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(54) CONDUCTOR COUPLING ARRANGEMENT FOR COUPLING CONDUCTORS

(57) The present invention provides a conductor coupling arrangement 100 for coupling conductors 101, 102, comprising a first conductor 101, and a second conductor 102, wherein a protrusion 103, formed of conductive material on the first conductor 101, extends essentially perpendicular to a longitudinal extension of the first conductor 101, and wherein at least one coupling surface 103a of the protrusion 103 is separated from a coupling portion 104 of the second conductor 102 by at least a dielectric material 105, forming a capacitive coupling between the first conductor 101 and the second conductor 102.

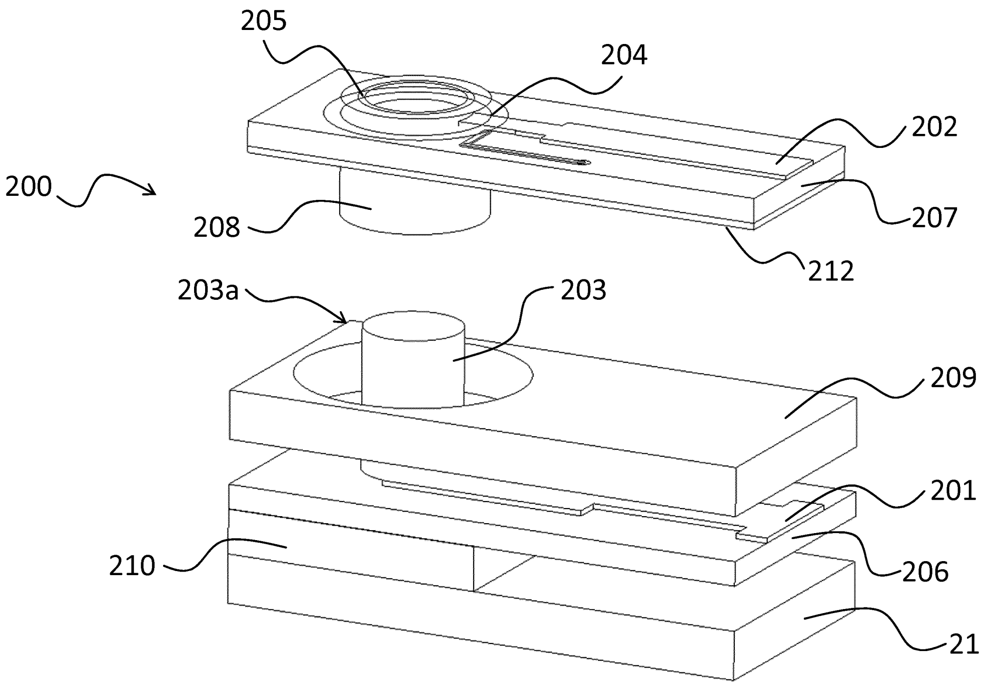

Fig. 2

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Description

TECHNICAL FIELD

[0001] The present invention relates to the field of radio frequency (RF) systems and in particular provides a conductor coupling arrangement for enabling a capacitive coupling between RF system conductors.

BACKGROUND

[0002] In common RF systems, e.g. antenna systems, coupling of RF system components is facilitated by coaxial cables. Components such as an antenna feeding network, a phase shifter, an antenna element (e.g. an antenna radiator) are connected by coaxial cables. The coaxial cables, for example, connect an input port of the antenna feeding network to a phase shifter, and an output port of the phase shifter to antenna elements. The RF system components of the RF system are typically operated in a predefined frequency band. As the RF systems are often multi-band systems, there are typically a number of RF system components connected by coaxial cables. As coaxial cables require specific application measures (e.g. maximum bending radius) and also each cable has to be individually connected, such RF systems are difficult to assemble and the connections take up a lot of space.

[0003] Also when using printed circuit board (PCB) based RF system components, conductors, such as conductors of striplines and/or microstrips (or micro strip lines) formed in and/or on PCBs, are often connected to other RF system components by coaxial cables.

[0004] An example for such a connection is known from EP 0901181 A2, which describes a galvanic coupling between microstrip lines and a coaxial cable. There, a galvanic coupling between an antenna feeding network and an antenna element is formed by galvanically connecting the inner and the outer conductor of the coaxial cable to respective microstrip lines. A stable and mechanical support is required to allow for a reliable connection, as mechanical strain can damage the galvanic connection. Also, the implementation is complex, subject to a time consuming manufacturing process and not suitable for low-passive intermodulation (PIM) operation. PIM refers to the disadvantageous effect of additional RF signals appearing when two or more different RF signals are processed in a RF system.

[0005] Further, US 7629944 B2 describes another approach. Coaxial cables are connected to a non-cable antenna feeding network by soldering both conductors of the coaxial cable to the non-cable antenna feeding network by hand, which is not desirable for mass production and can be a source of PIM.

[0006] According to these approaches, a strong coupling by solder or a galvanic connection is necessary in order to avoid disadvantageous effects such as signal damping or signal interference and in particular to avoid PIM.

[0007] An alternative solution for coupling RF system components without soldering, and even without the necessity of using coaxial cables is mechanically fixing together RF system components. This can be for example achieved by a screw connection.

[0008] US 20120256794 A1 describes how to establish capacitive coupling of a microstrip and a stripline. An air suspended stripline is connected to an air suspended microstrip. A ground plane of the stripline is at the same time a ground plane for the microstrip. A portion of the stripline is coupled via a capacitive section to a portion of the microstrip. The coupling is ensured by using a screw connection, which presses the two portions to the capacitive coupling section wherein the used screw extends through both portions. This concept can only be used for thick metal sheet conductors, as the conductors need to provide a sufficient amount of stability to support the screw connection of the two portions. However, the assembling process is difficult as both thick metal sheet conductors need to be properly aligned and may need to be precisely bent to facilitate a good coupling. Moreover, this solution is not suitable for PCB based RF system components.

[0009] Since the described approaches include manufacturing techniques like soldering or screwing, they are difficult to implement. Consequently, conventional approaches still result in high production times and production costs.

[0010] When conductors, especially of transmission lines and preferably of striplines and microstrips, are used to implement RF system components for RF systems, the problem remains as how to couple the input and output ports of the RF system components to other RF system components of the RF system.

[0011] Hence, the need arises for a way to implement coupling of RF system components that enables reducing manufacturing costs and manufacturing time as well as improving quality of the coupling. In an ideal case, the coupling can be implemented with a minimum number of production steps required. Specifically, the need arises for coupling conductors and/or transmission lines more easily, in particular microstrips or striplines, used to transmit RF signals and at the same time avoiding manufacturing steps such as soldering or screwing.

[0012] In view of the above, the present invention enables capacitive coupling of conductors, suitable for use with PCBs which allows an easy, detachable and non-galvanic or solderless connection between the conductors. It also solves the problem of high manufacturing costs and long manufacturing time. In particular, the present invention aims for a way to improve quality of capacitive conductor coupling.

SUMMARY

[0013] The above-mentioned object of the present invention is achieved by the solution provided by the independent claims. Advantageous implementations of the present invention are subject to the dependent claims.

[0014] According to a first aspect, the invention provides a conductor coupling arrangement for coupling conductors, comprising: a first conductor, and a second conductor, wherein a protrusion, formed of conductive material on the first conductor, extends (essentially) perpendicular to a longitudinal extension of the first conductor, and wherein at least one coupling surface of the protrusion is separated from a coupling portion of the second conductor by at least a dielectric material, forming a capacitive coupling between the first conductor and the second conductor.

[0015] Capacitive coupling of the first conductor and the second conductor allows avoiding manufacturing techniques such as soldering or screwing when coupling the conductors. As a consequence high manufacturing costs and long manufacturing time can be reduced when RF conductors are coupled capacitively. The characteristics of the capacitive coupling can be precisely controlled by the shape, arrangement and dimensions of the first conductor, the second conductor, the protrusion, the coupling portion and the dielectric material.

[0016] According to a first implementation of the first aspect, the coupling portion of the second conductor can be connected to a coupling member, wherein the coupling member preferably can be a hull, configured to receive and/or at least partially house the protrusion, and wherein the hull can preferably be formed on the second conductor and/or can be formed of conductive material.

[0017] This allows achieving optimal capacitive coupling of the protrusion and the hull, while the protrusion can be moveable along the longitudinal extension of the hull, which leads to increased mechanical flexibility.

[0018] According to a second implementation of the first aspect or any implementation thereof, the surfaces of the coupling member facing the at least one coupling surface of the protrusion can be at least partially covered with a dielectric material, especially where the protrusion is received and/or housed.

[0019] The dielectric material enables capacitive coupling and influences quality of capacitive coupling, e.g. by its thickness and permittivity. Being able to precisely control where and how much dielectric material is applied allows improving quality of capacitive coupling.

[0020] According to a third implementation of the first aspect or any implementation thereof, the protrusion can be essentially cylindrical, barrel shaped, conical, pyramid shaped, toric, prismatic and/or ellipsoid shaped.

[0021] A cylindrical or barrel shaped protrusion allows the protrusion to be moveable along the longitudinal extension of the hull. A conical or pyramid shaped protrusion enables to automatically center the protrusion with the coupling member, in case that the coupling member is shaped complementary to the protrusion. A toric, prismatic or ellipsoid shaped protrusion allows establishing capacitive coupling in complex arrangement manners of the protrusion and the coupling member. A cylindrical, barrel shaped or conical protrusion can allow the protrusion and/or the hull to rotate about the longitudinal axis of the protrusion and/or the coupling member.

[0022] According to a fourth implementation of the first aspect or any implementation thereof, the protrusion can be soldered to the first conductor and/or the coupling member can be soldered to the second conductor.

[0023] Soldering the protrusion and/or the coupling member to the conductors provides a strong mechanical connection and ensures a high coupling quality. Soldering is beneficial as it can be implemented by basic semiconductor manufacturing technology, preferably in advance to the assembly of the RF system.

[0024] According to a fifth implementation of the first aspect or any implementation thereof, the first conductor can be formed on a first non-conductive plate and/or the second conductor can be formed on a second non-conductive plate, e.g. as a PCB or MID.

[0025] Being able to form the first conductor and/or the second conductor on non-conductive plates allows equipping various RF system components with the conductor coupling arrangement according to the present invention, as RF system components are typically manufactured using non-conductive plates such as PCBs or MIDs.

[0026] According to a sixth implementation of the first aspect or any implementation thereof, the coupling member can be a conductive area separated from the second conductor by the second non-conductive plate, preferably arranged on an opposite side of the second non-conductive plate, and/or the coupling member can be conductively linked to the coupling portion of the second conductor, e.g. by vias.

[0027] This ensures that the design of the conductor coupling arrangement enables capacitive coupling in various arrangement manners of the first conductor and the second conductor in order to comply with design requirements of various RF system components.

[0028] According to a seventh implementation of the first aspect or any implementation thereof, the protrusion can protrude a first ground plane, in electric isolation therefrom, and/or can at least partially protrude the second non-conductive plate, and/or the first ground plane can be arranged between the first conductor and the second conductor.

[0029] This ensures that the design of the conductor coupling arrangement can comply with the design requirements of various RF system components.

[0030] According to an eighth implementation of the first aspect or any implementation thereof, the coupling member can extend, at least partially, through the second non-conductive plate.

[0031] This ensures that capacitive coupling of the coupling member and the protrusion can be established in various arrangement manners of the coupling member, the protrusion and the second non-conductive plate.

[0032] According to a ninth implementation of the first aspect or any implementation thereof, the first conductor can be, directly or indirectly, supported by a support means, preferably distancing the first conductor from a second ground plane, wherein the support means can be configured to support the first conductor especially in an area comprising the protrusion, and/or wherein the support means can be formed of non-conductive material.

[0033] The support means prevents the first conductor, the protrusion or the first non-conductive plate from being damaged when force is applied to the protrusion for establishing capacitive coupling with the second conductor and/or the coupling portion and/or the coupling member.

