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(54) ELECTRICAL CABLE DEVICE WITH WATERPROOF STRUCTURE

(57) The present invention is an electrical cable device with waterproof structure, comprising: power module, mounted with the connection port and the first rubber ring, wherein the first longitudinal arm and the second longitudinal arm are located at the connection port; connection cable, comprising with connection cable shell; and, connection head, mounted at the front end of connection cable shell, wherein the surface in the front end of connection cable shell having second rubber ring, the leak-tightness is improved by the power module electrical coupling with connection cable through fixing the electrical cable device via pressing and squeezing the second rubber ring and the first rubber ring.

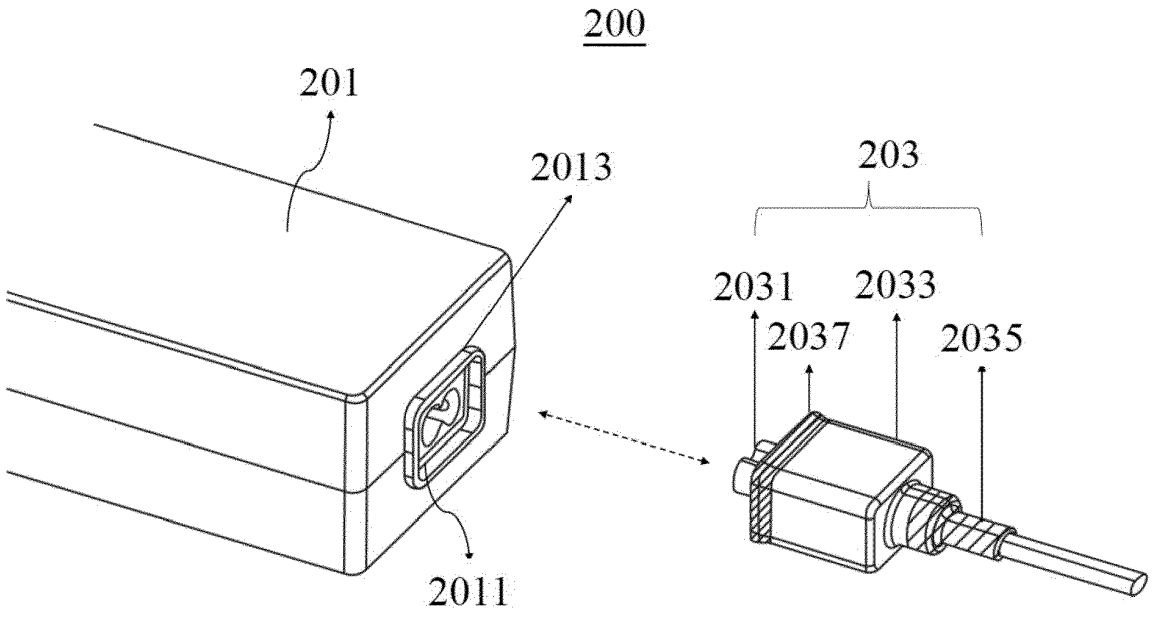

Fig. 2

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Description

TECHNICAL FIELD

[0001] The present invention mainly relates to an electrical cable device with waterproof structure, more particularly, an electrical cable device with rubber material, mounted among the placement of connection of the power source, increasing the impermeability by plurality of longitudinal arms and transverse arms structure, to prevent the infiltration of water or moisture for reducing the risk of accidents.

BACKGROUND

[0002] Since the electrical power was widely used in civilization, various sorts of electrical devices have been entered into daily life of humans, under the comprehensive application of electrical devices, the electrical cable devices were disposed in the electrical devices for transmitting the electrical energy, electrical signal, or making the achievement of transformation and rectification between the AC current and DC current. For example, the power cable device of the notebook computer commonly used has a rectification function; the power cable device of the portable smart device has both signal and power transmission, rectification function.

