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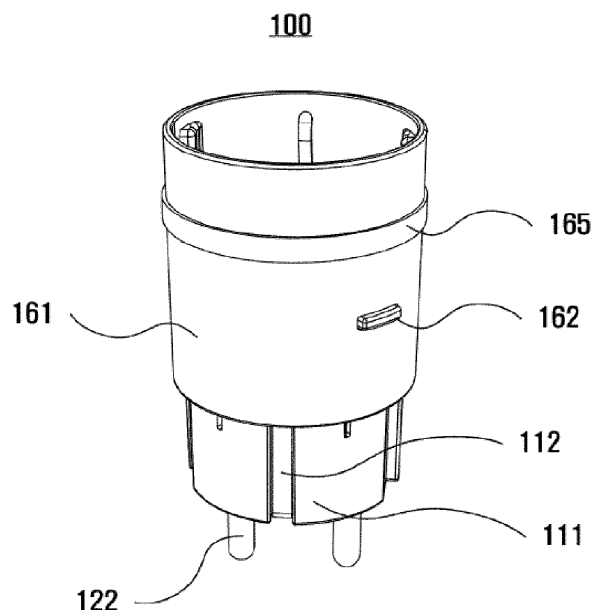
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(54) **SMART PLUG SOCKET DEVICE WITH BENT ANTENNA EMBEDDED THEREIN**

(57) Provided is a smart plug socket device in which a bent antenna is embedded therein. The smart plug socket device includes: a lower housing in which a pair of through-holes are formed in the lower surface thereof; and an upper housing, which is mutually coupled to the lower housing so as to form an inner space and in which a pair of insertion holes into which a plug pin of an elec-

tronic device can be inserted are formed in the lower surface thereof. The upper housing further includes a wireless communication antenna coupled to the inside surface of the upper housing, and the antenna includes an antenna pattern part that is bent along the inner circumference of the upper housing, thereby extending in a horizontal direction.

Fig. 1



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Description

Technical Field

[0001] The present invention relates generally to a smart plug socket device, and more particularly, to a smart plug socket device with an antenna embedded therein.

Background Art

[0002] A smart plug socket device is a device that is connected between an outlet and a plug of an electronic device to monitor the power consumption state of the electronic device or to supply or cut off power to the electronic device according to a control command from a user device. A conventional smart plug socket device is provided in the form of a tablet having a large volume with a rectangular cross-section, which causes interference with a plug of an electronic device inserted in the neighboring plug insertion opening of the outlet or another smart plug socket device. Further, since the conventional smart plug socket device is provided with internal components thereof integrally formed, it is difficult to individually test whether each component is defective during the assembly process. Further, since a space occupied by an antenna is large in the conventional smart plug socket device, it is difficult to produce compact-sized products.

Disclosure

Technical Problem

[0003] Accordingly, an object of the present invention is to provide a smart plug socket device with a bent antenna embedded therein.

[0004] This object together with others not specifically mentioned will become clear to those skilled in the art from the following description.

Technical Solution

[0005] In order to achieve the above object, according to one aspect of the present invention, there is provided a smart plug socket device including: a lower housing formed with a pair of through-holes in a lower surface thereof; an AC-DC converter board including: a pair of plug pins passing through the pair of through-holes of the lower housing; a transformer supplied with AC power through the pair of plug pins, and configured to convert the AC power to DC power; a first power connector for transmitting the DC power; and a pair of power supply wirings supplied with the AC power through the pair of plug pins; a relay board being stacked on the AC-DC converter board, and including: a pair of connection terminals in which a plug pin of an electronic device is fitted; a relay module supplied with the AC power through the

pair of power supply wirings, and configured to supply or cut off the AC power to the pair of connection terminals according to a control command from a controller module; a second power connector electrically and mechanically connected to the first power connector of the AC-DC converter board; and a first power signal connector for transmitting the DC power and for signal exchange with the controller module; a controller board being stacked on the relay board, being formed with a through-hole through which the pair of connection terminals pass, and including: the controller module controlling operation of the smart plug socket device, and performing wireless communication with an external device; a second power signal connector electrically and mechanically connected to the first power signal connector of the relay board; and an antenna contact connected to an antenna; and an upper housing coupled to the lower housing to form a space therein, and formed with a pair of insertion holes in a lower surface thereof to allow a plug pin of an electronic device to be inserted thereinto, wherein the upper housing further includes an antenna for wireless communication coupled to an inner surface of the upper housing, the antenna includes an antenna pattern portion that is bent along an inner circumference of the upper housing body and extends in a horizontal direction.

[0006] In an embodiment of the present invention, the antenna may further include an antenna body that extends in a vertical direction from an end of the antenna pattern portion, and the upper housing may further include a support wall protruding from the inner surface of the upper housing at a side of the antenna body to support the side of the antenna body.

[0007] In an embodiment of the present invention, the antenna may further include an antenna body that extends in a vertical direction from an end of the antenna pattern portion, and the upper housing may further include a support that is provided adjacent to a surface of the antenna body, extends in the vertical direction along the antenna body, and supports the antenna body.

[0008] Further, the antenna may further include an antenna contact portion provided at a lower portion of the antenna body and connected to the antenna contact of the controller board, the antenna contact portion may include a plurality of contacts extending parallel to each other while being spaced apart from each other, and the support may be disposed between the plurality of contacts.

[0009] In an embodiment of the present invention, the antenna may further include: an antenna body that extends in a vertical direction from an end of the antenna pattern portion; and an antenna contact portion provided at a lower portion of the antenna body, and connected to the antenna contact of the controller board, and the antenna contact portion may be bent at least once at a predetermined angle to have an elastic force.

[0010] In an embodiment of the present invention, the upper housing may further include a groove formed along a circumference of the lower surface of the upper housing

body, and at least a part of the antenna pattern portion may be accommodated in the groove.

[0011] Further, the upper housing may further include at least one support that is provided by connecting the inner surface and the lower surface of the upper housing from under the groove, and supports the at least a part of the antenna pattern portion.

[0012] The at least one support may be formed by heat fusing at least one support member provided at a position adjacent to the groove along the circumference of the lower surface of the upper housing body.

[0013] In an embodiment of the present invention, the antenna pattern portion may include a protruding pattern protruding toward a center of the upper housing, and the lower surface of the upper housing may be provided with a stepped portion accommodating the protruding pattern.

[0014] In an embodiment of the present invention, the antenna may be applicable to at least one wireless communication method of Z-Wave, Wi-Fi, ZigBee, and Bluetooth.

[0015] Other specific details of the invention are contained in the detailed description and the accompanying drawings.

Advantageous Effects

[0016] According to the present invention, there can be provided a smart plug socket device with a bent antenna embedded therein.

[0017] Effects of the present invention are not limited to the effect mentioned above, and other effects not mentioned can be clearly understood to those skilled in the art from the following description.

Description of Drawings

[0018]

FIG. 1 is a perspective view illustrating a smart plug socket device according to an embodiment of the present invention.

FIG. 2 is an exploded perspective view illustrating the smart plug socket device of FIG. 1.

FIG. 3 is a view illustrating a coupling structure of a lower housing of FIG. 2.

FIG. 4 is a view illustrating a coupling structure of an AC-DC converter board of FIG. 2.

FIG. 5 is a view illustrating arrangement of a temperature sensor on the AC-DC converter board of FIG. 2.

FIG. 6 is a view illustrating a coupling structure of a relay board of FIG. 2.

FIG. 7 is a view illustrating arrangement of a temperature sensor on the relay board of FIG. 2.

FIG. 8 is a view illustrating a coupling structure of a board cover of FIG. 2.

FIG. 9 is a view illustrating that component assembly is accommodated in the lower housing of FIG. 2.

FIG. 10 is a view illustrating a coupling structure of a controller board of FIG. 2.

FIG. 11 is a view illustrating a coupling structure of an upper housing of FIG. 2.

FIGS. 12 to 13 are views illustrating arrangement of an antenna on the upper housing of FIG. 2.

FIG. 14 is a view illustrating that component assembly is accommodated in the upper housing of FIG. 2.

FIG. 15 is a view illustrating a modification of the antenna of FIG. 2.

Mode for Invention

[0019] The advantages and features of the present invention and the manner of achieving them will become apparent with reference to the embodiments described in detail below with reference to the accompanying drawings. The exemplary embodiments described herein are provided for fully conveying the scope and spirit of the invention to those skilled in the art, so it should be understood that the invention is not limited to the disclosed embodiments, but may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein.

[0020] The terminology used herein is for the purpose of describing particular aspects (or embodiments) only and is not intended to be limiting of the present invention. As used herein, the singular forms are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," or "includes" and/or "including," when used in this specification, specify the presence of stated features, regions, integers, steps, operations, elements and/or components, but do not preclude the presence or addition of one or more other features, regions, integers, steps, operations, elements, components and/or groups thereof. It will be understood that, although the terms first, second, etc. may be used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element, from another element. For instance, a first element discussed below could be termed a second element without departing from the teachings of the present invention.

[0021] Unless otherwise defined, the meaning of all terms including technical and scientific terms used herein is the same as that commonly understood by one of ordinary skill in the art to which the present invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning which is consistent with their meaning in the context of the relevant art and the present disclosure, and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0022] Furthermore, spatially relative terms, such as "below", "beneath" or "lower", and "above" or "upper" may be used herein to describe one element's relation-

ship to other elements as illustrated in the drawings. It will be understood that relative terms are intended to encompass different orientations of the device in addition to the orientation depicted in the drawings. For example, if the device in one of the drawings is turned over, elements described as being on the "lower" side of other elements would then be oriented on the "upper" side of the other elements. The exemplary term "lower" can, therefore, encompass both an orientation of "lower" and "upper," depending upon the particular orientation of the figure. The components can also be oriented in different directions, so that spatially relative terms can be interpreted according to orientation.

