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(54) END CAP STRUCTURE OF LAMP TUBE

(57) An end cap structure (101) of a lamp tube includes a housing, an electrical connecting port (120) disposed on the housing for receiving an external power source, a first switch unit (130) movably disposed on the housing, a second switch unit (140) movably disposed on the housing and a conductive elastic piece (150) separated from the electrical connecting port and synchronously moving with the second switch unit. When the lamp tube is disposed on a lamp base, the first switch unit is subjected to an external force so as to move from an original position to a limiting position. When the first switch unit is located at the limiting position, the conductive elastic piece electrically connects to the electrical connecting port by a movement of the second switch unit relative to the housing, and the second switch unit is stopped by the first switch unit.

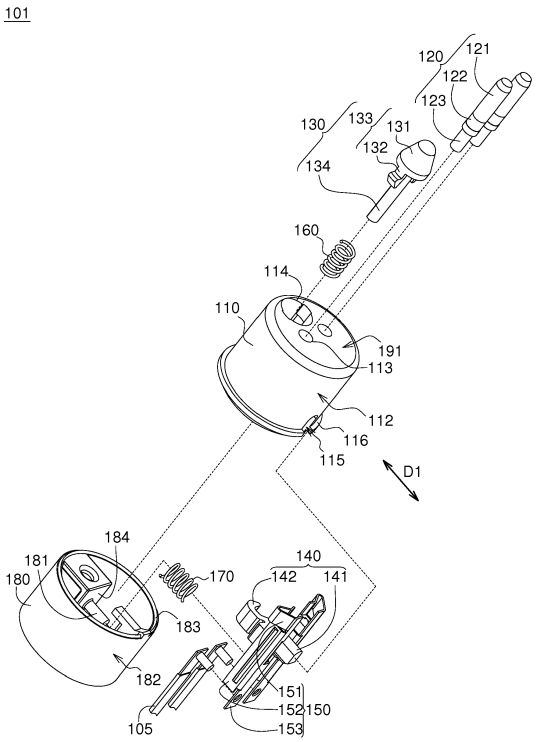

FIG. 7

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The invention relates in general to an end cap structure of a lamp tube, and more particularly to an end cap structure with manual switching function thereof.

Description of the Related Art

[0002] To comply with the design of the fluorescent lamp base, each of the two ends of the lamp tube has two electrical connecting ports through which the lamp tube is electrically connected to the power sockets disposed on the lamp base to form a power supply circuit for supplying power source to the lamp tube.

[0003] However, during the installation or un-installation of the lamp tube on the lamp base, the electrical connecting port disposed on one side of the lamp tube is already electrically connected to the power socket on the one side but the electrical connecting port disposed on the other side of the lamp tube has not been loaded to the power socket disposed on the other side. In this situation, if the user touches the electrical connecting port exposed on the other side of the lamp tube with his/her hand, it is possible that electrocution hazards happens to the user once the electric current flowing through the human body is grounded and forms an electric loop.

SUMMARY OF THE INVENTION

[0004] The invention is directed to an end cap structure for a lamp tube with manual switching function thereof to prevent the user from electrocuting.

[0005] According to an aspect of the present invention, an end cap structure for a lamp tube is provided. The end cap structure includes a housing, an electrical connecting port, a first switch unit, a second switch unit and a conductive elastic piece. The housing includes a bottom portion and a side portion connecting to and surrounding the bottom portion to form an accommodation space. The electrical connecting port is disposed on the bottom portion for receiving an external power source. One portion of the electrical connecting port is located outside the bottom portion; another portion of the electrical connecting port is located inside the accommodation space. The first switch unit is movably disposed on the bottom portion. One portion of the first switch unit is located outside the bottom portion; another portion of the bottom portion is located inside the accommodation space. When subjected to an external force, the first switch unit moves from an original position to a limiting position. The second switch unit is movably disposed on the side portion. The conductive elastic piece is disposed inside the accommodation space and synchronously moves with the second switch unit, wherein the conductive elastic piece is separated from the electrical connecting port by a distance. When the first switch unit is located at the limiting position, the conductive elastic piece electrically connects to the electrical connecting port by a movement of the second switch unit relative to the side portion, and the second switch unit is stopped by the first switch unit.

[0006] The above and other aspects of the invention will become better understood with regard to the following detailed description of the preferred but non-limiting embodiment(s). The following description is made with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007]

FIGS. 1A and 1B are circuit diagrams of a lamp tube and a power supply circuit according to an embodiment of the invention.

FIGS. 1C and 1D are circuit diagrams of a lamp tube and a power supply circuit according to another embodiment of the invention.

FIG. 2 is a schematic diagram of the lamp tube according to an embodiment of the invention.

FIG. 3A is a schematic diagram of a first switch unit of an end cap structure of the lamp tube located at an original position according to an embodiment of the invention.

FIG. 3B is a schematic diagram of the first switch unit of the end cap structure of FIG. 3A located at a limiting position.

FIG. 4 is an exploded drawing of the end cap structure of FIG. 3A.

FIGS. 5A-5G are schematic diagrams of the internal end cap structure of FIG. 3A.

FIG. 6A is a schematic diagram of a first switch unit of an end cap structure of the lamp tube located at an original position according to another embodiment of the invention.

FIG. 6B is a schematic diagram of the first switch unit of the end cap structure of FIG. 6A located at a limiting position.

FIG. 7 is an exploded drawing of the end cap structure of FIG. 6A.

FIGS. 8A-8D are schematic diagrams of the internal end cap structure of FIG. 6A.

FIG. 9A is a schematic diagram of a first switch unit

of an end cap structure of the lamp tube located at an original position according to still another embodiment of the invention.

FIG. 9B is a schematic diagram of the first switch unit of the end cap structure of FIG. 9A located at a limiting position.

FIG. 10A is an exploded drawing of the end cap structure of FIG. 9A.

FIG. 10B is a partially enlarged drawing of the first limiting portion of the end cap structure of FIG. 10A.

FIG. 10C is a partially enlarged drawing of the second limiting portion of the end cap structure of FIG. 10A.

FIGS. 11A-11D are schematic diagrams of the internal end cap structure of FIG. 9A.

DETAILED DESCRIPTION OF THE INVENTION

[0008] A number of embodiments are disclosed below for elaborating the invention. However, the embodiments of the invention are for detailed descriptions only, not for limiting the scope of protection of the invention. The same reference numerals are used to indicate the elements with the same or similar functions if it is not particularly indicated.

[0009] Referring to FIGS. 1A-1D and FIG. 2, FIGS. 1A and 1B are circuit diagrams of a lamp tube 100 and a power supply circuit 10 according to an embodiment of the invention, FIGS. 1C and 1D are circuit diagrams of a lamp tube 100 and a power supply circuit 10' according to another embodiment of the invention, and FIG. 2 is a schematic diagram of the lamp tube 100 according to an embodiment of the invention. The lamp tube 100 includes a first end cap structure 11, a second end cap structure 12 and a tube 103. The first end cap structure 11 is disposed on the first end of the tube 103, and the second end cap structure 12 is disposed on the second end of the tube 103. The tube 103 has a light bar and a driver 104 inside. The light bar may include a circuit board 20 which the driver 104 is electrically connected to and a plurality of light emitting diodes 30 disposed on the circuit board 20. In FIGS. 1A and 1B, the light bar may be electrically connected to the first end cap structure 11 and the second end cap structure 12 via an internal power wire PW3. In FIGS. 1C and 1D, the light bar may be electrically connected to the first end cap structure 11 and the second end cap structure 12 via the internal power wires PW8, PW9, PW10 and PW11. In one embodiment, the first end cap structure 11 and the second end cap structure 12 may be end cap structures with manual switching function. In one embodiment, the second end cap structure 12 may be the same as the first end cap structure 11. In such a condition, the operation method of the first end cap structure 11 may be made as reference to the operation method of the second end cap structure 12. In another embodiment, the first end cap structure 11 may be different from the second end cap structure 12, but both are provided with manual switching function. The first end cap structure 11 will be used for a further description below.

[0010] Refer to FIGS. 1A and 1B. When the first end cap structure 11 and the second end cap structure 12 of the lamp tube 100 are installed on the lamp base, the electrical connecting port 120 of the first end cap structure 11 is electrically connected to a first power wire PW1 of the power supply circuit 10, and the electrical connecting port 120 of the second end cap structure 12 is electrically connected to a second power wire PW2 of the power supply circuit 10. Refer to FIGS. 1C and 1D. When the first end cap structure 11 and the second end cap structure 12 of the lamp tube 100 are installed on the lamp base, two pins of the electrical connecting port 120 of the first end cap structure 11 are respectively electrically connected to a third power wire PW4 and a fourth power wire PW5 of the power supply circuit 10', and two pins of the electrical connecting port 120 of the second end cap structure 12 are respectively electrically connected to a fifth power wire PW6 and a sixth power wire PW7 of the power supply circuit 10. Afterwards, if the user turns the switches SW1 and SW2 on manually by tools (as FIGS. 1A and 1C), or the switches SW1 and SW2 are turned off automatically (as FIGS. 1B abd 1D), so as to turn on or turn off an external power source 200 (such as an alternating current power or a direct current power) supplied to the lamp tube 100. In one embodiment, the lamp base may be a conventional lamp base having two ends inserted with opposite power sockets for combining with two ends of the lamp tube 100.

[0011] As shown in FIG. 1A, the power supply circuit 10 is exemplarily an alternating current circuit powered via two ends of the lamp tube 100. When the lamp tube 100 is installed on the lamp base, the user may turn the switches SW1 and SW2 on manually by tools. Therefore, the internal power wire PW3 of the lamp tube 100 electrically connects to the first power wire PW1 and the second power wire PW2, and the driver 104, on receiving the external power source 200, is driven and turned on by an electric current, such that the lamp tube 100 is switched on in the power supply circuit 10. In FIG. 1B, when the lamp tube 100 is un-installed from the lamp base, the switches SW1 and SW2 of the first end cap structure 11 and the second end cap structure 12 may all be turned off automatically, such that the internal power wire PW3 is electrically insulated from the first power wire PW1 and the second power wire PW2. Therefore, the external power source 200 connected to the driver 104 is cut off, such that the lamp tube 100 is switched off in the power supply circuit 10. As a result, even if the user touches the electrical connecting port 120 of the second end cap structure 12 when firstly un-installing the second end cap structure 12 from the lamp base, the

electric current flowing through the human body will not be grounded to form an electric loop because the switch SW2 of the second end cap structure 12 will be turned off automatically, such that the user will not be electrocuted.

[0012] In another embodiment, as shown in FIG. 1C, when the lamp tube 100 is installed on the lamp base, the user may also turn the switches SW1 and SW2 on manually by tools. In detail, if the switch SW1 is turned on, the internal power wire PW8 of the lamp tube 100 will connect to the fourth power wire PW5, and the internal power wire PW9 of the lamp tube 100 will connect to the third power wire PW4. If the switch SW2 is turned on, the internal power wire PW10 of the lamp tube 100 will connect to the sixth power wire PW7, and the internal power wire PW11 of the lamp tube 100 will connect to the fifth power wire PW6. Thus, when the switches SW1 and SW2 are turned on, the driver 104, on receiving the external power source 200, is driven and turned on by an electric current, such that the lamp tube 100 is switched on in the power supply circuit 10'. On the contrary, as shown in FIG. 1D, when the lamp tube 100 is un-installed from the lamp base, the switches SW1 and SW2 of the first end cap structure 11 and the second end cap structure 12 may all be turned off automatically, such that the internal power wire PW8 is electrically insulated from the fourth power wire PW5, the internal power wire PW9 is electrically insulated from the third power wire PW4, the internal power wire PW10 is electrically insulated from the sixth power wire PW7, and the internal power wire PW11 is electrically insulated from the fifth power wire PW6. Therefore, the external power source 200 connected to the driver 104 is cut off, such that the lamp tube 100 is switched off in the power supply circuit 10'. As a result, even if the user touches the electrical connecting port 120 of the second end cap structure 12 when firstly un-installing the second end cap structure 12 from the lamp base, the electric current flowing through the human body will not be grounded to form an electric loop because the switch SW2 of the second end cap structure 12 will be turned off automatically, such that the user will not be electrocuted.

[0013] Referring to FIGS. 3A and 3B, the first end cap structure 11 with double switch structures is exemplified for explanation. However, the second end cap structure 12 may be the same as or different from the first end cap structure 11, but both are provided with double switch structures. A first switch unit 130 and a second switch unit 140 with pressing function serve as the double switch structures. FIG. 3A is a schematic diagram of the first switch unit 130 of the first end cap structure 11 of the lamp tube located at an original position according to an embodiment of the invention, such as the state when the lamp tube 100 has not been installed on the lamp base, the first end cap structure 11 does not abut against one end of the lamp base such that the first switch unit 130 has not been pressed. FIG. 3B is a schematic diagram of the first switch unit 130 of the end cap structure 11 of FIG. 3A located at a limiting position, such as the state when the lamp tube 100 is installed on two sides of the lamp base, the first end cap structure 11 and the second end cap structure 12 abut against two ends of the lamp base such that the first switch unit 130 is pressed into an accommodation space C of the end cap structure 11. Hence, when the lamp tube 100 is installed on a lamp base, the first switch unit is pressed to be turned on. Afterwards, the user may turn on the second switch unit manually or by tools, such that the lamp tube 100 receives the external power source. Furthermore, when the lamp tube 100 is un-installed from the lamp base, the double switch structures will return back automatically, such that the external power source connected to the lamp tube 100 is cut off. As a result, the end cap structure for the lamp tube may avoid the user being electrocuted due to mis-touch during the installation or un-installation of the lamp tube; meanwhile, such kind of lamp tube 100 may also conform to a variety of safety regulations.