[0003] Please refer to Fig. 1, which illustrate the structure of common used power cable device (100) in the prior art, including power module (101), comprising with printed circuit (1011) or electrical elements, the connection cable (103) for transmitting electrical energy and electrical signals is coupled to connection port (1013), which is disposed on the power module (101) through corresponding male and female connectors. However, since the connection port (1013) of said power cable device (100) in the prior art lack the waterproof or dust proof structure, resulting in the moisture or suspended particulate was easily infiltrated into the electrode of connection port (1013), rusting said electrode and making malfunction or short circuit after the life raising of power cable device (100), in that case, the voltage of the power cable device (100) may instantly raise, injuring the electrical equipment that supplies electrical energy, shortening its life, and even causing fire or leakage electrical power.

[0004] Therefore, some of manufacturers providing several kinds of technical solutions in the prior art, such as European Patent EP1059698A2, which discloses a waterproof connector, comprising the rubber mat plug or rubber-like material in the structure of the connector housing, disposed on the plane of engaging recess with a plurality of bores in the front end of the connector housing, allowing electric wires passing through the inside and outside of the waterproof connector. During the connecting process in said waterproof connector, the engaging recess and the electric wires are tightly engaged with each other through the deformation of the rubber mat plug, reaching the purpose with a certain level of waterproof performance. However, in the prior art, there did exist some disadvantage waiting for the improvement.

[0005] First of all, taking the rubber mat plug as concern, in the prior art, the rubber mat plug or rubber-like material of waterproof connector mostly limited the mounted position on the plane of engaging recess, nearing the electric wires, but not completely laid on the entire surface of the engaging recess, so that the moisture or suspended particulate still has the opportunity to infiltrate, unabling to achieve comprehensive waterproof performance; moreover, the plane of the engaging recess and the electric wires lack the structure which could press out the residual air inside the waterproof connector during the connection process, leaving small amount of residual air in the gap between the engaging recess and the electric wires, thus, impermeability of the waterproof connector still needs to improve.

[0006] To sum up, it still needs to improve the waterproof structure of the power connection device for raising the waterproof performance, preventing the moisture or suspended particulate from entering the power cable device.

SUMMARY OF THE INVENTION

[0007] In view of the disadvantages in the prior art, a novel electrical cable device with waterproof structure is proposed, said electrical cable device comprising: power module, mounted with the connection port and the first rubber ring; the first longitudinal arm and the second longitudinal arm are located at the connection port, and the length of first longitudinal arm is larger than second longitudinal arm; connection cable, comprising with connection cable shell; and, connection head, mounted at the front end of connection cable shell; the surface in the front end of connection cable shell having second rubber ring, the electrical cable device is fixed by pressing and squeezing the second rubber ring and the first rubber ring when the power module electrical coupling with connection cable, wherein the direction of the first longitudinal arm and the second longitudinal arm are perpendicular to connection head, pressing out the residual air inside and raising the impermeability of electrical cable device.

[0008] According to the content of the present invention, the electrical cable device further comprising the first transverse arm and the second transverse arm. When the connection port is coupled to the connection head, the transverse and longitudinal pressure are formed via the first transverse arm, the second transverse arm, the first longitudinal arm, and second longitudinal arm. The transverse and longitudinal pressure causes the air in the gap between the connection port and connection head to be slowly discharged, further improving the impermeability of the electrical cable device.

[0009] As the mentioned as above, in the front view of connection head, the plurality of first transverse arm and second transverse arm are arranged as "∞"-like config-

uration, in the process of said connection head with "∞"-like configuration which is coupled to the power module, since the area of the surface on contact is larger than the conventional "O"-like configuration, preventing the non consistent of pressure among the left and right ends of the connection head, making a gap is formed at one end through the lower pressure, so that the ambient air, moisture and suspended particles have the opportunity to infiltrate inside and affect the normal operation of the power cable device.

[0010] In addition, at the rear end of the connection cable shell, a rear-end rubber jacket is disposed to seal the gap between the connection cable and the connection cable shell, so that the outer portion of the connection cable shell is isolated from the inner portion, for blocking the external ambient air, moisture and suspended particles.