[0034] According to a tenth implementation of the first aspect or any implementation thereof, the support means can be or can comprise a resilient means, configured to apply a force to the protrusion, wherein the force can be applied essentially in parallel to a longitudinal extension of the protrusion, pressing the protrusion towards the second conductor.

[0035] The resilient means facilitates quality of capacitive coupling, as it avoids gaps between the protrusion, the dielectric material and the coupling portion or the coupling member, which can negatively affect the coupling quality.

[0036] According to an eleventh implementation of the first aspect or any implementation thereof, at least two of the first non-conductive plate, the second non-conductive plate, the first ground plane, the second ground plane, the protrusion and the coupling member can be secured with or against each other by a clamping mechanism.

[0037] The clamping mechanism ensures that a RF system can be assembled with a minimum number of processing steps, tools and/or separate parts required. This is facilitated by capacitively coupling two RF system components of an RF system by means of the clamping mechanism of the conductor coupling arrangement.

[0038] According to a twelfth implementation of the first aspect or any implementation thereof, the clamping mechanism can comprise clamping means, the clamping means can be in particular integrally formed with the first non-conductive plate and/or the second non-conductive plate.

[0039] Being able to form the clamping means integrally with the first non-conductive plate and/or the second non-conductive plate enables reducing manufacturing steps when producing the conductor coupling arrangement, since fewer components have to be manufactured and assembled.

[0040] According to a thirteenth implementation of the first aspect or any implementation thereof, the coupling portion can be accessible from an opposite side of the second non-conductive plate.

[0041] This ensures that capacitive coupling of the coupling member and the protrusion can be established in various arrangement manners of the coupling member and the protrusion.

[0042] According to a second aspect, the invention provides a RF system, comprising a conductor coupling arrangement according to the first aspect or any one of the first implementation of the first aspect to the thirteenth implementation of the first aspect.

[0043] This provides a way to include the conductor coupling arrangement in any kind of system that is operated with radio frequency. The conductor coupling arrangement can for example be used in an antenna system, an antenna feeding network, an antenna element, an antenna radiator or a phase shifter.

[0044] The system according to the second aspect and its implementation forms achieve the same advantages as the conductor coupling arrangement of the first aspect and its implementation forms.

BRIEF DESCRIPTION OF THE DRAWINGS

[0045] The above-described aspects and implementation forms of the present invention will be explained in more detail in the following in view of the enclosed drawings.

- Fig. 1 shows a schematic overview of a conductor coupling arrangement according to an embodiment of the present invention.
- Fig. 2 shows a schematic overview of a conductor coupling arrangement according to an embodiment of the present invention in more detail.
- Fig. 3 shows a schematic overview of a conductor coupling arrangement according to another embodiment of the present invention in detail.
- Fig. 4 shows a schematic overview of an implementation manner of a coupling member according to an embodiment of the present invention.
- Fig. 5 shows a schematic overview of an implementation example of the present invention including a clamping mechanism.
- Fig. 6 shows a schematic overview of another implementation example of the present invention including a clamping mechanism.
- Fig. 7 shows a schematic overview of an implementation example of the present invention.
- Fig. 8 shows a schematic overview of another implementation example of the present invention.
- Fig. 9 shows a schematic overview of another implementation example of the present invention.
- Fig. 10 shows a schematic overview of a system according to an embodiment of the present invention.

DETAILED DESCRIPION OF THE EMBODIMENTS

[0046] Fig. 1 shows a schematic overview of a conductor coupling arrangement 100 for coupling conductors 101, 102 according to an embodiment of the present invention. The conductor coupling arrangement 100 comprises a first conductor 101 and a second conductor 102. The first conductor 101 and the second conductor 102 can be made of any kind of electrically conductive material, in particular a wire or a metal strip. The conductors 101, 102 can also be part of a transmission lines, e.g. microstrips and/or striplines and preferably can be part of two different transmission lines.

[0047] To provide capacitive coupling of the first conductor 101 and the second conductor 102, a protrusion 103, preferably of electrically conductive material, is formed on the first conductor 101, and a coupling portion 104 is or is formed as a part of the second conductor 102. The protrusion 103 is conductively connected to the first conductor 101, while the coupling portion 104 is conductively connected to the second conductor 102. The protrusion 103 can be integrally formed with the first conductor 101. The coupling portion 104 can be integrally formed with the second conductor 102. In particular, the coupling portion 104 can be regarded as a portion of the second conductor 102, in which capacitive coupling is established with the protrusion 103. The protrusion 103 can also be a separate conductive element that is galvanically connected, soldered and/or screwed to the first conductor 101. The coupling portion 104 can also be a separate conductive element that is galvanically connected, soldered and/or screwed to the second conductor 102. Especially soldering ensures a high coupling quality, provides a strong mechanical connection and simplifies manufacturing, as it can be performed using basic semiconductor manufacturing technology (SMT) during the manufacturing process of the first conductor 101 and the second conductor 102.

[0048] To establish capacitive coupling of the first conductor 101 and the second conductor 102, at least one coupling surface 103a of the protrusion 103 and the coupling portion 104 are separated by at least one dielectric material 105. The dielectric material 105 can be an electrical insulator that prevents flow of electric charges. The dielectric material 105 can be a solid layer, a liquid layer, a gaseous layer or a (high) vacuum layer. Example dielectric materials 105 can, e.g., include crystals, glass, porcelain, plastics, polymers, oil, air and/or nitrogen materials. The transfer of energy from one conductor 101, 102 to another is achieved by interaction of a mutual electric capacity of the first conductor 101 and the second conductor 102 at the coupling portion 104 and at least the at least one coupling surface 103a of the protrusion 103. In case the at least one dielectric material 105 is liquid or solid, the dielectric material 105 can simultaneously contact the protrusion 103 at the at least one coupling surface 103a and the coupling portion 104. It is also possible that the dielectric material 105 contacts only one of the protrusion 103 or the coupling portion 104 at a time, or does neither contact the protrusion 103 nor the coupling portion 104 when arranged between the protrusion 103, and specifically the at least one coupling surface 103a, and the coupling portion 104.

[0049] In another implementation, the protrusion 103 and the coupling portion 104 can be distanced from each other and can be separated by a gaseous dielectric material that at least partially surrounds the protrusion 103, the at least one coupling surface (103a) and/or the coupling portion 104. To enable capacitive coupling, the surfaces of the protrusion 103 and the coupling portion 104 can be completely covered by the at least one dielectric material 105. It is also sufficient if the surfaces, especially the at least one coupling surface 103a, of the protrusion 103 and the coupling portion 104 are at least partially covered with the at least one dielectric material 105, or are separated by the dielectric material 105. To isolate the protrusion 103 from the coupling portion 104, at least one dielectric material 105 can be used. It is also possible to combine several dielectric materials 105 according to the above described arrangement manners. A capacitive coupling of the first conductor 101 and the second conductor 102 can be achieved exclusively by utilizing the at least one coupling surface 103a, the coupling portion 104 and the dielectric material 105.

[0050] To facilitate the capacitive coupling, the protrusion 103 extends essentially perpendicular to a longitudinal extension of the first conductor 101. This provides that the at least one coupling surface 103a can be brought into close alignment with the coupling portion 104 to form capacitive coupling of the first conductor 101 and the second conductor 102, while, at the same time, the first conductor 101 and the second conductor 102 can be spatially separated from each other. It is ensured that the first conductor 101 and the second conductor 102, which can each be part of separate RF system components, can be capacitively coupled, while the RF system components are arranged spatially distanced. Thereby, a flexible way of arranging and coupling separate RF system components is possible. RF system components can also be RF subsystems.

[0051] The protrusion 103 can generally be of arbitrary three-dimensional shape, wherein the at least one coupling surface 103a of the protrusion 103 faces the coupling portion 104.

[0052] Fig. 2 shows a schematic overview of a conductor coupling arrangement 200 according to an embodiment of the present invention in more detail. In Fig. 2 a first conductor 201, a second conductor 202, a protrusion 203 with at least one coupling surface 203a, a coupling portion 204 and a dielectric material 205 are shown. These features essentially correspond to those of Fig. 1. Hence, the conductor coupling arrangement 200, the first conductor 201, the second conductor 202, the protrusion 203, the at least one coupling surface 203a, the coupling portion 204 and the dielectric material 205 described now in view of Fig. 2 essentially comprise the features and functionality of the respective components described for the conductor coupling arrangement 100 in view of Fig. 1.

[0053] The coupling portion 204 of the second conductor 202 can be connected to a coupling member 208. In case that the coupling member 208 is present, the coupling portion 204 may be generally a portion that connects the coupling member 208 to the second conductor 202. The coupling member 208 can be preferably formed on the second conductor 202 and can be made of conductive material. The coupling member 208 can be soldered, screwed to or integrally formed with the second conductor 202 and/or with the coupling portion 204 in order to improve efficiency of manufacturing, improve quality of coupling, provide strong mechanical stability and in particular provide PIM-free operation. SMT can be used for soldering.

[0054] In order to improve the quality of the capacitive coupling, the coupling member 208 can be a hull. A hull-shaped coupling member 208 allows receiving and/or housing of the protrusion 203, at least of the at least one coupling surface 203a. For being received and/or housed by the coupling member 208, the protrusion 203 can extend into an opening of the coupling member 208. Thus, a flexible and especially removable capacitive coupling of the protrusion 203 and the coupling member 208 can be provided. Capacitive coupling is realized in the area where the protrusion 203, especially the at least one coupling surface 203a, and the coupling member 208 overlap. This allows an optimal capacitive coupling of the protrusion 203 and the coupling member 208, while the protrusion 203 can be moveable along the longitudinal axis of the coupling member 208. The protrusion 203 can be received and/or housed by the coupling member 208 completely, or at least partly. The coupling member 208, when formed as the hull, can be open at both ends but also be closed at one end. In case that the coupling member 208 is open at both ends, the protrusion 203 can extend completely through the inner portion of the coupling member 208 and also beyond the coupling member 208. This ensures that the protrusion 203 and the coupling member 208 can be movable against each other while capacitive coupling is maintained as long as the protrusion 203 is at least partly received by the coupling member 208.

[0055] Generally, the shape of the coupling member 208 is adapted to be able to receive the protrusion 203 and hence is preferably formed as a counterpart to the protrusion 203 reflecting the shape of the protrusion 203. Preferably, the coupling member 208 is of cylindrical shape. However, the coupling member 208 can have any other shape adjusted to the shape of the protrusion 203 and allows receiving and/or housing of the protrusion 203.

[0056] To enable capacitive coupling of the protrusion 203 and the coupling member 208, at least one surface of the coupling member 208 that faces at least one coupling surface 203a of the protrusion 203 can at least partially be covered or coated with the dielectric material 205. In case that the coupling member 208 is closed at one end, the dielectric material 205 can be applied to the surface of the closed end of the coupling member 208 in order to avoid direct conductive contact of the at least one coupling surface 203a of the protrusion 203 and the closed end of the coupling member 208. In another example, capacitive coupling of the protrusion 203 and the coupling member 208 can be realized by covering the at least one coupling surface 203a of the protrusion 203 at least partially with the dielectric material 205, wherein the at least one coupling surface of the protrusion 203 faces at least one surface of the coupling member 208. As an alternative to the illustration in Fig. 2, this example would result in the protrusion 203 being at least partially covered with the dielectric material 205, while the inner surface of the coupling member 208 stays conductive.

[0057] Characteristics of capacitive coupling can be controlled by the dimensions of the protrusion 203, the thickness of the dielectric material 205, and by the size of a coupling area in which the protrusion 203 and the coupling member 208 overlap. The coupling area can in particular be an area in which the coupling member 208 overlaps the protrusion 203 when the protrusion 203 is received and/or housed by the coupling member 208.