[0014] The end cap structure 11 includes a housing 190, an electrical connecting port 120, a first switch unit 130 and a second switch unit 140. The housing 190 may be formed by a combination of a first casing 110 and a second casing 180, but may also be integrally formed. The housing 190 has a bottom portion 191 and a side portion 192. The side portion 192 connects to and surrounds the bottom portion 191 to form an accommodation space C between the bottom portion 191 and the side portion 192. The electrical connecting port 120 is disposed on the bottom portion 191 for receiving an external power source. In one embodiment, the electrical connecting port 120 may include two electrical terminals. The first switch unit 130 is movably disposed on the bottom portion 191, and the second switch unit 140 is movably disposed on the side portion 192. One portion of the electrical connecting port 120 and one portion of the first switch unit 130 are located outside the bottom portion 191, and another portion of the electrical connecting port 120 and another portion of the first switch unit 130 are located inside the accommodation space C. In case that the housing 190 is formed by a combination of the first casing 110 and the second casing 180, the side portion 192 may include a first side 112 of the first casing 110 and a second side 182 of the second casing 180. In the present embodiment, the second switch unit 140 is movably disposed on the first side 112 of the first casing 110.

[0015] Referring to FIG. 4, an exploded drawing of the end cap structure 11 of FIG. 3A is shown. The end cap structure 11 further includes a conductive elastic piece 150, a first elastic element 160, a second elastic element 170, a stopper portion 185, a plate 184 and a third elastic element 172.

[0016] Refer to FIGS. 3A, 3B and FIG. 4 at the same time. The first casing 110 may include an annular wall 117. The annular wall 117 may be fit into the inner wall 187 of the second casing 180. Therefore, the first casing 110 may be integrated with the inner wall 187 of the second casing 180 via the annular wall 117 to form the hous-

ing 190. The bottom portion 191 of the housing 190 may have an accommodation hole 113. The electrical connecting port 120 may include an electrical receiving portion 121, a fixing portion 122 and a contact portion 123. The electrical connecting port 120 may be fixed into the accommodation hole 113 via the fixing portion 122. The electrical receiving portion 121 protrudes from to be outside the bottom portion 191 of the housing 190 for receiving the external power source. The contact portion 123 is disposed inside the accommodation space C for electrically connecting to the conductive elastic piece 150.

[0017] Moreover, the bottom portion 191 of the housing 190 may further have a guiding hole 114 for accommodating the first switch unit 130. The first switch unit 130 may include a pressing portion 133 and a first limiting portion 134. The first limiting portion 134 connects to the pressing portion 133 and is disposed inside the accommodation space C. The exposed portion 131 of the pressing portion 133 protrudes from the bottom portion 191 of the housing 190 for being pressing. The guiding portion 132 of the pressing portion 133 is disposed in the guiding hole 114, such that the first switch unit 130 is movable on the bottom portion 191. Moreover, the guiding portion 132 may have a hook structure, so as to avoid the first switch unit 130 falling out from the housing 190.

[0018] The first limiting portion 134 passes through the hollow portion of the first elastic element 160, such that the first elastic element 160 may be fit on the first limiting portion 134 and disposed under the pressing portion 133. The first elastic element 160 may be a compression spring having a first end 160e1 connecting to the bottom of the pressing portion 133 and a second end 160e2 opposite the first end 160e1 connecting to and fixed on the first casing 110 within the accommodation space C. Therefore, the second end 160e2 of the first elastic element 160 may be a fixed end, and the first end 160e1 of the first elastic element 160 may be an elastic end for applying a pushing force to the pressing portion 133 so as to force the first switch unit 130 to be located at the original position. Specifically, if the pressing portion 133 is subjected to an external force, the first elastic element 160 will deform. If the pressing portion 133 is no longer subjected to the external force, the first switch unit 130 will return back to the original position automatically due to the resilient force (i.e., the pushing force) generated form the deformation of the first elastic element 160.

[0019] The plate 184 is located inside the second casing 180. The stopper portion 185 is disposed in a recess of the plate 184, movably disposed under and abuts against the first limiting portion 134. The third elastic element 172 may be fit on a fixing pillar 186 of the stopper portion 185 for moving the stopper portion 185 to a stop position. In detail, the third elastic element 172 may be a compression spring having a first end 172e1 connecting to the bottom of the stopper portion 185 and a second end 172e2 opposite the first end 172e1 connecting to and fixed on the second casing 180 within the accommodation space C. Therefore, the second end 172e2 of the third elastic element 172 may be a fixed end, and the first end 172e1 of the third elastic element 172 may be an elastic end for applying an elastic force to the stopper portion 185 so as to force the stopper portion 185 back to the stop position. Specifically, as shown in FIG. 3B, when the pressing portion 133 of the first switch unit 130 is subjected to the external force so that the first switch unit 130 moves from the original position to the limiting position, the stopper portion 185 synchronously moves with the first limiting portion 134. Accordingly, the third elastic element 172 deforms. If the pressing portion 133 is not subjected to the external force anymore, the first switch unit 130 will move back to the original position automatically. Hence, the stopper portion 185 will move back to the stop position (as shown in FIG. 3A) due to the elastic force generated form the deformation of the third elastic element 172.

[0020] As shown in FIG. 4, the second switch unit 140 may be partially disposed inside the accommodation space C, and may include a trigger portion 141 and a second limiting portion 142. The first side 112 of the first casing 110 may have a recess 115 which the second switch unit 140 is movably disposed on. The trigger portion 141 may be a button exposed from the recess 115 of the first side 112. The second limiting portion 142 connects to the trigger portion 141 and is disposed inside the accommodation space C. As shown in FIG. 4, since the first side 112 of the first casing is a cylindrical surface, the second switch unit 140 may move linearly in a radial direction D1 perpendicular the first side 112. However, as shown in FIG. 3B, when the stopper portion 185 is located at the stop position, the second switch unit 140 cannot move linearly in the radial direction D1. That is, the stopper portion 185 stops the second switch unit 140 from moving in the radial direction D1.

[0021] Refer to FIGS. 3A, 3B and FIG. 4 at the same time. The conductive elastic piece 150 may be further disposed inside the accommodation space C and disposed on the second switch unit 140. Furthermore, the conductive elastic piece 150 may synchronously move with the second switch unit 140. For example, one side of the conductive elastic piece 150 may be formed into an engaging portion 152. The conductive elastic piece 150 may be fixed to the second switch unit 140 via the engaging portion 152, so that the conductive elastic piece 150 synchronously moves with the second switch unit 140. Moreover, the conductive elastic piece 150 may further include a pad sheet 153. One end of the pad sheet 153 may extend close to the contact portion 123 of the electrical connecting port 120 and be bent into an electric contact portion 151. In addition, the electric contact portion 151 is separated from the contact portion 123 by a distance D (designated in FIG. 5A) in the radial direction D1. The other end of the pad sheet 153 may be formed into a bending portion 154. The bending portion 154 is separated from a pad P on the circuit board 20 of the end portion of the light bar also by the distance D (designated

in FIG. 5A) in the radial direction D1.

[0022] In the present embodiment, since the stopper portion 185 at the stop position stops the second switch unit 140 from moving in the radial direction D1. Even though the user touches the trigger portion 141 accidentally, the second switch unit 140 cannot move linearly in the radial direction D1. Therefore, it may prevent the electric contact portion 151 and the bending portion 154 from electrically connecting to the contact portion 123 and the pad P respectively before the end cap structure 11 has been installed on the lamp base completely.

[0023] Moreover, the second elastic element 170 may be fit on a fixing pillar 181 of the plate 184 and connect to the second switch unit 140. The second elastic element 170 may be a compression spring having a first end 170e1 connecting to the plate 184 and a second end 170e2 opposite the first end 170e1 connecting to the second switch unit 140 and applying a restoring force to the second switch unit 140. Specifically, if the second switch unit 140 is subjected to a pressing force, the second elastic element 170 will deform. If the second switch unit 140 is no longer restricted, the second switch unit 140 will return back automatically due to the resilient force (i.e., the restoring force) generated form the deformation of the second elastic element 170.

[0024] As shown in FIG. 4, the first limiting portion 134 of the present embodiment may include a pillar, and the second limiting portion 142 may include a hook for hooking the pillar (as shown in FIG. 5D). Therefore, the pillar may stop the hook from moving in the radial direction D1 so as to restrict the movement of the second switch unit 140 in the radial direction D1. Although the pillar and the hook are respectively taken as examples of the first limiting portion 134 and the second limiting portion 142 of the present embodiment, the present invention is not limited thereto. Those skilled in the related art should understand that the structures which may achieve the objective that the first limiting portion 134 stops the second limiting portion 142 in the radial direction D1 are protected with the scope of the present invention.

[0025] FIGS. 5A-5G are schematic diagrams of the internal end cap structure 11 of FIG. 3A. To simplify the drawings, the housing 190 is not shown therein.

[0026] Refer to FIGS. 5A-5C at the same time. FIG. 5A is a schematic diagram of the first switch unit 130 located at the original position. At this time, the electric contact portion 151 is separated from the contact portion 123 by the distance D in the radial direction D1 while the bending portion 154 is separated from the pad P also by the distance D in the radial direction D1, such that the electric contact portion 151 and the bending portion 154 are electrically insulated from the contact portion 123 and the pad P, respectively. In addition, the stopper portion 185 is located at the stop position, thereby stopping the second switch unit 140 from moving in the radial direction D1. When the end cap structure 11 is installed on the lamp base, the pressing portion 133 is subjected to the external force F1 such that the first switch unit 130 moves. At this time, the stopper portion 185 which the first limiting portion 134 abuts against moves away from the stop position due to the push of the first limiting portion 134, as shown in FIGS. 5B and 5C. Moreover, the first elastic element 160 and the third elastic element 172 both deform as being compressed.

[0027] Referring to FIG. 5C, the first limiting portion 134 includes a pillar that may has a length L. The length L is sufficient for the pillar to be located at the limiting position, so that the hook of the second limiting portion 142 can hook the pillar in the radial direction D1, and the pillar can stop the hook in the radial direction D1. In addition, when the pressing portion 133 is no longer subjected to the external force, the length L is sufficient for the pillar to move away from the limiting position, so that the pillar can release the hook in the radial direction D1.

[0028] Refer to FIGS. 5C and 5D at the same time. When the pillar (the first limiting portion 134) is located at the limiting position, the second switch unit 140 is no longer stopped by the stopper portion 185. Therefore, the user may press the trigger portion 141 of the second switch unit 140 in the radial direction D1. The trigger portion 141 is subjected to the pressing force F2, thereby driving the hook (the second limiting portion 142), the electric contact portion 151 and the bending portion 154 to move the distance D in the radial direction D1. As a result, the hook (the second limiting portion 142) may hook the pillar (the first limiting portion 134), such that the hook (the second limiting portion 142) may be stopped in the radial direction D1 rather than moving in the radial direction D1. Meanwhile, the electric contact portion 151 may remain to contact with the contact portion 123 while the bending portion 154 may remain to contact with the pad P, such that the electric contact portion 151 and the bending portion 154 may electrically connect to the contact portion 123 and the pad P, respectively. At this moment, the second elastic element 170 may deform as being compressed.

[0029] Refer to FIGS. 5D-5F at the same time. When the end cap structure 11 is un-installed from the lamp base, the pressing portion 133 is no longer subjected to the external force. At this moment, the first switch unit 130 may move away from the limiting position and towards the original position as shown in FIG. 5F automatically via the resilient force (i.e., the pushing force F3) generated by the deformation of the first elastic element 160. Meanwhile, since the first switch unit 130 moves away from the limiting position, the first limiting portion 134 releases the second limiting portion 142. Hence, the second limiting portion 142 is no longer restricted by the first limiting portion 134, and thus the second switch unit 140 will return back automatically due to the resilient force (i.e., the restoring force F4) generated by the deformation of the second elastic element 170. At this time, the electric contact portion 151 is separated from the contact portion 123 and the bending portion 154 is separated from the pad P both by the distance D in the radial direction D1, such that the electric contact portion 151 and the bending

portion 154 are electrically insulated from the contact portion 123 and the pad P, respectively.

[0030] In the process from FIG. 5D to FIG. 5F, the first switch unit 130 moves to the original position first. Then, the first limiting portion 134 releases the second limiting portion 142, such that the second switch unit 140 returns back via the second elastic element 170. After the second switch unit 140 returns back, the stopper portion 185 moves towards the stop position as shown in FIG. 5G via the elastic force F5 generated by the deformation of the third elastic element 172.

[0031] Accordingly, the first switch unit 130 and the second switch unit 140 are disposed on the bottom portion and the side portion of the housing of the lamp tube in the present invention. When the lamp tube is installed into the lamp base, the first switch unit 130 is pressed. Afterwards, the user may turn on the second switch unit 140 manually or by tools, such that the lamp tube receives the external power source. When the lamp tube is uninstalled from the lamp base, the first switch unit 130 and the second switch unit 140 return back and turn off automatically. Therefore, the present invention may not only prevent the user from electrocuting during the installation of the lamp tube, but also avoid breaking the lamp tube directly during the operation of the live wire.

[0032] Refer to FIGS. 6A and 6B. FIG. 6A is a schematic diagram of a first switch unit 130 of an end cap structure 101 of the lamp tube located at an original position according to another embodiment of the invention. FIG. 6B is a schematic diagram of the first switch unit 130 of the end cap structure 101 of FIG. 6A located at a limiting position. The difference between the end cap structure 101 of the present embodiment and the end cap structure 11 of FIGS. 3A and 3B is that the stopper portion 185 and the third elastic element 172 may be omitted in the present embodiment, and the way to electrically connect the conductive elastic piece 150 and the light bar in the present embodiment differs from that in FIGS. 3A and 3B. Other common structures and functions will not be repeated here.

