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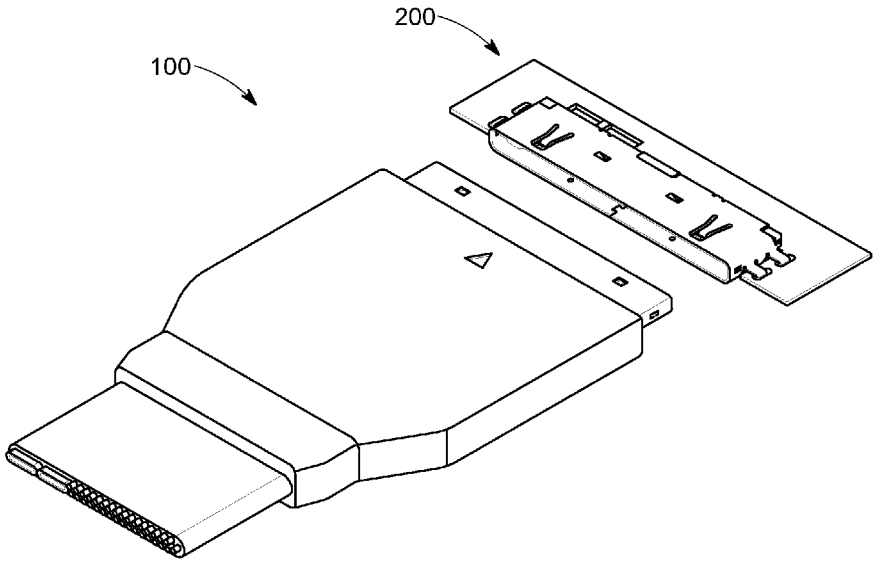


FIG. 1

(57) Abstract: The present disclosure relates to a connector assembly for high speed signal transmission, which enables signal transmission and reception between an antenna module having a microstrip circuit and a wave guide having a dielectric layer. The connector assembly includes: a plug including: a wave guide module; a first housing; and a first connector shell, the wave guide module including a wave guide for transmitting an RF signal along a dielectric filled therein, and a guide block integrally formed with an exterior of the wave guide to guide coupling of the wave guide, the first housing formed of an insulating material to receive a leading end of the wave guide, the first connector shell coupled along a surface of the first housing; and a receptacle including: a control substrate; an antenna module arranged on the control substrate and having an RF chip mounted on an RF substrate having a microstrip line formed therein to transmit and receive an RF signal: a second housing having a space to receive the antenna module and receiving the antenna

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module on one side; and a second connector shell mounted on the control substrate while being coupled along a surface of the second housing, wherein the first connector shell and the second connector shell are fastened to each other such that one surface of the wave guide and one surface of the antenna module face each other, and are configured to transmit an RF signal between the dielectric and the microstrip line.

CONNECTOR ASSEMBLY FOR HIGH SPEED SIGNAL TRANSMISSION USING DIELECTRIC WAVE GUIDE

RELATED APPLICATIONS

[0001] This application claims priority to Korean Application No. 10-2017-0025709, filed February 27, 2017, which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] The present disclosure relates to a connector, and more particularly, to a connector assembly for high speed signal transmission, which enables signal transmission and reception between an antenna module having a microstrip circuit and a wave guide having a dielectric layer.

BACKGROUND ART

[0003] In recent years, there is an increasing demand for a bandwidths in wired communication, and this requires high-speed, low-power, and low-price input/output (I/O). For example, high speed signal transmission and reception of 100 Gbps or higher is required between a main body of a next-generation TV and a set-top box.

[0004] Related-art signal transmission means using a conductor (for example, Cu) have a signal attenuation problem that is caused by a skin effect on a metal surface of the conductor, and thus is not suitable for high speed signal transmission.

[0005] An optical communication solution may be used as an appropriate example of high speed communication means, and the optical communication solution may not cause a signal attenuation phenomenon such as a skin effect, and thus may be advantageous to high speed signal transmission of 100 Gbps or higher. However, since the optical communication solution

should achieve exact signal transmission in a connector assembly, it requires a high precision coupling structure between a plug and a receptacle, and also, requires optical cables and numerous coupling components for connecting the optical cables, and thus they are a great burden in terms of total cost.

[0006] Korean Patent Registration No. 10-1375938, etc. recently introduces a high-speed signal transmission means using a microstrip line and a dielectric wave guide, which enables high speed signal transmission without causing signal leakage between a plug and a receptacle.

[0007] A connector coupling the microstrip line and the dielectric wave guide is configured to provide a signal of the microstrip line to the dielectric wave guide or to provide a signal of the dielectric wave guide to the microstrip line. The microstrip line is connected to a radio frequency (RF) chip generating an RF signal, and functions as a channel for transmitting or receiving an RF signal. For example, a signal received from an RF antenna in the form of a microstrip may be provided to a dielectric wave guide, or a signal of the dielectric wave guide may be provided to the RF antenna in the form of the microstrip. In this case, a signal may be transmitted by a cable (hereinafter, referred to as a "wave guide") which uses a dielectric as a signal transmission means, and the wave guide is provided with a connector to connect to an RF antenna. The connector of the wave guide may exchange a signal with the RF antenna in an Rx mode or a Tx mode.

[0008] Patent Document 0001: Korean Patent Registration No. 10-1375938 (registered on March 12, 2014)

[0009] Patent Document 0002: Korean Patent Registration No. 10-1492714 (registered on February 5, 2015)

[0010] Patent Document 0003 : International Patent Publication No. WO2015/049927 (published on April 9, 2015)

SUMMARY

[0011] Signal transmission using a recently suggested wave guide enables much

information to be transmitted and received in real time, and accordingly, there is a demand for a connector which can be usefully applied to high speed transmission using a wave guide.

[0012] An object of the present disclosure is to provide a connector which is suitable for high speed signal transmission using a wave guide, and more specifically, a connector for high speed signal transmission, which enables signal transmission between an RF antenna and a wave guide.

[0013] Another object of the present disclosure is to provide a connector for high speed signal transmission, which can enhance efficiency of signal transmission between an RF antenna and a wave guide.

[0014] To achieve the above-described objects, a connector assembly for high speed signal transmission may include a plug and a receptacle. The plug may include: a wave guide module; a first housing; and a first connector shell. The wave guide module may include a wave guide for transmitting an RF signal along a dielectric filled therein, and a guide block integrally formed with an exterior of the wave guide to guide coupling of the wave guide. The first housing may be formed of an insulating material to receive a leading end of the wave guide, and the first connector shell may be coupled along a surface of the first housing. The receptacle may include: a control substrate; an antenna module arranged on the control substrate and having an RF chip mounted on an RF substrate having a microstrip line formed therein to transmit and receive an RF signal; a second housing having a space to receive the antenna module and receiving the antenna module on one side; and a second connector shell mounted on the control substrate while being coupled along a surface of the second housing. The first connector shell and the second connector shell may be fastened to each other such that one surface of the wave guide and one surface of the antenna module face each other, and may be configured to transmit an RF signal between the dielectric and the microstrip line.

[0015] The antenna module may be received in a receiving space of the second housing such that a center line of the antenna module is aligned with a center line of the second housing with respect to a thickness direction, and the first connector shell and the second connector shell may be fastened to each other in a horizontal direction in which a center line of the wave guide and a center line of the microstrip line are aligned with each other.

[0016] In addition, the second connector shell may include coupling ribs protruding from both side portions of a plate thereof, and may be mounted on the control substrate in a mid-mount structure using the coupling ribs.

[0017] In addition, the first connector shell may protrude to the front of the wave guide to form a first receiving space therein, and the second connector shell may protrude to the front of the antenna module to form a second receiving space therein, and the first connector shell and the second connector shell may be fastened to each other such that one surface of the wave guide and one surface of the antenna module face each other in a space where the first receiving space and the second receiving space overlap each other.

[0018] In addition, the wave guide and the microstrip line may form a plurality of channels.

[0019] In addition, the wave guide module may further include a position adjustment portion for moving the wave guide forward and backward. The position adjustment portion may include: a cover member to receive the guide block therein; a support block fixedly arranged inside the cover member to support the guide block; and a screw member fastened to be exposed from the rear of the cover member to an outside of the cover member and to move the guide block forward or backward.

[0020] In addition, the plug may include a plurality of coaxial cables and a plurality of first contact terminals connected to the respective coaxial cables, and the receptacle may include second contact terminals connected to contact pads of the control substrate and coming into contact with the first contact terminals to transmit a signal, and the connector assembly may further include a conductive signal transmission module configured to transmit a signal along conductors of the coaxial cables, the first contact terminals, and the second contact terminals.

[0021] The connector assembly of the present disclosure is configured such that one surface of the wave guide of the plug and one surface of the RF antenna module of the receptacle face each other, and thus signal transmission efficiency can be enhanced.

[0022] In addition, according to the present disclosure, the housing and the connector

shell receiving the RF antenna module is mounted on the control substrate in the mid-mount structure, and thus it is advantageous to achieve slimness of the connector assembly.

[0023] In addition, according to the present disclosure, signal transmission between the wave guide and the RF antenna module is performed in a space which is doubly shielded by the connector shells, and thus signal transmission efficiency can be enhanced.

[0024] In addition, according to the present disclosure, a distance between the wave guide and the antenna module can be adjusted, and thus the plug and the receptacle can be fastened to each other to have optimal transmission efficiency according to various conditions, such as an intensity of a signal, a type of a dielectric, etc.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] FIG. 1 is a perspective view showing a plug and a receptacle of a connector according to an exemplary embodiment of the present disclosure;

[0026] FIG. 2 is an exploded perspective view showing the plug according to an exemplary embodiment of the present disclosure;

[0027] FIG. 3 is a perspective view showing a housing and a wave guide module which are main parts of FIG. 2;

[0028] FIGS. 4A to 7B are bottom surface perspective views showing various examples of a coupling structure between the wave guide module and the housing;

[0029] FIG. 8 is an exploded perspective view showing the receptacle according to an exemplary embodiment of the present disclosure;

[0030] FIG. 9 is a front view showing the receptacle of FIG. 8;

[0031] FIG. 10 is a perspective view showing the connector according to an exemplary embodiment of the present disclosure;

[0032] FIGS. 11 and 12 are cross-sectional views showing a fastening structure of the connector of FIG. 10;

[0033] FIG. 13 is a perspective view showing a configuration for fixing the fastening of the connector of FIG. 10;

[0034] FIG. 14 is a perspective view showing a plug according to another exemplary embodiment of the present disclosure; and

[0035] FIGS. 15 and 16 are perspective views showing an interior structure of the plug of FIG. 14.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0036] The present disclosure and the technical objects achieved by embodiments of the present disclosure will be more apparent by preferred embodiments of the present disclosure which will be described below. Hereinafter, preferred embodiments of the present disclosure will be described in detail with reference to the accompanying drawings. In the description of the present disclosure, expressions "front," "rear," "upper," "lower," or the like indicate relative directions or positions, and the same expression may indicate a different direction or position according to a configuration of the present disclosure.

[0037] FIG. 1 is a perspective view showing a plug and a receptacle of a connector according to an exemplary embodiment. As shown in the drawing, a connector for high speed signal transmission of the present disclosure includes a plug 100 provided with a wave guide, and a receptacle 200 provided with an RF antenna.

[0038] The plug 100 may be provided at both ends of the wave guide having a predetermined length, and the receptacle 200 may be installed in a pair of devices (for example, a set-top box and a TV main body) which require high speed signal transmission. The plug 100 at one side may be coupled to the receptacle 200 of the set-top box and operate as a transmission module (Tx) to transmit an RF signal to the TV main body, and the plug 100 at the other side may be coupled to the receptacle 200 of the TV main body and operate as a reception module

(Rx) to receive a signal of the set-top box. As described above, the connector to which the plug 100 and the receptacle 200 are coupled functions as a transmission module or a reception module of high speed signal transmission.

[0039] Hereinafter, the plug, the receptacle, and a configuration for fastening the same regarding the connector of the present disclosure will be described in detail.