[0011] According to the content of present invention, the material of the first rubber ring and the second rubber ring could be, but not limit to Polyurethane (PU), Butyl Rubber (IIR), Hypalon Polyethlene Rubber (CSM), Natural Rubber (NR), Polyacrylate Rubber (ACM), Neoprene Rubber (CR), or the combination of the above.

[0012] According to the embodiments of present invention, the degree of protection provided against ambient air, moisture and suspended particles could reach the level of IPX4-IPX8 (International Protection Marking).

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The components, characteristics and advantages of the present invention may be understood by the detailed descriptions of the preferred embodiments outlined in the specification and the drawings attached:

Fig. 1 illustrates the structure of electrical cable device according to the prior art.

Fig. 2 illustrates the structure of electrical cable device with waterproof structure in the present invention.

Fig. 3 displays the fine-structure of electrical cable device and illustrates how the impermeability could be improved in the present invention.

Fig. 4A-4C illustrates the assembly process of the connection cable.

Fig. 5 illustrates in the front view of connection head are arranged form "∞"-like configuration.

DETAILED DESCRIPTION

[0014] Some preferred embodiments of the present invention will now be described in greater detail. However, it should be recognized that the preferred embodiments of the present invention are provided for illustration rather than limiting the present invention. In addition, the present invention can be practiced in a wide range of other embodiments besides those explicitly described, and the scope of the present invention is not expressly limited except as specified in the accompanying claims.

[0015] The purpose of the present invention is to improve the structure of electrical cable device in the prior art. First of all, in the portion of rubber ring adopted the method of insert molding, which is completely mounted in the interface plane of the connection port and the connection head, including the position close to the electrode, reducing the probability of moisture and suspended particles infiltrating into the interior of the connection cable shell; second, pressing out the residual air inside the electrical cable device during the connection process between the power module and connection cable via the structure proposed in the present invention, reducing the residual air as less as possible, homogenizing the pressure at both ends of the connection head for reducing the probability of moisture infiltration in the low pressure end; finally, the numbers of said first longitudinal arm, said second longitudinal arm, said first transverse arm, said second transverse arm could be disposed according to the need of embodiments, also could be generally known as "longitudinal arm" and "transverse arm". Similarly, it should be recognized that the structure in preferred embodiments of the present invention are provided for illustration rather than limiting the present invention.

[0016] Please refer to Fig. 2 and Fig. 3, the present invention proposed an electrical cable device (200) with waterproof structure, comprising: power module (201), mounted with the connection port (2013) and the first rubber ring (2011); the first longitudinal arm (2015) and the second longitudinal arm (2017) are located at the connection port (2013), and the length of first longitudinal arm (2015) is larger than second longitudinal arm (2017); connection cable (203), comprising with connection cable shell (2033); and, connection head (2031), mounted at the front end of connection cable shell (2033); the surface in the front end of connection cable shell (2033) having second rubber ring (2037), the electrical cable device (200) is fixed by pressing and squeezing the second rubber ring (2037) and the first rubber ring (2011) when the power module (201) electrical coupling with connection cable (203), wherein the direction of the first longitudinal arm (2015) and the second longitudinal arm (2017) are perpendicular to connection head (2031), pressing out the residual air inside and raising the impermeability of electrical cable device (200).

[0017] As mentioned above, the connecting cable shell (2033) has a case-like configuration and at least one through hole at the front end and the rear end, so that the cable of the connection cable (203) could be passed through, the through hole of the front end is matched with the transverse arm, shaped as "∞" -like structure, the rear end of connecting cable shell (2033) is made by two or more cylindrical shapes with different radius, in that case, therefore, the connection cable (203) could be gradually converging to raise the impermeability of the connection cable shell (2033).

[0018] Please refer to Fig. 3, in one embodiment of the present invention, the first longitudinal arm (2015) is lo-

cated at the left of the second longitudinal arm (2017), and the length of the first longitudinal arm (2015) is larger than the second longitudinal arm (2017). The characteristic of structure above could make the pressure providing via the first longitudinal arm (2015) at left side greater than the pressure provided by second longitudinal arm (2017), ensured that the residual air air could be pressed and exhausted from the power cable device (200) due to the compress of the first rubber ring (2011) and the second rubber ring (2037), preventing the ambient air, moisture and suspended particles have the opportunity to infiltrate inside the power cable device (200).