[0033] FIG. 7 is an exploded drawing of the end cap structure 101 of FIG. 6A. Refer to FIGS .6A, 6B and 7 at the same time. The first casing 110 may include a socket 116, and the socket 116 may have an annular concave part. The second casing 180 may include a snap ring 183, and the snap ring 183 may have an annular convex part corresponding to the annular concave part of the socket 116. Accordingly, the first casing 110 may be integrated with the snap ring 183 of the second casing 180 via the socket 116 to form the housing 190.

[0034] The second switch unit 140 may be disposed inside the accommodation space C and movably disposed on the recess 115 of the first side 112 along the radial direction D1. In addition, the trigger portion 141 of the second switch unit 140 may be exposed from the recess 115 and sink into the first side 112 to be disposed inside the accommodation space C. In the present embodiment, the trigger portion 141 may be a button. Since the button is exposed from the recess 115 of the first side 112 and sink into the first side 112, the user needs to press the button by tools (such as a pin) in the radial direction D1 rather than by manual operation, so as to conform to the safety regulations.

[0035] Moreover, one end of the pad sheet 153 of the conductive elastic piece 150 may extend close to the contact portion 123 and be bent into an electric contact portion 151 separated from the contact portion 123 by the distance D (designated in FIG. 8A) in the radial direction D1. The other end of the pad sheet 153 may extend close to a signal wire 105 at the end portion of the light bar and electrically connect to one end of the signal wire 105. The other end of the signal wire 105 may electrically connect to the driver 104 (designated in FIGS. 1A-1D) and the light bar for supplying the external power source to the driver 104 and the light bar. In one embodiment, the way to electrically connect the conductive elastic piece 150 and the light bar in the present embodiment may be the same as that of the end cap structure 11 in FIGS. 3-5.

[0036] FIGS. 8A-8D are schematic diagrams of the internal end cap structure 101 of FIG. 6A. To simplify the drawings, the housing 190 is not shown therein.

[0037] Refer to FIGS. 8A and 8B at the same time. FIG. 8A is a schematic diagram of the first switch unit 130 located at the original position. At this time, the electric contact portion 151 is separated from the contact portion 123 by the distance D in the radial direction D1, such that the electric contact portion 151 is electrically insulated from the contact portion 123. When the end cap structure 101 is installed on the lamp base, the pressing portion 133 is subjected to the external force F1 such that the first switch unit 130 moves from the original position to the limiting position as sown in FIG. 8B. In addition, the first elastic element 160 deforms as being compressed.

[0038] Referring to FIG. 8B, the pillar (the first limiting portion 134) may have a length L. The length L is sufficient for the pillar to be located at the limiting position, so that the hook (the second limiting portion 142) can hook the pillar in the radial direction D1, and the pillar can stop the hook in the radial direction D1. In addition, when the pressing portion 133 is no longer subjected to the external force, the length L is sufficient for the pillar to move away from the limiting position, so that the pillar can release the hook in the radial direction D1.

[0039] Refer to FIGS. 8B and 8C at the same time. When the pillar (the first limiting portion 134) is located at the limiting position, the user may press the trigger portion 141 of the second switch unit in the radial direction D1 by tools. The trigger portion 141 is subjected to the pressing force F2, thereby driving the hook (the second limiting portion 142) and the electric contact portion 151 to move the distance D in the radial direction D1. As a result, the hook (the second limiting portion 142) may hook the pillar (the first limiting portion 134), such that the hook (the second limiting portion 142) may be

stopped in the radial direction D1 rather than moving in the radial direction D1. Meanwhile, the electric contact portion 151 may remain to contact with the contact portion 123, such that the electric contact portion 151 may electrically connect to the contact portion 123. At this moment, the second elastic element 170 may deform as being compressed.

[0040] Refer to FIGS. 8C and 8D at the same time. When the end cap structure 101 is un-installed from the lamp base, the pressing portion 133 is no longer subjected to the external force. At this moment, the first switch unit 130 may move away from the limiting position and return back to the original position as shown in FIG. 8D automatically via the resilient force (i.e., the pushing force F3) generated by the deformation of the first elastic element 160. Meanwhile, since the first switch unit 130 moves away from the limiting position, the first limiting portion 134 releases the second limiting portion 142. Hence, the second limiting portion 142 is no longer restricted by the first limiting portion 134, and thus the second switch unit 140 will return back automatically due to the resilient force (i.e., the restoring force F4) generated by the deformation of the second elastic element 170. At this time, the electric contact portion 151 is separated from the contact portion 123 by the distance D, such that the electric contact portion 151 is electrically insulated from the contact portion 123.

[0041] Refer to FIGS. 9A and 9B. FIG. 9A is a schematic diagram of a first switch unit 230 of an end cap structure 201 of the lamp tube located at an original position according to still another embodiment of the invention. FIG. 9B is a schematic diagram of the first switch unit 230 of the end cap structure 201 of FIG. 9A located at a limiting position. The difference between the end cap structure 201 of the present embodiment and the end cap structure 101 of FIGS. 6A and 6B lies in the structures of the first switch unit 230 and the second switch unit 240. Other common structures and functions will not be repeated here.

[0042] In the present embodiment, the first switch unit 230 is movably disposed on the bottom portion 191, and the second switch unit 240 is movably disposed on the side portion 192. In case that the housing 190 is formed by a combination of the first casing 110 and the second casing 180, the second switch unit 240 is movably disposed on the second side 182 of the second casing 180. Particularly, one of the differences between the end cap structure 201 of the present embodiment and the end cap structure 101 of FIGS. 6A and 6B is that the second switch unit 240 of the present embodiment is rotatably disposed on the side portion 192.

[0043] Referring to FIG. 10A, an exploded drawing of the end cap structure 201of FIG. 9A is shown. The end cap structure 201 further includes a conductive elastic piece 250, a first elastic element 260 and a second elastic element 270.

[0044] Refer to FIGS. 9A, 9B and 10A at the same time. The first casing 110 may be integrated with the second casing 180 via a hook portion 215 to form the housing 190.

[0045] Moreover, the first switch unit 230 may include a pressing portion 133 and a first limiting portion 234. The first limiting portion 234 connects to the pressing portion 133 and is disposed inside the accommodation space C.

[0046] In FIG. 9A, the first switch unit 230 is located at an original position, namely the state when the end cap structure 201 has not been installed on the lamp base. In FIG. 9B, the first switch unit 230 is located at a limiting position, namely the state when the end cap structure 201 of the lamp tube has been installed on the lamp base, such that the entire first switch unit 230 is pressed into the accommodation space C. In the present embodiment, the first limiting portion 234 passes through the hollow portion of the first elastic element 260, such that the first elastic element 260 may be fit on the first limiting portion 234 and disposed under the pressing portion 133. The first elastic element 260 may be a compression spring having a first end connecting to the bottom of the pressing portion 133 and a second end opposite the first end connecting to and fixed on the housing 190 within the accommodation space C. Therefore, the second end of the first elastic element 260 may be a fixed end, and the first end of the first elastic element 260 may be an elastic end for applying a pushing force to the pressing portion 133 so as to force the first switch unit 230 to be located at the original position. Specifically, if the pressing portion 133 is subjected to an external force, the first elastic element 260 will deform. If the pressing portion 133 is no longer subjected to the external force, the first switch unit 230 will return back to the original position automatically due to the resilient force (i.e., the pushing force) generated form the deformation of the first elastic element 260.

[0047] Referring to FIGS. 9A, 9B and FIG. 10A at the same time, the second switch unit 240 is disposed inside the accommodation space C. The second side 182 of the second casing 180 may have a sliding portion 281 which the second switch unit 240 is rotatably disposed on. In addition, although the second switch unit 240 is disposed inside the accommodation space C, the second switch unit 240 may be partially exposed from the sliding portion 281 for being rotated by virtue of the sliding portion 281. As shown in FIG. 10A, since the second side 182 of the second casing 180 casing is a cylindrical surface, the second switch unit 240 may rotate in a circumferential direction R1 of the second side 182.

[0048] In FIG. 10A, the second switch unit 240 is disposed inside the accommodation space C and may include a trigger portion 241, a second limiting portion 242 and a rotatable body 243. The trigger portion 241 may be exposed from the sliding portion 281 of the second side 182 and sink into the second side 182. The rotatable body 243 is disposed on the second side 182 and movable in the circumferential direction R1. In the present embodiment, the trigger portion 241 may include a notch disposed on the rotatable body 243, and the notch is

slidably exposed from the sliding portion 281 along the circumferential direction R1. Since the notch is exposed from the sliding portion 281 of the second side 182 and sinks into the second side 182, the user needs to shift the notch in the circumferential direction R1 by tools (such as a flathead screwdriver) rather than by manual operation, so as to conform to the safety regulations.

[0049] Moreover, the conductive elastic piece 250 may be further disposed inside the accommodation space C. In the present embodiment, one end of the conductive elastic piece 250 may be disposed on the rotatable body 243. As a result, the conductive elastic piece 250 may be fixed on the rotatable body 243 and synchronously move with the second switch unit 240. Furthermore, the other end of the conductive elastic piece 250 may pass through the rotatable body 243 and extend downwards the rotatable body 243, so as to electrically connect to one end of the signal wire 105 at the end portion of the light bar.

[0050] Moreover, the second elastic element 270 may connect to the second switch unit 240. The second elastic element 270 may be a torsional spring having one end connecting to the second casing 280 and the other end connecting to the rotatable body 243 and applying a restoring force to the second switch unit 240. Specifically, if the second switch unit 240 rotates in the circumferential direction R1, the second elastic element 270 will deform due to the torsional force. If the second switch unit 240 is no longer restricted, the second switch unit 240 will return back automatically due to the resilient force (i.e., the restoring force) generated form the deformation of the second elastic element 270.

[0051] FIG. 10B is a partially enlarged drawing of the first limiting portion 234 of the end cap structure 201 of FIG. 10A. FIG. 10C is a partially enlarged drawing of the second limiting portion 242 of the end cap structure 201 of FIG. 10A.

[0052] As shown in FIG. 10B, the first limiting portion 234 of the present embodiment may include a groove 2341 which may extend along a direction perpendicular to the bottom portion 191. Moreover, the first limiting portion 234 may further include an extending column 2342 which may extend from the bottom portion of the groove 2341 along the direction perpendicular to the bottom portion 191. In another embodiment, the first limiting portion 234 may include the groove 2341 only but may not include the extending column 2342. In case that the first limiting portion 234 includes the extending column 2342, a stepped opening 2343 is formed between the groove 2341 and the extending column 2342.

[0053] As shown in FIG. 10C, the second limiting portion 242 may include a protrusion 2421. Referring to FIGS. 10B and 10C, the groove 2341 may correspond to the protrusion 2421. As a result, when the protrusion 2421 is inserted into the groove 2341, the protrusion 2421 may slide in the groove 2341 along the direction where the groove 2341 extends instead of moving along the circumferential direction R1.

[0054] Moreover, the rotatable body 243 may have a through section 2431. The through section 2431 may extend along the circumferential direction R1 and penetrate the rotatable body 243. In such a case, the protrusion 2421 may be connected to the rotatable body 243 via an arm 2422 and disposed in the through section 2431.

[0055] Although the above are exemplified as the first limiting portion 234 and the second limiting portion 242 of the present embodiment for explanation, the present invention is not limited thereto. Those skilled in the related art should understand that the structures which may achieve the objective that the first limiting portion 234 stops the second limiting portion 242 in the circumferential direction R1 are protected with the scope of the present invention.

[0056] FIGS. 11A-11D are schematic diagrams of the internal end cap structure 201 of FIG. 9A. To simplify the drawings, the housing 190 is not shown therein.

[0057] Refer to FIGS. 11A and 11B at the same time. FIG. 11A is a schematic diagram of the first switch unit 230 located at the original position. At this time, the conductive elastic piece 250 does not contact with the contact portion 123, thereby being electrically insulated from the contact portion 123. As shown in FIG. 11A, the groove 2341 and the extending column 2342 may pass through the through section 2431. When the end cap structure 201 is installed on the lamp base, partial pressing portion 233 which protrudes from the bottom portion 191 of the housing 190 is subjected to the external force F1 such that the first switch unit 230 moves from the original position to the limiting position as sown in FIG. 11B. In addition, the first elastic element 260 deforms as being compressed.

[0058] Refer to FIGS. 11B and 11C at the same time. When the groove 2341 is located at the limiting position, the user may shift the trigger portion 241 in the circumferential direction R1 by tools, such that the protrusion 2421 and the conductive elastic piece 250 rotate synchronously with the rotatable body 243 in the circumferential direction R1 via a torque T1 subjected to the rotatable body 243, and the protrusion 2421 is inserted into the groove 2341. As a result, the groove 2341 may stop the protrusion 2421 from moving in the circumferential direction R1, such that the protrusion 2421 cannot move in the circumferential direction R1. Meanwhile, the conductive elastic piece 250 remains to contact with the contact portion 123, thereby electrically connecting to the contact portion 123. At this time, the second elastic element 270 (not shown as being hidden) deforms due to the torque.

[0059] Refer to FIGS. 11C and 11D at the same time. When the end cap structure 201 is un-installed from the lamp base, the pressing portion 233 is no longer subjected to the external force. At this moment, the first switch unit 230 may move away from the limiting position and return back to the original position as shown in FIG. 11D automatically via the resilient force (i.e., the pushing force F3) generated by the deformation of the first elastic ele-

ment 260. Meanwhile, as shown in FIG. 11D, the groove 2341 moves away from the limiting position, so that the protrusion 2421 is no longer restricted in the circumferential direction R1 via the stepped opening 2343. Hence, the stepped opening 2343 may release the protrusion 2421 in the circumferential direction R1. The rotatable body 243 will return back automatically due to the resilient force (i.e., the restoring force T2) generated by the deformation of the second elastic element 270, such that the conductive elastic piece 250 does not contact with the contact portion 123 any longer, thereby being electrically insulated from the contact portion 123.

