, and M42 and the metal layers M45, M43, and M41 are interlaced with a view to the inductor symmetry.

[0032] From what has been discussed in FIG.3 and FIG.4 above, we can see that the layout manner of the spiral inductor disclosed in the present invention can increase the inductor symmetry by reference to the thickness of the metal layers. As an illustration, if the thickness of the metal layers within the integrated circuit are different from each other, the "L-shape crossover structure" (i.e., the crossover structure shown in 1A of FIG.1 or FIG.3) can be adopted

in layout with a view to an optimum inductor symmetry. In addition, if the thickness of each metal layer within the integrated circuit are identical to each other, the "interdigitated crossover structure" (i.e., the crossover structure shown in 1B of FIG.1 or FIG.4) can be adopted in layout with a view to an optimum inductor symmetry.

[0033] As can be known from the embodiments above, the stacked structure of the spiral inductor disclosed in the present invention is capable of optimizing a quality factor of the inductor by making use of metal layers of the crossover region as shunt windings. As a result, parasitic resistors of the spiral inductor won't be restricted by a conductivity of the crossover region, a number of the vias, and resistance of the vias.

[0034] Please refer to FIG.5 together with FIG.6. FIG.5 is a top view diagram showing an exemplary embodiment of a symmetric spiral inductor 500 combining a serial winding with a shunt winding, and FIG.6 (including 6A and 6B) is a diagram illustrating a first inductor 510 (as is shown in 6A) and a second inductor 610 (as is shown in 6B) of the symmetric spiral inductor 500 shown in FIG.5. The symmetric spiral inductor 500 is a multi-layer stacked spiral inductor combining the first inductor 510 (i.e., the serial winding) with the second inductor 610 (i.e., the shunt winding), such that the series inductance under the same area can be increased in order to improve the usage of chip area. As shown in 6A, the first inductor 510 may be a traditional single-layer symmetric inductor, which adopts a metal layer MT1 as the winding and adopts another metal layer MT2 as the crossover region. Herein the center taps of the first inductor 510 are used as the joints A and B of the first serial winding 520 and the second serial winding 530, and the joints A and B can be disconnected so as to connect with the center taps of the second inductor 610 (namely, the joints A' and B' of the first shunt winding 620 and the second shunt winding 630). On the other hand, the second inductor 610 shown in 6B can be implemented by adopting the first stacked structure of 1A (i.e., the L-shape crossover structure) or

the second stacked structure of 1B (i.e., the interdigitated crossover structure). The second inductor 610 uses metal layers MT13, MT4, MT5, and MT6 as the winding and the crossover region, wherein the metal layers MT1, MT2, MT3, MT4, MT5, and MT6 are parallel to each other from top to bottom.

[0035] Please refer to FIG.7. FIG.7 is a transverse section view of the symmetric spiral inductor 500 shown in FIG.5 along the dotted line KK', which is implemented by adopting the first stacked structure of 1A. As FIG.7 depicts, the symmetric spiral inductor 500 consists of the first inductor 510 and the second inductor 610. In this embodiment, the first inductor 510 adopts the metal layer MT1 as the windings (including the first serial winding 520 and the second serial winding 530), and adopts the metal layer MT2 as the crossover region. The second inductor 610 is implemented by adopting the L-shape crossover structure shown in 1A of FIG.1, wherein the metal layers MT3 and MT4 can correspond to the metal layers M16~M14 shown in 1A of FIG.1, and the metal layers MT5 and MT6 can correspond to the metal layers M13~M11 shown in 1A of FIG.1.

[0036] Please refer to FIG.8. FIG.8 is a transverse section view of the symmetric spiral inductor 500 shown in FIG.5 along the dotted line KK', which is implemented by adopting the second stacked structure of 1B. As FIG.8 depicts, the symmetric spiral inductor 500 consists of the first inductor 510 and the second inductor 610. In this embodiment, the second inductor 610 is implemented by adopting the interdigitated crossover structure shown in 1B of FIG.1, wherein the metal layers MT3 and MT5 can correspond to the metal layers M26, M24, and M22 shown in 1B of FIG.1, and the metal layers MT4 and MT6 can correspond to the metal layers M25, M23, and M21 shown in 1B of FIG.1.