[0058] In order to provide the capacitive coupling, the thickness d of the dielectric material 205, the permittivity ε_r of the dielectric material 205, the dielectric constant or free space permittivity ε_0, and the surface of the coupling area A should satisfy the following relation:

$$\frac{d}{2\pi f \varepsilon_r \varepsilon_0 A} \leq 1$$

[0059] In particular, it is beneficial if the length of the largest extent of the coupling area A is smaller than a quarter of the wavelength f of a working frequency of signals that are capacitively coupled by the conductor coupling arrangement 200.

[0060] The conductor coupling arrangement 200 according to the present invention also works with values which do not satisfy to the above-mentioned relation, if suitable matching structures are supplied.

[0061] To improve quality of capacitive coupling, disadvantageous effects of capacitive coupling can be compensated by using matching structures, which are for example applied on the first conductor 201 and the second conductor 202, the protrusion 203, the at least one coupling surface 203a, the coupling portion 204, or the coupling member 208. To compensate the capacitive effect of the coupling it can be advantageous to use inductive matching structures that are in series with one or both of the first conductor 201 and the second conductor 202. Inductive matching structures can be thin lines which are thinner compared to the width of the input and output transmission lines, i.e. the first and/or second conductor 201, 202. A characteristic impedance that is present in the coupling area can be different from an input impedance that is present at the first conductor 201 or the second conductor 202 and can be used to tune the capacitive coupling to a predefined frequency band. The characteristic impedance which is present at the coupling area can also be adapted to the impedances which are present at the inputs of the first and/or second conductor 201, 202 using stepped impedance transformers. The matching can e.g. be achieved by changing the shape of the copper lines on the PCB.

[0062] The shape of the protrusion 203 can be essentially cylindrical, barrel shaped, conical, pyramid shaped, toric, prismatic and/or ellipsoid shaped. A cylindrical or barrel shaped protrusion 203 e.g. allows the protrusion 203 to be moveable along the longitudinal extension of the hull 208. A cylindrical, barrel shaped or conical protrusion 203 can allow the protrusion and/or the hull to rotate about at least a longitudinal axis of the protrusion and/or the hull 208. A conical or pyramid shaped protrusion 203, for example, enables to automatically center the protrusion 203 within the coupling member 208, in case that the coupling member 208 is shaped complementary to the protrusion 203. A toric, prismatic or ellipsoid shaped protrusion 203 may allow establishing capacitive coupling in complex arrangement manners of the protrusion 203 and the coupling member 208. The protrusion 203 can also be of circular, ellipsoidal, triangular, rectangular, trapezoid or polygonal cross section. Generally, the protrusion 203 may also be any kind of pin or bolt. The pin or bolt can be of homogeneous or inhomogeneous shape. The pin or bolt can include sections with different diameters along its longitudinal extension to improve capacitive coupling. The shape of the at least one coupling surface 203a can, at least partially or fully, reflect and/or follow the shape of the protrusion 203.

[0063] Fig. 2 further shows the first non-conductive plate 206 and the second non-conductive plate 207. The first non-conductive plate 206 and the second non-conductive plate 207 can e.g. be a PCB or a molded interconnect device (MID) structure, wherein MID technology is used for manufacturing three-dimensional electronic components, modules and circuits. Although the first non-conductive plate 206 and the second non-conductive plate 207 are referred to as plates, an arbitrary three-dimensional shape of the first non-conductive plate 206 and/or the second non-conductive plate 207 is possible, in particular when the first non-conductive plate 206 or the second non-conductive plate 207 are MIDs. In an example implementation of the conductor coupling arrangement 200 including the non-conductive plates 206, 207 which are MIDs, a side of the non-conductive plate 206, 207 may be regarded as a surface of the MID, wherein an opposite side or other side of the MID may be regarded as any other surface of the MID.

[0064] In order to provide a PCB or MID based conductor coupling arrangement 200, the conductors 201, 202 can be formed on the non-conductive plates 206, 207. Specifically, the first conductor 201 can be formed on the first non-conductive plate 206, and the second conductor 202 can be formed on the second non-conductive plate 207. To establish capacitive coupling of different types of transmission lines preferably formed by the conductors 201, 202 and the ground planes 211 and 209, e.g. a stripline and a microstrip, the conductor of the stripline can be formed on the first non-conductive plate 206 and the conductor of the microstrip can be formed on the second non-conductive plate 207, or vice versa.

[0065] To improve manufacturing of RF systems, further RF system components, such as antenna feeding network components, phase shifters or antenna elements (i.e. antenna radiators) can be arranged on the non-conductive plates 206, 207 and can be electrically connected to the conductors 201, 202, respectively. In an example implementation of an RF system comprising the conductor coupling arrangement 200, it is possible to arrange an antenna feeding network on the first non-conductive plate 206 and to arrange an antenna element on the second non-conductive plate 207.

[0066] To enable various arrangements of the first conductor 201, the second conductor 202, the protrusion 203, the coupling portion 204, the first non-conductive plate 206 and the second non-conductive plate 207, the coupling portion 204 is accessible from an opposite side of the second non-conductive plate 207. In particular, the protrusion 203 can at least partially protrude the second non-conductive plate 207 to reach the coupling portion 204.

[0067] In an example implementation of the conductor coupling arrangement 200 that does not comprise the coupling member 208, the second conductor 202 including the coupling portion 204 can be arranged on one side of the second non-conductive plate 207, while the coupling portion 204 is accessible from an opposite side of the second non-conductive plate 207. This can be achieved by an opening in the second non-conductive plate 207. As the coupling portion 204 is accessible from the opposite side of the second non-conductive plate 207 through an opening in the non-conductive plate 207, capacitive coupling can be established with the protrusion 203 that is separated from the second conductor 202 by the dielectric material 205. The dielectric material 205 can be at least partially applied to the surface of the protrusion 203 or the surface of the coupling member 204 in this case, or can be arranged between the protrusion 203 and the coupling member 204.

[0068] In an example implementation of the conductor coupling arrangement 200 that includes the second non-conductive plate 207 and the coupling member 208, the coupling member 208 can extend, at least partially, through the second non-conductive plate 207. This ensures that capacitive coupling of the coupling member 208 and the protrusion 203 can be established, if the second conductor 202 is arranged on one side of the second non-conductive plate 207 and the protrusion 203 is located on an opposite side of the second non-conductive plate 207. In a specific implementation example in which the coupling member 208 is the hull, the coupling member 208 can extend through the second non-conductive plate 207 and can receive and/or house the protrusion 203 from any side of the second non-conductive plate 207.

[0069] The conductor coupling arrangement 200 can also include a first ground plane 209. The protrusion 203 can protrude the first ground plane 209 to enable the arrangement of the components of the conductor coupling arrangement 200. The protrusion 203 can be isolated from the first ground plane 209, by the dielectric material described already in view of Fig. 1, e.g. air. The first ground plane 209 can in particular be arranged between the first conductor 201 and the second conductor 202 in order to avoid disadvantageous effects such as signal damping or signal interference., To enable capacitive coupling of the first conductor 201 and the second conductor 202, the protrusion 203 can protrude the first ground plane 209 and additionally can protrude the second non-conductive plate 207, at least partially.

[0070] Fig. 2 further shows a support means 210 and a second ground plane 211. The support means 210 is applied in order to mechanically support and stabilize the first conductor 201. The support means 210 can stabilize the first conductor 201 directly or indirectly. That is, the support means 210 can directly support the first conductor 201 when the first conductor 201 directly rests on the support means 210, or the support means 210 can indirectly support the first conductor 201 by supporting the first non-conductive plate 206 on which the first conductor 201 is formed and/or additional intermediate layers. The support means 210 in particular supports the first conductor 201 in an area where the protrusion 203 is formed on the first conductor 201. This prevents the first conductor 201, the protrusion 203 or the first non-conductive plate 206 from being damaged when force is applied to the protrusion 203 to establish capacitive coupling with the second conductor 202 and/or the coupling portion 204 and/or the coupling member 208. The support means 210 can be formed of non-conductive material, e.g. the dielectric material as described in view of Fig. 1.

[0071] The support means 210 can further distance the first conductor 201 and/or the protrusion 203 and/or the first non-conductive plate 206 on which the first conductor 201 is formed from the second ground plane 211. This in particular ensures that the first conductor 201, which is arranged between the first ground plane 209 and the second ground plane 211, is properly distanced from the ground planes 209, 211. Additionally, the support means 210 that supports the first conductor 201 and/or the protrusion 203 and/or the first non-conductive plate 206 is additionally supported by the second ground plane 211, which provides additional mechanical stability.

[0072] In addition, the support means 210 can be or can comprise a resilient means. The resilient means can be an elastic, such as a spring or rubber, or a mechanic, an electric, a pneumatic and/or a hydraulic apparatus which is adapted to apply force to the first conductor 201 and/or the protrusion 203 and/or the first non-conductive plate 206. The resilient means can be configured to apply force to the protrusion 203. The force can in particular be applied essentially parallel to the direction of the longitudinal extension of the protrusion 203 in order to improve capacitive coupling of the first conductor 201 and the second conductor 202. This can be specifically implemented by pressing the protrusion 203 towards the second conductor 202, the coupling portion 204 and/or the coupling member 208.

[0073] In a specific implementation example, the protrusion 203 can be pressed towards the second conductor 202 and/or the coupling portion 204 and/or the coupling member 208 which are formed on one side of the second non-conductive plate 207 and which are accessible from the opposite side of the second non-conductive plate 207, e.g. by means of an opening in the second non-conductive plate 207, wherein the protrusion is pressed towards the opposite side of the second non-conductive plate 207.

[0074] In each of the above described cases, a dielectric material 205 is arranged between the protrusion 203, the coupling portion 204 and/or the coupling member 208.

[0075] In another specific implementation example, the protrusion 203 can be pressed towards the coupling member 208, e.g. the hull. The coupling member 208 is closed at one end. Capacitive coupling of the protrusion 203 and the coupling member 208 is enabled by receiving and/or housing the protrusion 203 through the open end of the coupling member 208 wherein the protrusion 203 is further pressed to the inner surface of the closed end of the coupling member 208. The protrusion 203 and the inner surface of the closed end of the coupling member 208 are separated by means of the dielectric material 205.

[0076] The resilient means ensures quality of capacitive coupling, as it avoids gaps between the protrusion 203, the dielectric material 205 and the coupling portion 204, and/or the coupling member 208, which can negatively affect the coupling quality.

[0077] As illustrated in Fig. 2, to further improve quality of capacitive coupling, an insulating layer 212 can be applied on a side of the second non-conductive plate 207. The insulating layer 212 can be made of the dielectric material as described in view of Fig. 1. The insulating layer 212 can in particular be air. In a specific implementation manner, the insulating layer 212 can be arranged between the second non-conductive plate 207 and the first ground plane 209. The insulating layer 212 can be used to avoid disadvantageous effects of capacitive coupling, in particular to improve PIM behaviour. Specifically, by the insulating layer 212 prevents conductive contact between the first ground plane 209 and the second ground plane 210. The insulating layer 212 is typically used for capacitive coupling of the ground planes 209, 210.

[0078] Fig. 3 shows a schematic overview of a conductor coupling arrangement 300 according to another embodiment of the present invention. In Fig. 3 a first conductor 301, a second conductor 302, a protrusion 303 with least one coupling surface 303a, a coupling portion 304, a dielectric material 305, a first non-conductive plate 306, a second non-conductive plate 307, a first ground plane 309, a support means 310, a second ground plane 311 and an insulating layer 312 are shown. The conductor coupling arrangement 300, the first conductor 301, the second conductor 302, the protrusion 303, the coupling portion 304, the dielectric material 305, the first non-conductive plate 306, the second non-conductive plate 307, the first ground plane 309, the support means 310, the second ground plane 311 and the insulating layer 312 described in view of Fig. 3 essentially comprise the features and functionality of the respective components described in view of Figs. 1 and/or 2.