[0060] According to the above disclosed embodiments, the lamp tube 100 and the end cap structures 11, 12, 101 and 201 thereof are provided with double switch structures (i.e., the first switch unit and the second switch unit) on the end cap structures. When the end cap structure is installed on the lamp base, the first switch unit will be forced to move to the limiting position. Afterwards, the user needs to turn the second switch unit on manually or by tools, so that the lamp tube receives the external power source. Moreover, when the end cap structure is un-installed from the lamp base, the double switch structures will return back automatically, so that the external power source is cut off. As a result, it may prevent the user from being electrocuted due to mis-touch during the installation or un-installation of the lamp tube; meanwhile, such kind of lamp tube may also conform to a variety of safety regulations.

[0061] While the invention has been described by way of example and in terms of the preferred embodiment(s), it is to be understood that the invention is not limited thereto. On the contrary, it is intended to cover various modifications and similar arrangements and procedures, and the scope of the appended claims therefore should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements and procedures.

Claims

1. An end cap structure (11, 12, 101, 201) for a lamp tube (100), **characterized in that** the end cap structure comprising:

   a housing (190) having an accommodation space (C);
   an electrical connecting port (120) disposed on the housing (190) for receiving an external power source (200);
   a first switch unit (130, 230) movably disposed on the housing (190);
   a second switch unit (140, 240) movably disposed on the housing (190); and
   a conductive elastic piece (150, 250) disposed inside the accommodation space (C) and synchronously moving with the second switch unit (140, 240), wherein the conductive elastic piece (150, 250) is separated from the electrical connecting port (120) by a distance (D);
   wherein when the lamp tube (100) is disposed on a lamp base, the first switch unit (130, 230) is subjected to an external force (F1) so as to move from an original position to a limiting position; when the first switch unit (130, 230) is located at the limiting position, the conductive elastic piece (150, 250) electrically connects to the electrical connecting port (120) by a movement of the second switch unit (140, 240) relative to the housing (190), and the second switch unit (140, 240) is stopped by the first switch unit (130, 230).

2. The end cap structure according to claim 1, further comprising:

   a first elastic element (160, 260) disposed under the first switch unit (130, 230) and applying a pushing force (F3) to the first switch unit (130, 230); and
   a second elastic element (170, 270) connecting to the second switch unit (140, 240) and applying a restoring force (F4, T2) to the second switch unit (140, 240);
   wherein when the first switch unit (130, 230) located at the limiting position is free of the external force (F1), the first switch unit (130, 230) moves away from the limiting position and back to the original position by the pushing force (F3), and the second switch unit (140, 240) electrically isolates the conductive elastic piece (150, 250) and the electrical connecting port (120) by the restoring force (F4, T2).

3. The end cap structure according to claim 2, wherein the second elastic element is a compression spring (170) or a torsional spring (270).

4. The end cap structure according to claim 2, wherein the first switch unit (130, 230) comprises a pressing portion (133) disposed on the housing (190) for receiving the external force (F1) and a first limiting portion (134, 234) connecting to the pressing portion (133) and disposed inside the accommodation space (C);
   the second switch unit (140, 240) comprises a trigger portion (141, 241) exposed on the housing (190) and a second limiting portion (142, 242) connecting to the trigger portion (141, 241) and disposed inside the accommodation space (C);
   when the conductive elastic piece (150, 250) electrically connects to the electrical connecting port (120), the first limiting portion (134, 234) stops the second limiting portion (142, 242) from moving; and
   when the first switch unit (130, 230) moves from the

limiting position back to the original position, the first limiting portion (134, 234) releases the second limiting portion (142, 242).

5. The end cap structure according to claim 4, wherein the second switch unit (140) is movable linearly in a radial direction (D1).

6. The end cap structure according to claim 5, wherein the first limiting portion (134) comprises a pillar, and the second limiting portion (142) comprises a hook for hooking the pillar so that the pillar stops the hook from moving in the radial direction (D1).

7. The end cap structure according to claim 6, wherein the pillar has a length (L);
when the pressing portion (133) is subjected to the external force (F1), the length (L) is sufficient for the pillar to be located at the limiting position; and
when the pressing portion (133) is free of the external force (F1), the length (L) is sufficient for the pillar to move away from the limiting position.

8. The end cap structure according to claim 7, further comprising a stopper portion (185) movably disposed under the pillar and a third elastic element (172) connecting to the stopper portion (185) for moving the stopper portion (185) to a stop position, wherein when the stopper portion (185) is located at the stop position, the stopper portion (185) stops the hook from moving in the radial direction (D1).

9. The end cap structure according to claim 5, wherein the housing (190) has a recess (115), the trigger portion (141) comprises a button disposed in the recess (115) and movable in the radial direction (D1), and when the first limiting portion (134) is located at the limiting position, the conductive elastic piece (150) electrically connects to the electrical connecting port (120) by a movement of the button to move the distance (D).

10. The end cap structure according to claim 4, wherein the second switch unit (240) is rotatable in a circumferential direction (R1).

11. The end cap structure according to claim 10, wherein the second switch unit (240) further comprises a rotatable body (243) disposed on the housing (190) along the circumferential direction (R1), the conductive elastic piece (250) is disposed on the rotatable body (243), and when the first limiting portion (234) is located at the limiting position, the conductive elastic piece (250) electrically connects to the electrical connecting port (120) by a rotation of the rotatable body (243).

12. The end cap structure according to claim 11, wherein the housing (190) has a sliding portion (281), the trigger portion (241) comprises a notch disposed on the rotatable body (243), and the notch is slidably disposed in the sliding portion (281) along the circumferential direction (R1).

13. The end cap structure according to claim 11, wherein the first limiting portion (234) comprises a groove (2341), the second limiting portion (242) comprises a protrusion (2421) connecting to the rotatable body (243), and the groove (2341) corresponds to the protrusion (2421), thereby stopping the protrusion (2421) from moving in the circumferential direction (R1).

14. The end cap structure according to claim 13, wherein the first switch unit (230) further comprises an extending column (2342) extending from the groove (2341), and a stepped opening (2343) is formed between the groove (2341) and the extending column (2342) for the groove (2341) to release the protrusion (2421) in the circumferential direction (R1).

15. The end cap structure according to claim 14, wherein the rotatable body (243) has a through section (2431) penetrating the rotatable body (243) along the circumferential direction (R1), the groove (2341) and the extending column (2342) pass through the through section (2431), and the protrusion (2421) is connected to the rotatable body (243) via an arm (2422) and disposed in the through section (2431).

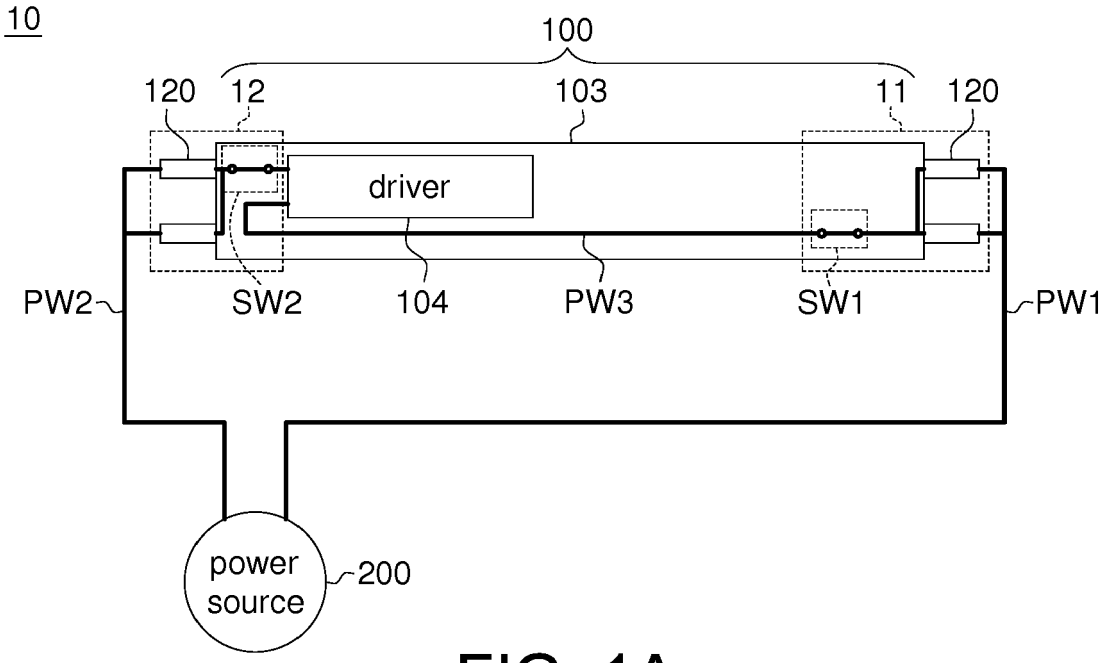

10
100
120
12
103
11
120
driver
PW2
SW2
104
PW3
SW1
PW1
power source
200

FIG. 1A

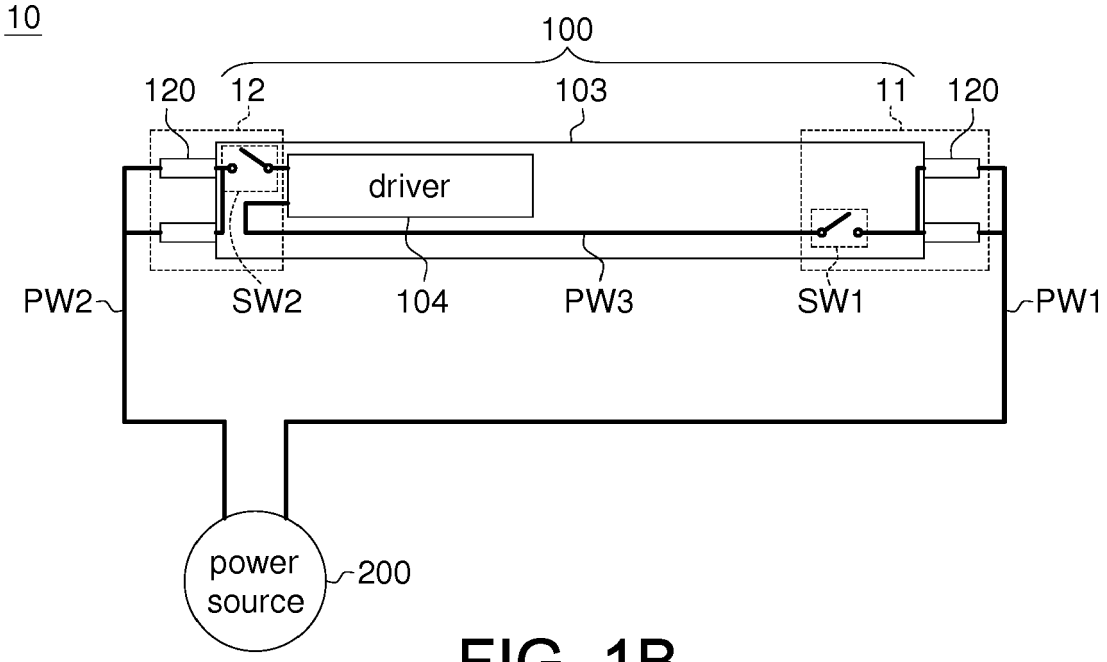

10
100
120
12
103
11
120
driver
PW2
SW2
104
PW3
SW1
PW1
power source
200

FIG. 1B

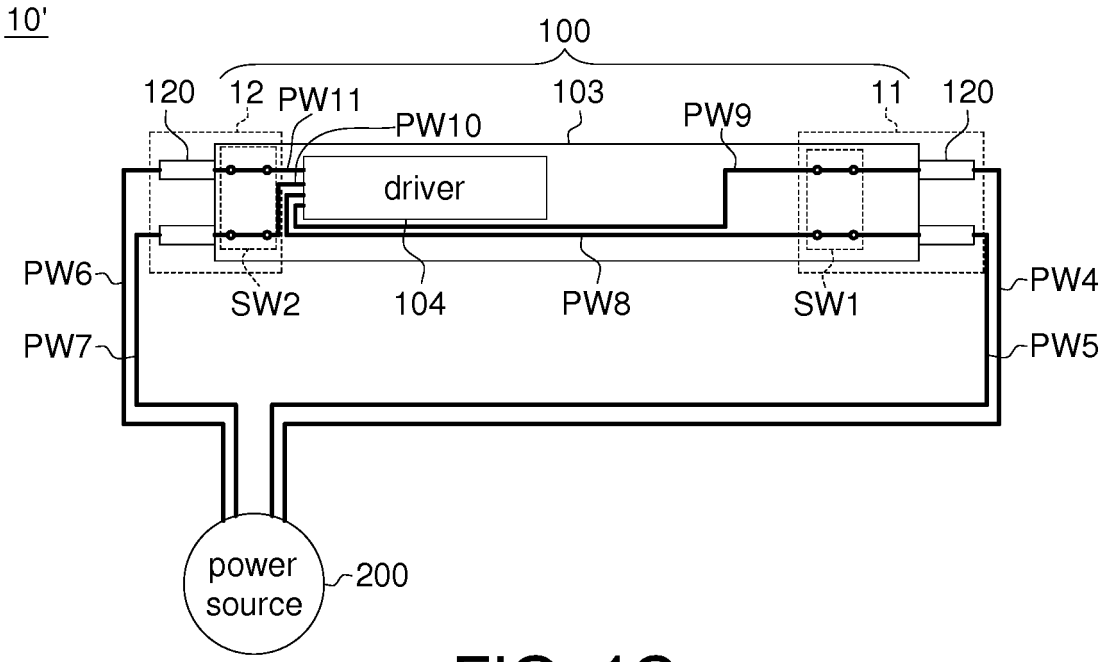

10'
100
120
12
PW11
PW10
103
PW9
11
120
driver
PW6
PW4
SW2
104
PW8
SW1
PW7
PW5
power source
200