[0037] Please refer to FIG.9. FIG.9 (including 9A, 9B, 9C and 9D) is a diagram of stacked structures of a spiral inductor according to another embodiment of the present invention. Herein 9A and 9B

represent a trench-shape crossover structure, 9C and 9D represent an interdigitated crossover structure. In this embodiment, all of the crossover structures shown in 9A, 9B, 9C, and 9D are applied to a non-symmetric spiral inductor. As shown in 9A, the first stacked structure of a spiral inductor 900A consists of six metal layers M96A~M91A, a first set of vias 910A, and a second set of vias 920A. The metal layers M96A~M94A respectively have segments S91A, S92A, and S93A, wherein the segment S93A is connected to the segment S91A and the segment S92A and is positioned between the segment S91A and the segment S92A. The metal layers M93A~M91A respectively have segments S94A, S95A, and S96A, wherein the segment S96A is positioned between the segment S94A and the segment S95A. Moreover, the first set of vias 910A connects the segment S91A and the segment S94A, while the second set of vias 920A connects the segment S92A and the segment S95A. Be noted that the segment S91A of the metal layers M96A~M94A, the segment S94A of the metal layers M93A~M91A, together with the first set of vias 910A construct a first shunt winding 930A of the spiral inductor 900A; the segment S92A of the metal layers M96A~M94A, the segment S95A of the metal layers M93A~M91A, together with the second set of vias 920A construct a second shunt winding 940A of the spiral inductor 900A; and the segment S93A together with the segment S96A construct a crossover region 950A. In addition, the second stacked structure of the spiral inductor 900B shown in 9B is similar to the first stacked structure of the spiral inductor 900A shown in 9A, and the difference between them is that the second stacked structure of the spiral inductor 900B is the inverse of the first stacked structure of the spiral inductor 900A. In other words, the metal layers M96A~M94A are positioned above the metal layers M93A~M91A in 9A, while the metal layers M93B~M91B are positioned under the metal layers M96B~M94B in 9B.

[0038] As shown in 9C, the third stacked structure of a spiral inductor 900C consists of six metal layers M96C~M91C, a first set of vias 910C, and a second set of vias 920C. The metal layers M96C, M94C, and M92C

respectively have segments S91C, S92C, and S93C, wherein the segment S93C is connected to the segment S91C and the segment S92C and is positioned between the segment S91C and the segment S92C. The metal layers M95C, M93C, and M91C respectively have segments S94C, S95C, and S96C, wherein the segment S96C is positioned between the segment S94C and the segment S95C. Moreover, the first set of vias 910C connects the segment S91C and the segment S94C, while the second set of vias 920C connects the segment S92C and the segment S95C. Be noted that the segment S91C of the metal layers M96C, M94C, and M92C, the segment S94C of the metal layers M95C, M93C, and m91C, together with the first set of vias 910C construct a first shunt winding 930C of the spiral inductor 900C; the segment S92C of the metal layers M96C, M94C, and M92C, the segment S95C of the metal layers M95C, M93C, and M91C, together with the second set of vias 920C construct a second shunt winding 940C of the spiral inductor 900C; and the segment S93C of the metal layers M96C, M94C, and M92C together with the segment S96C of the metal layers M95C, M93C, and M91C construct a crossover region 950C. In addition, the fourth stacked structure of the spiral inductor 900D shown in 9D is similar to the third stacked structure of the spiral inductor 900C shown in 9C, and the difference between them is that the fourth stacked structure of the spiral inductor 900D is the inverse of the third stacked structure of the spiral inductor 900C.

[0039] Please refer to FIG.10 together with FIG.11. FIG.10 is a top view diagram showing an exemplary embodiment of a non-symmetric spiral inductor 1000, and FIG.11 (including 11A and 11B) is a diagram illustrating the first shunt winding 1100 (as is shown in 11A) and the second shunt winding 1200 (as is shown in 11B) of the non-symmetric spiral inductor 1000 shown in FIG.10.