[0079] As shown in Figs. 3 and 4, a coupling member 408 can be a conductive area separated from the second conductor 302 by the second non-conductive plate 307. The coupling member 408 is shown in more detail in Fig. 4, which schematically shows the side of the second non-conductive plate 307 opposite of the side the second conductor 302 is arranged on. The coupling member 408 in particular can be arranged on the side of the second non-conductive plate 307 facing the at least one coupling surface 303a of the protrusion 303, or the least one coupling surface 303a, respectively. To enable capacitive coupling of the first conductor 301 and the second conductor 302, the coupling member 408 is conductively linked to the coupling portion 304 of the second conductor 302 e.g. by vias 313, which reach through the second non-conductive plate 307. The vias 313 can be integrally formed with the second conductor 302 (schematically indicated by dashed lines in Fig. 4) and/or the coupling member 408.

[0080] Fig. 4 in particular shows that he coupling member 408 is a conductive area arranged on the second non-conductive plate 307, which can be conductively linked to the coupling portion 304 of the second conductor 302. The coupling member 408 in particular can be of circular shape, but may also be of any other shape that matches the shape of the coupling surface of the protrusion 303.

[0081] In a specific implementation example, the second ground plane 309 can be realized as a metalized layer on the side of the second non-conductive plate 307 opposite of the side the second conductor 302 is arranged on. The coupling member 408 can be arranged on the same side as the metalized layer. In order to enable capacitive coupling of the at least one coupling surface 303a of the protrusion 303 and the coupling member 408, the coupling member 408 has to be isolated from the metalized layer to avoid direct contact of the coupling member 408 and the metalized layer. This can be achieved by providing a portion of the second non-conductive plate 307 without metalized layer, in which the coupling member 408 is positioned and/or leaving an isolating border zone around the coupling member 408.

[0082] As shown in Figs. 3 and 4, capacitive coupling according to this embodiment is provided by the at least one coupling surface 303a of the protrusion 303, the dielectric material 305 and the coupling member 408. Quality of capacitive coupling can be improved by the support means 310, which presses the protrusion 303 towards the coupling member 408, whereby the at least one coupling surface 303a of the protrusion 303 and the coupling member 408 are separated by the dielectric material 305. This solution improves quality of capacitive coupling by minimizing gaps between the protrusion 303 and the dielectric material 305 respectively the dielectric material 305 and the coupling member 408. In Fig. 3 the support means 310 is a resilient means pressing the protrusion 303 towards the coupling member. The resilient means is illustrated as a spring. However, the resilient means can be any resilient means, for example, as described in view of Fig. 2.

[0083] Characteristics of the capacitive coupling can be controlled by the dimensions of the least one coupling surface 303a of the protrusion 303 (e.g. by its diameter), the thickness of the dielectric material 305, and by the size of a coupling area in which the protrusion 303 and the coupling member 408 overlap. In view of Fig. 3 and Fig. 4, the coupling area is the area in which the at least one coupling surface 303a of the protrusion 303 is aligned with the coupling member 408. The surface of the coupling area is in particular determined by the diameter of the smaller one of the at least one coupling surface 303a of the protrusion 303 and the surface of the coupling member 408.

[0084] In order to provide good capacitive coupling, the thickness d of the dielectric material 305, the permittivity ε_r of the dielectric material 305, the dielectric constant or free space permittivity ε_0, and the surface of the coupling area A should, but do not have to satisfy the following relation:

$$\frac{d}{2\pi f \varepsilon_r \varepsilon_0 A} \leq 1$$

[0085] If the relation cannot be met by the design, the capacitance introcduced by the capacitive coupling can be compensated by suitable matching structures as previously described with reference to Fig. 2. In order to address manufacturing tolerances and mechanical misalignment, the surface of the coupling member 408 can be larger than the at least one coupling surface 303a of the protrusion 303. The same effect can be reached, vice versa, when the at least one coupling surface 303a of the protrusion 303 is larger than the surface of the coupling member 408.

[0086] A further implementation example of the conductor coupling arrangement 200 is now described with reference to Fig. 5. Fig. 5 shows a schematic overview of an implementation example based on the conductor coupling arrangement 200 according to the present invention, which includes a clamping mechanism. More specifically, Fig. 5 shows a dual connector for coupling RF system components with two conductor coupling arrangements 500.

[0087] In Fig. 5, the conductor coupling arrangement 500, a protrusion 503, a dielectric material 505, a first non-conductive plate 506, a second non-conductive plate 507, a coupling member 508, a first ground plane 509 and a second ground plane 511 are shown. The conductor coupling arrangement 500, the protrusion 503, the dielectric material 505, the first non-conductive plate 506, the second non-conductive plate 507, the coupling member 508, the first ground plane 509 and the second ground plane 511 essentially comprise the features and functionality of the respective components of the conductor coupling arrangement 200.

[0088] Fig. 5 additionally shows a clamping mechanism. The clamping mechanism ensures that at least two of the first non-conductive plate 506, the second non-conductive plate 507, the first ground plane 509, the second ground plane 511, the protrusion 503, the coupling portion 204 (not shown in Fig. 5), the dielectric material 505, and the coupling member 508 can be secured with or against each other. The clamping mechanism can include clamping means 514. The clamping means 514 can in particular be formed integrally with, or fastened to the first non-conductive plate 506 and/or the second non-conductive plate 507. However, the clamping means 514 can also be integrally formed with, or fastened to, the protrusion 503, the dielectric material 505, the coupling member 508, the first ground plane 509 and/or the second ground plane 511.

[0089] In Fig. 5, the clamping means 514 is illustrated as a snap hook 514, which is used to secure the first non-conductive plate 506 with or against the second non-conductive plate 507. In the example shown in Fig. 5, the clamping mechanism can be used to mount an antenna element, which is disposed on the second non-conductive plate 507, to an antenna feeding network, which is disposed on the first non-conductive plate 506. The first ground plane 509 can at the same time be an antenna reflector of the antenna element. The clamping mechanism ensures that a RF system can be assembled with a minimum number of processing steps, tools and/or separate parts. Specifically, the two RF system components can be clamped together by using the snap hooks 514.

[0090] A similar clamping mechanism can also be applied to the conductor coupling arrangement 300. Fig. 6 shows a schematic overview of an implementation example based on the conductor coupling arrangement 300. More specifically, Fig. 6 shows a dual connector for coupling RF system components that implements two conductor coupling arrangements 300.

[0091] In Fig. 6, a conductor coupling arrangement 600, a protrusion 603, a coupling portion 604, a dielectric material 605, a first non-conductive plate 606, a second non-conductive plate 607, a coupling member 608, a first ground plane 609, a support means 610 and a second ground plane 611 are shown. The conductor coupling arrangement 600, the protrusion 603, the coupling portion 604, the dielectric material 605, the first non-conductive plate 606, the second non-conductive plate 607, the coupling member 608, the first ground plane 609, the support means 610 and the second ground plane 611 essentially comprise the features and functionality of the respective components described in view of Fig. 3.

[0092] Fig. 6 shows the clamping mechanism. The clamping mechanism ensures that at least two of the first non-conductive plate 606, the second non-conductive plate 607, the first ground plane 609, the second ground plane 611, the protrusion 603, the coupling portion 604 the dielectric material 605, the coupling member 608 and the support means 610 can be secured with or against each other. The clamping mechanism can include clamping means 614. The clamping means can in particular be formed integrally with, or fastened to the first non-conductive plate 606 and/or the second non-conductive plate 607. However, the clamping means 614 can also be integrally formed with, or fastened to the protrusion 603, the coupling portion 604, the electric material 605, the coupling member 608, the first ground plane 609, the support means 610 and/or the second ground plane 611.

[0093] In Fig. 6, the clamping means 614 is illustrated as a snap hook 614 which is used to secure the first non-conductive plate 606 with or against the second non-conductive plate 607. In the example as shown in Fig. 6, the clamping mechanism is used to capacitively connect RF system components. As the conductor coupling arrangement 600 described in view of Fig. 6 is based on the conductor coupling arrangement 300 as described in view of Fig. 3, the support means 610 is a resilient means illustrated as a spring that ensures good capacitive coupling of the protrusion 603 and the coupling member 608 which are separated by the dielectric material 605. The clamping mechanism ensures that a RF system comprising the conductor coupling arrangement 600 can be assembled with a minimum number of processing steps, tools and/or parts. Specifically, the two RF components can be clamped together by using the snap hooks 614.

[0094] According to an implementation example of the present invention based on the conductor coupling arrangement 600, a conductor coupling arrangement 700 is now described in view of Fig. 7. In Fig. 7 a second conductor 702, a protrusion 703, a coupling portion 704, a dielectric material 705, a first non-conductive plate 706, a second non-conductive plate 707, a coupling member 708, a support means 710, a second ground plane 711 and a clamping means 714 are shown, which essentially comprise the features and functionality of the respective components described in view of Fig. 6.

[0095] The operating principle of the conductor coupling arrangement 700 relates to the operating principle of the conductor coupling arrangement 600 as described in view of Fig. 6. Fig. 7 differs from Fig. 6 in that the position of the protrusion 703 and the position of the coupling member 708 are reversed compared to the position of the protrusion 603 and the position of the coupling member 608. The coupling member 708 is formed on a first conductor. For ease of illustration, the first conductor is not shown in Fig. 7. The first conductor is arranged on the first non-conductive plate 706. The second conductor 702 is arranged on the second non-conductive plate 707 and conductively linked to the protrusion 703 by means of the coupling portion 704. Capacitive coupling of the first conductor and the second conductor 702 is facilitated by the protrusion 703, the dielectric material 705 and the coupling member 708. For ease of illustration, the dielectric material 705 and the coupling member 708 are shown as one entity in Fig. 7. However, the dielectric material 705 is arranged between the protrusion 703 and the coupling member 708. To secure the first non-conductive plate 706 and the second non-conductive plate 707 with or against each other, a clamping mechanism comprising the clamping means 714 is implemented. In order to improve quality of capacitive coupling, the coupling member 708 is pressed towards the protrusion 703 by the support means 710, which is arranged on an opposite side of the first non-conductive plate 706. The support means 710 is a resilient means, illustrated as a spring in Fig. 7. The support means 710 is further configured to distance the first non-conductive plate 706 from the second ground plane 711.

[0096] The implementation example as described in view of Fig. 7 allows manufacturing of a dual connector for connecting RF system components, e.g. for connecting an antenna element to a feeding network, wherein the protrusion 703 is soldered to the antenna element and the coupling member 708 is soldered to the feeding network. This ensures that multiple ways to arrange RF system components are provided when using the conductor coupling arrangement 700.

[0097] According to an implementation example of the present invention based on the conductor coupling arrangement 500, a conductor coupling arrangement 800 is now described in view of Fig. 8. In Fig. 8 a protrusion 803, a dielectric material 805, a first non-conductive plate 806, a second non-conductive plate 807, a coupling member 808 and a clamping means 814 are shown. The conductor coupling arrangement 800, the protrusion 803, the dielectric material 805, the first non-conductive plate 806, the second non-conductive plate 807, the coupling member 808 and the clamping means 814 essentially comprise the features and functionality of the respective components described in view of Fig. 5.

[0098] Fig. 8 shows a cross-section of the conductor coupling arrangement 800 in which the protrusion 803 is implemented as a conical pin on a conical portion of a molded interconnect device (MID) structure 806. The MID structure 806 represents the first non-conductive plate 806. The protrusion 803 is formed on a first conductor. The first conductor is not shown in Fig. 8. The first conductor however can be formed on or in the first non-conductive plate 806. It is possible for multiple conductor coupling arrangements 800 to share the same first non-conductive plate 806, respectively the same second non-conductive plate 807. To enable capacitive coupling, the coupling member 808 is separated from the protrusion 803 by the dielectric material 805. The dielectric material 805 and the coupling member 808 also can be shaped conical so as to match the shape of the protrusion 803. The coupling member 808 as shown in Fig. 8 may be regarded as a conical hull 808 that receives and/or houses the conical protrusion 803. A clamping mechanism can be used to secure the first non-conductive plate 806 with or against the second non-conductive plate 807 by using clamping means 814. In Fig. 8 the clamping means 814 and the first non-conductive plate 806 are formed as an integral MID structure.