FIG. 1C

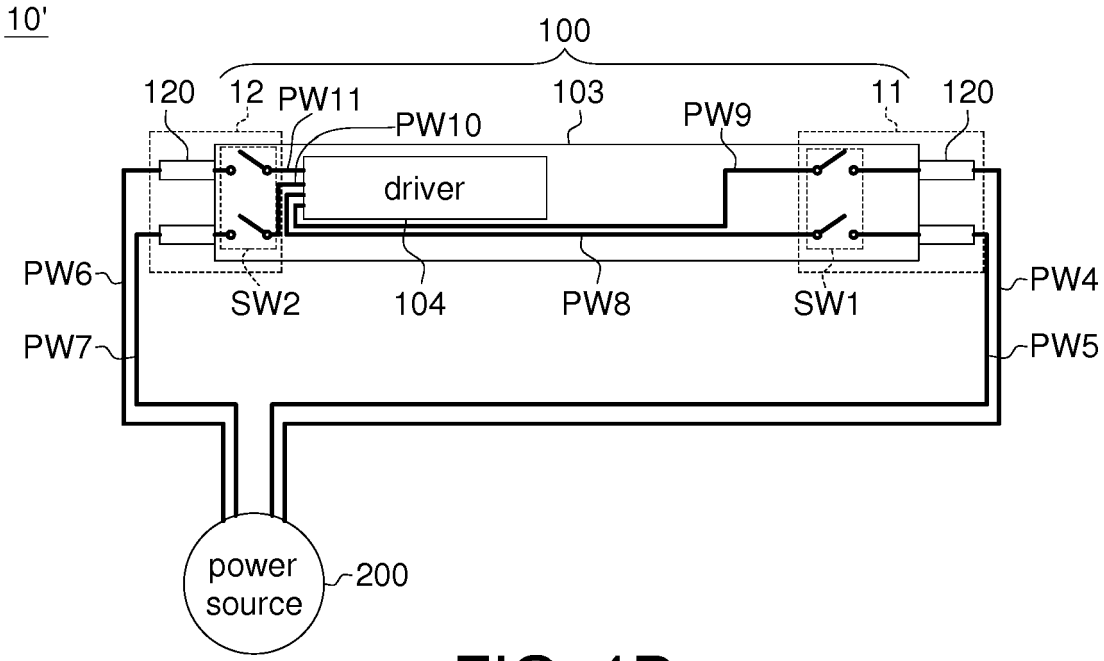

10'
100
120
12
PW11
PW10
103
PW9
11
120
driver
PW6
PW4
SW2
104
PW8
SW1
PW7
PW5
power source
200

FIG. 1D

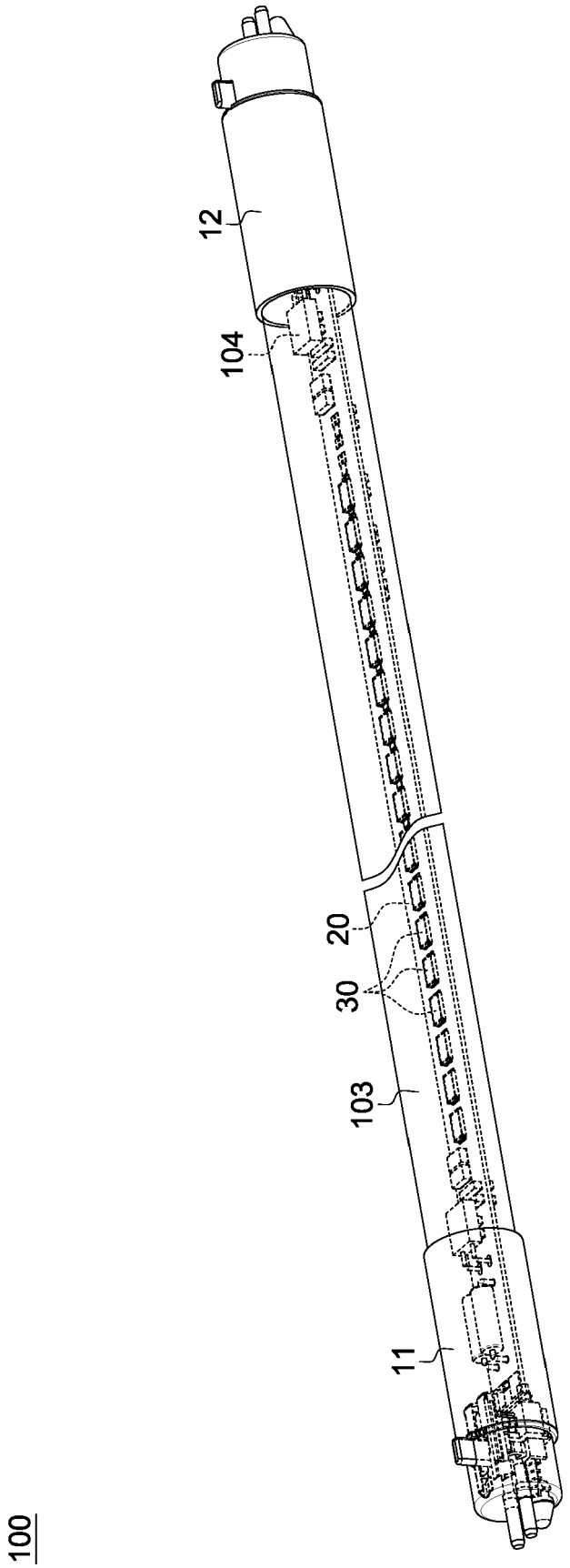


FIG. 2

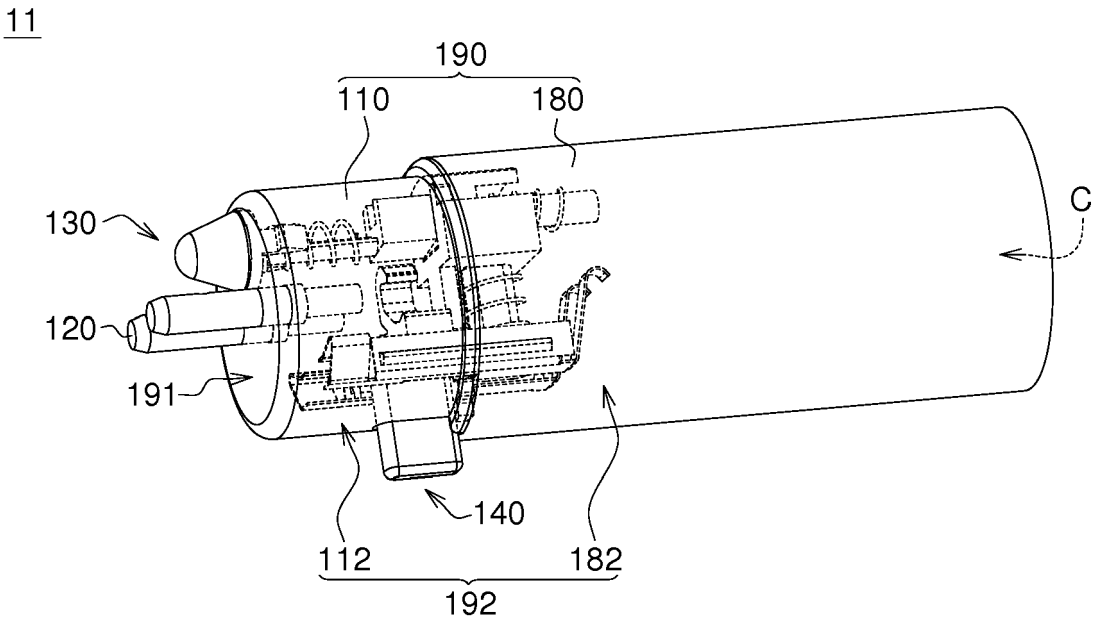

11
190
110
180
130
C
120
191
140
112
182
192

FIG. 3A

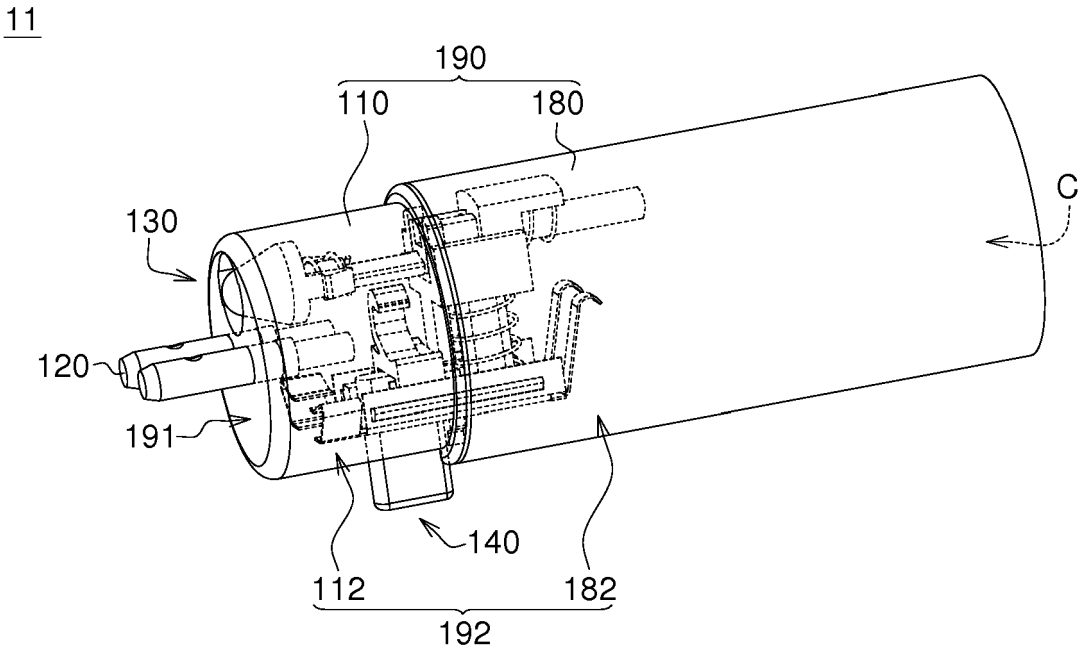

11
190
110
180
C
130
120
191
140
112
182
192

FIG. 3B

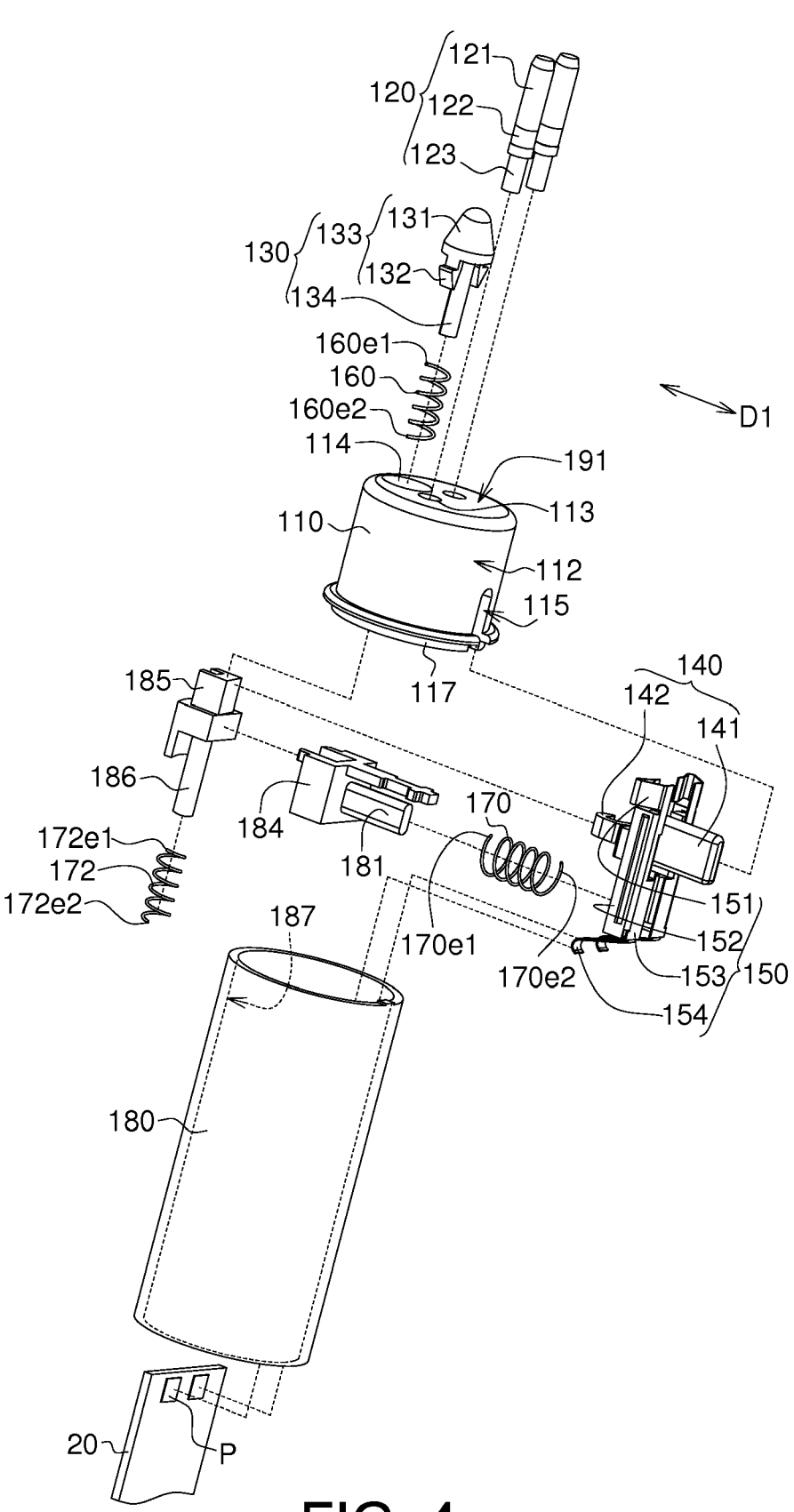

11
121
120
122
123
131
130
133
132
134
160e1
160
160e2
114
191
D1
110
113
112
115
117
140
142
141
185
186
184
170
172e1
172
181
172e2
187
170e1
151
152
153
150
170e2
154
180
20
P