[0040] Please refer to FIG.12. FIG.12 is a transverse section view of the non-symmetric spiral inductor 1000 shown in FIG.10 along the dotted line CC', which is implemented by adopting the first stacked structure of 9A. As FIG.12 depicts, the stacked structure of the

non-symmetric spiral inductor 1000 consists of five metal layers M126 ~M122, a first set of vias 1210, and a second set of vias 1220. In this embodiment, a segment S121 of the metal layer M126, a segment S124 of the metal layers M125~M122, together with the first set of vias 1210 construct a first shunt winding 1100 of the spiral inductor 1000; a segment S122 of the metal layer M126, a segment S125 of the metal layers M125~M122, together with the second set of vias 1220 construct a second shunt winding 1200; and a segment S123 of the metal layer M126 together with a segment S126 of the metal layers M125 ~M122 construct a crossover region 1250 (including a first portion 1250A and a second portion 1250B).

[0041] Please note that in this embodiment, since a thickness of the metal layer M126 is greater than a thickness of the metal layers M125 ~M122, the first portion 1250A of the crossover region 1250 is implemented by adopting a single metal layer (namely, the segment S123 of the metal layer M126), and the second portion 1250B of the crossover region 1250 is implemented by adopting multiple stacked metal layers (namely, the segment S126 of the metal layers M125~M122). Furthermore, all of the metal layers M125~M122 are positioned under the metal layer M126 with a view to the inductor symmetry.

[0042] Please refer to FIG.13. FIG.13 is a transverse section view of the non-symmetric spiral inductor 1000 shown in FIG.10 along the dotted line CC', which is implemented by adopting the second stacked structure of 9B. The stacked structure shown in FIG.13 is similar to that shown in FIG.12, and the difference between them is that the stacked structure shown in FIG.13 is the inverse of the stacked structure shown in FIG.12.

[0043] Please refer to FIG.14. FIG.14 is a transverse section view of the non-symmetric spiral inductor 1000 shown in FIG.10 along the dotted line CC', which is implemented by adopting the third stacked structure of 9C. As FIG.14 depicts, the stacked structure of the

non-symmetric spiral inductor 1000 consists of six metal layers M146 ~M141, a first set of vias 1410, and a second set of vias 1420. In this embodiment, a segment S141 of the metal layers M146, M144, and M142, a segment S144 of the metal layers M145, M143, and M141, together with the first set of vias 1410 construct a first shunt winding 1100 of the spiral inductor 1000; a segment S142 of the metal layers M146, M144, and M142, a segment S145 of the metal layers M145, M143, and M141, together with the second set of vias 1420 construct a second shunt winding 1200; and a segment S143 of the metal layers M146, M144, and M142 together with a segment S146 of the metal layers M145, M143, and M141 construct a crossover region 1450 (including a first portion 1450A and a second portion 1450B).

[0044] Please note that in this embodiment, since a thickness of the metal layer M146/M144/M142 is equal to a thickness of the metal layer M145/M143/M141, the first portion 1450A of the crossover region 1450 is implemented by adopting multiple stacked metal layers (namely, the segment S143 of the metal layers M146, M144, and M142), and the second portion 1450B of the crossover region 1450 is implemented by adopting multiple stacked metal layers (namely, the segment S146 of the metal layers M145, M143, and M141) as well. Furthermore, the metal layers M146, M144, and M142 and the metal layers M145, M143, and M141 are interlaced with a view to the inductor symmetry. Certainly, the non-symmetric spiral inductor 1000 can be implemented by adopting the fourth stacked structure of 9D. Since the fourth stacked structure of 9D is the inverse of the stacked structure of FIG.14, and further description is omitted here for brevity.