[0040] FIG. 2 is an exploded perspective view showing the plug according to an exemplary embodiment, and FIG. 3 is a perspective view showing a housing and a wave guide module which are main parts of FIG. 2.

[0041] Referring to FIG. 2, the plug 100 of the present disclosure includes a wave guide module 110 for high speed signal transmission, a coaxial cable module 140 for normal signal transmission, a first housing 150 for receiving and fixing the wave guide module and the coaxial cable module, a shielding shell 160 coupled to an exterior of the first housing at the rear of the first housing, a first connector shell 170 coupled to a surface of the first housing at the front of the first housing, and an insulating resin 180 surrounding the shielding shell. Herein, the "front" refers to a direction in which the plug advances toward the receptacle to be coupled to the receptacle, and the "rear" refers to the opposite direction thereof.

[0042] The wave guide module 110 may be a high-speed signal transmission means for transmitting an RF signal, and may include a wave guide 120 having a dielectric for signal transmission, and a guide block 130 for guiding the wave guide 120.

[0043] The wave guide 120 may include a dielectric layer 121 formed in the center of the inside thereof, a clad layer 122 sheathing the dielectric layer, and an insulating layer 123 surrounding the clad layer as shown in FIG. 3. The dielectric layer 121 may be configured to provide an RF signal provided from a transmission module at one side to a reception module at the other side, and may be configured by a dielectric having a predetermined dielectric constant and filled inside the clad layer 122. The clad layer 122 may prevent a leakage of a signal transmitted via the dielectric layer 121, and may prevent interference of signals between adjacent wave guides 120 in the wave guides 120 formed of a plurality of channels. Such a clad layer 122 may be formed of a metallic material to seal the dielectric layer 121, and for

example, may be formed of a copper layer. The insulating layer 123 may be configured to insulate the wave guide 120 from the outside, and an insulating resin may be coated or sheathed over the surface of the clad layer.

[0044] The wave guide 120 may be formed of a single channel, or may be formed of two or more channels to enhance signal transmission efficiency as shown in the drawings.

[0045] The guide block 130 may guide the wave guide 120 to couple the wave guide module 110 to the first housing 150, and simultaneously, to stably maintain the coupling between the wave guide module 110 and the first housing 150. The guide block 130 may be formed of a resin molding body integrally molded with the insulating layer 123 of the wave guide 120 and having an insulating property, and may include coupling protrusions 131 formed on both side portions thereof to be coupled to the first housing 150.

[0046] Such a guide block 130 may guide the wave guide 120 to be coupled to the first housing 150 in a right position. In general, it is difficult to place a center line of the wave guide 120 in a right position when the wave guide 120 is coupled to the first housing 150, and, when the wave guide 120 is not coupled in the right position, a leakage of a signal may occur in the signal transmission process with a microstrip line 232. Accordingly, the guide block 130 may be integrally formed with the wave guide 120, and may guide the center line of the wave guide 120 to be positioned on a center of the first housing 140 in a thickness direction (that is, a longitudinal direction) when the wave guide module 110 is coupled to the first housing 150. A detailed configuration for coupling the wave guide module 110 and the first housing 150 by means of the guide block 130 will be described below.

[0047] The coaxial cable module 140 is a signal transmission means for transmitting power and a normal signal. The coaxial cable module 140 may include a plurality of coaxial cables 141 having a conductive metal such as copper therein, and a guide plate 142 having a plurality of contact pads 143 for guiding the coaxial cables and connecting an electric signal to each of the coaxial cables. The coaxial cable module 140 of the present disclosure may be configured by a well-known signal transmission means provided to transmit a signal between a transmission module and a reception module.

[0048] The first housing 150 may receive and fix the wave guide module 110 and the coaxial cable module 140, and may connect the wave guide module 110 and the coaxial cable module 140 to an antenna module 230 or second contact terminals 253 in a contactless or contact manner when the plug 100 is coupled to the receptacle 200. Such a first housing 150 may be formed of a resin molding body having an insulating property.

[0049] In addition, the first housing 150 may have a tube receiving recess 151 formed on one side of the rear thereof to receive the wave guide module 110, and a tube insertion hole 154 to allow the wave guide 120 to be inserted thereinto. In this case, the tube insertion hole 154 may have an inner diameter having a size and a shape corresponding to an outer diameter of the wave guide 120, such that the inserted wave guide 120 is not moved.

[0050] In addition, the first housing 150 may have a plate receiving recess 152 formed on the other side of the rear thereof to receive the guide plate 142 of the coaxial cable module 140, and a plurality of first contact terminals 153 may be assembled with the plate receiving recess 152 to come into contact the contact pads 143.

[0051] The shielding shell 160 may be assembled to cover the first housing 150 in which the wave guide module 110 and the coaxial cable module 140 are received, thereby preventing signal interference of the wave guide module 110 and the coaxial cable module 140 from an external noise, electromagnetic interference (EMI), etc. The shielding shell 160 may be formed by extruding or bending a metal plate, and may be divided into an upper plate 160a and a lower plate 160b, which are integrally assembled with each other on the upper and lower portions of the first housing 150 to shield the wave guide module 110 and the coaxial cable module 140 from the outside along with the first housing 150.

[0052] The first connector shell 170 may be coupled to the front of the first housing 150 to fasten the plug 100 to the receptacle 200. The first connector shell 170 may be formed by extruding or bending a metal plate, and may be formed in the shape of a box having a hollow to correspond to the exterior of the first housing 150. The first connector shell 170 may have a plurality of coupling pieces 171 formed on rear portions of upper and lower plates thereof to be coupled to the first housing 150, and a plurality of protrusions 157 may be formed on the first housing 150 to correspond to hole portions 171a of the coupling pieces 171.

[0053] The insulating resin 180 may electrically insulate the conductive shielding shell 160 from the outside while surrounding the shielding shell 160. The insulating resin 180 may be formed of plastic or a resin having a contractile force.

[0054] The plug 100 having the above-described configuration may be fastened to the receptacle 200 by fastening the first connector shell 170 protruding forwardly to a second connector shell 270.

[0055] Meanwhile, in the plug according to an exemplary embodiment, the wave guide module 110 is assembled with the first housing 150 while the wave guide 120 is guided to be in the right position by the guide block 130. FIGS. 4A to 7B are bottom surface perspective views showing various examples of a structure of coupling the wave guide module and the first housing by means of the guide block.

[0056] First referring to FIGS. 4A and 4B, the coupling protrusions 131 may protrude from both side portions of the hexahedral guide block 130, and a front surface of each of the coupling protrusions 131 in an assembly direction toward the first housing 150 may form an inclined surface 131a having a predetermined inclination, and a rear surface in a disassembly direction from the first housing 150 may form a vertical surface 131b.

[0057] In addition, the first housing 150 may have insertion recesses 155 formed on inner surfaces of both sides of the tube receiving recess 151 in a transverse direction to allow the coupling protrusions 131 to be inserted thereinto, and seating recesses 156 formed in a longitudinal direction to allow the inserted coupling protrusions 131 to be seated therein. The insertion recess 155 may be formed by cutting a portion of an upper surface on the drawing with respect to the thickness direction (that is, the longitudinal direction) of the housing molding body, and the seating recess 156 may be formed on a center region. In this case, the insertion recess 155 in the transverse direction and the seating recess 156 in the longitudinal direction may be connected to each other by an inclined surface 155a having a predetermined inclination, and a rear surface of the seating recess 156 in the disassembly direction of the coupling protrusion 131 may form a vertical surface 156b in an inward direction.

[0058] Due to the structures of the coupling protrusions 131 and the insertion recesses

155 described above, the coupling protrusions 131 of the guide block 130 slide along the insertion recesses 155 with the wave guide module 110 being lifted upwardly on the drawing as shown in FIG. 4A, and the wave guide 120 is inserted into the tube insertion hole 154, and, after the wave guide 120 is inserted into the tube insertion hole 154, the coupling protrusions 131 are inserted into the seating recesses 156 as shown in FIG. 4B, and the wave guide module 110 is completely assembled while forming a horizontal direction. After the assembly of the wave guide module 110 and the first housing 150 is completed, the assembly is fixed by the vertical surfaces 131b of the coupling protrusions 131 and the vertical surfaces 156b of the seating recesses 156 coming into contact with each other.

[0059] In addition, referring to FIGS. 5A and 5B, the insertion recess 155 of the first housing 150 may be formed on a center region with respect to the thickness direction of the housing molding body. Accordingly, as shown in FIG. 5A, the coupling protrusions 131 of the guide block 130 may allow the wave guide 120 to be inserted into the tube insertion hole 154 in a horizontal direction, and may allow the wave guide module 110 to be assembled with the first housing 150. In this case, the front surface of the coupling protrusion 131 may form the inclined surface 131a, and may slide along the insertion recess 155 in an interference fitting manner, and as shown in FIG. 5B, after the coupling protrusions 131 are inserted into the seating recesses 156, the assembly is fixed by the vertical surfaces 131b of the coupling protrusions 131 and the vertical surfaces 156b of the seating recesses 156 coming into contact with each other.

[0060] In addition, referring to FIGS. 6A and 6B, the guide block 130 may include elastic pieces 132 formed on both side portions thereof and having a predetermined length, and the elastic piece 132 has one end of a rib connected to the body of the guide block 130, and a coupling protrusion 131 may be formed on a side surface of the elastic piece 132. Accordingly, when the wave guide module 110 is assembled with the first housing 150, the coupling protrusions 131 may come into close contact with the body of the guide block 130 along with the elastic pieces 132, and may easily slide along the insertion recesses 155. In addition, after the assembly of the wave guide module 110 and the first housing 150 is completed, the coupling protrusions 131 may return to the outside along with the elastic pieces 132 and may be seated in the seating recesses 156, and the assembly is fixed by the vertical surfaces 131b of the

coupling protrusions 131 and the vertical surfaces 156b of the seating recesses 156 coming into contact with each other.

[0061] In addition, referring to FIGS. 7A and 7B, the guide block 130 may include an elastic piece 132 formed on an upper surface of the body thereof, and a second coupling protrusion 133 may protrude from a surface of the elastic piece 132. In addition, the first housing 150 may have a coupling recess 158 formed on an upper surface of the molding body of the tube receiving recess 151 to correspond to the second coupling protrusion 133. The wave guide module 110 having the above-described configuration may be inserted into the tube receiving recess 151 and assembled with the elastic piece 132 coming into close contact with the body of the guide block 130, and, after the assembly is completed, the elastic piece 132 may be returned to the outside and the second coupling protrusion 131 may be inserted into the coupling recess 158, such that the assembly is fixed. In this case, the coupling protrusions 131 may be seated in the seating recesses 156, thereby fixing the assembly.

[0062] FIG. 8 is an exploded perspective view showing the receptacle according to an exemplary embodiment, and FIG. 9 is a front view showing the receptacle of FIG. 8.

[0063] As shown in these drawings, the receptacle 200 of the present disclosure includes a signal transmission and reception module 210 for high speed signal transmission and reception, a second housing 250 for receiving the signal transmission and reception module 210, and a second connector shell 270 which is coupled to the second housing.

[0064] The signal transmission and reception module 210 may be configured to generate electric signals as various control signals and to provide the signals to the plug 100, or may be configured to receive a control signal from the plug 100 and to convert the control signal into an electric signal. The signal transmission and reception module 210 may include a control substrate 220 having a circuit printed thereon, and an antenna module 230 mounted on the control substrate to provide or receive an RF signal for high speed signal transmission.

[0065] The control substrate 220 may be a main substrate of the transmission and reception module, and may have a circuit of various functions printed thereon, for the flow of an electric signal. In addition, the control substrate 220 may have the antenna module 230

mounted on an upper portion of one side thereof, for high speed signal transmission, and may have a plurality of contact pads 223 formed on a surface of the other side thereof to allow the second contact terminals 253 to come into contact therewith.