FIG. 4

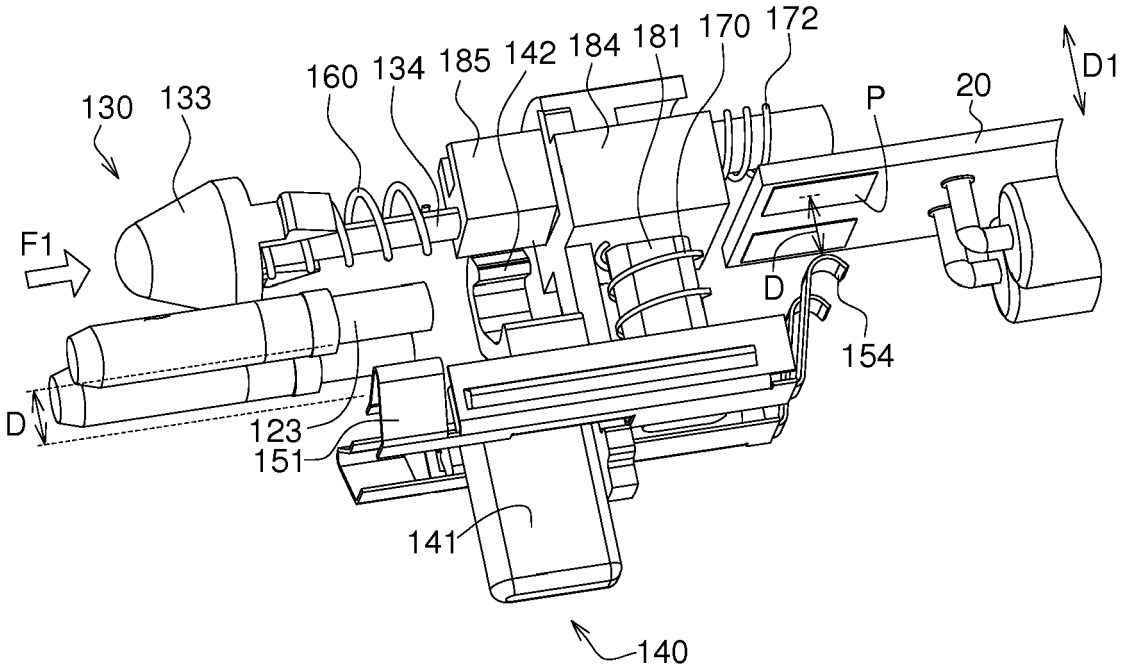

130
133
160
134
185
142
184
181
170
172
P
20
D1
F1
D
154
D
123
151
141
140

FIG. 5A

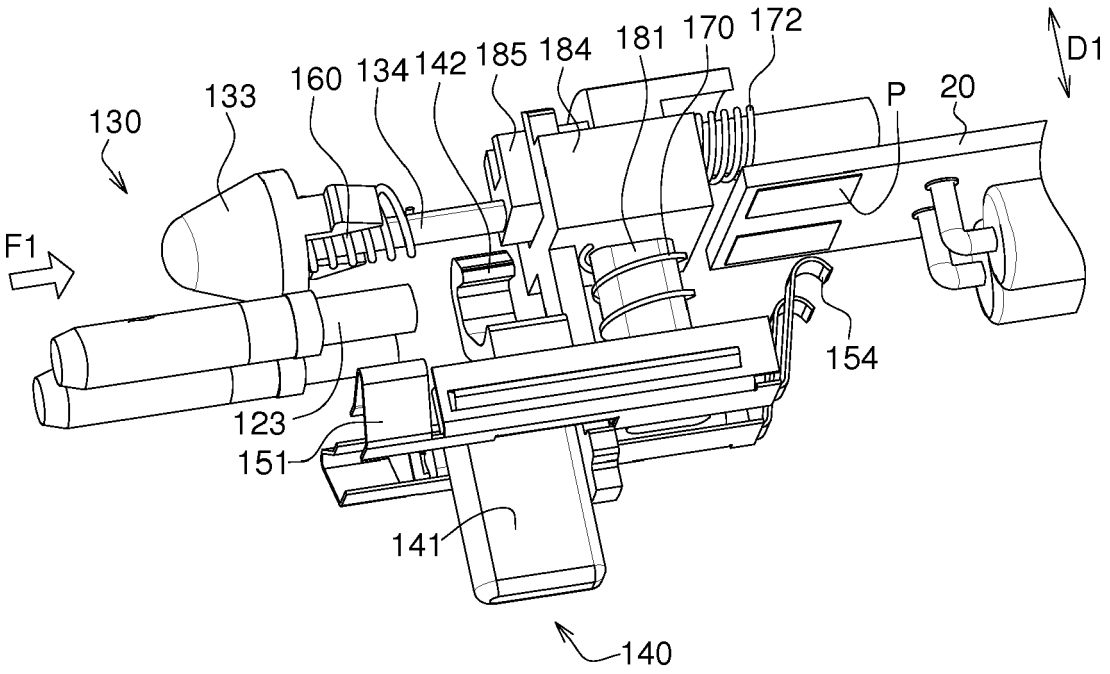

130
133
160
134
142
185
184
181
170
172
P
20
D1
F1
154
123
151
141
140

FIG. 5B

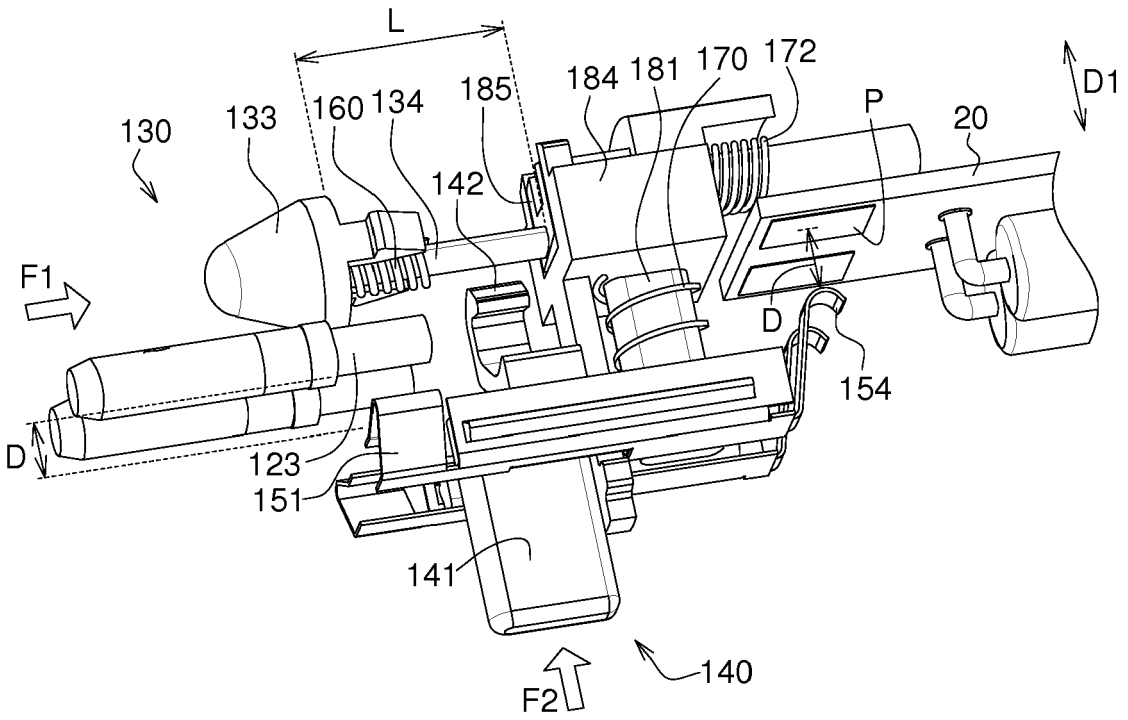

L
130
133
160
134
185
184
181
170
172
P
20
D1
142
F1
D
154
123
151
141
140
F2

FIG. 5C

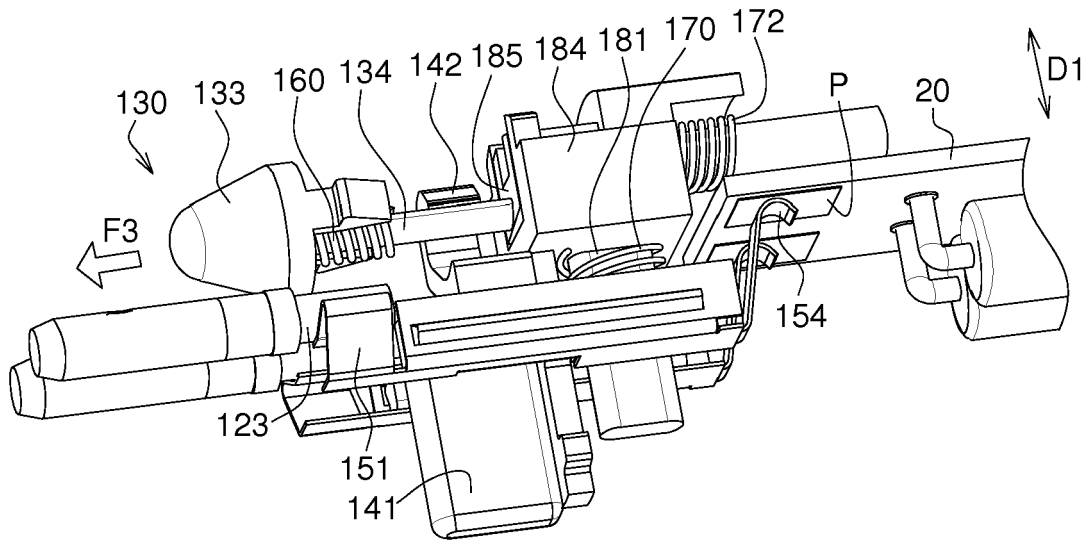

130
133
160
134
142
185
184
181
170
172
P
20
D1
F3
154
123
151
141

FIG. 5D

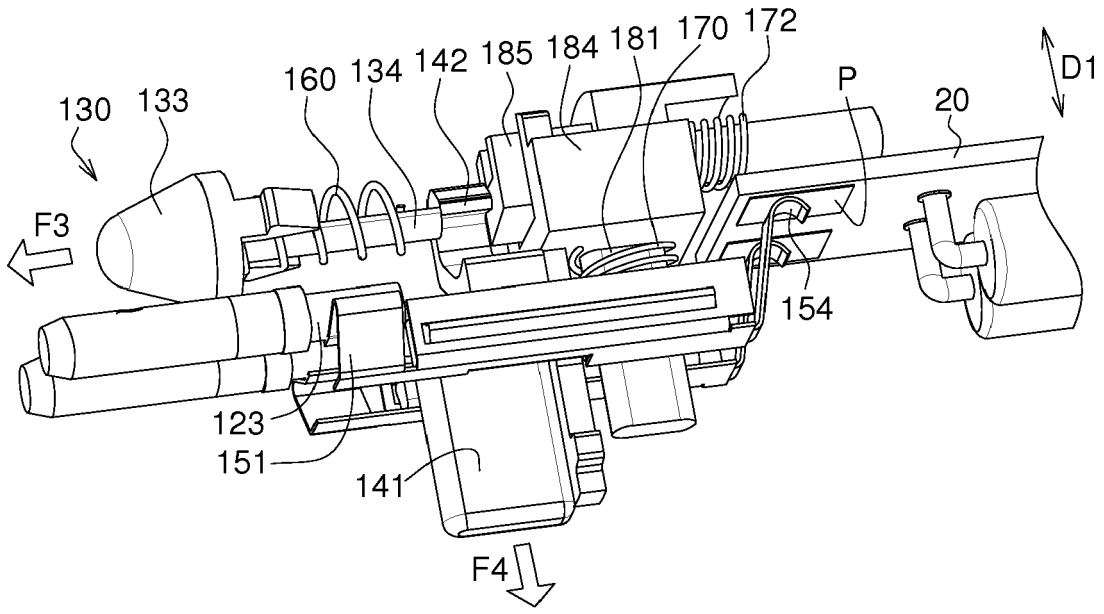

130
133
160
134
142
185
184
181
170
172
P
20
D1
F3
154
123
151