[0099] The implementation example as described in view of Fig. 8 allows manufacturing of conductor coupling arrangements 800 in arbitrary three-dimensional shape, e.g. by using MID structures, to enable capacitive coupling. The MID structure 806 in particular allows integrally forming of clamping means in the MID structure 806.

[0100] According to an implementation example of the present invention based on the conductor coupling arrangement 200, a conductor coupling arrangement 900 is now described in view of Fig. 9. In Fig. 9 a protrusion 903, a first non-conductive plate 906, a second non-conductive plate 907, a coupling member 908 and a first ground plane 909 are shown. The conductor coupling arrangement 900, the protrusion 903, the first non-conductive plate 906, the second non-conductive plate 907, the coupling member 908 and the first ground plane 909 essentially comprise the features and functionality of the respective components described in view of Fig. 2.

[0101] Fig. 9 shows a cross-section of a conductor coupling arrangement 900 in which the protrusion 903 is formed as a conical portion of an MID structure 906. The MID structure 906 is the first non-conductive plate 906. A first conductor, which is not shown for ease of illustration, can be formed in or on the MID structure 906. In order to establish capacitive coupling, the conical portion of the MID structure 906 on which the conical protrusion 903 is formed can protrude the first ground plane 909 to be pressed towards or against the coupling member 908. The coupling member 908 is also shaped conical in order to receive and/or house the conical protrusion 903. The coupling member 908 can also be regarded as a conical hull 908. A dielectric material is arranged between the protrusion 903 at the coupling member 908 in order to enable capacitive coupling. The dielectric material is not shown in Fig. 9. In Fig. 9 the coupling member 908 is arranged on the second non-conductive plate 907. A second conductor and a coupling portion can be present on the second non-conductive plate 907, but are not shown in Fig. 9 in order to facilitate ease of illustration.

[0102] The MID structure 906 as shown in Fig. 9 can be used to house an antenna element, such as an antenna radiator or an antenna dipole. The MID structure 906 can further be used to additionally house an antenna feeding network. This facilitates to directly capacitively couple an antenna element, comprising an antenna radiator and an antenna feeding network, to a RF device without the need for further RF system components.

[0103] In Fig. 10, a schematic overview of a RF system 1000 comprising a conductor coupling arrangement 100 according to an embodiment of the present invention is shown. The conductor coupling arrangement 100 as shown in Fig. 10 is the conductor coupling arrangement 100 according to Fig. 1. However, the RF system 1000 can also comprise a conductor coupling arrangement as described in view of any one of Figs. 2 to 9. The RF system 1000 can be any kind of system that is operated with radio frequency. The RF system 1000 can for example be an antenna system, an antenna feeding network, an antenna element, an antenna radiator or a phase shifter. The RF system 1000 can be operated with radio frequency of any bandwidth, preferably with a bandwidth from 250 MHz to 70 GHz, more preferably with a bandwidth from 300 MHz to 30 GHz. The conductor coupling arrangement 100 is used in the RF system 1000 to couple RF system components of the RF system 1000. The RF system 1000 can also comprise a various amount of conductor coupling arrangements 100 in order to couple various RF system components.

[0104] The invention has been described in conjunction with various embodiments herein. However, other variations to the enclosed embodiments can be understood and effected by those skilled in the art and practicing the claimed invention, from a study of the drawings, the disclosure and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. A single processor or other unit may fulfill the functions of several items recited in the claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. A computer program may be stored/distributed on a suitable medium, such as an optical storage medium or a solid-state medium supplied together with or as part of other hardware, but may also be distributed in other forms, such as via the internet or other wired or wireless telecommunication systems.

Claims

1. Conductor coupling arrangement (100) for coupling conductors (101, 102), comprising:

- a first conductor (101), and
- a second conductor (102), wherein

a protrusion (103), formed of conductive material on the first conductor (101), extends essentially perpendicular to a longitudinal extension of the first conductor (101), and wherein at least one coupling surface (103a) of the protrusion (103) is separated from a coupling portion (104) of the second conductor (102) by at least a dielectric material (105), forming a capacitive coupling between the first conductor (101) and the second conductor (102).

2. Conductor coupling arrangement (200) according to claim 1, wherein
the coupling portion (204) of the second conductor (202) is connected to a coupling member (208), wherein the coupling member (208) preferably is a hull, configured to receive and/or at least partially house the protrusion (203), and wherein the hull is preferably formed on the second conductor (202) and/or is formed of conductive material.

3. Conductor coupling arrangement (200) according to claim 1 or 2, wherein
surfaces of the coupling member (208) facing the at least one coupling surface (203a) of the protrusion (203) are at least partially covered with a dielectric material (205), especially where the protrusion (203) is received and/or housed.

4. Conductor coupling arrangement (200) according to any one of the preceding claims, wherein the protrusion (203) is essentially cylindrical, barrel shaped, conical, pyramid shaped, toric, prismatic and/or ellipsoid shaped.

5. Conductor coupling arrangement (200) according to any one of the preceding claims, wherein the protrusion (203) is soldered to the first conductor (201) and/or wherein the coupling member (208) is soldered to the second conductor (202).

6. Conductor coupling arrangement (200) according to any one of the preceding claims, wherein the first conductor (201) is formed on a first non-conductive plate (206) and/or the second conductor (202) is formed on a second non-conductive plate (207), e.g. as a PCB or MID.

7. Conductor coupling arrangement (300) according to any one of the preceding claims, wherein the coupling member (408) is a conductive area separated from the second conductor (302) by the second non-conductive plate (307), preferably arranged on an opposite side of the second non-conductive plate (307), and/or wherein the coupling member (408) is conductively linked to the coupling portion (304) of the second conductor (302), e.g. by vias (313).

8. Conductor coupling arrangement (200) according to any one of the preceding claims, wherein the protrusion (203) protrudes a first ground plane (209), in electric isolation therefrom, and/or at least partially protrudes the second non-conductive plate (207), and/or wherein the first ground plane (209) is arranged between the first conductor (201) and the second conductor (202).

9. Conductor coupling arrangement (200) according to any one of the preceding claims, wherein the coupling member (208) extends, at least partially, through the second non-conductive plate (207).

10. Conductor coupling arrangement (200) according to any one of the preceding claims, wherein the first conductor (201) is, directly or indirectly, supported by a support means (210), preferably distancing the first conductor (201) from a second ground plane (211), wherein the support means (210) is configured to support the first conductor (201) especially in an area comprising the protrusion (203; 303), and/or wherein the support means (210) is formed of non-conductive material.

11. Conductor coupling arrangement (200) according to any one of the preceding claims, wherein the support means (210) is or comprises a resilient means, configured to apply a force to the protrusion (203), the force being applied essentially in parallel to a longitudinal extension of the protrusion (203), pressing the protrusion (203) towards the second conductor (202).

12. Conductor coupling arrangement (200) according to any one of the preceding claims, wherein at least two of the first non-conductive plate (206), the second non-conductive plate (207), the first ground plane (209), the second ground plane (211), the protrusion (203) and the coupling member (208) are secured with or against each other by a clamping mechanism.

13. Conductor coupling arrangement (200) according to any one of the preceding claims, wherein the clamping mechanism comprises clamping means (514), the clamping means (514) being in particular integrally formed with the first non-conductive plate (206) and/or the second non-conductive plate (207).

14. Conductor coupling arrangement (200) according to any one of the preceding claims, wherein the coupling portion (204) is accessible from an opposite side of the second non-conductive plate (207).