[0066] The antenna module 230 may generate an RF signal and provide the RF signal to the wave guide 120 of the plug 100, or may receive an RF signal from the wave guide 120 and convert the RF signal into an electric signal. The antenna module 230 may be configured as an RF module having an RF chip 233 mounted on an RF substrate 231 which has a microstrip line 232 formed therein. The microstrip line 232 may be connected with the wave guide 120 in a contactless manner and may operate as a channel to provide an RF signal to the wave guide 120 or to receive an RF signal from the wave guide 120. Such a microstrip line 232 may be formed of a single channel, or may be formed of two or more channels corresponding to the wave guide 120 to enhance signal transmission efficiency. The RF chip 233 may be configured to mutually convert an electric signal and an RF signal, and the RF signal generated in the RF chip 233 may be provided to the wave guide 120 via the microstrip line 232, and the RF signal provided from the wave guide 120 may be transmitted to the RF chip 233 via the microstrip line 232. In addition, a ground pattern 234 may be formed on upper and lower surfaces of the RF substrate 231.

[0067] The second housing 250 may receive the antenna module 230 and the plurality of second contact terminals 253, and may connect the antenna module 230 and the second contact terminals 253 to the wave guide module 110 and the first contact terminals 153 in a contactless or contact manner when the receptacle 200 is coupled to the plug 100. Such a second housing 250 may be formed of a resin molding body having an insulating property.

[0068] In addition, the second housing 250 may have an antenna receiving recess 251 formed on one side of the front thereof to receive the antenna module, and a terminal receiving portion 252 protruding toward the front from the other side to receive the plurality of second contact terminals 253. Herein, the "front" refers to a direction in which the receptacle advances toward the plug to be coupled to the plug, and the opposite direction thereof is referred to as the "rear."

[0069] The antenna receiving recess 251 may be formed in a recess shape which is dented

upwardly from a lower surface of the second housing 250, or may be formed in a hole shape penetrating through the front and rear of the second housing 250. In this case, the antenna module 230 may be received in the antenna receiving recess 251 such that its center line (C, that is, the microstrip line in the RF substrate) is positioned on a center of the second housing 250 with respect to the thickness direction. Due to the above-described configuration, the dielectric layer 121 and the microstrip line 232 are positioned in the right position when the plug 100 and the receptacle 200 are fastened to each other, such that a leakage can be prevented in the signal transmission process. That is, the receptacle 200 of the present disclosure is configured to have an avoidance recess formed in the second housing 250 and to align the center line of the antenna module 230 (see C of FIG. 9) with the wave guide 120.

[0070] The terminal receiving portion 252 may come into contact with the first contact terminals 153 of the first housing 150 to transmit power or a signal in a transmission mode or a reception mode, and a well-known configuration may be applied for a power and signal transmission means.

[0071] The second connector shell 270 may be coupled while covering the second housing 250, thereby coupling the second housing 250 to the control substrate 220 and fastening the receptacle 200 to the plug 100. The second connector shell 270 may be formed by extruding or bending a metal plate, and may be formed in the shape of a box having a hollow formed therein to correspond to the exterior of the second housing 250. The second connector shell 270 may have a fixing protrusion 274 formed on an upper portion of the plate thereof to fix the assembly with the second housing 250, and a fixing recess 254 may be formed on the second housing 250 to correspond to the fixing protrusion 274.

[0072] In addition, the second connector shell 270 may receive the second housing 250 and the antenna module 230 in an inner space thereof, while protecting the antenna module 230 from an external noise, EMI, etc.

[0073] In addition, the second connector shell 270 may include coupling ribs 271 protruding from both side portions of the plate thereof to be assembled to the control substrate 220, and the control substrate 220 may have rib recesses 221 formed thereon to correspond to the coupling ribs 271. The second connector shell 270 may be assembled by the coupling ribs

271 being inserted into the rib recesses 221 of the control substrate 220, and soldering may be applied to the coupling ribs 271 to fix the assembly with the control substrate 220.

[0074] The coupling ribs 271 of the second connector shell 270 may be formed in the proximity of the center with respect to the thickness direction of the second connector shell 270. The second connector shell 270 being coupled to the control substrate 220 by means of the coupling ribs 271 is coupled to the control substrate 220 in a mid-mount structure, such that there is an effect of reducing the thickness of the receptacle 200. When a connector shell is mounted on a substrate in an on-board structure, both the thickness of the substrate and the thickness of the connector shell may form the full thickness of a receptacle. However, when the connector shell is coupled to the substrate in the mid-mount structure by means of the coupling ribs, only the thickness of the connector shell may form the thickness of the receptacle and thus it is advantageous to implement a slim type connector.

[0075] FIG. 10 is a perspective view showing the connector according to an exemplary embodiment, FIGS. 11 and 12 are cross-sectional views showing a fastening structure of the connector of FIG. 10, taken on lines I-I, and FIG. 13 is a perspective view showing a configuration for fixing the fastening of the connector of FIG. 10.

[0076] Referring to FIGS. 10 to 12, the plug 100 and the receptacle 200 may be fastened to each other by inserting the first connector shell 170 into the inner space of the second connector shell 270. To achieve this, the second connector shell 270 may extend to the front from the second housing 250 by a predetermined width, thereby forming a second receiving space 270a therein.

[0077] In addition, in the plug 100 and the receptacle 200, the antenna module 230 is inserted into the inner space of the first housing 150 while the first connector shell 170 and the second connector shell 270 are fastened to each other. To achieve this, the first housing 150 and the first connector shell 170 extend to the front from the wave guide 120 by a predetermined width, thereby forming a first receiving space 170a therein. In this case, it is preferable that the antenna module 230 protrudes to the front from the second housing 250.

[0078] One surface 120a of the wave guide 120 through which an RF signal of the plug

100 is inputted and outputted, and one surface 230a of the antenna module 230 through which an RF signal of the receptacle 200 is inputted and outputted may be fastened to face each other inside a space, where the second receiving space 270a formed inside the second connector shell 270 of the receptacle 200 and the first receiving space 170a formed inside the first connector shell 170 of the plug 100 overlap each other, and thus the RF signal may be transmitted between the dielectric layer 121 and the microstrip line 232. Accordingly, since the transmission of the RF signal between the plug 100 and the receptacle 200 is achieved in a space which is doubly shielded by the first connector shell 170 and the second connector shell 270, external interference caused by a noise, EMI, etc. in the signal transmission process can be prevented, and a leakage of signals to the outside can be prevented, and thus signal transmission can be efficiently performed.

[0079] In addition, the first connector shell 170 and the second connector shell 270 may include their respective locking means for maintaining the fastening after they are fastened to each other. Referring to FIG. 13, the second connector shell 270 may include a pressing piece 275 formed by cutting a portion of an upper surface of the plate thereof, and the pressing piece 275 may have a pressing protrusion 275a formed by bending an end of the front thereof downwardly to elastically press. The first connector shell 170 may have a pressing hole 175 formed on a position corresponding to the pressing protrusion 275a by cutting a portion of an upper surface of the plate of the first connector shell 170 to receive the pressing protrusion 275a

[0080] In addition, locking pieces 176 may be further fastened to both side portions of the first housing 150. The locking pieces 176 may protrude to the outside through penetrating holes 177,277 formed on side portions of the first connector shell 170 and the second connector shell 270 to fix the fastening of the plug 100 and the receptacle 200.

[0081] In addition, the first connector shell 170 and the second connector shell 270 may include misassembly preventing means formed on both side portions of the fronts thereof, and the misassembly preventing means may be configured to have an inclined surface 178, 278 formed on one side of the front of each connector shell 170, 270 in such a shape such that portions of the plates correspond to each other.

[0082] FIG. 14 is a perspective view showing a plug according to another exemplary embodiment, and FIGS. 15 and 16 are perspective views showing an interior structure of the plug of FIG. 14.

[0083] As shown in FIG. 14, the plug according to another exemplary embodiment may be formed of only a wave guide module, and in this case, a signal transmission and reception module of a receptacle may be formed of only an antenna module for transmitting and receiving only an RF signal.

[0084] In addition, the plug (that is, the wave guide module) according to another exemplary embodiment may include a position adjustment portion for adjusting a position of a wave guide. As shown in the drawings, the wave guide module 310 forming the plug may include a wave guide 320 formed of a dielectric tube for signal transmission, and a guide block 330 for guiding the wave guide 320, and may further include a position adjustment portion 340 receiving the guide block 330 therein. Herein, the wave guide 320 and the guide block 330 may have the same configurations as those of the plug according to the embodiment of FIG. 2, and hereinafter, the position adjustment portion 340 will be described in detail.

[0085] Referring to FIGS. 15 and 16, the position adjustment portion 340 is configured to adjust the position of the wave guide 320 by moving the position of the guide block 330 forward and backward. By moving the wave guide 320 forward and backward, a distance (see d of FIG. 12) between one surface (see 120a of FIG. 12) of the wave guide 320 through which an RF signal is transmitted, and one surface (see 230a of FIG. 12) of the antenna module 230 may be adjusted. The distance d between the wave guide 320 and the antenna module 230 is a factor that greatly influences transmission efficiency of the RF signal, and should be exactly controlled. For example, the distance d between the wave guide 320 and the antenna module 230 may be controlled to be 1.0mm, and this distance may be set by considering an intensity of an RF signal, a type of a dielectric, a size of a signal input/output surface, etc.

[0086] The position adjustment portion 340 to control the distance may include a cover member 341 forming a hollow box shape while forming a space for receiving the guide block 330, a support block 342 arranged in the inner space of the cover member 341 to support the guide block 330 and to provide a position change distance, a pair of screw members 343

fastened to screw from the rear of the cover member 341 toward the front, and elastic members 344 elastically supporting the guide block 330 toward the rear in the same line as the screw members 343.

[0087] Specifically, the cover member 341 may be formed in a substantially hexahedral box shape having a space formed therein, and may be divided into an upper cover and a lower cover. In addition, the cover member 341 may have openings formed on the front and the rear thereof to allow the wave guide 320 to penetrate therethrough, and may receive the guide block 330 in the inner space.

[0088] The support block 342 may be arranged in the inner space of the cover member 341, and may have openings formed on the front and the rear thereof to allow the wave guide 320 to penetrate therethrough. In addition, the support block 342 may have a front sidewall 342a and a rear sidewall 342b formed thereon, respectively, and a moving space 342c having a predetermined width may be formed between the front sidewall 342a and the rear sidewall 342b, and the guide block 330 may move forward and backward to a predetermined distance in the moving space 342c.

[0089] The screw members 343 may be fastened to have a portion exposed from the rear of the cover member 341, and may be rotated in one direction or the opposite direction to move the guide block 330 forward or backward. The elastic members 344 may be interposed between the guide block 330 and the front sidewall 342a of the support block 342 to support the guide block 330 and to elastically press the guide block 330 backward.

[0090] When the screw members 343 are rotated in one direction in the wave guide module 310 having the above-described configuration, the guide block 330 may move forward and thus the wave guide 320 may also move, such that one surface of the wave guide 320 approaches close to one surface of the antenna module 230. In addition, when the screw members 343 are rotated in the opposite direction in the wave guide module 310, the guide block 330 may be moved backward by the screw members 343 or the elastic members 344, and simultaneously, one surface of the wave guide 320 and one surface of the antenna module 230 may be spaced apart from each other.

[0091] Although the present disclosure has been described with reference to embodiments illustrated in the drawings, it will be understood by an ordinary person skilled in the related art that various changes can be made therefrom and other equivalent embodiments are possible. In particular, although the structure for fastening the plug and the receptacle in the horizontal direction is illustrated in the present disclosure, a structure for fastening in the vertical direction is possible according to a structure of an antenna module. In addition, the plug and the receptacle are distinguished according to their fastening positions, and the wave guide module may operate as a receptacle or the signal transmission and reception module may operate as a plug.