141
F4

FIG. 5E

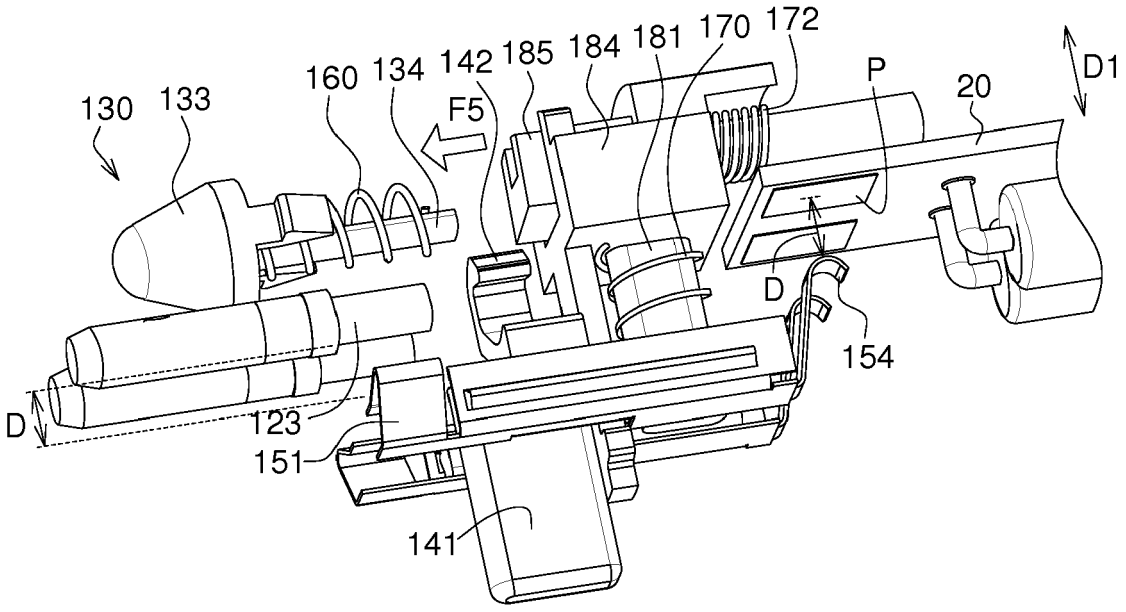

130
133
160
134
142
F5
185
184
181
170
172
P
20
D1
D
154
D
123
151
141

FIG. 5F

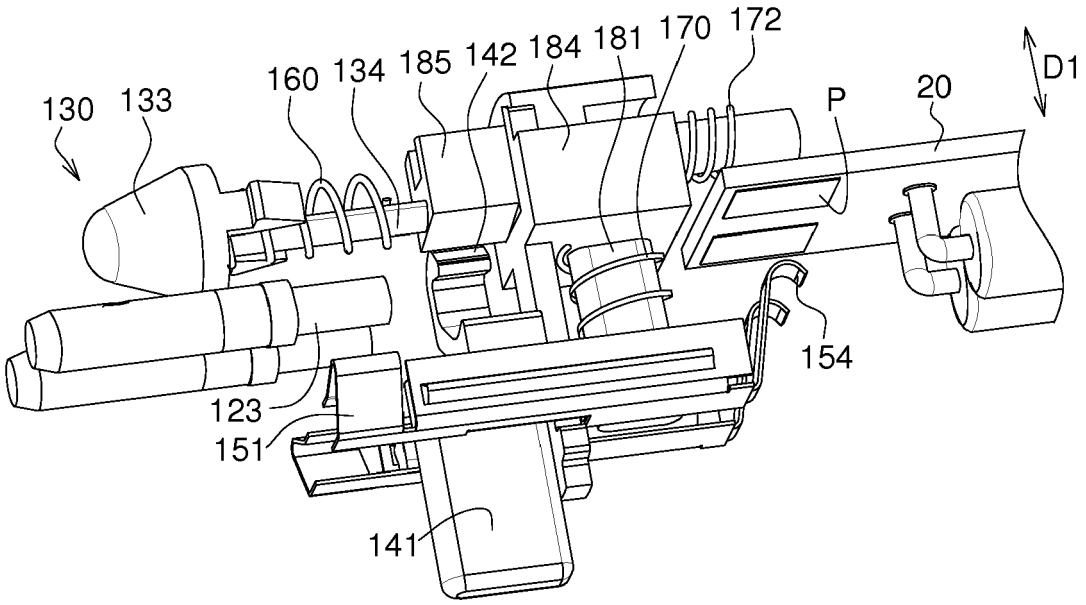


FIG. 5G

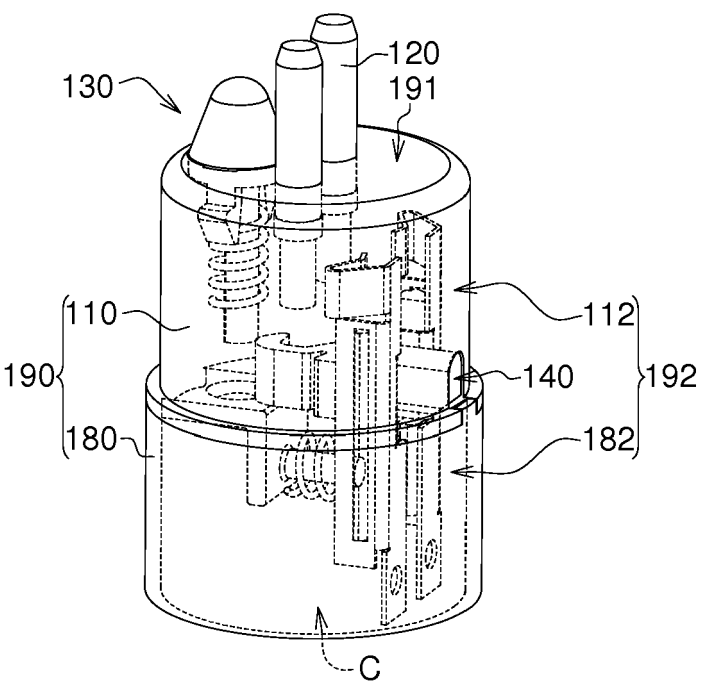
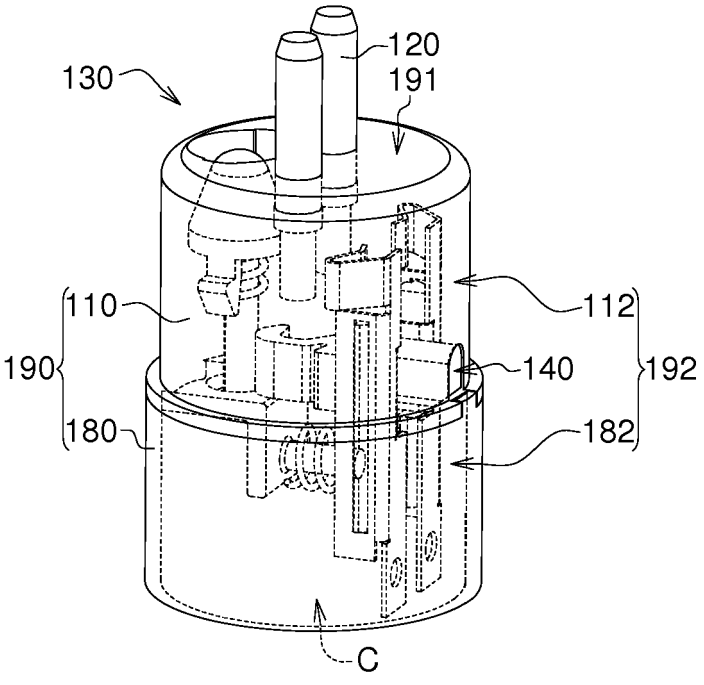

101
120
130
191
110
112
190
140
192
180
182
C

FIG. 6A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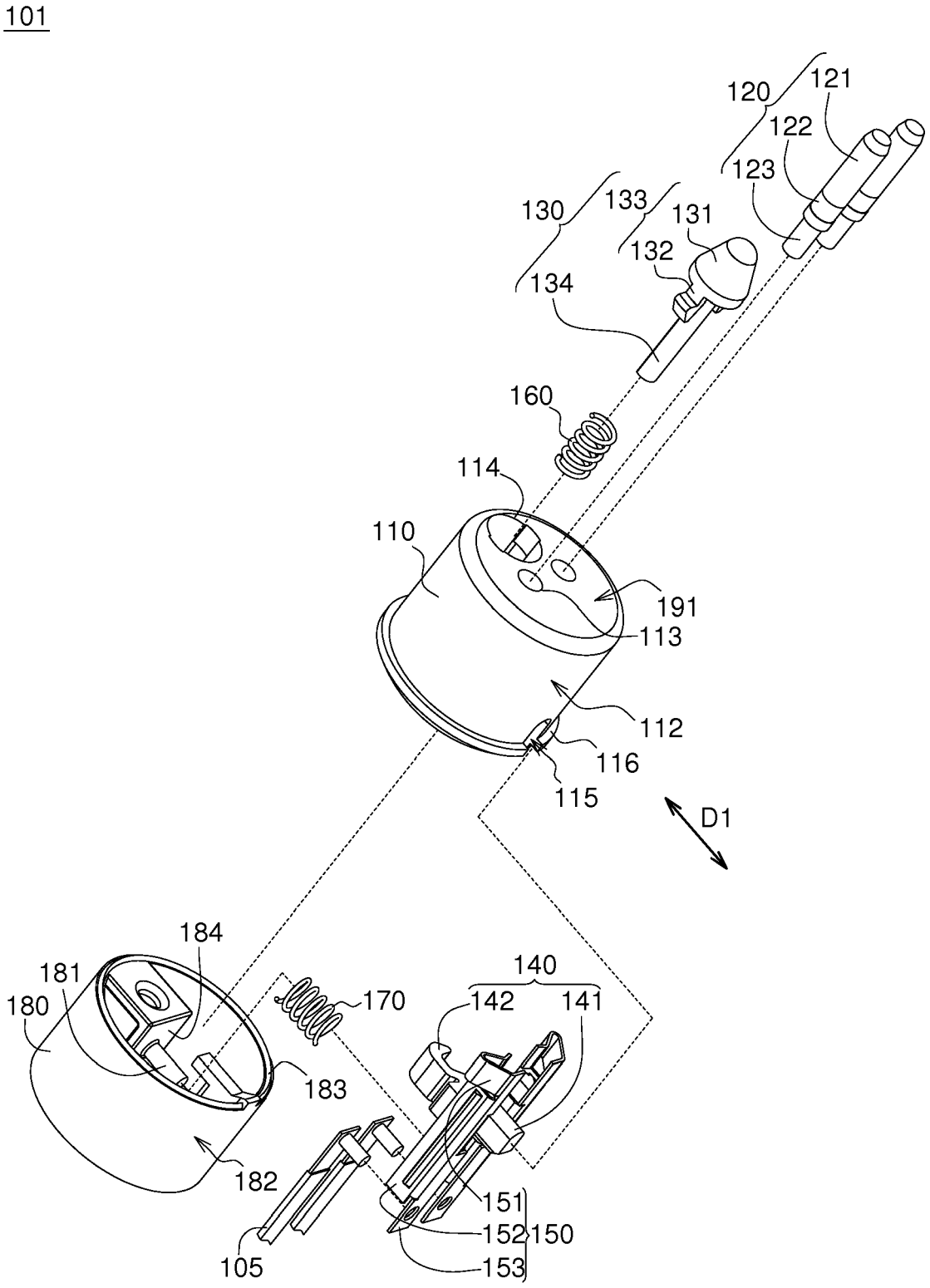
C

FIG. 6B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D1
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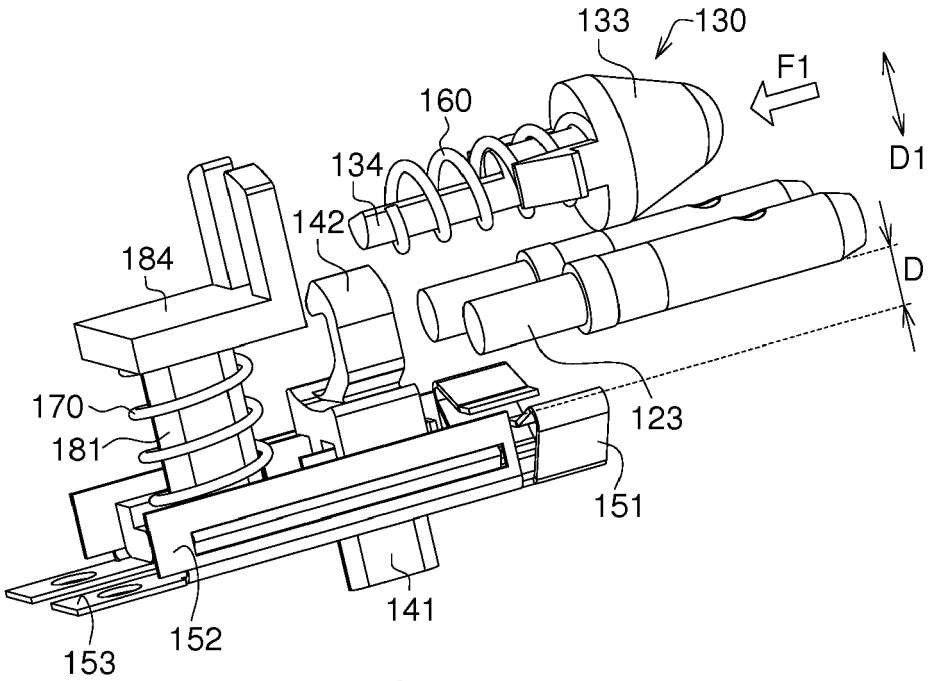
183
182
151
152
150
153
105