[0023] Hereinafter, exemplary embodiments of the present invention will be described in detail with reference to the accompanying drawings.

[0024] With reference to FIGS. 1 to 14, a smart plug socket device 100 according to an embodiment of the present invention includes a housing 110, 160, an AC-DC converter board 120 accommodated in the housing 110, 160 and coupled thereto, a relay board 130, a board cover 140, and a controller board 150.

[0025] The housing 110, 120 forms an entire appearance of the smart plug socket device 100. The housing 110, 120 has a cylindrical shape and is formed of a non-conductive material. The housing 110, 120 includes a lower housing 110, and an upper housing 120. The lower housing 110 and the upper housing 120 are coupled to each other to form a space therein. The lower housing 110 has a diameter smaller than that of the upper housing 120, and the upper portion of the lower housing 110 is fitted in the lower portion of the upper housing 120.

[0026] The lower housing 110 includes a lower housing body 111 formed in a cylindrical shape having a substantially circular cross-section open at one side thereof. The outer diameter of the lower housing body 111 has a size corresponding to a plug insertion opening of an outlet. Although not clearly shown, the lower surface of the lower housing body 111 is formed with a pair of through-holes through which a pair of plug pins 122 to be described later pass. Although not clearly shown, each of the pair of through-holes of the lower surface of the lower housing body 111 is formed on the inner circumferential surface thereof with a concave-convex portion to be engaged with a concave-convex portion 122a of an end of each of the pair of plug pins 122. Thus, it is possible to prevent separation of the pair of plug pins 122, and to securely fix the pair of plug pins 122. A ground 112 for grounding is coupled to the lower surface of the lower housing body 111. The ground 112 is formed in a band shape having a predetermined length and has a substantially U-shaped cross section. The central portion of the ground 112 may be coupled to the lower surface of the lower housing body 111 by a rivet 113. The central portion of the ground 112 is supported on the lower surface of the lower housing body 111 to be exposed by being in close contact therewith, and the side portions of the ground 112 are supported on the side surfaces of the lower housing body

111, respectively, to be exposed by being in close contact therewith. Further, as described later, the side portions of the ground 112 pass through opposite sides of the lower surface of an upper housing body 161 and are exposed on the lower surface of the upper housing body 161.

[0027] The AC-DC converter board 120 includes a planar substrate 121. The pair of plug pins 122 is coupled to the lower surface of the substrate 121. An end 122a of each of the pair of plug pins 122 may be coupled to the lower surface of the substrate 121 by soldering. The plug pin 122 has a rod shape with a predetermined length and is formed of a conductive material. The end of the plug pin 122 is formed on the outer circumferential surface thereof with the concave-convex portion 122a to be engaged with the concave-convex portion of the lower surface of the lower housing body 111 above described. As described later, the pair of plug pins 122 are exposed on the lower surface of the lower housing body 111 by passing through the lower surface of the lower housing body 111.

[0028] As shown in FIG. 5, a first temperature sensor 126 is disposed adjacent to the pair of plug pins 122. The first temperature sensor 126 may be centrally disposed between the pair of plug pins 122 to measure the temperature around the pair of plug pins 122. When a connection terminal of an outlet of a multi-tap into which a pair of plug pins 122 are fitted or the pair of plug pins 122 is overheated, the heat generated therefrom raises ambient temperature, and the first temperature sensor 126 senses change in the ambient temperature. The first temperature sensor 126 is operated by receiving DC power from a transformer 123 to be described later. Although only one first temperature sensor 126 is shown in FIG. 5, the present invention is not limited thereto. Two or more first temperature sensors 126 may be disposed adjacent to the pair of plug pins 122, respectively.

[0029] The transformer 123, a pin-type first power signal connector 124, and a pair of power supply wirings 125 are coupled to the upper surface of the substrate 121. The transformer 123 converts AC power supplied (from the outlet) through the pair of plug pins 122 to DC power to generate internal power for the internal components of the smart plug socket device 100. For example, a relay module 132, a controller module 152, and the like, which will be described later, may be operated using the internal power generated by the transformer 123. The first power signal connector 124 receives internal DC power from the transformer 123, transmits the internal DC power to the relay board 130 to be described later, and exchanges signals. The first power signal connector 124 may transmit a signal from the first temperature sensor 126 to a second power signal connector 133 to be described later. The pair of power supply wirings 125 is for transmitting AC power supplied through the pair of plug pins 122 to the relay board 130 to be described later. The pair of power supply wirings 125 may include a conductive metal and be formed through press working. The

pair of power supply wirings 125 support the relay board 130 to prevent movement of the substrate 121 due to an external force applied to the pair of plug pins 122.

[0030] The relay board 130 is stacked on the AC-DC converter board 120 and is coupled thereto. The relay board 130 includes a planar substrate 131. The relay module 132, and the pin-type second power signal connector 133 are coupled to the lower surface of the substrate 131. The relay module 132 may be supplied with AC power through the pair of power supply wirings 125 and may supply or cut off the AC power to a pair of connection terminals 135 according to a control command from the controller module 152. The second power signal connector 133 is electrically and mechanically connected to the first power signal connector 124 of the AC-DC converter board 120 to receive internal DC power and exchange signals. The second power signal connector 133 transmits the internal DC power to the relay module 132. The second power signal connector 133 receives a signal from the first temperature sensor 126, from the first power signal connector 124. A pin-type third power signal connector 134 and the pair of connection terminals 135 are coupled to the upper surface of the substrate 131. The third power signal connector 134 is for transmitting the internal DC power to the controller board 150 to be described later and exchanging signals. The third power signal connector 134 may transmit a signal from the first temperature sensor 126 or a signal from a second temperature sensor 136 to a fourth power signal connector 133 to be described later. A plug pin of an electronic device may be fitted in the pair of connection terminals 135. The pair of connection terminals 135 is formed of a conductor material, and may supply AC power supplied from the pair of power supply wirings 125 to the plug pin of the electronic device.

[0031] As shown in FIG. 7, the second temperature sensor 136 is disposed adjacent to the pair of connection terminals 135. The second temperature sensor 136 may be centrally disposed between the pair of connection terminals 135 to measure the temperature around the pair of connection terminals 135. When the pair of connection terminals 135 or a plug pin of an electronic device fitted in the pair of connection terminals 135 is overheated, the heat generated therefrom raises ambient temperature, and the second temperature sensor 136 senses change in the ambient temperature. The second temperature sensor 136 is operated by receiving DC power from the second power signal connector 133. Although only one second temperature sensor 136 is shown in FIG. 7, the present invention is not limited thereto. Two or more second temperature sensors 136 may be disposed adjacent to the pair of connection terminals 135, respectively.

[0032] The board cover 140 is stacked on the relay board 130 and is coupled thereto. The board cover 140 electrically separates the relay board 130 from the controller board 150 to be described later, and simultaneously fixes the controller board 150 onto the relay board 130. The board cover 140 includes a planar cover 141.

The cover 141 is formed with a hole 144 to expose the third power signal connector 134 of the relay board 130. A pair of terminal covers 142 and at least one latch 13 are formed on the upper surface of the cover 141. The pair of terminal covers 142 exposes and surrounds the pair of connection terminals 135. The pair of terminal covers 142 may be formed higher than the pair of connection terminals 135 to prevent electrical sparks generated from the pair of connection terminals 135 from causing electrical problems to the controller board 150. The at least one latch 143 fixes the controller board 150 to be described later onto the board cover 140.

[0033] As shown in FIG. 9, in the assembly process of the smart plug socket device 100, component assembly, in which the AC-DC converter board 120, the relay board 130, and the board cover 140 are assembled together, is inserted and accommodated in the lower housing 110. Further, the component assembly may be fixed to the lower housing 110 by heat fusion or bolt fastening.

[0034] The controller board 150 is stacked on the board cover 140 and is coupled thereto. The controller board 150 includes a planar substrate 151. The substrate 151 is formed with through-holes 155 through which the pair of terminal covers 142 of the board cover 140 pass. A pin-type fourth power signal connector 153 is coupled to the lower surface of the substrate 151. The fourth power signal connector 153 is electrically and mechanically connected to the third power signal connector 134 of the relay board 130 to receive internal DC power and exchange signals. The fourth power signal connector 153 supplies the internal DC power to the controller module 152. The fourth power signal connector 153 transmits a signal from the first temperature sensor 126 and a signal from the second temperature sensor 136 to the controller module 152. The power signal connectors 134 and 153 of the relay board 130 and the controller board 150 may exchange signals between the controller module 152 and the relay module 132. The controller module 152, an internal button 154, and an antenna contact 156 are coupled to the upper surface of the substrate 151. The controller module 152 controls the overall operation of the smart plug socket device 100. For example, the controller module 152 may include a processor for performing operations and processing of data, a memory for storing data, and a communication unit for performing wireless communication with an external device, but is not limited thereto. The controller module 152 may measure and calculate the power consumption, power factor, cumulative power, carbon dioxide emission, power charge, etc. of an electronic device, and transmit the same to a user device. The controller module 152 may turn on/off the power supply to the electronic device when an abnormal condition is detected or according to a control command received from the user device. The controller module 152 may control the relay module 132 to cut off the power supply to the electronic device when the temperature measured by the temperature sensor 126 or 136 is equal to or more than a predetermined critical temperature. At

the same time, the controller module 152 may send an overheat warning message to the user device. The internal button 154 may transmit a command signal to the controller module 152 in response to a pressing operation. According to the command signal, the controller module 152 may perform the turn-on/off operation of the smart plug socket device 100, supply/cutoff operation of the AC power to the plug pin of the electronic device, and a pairing operation with the user device, but is not limited thereto. The antenna contact 156 is connected to a contact portion 164c of an antenna 164 to be described later. The controller module 152 may perform wireless communication with the user device via the antenna 156.