[0019] In one preferred embodiment of the present invention, the length of the second transverse arm (2039) is larger than the first transverse arm (2038), resulting in the length of central on connection head (2031) is larger than the surrounding and making the transverse arms parallel to each others as well. In one aspect of the present invention, when the connection head (2031) is inserted into the power module (201), the pressure provided by second transverse arm (2039) at the center to compress the residual air could be larger than the surrounding of the first transverse arm (2038), thus, the residual air could be fully discharged, in that case, the pressure generated from two directions would be enhanced and promoted the impermeability of the electrical cable device (200).

[0020] Please refer to Fig. 5, in the front view of connection head (2031) mounted on the connection cable (203), the plurality of first transverse arm (2038) and second transverse arm (2039) are arranged as "∞"-like configuration to raise the contact area of the surface as large as possible, providing the pressure consistent among the left and the right end, and, the second rubber ring (2037) is completely mounted on the inner of the connection head (2031) and is parallel to the surface.

[0021] Furthermore, in one aspect of application in the present invention, the numbers of longitudinal arm and the transverse arm could be disposed according to the need of massive transmission of electrical energy and electrical signal. For instance: when a high throughput charger, or a transmitter with high flux of data which the multiple-pin is require. Therefore, plurality of connection head (2031) with "∞"-like configuration would raise impermeability through providing the pressure consistent of electrical cable device (200). In the waterproof structure proposed by the present invention, it can meet the requirements of IPX4 or higher standard at a relatively economical cost, according to the International Protection Marking standard (IP), the electrical cable device (200) is sufficient to withstand liquid pressure of 80-100 kPa, flow rate of 10 L/min, flow splash for 5 minutes without damaging the equipment, and the waterproof standard can be raised to the level of IPX8 according to the needs of the application, also, in the present invention, the range of impermeability is rough vacuum to medium vacuum, i.e., between 10 and 750 Torr.

[0022] Please refer to Fig. 4A-4C, it illustrates the assembly process of the connection cable. The connection cable shell (2033) adopted the method of insert molding, and the second rubber ring (2037) is placed in the mold beforehand in the manufacture, and when the connection cable shell (2033) is taken out, the second rubber ring (2037) could completely conform to the configuration of the first transverse arm (2038) and the second transverse arm (2039) based on its own elasticity, reducing the volume of the connection cable shell (2033) and improve the engineering tolerance. Also, the characteristic of the present invention could improve the impermeability and overcome the disadvantage of prior art, which the rubber ring is directly attached on the surface of the device via adhesive or high vacuum grease with low impermeability. In another embodiment of the present invention, the method of assembly process is not limited to insert molding.

[0023] Please refer to Fig. 4A-4C, according to the present invention, the power connection device (200) is assembled by inserting the cable of the connection cable (203) into the connection cable shell (2033) from the front end to the rear end of the connection head (2031), and fixing the cable to the connection cable shell (2033) tightly. After the connection cable shell (2033), the rear-end rubber jacket (2035) is mounted on the rear end of the connecting cable (203), wherein the rear-end rubber jacket (2035) fixes the connection cable shell (2033), avoiding the infiltration into said power connection device (200) by moisture. Moreover, the rear-end rubber jacket (2035) is located at the rear end of the connection cable shell (2033) with cylindrical shape for acting in concert with the structure at the rear end of the connection cable shell (2033), the radius of the rear-end rubber jacket (2035) in the rear end is smaller than the front end, therefore, the connection cable (203) could be converted. In the embodiments of the present invention, the radius of the rear rubber sleeve (2035) could be continuous gradient change, or a superposition of two or more cylinders with different radius.

