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(54) Title: METHOD FOR MANUFACTURING AN ANTENNA ELEMENT

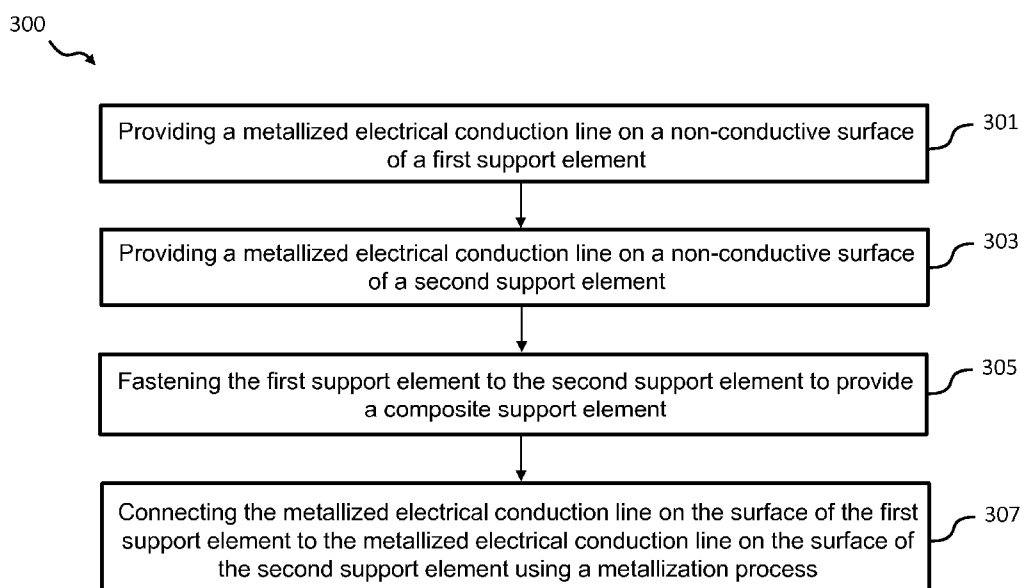


Fig. 3

(57) Abstract: A method (300) for manufacturing an antenna element for transmitting or receiving a RF signal comprises: providing (301) a metallized electrical conduction line on a non-conductive surface of a first support element; providing (303) a metallized electrical conduction line on a non-conductive surface of a second support element; fastening (305) the first support element to the second support element to provide a composite support element; and connecting (307) the metallized electrical conduction line on the surface of the first support element to the metallized electrical conduction line on the surface of the second support element using a metallization process.

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DESCRIPTION**METHOD FOR MANUFACTURING AN ANTENNA ELEMENT**5 TECHNICAL FIELD

The present invention relates to equipment for wireless communication systems. More specifically, the invention relates to a method for manufacturing an antenna element of an antenna for a base station for wireless communication in a communication network, in particular a 5G communication network.

BACKGROUND

Antennas for base stations in mobile communication networks may comprise array
15 antennas which consist of several antenna elements in the form of dipoles (also referred to as radiators). The antenna elements may be arranged in a cross configuration in order to generate a $+45^\circ$ and -45° polarization. Different technologies are commonly used for manufacturing such radiators. It is known, for instance, to use die cast radiators in combination with additional plastic parts. Furthermore, it is known to use etched planar
20 radiators which consist of several planar substrates (PCBs) and additional plastic parts (sometimes, although less often injection moulded plastic parts with metallized lines thereon).

Manufacturing a radiator may involve several manufacturing steps, comprising, for
25 instance, alignment of the different radiator parts, soldering the different radiator parts together for providing electrical contact and adding, i.e. attaching additional plastic parts for providing better mechanical stability or electrical performance (also known as matching and pattern correction). These steps can be time-consuming.

30 As a radiator for an antenna for wireless communication in a communication network usually is made up from several parts, the costs for assembling the radiator may contribute quite substantially to the overall manufacturing costs for an antenna. Moreover, the reliability of an antenna in the field can be negatively impacted by a complex structure of the antenna and/or a complex manufacturing process of the antenna.

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In order to provide a light-weight dipole with as few parts as possible in a cost-efficient manner, a dipole is often made of one or more plastic support bodies having complex 3D shapes, wherein the radiator lines and feed lines are metallized structures on the one or more plastic support bodies. Figures 1a and 1b show perspective views of a dipole 100 comprising a plastic support body 101 with a plurality of metallized lines 103 provided on a surface thereof.

Manufacturing 3D printed plastic parts for an antenna element is, however, often very expensive. This is because in order to be solderable usually the whole part has to be made of a solderable plastic material, which compared to a common non-solderable plastic material is very expensive.

Moreover, using 3D printing for manufacturing plastic parts for an antenna element is limited with respect to creating complex dipole shapes because of the limitations of plating processes and limitations of creating plastic parts with injection moulding or deep-drawing processes. Further limitations are due to areas of the dipole that cannot be accessed by metallizing equipment.

Thus, there is a need for an improved manufacturing method for providing dipoles, i.e. antenna elements having a complex shape.

SUMMARY

It is an object of the invention to provide an improved manufacturing method for providing dipoles, i.e. antenna elements having a complex shape.

The foregoing and other objects are achieved by the subject matter of the independent claims. Further implementation forms are apparent from the dependent claims, the description and the figures.

According to a first aspect the invention relates to a method for manufacturing an antenna element for transmitting or receiving a RF signal. The method comprises the steps of: providing a metallized electrical conduction line on a non-conductive surface of a first support element; providing a metallized electrical conduction line on a non-conductive surface of a second support element; fastening the first support element to the second support element to provide a composite support element; and connecting the metallized

electrical conduction line on the surface of the first support element to the metallized electrical conduction line on the surface of the second support element using a metallization process.

5 Thus, embodiments of the invention allow manufacturing antenna elements having complex shapes and to use expensive material only in those areas of the antenna elements where it is actually necessary. Moreover, embodiments of the invention allow manufacturing antenna elements with PIM free connections and without excessive temperatures at the connection points.

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In a further possible implementation form of the first aspect, the first support element further comprises a radiator element, wherein the metallized electrical conduction line on the surface of the first support element conductively connects to the radiator element and wherein the radiator element is configured to transmit a RF signal when supplied with an electric current via the metallized electrical conduction line on the surface of the first support element.

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In a further possible implementation form of the first aspect, the radiator element is a metallized patch located on the surface of the first support element. Thereby, the radiator element can be provided by a simple cost-efficient manufacturing process.

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In a further possible implementation form of the first aspect, the second support element comprises one or more solderable connection pins for connecting the antenna element to a power source, wherein the metallized electrical conduction line on the surface of the second support element is conductively connected to the one or more solderable connection pins and wherein the power source is configured to supply an electric current to the metallized electrical conduction line on the surface of the second support element. Thereby, the antenna element can be easily connected to further components of an antenna or antenna array.

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In a further possible implementation form of the first aspect, the metallization process comprises a plating process, in particular a cold plasma plating process, a plasma plating process or a jet painting process. Thereby, conductive connections can be provided with temperatures much less than the temperatures required for conventional soldering processes.

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In a further possible implementation form of the first aspect, the metallization process comprises applying a conductive ink. Thereby, conductive connections can be provided with temperatures much less than the temperatures required for conventional soldering processes.

In a further possible implementation form of the first aspect, the method further comprises providing the first support element and the second support element by different manufacturing processes. For instance, one of the support elements may be an injection moulded support element, while the other support element is a deepdrawn support element. Thereby, an optimal (for instance with respect to costs) manufacturing process can be chosen for each support element.

In a further possible implementation form of the first aspect, the step of fastening the first support element to the second support element comprises fastening the first support element to the second support element by one or more of the following fastening processes: bonding, welding, in particular ultrasonic welding, or using an adhesive tape.

In a further possible implementation form of the first aspect, the step of providing the metallized electrical conduction line on the surface of the first support element and/or the second support element comprises providing the metallized electrical conduction line on the surface of the first support element and/or the second support element by one or more of the following processes: plasma coating, jet printing, or applying a conductive ink or paste to the surface of the first support element and/or the second support element.

In a further possible implementation form of the first aspect, the second support element is a planar plastic sheet having a substantially uniform thickness. Thereby, the second support element can be provided by a cost-efficient manufacturing process.

In a further possible implementation form of the first aspect, the first support element comprises or consists of a non-solderable plastic material. Thereby, the first support element can be provided by a cost-efficient manufacturing process.

In a further possible implementation form of the first aspect, the second support element comprises or consists of one or more of the following: a solderable plastic material or a solderable metal material.

According to a second aspect the invention relates to an antenna element manufactured using a method according to the first aspect of the invention.

- 5 According to a third aspect the invention relates to an antenna comprising a plurality of antenna elements, wherein each antenna element of the antenna is provided by a manufacturing method according to the first aspect of the invention.

- 10 Details of one or more embodiments are set forth in the accompanying drawings and the description below. Other features, objects, and advantages will be apparent from the description, drawings, and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

- 15 In the following embodiments of the invention are described in more detail with reference to the attached figures and drawings, in which:

Figs. 1a and 1b are perspective views of a conventional antenna element;

- 20 Figs. 2a-d are perspective views of an antenna element manufactured using a manufacturing method according to an embodiment of the invention;

Fig. 3 is a flow diagram illustrating steps of a method for manufacturing an antenna element according to an embodiment of the invention;

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Figs. 4a-c are perspective views of an antenna element manufactured using a manufacturing method according to a further embodiment of the invention; and

- 30 Figs. 5a-d are perspective views of an antenna element manufactured using a manufacturing method according to a further embodiment of the invention.