[0045] Certainly, the aforementioned stacked guard ring can be adopted for improving noise-blocking ability. Moreover, in the abovementioned embodiments, a rectangle and an octagon are cited as examples for the shape of the first shunt winding and the second shunt winding, but this is not meant to be a limitation of the present invention. That is, the stacked structure of the spiral inductor disclosed in the present invention is suitable for a variety of shapes.

[0046] The abovementioned embodiments are presented merely for describing the features of the present invention, and in no way should be considered to be limitations of the scope of the present invention. In summary, a stacked structure of a spiral inductor is provided in the present invention, such that the spiral inductor with multiple stacked metal layers can obtain an optimum quality factor by making use of metal layers of a crossover region as shunt windings. Furthermore, the stacked structure of the spiral inductor disclosed in the present invention has a wide range of applications, which can be applied to a symmetric inductor and a non-symmetric inductor. Additionally, in the light of metal layers with different thicknesses, various kinds of crossover structures are proposed with a view to the inductor symmetry. What's more, a stacked guard ring is further proposed in the present invention, such that noise-blocking ability can be improved.

[0047] Those skilled in the art will readily observe that numerous modifications and alterations of the device and method may be made while retaining the teachings of the invention.

Electronic Patent Application Fee Transmittal				
Application Number:				
Filing Date:				
Title of Invention:		STACKED STRUCTURE OF A SPIRAL INDUCTOR		
First Named Inventor/Applicant Name:		Kai-Yi Huang		
Filer:		Winston Hsu/Sibyl Yu		
Attorney Docket Number:		REAP0577USA		
Filed as Large Entity				
Utility under 35 USC 111(a) Filing Fees				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Utility application filing	1011	1	330	330
Utility Search Fee	1111	1	540	540
Utility Examination Fee	1311	1	220	220
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				1090

Electronic Acknowledgement Receipt	
EFS ID:	7532214
Application Number:	12773024
International Application Number:	
Confirmation Number:	5061
Title of Invention:	STACKED STRUCTURE OF A SPIRAL INDUCTOR
First Named Inventor/Applicant Name:	Kai-Yi Huang
Customer Number:	27765
Filer:	Winston Hsu/Janine Chang
Filer Authorized By:	Winston Hsu
Attorney Docket Number:	REAP0577USA
Receipt Date:	04-MAY-2010
Filing Date:	
Time Stamp:	04:51:48
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$1090
RAM confirmation Number	13039
Deposit Account	503105
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)					
Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)					
Charge any Additional Fees required under 37 C.F.R. Section 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	835255.PDF	780929	no	5
			abde6fb8bbf24b1b3d86ddb6ba7b7087c14f57e6		
Warnings:					
Information:					
2	Oath or Declaration filed	835249.PDF	378193	no	4
			12c1aa4397b7421159bb91ef22f3afe3eedeb26d		
Warnings:					
Information:					
3	Power of Attorney	835248.PDF	110982	no	2
			6ea233185e474ad4001f4fac49e77d25b7e5f008		
Warnings:					
Information:					
4	Drawings-only black and white line drawings	835175.PDF	547846	no	14
			7bbd992400c3a23ee1a954ca5dda2002acaff1ca		
Warnings:					
Information:					
5	Abstract	835174.PDF	8088	no	1
			459231bfefed4388a1ef33666305363f907ee1da		
Warnings:					
Information:					
6	Claims	835173.PDF	13808	no	5
			a725c3d5b40473338058ffc98446ee12a0867d6a		
Warnings:					
Information:					
7	Specification	835172.PDF	67934	no	16
			9091ed3f1a8d8358986ee69bfb3a4817529b7758		
Warnings:					
Information:					
8	Fee Worksheet (PTO-875)	fee-info.pdf	32732	no	2
			706ba9705807052ef607edfbf64b70e968bea0a5		

Warnings:	
Information:	
Total Files Size (in bytes):	1940512
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. <u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application. <u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course. <u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.	

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

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	REAP0577USA
		Application Number	
Title of Invention	STACKED STRUCTURE OF A SPIRAL INDUCTOR		
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.			