15. RF system, comprising a conductor coupling arrangement (100) according to any one of the preceding claims.

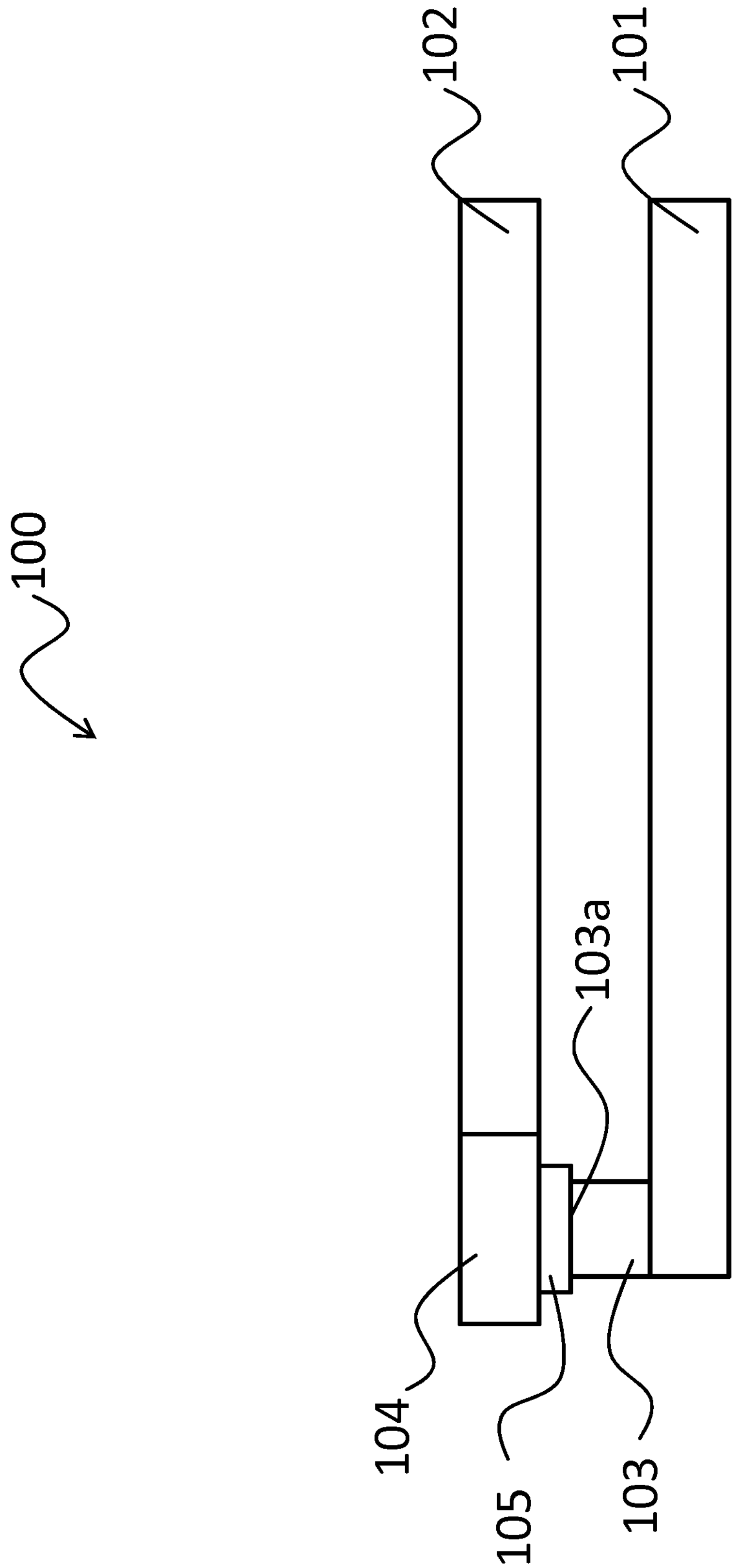

Fig. 1

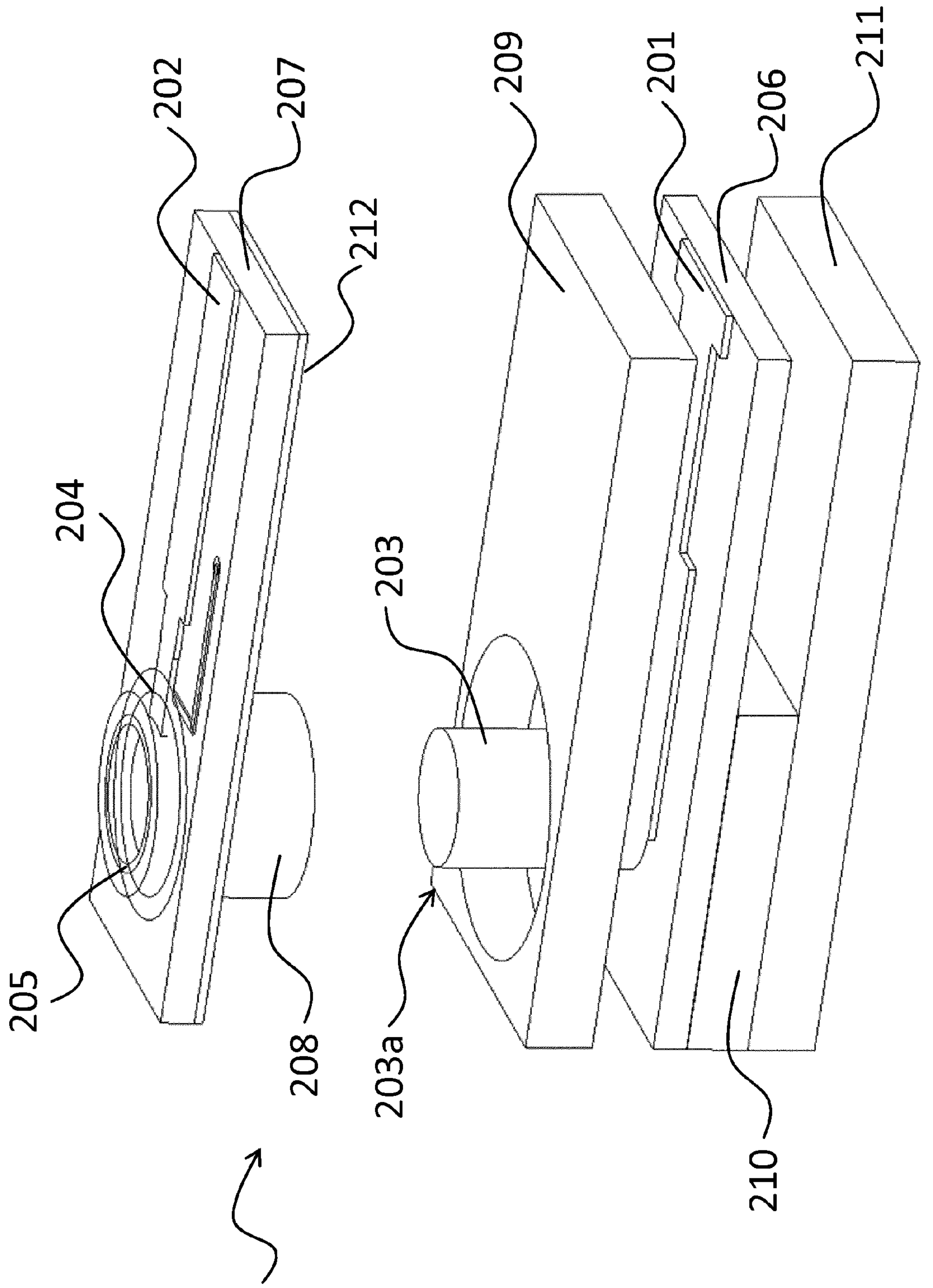

Fig. 2

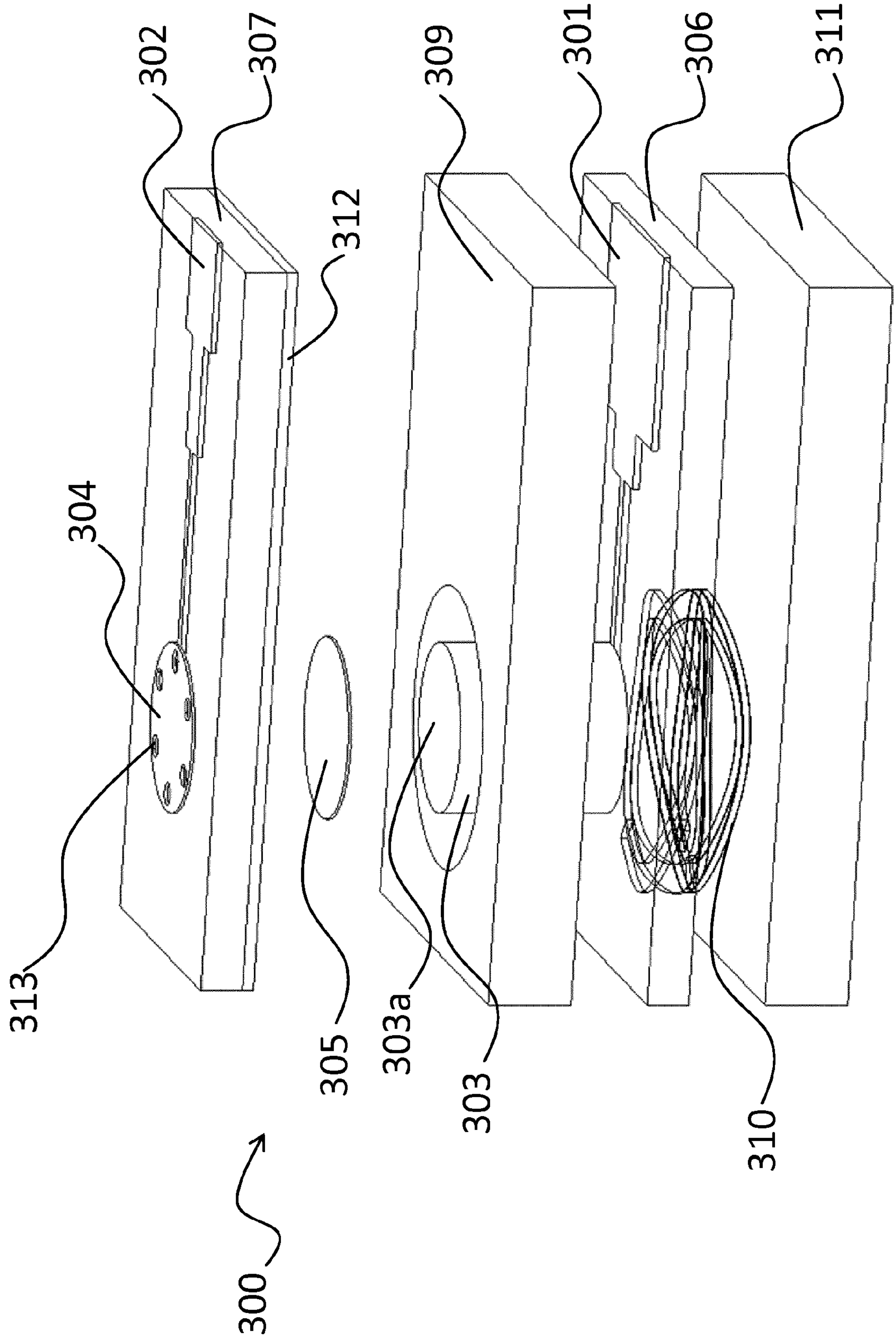

Fig. 3

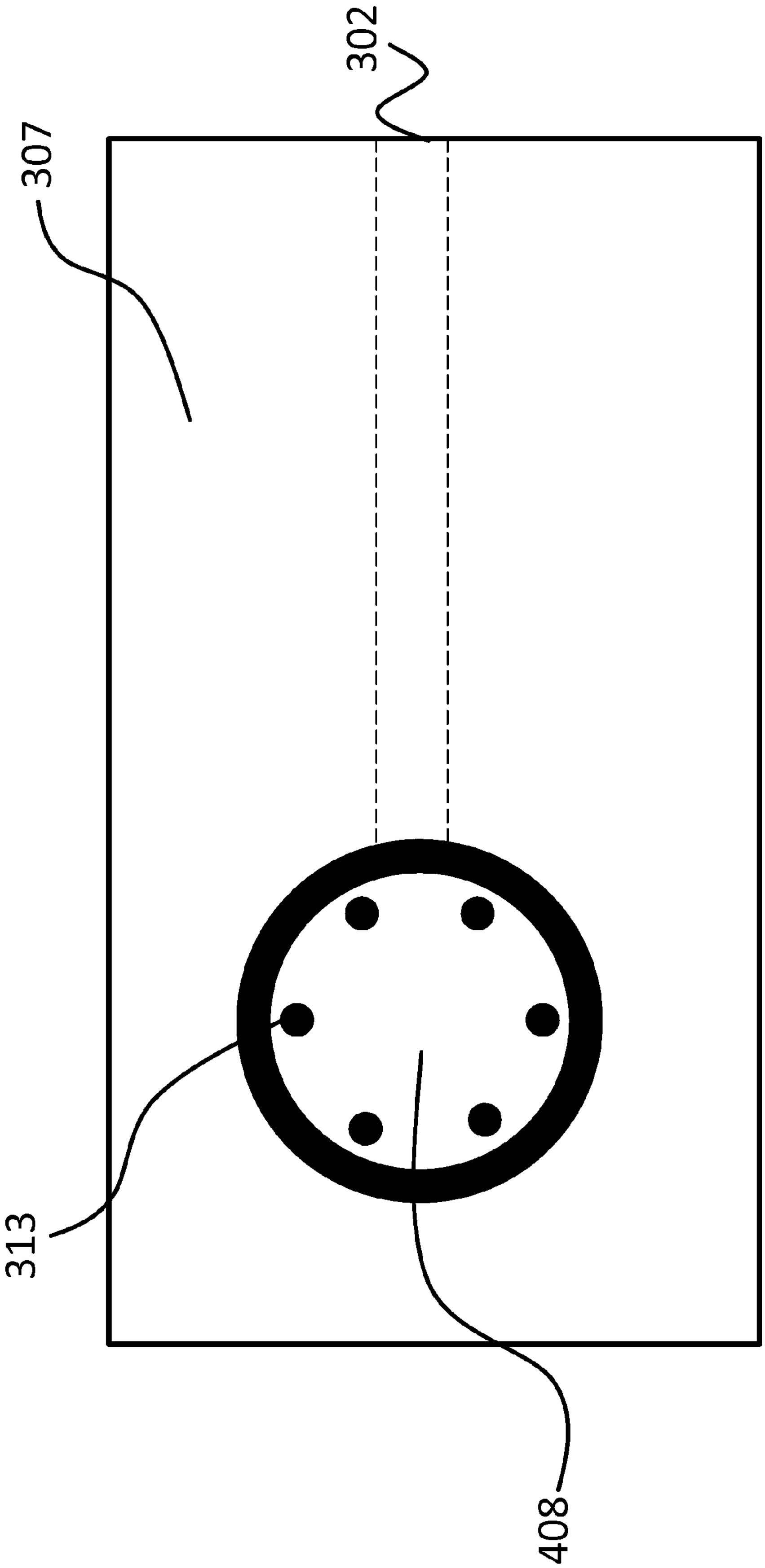

Fig. 4

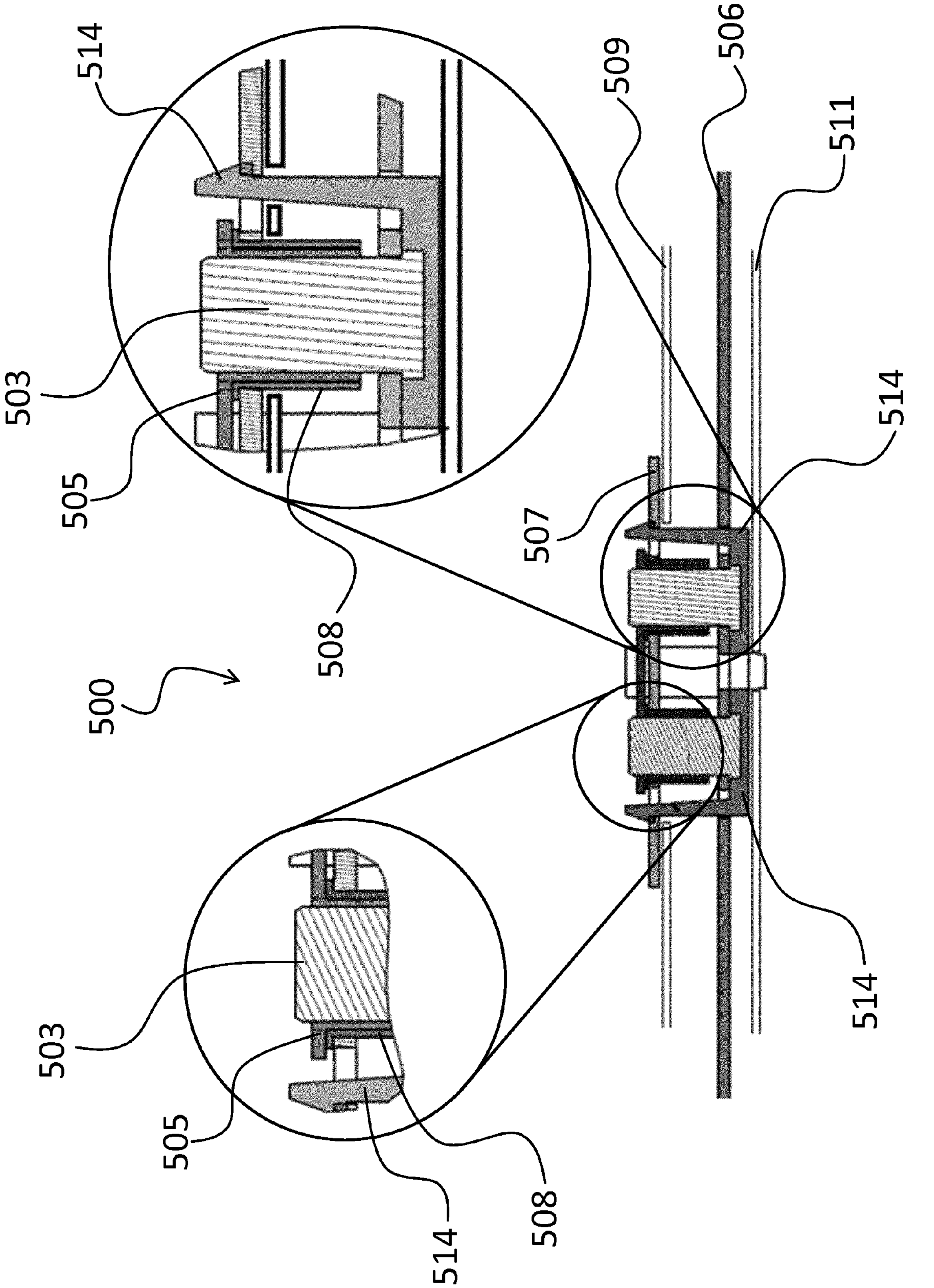

Fig. 5

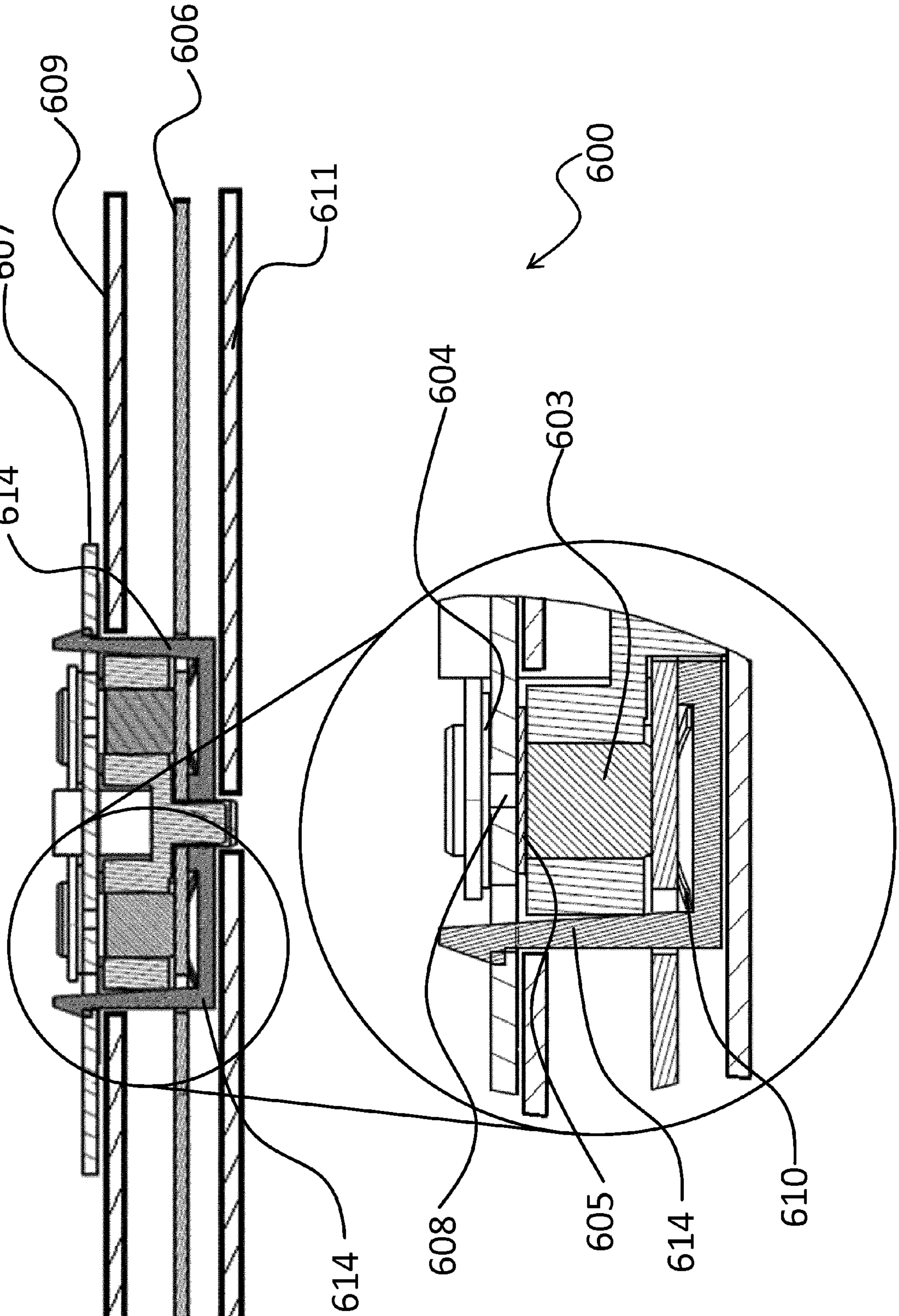

Fig. 6

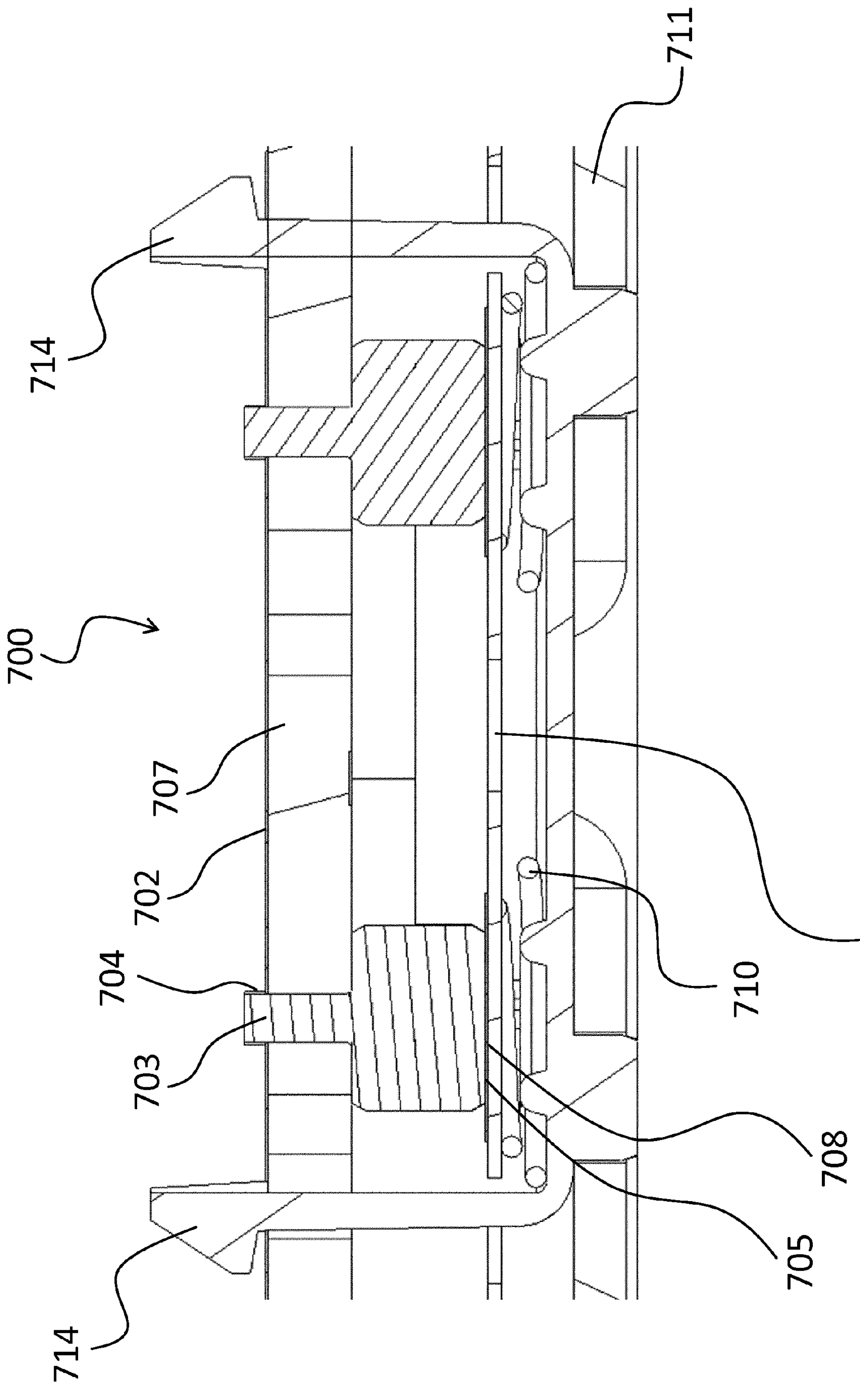

Fig. 7

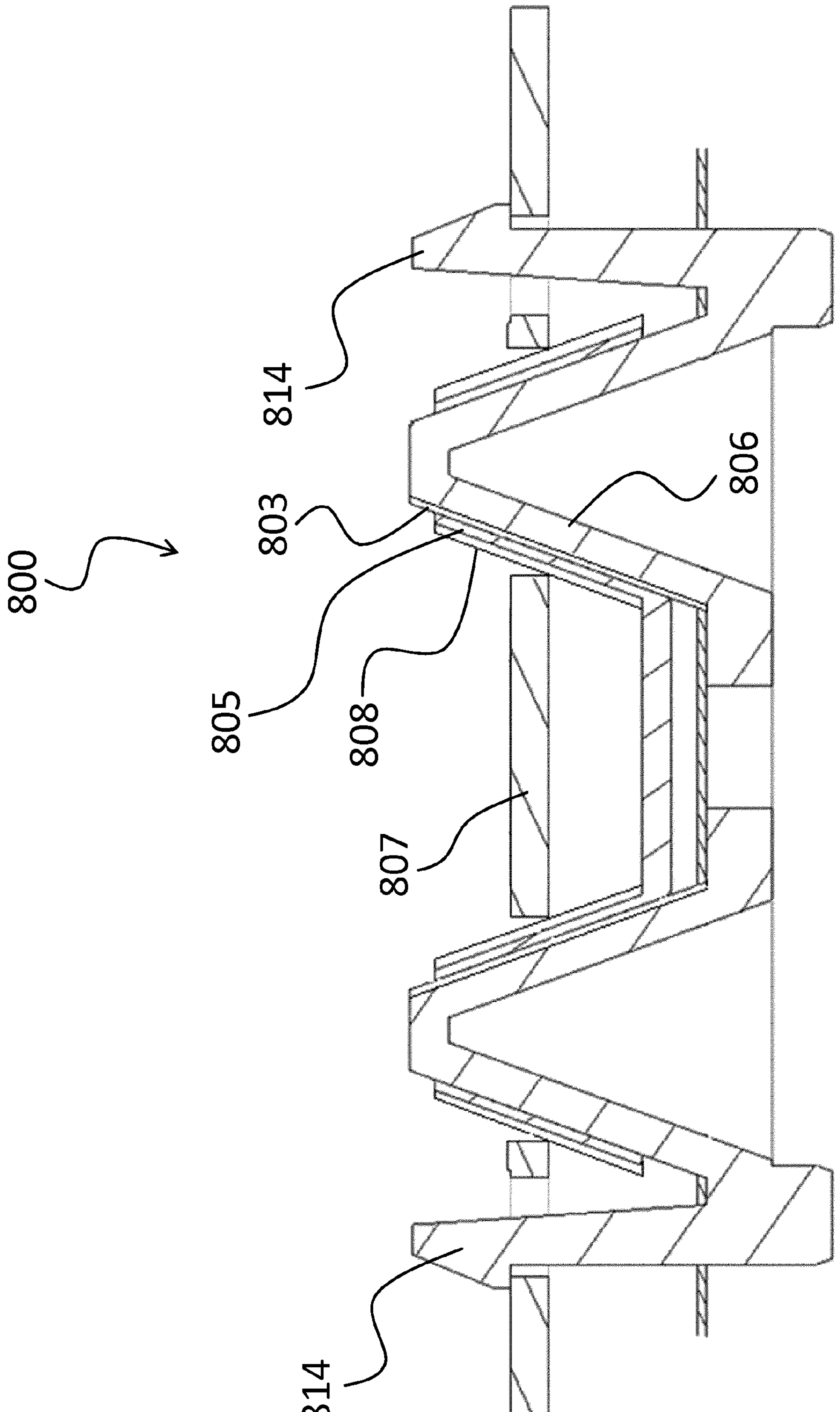

Fig. 8

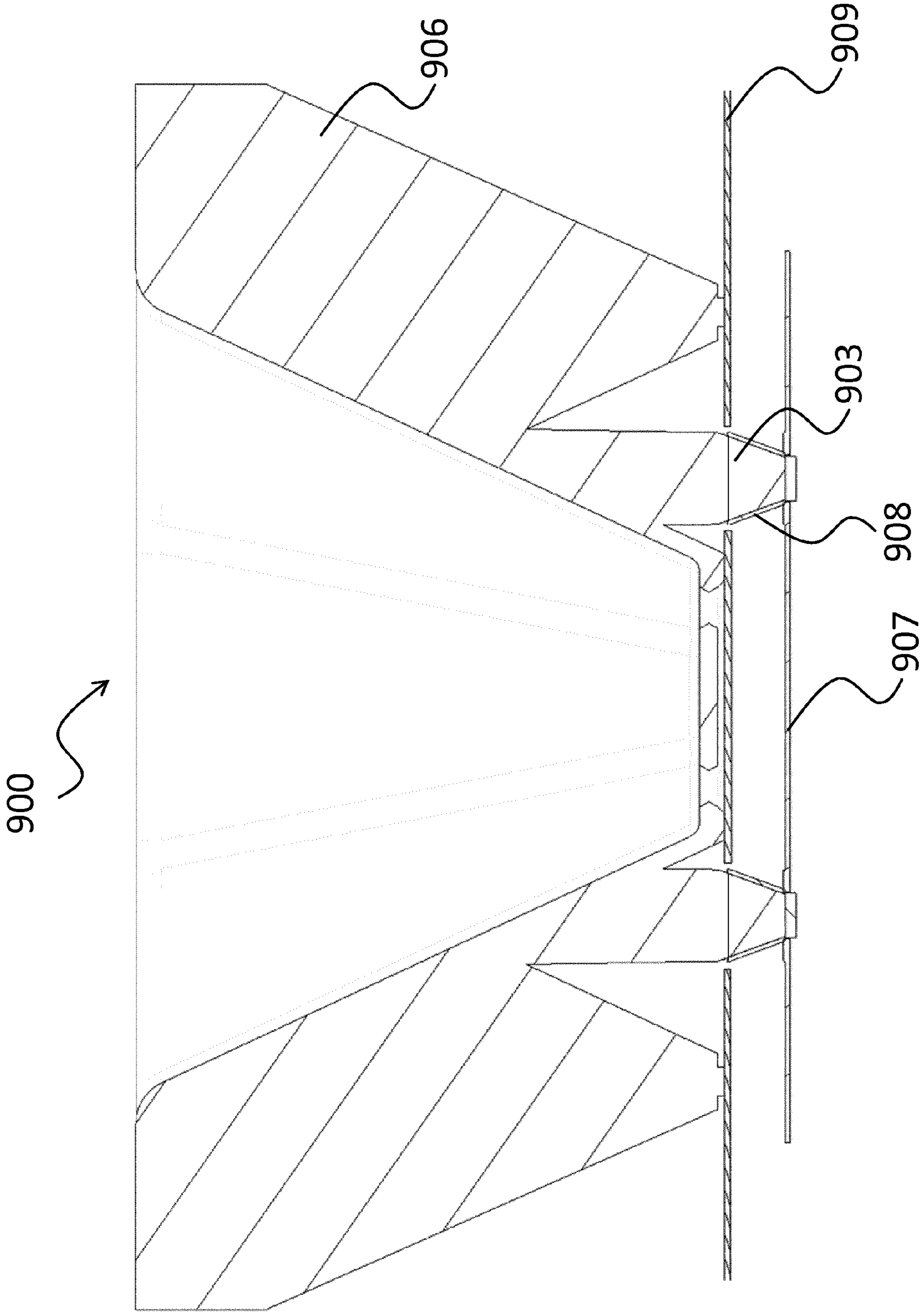

Fig. 9