[0035] The upper housing 160 includes an upper housing body 161 formed in a cylindrical shape having a substantially circular cross-section open at opposite sides thereof. The inner diameter of the upper housing body 161 has a size corresponding to a plug of an electronic device. A lower surface 167 of the upper housing body 161 is formed at a middle portion of a predetermined depth from the upper portion of the upper housing body. Although not clearly shown, the lower surface 167 of the upper housing body 161 is formed with a pair of insertion holes into which a plug pin of an electronic device is inserted. Further, the lower surface 167 of the upper housing body 161 is formed at opposite sides thereof with a pair of through-holes through which the side portions of the ground 112 of the lower housing 110 pass. The side surface of the upper housing body 161 is formed with a slit 166 so that a part of an external button 162 is protrudingly exposed on the side surface of the upper housing body 161 through the slit 166 to be coupled to the inner side surface of the upper housing body 161. The external button 162 is operated in conjunction with the internal button 154 of the controller board 150.

[0036] A safety assembly 163 is coupled to a position corresponding to the pair of insertion holes of the lower surface 167 of the upper housing body 161. The safety assembly 163 includes a safety cover 163a, a spring 163b, and a safety bar 163c. Although not clearly shown, the safety bar 163c is formed with a pair of through-holes to correspond to the pair of insertion holes. The safety cover 163a is rotatably coupled onto the safety bar 163c. The spring 163b provides an elastic force such that the safety cover 163a closes the pair of through-holes of the safety bar 163c. When the plug pin of the electronic device is inserted through the pair of insertion holes of the upper housing body 161, the safety cover 163a is rotated to one side while compressing the spring 163b, thereby opening the pair of through-holes of the safety bar 163c. Accordingly, it is possible to prevent an instrument other than a plug of an electronic device from being inserted into the inside of the smart plug socket device 100.

[0037] As shown in FIGS. 12 to 13, the antenna 164 for wireless communication is bent along the inner circumference of the upper housing body 161 and is coupled to the inner surface of the upper housing body 161. The antenna 164 may have the form of a plate antenna.

[0038] The antenna 164 includes an antenna pattern portion 164a that is bent along the inner circumference of the upper housing body 161 and extends in the horizontal direction. An oblong groove 167a is formed along a circumference of the lower surface 167 of the upper housing body 161. At least a part (for example, a part of an upper portion) of the antenna pattern portion 164a is accommodated in the groove 167a. A support member 168c is formed at a position adjacent to the groove 167a along a circumference of the lower surface 167 of the upper housing body 161. Depending on the length of the antenna pattern portion 164a, one support member 168c may be formed, or two or more support members 168c may be formed spaced apart from each other at a predetermined interval. Although not clearly shown, in the assembly process of the smart plug socket device 100, the support member 168c may be fixed to the inner surface of the upper housing body 161 by heat fusion. A support (not shown) connects the inner surface of the upper housing body 161 and the lower surface 167 from under the groove 167a, and the antenna pattern portion 164a is accommodated in the groove 167a and at least a part of the antenna pattern portion 164a is supported by the support. Thus, movement or separation of the antenna pattern portion 164a due to an external impact is prevented. The overall shape of the antenna pattern portion 164a is not limited to the embodiment shown in FIG. 11. The antenna pattern portion 164a may be provided in various forms according to the wireless communication method (for example, Z-Wave, Wi-Fi, ZigBee, Bluetooth, etc.) of the smart plug socket device 100.

[0039] An antenna body 164b extends in a vertical direction from one end of the antenna pattern portion 164a. The antenna body 164b is provided at a side thereof with a support wall 168a protruding from the inner surface of the upper housing body 161. The support wall 168a blocks the groove 167a in one direction of the antenna body 164b. Since the support wall 168a supports one side of the antenna 164, it is possible to prevent movement, separation, etc. of the antenna 164 due to external impact.

[0040] The antenna contact portion 164c is provided at a lower portion of the antenna body 164b. The antenna contact portion 164c has a plurality of contacts, and the plurality of contacts extend parallel to each other from the antenna body 164b while being spaced apart from each other. The antenna contact portion 164c is connected to the antenna contact 156 of the controller board 150. The antenna contact portion 164c may be bent at least once at a predetermined angle to have an elastic force. As a result, the antenna contact portion 164c and the antenna contact 156 of the controller board 150 can be brought into close contact with each other.

[0041] A support column 168b is formed adjacent to the groove 167a on the lower surface 167 of the upper housing body 161. The support column 168b is adjacent to one side of the antenna body 164b. The support column 168b may extend in the vertical direction along an-

tenna body 164b. The support column 168b is disposed between the plurality of contacts of the antenna contact portion 164c. The support column 168b supports the antenna body 164b and/or the antenna contact portion 164c to limit the bending range of the antenna 164 and prevent damage to the antenna 164 when the antenna 164 and the controller board 150 are connected to each other. The antenna 164 may be formed of a metal or alloy such as silver, copper, aluminum, and iron.

[0042] A band 165 is coupled to the upper portion of the upper housing body 161. A groove may be formed on the outer circumferential surface of the upper portion of the upper housing body 161, and the band 165 may be fitted over the groove. The band 165 is formed of a silicon material having a predetermined color, thereby improving appearance of the smart plug socket device 100 and providing ease of use thereof.

[0043] As shown in FIG. 14, in the assembly process of the smart plug socket device 100, component assembly, in which the lower housing 110, the AC-DC converter board 120, the relay board 130, the board cover 140, and the controller board 150 are assembled together, is inserted and accommodated in the upper housing 160. Further, the component assembly may be fixed to the upper housing 160 by ultrasonic welding.

[0044] As shown in FIG. 15, an antenna 164' may be provided in a shape different from that of the antenna 164. The modified antenna 164' includes the antenna pattern portion 164a extending longer than that of the antenna 164. The antenna pattern portion 164a includes a protruding pattern 164d that is bent to protrude toward the center of the upper housing body 161. The protruding pattern 164d may have a small width compared to other portions of the antenna pattern portion 164a. The protruding pattern 164d is accommodated in a stepped portion 167b formed on the lower surface 167 of the upper housing body 161.

[0045] In the smart plug socket device 100 described above, since the planar boards 120, 130 and 150 are sequentially stacked along the vertical axis, it is easy to make the size of the smart plug socket device compact. Further, in the smart plug socket device 100, since each of the boards 120, 130 and 150 has a terminal/connector for receiving power, it is easy to test whether each board is defective or not in the process of assembling the smart plug socket device 100.

[0046] The above-described smart plug socket device 100 may supply or cut off AC power to the pair of connection terminals 135. Further, the smart plug socket device 100 may wirelessly transmit information, such as power consumption of an electronic device measured based on the current/voltage supplied to the pair of connection terminals 135, to a user device.

[0047] When an outlet, the smart plug socket device 100 or a plug of an electronic device is overheated due to external environmental factors such as looseness of connection, incomplete insertion, connection failure, or internal factors, the smart plug socket device 100 senses

this and cuts off the power supplied to the electronic device, and sends an overheat warning message to the user device to prevent overheating and prevent accidents due to overheating.

[0048] Since the above-described smart plug socket device 100 is configured such that the antenna 164 is bent and embedded along the inner circumference of the upper housing body 161, the space can be secured easily, thereby making it possible to make the size of the smart plug socket device compact, increasing the stability of the signal, and providing ease of assembly.

[0049] The steps of a method or algorithm described in connection with an embodiment of the invention may be directly implemented by hardware and software module executed by hardware, or a combination thereof. The software module may reside in a random access memory (RAM), a read only memory (ROM), an erasable programmable ROM (EPROM), an electrically erasable programmable ROM (EEPROM), a flash memory, a hard disk, a removable disk, a compact disc-read only memory (CD-ROM), or in any form of computer readable recording medium well known in the art to which the present invention belongs.

[0050] While the invention has been described in its preferred embodiments, it is to be understood that the words which have been used are words of description rather than limitation and that changes within the purview of the appended claims may be made without departing from the true scope and spirit of the invention in its broader aspects.

Claims

1. A smart plug socket device comprising:

a lower housing formed with a pair of through-holes in a lower surface thereof;
 an AC-DC converter board including: a pair of plug pins passing through the pair of through-holes of the lower housing; a transformer supplied with AC power through the pair of plug pins, and configured to convert the AC power to DC power; a first power connector for transmitting the DC power; and a pair of power supply wirings supplied with the AC power through the pair of plug pins;
 a relay board being stacked on the AC-DC converter board, and including: a pair of connection terminals in which a plug pin of an electronic device is fitted; a relay module supplied with the AC power through the pair of power supply wirings, and configured to supply or cut off the AC power to the pair of connection terminals according to a control command from a controller module; a second power connector electrically and mechanically connected to the first power connector of the AC-DC converter board; and a first

power signal connector for transmitting the DC power and for signal exchange with the controller module;

a controller board being stacked on the relay board, being formed with a through-hole through which the pair of connection terminals pass, and including: the controller module controlling operation of the smart plug socket device, and performing wireless communication with an external device; a second power signal connector electrically and mechanically connected to the first power signal connector of the relay board; and an antenna contact connected to an antenna; and

an upper housing coupled to the lower housing to form a space therein, and formed with a pair of insertion holes in a lower surface thereof to allow a plug pin of an electronic device to be inserted thereinto,

wherein the upper housing further includes an antenna for wireless communication coupled to an inner surface of the upper housing,

the antenna includes: an antenna pattern portion that is bent along an inner circumference of the upper housing body and extends in a horizontal direction; and an antenna body that extends in a vertical direction from an end of the antenna pattern portion, and

the upper housing further includes a support wall protruding from the inner surface of the upper housing at a side of the antenna body to support the side of the antenna body.