[0024] According to the content of present invention, the material of the first rubber ring (2011) and the second rubber ring (2037) could be, but not limit to Polyurethane (PU), Butyl Rubber (IIR), Hypalon Polyethlene Rubber (CSM), Natural Rubber (NR), Polyacrylate Rubber (ACM), Neoprene Rubber (CR), or the combination of the above. In the preferred embodiments of the present invention, the Polyurethane (PU) is adopted for rubber ring because the deliberation of tensile force, abrasion resistance and impermeability, which could raise the numbers of swap lifetime. In one preferred embodiment of the present invention, the numbers of swap lifetime would be 9000-15000 under the requirement of IPX4-IPX8 (International Protection Marking).

[0025] As will be understood by persons skilled in the art, the foregoing preferred embodiment of the present invention illustrates the present invention rather than limiting the present invention. Having described the invention in connection with a preferred embodiment, modifi-

cations will be suggested to those skilled in the art. Thus, the invention is not to be limited to this embodiment, but rather the invention is intended to cover various modifications and similar arrangements included within the spirit and scope of the appended claims, the scope of which should be accorded the broadest interpretation, thereby encompassing all such modifications and similar structures. While the preferred embodiment of the invention has been illustrated and described, it will be appreciated that various changes can be made without departing from the spirit and scope of the invention.

Claims

1. An electrical cable device (200) with waterproof structure, comprising:

   a power module (201), mounted with a connection port (2013) and a first rubber ring (2011);
   wherein a plurality of longitudinal arms are located at the connection port (2013), comprising a first longitudinal arm (2015) and a second longitudinal arm (2017), the length of the first longitudinal arm (2015) is larger than the second longitudinal arm (2017);
   a connection cable (203), comprising a connection cable shell (2033); and,
   a connection head (2031), mounted at the front end of the connection cable shell (2033), a second rubber ring (2037) is mounted on the surface in the front end of the connection cable shell (2033), when the power module (201) electrical coupling with connection cable (203), the electrical cable device (200) is fixed by squeezing the second rubber ring (2037) and the first rubber ring (2011);
   wherein the direction of the first longitudinal arm (2015) and the second longitudinal arm (2017) are perpendicular to the connection head (2031), pressing out residual air inside the electrical cable device (200).

2. The electrical cable device (200) with waterproof structure of claim 1, wherein the connection head (2031) comprises a plurality of transverse arms, said plurality of transverse arms are perpendicular to said first longitudinal arm (2015) and said second longitudinal arm (2017), wherein the direction of the first longitudinal arm (2015) and the second longitudinal arm (2017) are perpendicular to connection head (2031), generating the pressure from transverse and longitudinal directions, raising the impermeability of electrical cable device (200) when the power module (201) electrical coupling with connection head (2031).

3. The electrical cable device (200) with waterproof structure of claim 2, the plurality of transverse arms further comprises a second transverse arm (2039), and a plurality of first transverse arm (2038), the length of the plurality of second transverse arm (2039) are larger than the first transverse arm (2038), wherein the numbers of the plurality of first transverse arm (2038) $n \geqq 2$.

4. The electrical cable device (200) with waterproof structure of claim 1, the material of the first rubber ring (2011) and the second rubber ring (2037) could be, but not limit to Polyurethane (PU), Butyl Rubber (IIR), Hypalon Polyethlene Rubber (CSM), Natural Rubber (NR), Polyacrylate Rubber (ACM), Neoprene Rubber (CR), or the combination of the above.

5. The electrical cable device (200) with waterproof structure of claim 1, the rear end of said connection cable shell (2033) further comprises a rear-end rubber jacket (2035), said rear-end rubber jacket (2035) with cylindrical shape and the radius of the rear end is smaller than the front end, the radius of said rear-end rubber jacket (2035) could be continuous gradient change, or a superposition of two or more cylinders with different radius.

6. The electrical cable device (200) with waterproof structure of claim 1, the structure the front of said connection head (2031) is arranged by said plurality of the transverse arms shaped as at least one "∞"-like structure, wherein said at least one "∞"-like structure provide consistent pressure between the left side and the right side in the coupled process of power module (201).

7. The electrical cable device (200) with waterproof structure of claim 1, said electrical cable device (200) could meet the requirement of IPX4-IPX8.