In the following identical reference signs refer to identical or at least functionally equivalent features.

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DETAILED DESCRIPTION OF THE EMBODIMENTS

In the following description, reference is made to the accompanying figures, which form part of the disclosure, and which show, by way of examples, specific aspects of
5 embodiments of the invention or specific aspects in which embodiments of the invention may be used. It is understood that embodiments of the invention may be used in other aspects and comprise structural or logical changes not depicted in the figures. The following detailed description, therefore, is not to be taken in a limiting sense, and the scope of the invention is defined by the appended claims.

10 For instance, it is to be understood that a disclosure in connection with a described method may also hold true for a corresponding device or system configured to perform the method and vice versa. For example, if one or a plurality of specific method steps are described, a corresponding device may include one or a plurality of units, e.g. functional
15 units, to perform the described one or plurality of method steps (e.g. one unit performing the one or plurality of steps, or a plurality of units each performing one or more of the plurality of steps), even if such one or more units are not explicitly described or illustrated in the figures. On the other hand, for example, if a specific apparatus is described based on one or a plurality of units, e.g. functional units, a corresponding method may include
20 one step to perform the functionality of the one or plurality of units (e.g. one step performing the functionality of the one or plurality of units, or a plurality of steps each performing the functionality of one or more of the plurality of units), even if such one or plurality of steps are not explicitly described or illustrated in the figures. Further, it is understood that the features of the various exemplary embodiments and/or aspects
25 described herein may be combined with each other, unless specifically noted otherwise.

Figures 2a-d show perspective views of an antenna element 200 manufactured according to a manufacturing method according to a first embodiment of the invention. The antenna element 200, which can be a component of a larger antenna array, is configured to
30 transmit and/or receive an RF signal.

In a first stage of the manufacturing method illustrated in Figure 2a a first support element 201 defining a non-conductive surface and a second support element 211 defining a non-conducting surface are brought into a contacting relationship, for instance, at a contact
35 area of the non-conductive surface of the first support element 201 and a contact area 212 of the non-conductive surface of the second support element 211. According to an

embodiment, the first support element 201 comprises or consists of a non-solderable plastic material, such as polyoxymethylene (POM), polystyrole (PS), polypropylene (PP) or polycarbonate (PC). According to an embodiment, the second support element 211 comprises or consists of a solderable plastic material, such as liquid crystal polymers (LCP), polyphenylene sulfide (PPS), polyimide or polyether ether ketone, and/or a solderable metal material, such as tin, silver, copper or gold. According to an embodiment, the first support element 201 and the second support element 211 are provided by different manufacturing processes. For instance, the first support element 201 may be provided by an injection moulding process while the second support element 211 may be provided by a deep-drawing process.

As illustrated in figure 2a, one or more metallized electrical conduction lines 203 are provided on the non-conductive surface of the first support element 201 and one or more metallized electrical conduction lines 213 are provided on the non-conductive surface of the second support element 211. According to an embodiment, the one or more metallized electrical conduction lines 203 on the non-conductive surface of the first support element 201 can be provided by one or more of the following processes: plasma coating, jet printing, or applying a conductive ink or paste to the surface of the first support element 201. Likewise, the one or more metallized electrical conduction lines 213 on the non-conductive surface of the second support element 211 can be provided by one or more of the following processes: plasma coating, jet printing, or applying a conductive ink or paste to the surface of the second support element 211.

In a second stage of the manufacturing method the first support element 201 is fastened to the second support element 211 for providing a composite support element (as illustrated in figure 2b). According to an embodiment, the first support element 201 can be fastened to the second support element 211 by one or more of the following processes: bonding, welding, in particular ultrasonic welding, or using an adhesive tape or glue.

After fastening the first support element 201 to the second support element 211, in a third stage of the manufacturing method the one or more metallized electrical conduction lines 203 on the non-conducting surface of the first support element 201 are electrically connected to a respective one of the one or more metallized electrical conduction lines 213 on the non-conducting surface of the second support element 211 using a metallization process (as illustrated in figures 2c and 2d, which is a more detailed view of the connection area shown in figure 2c). As illustrated in figures 2c and 2d, the

metallization process can produce a layer 221 of metal material covering and, thus, electrically connecting a respective portion the one or more metallized electrical conduction lines 203 on the non-conducting surface of the first support element 201 and a respective portion of the one or more metallized electrical conduction lines 213 on the non-conducting surface of the second support element 211. According to an embodiment, the metallization process used for electrically connecting the metallized electrical conduction lines 203, 213, e.g. for providing the layer 221 may comprise a plating process, in particular a cold plasma plating process, a plasma plating process or a jet painting process. Alternatively or additionally, the metallization process for electrically connecting the metallized electrical conduction lines 203, 213 may comprise applying a conductive ink onto the metallized electrical conduction lines 203, 213 within the connection area of the first and second support element 201, 211.

According to an embodiment, the first support element 201 further comprises a radiator element, wherein the one or more metallized electrical conduction lines 203 on the non-conducting surface of the first support element 201 conductively connect to the radiator element and wherein the radiator element is configured to transmit a RF signal when supplied with an electric current via the one or more metallized electrical conduction lines 203 on the surface of the first support element 201. The radiator element can be provided as a metallized patch located on the surface of the first support element 201.

According to an embodiment, the second support element 213 may further comprise one or more solderable connection pins for connecting the composite antenna element 200 to a power source, wherein the one or more metallized electrical conduction lines 213 on the surface of the second support element 211 are conductively connected to the one or more solderable connection pins and wherein the power source is configured to supply an electric current to the one or more metallized electrical conduction lines 213 on the surface of the second support element 211.

It will be appreciated that for the embodiment shown in figures 2a-d special material properties, namely solderability, is only required for the second support element 211. Thus, the first support element 201 can be made from a less expensive plastic material and, advantageously, provides the bulk of the material of the composite antenna element 200. Moreover, it will be appreciated, that the manufacturing method disclosed herein allows manufacturing antenna elements 200 having very complex geometries, e.g. geometries not manufacturable as a single part.

Figure 3 is a flow diagram illustrating the steps of a method 300 for manufacturing the antenna element 200 according to an embodiment of the invention. The method 300 comprises the steps of: providing 301 the one or more metallized electrical conduction lines 203 on the non-conductive surface of the first support element 201; providing the one or more metallized electrical conduction lines 213 on the non-conductive surface of the second support element 211; fastening the first support element 201 to the second support element 211 to provide a composite support element; and connecting the one or more metallized electrical conduction lines 203 on the surface of the first support element 201 to the one or more metallized electrical conduction lines 213 on the surface of the second support element 211 using a metallization process.

Figures 4a-c are perspective views of an antenna element 200 manufactured according to a manufacturing method according to a further embodiment of the invention. Because of a complex, i.e. shaded geometry of the antenna element 200 shown in figures 4a and 4b it is not possible or at least very difficult to provide the metallized electrical conduction lines 203, 213, for instance, at certain areas of the bottom surface 201a of the first support element 201 and/or the top surface 211a of the second support element 211.

Advantageously, embodiments of the invention allow providing these metallized electrical conduction lines 203, 213 on the surface of the first support element 201 and/or the surface of the second support element 211, before the first support element 201 and the second support element 211 are fastened together. Thereby, metallized electrical conduction lines 203, 213 can be provided also in those areas of the surfaces of the first support element 201 and/or the second support element 211, which might be difficult to access with conventional metallizing equipment due to the geometry of the composite antenna element 200.

Figures 5a-d are perspective views of an antenna element 200 manufactured according to a manufacturing method according to a further embodiment of the invention. In the embodiment shown in figures 5a-d, the second support element 211 is a planar metallized plastic sheet having a substantially uniform thickness. The first support element 201 may be a deep-drawn plastic part having a small wall thickness. As can be taken from figures 5c and 5d (which provides a more detailed view of a portion of figure 5c), also in this embodiment, after fastening the first support element 201 to the second support element 211, the one or more metallized electrical conduction lines 203 on the non-conducting surface of the first support element 201 are electrically connected to a respective one of

the one or more metallized electrical conduction lines 213 on the non-conducting surface of the second support element 211, e.g., by means of suitable electric layer(s) 221 of metal material covering and, thus, electrically connecting a respective portion the one or more metallized electrical conduction lines 203 on the non-conducting surface of the first support element 201 and a respective portion of the one or more metallized electrical conduction lines 213 on the non-conducting surface of the second support element 211. For further details about the manufacturing stages illustrated in figures 5a-d reference is made to the corresponding description of figures 2a-d above.

In the several embodiments provided in the present application, it should be understood that the disclosed system, apparatus, and method may be implemented in other manners. For example, the described apparatus embodiment is merely exemplary. For example, the unit division is merely logical function division and may be other division in actual implementation. For example, a plurality of units or components may be combined or integrated into another system, or some features may be ignored or not performed. In addition, the displayed or discussed mutual couplings or direct couplings or communication connections may be implemented by using some interfaces. The indirect couplings or communication connections between the apparatuses or units may be implemented in electronic, mechanical, or other forms.

The units described as separate parts may or may not be physically separate, and parts displayed as units may or may not be physical units, may be located in one position, or may be distributed on a plurality of network units. Some or all of the units may be selected according to actual needs to achieve the objectives of the solutions of the embodiments.