2. A smart plug socket device comprising:

a lower housing formed with a pair of through-holes in a lower surface thereof;

an AC-DC converter board including: a pair of plug pins passing through the pair of through-holes of the lower housing; a transformer supplied with AC power through the pair of plug pins, and configured to convert the AC power to DC power; a first power connector for transmitting the DC power; and a pair of power supply wirings supplied with the AC power through the pair of plug pins;

a relay board being stacked on the AC-DC converter board, and including: a pair of connection terminals in which a plug pin of an electronic device is fitted; a relay module supplied with the AC power through the pair of power supply wirings, and configured to supply or cut off the AC power to the pair of connection terminals according to a control command from a controller module; a second power connector electrically and mechanically connected to the first power connector of the AC-DC converter board; and a first power signal connector for transmitting the DC

power and for signal exchange with the controller module;

a controller board being stacked on the relay board, being formed with a through-hole through which the pair of connection terminals pass, and including: the controller module controlling operation of the smart plug socket device, and performing wireless communication with an external device; a second power signal connector electrically and mechanically connected to the first power signal connector of the relay board; and an antenna contact connected to an antenna; and

an upper housing coupled to the lower housing to form a space therein, and formed with a pair of insertion holes in a lower surface thereof to allow a plug pin of an electronic device to be inserted thereinto,

wherein the upper housing further includes an antenna for wireless communication coupled to an inner surface of the upper housing,

the antenna includes: an antenna pattern portion that is bent along an inner circumference of the upper housing body and extends in a horizontal direction; and an antenna body that extends in a vertical direction from an end of the antenna pattern portion, and

the upper housing further includes a support that is provided adjacent to a surface of the antenna body, extends in the vertical direction along the antenna body, and supports the antenna body.

3. The device of claim 2, wherein the antenna further includes an antenna contact portion provided at a lower portion of the antenna body, and connected to the antenna contact of the controller board,

the antenna contact portion includes a plurality of contacts extending parallel to each other while being spaced apart from each other, and the support is disposed between the plurality of contacts.

4. A smart plug socket device comprising:

a lower housing formed with a pair of through-holes in a lower surface thereof;

an AC-DC converter board including: a pair of plug pins passing through the pair of through-holes of the lower housing; a transformer supplied with AC power through the pair of plug pins, and configured to convert the AC power to DC power; a first power connector for transmitting the DC power; and a pair of power supply wirings supplied with the AC power through the pair of plug pins;

a relay board being stacked on the AC-DC converter board, and including: a pair of connection terminals in which a plug pin of an electronic

device is fitted; a relay module supplied with the AC power through the pair of power supply wirings, and configured to supply or cut off the AC power to the pair of connection terminals according to a control command from a controller module; a second power connector electrically and mechanically connected to the first power connector of the AC-DC converter board; and a first power signal connector for transmitting the DC power and for signal exchange with the controller module;

a controller board being stacked on the relay board, being formed with a through-hole through which the pair of connection terminals pass, and including: the controller module controlling operation of the smart plug socket device, and performing wireless communication with an external device; a second power signal connector electrically and mechanically connected to the first power signal connector of the relay board; and an antenna contact connected to an antenna; and

an upper housing coupled to the lower housing to form a space therein, and formed with a pair of insertion holes in a lower surface thereof to allow a plug pin of an electronic device to be inserted thereinto,

wherein the upper housing further includes an antenna for wireless communication coupled to an inner surface of the upper housing,

the antenna includes: an antenna pattern portion that is bent along an inner circumference of the upper housing body and extends in a horizontal direction; an antenna body that extends in a vertical direction from an end of the antenna pattern portion; and an antenna contact portion provided at a lower portion of the antenna body, and connected to the antenna contact of the controller board, and

the antenna contact portion is bent at least once at a predetermined angle to have an elastic force.

5. A smart plug socket device comprising:

a lower housing formed with a pair of through-holes in a lower surface thereof;

an AC-DC converter board including: a pair of plug pins passing through the pair of through-holes of the lower housing; a transformer supplied with AC power through the pair of plug pins, and configured to convert the AC power to DC power; a first power connector for transmitting the DC power; and a pair of power supply wirings supplied with the AC power through the pair of plug pins;

a relay board being stacked on the AC-DC converter board, and including: a pair of connection

terminals in which a plug pin of an electronic device is fitted; a relay module supplied with the AC power through the pair of power supply wirings, and configured to supply or cut off the AC power to the pair of connection terminals according to a control command from a controller module; a second power connector electrically and mechanically connected to the first power connector of the AC-DC converter board; and a first power signal connector for transmitting the DC power and for signal exchange with the controller module;

a controller board being stacked on the relay board, being formed with a through-hole through which the pair of connection terminals pass, and including: the controller module controlling operation of the smart plug socket device, and performing wireless communication with an external device; a second power signal connector electrically and mechanically connected to the first power signal connector of the relay board; and an antenna contact connected to an antenna; and

an upper housing coupled to the lower housing to form a space therein, and formed with a pair of insertion holes in a lower surface thereof to allow a plug pin of an electronic device to be inserted thereinto,

wherein the upper housing further includes an antenna for wireless communication coupled to an inner surface of the upper housing,

the antenna includes an antenna pattern portion that is bent along an inner circumference of the upper housing body and extends in a horizontal direction,

the upper housing further includes a groove formed along a circumference of the lower surface of the upper housing body, and

at least a part of the antenna pattern portion is accommodated in the groove.

6. The device of claim 5, wherein the upper housing further includes at least one support that is provided by connecting the inner surface and the lower surface of the upper housing from under the groove, and supports the at least a part of the antenna pattern portion.

7. The device of claim 6, wherein the at least one support is formed by heat fusing at least one support member provided at a position adjacent to the groove along the circumference of the lower surface of the upper housing body.

8. A smart plug socket device comprising:

a lower housing formed with a pair of through-holes in a lower surface thereof;

an AC-DC converter board including: a pair of
 plug pins passing through the pair of through-
 holes of the lower housing; a transformer sup-
 plied with AC power through the pair of plug pins,
 and configured to convert the AC power to DC 5
 power; a first power connector for transmitting
 the DC power; and a pair of power supply wirings
 supplied with the AC power through the pair of
 plug pins;
 a relay board being stacked on the AC-DC con- 10
 verter board, and including: a pair of connection
 terminals in which a plug pin of an electronic
 device is fitted; a relay module supplied with the
 AC power through the pair of power supply wir- 15
 ings, and configured to supply or cut off the AC
 power to the pair of connection terminals accord-
 ing to a control command from a controller mod-
 ule; a second power connector electrically and
 mechanically connected to the first power con- 20
 nector of the AC-DC converter board; and a first
 power signal connector for transmitting the DC
 power and for signal exchange with the control-
 ler module;
 a controller board being stacked on the relay 25
 board, being formed with a through-hole through
 which the pair of connection terminals pass, and
 including: the controller module controlling op-
 eration of the smart plug socket device, and per-
 forming wireless communication with an exter- 30
 nal device; a second power signal connector
 electrically and mechanically connected to the
 first power signal connector of the relay board;
 and an antenna contact connected to an anten-
 na; and 35
 an upper housing coupled to the lower housing
 to form a space therein, and formed with a pair
 of insertion holes in a lower surface thereof to
 allow a plug pin of an electronic device to be
 inserted thereinto,
 wherein the upper housing further includes an 40
 antenna for wireless communication coupled to
 an inner surface of the upper housing,
 the antenna includes an antenna pattern portion
 that is bent along an inner circumference of the
 upper housing body and extends in a horizontal 45
 direction,
 the antenna pattern portion includes a protrud-
 ing pattern protruding toward a center of the up-
 per housing, and
 the lower surface of the upper housing is pro- 50
 vided with a stepped portion accommodating the
 protruding pattern.

9. The device of any one of claims 1 to 8, wherein the 55
 antenna is applicable to at least one wireless com-
 munication method of Z-Wave, Wi-Fi, ZigBee, and
 Bluetooth.