Secrecy Order 37 CFR 5.2

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

Applicant Information:

Applicant 1					Remove
Applicant Authority		☒ Inventor		☐ Legal Representative under 35 U.S.C. 117	☐ Party of Interest under 35 U.S.C. 118
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Kai-Yi		Huang		
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service					
City	Taipei City	Country Of Residenceⁱ	TW		
Citizenship under 37 CFR 1.41(b)ⁱ		TW			
Mailing Address of Applicant:					
Address 1		2F., No.23, Sec. 2, Tonghe E. St., Shihlin District			
Address 2					
City	Taipei City	State/Province			
Postal Code		Countryⁱ	TW		
Applicant 2					Remove
Applicant Authority		☒ Inventor		☐ Legal Representative under 35 U.S.C. 117	☐ Party of Interest under 35 U.S.C. 118
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Yuh-Sheng		Jean		
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service					
City	Yun-Lin Hsien	Country Of Residenceⁱ	TW		
Citizenship under 37 CFR 1.41(b)ⁱ		TW			
Mailing Address of Applicant:					
Address 1		No. 72-2, Songdong Rd., Songzhu Village, Dapi Hsiang			
Address 2					
City	Yun-Lin Hsien	State/Province			
Postal Code		Countryⁱ	TW		
Applicant 3					Remove
Applicant Authority		☒ Inventor		☐ Legal Representative under 35 U.S.C. 117	☐ Party of Interest under 35 U.S.C. 118
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Ta-Hsun		Yeh		
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service					
City	Hsin-Chu City	Country Of Residenceⁱ	TW		

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	REAP0577USA	
		Application Number		
Title of Invention	STACKED STRUCTURE OF A SPIRAL INDUCTOR			
Citizenship under 37 CFR 1.41(b) i		TW		
Mailing Address of Applicant:				
Address 1	No. 40, Tse-Fan Rd.			
Address 2				
City	Hsin-Chu City		State/Province	
Postal Code		Country	TW	
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button. Add				

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).			
☐ An Address is being provided for the correspondence Information of this application.			
Customer Number	27765		
Email Address	winstonhsu@naipo.com	Add Email	Remove Email

Application Information:

Title of the Invention	STACKED STRUCTURE OF A SPIRAL INDUCTOR		
Attorney Docket Number	REAP0577USA	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Suggested Class (if any)		Sub Class (if any)	
Suggested Technology Center (if any)			
Total Number of Drawing Sheets (if any)	14	Suggested Figure for Publication (if any)	

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)
☐ Request Not to Publish. I hereby request that the attached application not be published under 35 U.S. C. 122(b) and certify that the invention disclosed in the attached application has not and will not be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Enter either Customer Number or complete the Representative Name section below. If both sections are completed the Customer Number will be used for the Representative Information during processing.			
Please Select One:	☒ Customer Number	☐ US Patent Practitioner	☐ Limited Recognition (37 CFR 11.9)

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	REAP0577USA
		Application Number	
Title of Invention	STACKED STRUCTURE OF A SPIRAL INDUCTOR		
Customer Number	27765		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this 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(a)(2) or CFR 1.78(a)(4), and need not otherwise be made part of the specification.

Prior Application Status		Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)

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 benefit of foreign priority and to identify any prior foreign application for which priority is not claimed. 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(a).

			Remove
Application Number	Country ⁱ	Parent Filing Date (YYYY-MM-DD)	Priority Claimed
098116543	TW	2009-05-19	☒ Yes ☐ No

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. [Add](#)

Assignee Information:

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

Assignee 1					Remove
If the Assignee is an Organization check here. ☐					
Prefix	Given Name	Middle Name	Family Name	Suffix	

Mailing Address Information:

Address 1			
Address 2			
City		State/Province	
Country ⁱ		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee Data may be generated within this form by selecting the **Add** button. [Add](#)

Signature:

A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 10.18. Please see 37 CFR 1.4(d) for the form of the signature.