In addition, functional units in the embodiments of the invention may be integrated in one processing unit, or each of the units may exist alone physically, or two or more units are integrated into one unit.

CLAIMS

1. A method (300) for manufacturing an antenna element (200) for transmitting or
5 receiving a RF signal, wherein the method (300) comprises:
- providing (301) a metallized electrical conduction line (203) on a non-conductive surface
of a first support element (201);
- 10 providing (303) a metallized electrical conduction line (213) on a non-conductive surface
of a second support element (211);
- fastening (305) the first support element (201) to the second support element (211) to
provide a composite support element; and
- 15 connecting (307) the metallized electrical conduction line (203) on the surface of the first
support element (201) to the metallized electrical conduction line (213) on the surface of
the second support element (211) using a metallization process.
- 20 2. The method (300) of claim 1, wherein the first support element (201) further
comprises a radiator element, wherein the metallized electrical conduction line (203) on
the surface of the first support element (201) conductively connects to the radiator
element.
- 25 3. The method (300) of claim 2, wherein the radiator element is a metallized patch
located on the surface of the first support element (201).
4. The method (300) of any one of the preceding claims, wherein the second support
element (211) comprises one or more solderable connection pins for connecting the
30 antenna element (200) to a power source, wherein the metallized electrical conduction
line (211) on the surface of the second support element (213) is conductively connected to
the one or more solderable connection pins.
5. The method (300) of any one of the preceding claims, wherein the metallization
35 process comprises a plating process or a jet painting process.

6. The method (300) of any one of claims 1 to 4, wherein the metallization process comprises applying a conductive ink.

7. The method (300) of any one of the preceding claims, wherein the method (300) further comprises providing the first support element (201) and the second support element (211) by different manufacturing processes.

8. The method (300) of any one of the preceding claims, wherein the step of fastening (305) the first support element (201) to the second support element (211) comprises fastening the first support element (201) to the second support element (211) by one or more of the following: bonding, welding, or using an adhesive tape.

9. The method (300) of any one of the preceding claims, wherein the step of providing the metallized electrical conduction line on the surface of the first support element (201) and/or the second support element (211) comprises providing the metallized electrical conduction line on the surface of the first support element (201) and/or the second support element (211) by one or more of the following: plasma coating, jet printing, or applying a conductive ink or paste to the surface of the first support element (201) and/or the second support element (211).

10. The method (300) of any one of the preceding claims, wherein the second support element (211) is a planar plastic sheet having a substantially uniform thickness.

11. The method (300) of any one of the preceding claims, wherein the first support element (201) comprises or consists of a non-solderable plastic material.

12. The method (300) of any one of the preceding claims, wherein the second support element (211) comprises or consists of one or more of the following: a solderable plastic material or a solderable metal material.

13. An antenna element manufactured using a method (300) according to any one of the preceding claims.

14. An antenna comprising a plurality of antenna elements (200), wherein each antenna element (200) is provided by a method (300) according to any one of claims 1 to 12.

