

(43) International Publication Date
13 February 2014 (13.02.2014)(51) International Patent Classification:
H01R 12/57 (2011.01) *H01P 5/08* (2006.01)(21) International Application Number:
PCT/IB2013/056440(22) International Filing Date:
6 August 2013 (06.08.2013)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2012102831246 9 August 2012 (09.08.2012) CN(71) Applicants: **TYCO ELECTRONICS (SHANGHAI) CO. LTD.** [CN/CN]; Level 1, No. 142 He Dan Road, Waigaoqiao Free Trade Zone, Shanghai, 200233 (CN). **TYCO ELECTRONICS JAPAN G.K.** [JP/JP]; 3-5-8, Hisamoto, Takatsu-ku, Kawasaki-shi, Kanagawa 213-8535 (JP).(71) Applicant (for MG only): **TYCO ELECTRONICS UK LTD** [GB/GB]; Faraday Road, Dorcan, Swindon Wiltshire SN3 5HH (GB).(72) Inventors: **LAPIDOT, Doron**; 8-4-14 Fukasawa, Setagaya-Ku, Tokyo, Tokyo 158-0081 (JP). **AIZAWA, Masayuki**; Level 1, No. 142 He Dan Road, Waigaoqiao Free Trade Zone, Kawasaki, Kanagawa 214-8533 (JP). **MA, Anson**; c/o Tyco Electronics (Shanghai) Co. Ltd., Level 1, No. 142 He Dan Road, Waigaoqiao Free Trade Zone, Shanghai, 200233 (CN).(74) Agents: **HEINZ-SCHAEFER, Marion** et al.; c/o Tyco Electronics UK Ltd, European Patent Department, Faraday Road, Dorcan, Swindon Wiltshire SN3 5HH (GB).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))

[Continued on next page]

(54) Title: AN RF CONNECTOR

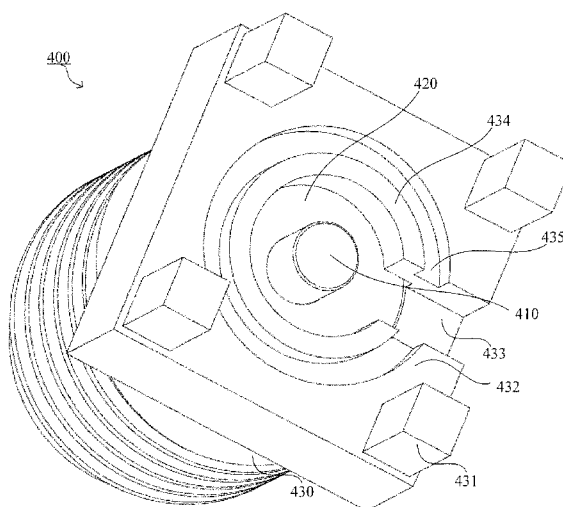


FIG. 4

(57) Abstract: The invention proposes a connector (400) for surface mounting to a circuit substrate, the connector comprises an insulator (420), a center conductor (410) centrically mounted to the insulator and a shielding shell (430) externally mounted on the insulator, the shielding shell comprises a first portion for connecting the shielding shell with a connector and a second portion for surface mounting the connector to the circuit substrate, the second portion includes a body (432) and a plurality of solder legs (431) formed on the body, wherein the body comprises a shielding portion (433) surrounding an extending portion of the center conductor and at least one opening (435) configured to communicate inner space between the center conductor and the shielding portion with outside space of the connector when the RF connector is soldered to the circuit substrate.



Published:

— with international search report (Art. 21(3))

— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

AN RF CONNECTOR

Field of the Invention

The present invention relates to an electrical connector and, in particular, to an RF connector in which the high-frequency characteristics are improved compared to a conventional RF connector.

Background of the Invention

An RF connector is an electrical connector designed to work at radio frequencies. RF connectors are typically used with coaxial cables and are designed to maintain the shielding that the coaxial cable offers.

FIG. 1a, 1b and 1c illustrate a conventional type of surface-mounted RF connector 100. This connector is composed of a center conductor 110, an insulator 120 and a shielding shell 130, wherein the shielding shell 130 is externally mounted on the insulated 120, and the center conductor 110 is inserted from the lower portion of the insulator 120 into a central insertion bore thereof (not shown).

In general, such an RF connector is surface-mounted on a circuit substrate such as a printed circuit board 200 illustrated in FIG. 2 via the center conductor 110 and four solder legs 131. Specifically, the four solder legs 131 are soldered into the corresponding through holes 250 in the printed circuit board 200 and the center conductor 110 is soldered to a solder pad 240 in the center of the printed circuit board 200 via the cylindrical shaped solder terminal.