8. The electrical cable device (200) with waterproof structure of claim 7, the numbers of swap lifetime of said first rubber ring (2011) and said second rubber ring (2037) is 9000-15000 under the requirement of IPX4-IPX8.

9. The electrical cable device (200) with waterproof structure of claim 7, the range of impermeability of said electrical cable device (200) is 10-750 Torr.

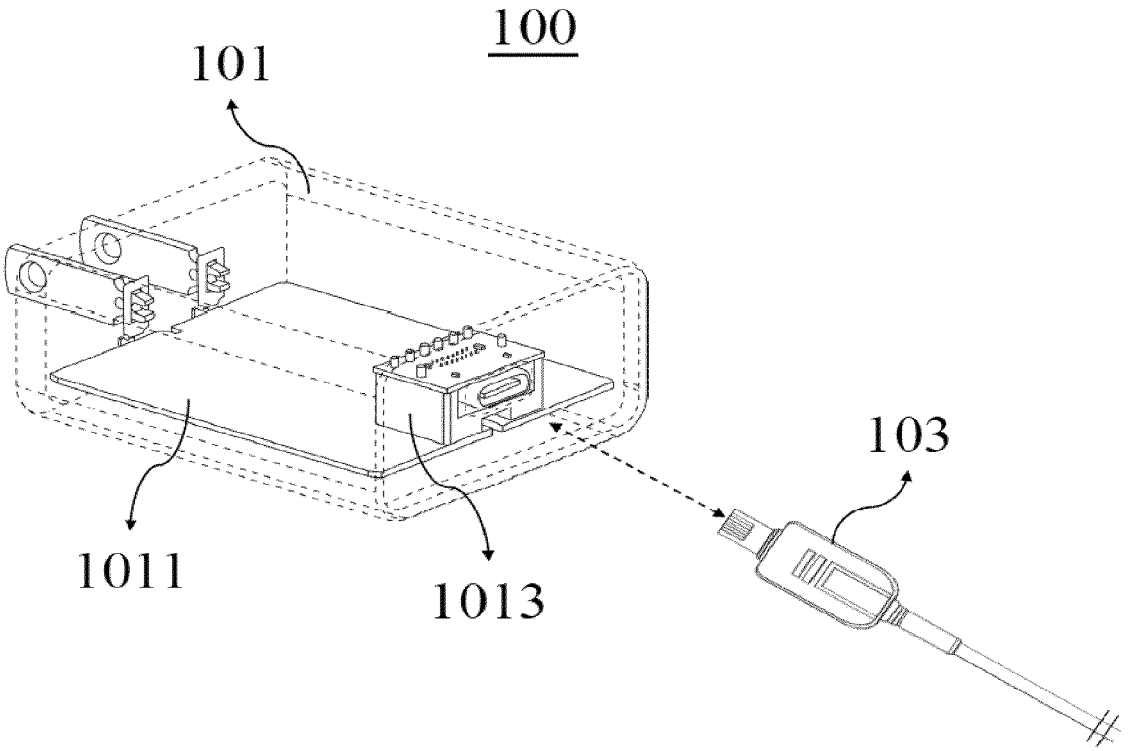
100
101
1011
1013
103

Fig. 1

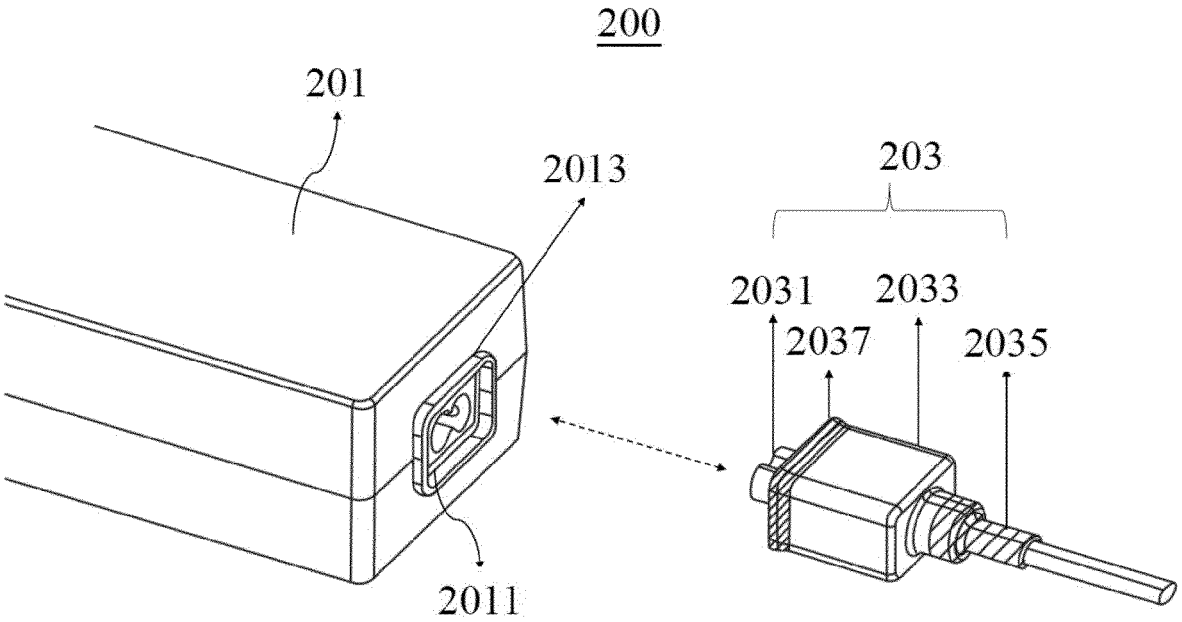
200
201
2013
203
2031
2033
2037
2035
2011