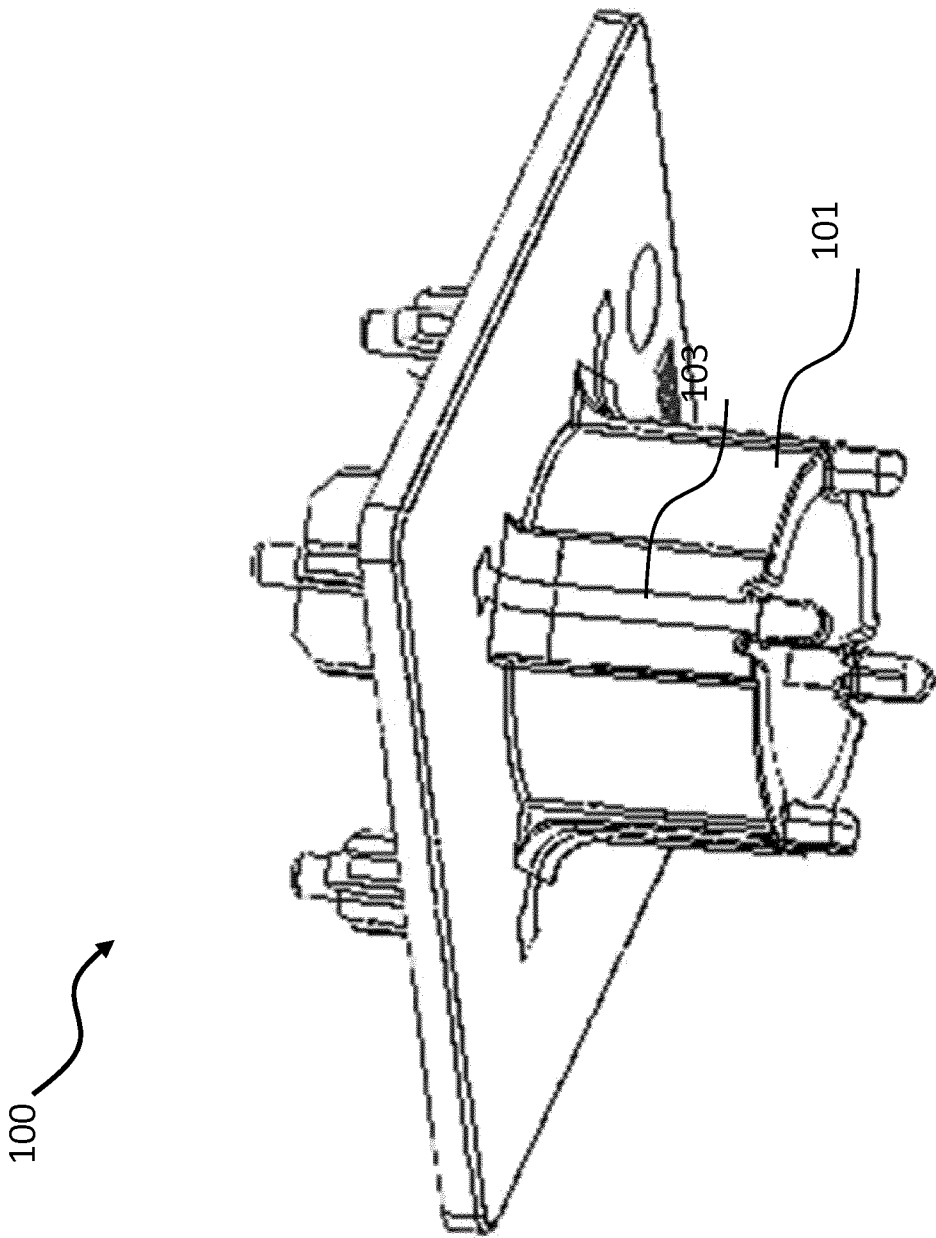


Fig. 1a

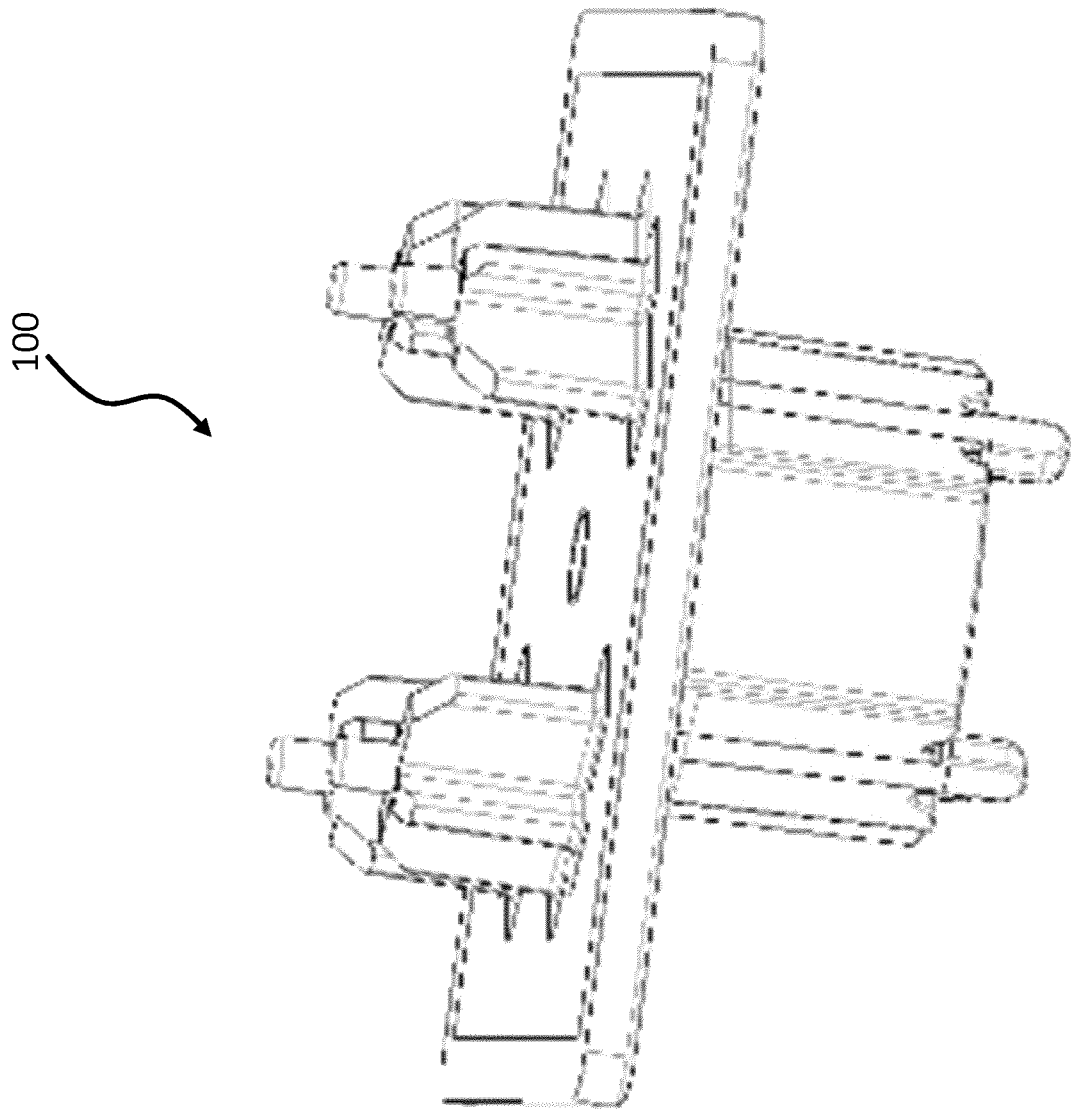


Fig. 1b

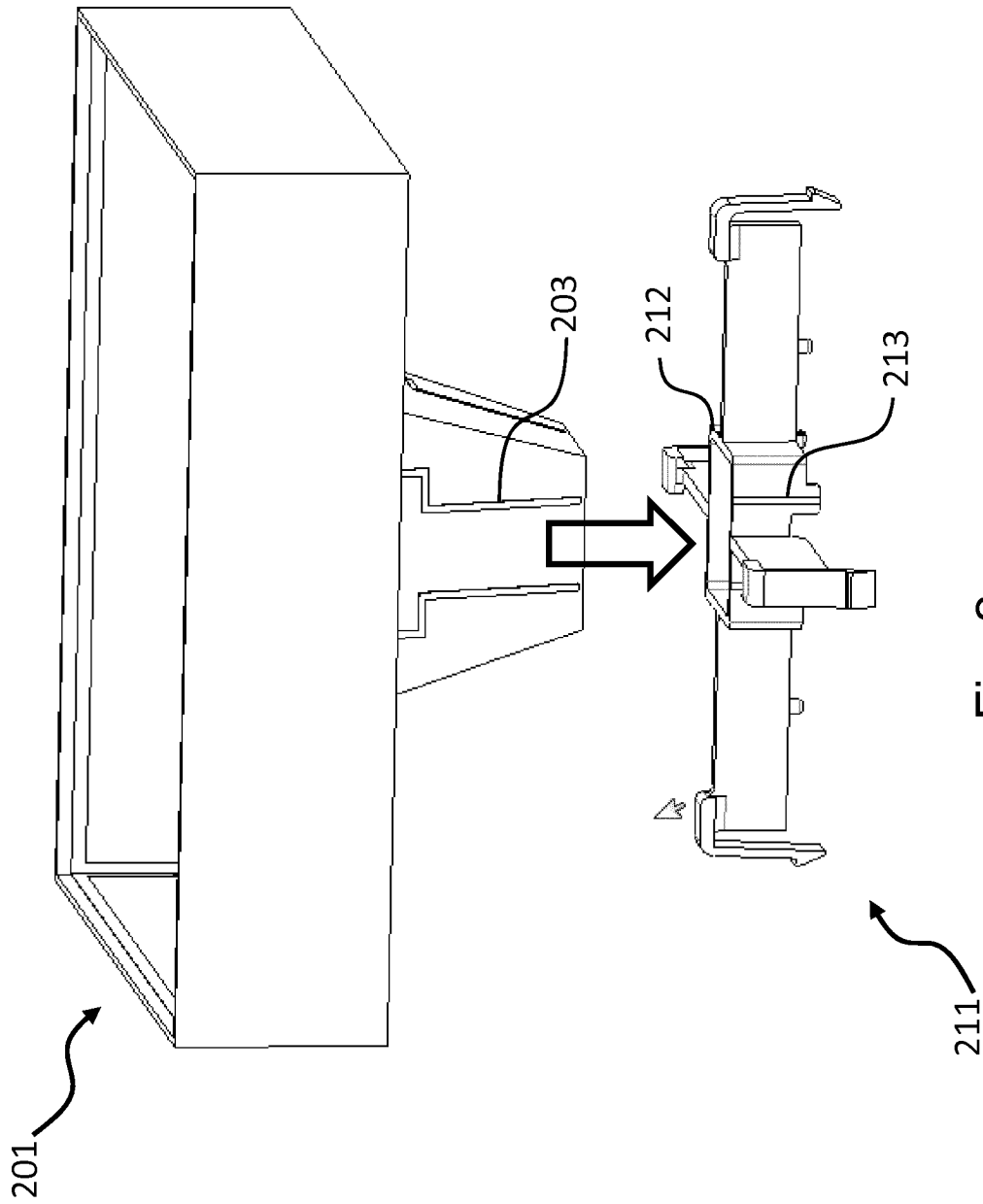