CLAIMS

What is claimed is:

1. A connector assembly for high speed signal transmission, the connector assembly comprising:

a plug comprising:

a wave guide module;

a first housing; and

a first connector shell,

the wave guide module comprising a wave guide for transmitting an RF signal along a dielectric filled therein, and a guide block integrally formed with an exterior of the wave guide to guide coupling of the wave guide, the first housing formed of an insulating material to receive a leading end of the wave guide, the first connector shell coupled along a surface of the first housing; and

a receptacle comprising:

a control substrate;

an antenna module arranged on the control substrate and having an RF chip mounted on an RF substrate having a microstrip line formed therein to transmit and receive an RF signal;

a second housing having a space to receive the antenna module and receiving the antenna module on one side; and

a second connector shell mounted on the control substrate while being coupled along a surface of the second housing,

wherein the first connector shell and the second connector shell are fastened to each other such that one surface of the wave guide and one surface of the antenna module face each other, and are configured to transmit an RF signal between the dielectric and the microstrip line.

2. The connector assembly for high speed signal transmission of claim 1,

wherein the antenna module is received in a receiving space of the second housing such that a center line of the antenna module is aligned with a center line of the second housing with respect to a thickness direction.

3. The connector assembly for high speed signal transmission of claim 1,

wherein the first connector shell and the second connector shell are fastened to each other in a horizontal direction in which a center line of the wave guide and a center line of the microstrip line are aligned with each other.

4. The connector assembly for high speed signal transmission of claim 1,

wherein the second connector shell comprises coupling ribs protruding from both side portions of a plate thereof, and is mounted on the control substrate in a mid-mount structure using the coupling ribs.

5. The connector assembly for high speed signal transmission of claim 1, wherein the first connector shell protrudes to the front of the wave guide to form a first receiving space therein, and the second connector shell protrudes to the front of the antenna module to form a second receiving space therein, and

wherein the first connector shell and the second connector shell are fastened to each other such that one surface of the wave guide and one surface of the antenna module face each other in a space where the first receiving space and the second receiving space overlap each other.

6. The connector assembly for high speed signal transmission of claim 1, wherein the wave guide and the microstrip line form a plurality of channels.

7. The connector assembly for high speed signal transmission of claim 1, wherein the wave guide module further comprises a position adjustment portion for moving the wave guide forward and backward.

8. The connector assembly for high speed signal transmission of claim 7, wherein the position adjustment portion comprises: a cover member to receive the guide block therein;

a support block fixedly arranged inside the cover member to support the guide block; and

a screw member fastened to be exposed from the rear of the cover member to an outside of the cover member and to move the guide block forward or backward.

9. The connector assembly for high speed signal transmission of claim 1,

wherein the plug comprises a plurality of coaxial cables and a plurality of first contact terminals connected to the respective coaxial cables, and the receptacle comprises second contact terminals connected to contact pads of the control substrate and coming into contact with the first contact terminals to transmit a signal, and

wherein the connector assembly further comprises a conductive signal transmission module configured to transmit a signal along conductors of the coaxial cables, the first contact terminals, and the second contact terminals.

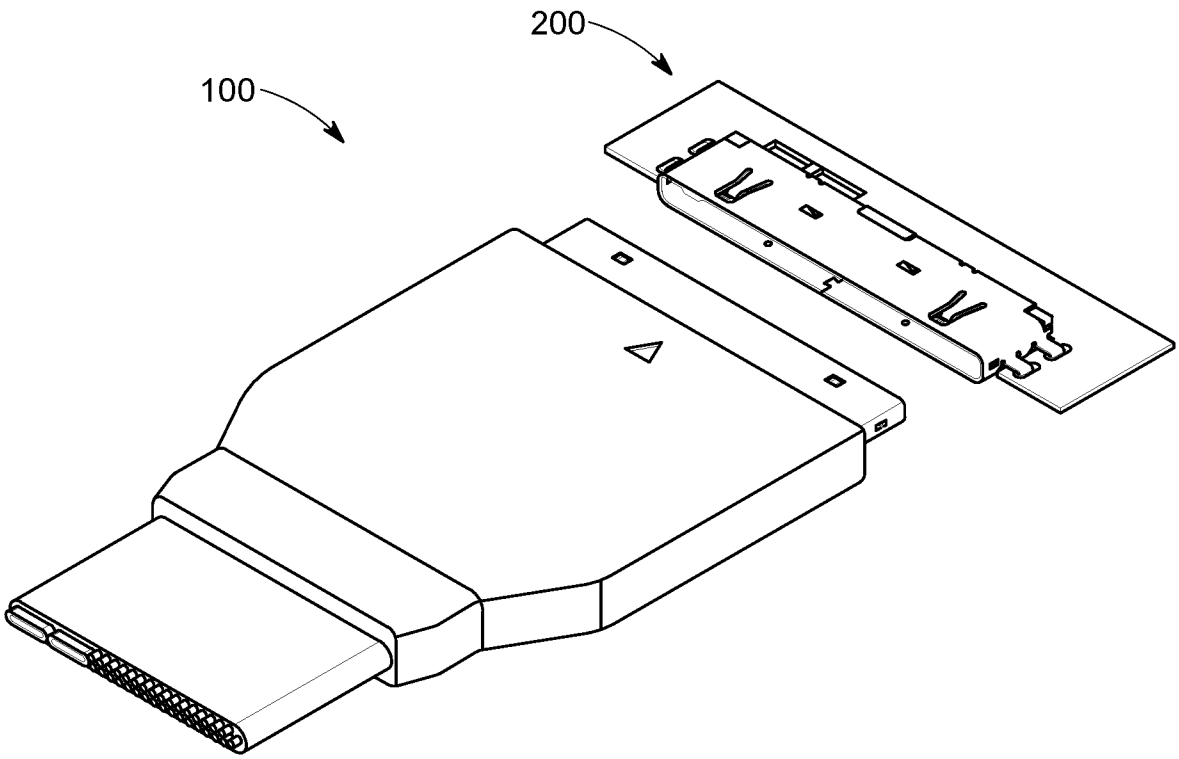


FIG. 1

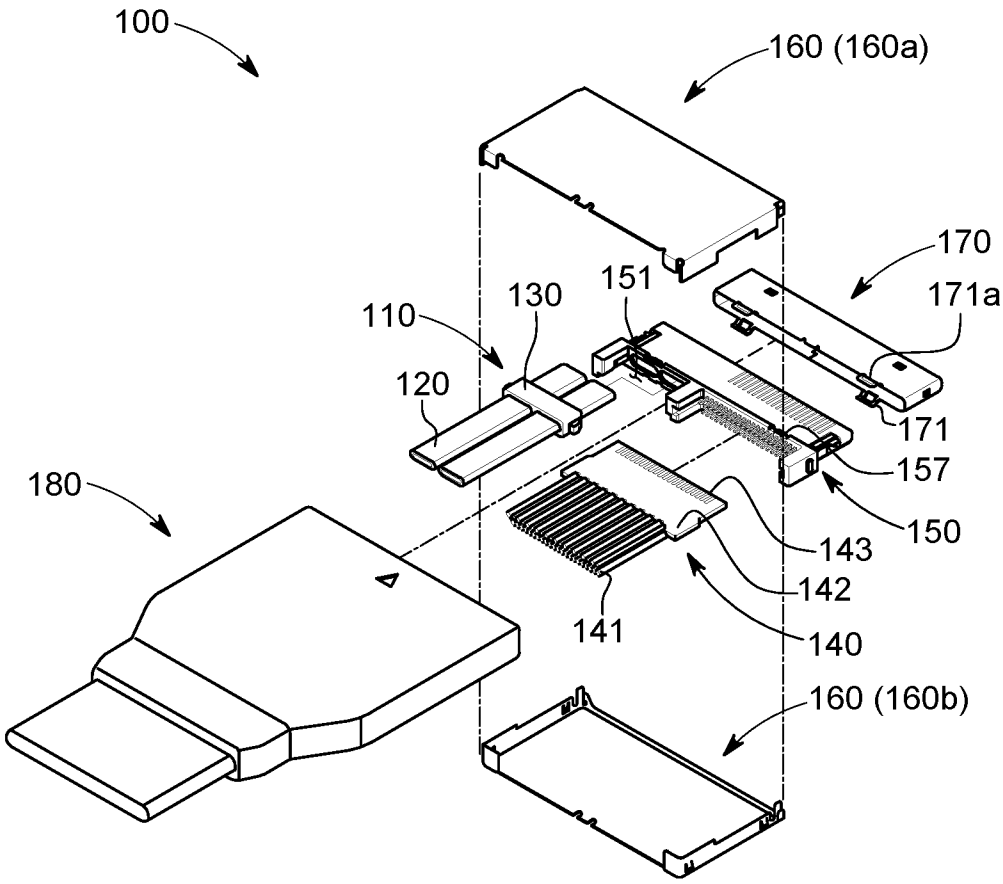

100
160 (160a)
170
171a
151
130
110
120
171
157
150
180
143
142
141
140
160 (160b)