Fig. 1

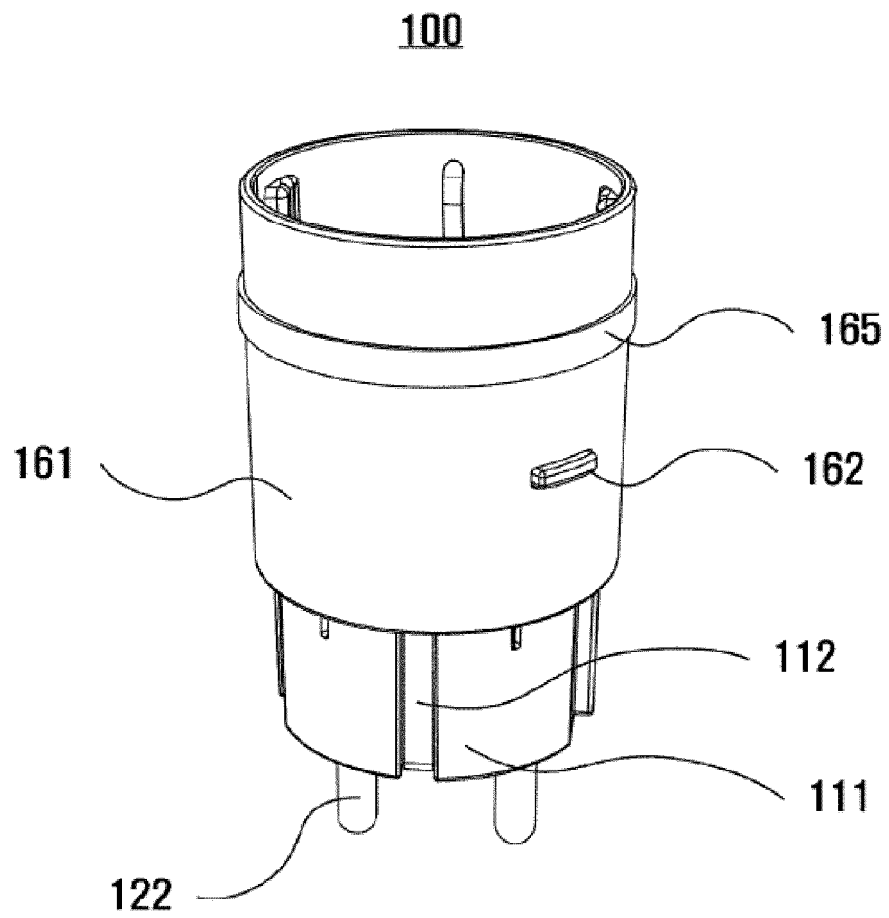


Fig. 2

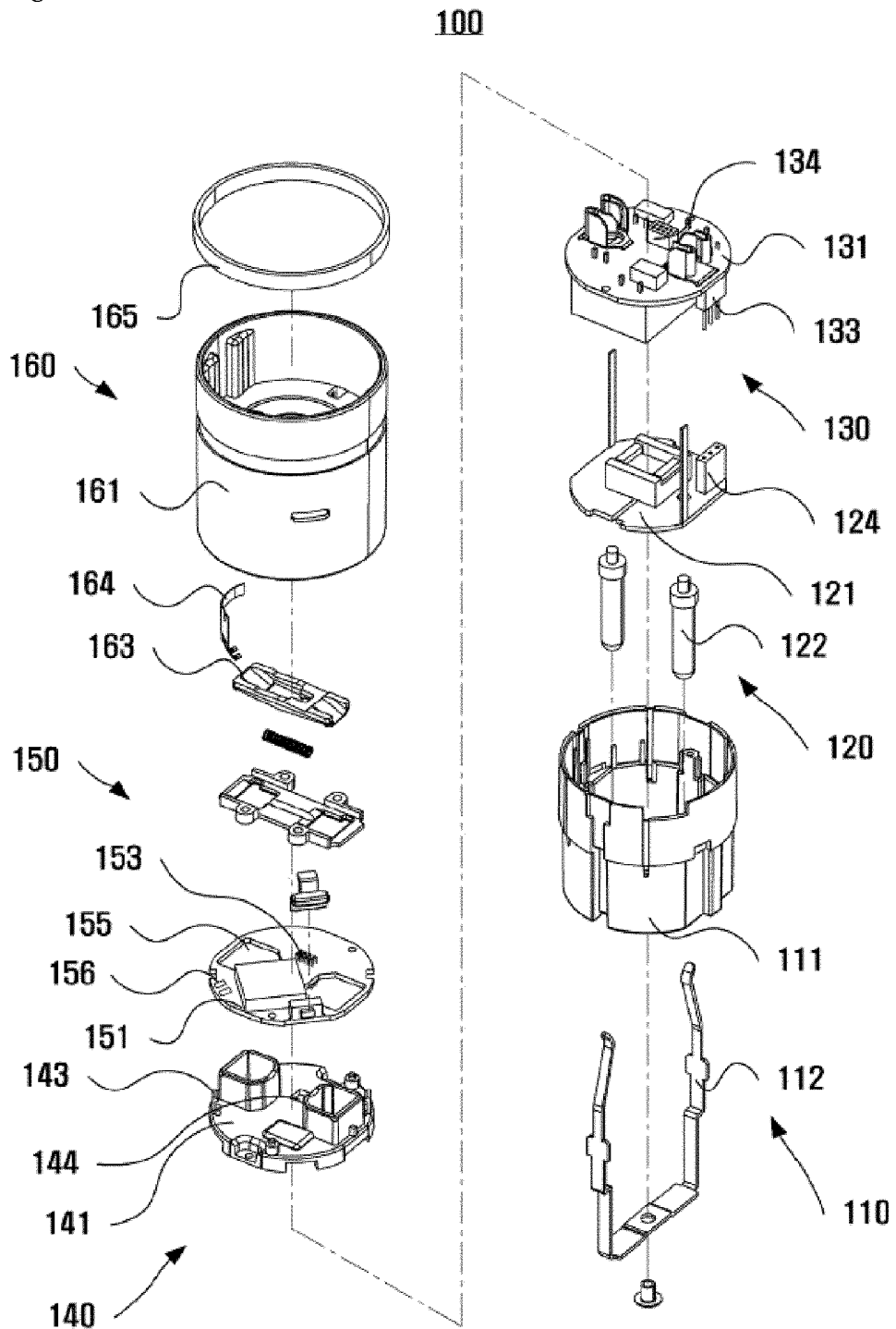


Fig. 3

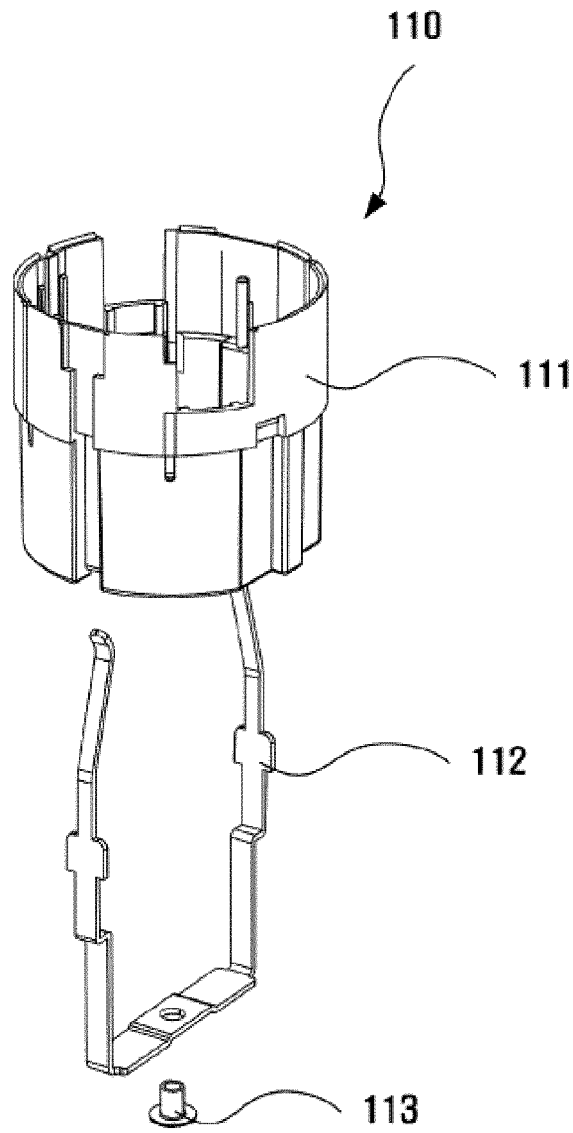


Fig. 4

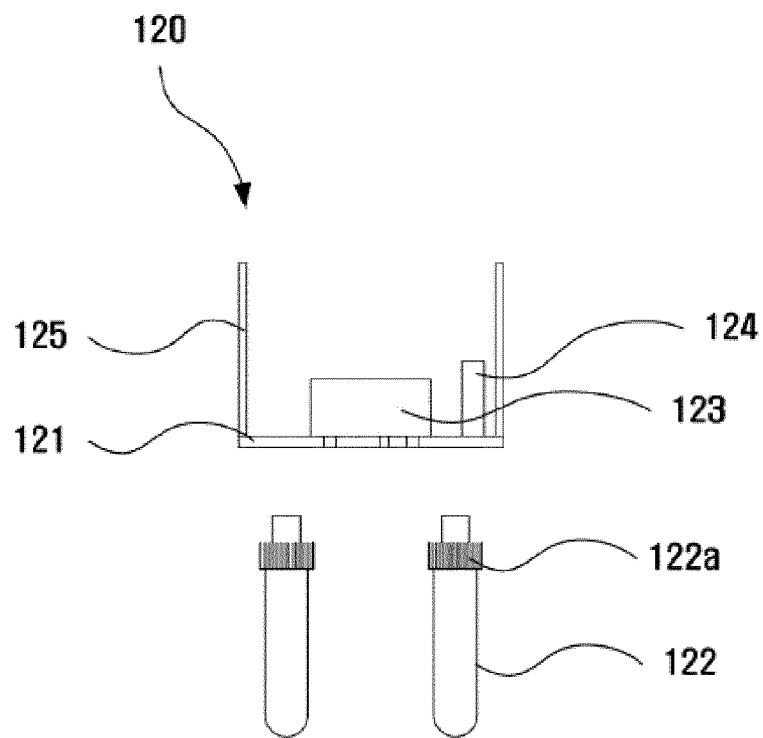