Fig. 2a

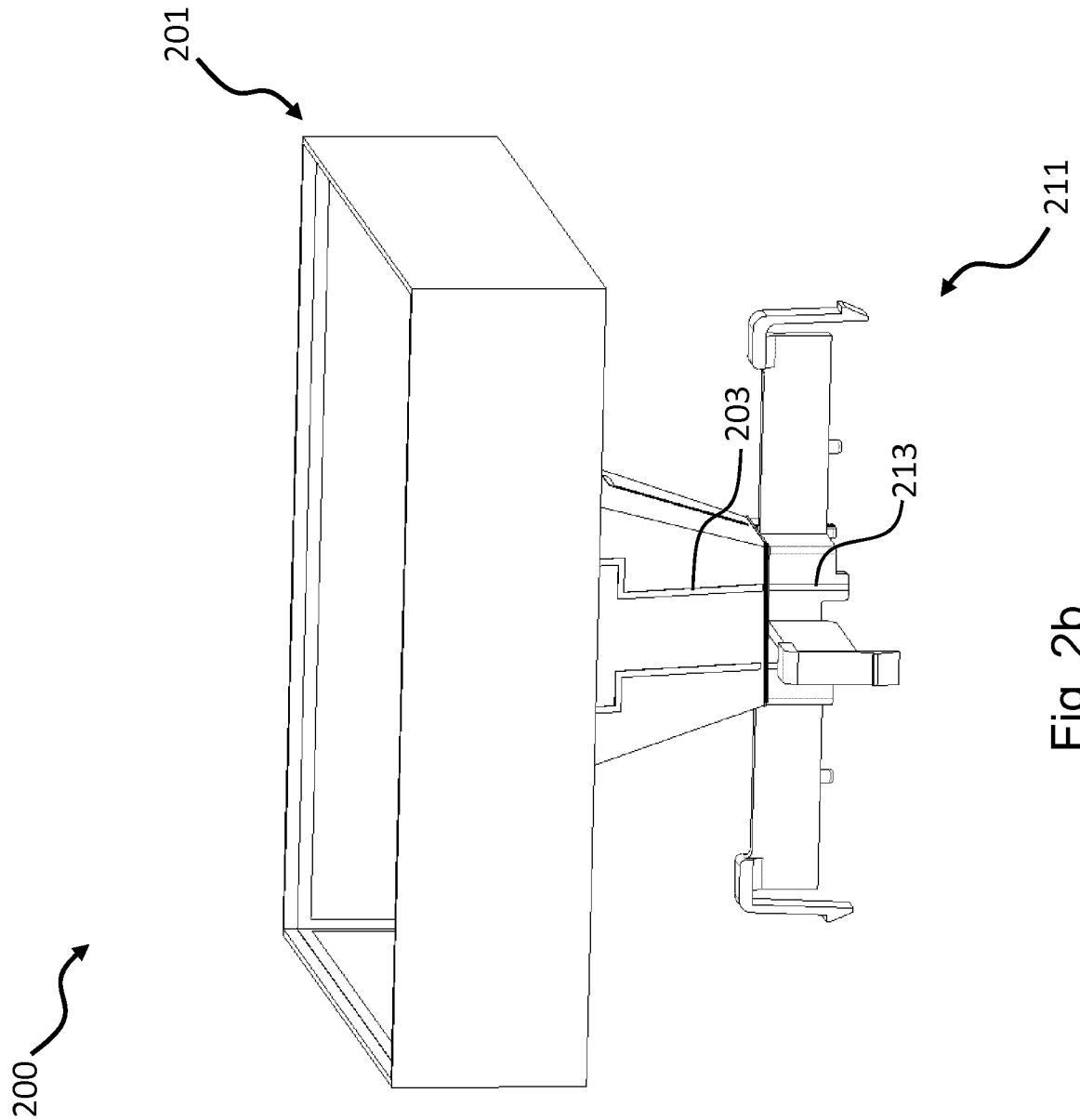


Fig. 2b

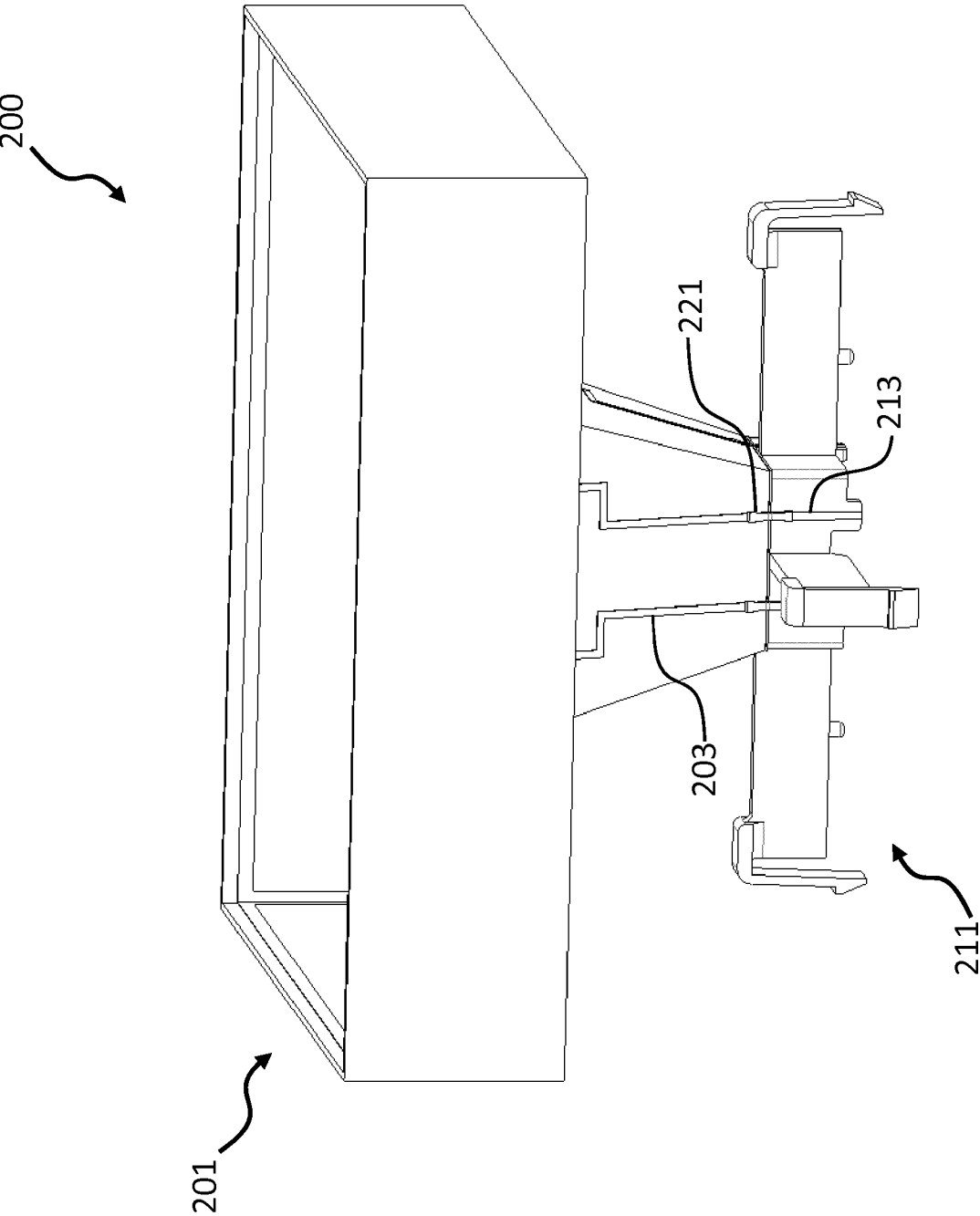


Fig. 2c