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

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	REAP0577USA
		Application Number	
Title of Invention	STACKED STRUCTURE OF A SPIRAL INDUCTOR		

Signature	/WINSTON HSU/		Date (YYYY-MM-DD)	2010-05-02	
First Name	WINSTON	Last Name	HSU	Registration Number	41526

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.

DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)		Attorney Docket Number	REAP0577USA
		First Named Inventor	Kai-Yi Huang
☒ Declaration Submitted With Initial Filing OR ☐ Declaration Submitted After Initial Filing (surcharge (37 CFR 1.16(f)) required)		COMPLETE IF KNOWN	
		Application Number	
		Filing Date	
		Art Unit	
		Examiner Name	

I hereby declare that: (1) Each inventor's residence, mailing address, and citizenship are as stated below next to their name; and (2) I believe the inventor(s) named below to be the original and first inventor(s) of the subject matter which is claimed and for which a patent is sought on the invention titled:

STACKED STRUCTURE OF A SPIRAL INDUCTOR

(Title of the Invention)

the application of which

☒ is attached hereto

OR

☐ was filed on (MM/DD/YYYY) _____ as United States Application Number or PCT International

Application Number _____ and was amended on (MM/DD/YYYY) _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified application, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

Authorization To Permit Access To Application by Participating Offices

☒ If 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 World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the above-identified patent application is filed access to the above-identified patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the above-identified patent application is filed to have access to the above-identified patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the above-identified patent application with respect to: 1) the above-identified patent application-as-filed; 2) any foreign application to which the above-identified patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the above-identified patent application; and 3) any U.S. application-as-filed from which benefit is sought in the above-identified patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date of filing the Authorization to Permit Access to Application by Participating Offices.

[Page 1 of 3]

Appl.Case#97A-097

DECLARATION — Utility or Design Patent Application

Claim of Foreign Priority Benefits

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or (f), or 365(b) of any foreign application(s) for patent, inventor's or plant breeder's rights certificate(s), or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent, inventor's or plant breeder's rights certificate(s), or any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached?	
				YES	NO
098116543	TW	05/19/2009	☐	☐	☒
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application number(s) are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

[Page 2 of 3]

Appl. Case#97A-097

DECLARATION — Utility or Design Patent Application

Direct all correspondence to: ☒		The address associated with Customer Number: 27765		OR ☐ Correspondence address below	
Name					
Address					
City			State		Zip
Country		Telephone		Email	
WARNING: Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available. Petitioner/applicant is advised that documents which form the record of a patent application (such as the PTO/SB/01) are placed into the Privacy Act system of records DEPARTMENT OF COMMERCE, COMMERCE-PAT-7, System name: <i>Patent Application Files</i>. Documents not retained in an application file (such as the PTO-2038) are placed into the Privacy Act system of COMMERCE/PAT-TM-10, System name: <i>Deposit Accounts and Electronic Funds Transfer Profiles</i>. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.					
NAME OF SOLE OR FIRST INVENTOR:			☐ A petition has been filed for this unsigned inventor		
Given Name (first and middle [if any])			Family Name or Surname		
Kai-Yi			Huang		
Inventor's Signature				Date	
<i>Kai-Yi Huang</i>				APR 30 2010	
Citizenship					
TWN					
☒ Additional inventors or a legal representative are being named on the <u>1</u> supplemental sheet(s) PTO/SB/02A or 02LR attached hereto					

[Page 3 of 3]