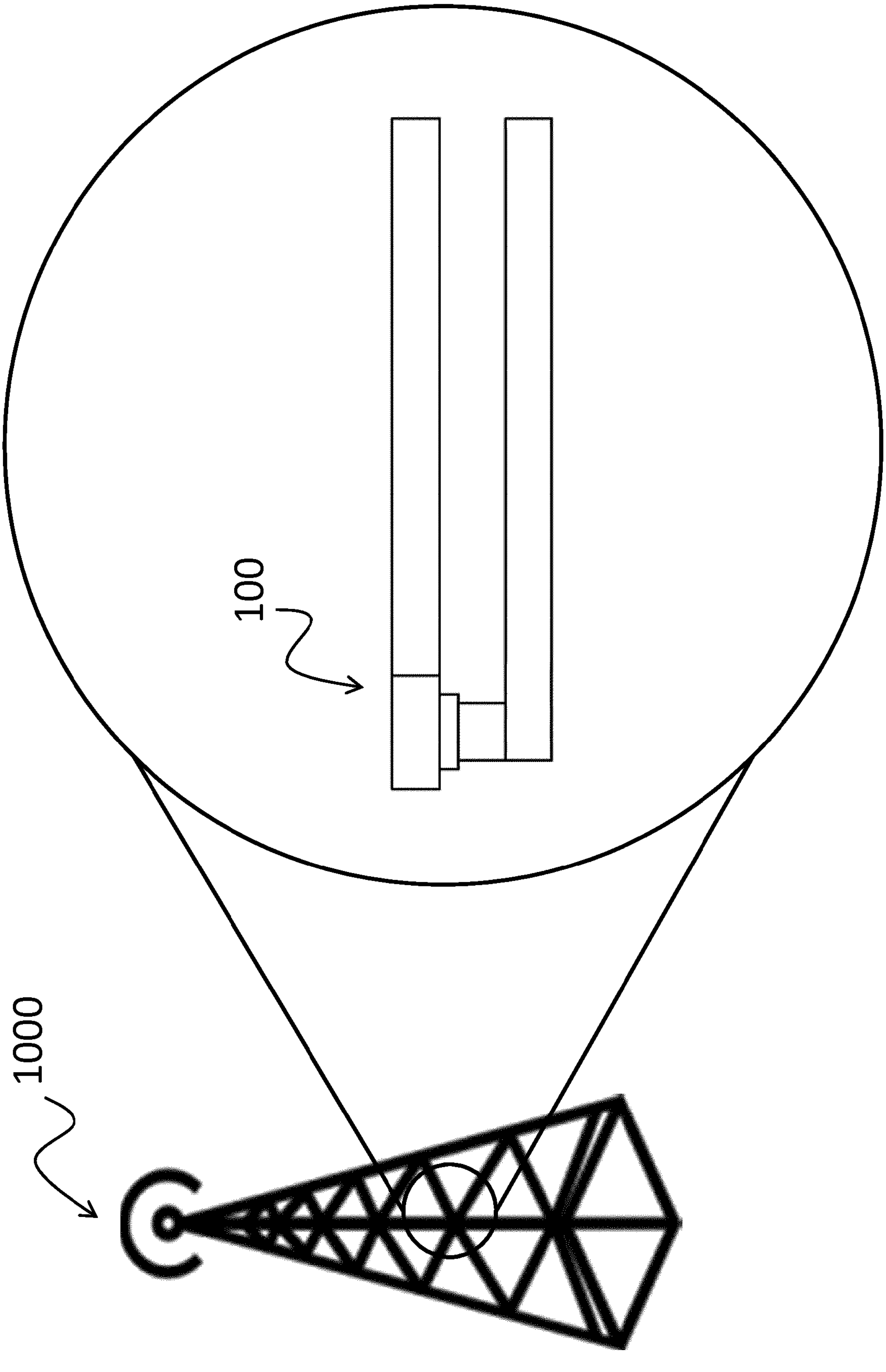

Fig. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 16 15 9209

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	US 5 156 559 A (SOMMER ERNST [DE] ET AL) 20 October 1992 (1992-10-20) * column 1, line 7 - column 2, line 60; figure 1 *	1-10,14, 15 11-13	INV. H01P5/02 H01R24/38 ADD. H01P5/08 H01R13/66
X A	"Method for Implementing an AC Capacitively-Coupled Interconnect Using Coaxial PTH Vias in Organic Packages", IP.COM JOURNAL, IP.COM INC., WEST HENRIETTA, NY, US, 17 June 2010 (2010-06-17), XP013138699, ISSN: 1533-0001 * the whole document *	1-4,6-8, 10,14,15 5,9, 11-13	
Y,D A	US 2012/256794 A1 (VEIHL JONATHON C [US] ET AL) 11 October 2012 (2012-10-11) * page 4, paragraph 97 - page 6, paragraph 116; figure 3 * * page 6, paragraph 117 - page 7, paragraph 119; figures 6-8 * * page 6, paragraph 120 - page 6, paragraph 123 *	11-13 1,3,10, 14,15	

TECHNICAL FIELDS SEARCHED (IPC)

H01P
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Place of search	Date of completion of the search	Examiner
The Hague	7 September 2016	Blech, Marcel

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