The body 132, center conductor 110, air between the body 132 and the extending portion 111 of the center conductor 110 form a coaxial structure, which has a characteristic impedance higher than 50 Ohm. And this impedance discontinuity will cause big reflection on signal transmission. As a result, the VSWR will be higher, especially at a higher working frequency. In one word, the characteristic impedance of the conventional RF connector illustrated in Fig. 1c is not continuous, because the transition portion 104 of the traditional RF connector 100 illustrated in Fig. 1c has a higher characteristic impedance than other portions.

Object and Summary of the Invention

This invention focuses on how to improve the impedance continuity in the transition portion. It provides a surface-mounted connector for a circuit substrate, the connector

comprising an insulator, a center conductor centrically mounted to the insulator and a shielding shell externally mounted on the insulator, the shielding shell comprising a first portion for connecting the connector with another mating connector and a second portion for surface mounting the connector to the circuit substrate, the second portion including a body and a plurality of solder legs formed on the body, wherein the body comprises:

a shielding portion, the internal surface of the shielding portion surrounding an extending portion of the center conductor; and

at least one opening configured to communicate inner space between the extending portion of the center conductor and the shielding portion with outside space of the connector when the connector is soldered to the circuit substrate.

The shielding portion performs a better shielding for the extending portion of the center conductor, and additionally the four solder legs form a better shielding when they are soldered to the corresponding solder pad on the circuit substrate.

Advantageously, the body further comprises a groove adjacent to the external surface of the shielding portion, the groove is configured to communicate with the at least one opening, so as to form a thermal relief when the connector is soldering to the circuit substrate and thus the groove guarantees a better soldering quality, when the connector is soldered to the circuit substrate.

Advantageously, the groove has a width and depth of 0.5mm.

Advantageously, the body is square and the number of at least one opening is four, wherein the four openings are located in the middle of each edge of the square body, so as to form a better thermal relief, when the connector is soldering to a circuit substrate and thus the soldering quality between the shielding portion and the corresponding solder pads can be improved.

Advantageously, the shielding portion is annular.

Advantageously, the shielding portion is annular and the internal diameter of the shielding portion is in a range of 2.80 to 3.10mm.

Advantageously, the internal diameter of the shielding portion is 3.00mm.

Advantageously, the external diameter of the shielding portion is 3.80mm.

Since the connector provided in this invention performs a better shielding for the extending portion of the center conductor, the return loss even at the extending portion is reduced and thus the impedance continuity of the RF connector is improved, which is advantageous in the high-frequency range. Accordingly, it is possible to significantly improve the high-frequency characteristic (VSWR). Further it is possible to enable using

the RF connector disclosed herein in high-frequency rang (for example 20 GHz) than previously and thus the RF connector can be used in high-frequency range instead of the traditional expensive RF connector, i. e, reducing the cost.

Brief Description of the Drawings

5 The structure of the invention, together with further objects and advantages thereof, may best be understood by reference to the following description, taken in connection with the accompanying drawings, wherein like reference numerals identify like elements in which:

FIG. 1a is an exploded view of a conventional type of an RF connector;

10 FIG. 1b is a perspective view of the conventional RF connector of FIG.1a;

FIG. 1c is a side view of the conventional RF connector of FIG.1a;

FIG. 2 depicts a corresponding PCB Layout for the conventional RF connector of FIG. 1b;

15 FIG. 3 illustrates an example RF connector according to a preferred embodiment of the present invention;

FIG. 4 illustrates an example RF connector according to another preferred embodiment of the present invention;

FIG. 5 illustrates an example RF connector according to another preferred embodiment of the present invention;

20 FIG. 6 depicts a corresponding PCB Layout for the RF connector of FIG. 5; and

FIG. 7 illustrates the VSWR curves of the conventional RF connector illustrated in FIG. 1b and the preferred embodiment of this invention illustrated in FIG. 5.

Detailed Description

25 While the invention may be susceptible to embodiment in different forms, there is shown in the drawings, and herein will be described in detail, specific embodiments with the understanding that the present disclosure is to be considered an exemplification of the principle of the invention, and is not intended to limit the invention to that as illustrated and described herein.

30 FIG. 1a, 1b and FIG. 2 illustrate a conventional RF connector 100 and a corresponding PCB Layout 200 for the conventional RF connector. The signals transmitted between the conventional RF connector 100 and the printed circuit board 200 are shielded worse as opposed to the coaxial cable which would adversely affect the impedance

continuity at the extending portion 110. The technical solution of this invention designs a different structure of the shielding shell 130 to form a better coaxial structure, so as to improve the VSWR feature of the transmitted signals.