Fig. 5

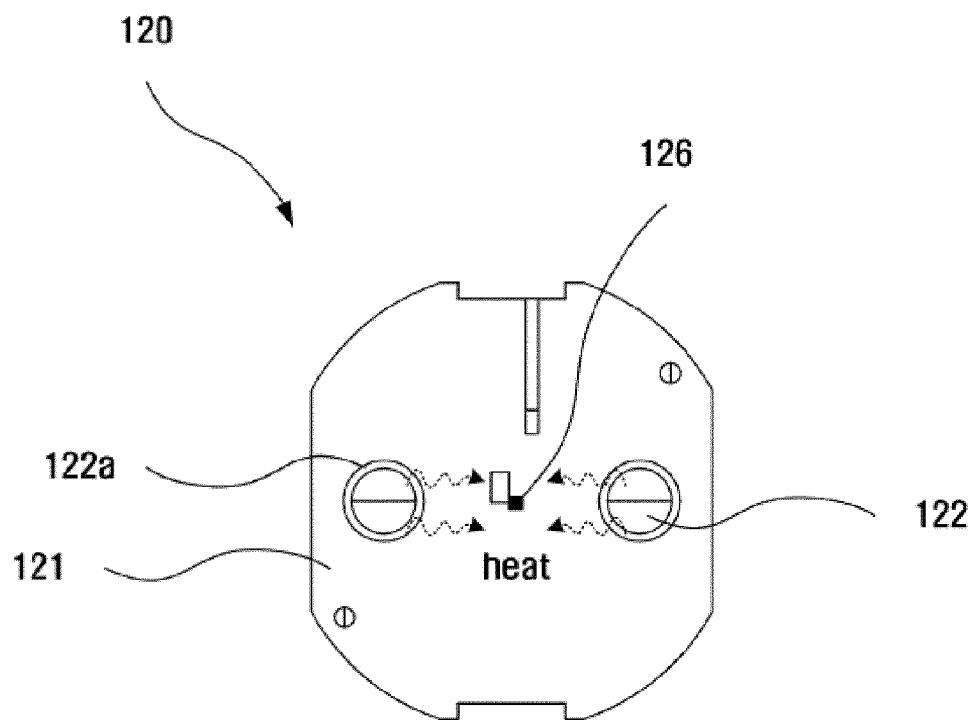


Fig. 6

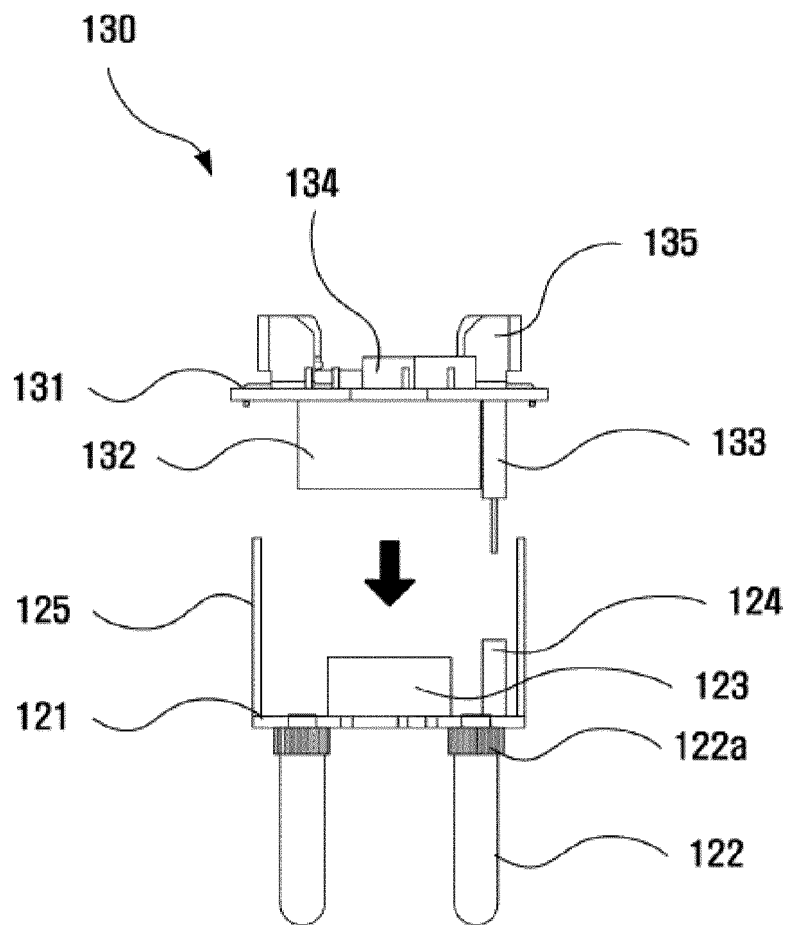


Fig. 7
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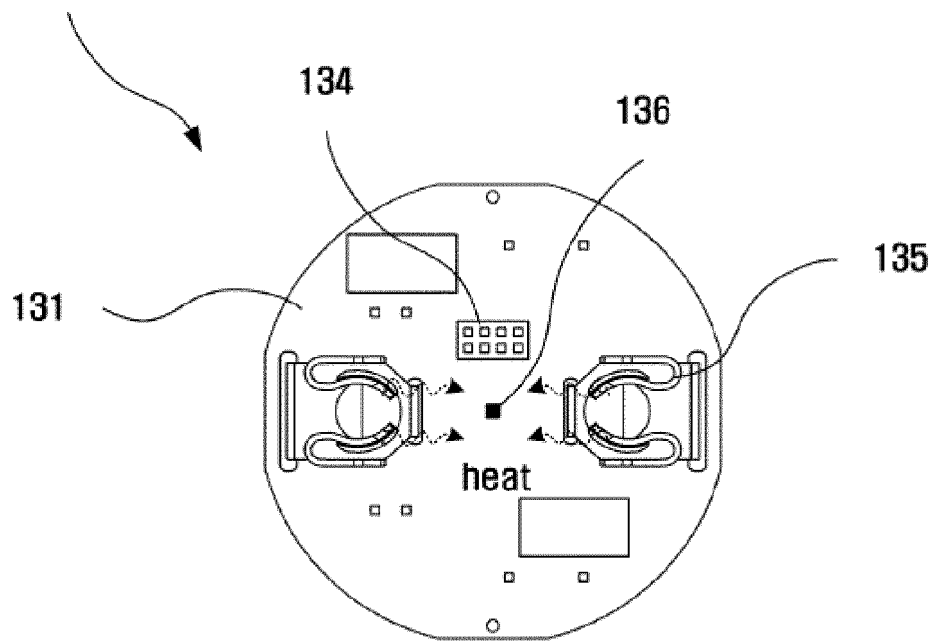