FIG. 2

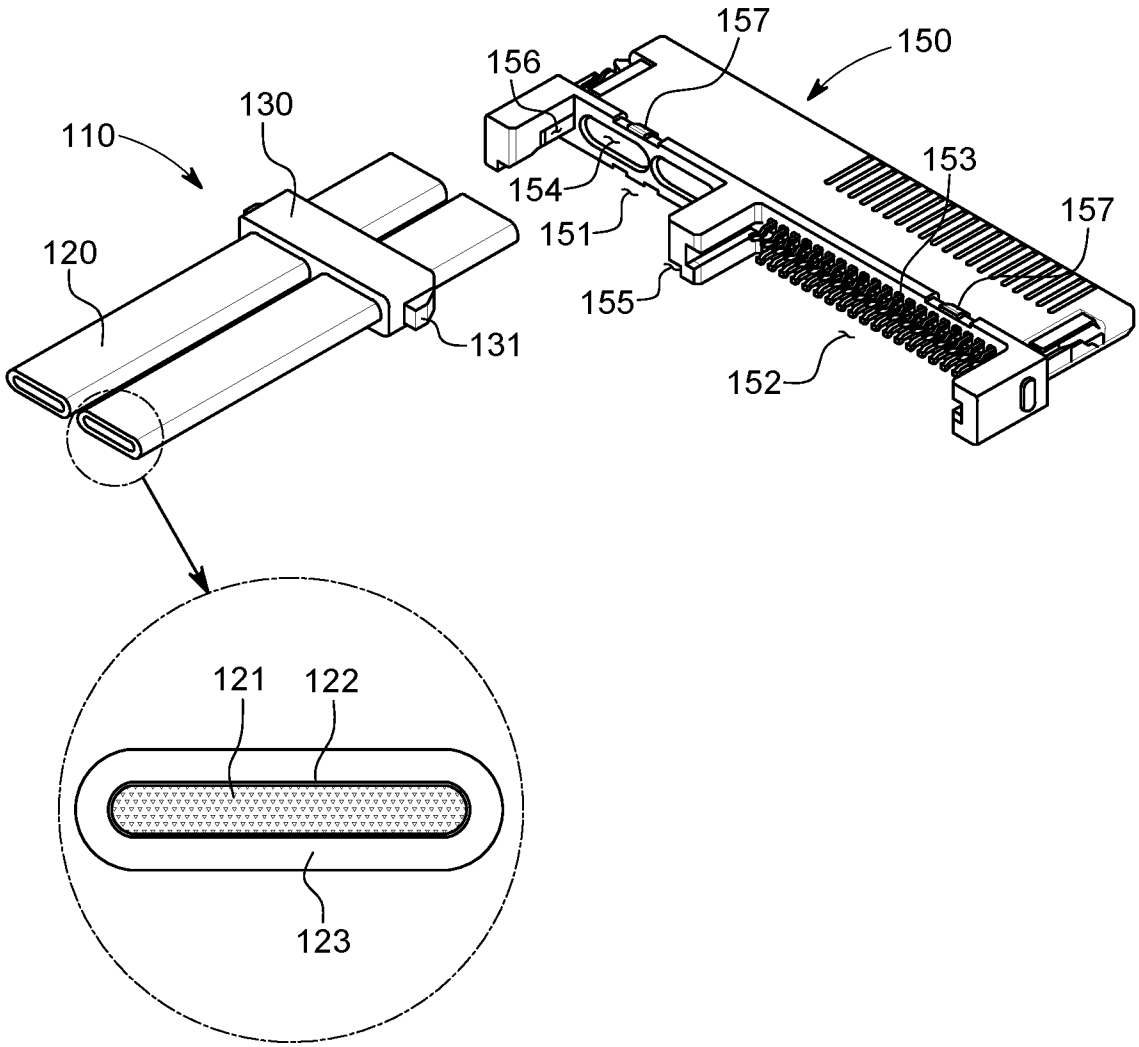


FIG. 3

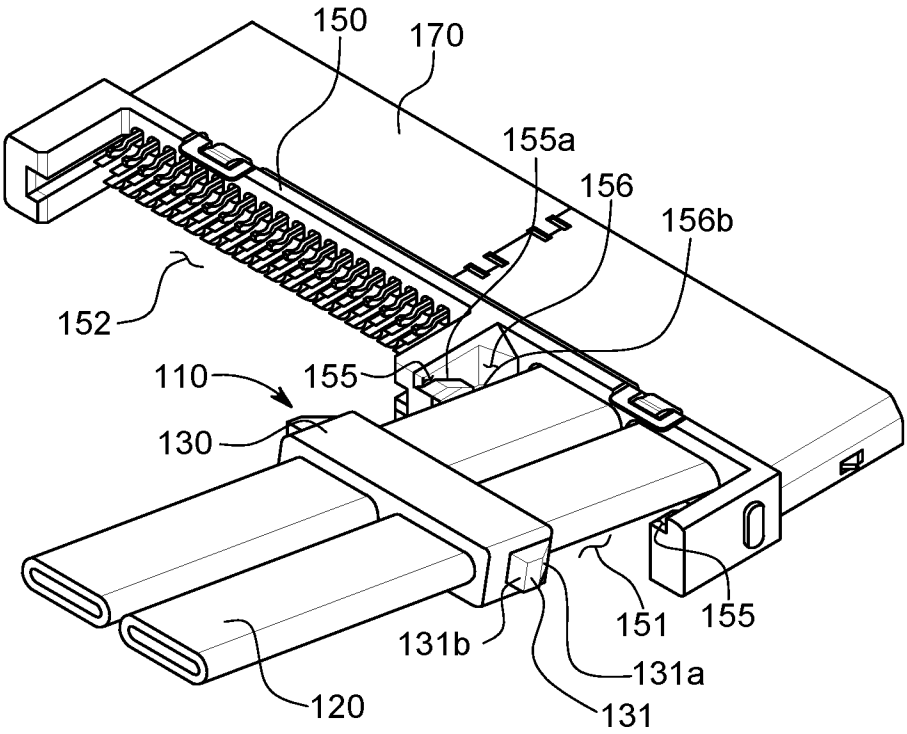
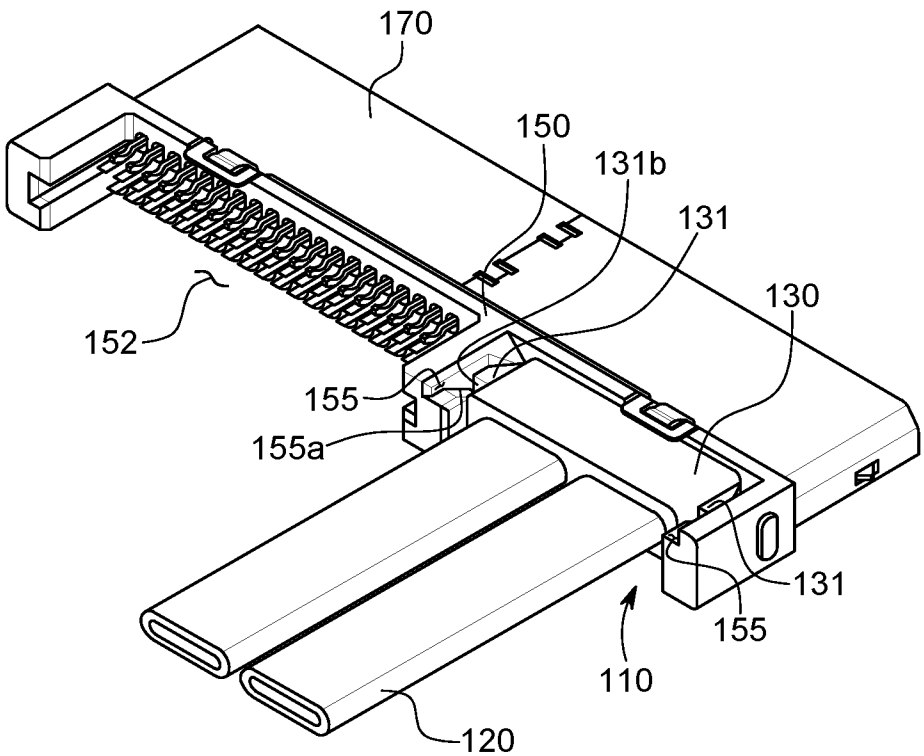

150
170
155a
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156b
152
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131b
131a
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FIG. 4A


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131b
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155a
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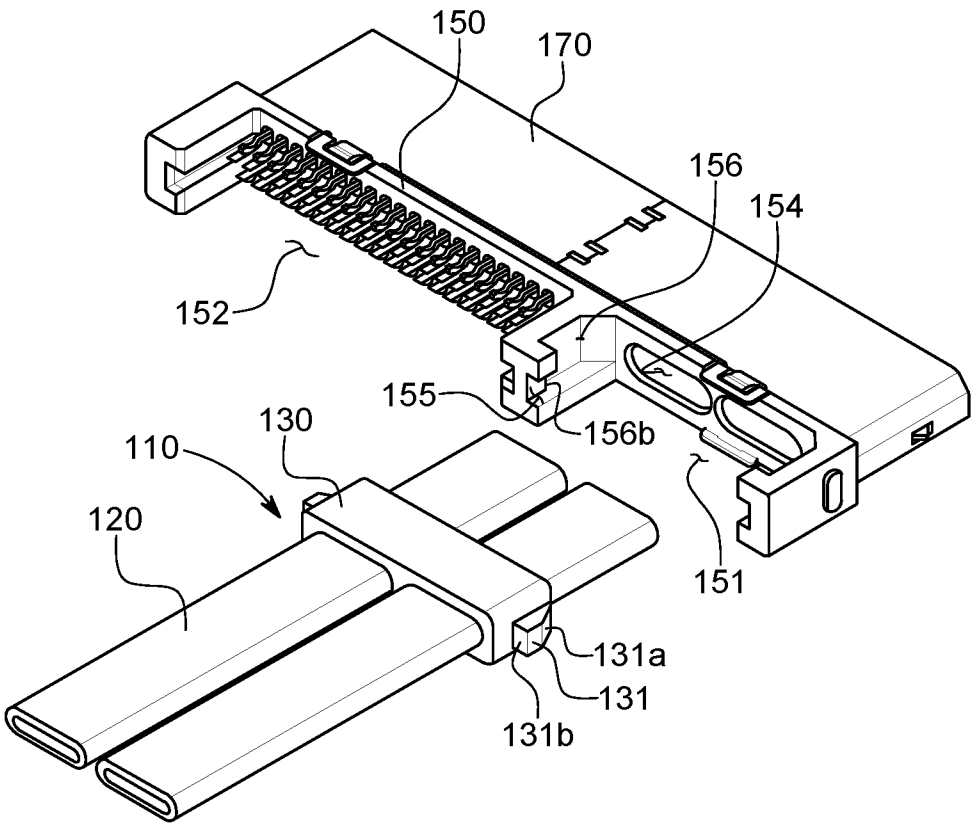
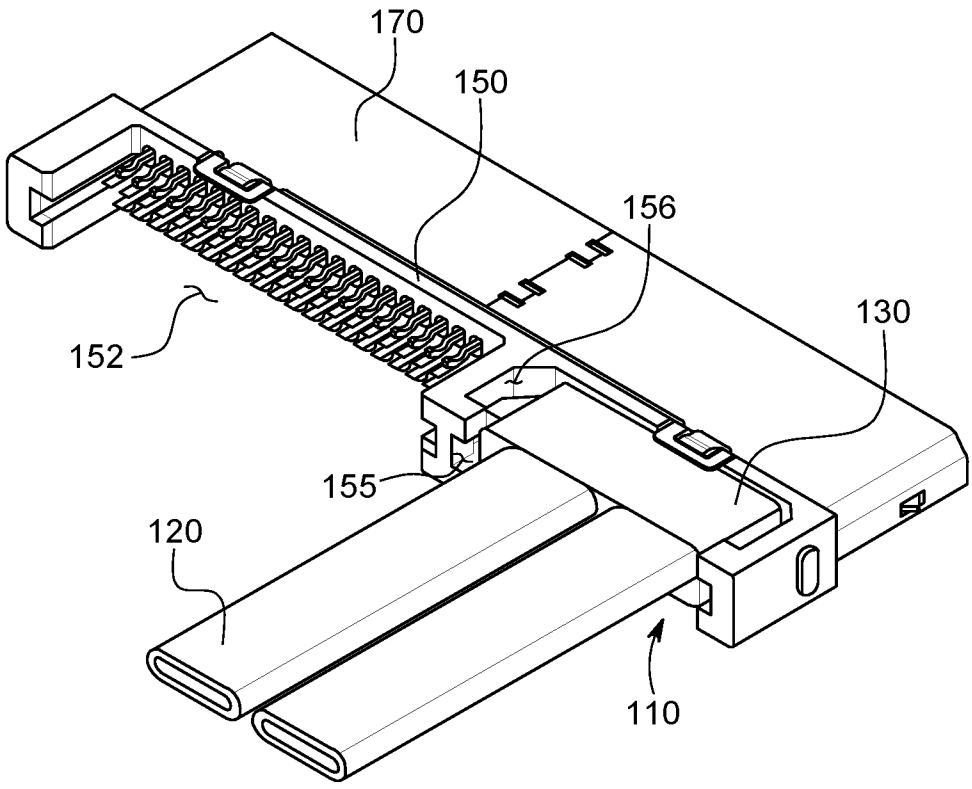

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156b
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131a
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131b