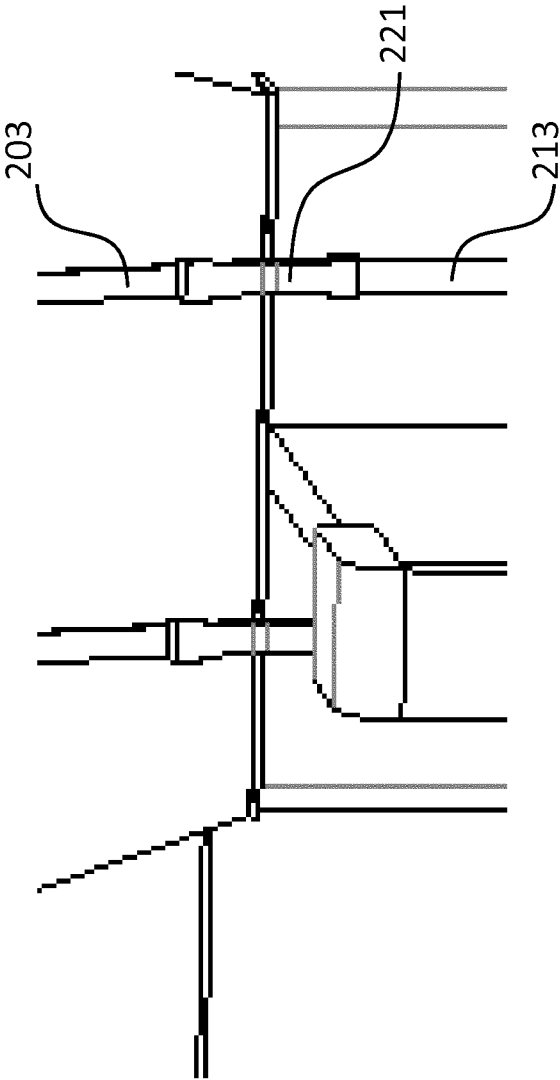


Fig. 2d

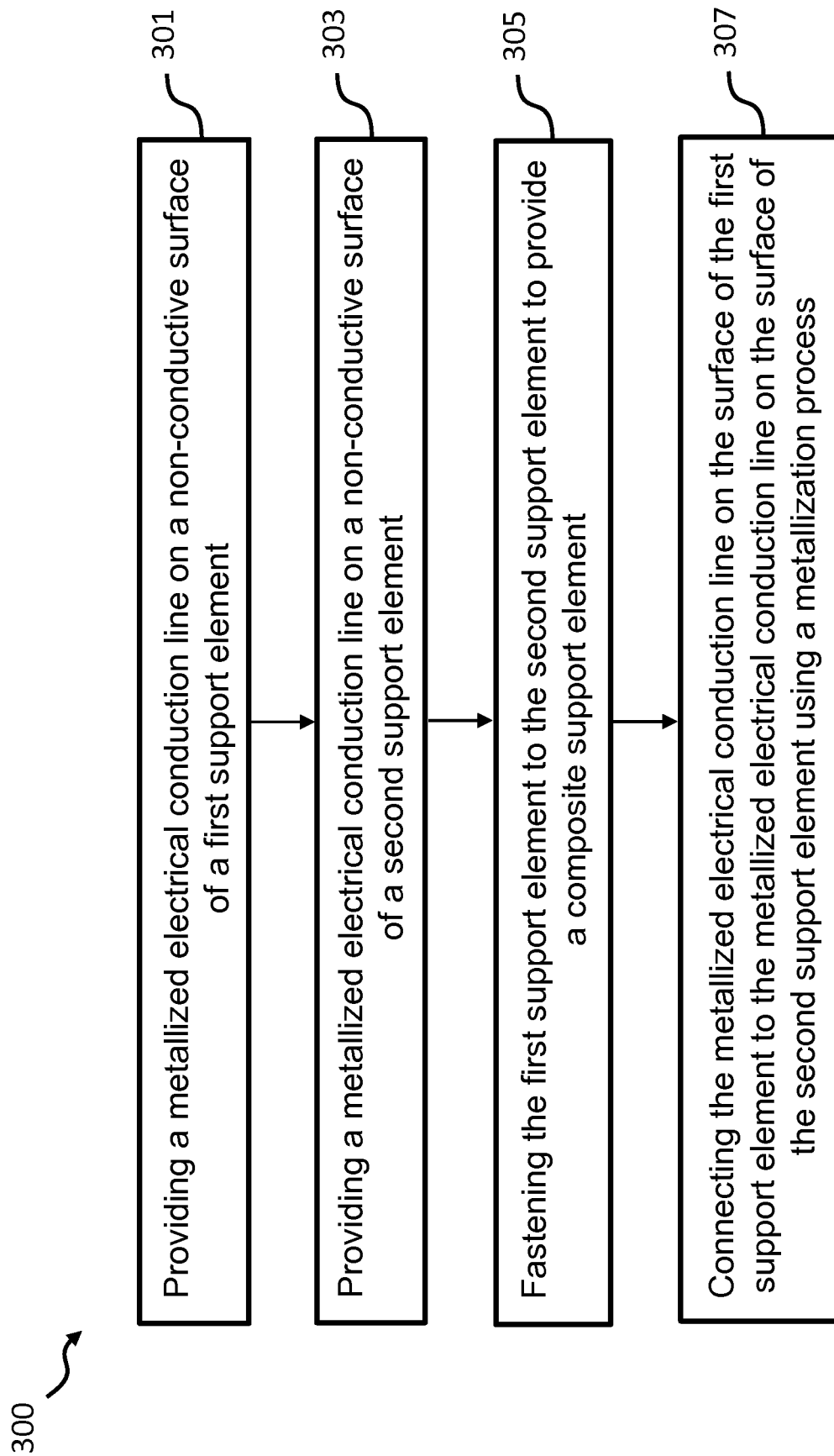
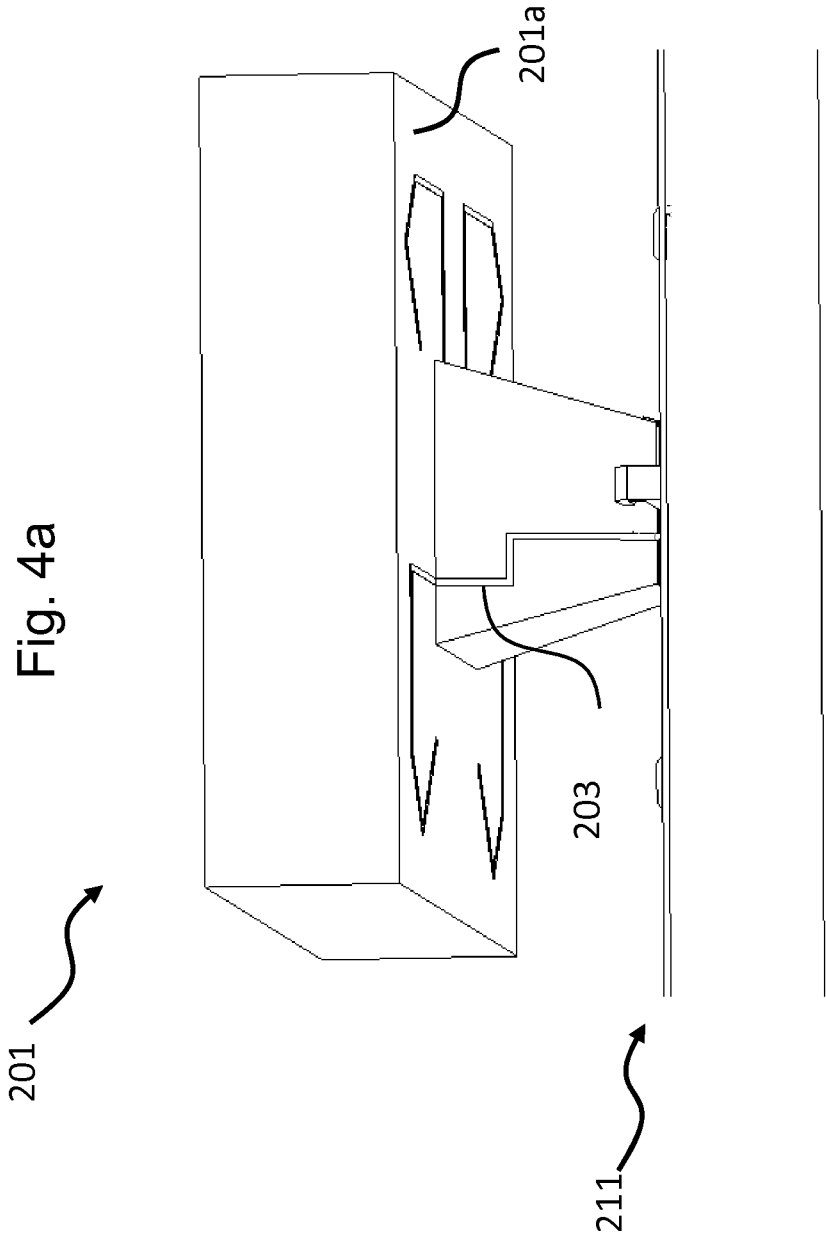