FIG. 3 illustrates an example RF connector 300 according to a preferred embodiment of the present invention. In this embodiment, the illustrated shielding shell 330 used in the RF connector 300 comprises a first portion 370 for connecting the RF connector with another mating connector (not shown) and a second portion 380 configured to be mounted to a circuit substrate (not shown), the second portion 380 includes a body 332 and four solder legs 331 formed on the body 332 and configured to be soldered to the circuit substrate, wherein the body 332 comprises a shielding portion 334 (circled with dashed line in FIG. 3) surrounding an extending portion of the center conductor 310, so as to improve the shielding of the signal transmitted between the RF connector 300 and the circuit substrate (not shown). The second portion 380 also has at least one opening 333 configured to communicate space between the extending portion of center conductor 310 and the shielding portion 334 with outside space of the RF connector when the RF connector 300 is soldered to a circuit substrate. In this embodiment, the internal diameter of the shielding portion is 3.00mm, it is adapted for the corresponding center conductor. When the diameters of the shielding portion and the center conductor are suitable for each other, the return loss of the signal transmitted between them can be maximal reduced.

FIG. 4 illustrates another example RF connector 400 according to a preferred embodiment of the present invention. The difference between the example RF connectors illustrated in FIG. 3 and FIG. 4 is the body 432 of the shielding shell 430 illustrated in FIG. 4 further comprises a groove 435 adjacent to the external surface of the shielding portion 434, in this embodiment the groove has a width and depth of 0.5mm, and now the groove 435 is configured to communicate with the opening 433, when the RF connector 400 is soldered to a circuit substrate. With this groove 435, the shielding portion 434 can be better soldered with the corresponding solder pad on the circuit substrate and thus a better shielding and shielding effect can be achieved.

FIG. 5 illustrates another example RF connector 500 according to a preferred embodiment of the present invention. The difference between the example RF connectors illustrated in FIG. 4 and FIG. 5 is the body 532 of the shielding shell 530 illustrated in FIG. 5 comprises four openings 533, so as to form a better thermal relief when the RF connector 500 is soldering to a circuit substrate and thus the soldering quality between the shielding portion and the corresponding solder pads can be improved. Accordingly, the VSWR

feature of the RF connector is improved.

FIG. 6 depicts a corresponding PCB Layout for the RF connector of FIG. 5. Compared with the PCB Layout depicted in FIG. 2, there are four additional solder pads on this PCB Layout, these four solder pads are configured to be soldered with the segmented shielding portion of the shielding shell illustrated in FIG. 5, so as to form a better shielding and a better shielding.

Since the RF connector provided in this invention perform a better shielding for the extending portion of the center conductor, the return loss even at the extending portion is reduced and thus the impedance continuity of the RF connector is improved, which is advantageous in the high-frequency range. Accordingly, it is possible to significantly improve the high-frequency characteristic (VSWR). Further, it is possible to enable using the RF connector disclosed herein in high-frequency rang (for example 20 GHz) than previously.

FIG. 7 illustrates the VSWR curves of the conventional RF connector illustrated in FIG. 1b and the preferred embodiment of this invention illustrated in FIG. 5. VSWR is an important feature in the field of signal transmission. The smaller the VSWR is, the better the RF connector is. It is obvious, that the VSWR of the improved structure illustrated in FIG. 5 is better than that of the conventional one. So it can be used in high-frequency instead of the traditional expensive RF connector.

It should be noted that the above described embodiments are given for describing rather than limiting the invention, and it is to be understood that modifications and variations may be resorted to without departing from the spirit and scope of the invention as those skilled in the art readily understand. Such modifications and variations are considered to be within the scope of the invention and the appended claims. The protection scope of the invention is defined by the accompanying claims. In addition, any of the reference numerals in the claims should not be interpreted as a limitation to the claims. Use of the verb “comprise” and its conjugations does not exclude the presence of elements or steps other than those stated in a claim. The indefinite article “a” or “an” preceding an element does not exclude the presence of a plurality of such elements.

What is claimed is:

1. A connector for surface mounting to a circuit substrate, the connector comprising an insulator, a center conductor centrically mounted to the insulator and a shielding shell externally mounted on the insulator, the shielding shell comprising a first portion for connecting the connector with another mating connector and a second portion for surface mounting the connector to the circuit substrate, the second portion including a body and a plurality of solder legs formed on the body, wherein the body comprises:

a shielding portion, the internal surface of the shielding portion surrounding an extending portion of the center conductor; and

at least one opening configured to communicate inner space between the extending portion of the center conductor and the shielding portion with outside space of the connector when the connector is soldered to the circuit substrate.

2. The connector of claim 1, wherein the body further comprises a groove adjacent to the external surface of the shielding portion, wherein the groove is configured to communicate with the at least one opening.

3. The connector of claim 2, wherein the groove has a width and depth of 0.5mm.

4. The connector of any one of claims 1 to 3, wherein the body is square and the number of at least one opening is four, wherein the four openings are respectively located in the middle of each edge of the square body.