FIG. 5A


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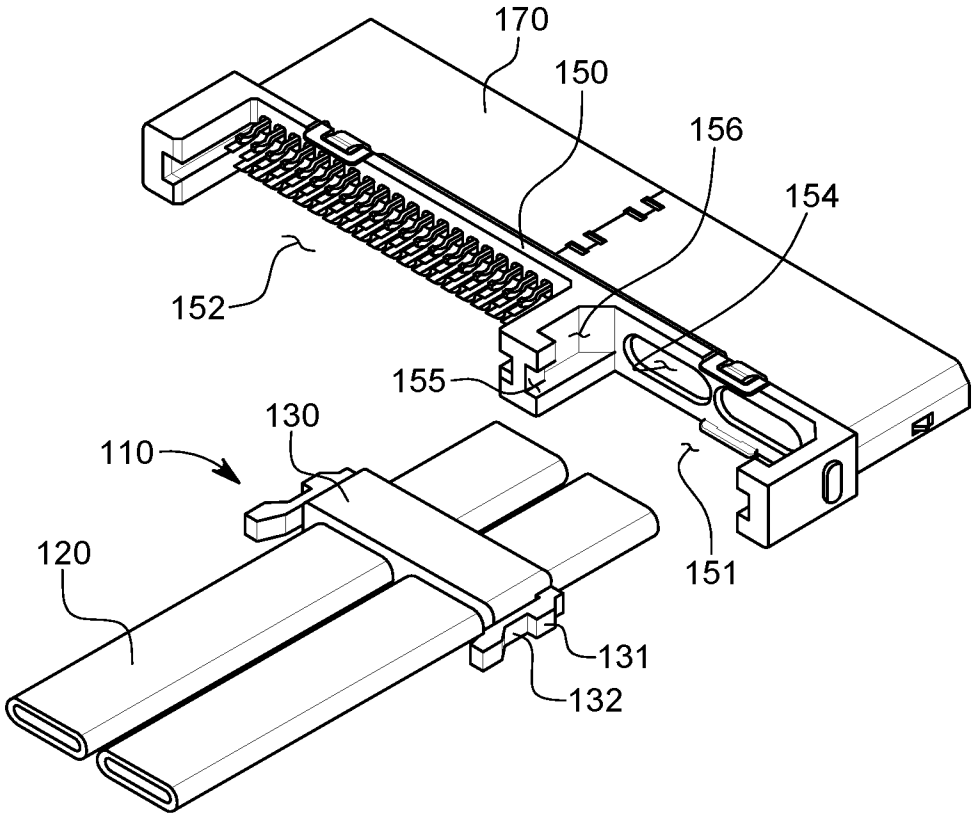
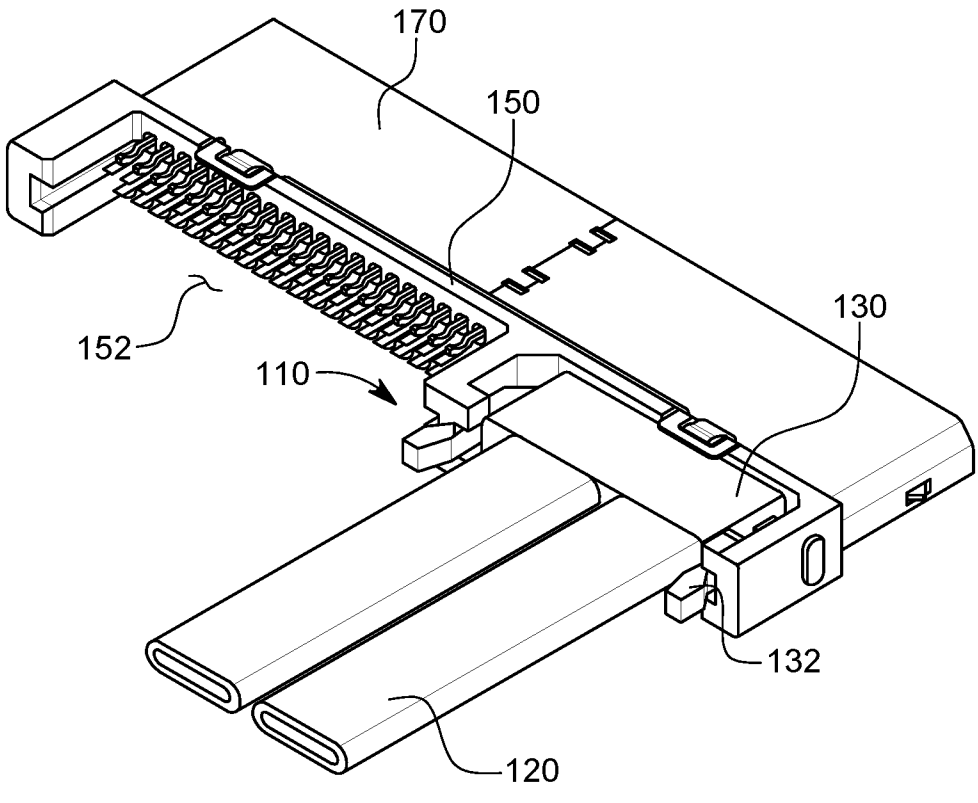

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132

FIG. 6A


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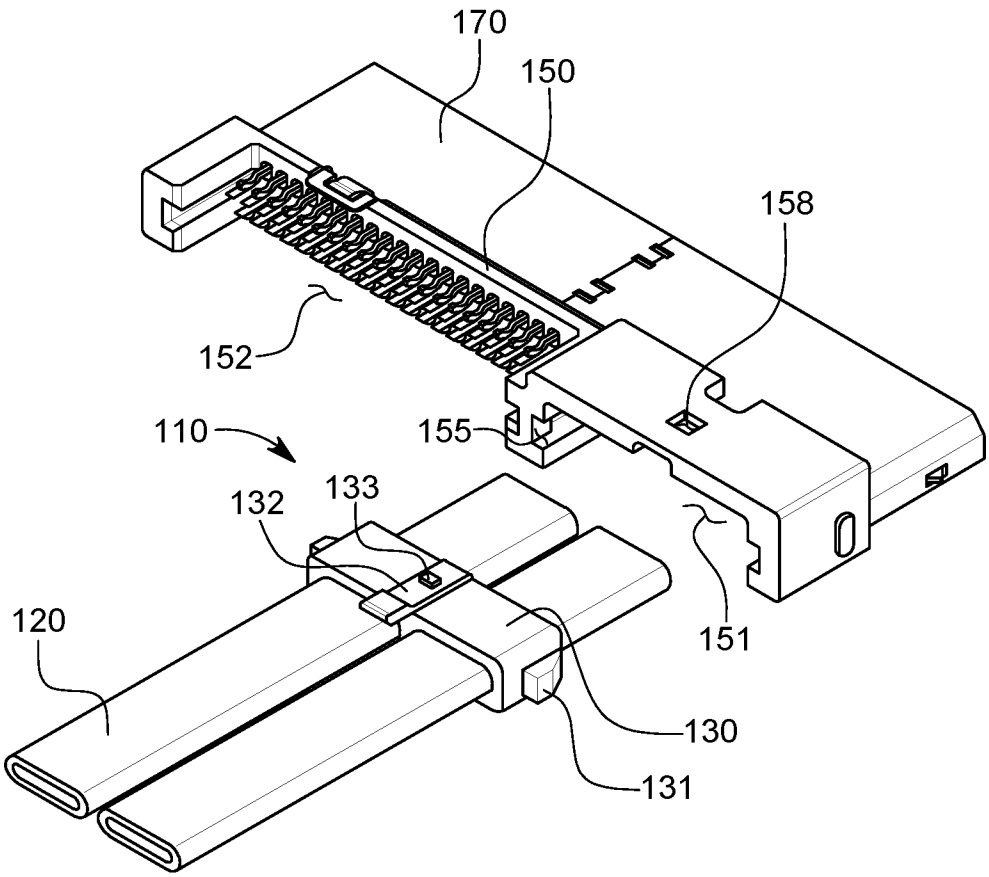
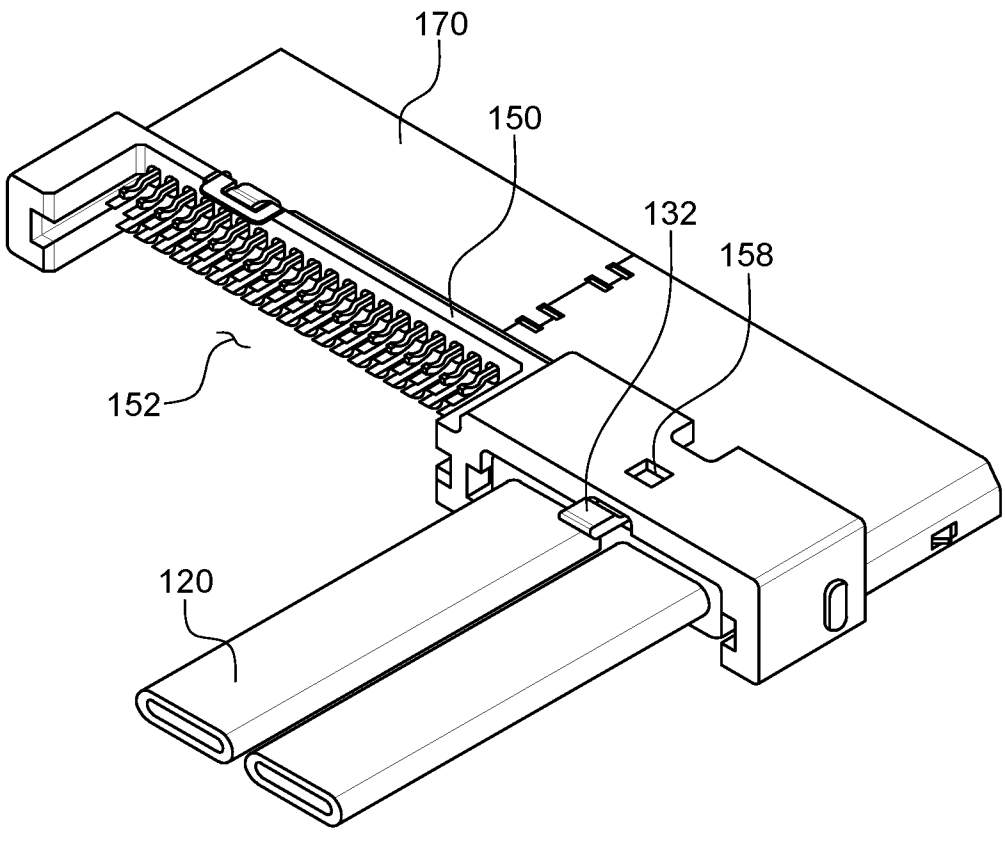

170
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158
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120
130
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FIG. 7A


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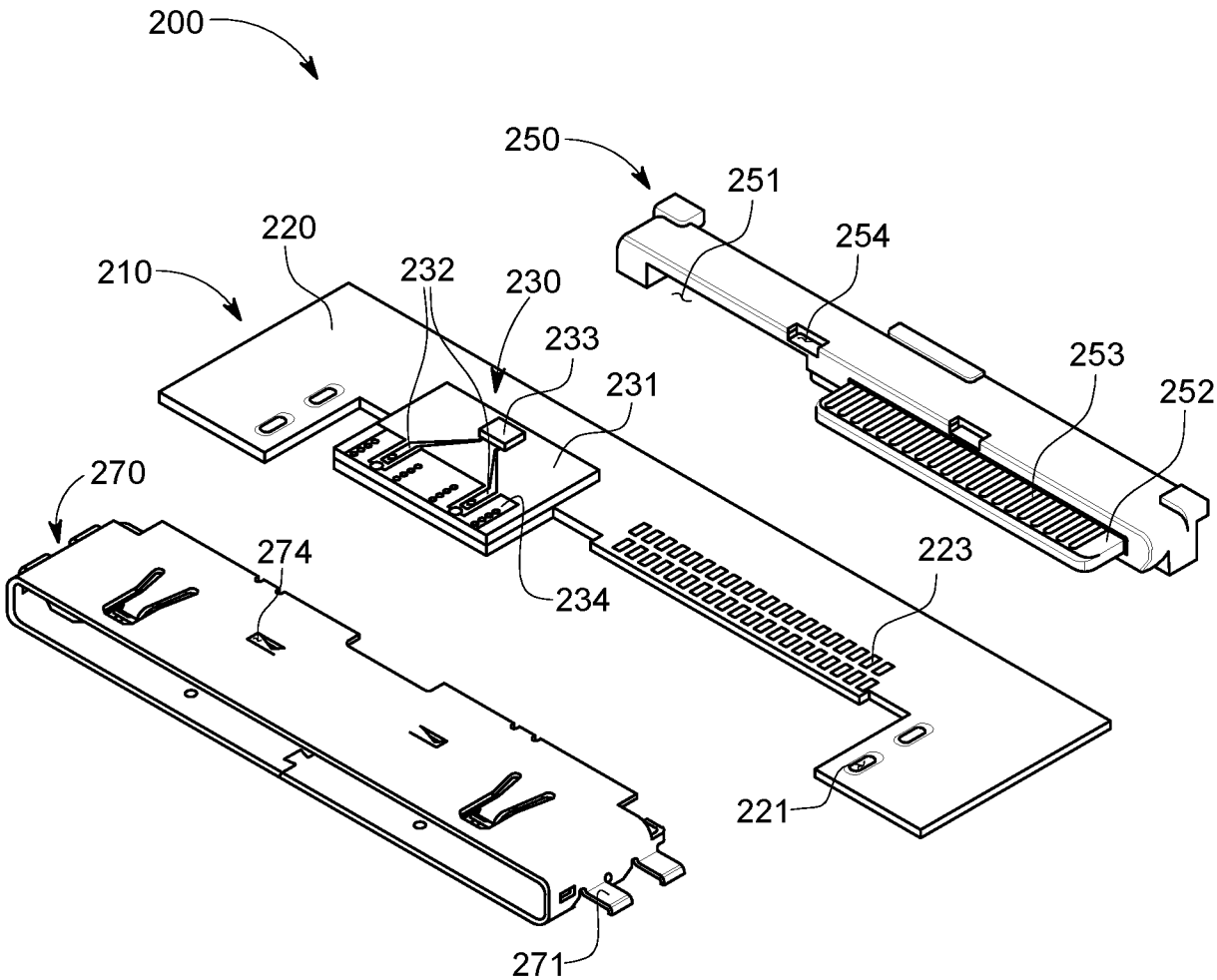