Appl.Case#97A-097

DECLARATION		ADDITIONAL INVENTOR(S) Supplemental Sheet	
		Page <u>1</u> of <u>1</u>	
Name of Additional Joint Inventor, if any:		☐ A petition has been filed for this unsigned inventor	
Given Name (first and middle (if any))		Family Name or Surname	
Yuh-Sheng		Jean	
Inventor's Signature <i>Yuh-Sheng Jean</i>		Date APR 30 2010	
Citizenship TWN			
Name of Additional Joint Inventor, if any:		☐ A petition has been filed for this unsigned inventor	
Given Name (first and middle (if any))		Family Name or Surname	
Ta-Hsun		Yeh	
Inventor's Signature <i>Ta-Hsun Yeh</i>		Date APR 30 2010	
Citizenship TWN			
Name of Additional Joint Inventor, if any:		☐ A petition has been filed for this unsigned inventor	
Given Name (first and middle (if any))		Family Name or Surname	
Inventor's Signature		Date	
Citizenship			
Name of Additional Joint Inventor, if any:		☐ A petition has been filed for this unsigned inventor	
Given Name (first and middle (if any))		Family Name or Surname	
Inventor's Signature		Date	
Citizenship			

Appl. Case #97A-097

Electronic Acknowledgement Receipt	
EFS ID:	7532214
Application Number:	12773024
International Application Number:	
Confirmation Number:	5061
Title of Invention:	STACKED STRUCTURE OF A SPIRAL INDUCTOR
First Named Inventor/Applicant Name:	Kai-Yi Huang
Customer Number:	27765
Filer:	Winston Hsu/Janine Chang
Filer Authorized By:	Winston Hsu
Attorney Docket Number:	REAP0577USA
Receipt Date:	04-MAY-2010
Filing Date:	
Time Stamp:	04:51:48
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$1090
RAM confirmation Number	13039
Deposit Account	503105
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)					
Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)					
Charge any Additional Fees required under 37 C.F.R. Section 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	835255.PDF	780929	no	5
			abde6fb8bbf24b1b3d86ddb6ba7b7087c14f57e6		
Warnings:					
Information:					
2	Oath or Declaration filed	835249.PDF	378193	no	4
			12c1aa4397b7421159bb91ef22f3afe3eedeb26d		
Warnings:					
Information:					
3	Power of Attorney	835248.PDF	110982	no	2
			6ea233185e474ad4001f4fac49e77d25b7e5f008		
Warnings:					
Information:					
4	Drawings-only black and white line drawings	835175.PDF	547846	no	14
			7bbd992400c3a23ee1a954ca5dda2002acaff1ca		
Warnings:					
Information:					
5	Abstract	835174.PDF	8088	no	1
			459231bfefed4388a1ef33666305363f907ee1da		
Warnings:					
Information:					
6	Claims	835173.PDF	13808	no	5
			a725c3d5b40473338058ffc98446ee12a0867d6a		
Warnings:					
Information:					
7	Specification	835172.PDF	67934	no	16
			9091ed3f1a8d8358986ee69bfb3a4817529b7758		
Warnings:					
Information:					
8	Fee Worksheet (PTO-875)	fee-info.pdf	32732	no	2
			706ba9705807052ef607edfbf64b70e968bea0a5		

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Total Files Size (in bytes):	1940512
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Date: 05/04/2010

PTO/SB/06 (12-04)
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875					Application or Docket Number 12/773,024					
APPLICATION AS FILED – PART I										
(Column 1)		(Column 2)		SMALL ENTITY		OR	OTHER THAN SMALL ENTITY			
FOR	NUMBER FILED	NUMBER EXTRA		RATE (\$)	FEE (\$)		RATE (\$)	FEE (\$)		
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A			N/A	330		
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A		N/A			N/A	540		
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A			N/A	220		
TOTAL CLAIMS (37 CFR 1.16(i))	20	*		X 26=		OR	X 52=			
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2	*		X 110=			X 220=			
APPLICATION SIZE FEE (37 CFR 1.16(s))				If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$270 (\$135 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR						
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				N/A			N/A			
				TOTAL			TOTAL	1090		
* If the difference in column 1 is less than zero, enter "0" in column 2.										
APPLICATION AS AMENDED – PART II										
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
AMENDMENT A	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))					N/A		OR	N/A	
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))					TOTAL ADD'T FEE		OR	TOTAL ADD'T FEE	
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
AMENDMENT 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))					N/A		OR	N/A	
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))					TOTAL ADD'T FEE		OR	TOTAL ADD'T FEE	
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3. ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20". *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3". The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.										

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