Fig. 8

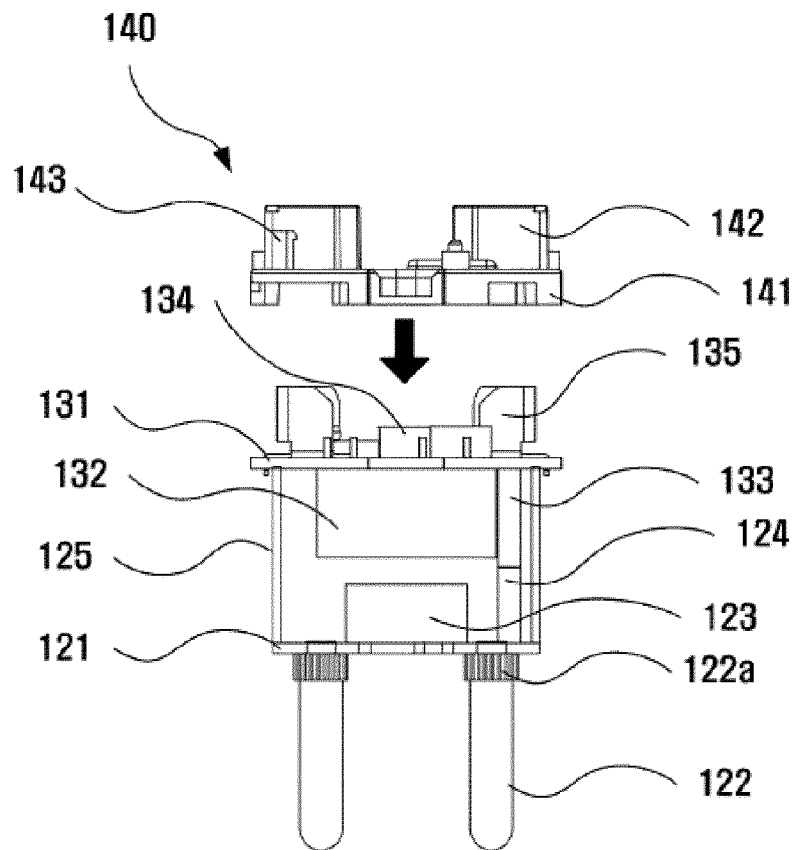


Fig. 9

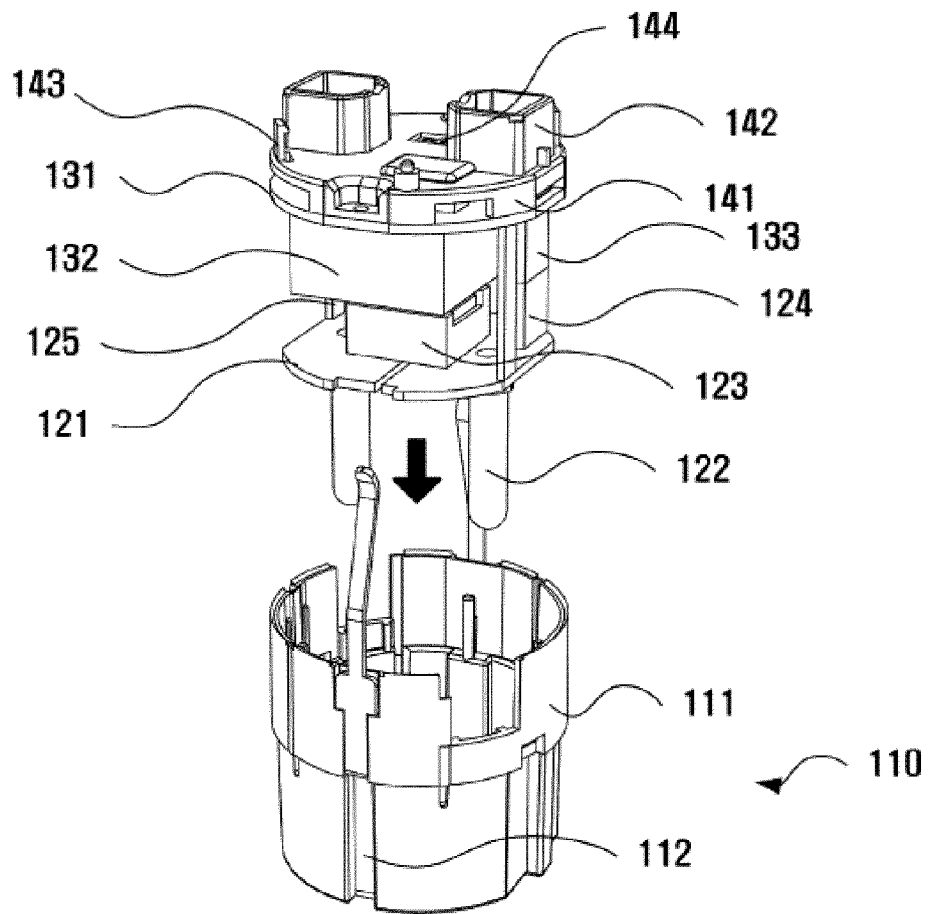


Fig. 10

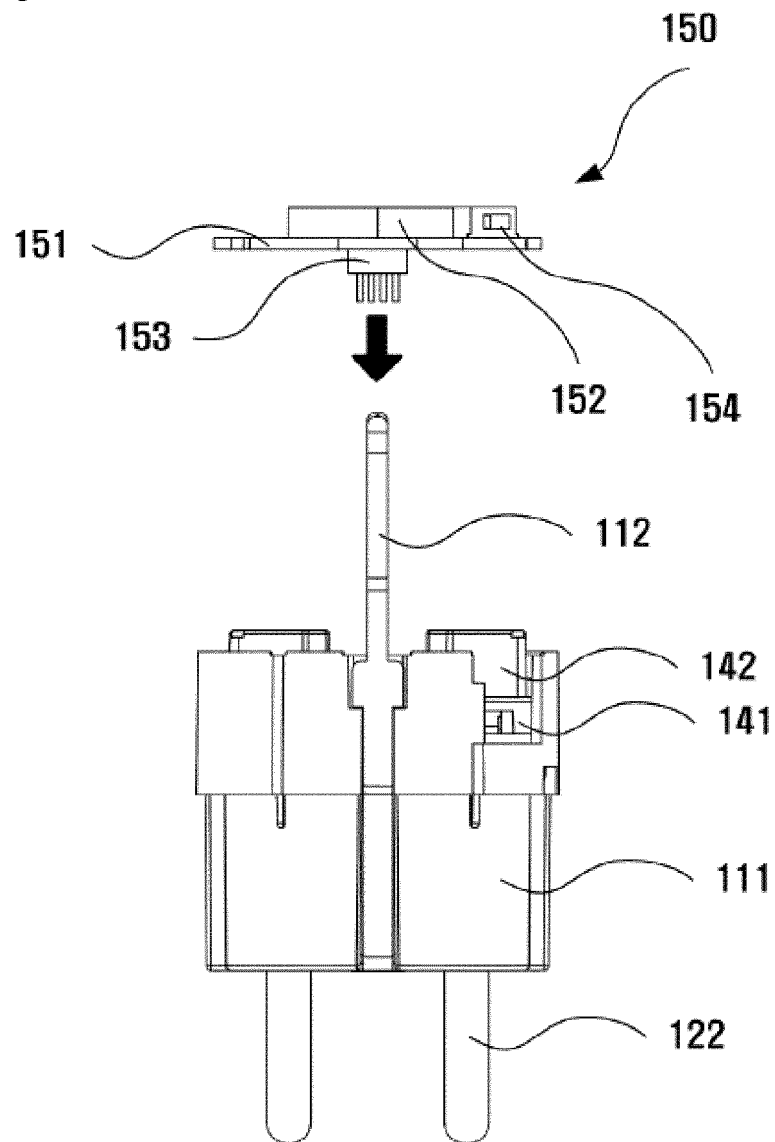


Fig. 11

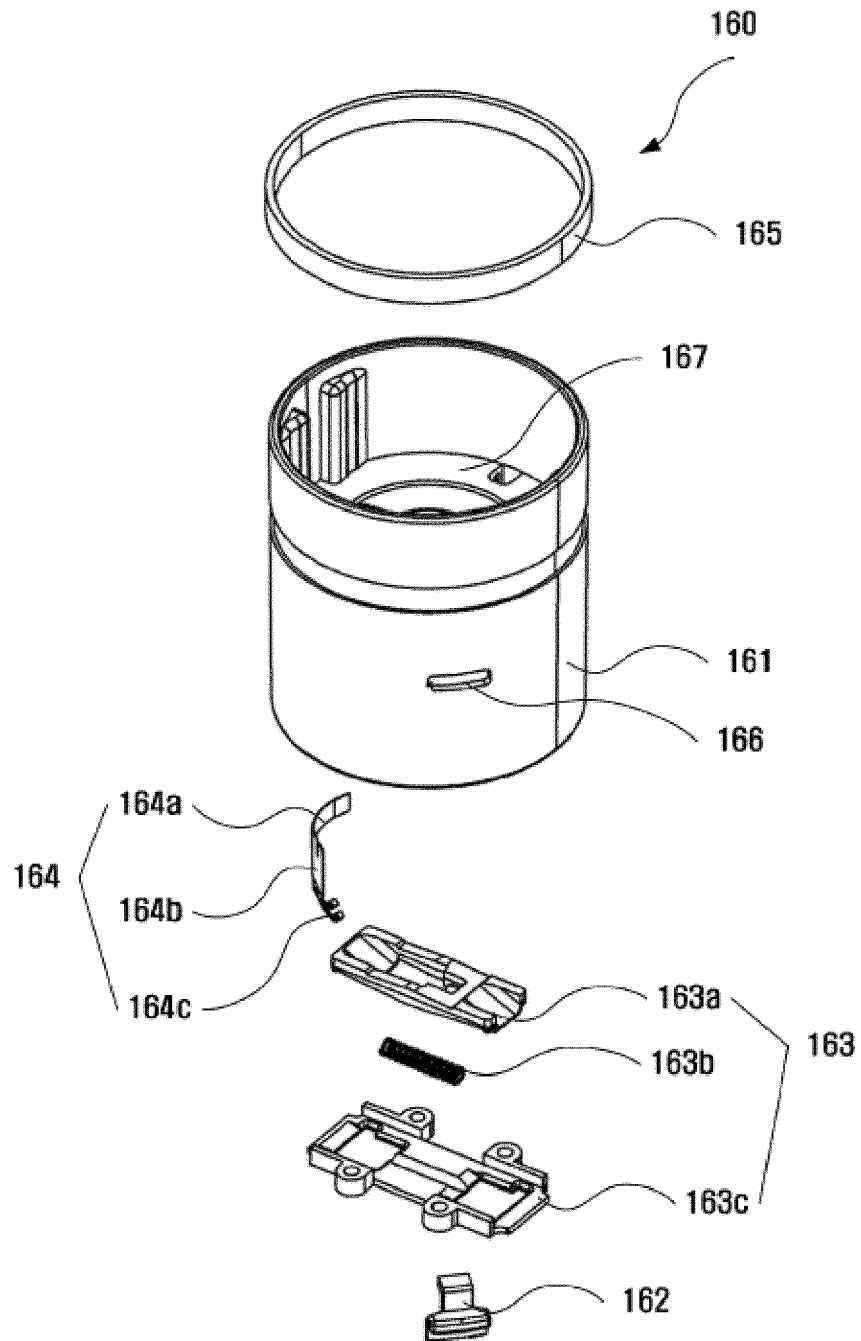


Fig. 12

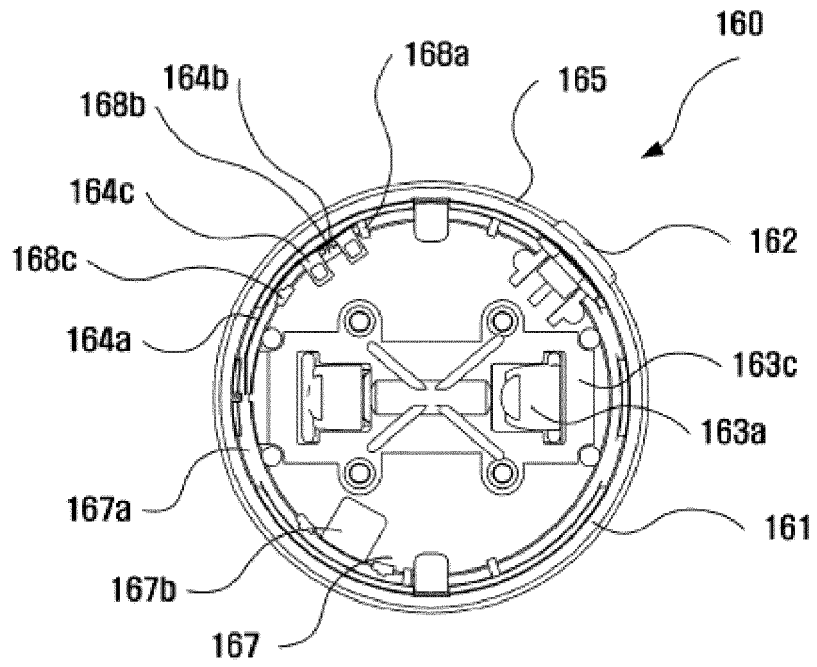


Fig. 13

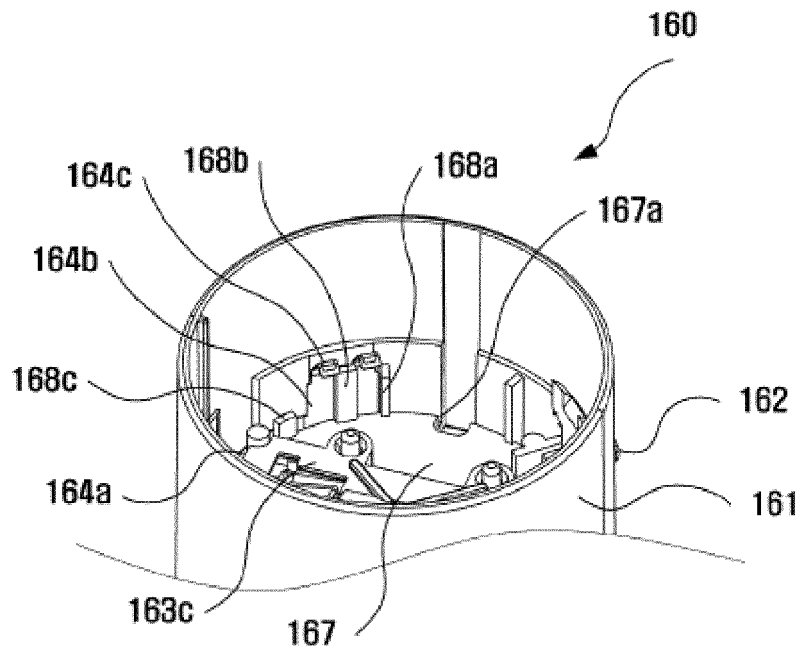


Fig. 14

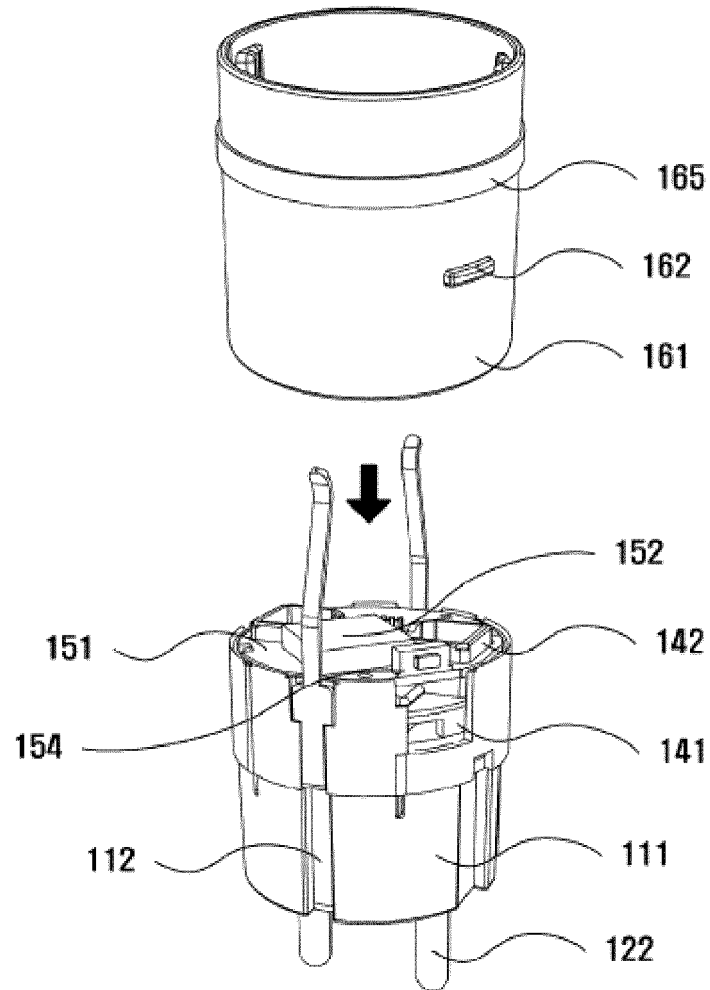
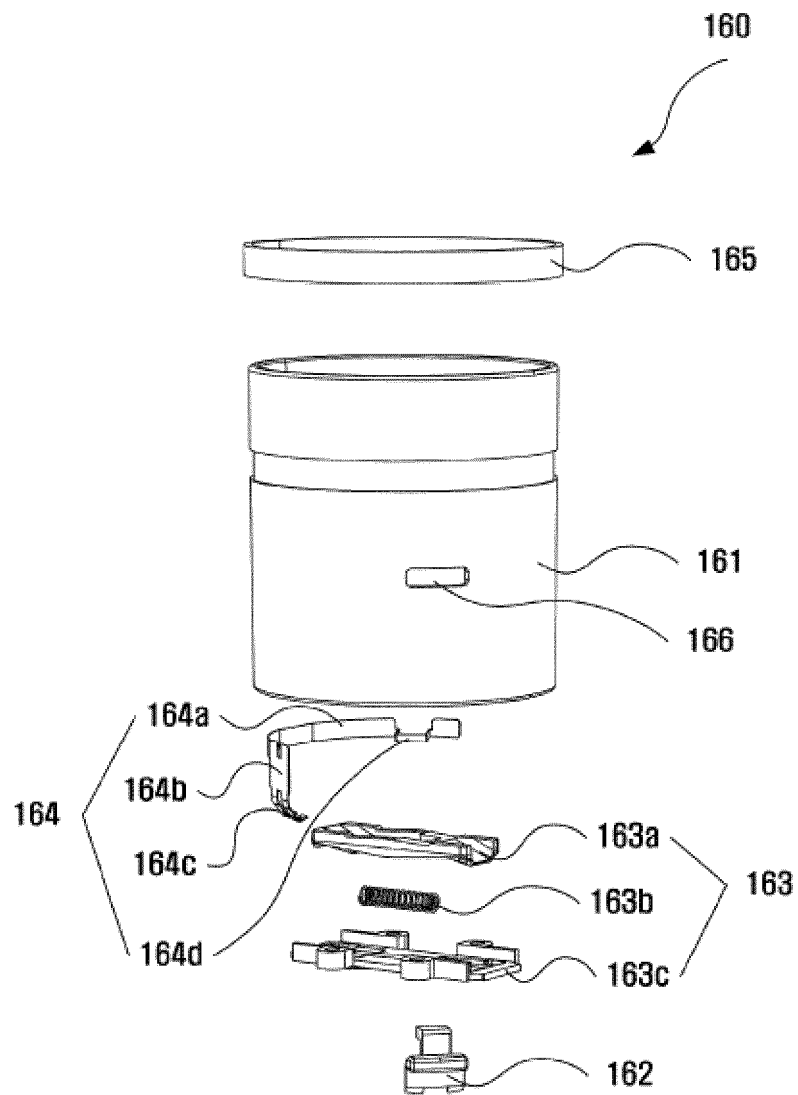



Fig. 15



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2017/014655

5	A. CLASSIFICATION OF SUBJECT MATTER		
	<i>H01R 13/70(2006.01)i, H01R 13/66(2006.01)i, H01Q 1/38(2006.01)i, H01Q 1/22(2006.01)i, H01R 13/10(2006.01)i</i>		
	According to International Patent Classification (IPC) or to both national classification and IPC		
	B. FIELDS SEARCHED		
10	Minimum documentation searched (classification system followed by classification symbols) H01R 13/70; H01R 13/66; H01R 31/06; G06K 17/00; H04Q 9/00; G01R 11/32; H01Q 1/38; H01Q 1/22; H01R 13/10		
	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: IPC as above Japanese Utility models and applications for Utility models: IPC as above		
15	Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) eKOMPASS (KIPO internal) & Keywords: socket, housing, AC-DC conversion board, relay board, controller board, antenna		
	C. DOCUMENTS CONSIDERED TO BE RELEVANT		
20	Category*	Citation of document, with indication, where appropriate, of the relevant passages	
		Relevant to claim No.	
	A	KR 10-2016-0003517 A (MODACOM CO., LTD.) 11 January 2016 See paragraphs [0019]-[0027] and figures 1-7.	1-9
25	A	KR 10-2011-0002269 A (CHOI, Chang Kwon) 07 January 2011 See paragraphs [0038]-[0065] and figure 2.	1-9