Fig. 3



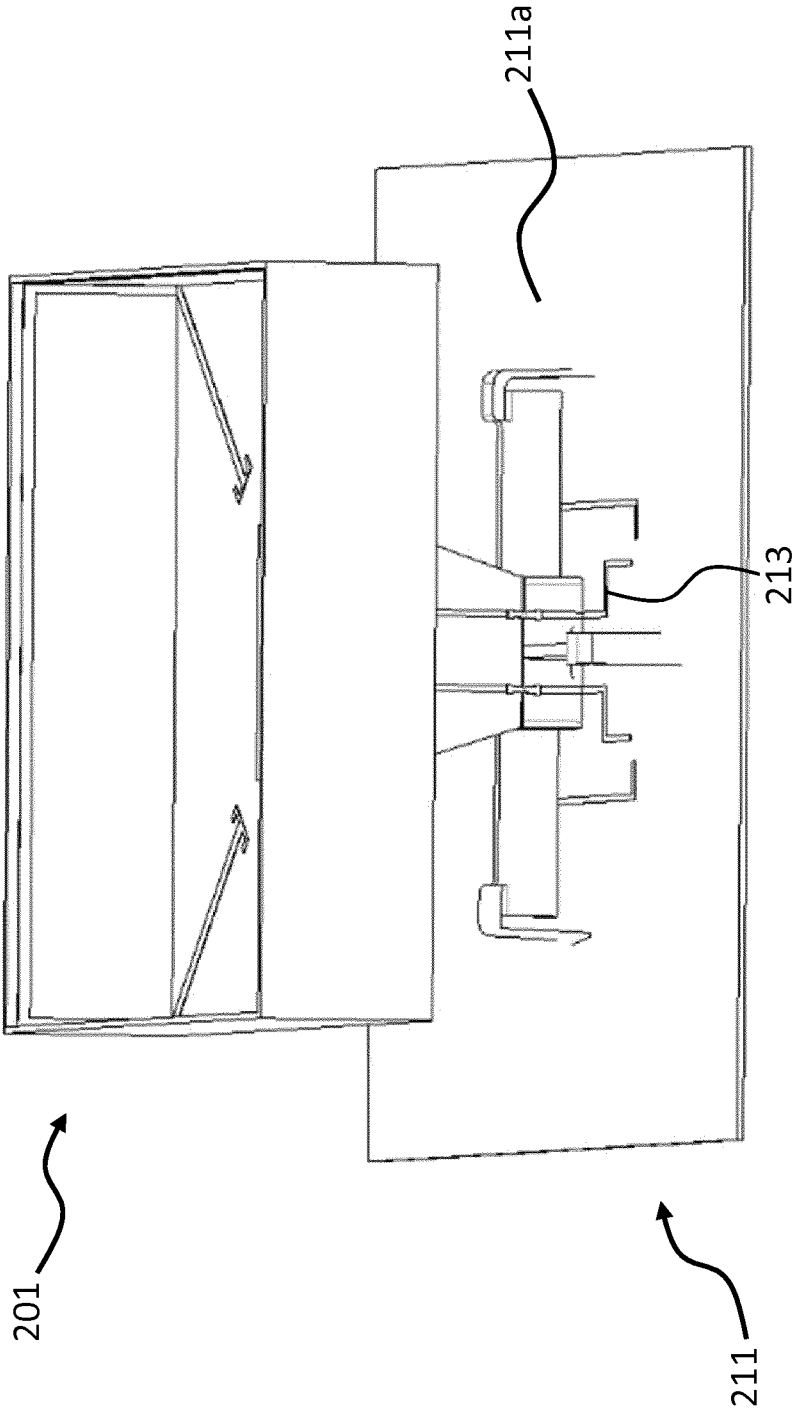


Fig. 4b

10/14

201

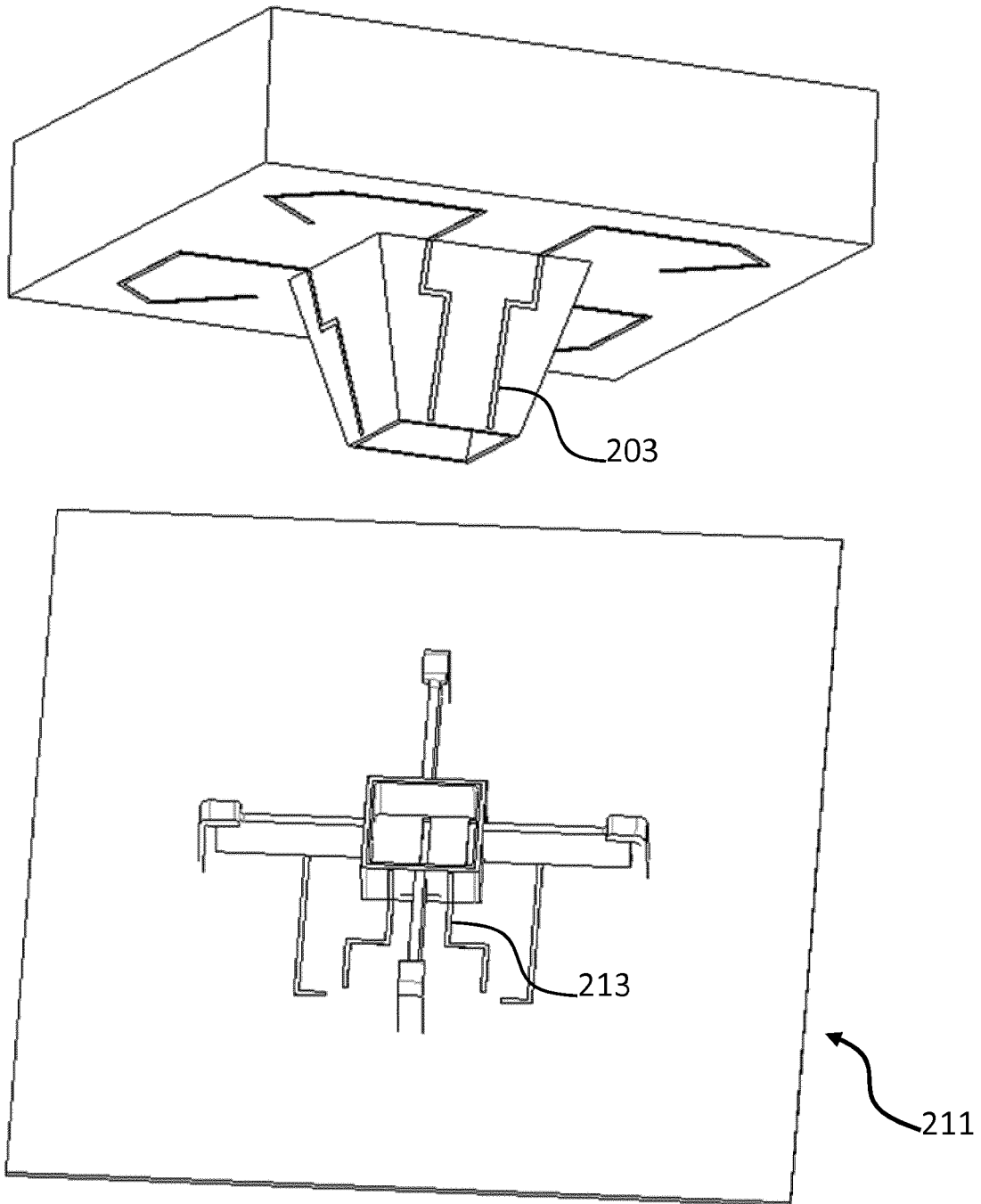


Fig. 4c

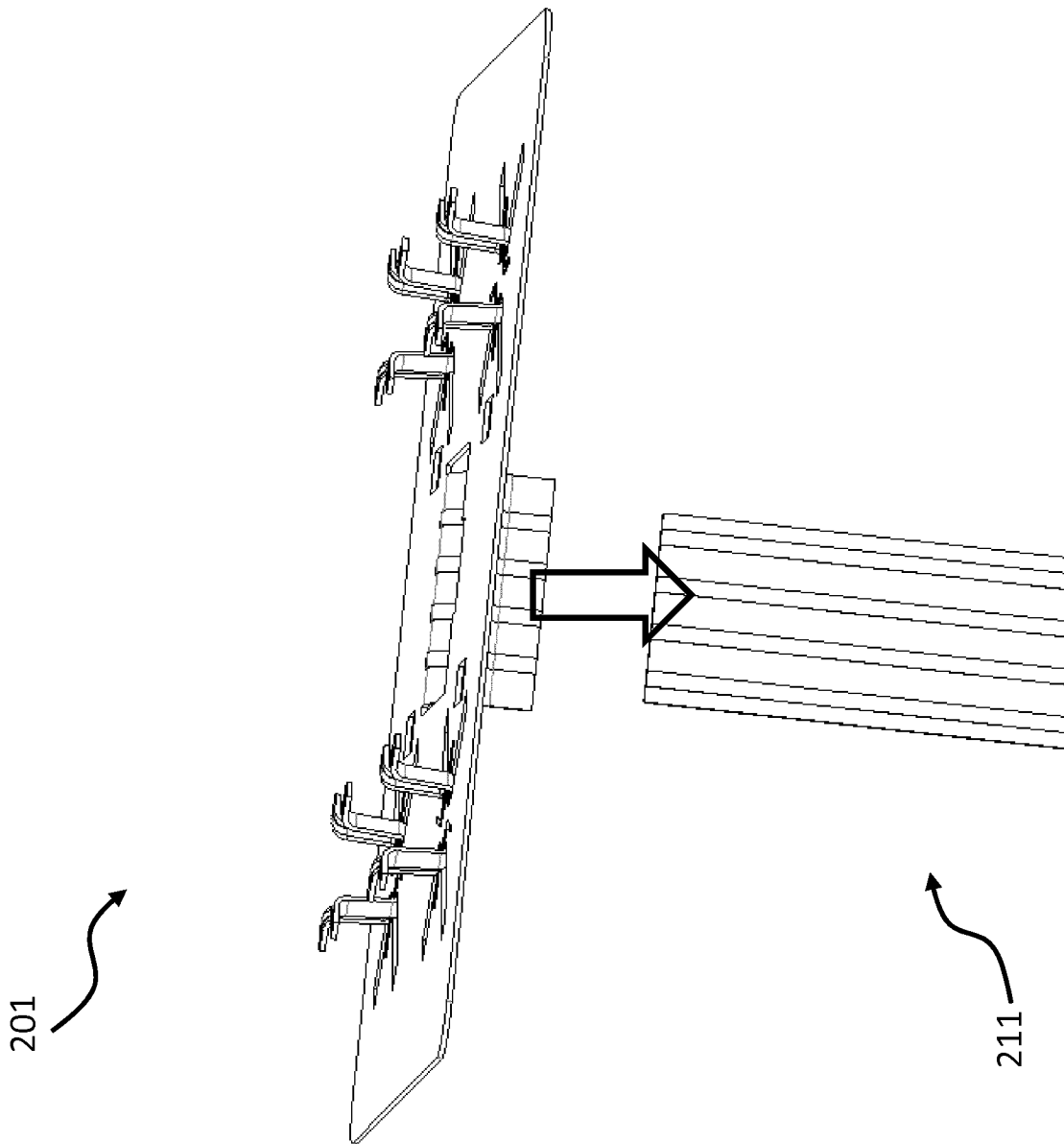


Fig. 5a

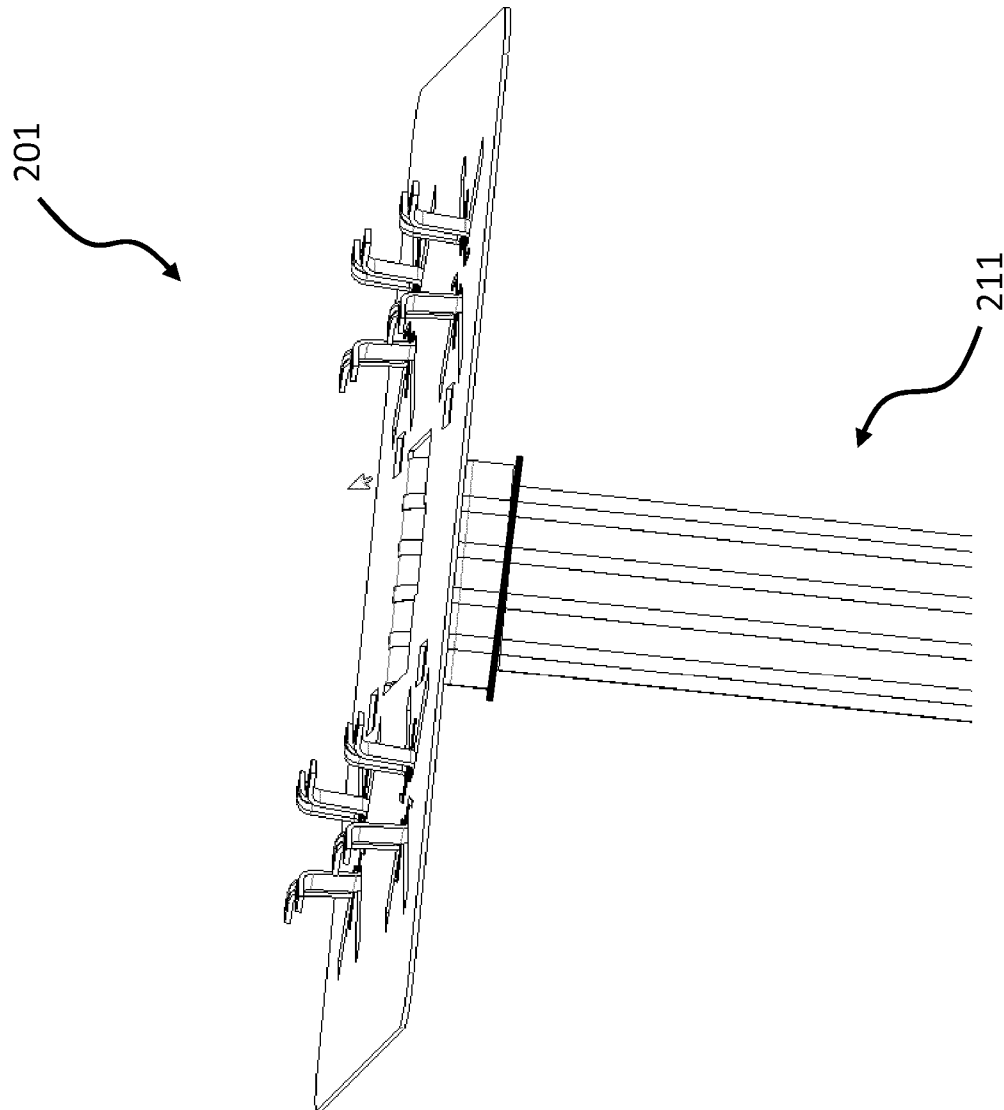


Fig. 5b

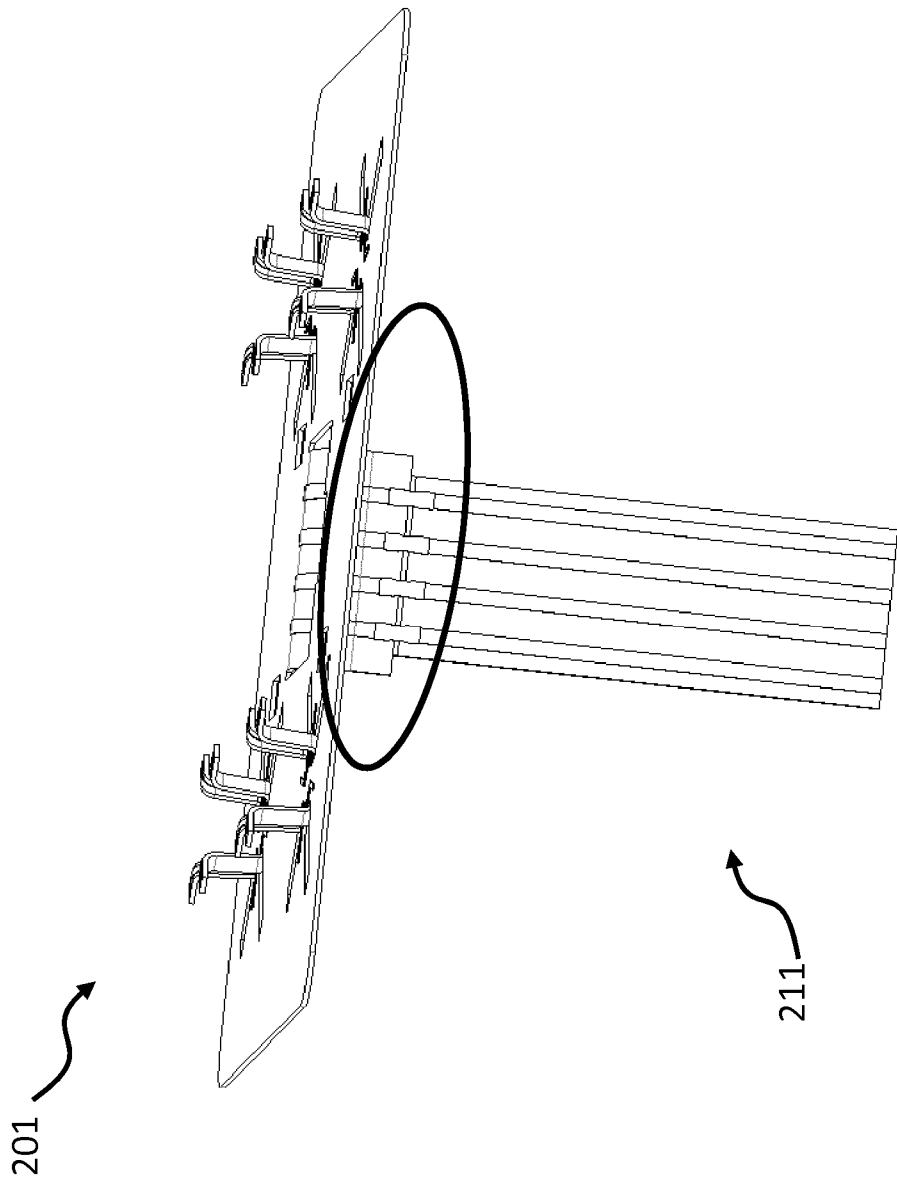


Fig. 5c

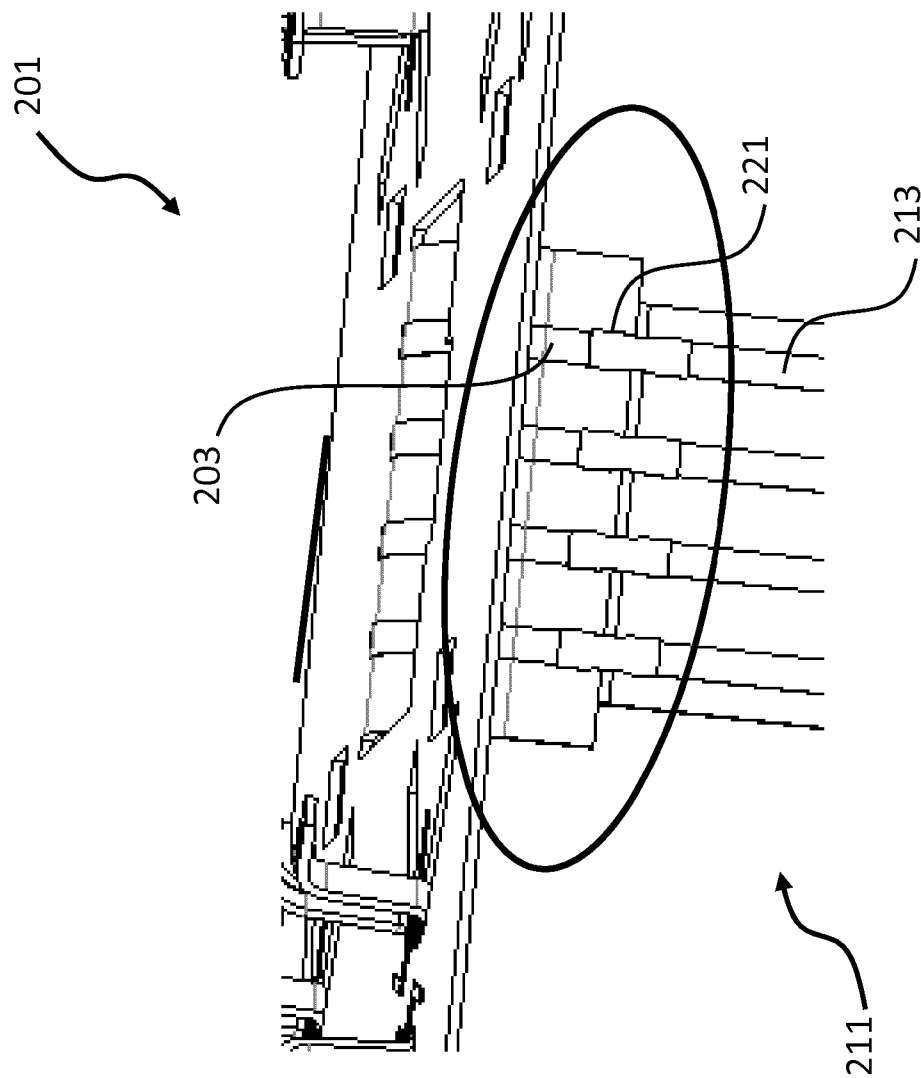


Fig. 5d

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/058545

A. CLASSIFICATION OF SUBJECT MATTER INV. H01P1/04 H01P5/02 H01Q1/24 H01Q1/38 H01Q9/04 H01Q9/36 H01Q21/00 H05K1/09 H05K1/14 H01Q9/28 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) H01P C08J H05K C09J H01Q 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) EPO-Internal, WPI Data											
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">Category*</th> <th style="width: 70%;">Citation of document, with indication, where appropriate, of the relevant passages</th> <th style="width: 20%;">Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; vertical-align: top;">X</td> <td style="vertical-align: top;"> US 2014/218253 A1 (PUZELLA ANGELO M [US] ET AL) 7 August 2014 (2014-08-07) paragraphs [0010] - [0013], [0034], [0040] - [0060], [0063], [0076], [0082] - [0083]; figures 1,1a,1b,4,4a,5,5a,6,6a,9,9a ----- </td> <td style="vertical-align: top; text-align: center;"> 1,2,4-9, 11-14 </td> </tr> <tr> <td style="text-align: center; vertical-align: top;">X</td> <td style="vertical-align: top;"> US 2015/200460 A1 (ISOM ROBERT S [US] ET AL) 16 July 2015 (2015-07-16) paragraphs [0002], [0015], [0016], [0020], [0032] - [0039], [0046]; figures 1,3,5,6,8 ----- -/- </td> <td style="vertical-align: top; text-align: center;"> 1-14 </td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	US 2014/218253 A1 (PUZELLA ANGELO M [US] ET AL) 7 August 2014 (2014-08-07) paragraphs [0010] - [0013], [0034], [0040] - [0060], [0063], [0076], [0082] - [0083]; figures 1,1a,1b,4,4a,5,5a,6,6a,9,9a -----	1,2,4-9, 11-14	X	US 2015/200460 A1 (ISOM ROBERT S [US] ET AL) 16 July 2015 (2015-07-16) paragraphs [0002], [0015], [0016], [0020], [0032] - [0039], [0046]; figures 1,3,5,6,8 ----- -/-	1-14
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X	US 2015/200460 A1 (ISOM ROBERT S [US] ET AL) 16 July 2015 (2015-07-16) paragraphs [0002], [0015], [0016], [0020], [0032] - [0039], [0046]; figures 1,3,5,6,8 ----- -/-	1-14									
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.											
<table style="width: 100%;"> <tr> <td style="width: 50%; vertical-align: top;"> * Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed </td> <td style="width: 50%; vertical-align: top;"> "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family </td> </tr> </table>			* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family							
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Date of the actual completion of the international search 19 November 2019		Date of mailing of the international search report 26/11/2019									
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Georgiadis, A									

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/058545

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 2015/138032 A1 (YONA HAIM [IL] ET AL) 21 May 2015 (2015-05-21) paragraphs [0024], [0030], [0033], [0040], [0043], [0050] - [0051], [0055] - [0059]; figures 1A, 2A, 3A, 4 -----	1-14
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INTERNATIONAL SEARCH REPORT

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International application No

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