200
250
251
254
220
210
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252
270
274
223
234
221
271

FIG. 8

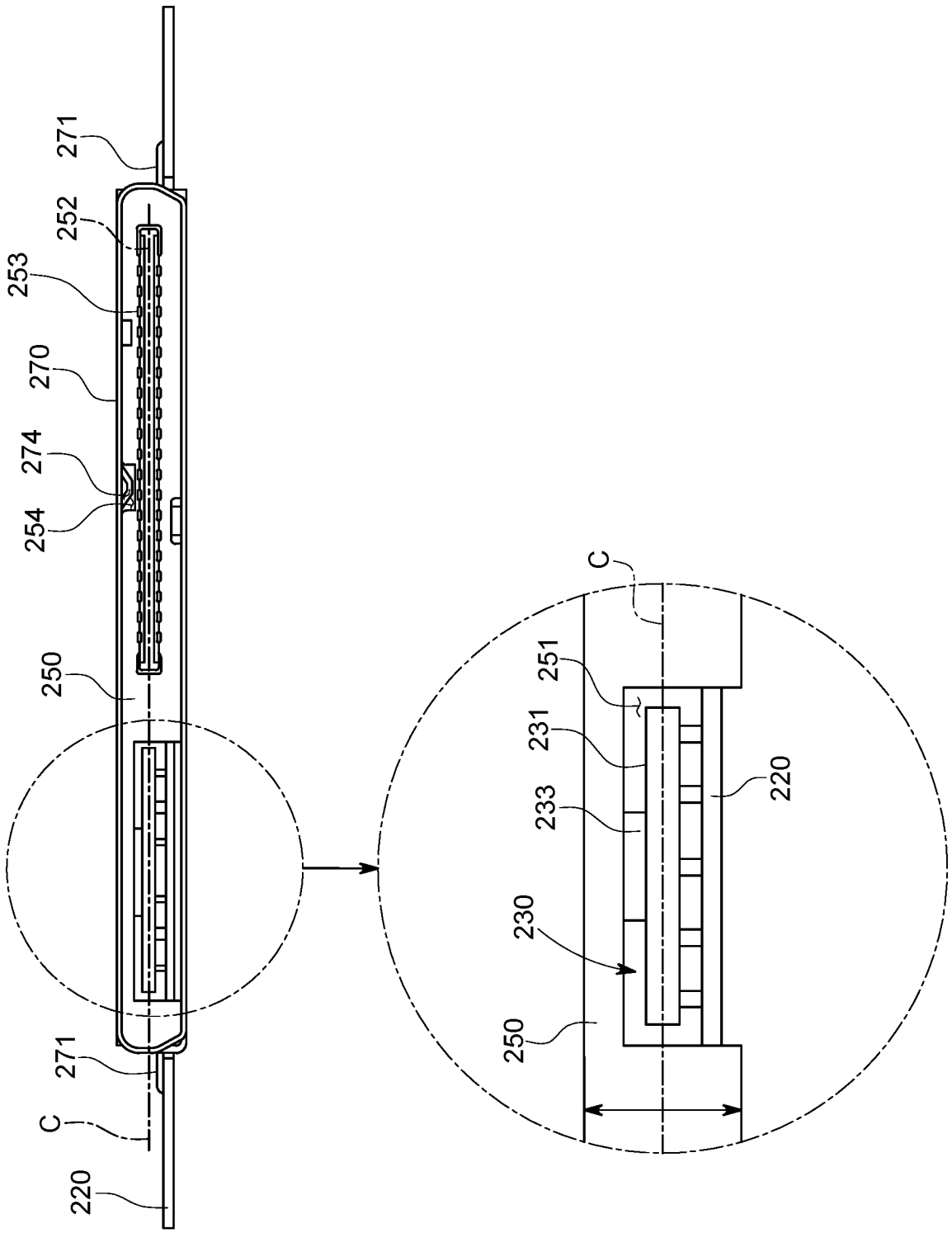


FIG. 9

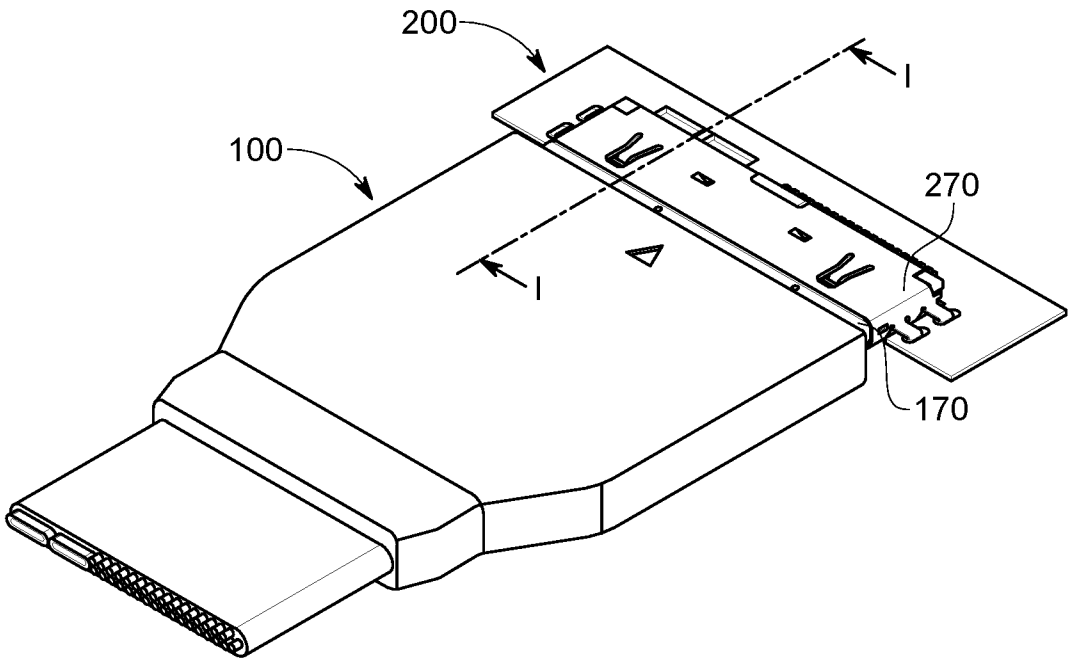

200
100
I
I
270
170

FIG. 10

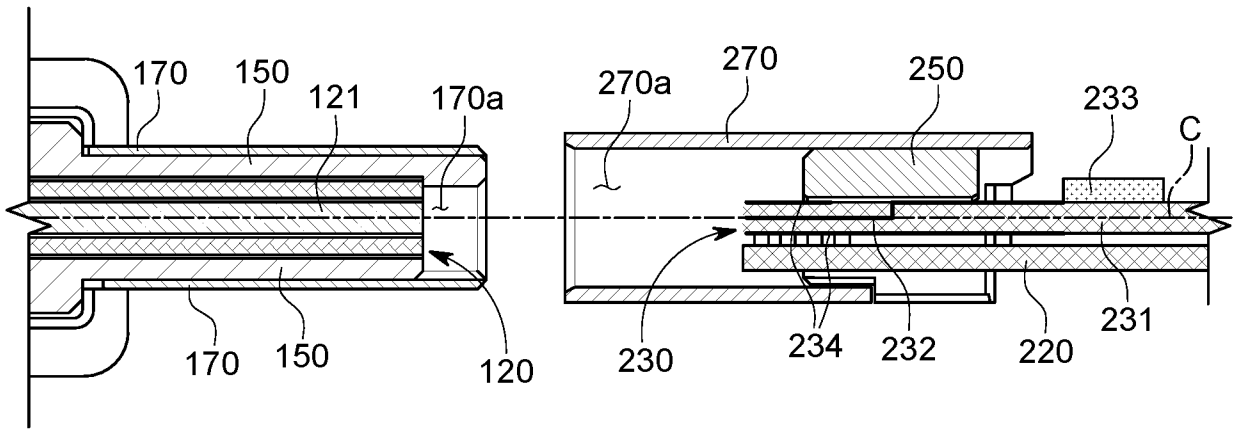

170
150
121
170a
270a
270
250
233
C
170
150
120
230
234
232
220
231

FIG. 11

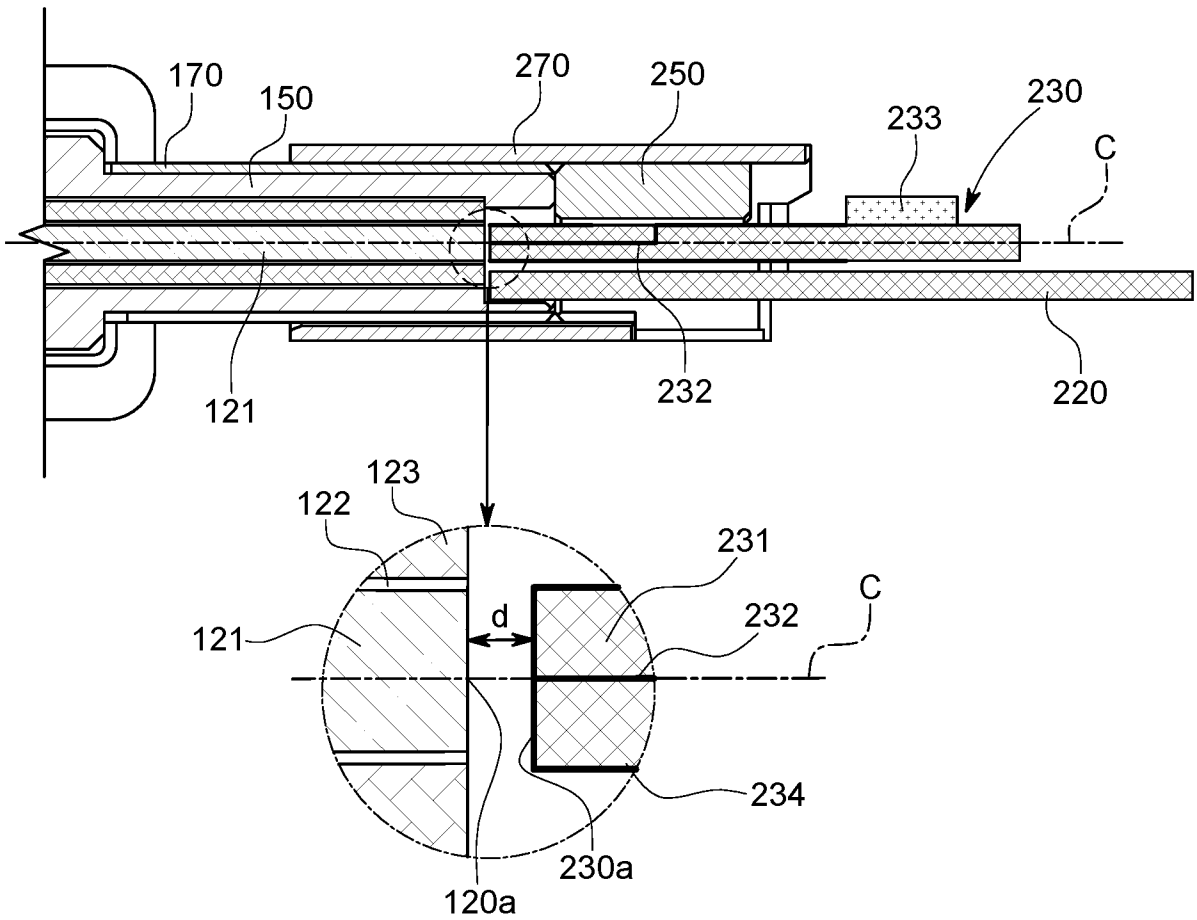

170
150
270
250
230
233
C
121
232
220
123
122
231
C
d
121
232
234
230a
120a

FIG. 12

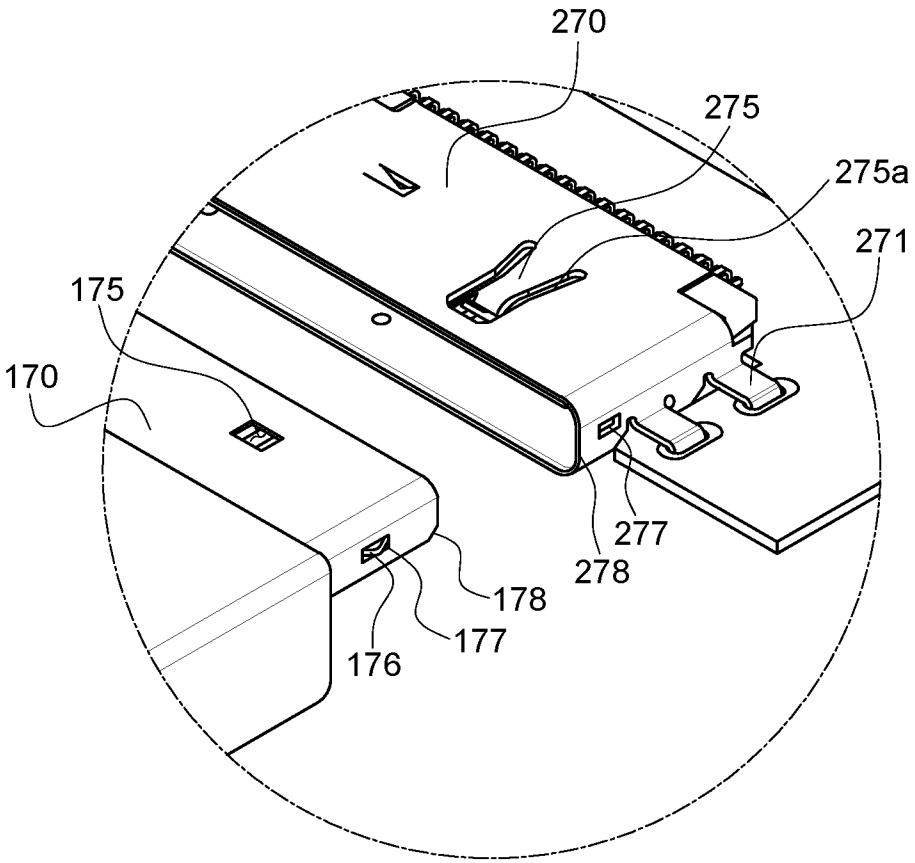


FIG. 13

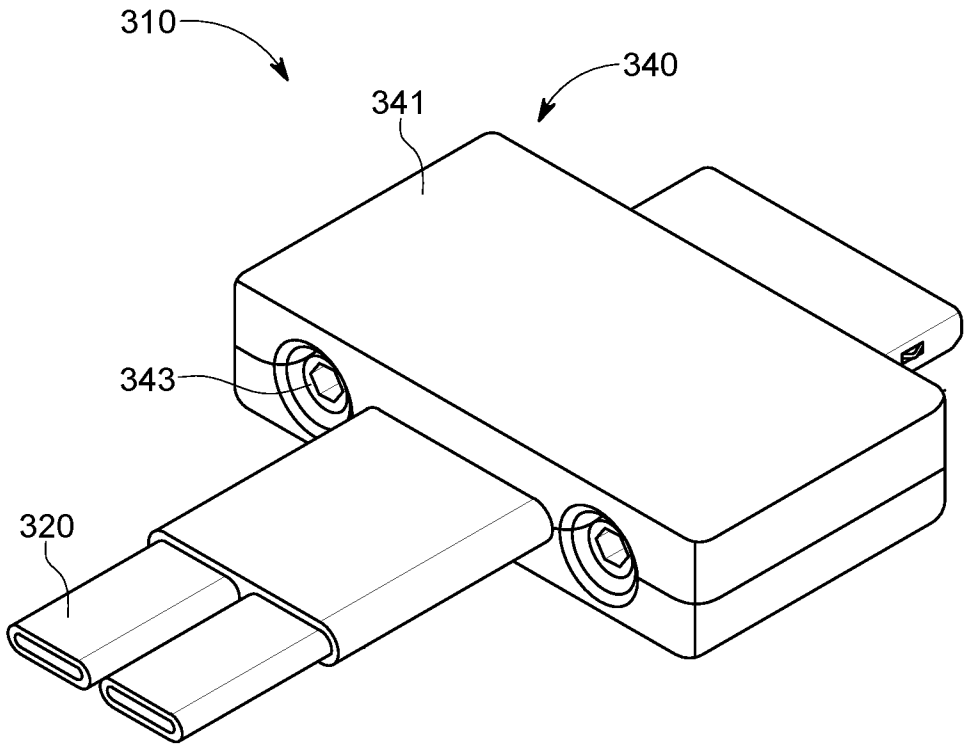

310
340
341
343
320

FIG. 14

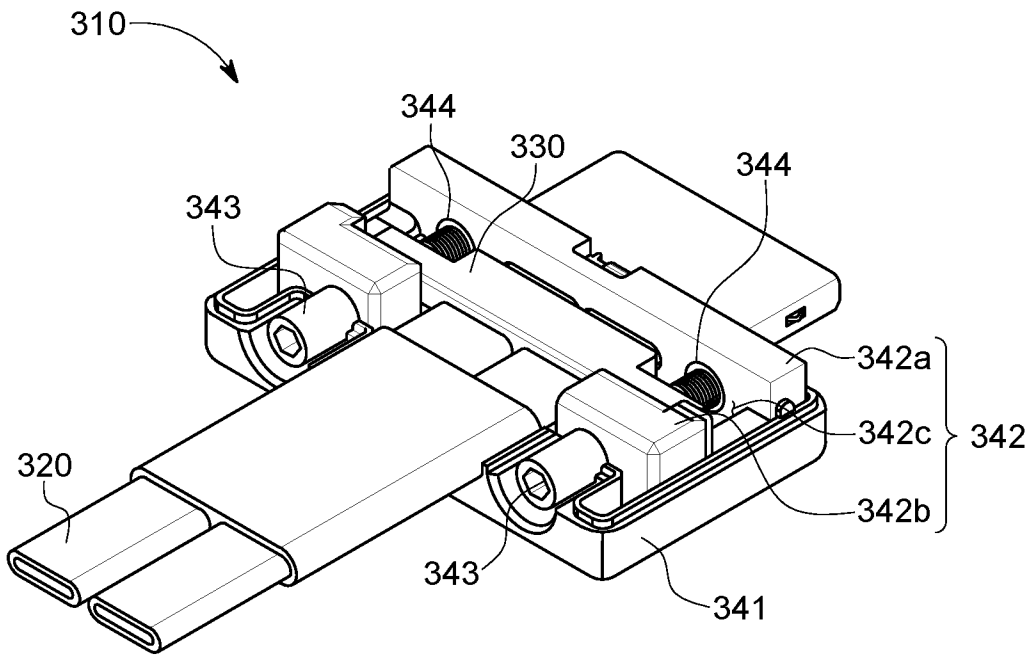

310
344
330
344
343
342a
342c
342
342b
320
343
341

FIG. 15

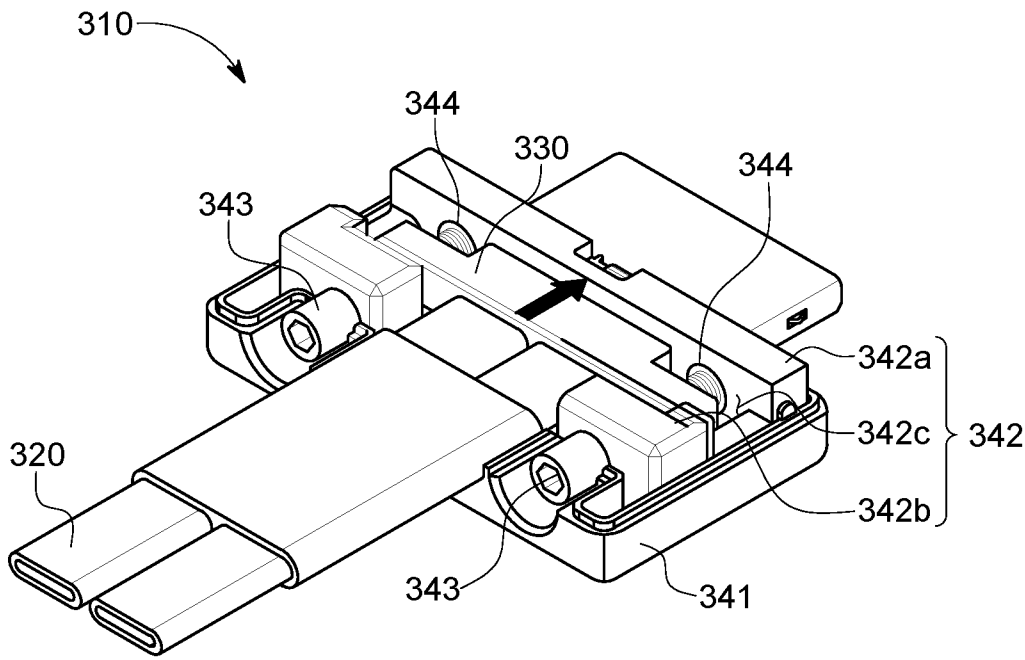


FIG. 16

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2018/018613

A. CLASSIFICATION OF SUBJECT MATTER

H01R 13/658(2011.01)i, H01Q 13/20(2006.01)i, H01R 13/639(2006.01)i, H01R 13/6582(2011.01)i, H01P 3/16(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01R 13/658; G02B 6/32; H01R 43/00; H01Q 13/00; G02B 6/42; H01R 25/00; G02B 6/36; H04B 10/40; H01P 1/04; H01Q 13/20; H01R 13/639; H01R 13/6582; H01P 3/16

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: signal transmission, wave guide, antenna, plug, receptacle