	A	KR 10-2016-0053722 A (LINKELECTRONICS CO., LTD. et al.) 13 May 2016 See paragraphs [0024]-[0034] and figure 1.	1-9
30	A	KR 10-2015-0125783 A (CHUNG-ANG UNIVERSITY INDUSTRY-ACADEMY COOPERATION FOUNDATION et al.) 10 November 2015 See paragraphs [0063]-[0075] and figure 5.	1-9
35	A	KR 10-2016-0076140 A (ENERCO CO., LTD.) 30 June 2016 See paragraphs [0023]-[0039] and figures 1-3.	1-9
40	<input type="checkbox"/> Further documents are listed in the continuation of Box C.		<input checked="" type="checkbox"/> See patent family annex.
	* Special categories of cited documents:		"I" 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
45	"A"	document defining the general state of the art which is not considered to be of particular relevance	"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
	"E"	earlier application or patent but published on or after the international filing date	"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
	"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
	"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	
50	Date of the actual completion of the international search	Date of mailing of the international search report	
	22 MARCH 2018 (22.03.2018)	22 MARCH 2018 (22.03.2018)	
55	Name and mailing address of the ISA/KR  Korean Intellectual Property Office Government Complex-Daejeon, 189 Seonsa-ro, Daejeon 302-701, Republic of Korea Facsimile No. +82-42-481-8578	Authorized officer Telephone No.	

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2017/014655

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KR 10-2011-0002269 A	07/01/2011	KR 10-1077016 B1	26/10/2011
KR 10-2016-0053722 A	13/05/2016	NONE	
KR 10-2015-0125783 A	10/11/2015	NONE	
KR 10-2016-0076140 A	30/06/2016	NONE	