5. The connector of any one of claims 1 to 3, wherein the shielding portion is annular.

6. The connector of claim 5, wherein the internal diameter of the shielding portion is in a range of 2.80 to 3.10mm.

7. The connector of claim 5, wherein the internal diameter of the shielding portion is 3.00mm.

8. The connector of claim 5, wherein the external diameter of the shielding portion is 3.80mm.

9. The connector of claim 1, wherein the connector is an RF connector.

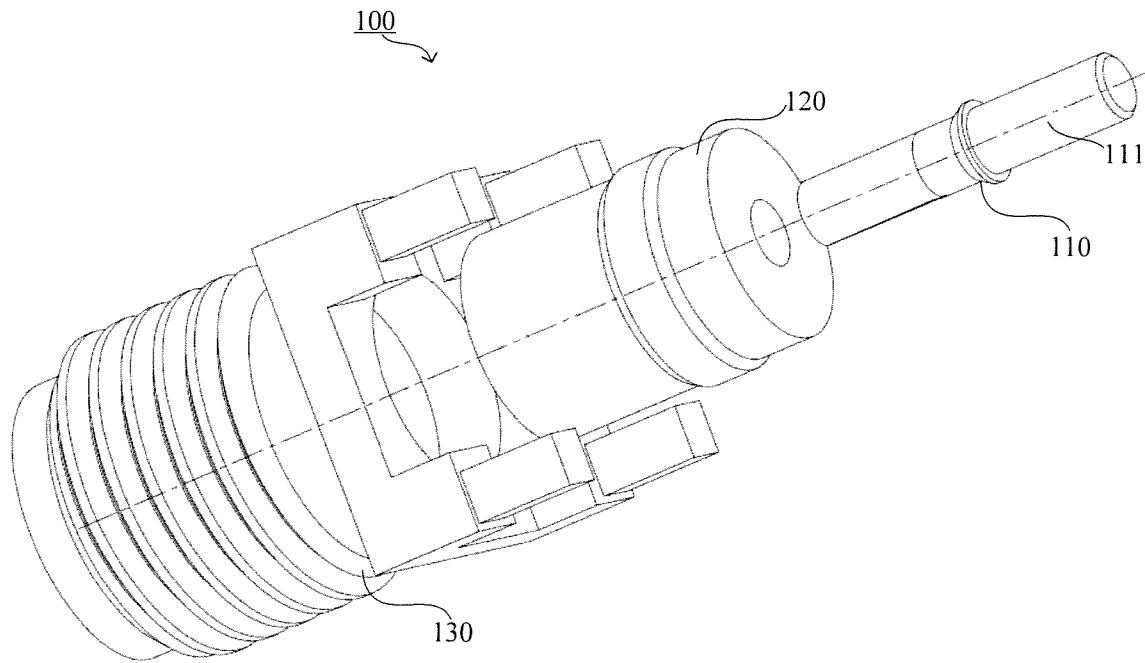


FIG. 1a

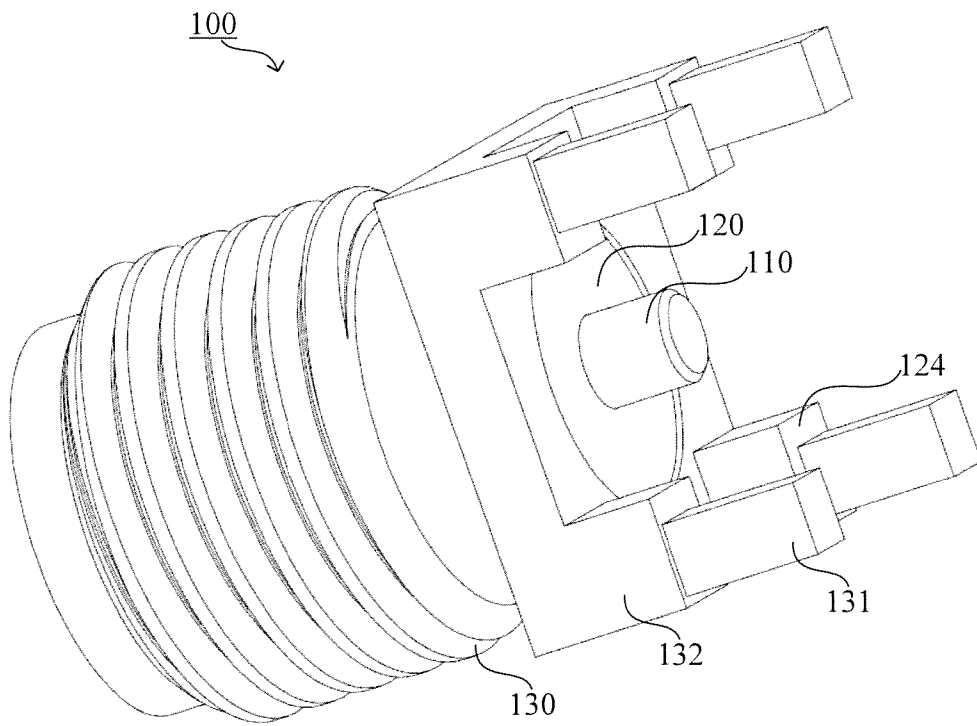


FIG. 1b

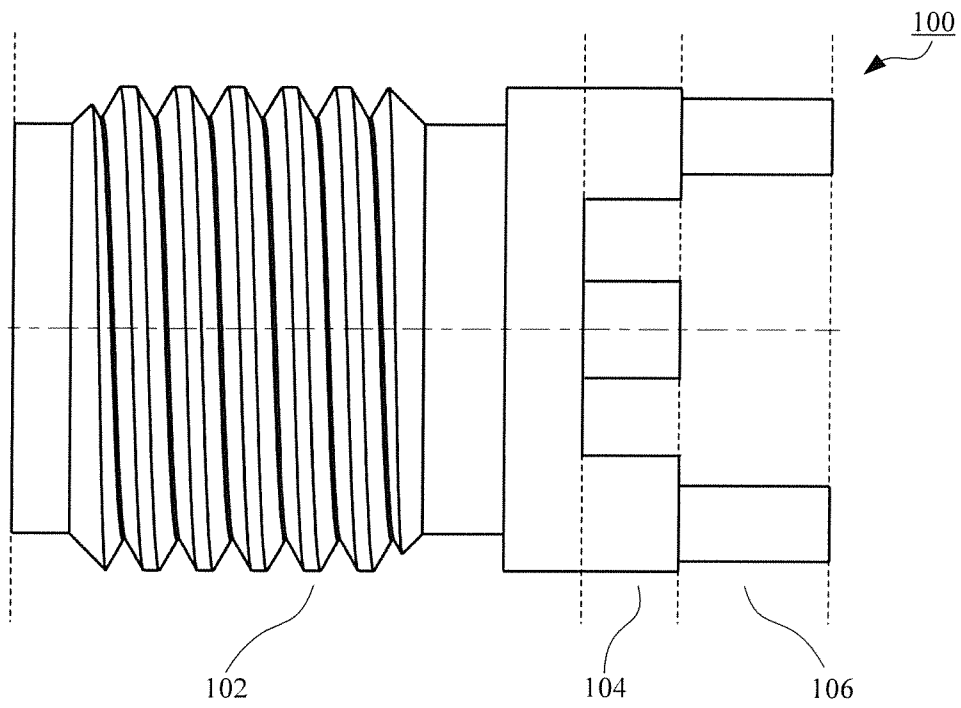


FIG. 1c

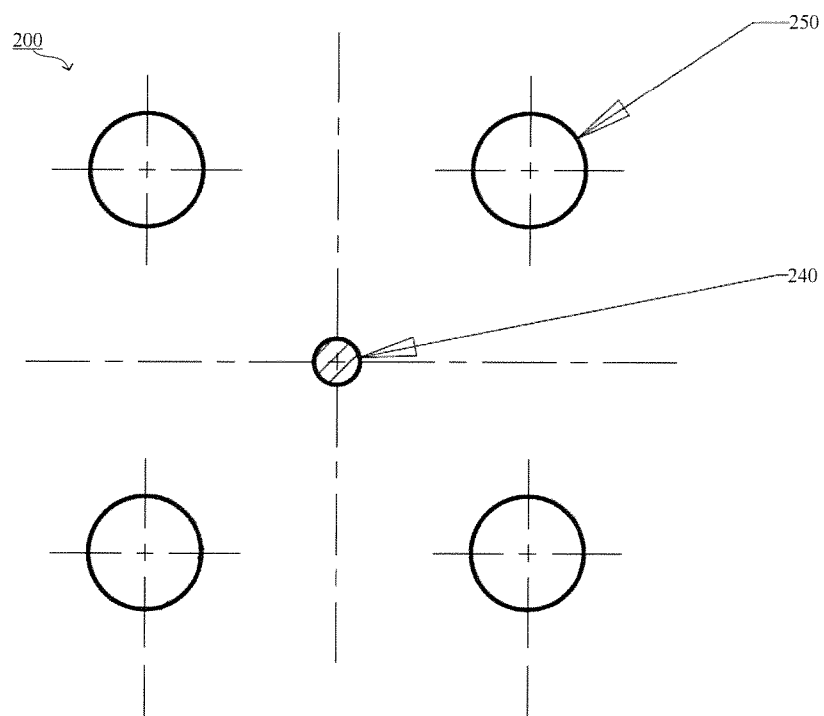


FIG. 2

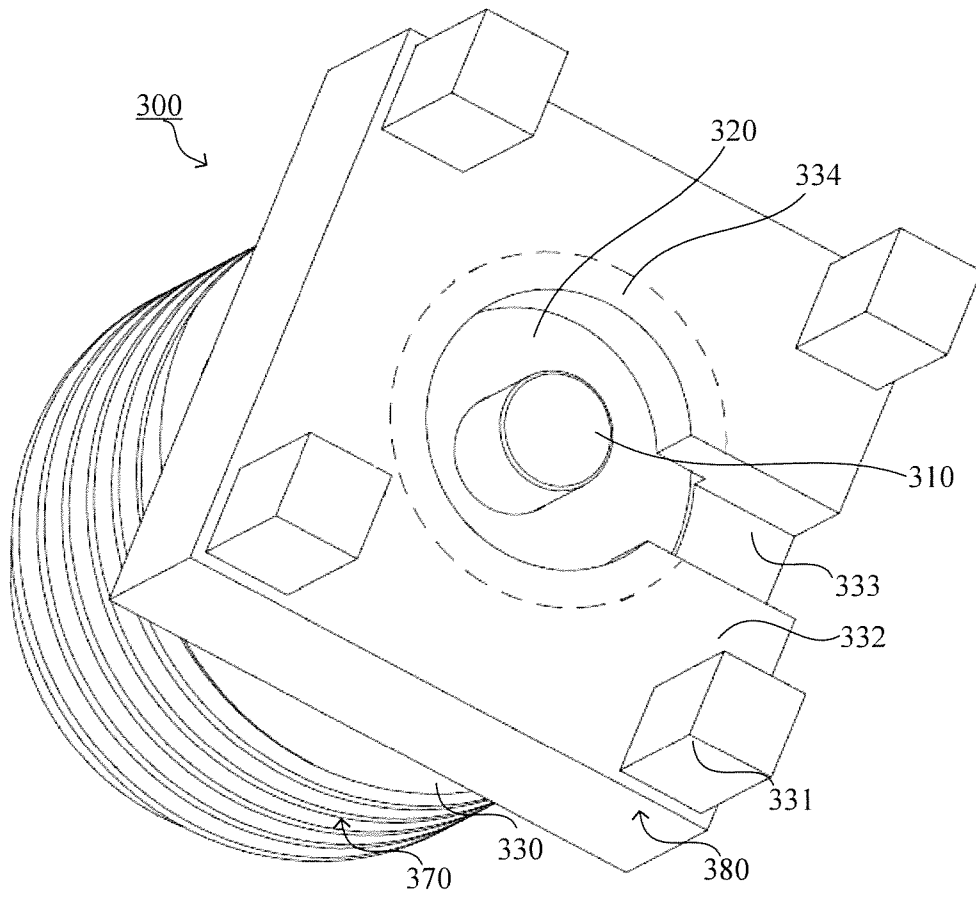


FIG. 3

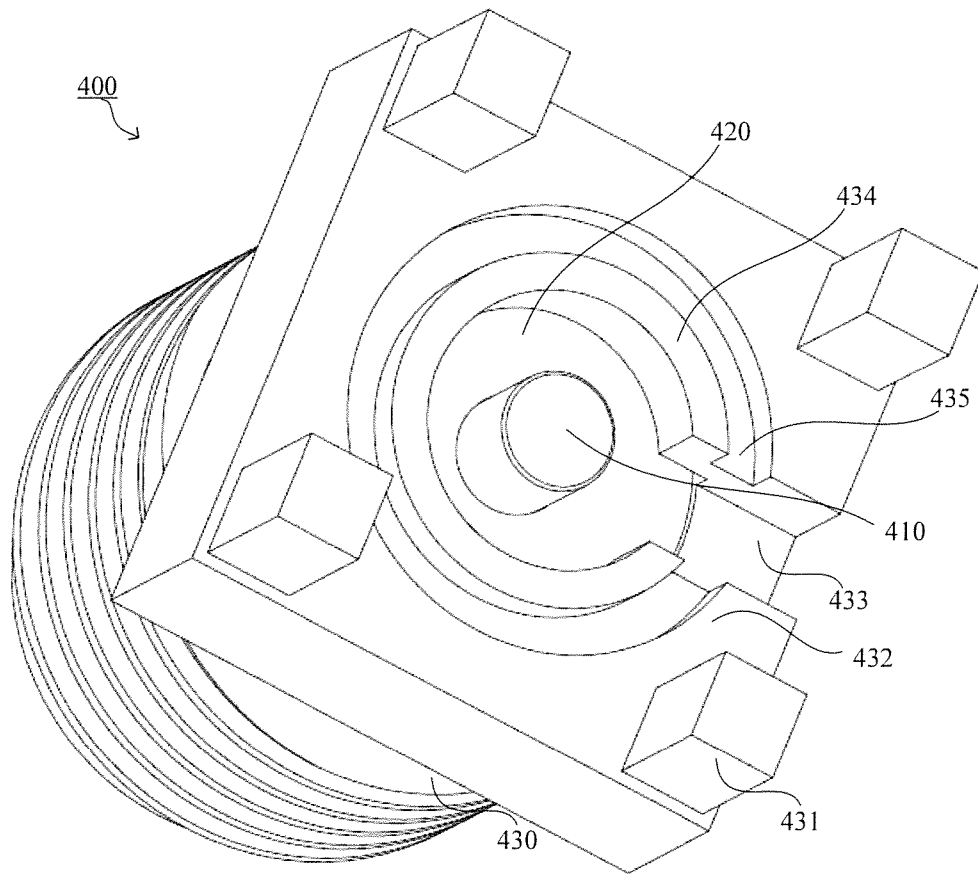


FIG. 4