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2011-0176778 A1 (TERRANCE F. LITTLE et al.) 21 July 2011 See paragraphs [0028]-[0040], claims 1-5 and figures 2-3, 8-9.	1-9
A	US 2011-0121924 A1 (CARSON R. WHITE et al.) 26 May 2011 See paragraphs [0048]-[0053], claim 1 and figure 3.	1-9
A	KR 10-2015-0026661 A (SAMSUNG ELECTRONICS CO., LTD.) 11 March 2015 See paragraphs [0027]-[0034], claims 1-3 and figures 2a-9.	1-9
A	US 2014-0050491 A1 (JAMYUEN KO et al.) 20 February 2014 See paragraphs [0023]-[0045], claim 1 and figures 1A-4.	1-9
A	US 2008-0266196 A1 (SHAWN SHI) 30 October 2008 See paragraphs [0015]-[0020] and figures 3-4.	1-9

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

☒ See patent family annex.

* Special categories of cited documents:
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"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

Date of the actual completion of the international search	Date of mailing of the international search report
31 July 2018 (31.07.2018)	**31 July 2018 (31.07.2018)**

Name and mailing address of the ISA/KR
International Application Division
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea
Facsimile No. +82-42-481-8578

Authorized officer
KIM, Sung Gon
Telephone No. +82-42-481-8746

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2018/018613

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