Fig. 2

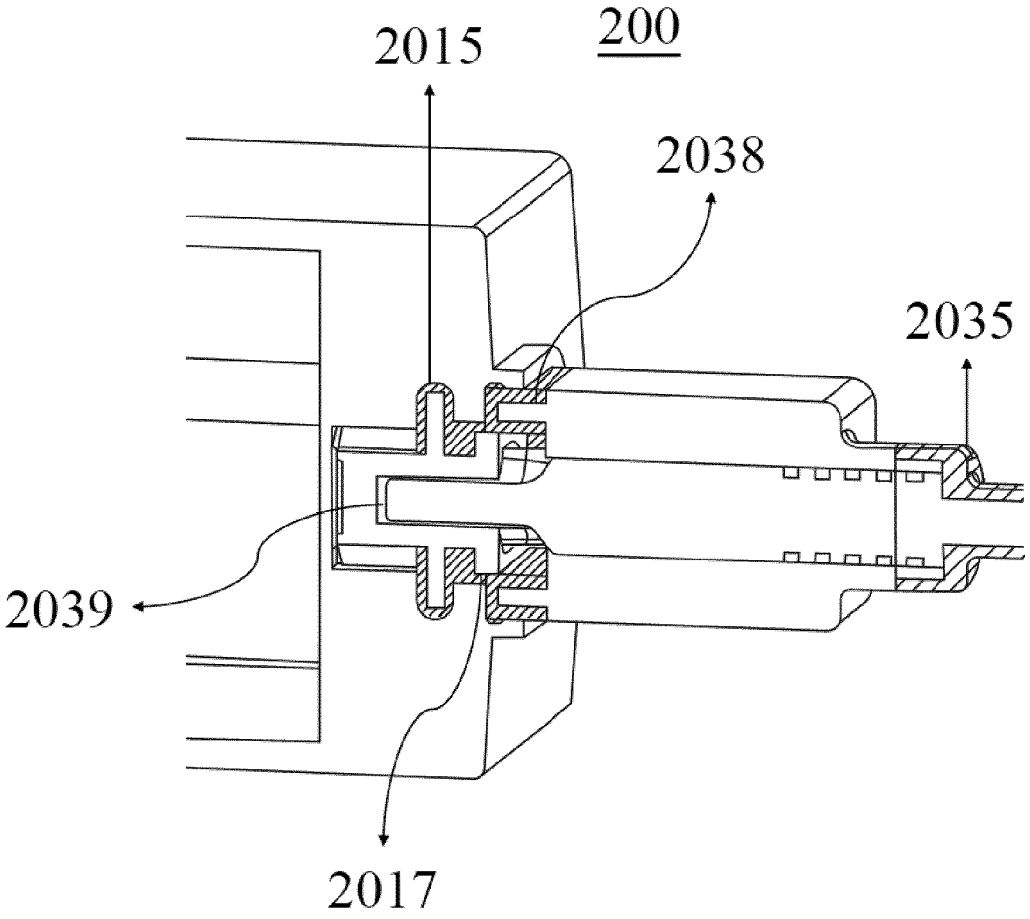

Fig. 3

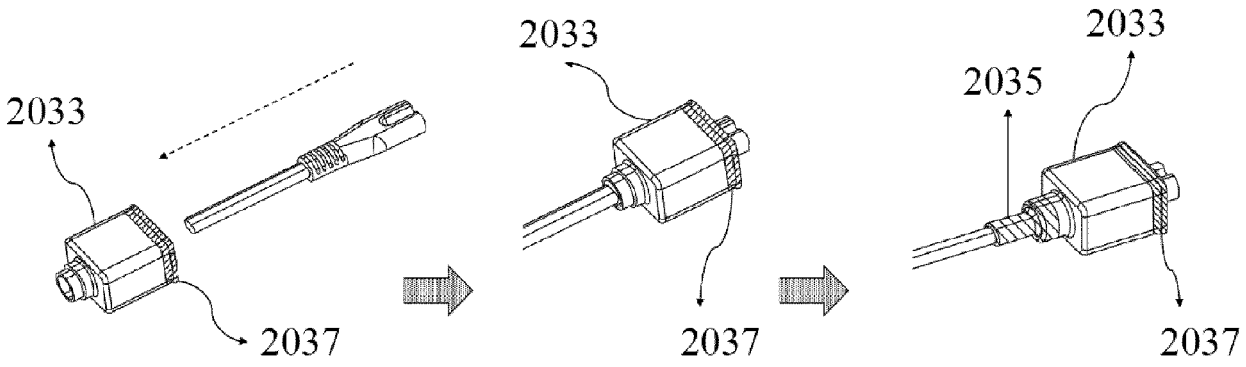

Fig. 4A Fig. 4B Fig. 4C

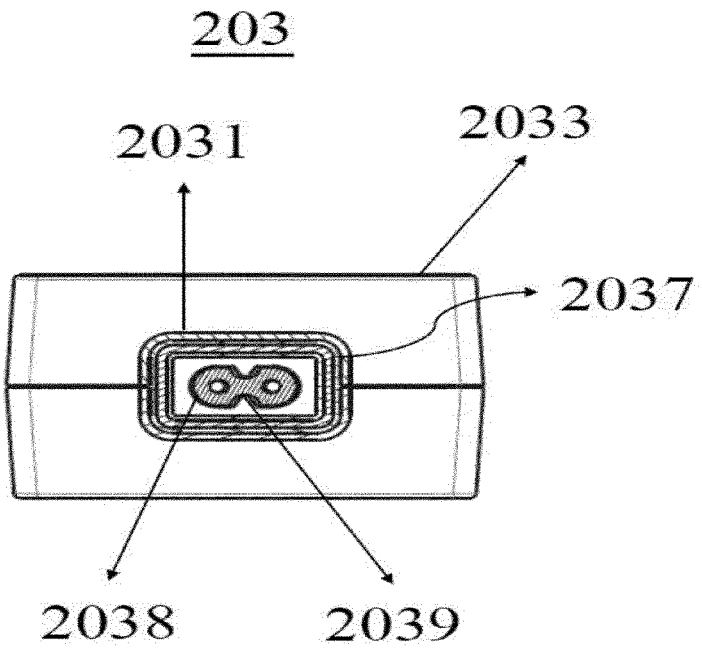

Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 19 16 7007

DOCUMENTS CONSIDERED TO BE RELEVANT

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	7 October 2019	López García, Raquel

CATEGORY OF CITED DOCUMENTS

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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