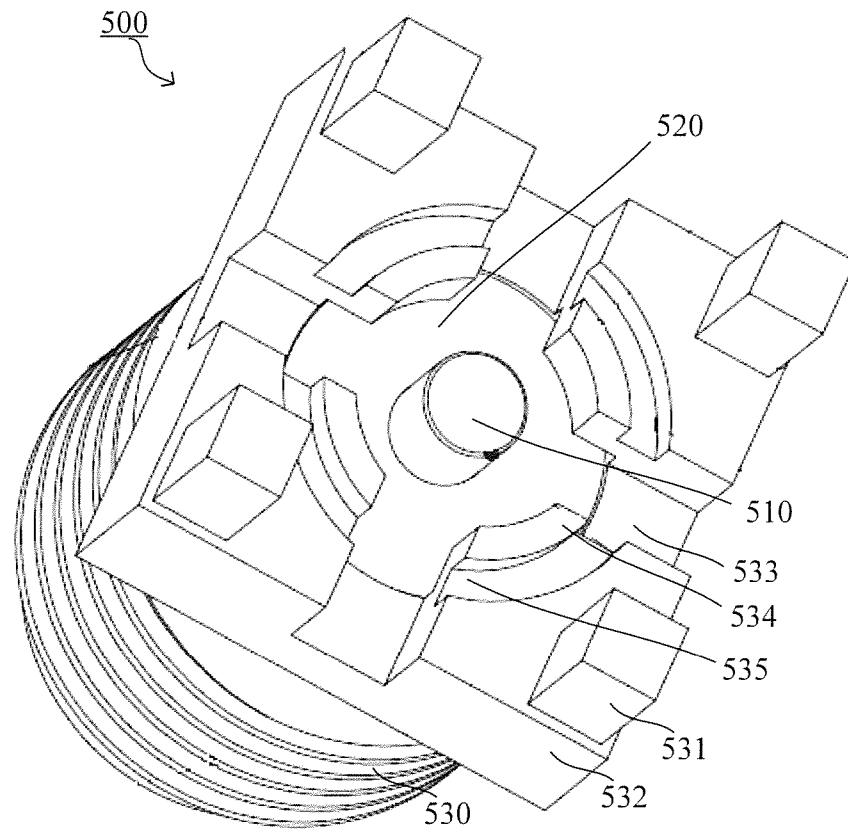


FIG. 5

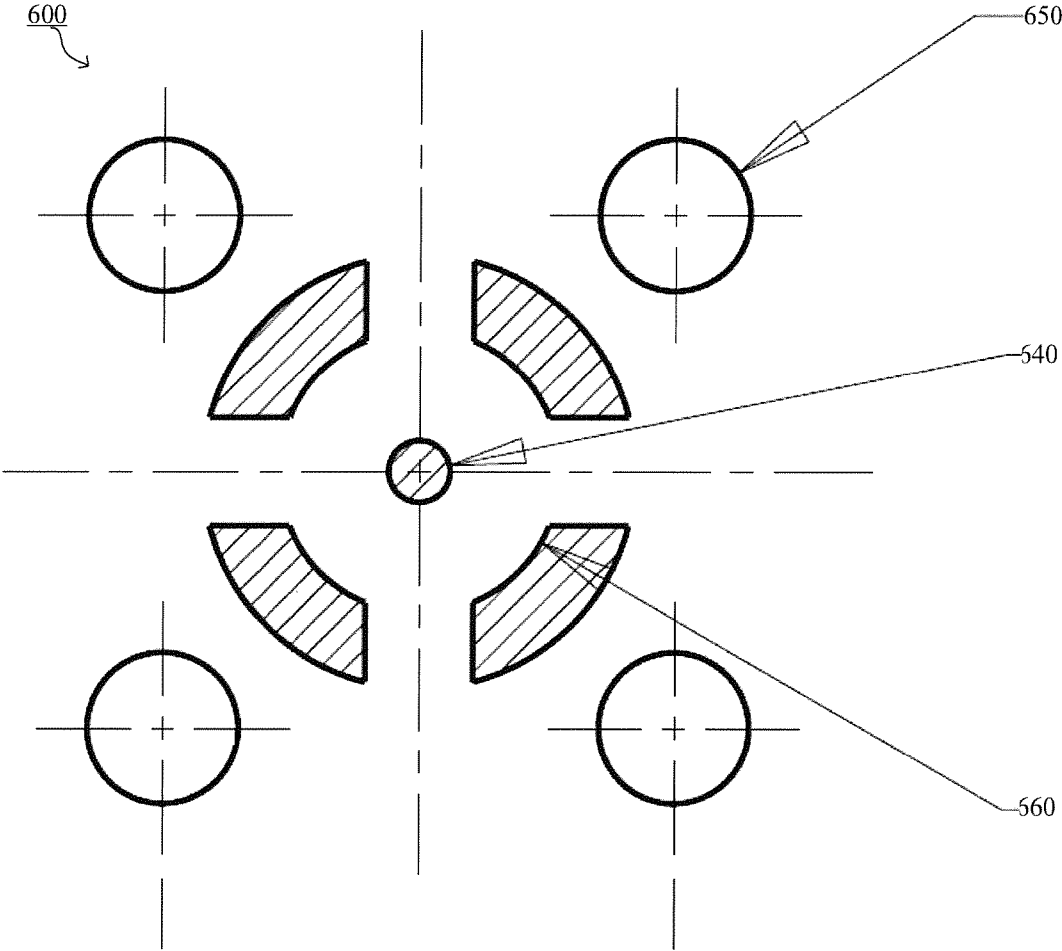


FIG. 6

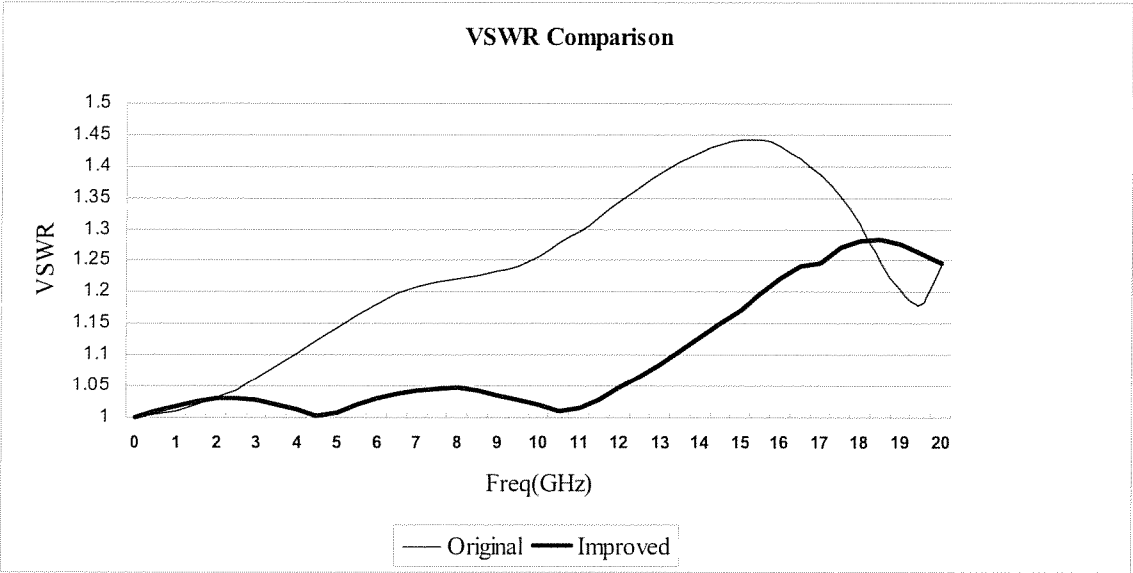


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2013/056440

A. CLASSIFICATION OF SUBJECT MATTER

INV. H01R12/57 H01P5/08
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01R H01P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EP0-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2005 026021 A (NEC ENGINEERING LTD) 27 January 2005 (2005-01-27)	1-4, 9
Y	paragraph [0007] - paragraph [0012]; figures 2-4	5-8
Y	----- US 2012/056696 A1 (CHENG JUI-CHING [TW] ET AL) 8 March 2012 (2012-03-08)	5-8
A	paragraph [0021] - paragraph [0025]; figures 3a, 3b	1-4, 9
A	----- US 4 964 805 A (GABANY ANDREW J [US]) 23 October 1990 (1990-10-23)	1-9
	figures 3,4 -----	

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search

4 December 2013

Date of mailing of the international search report

13/12/2013

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2013/056440

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
JP 2005026021	A	27-01-2005	NONE	
US 2012056696	A1	08-03-2012	NONE	
US 4964805	A	23-10-1990	NONE	