FIG. 7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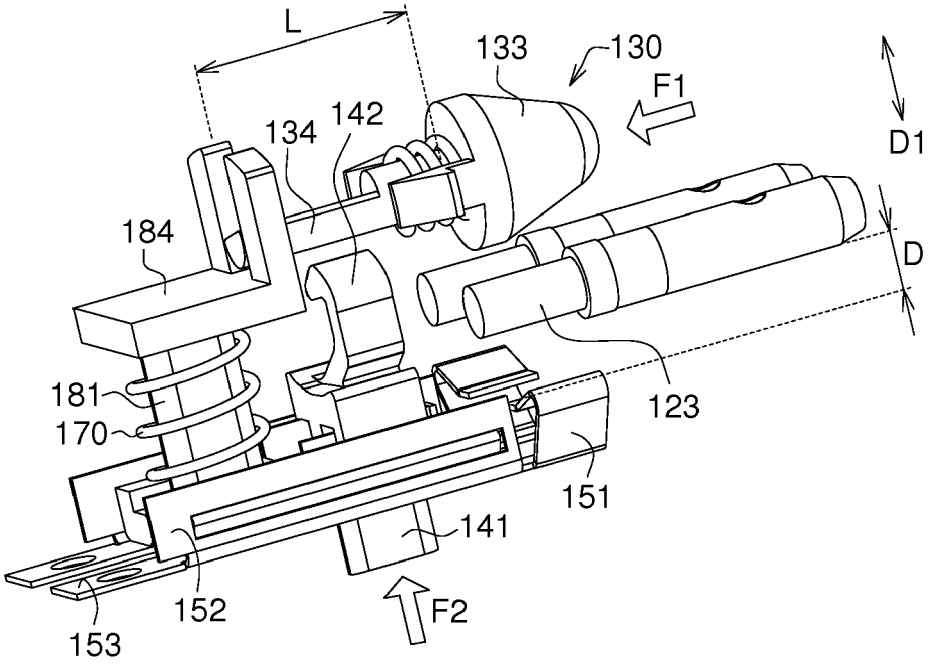
130
F1
160
D1
134
142
184
D
170
181
123
151
141
152
153

FIG. 8A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F2
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FIG. 8B

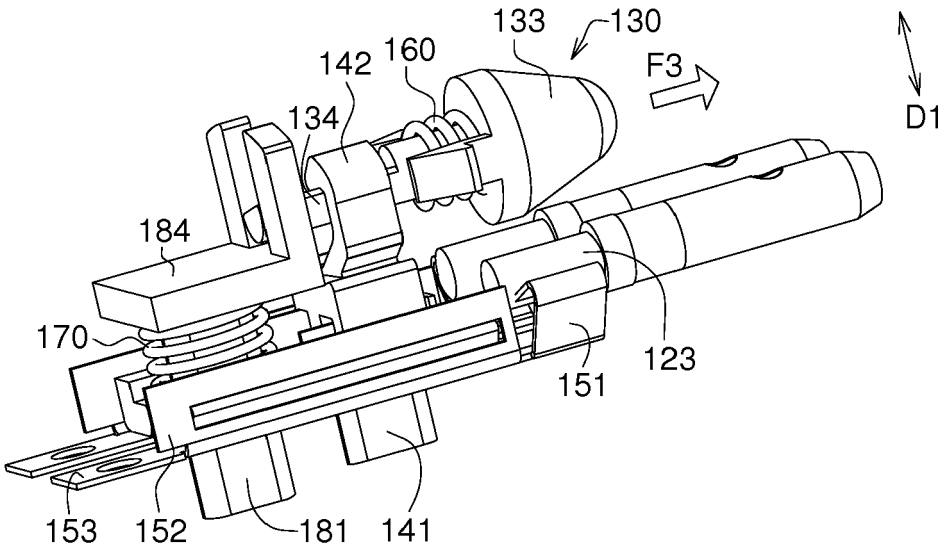
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FIG. 8C

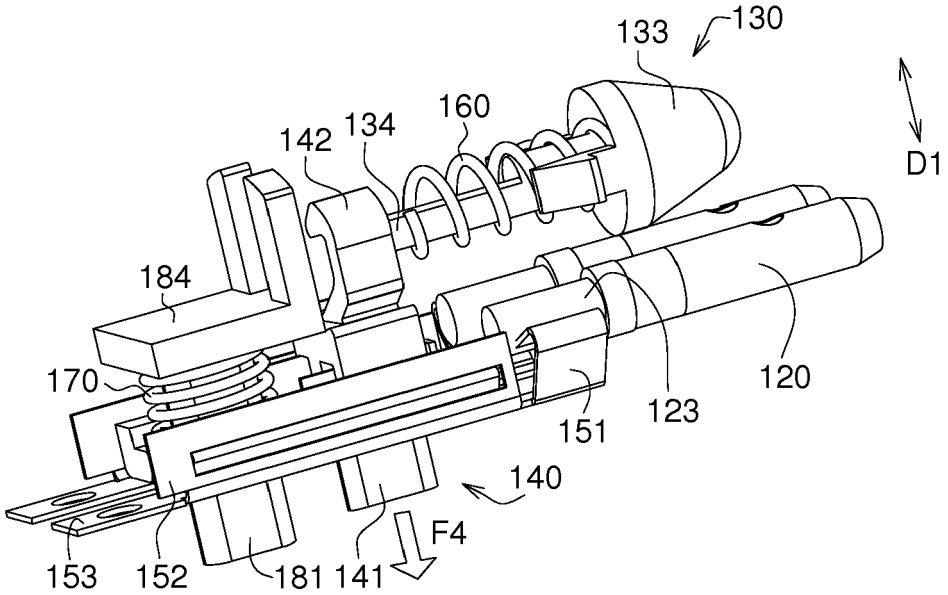
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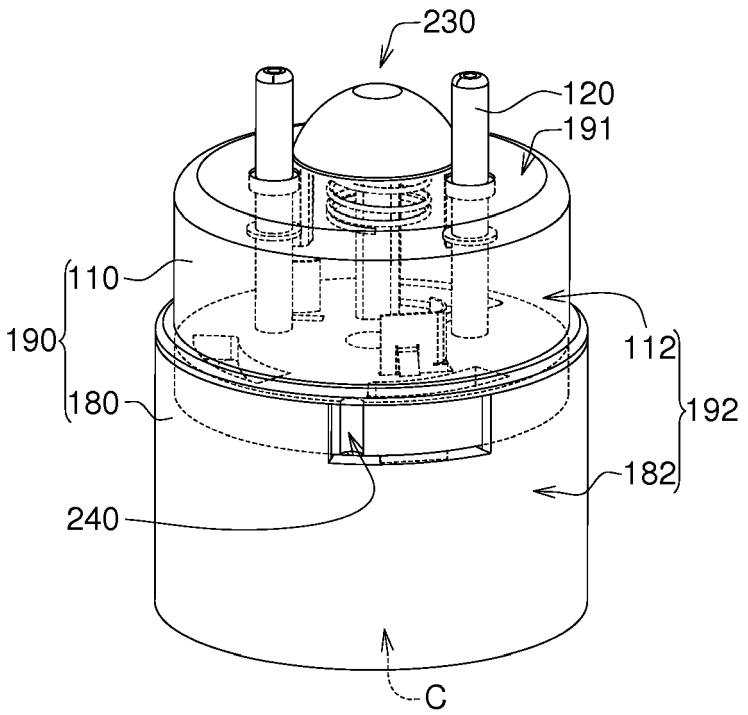
FIG. 8D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182
240
C

FIG. 9A

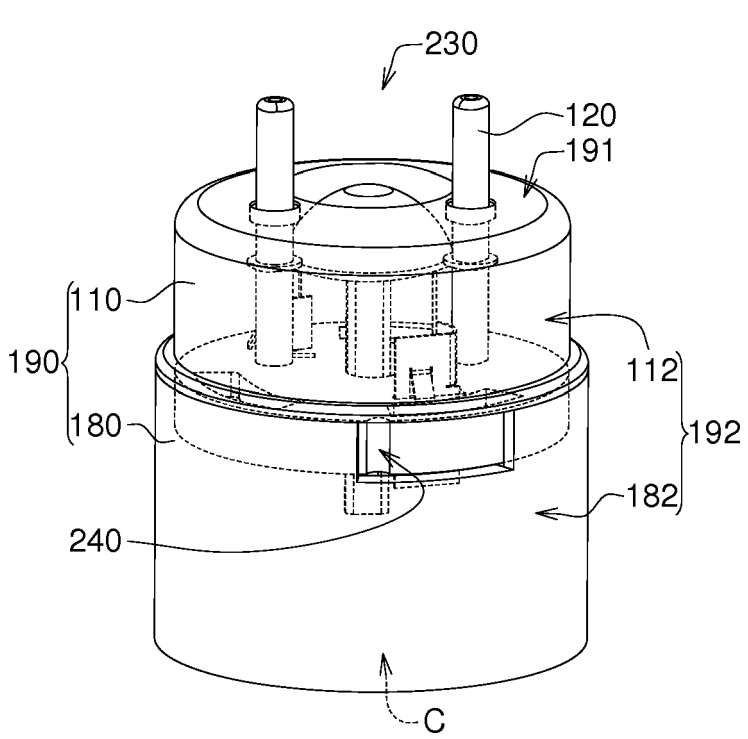
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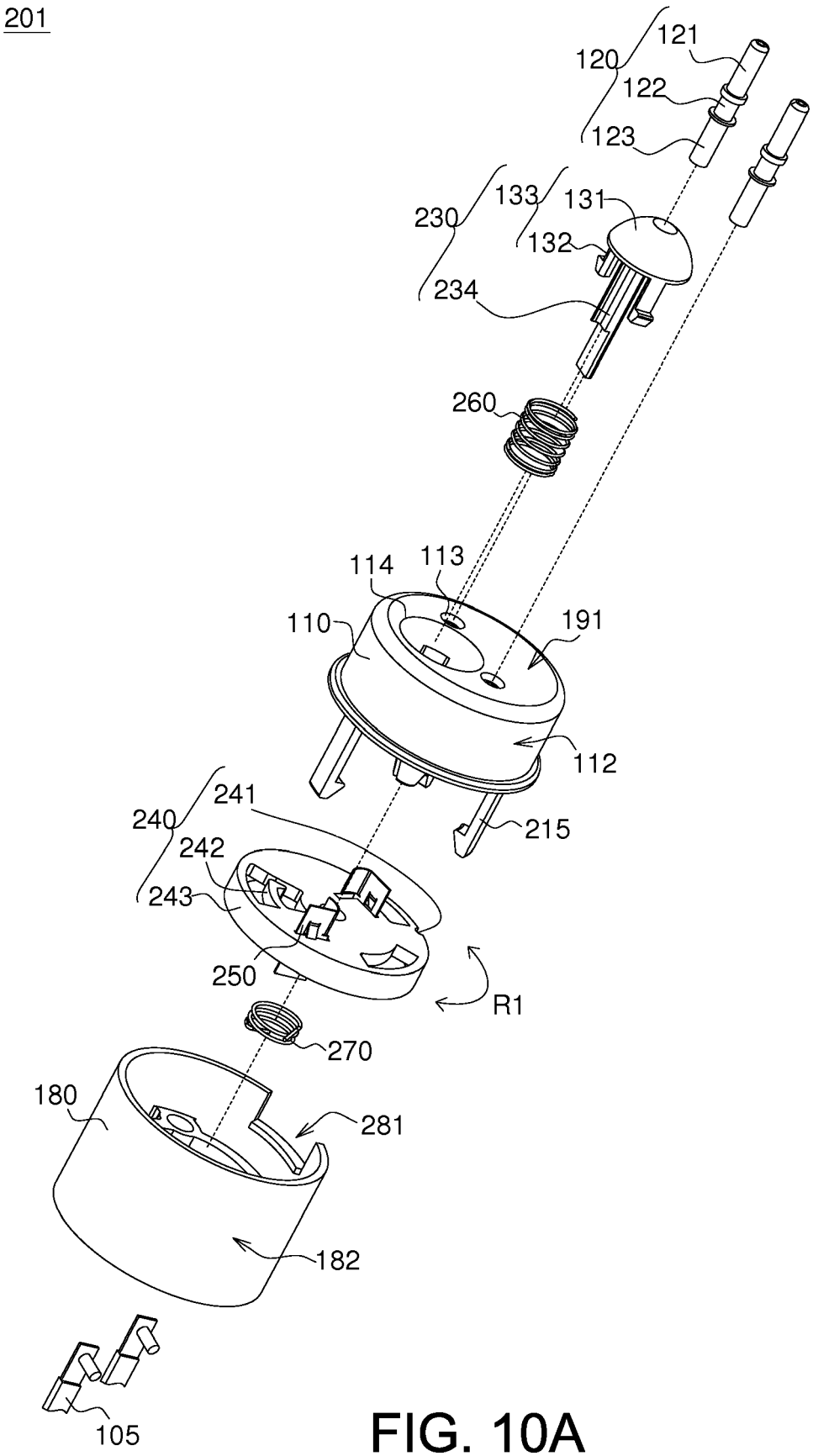
FIG. 9B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R1
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182
105

FIG. 10A

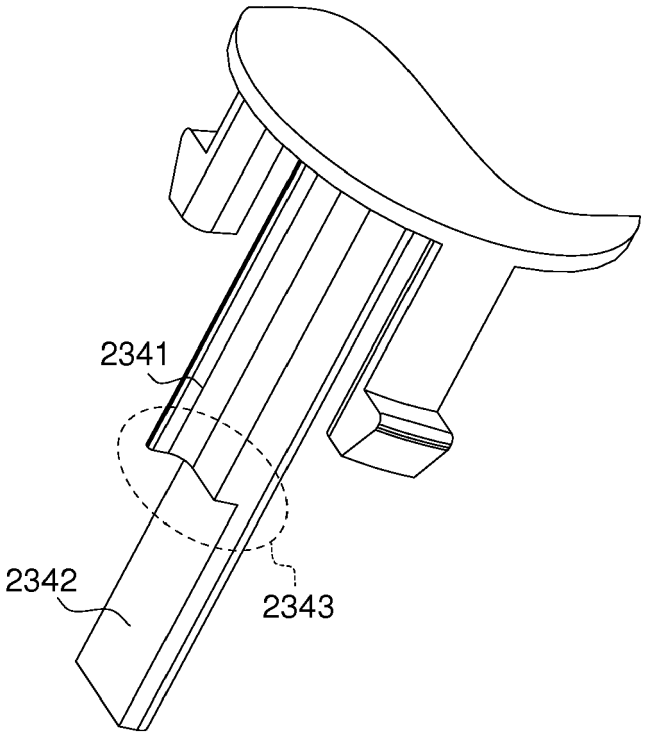

FIG. 10B

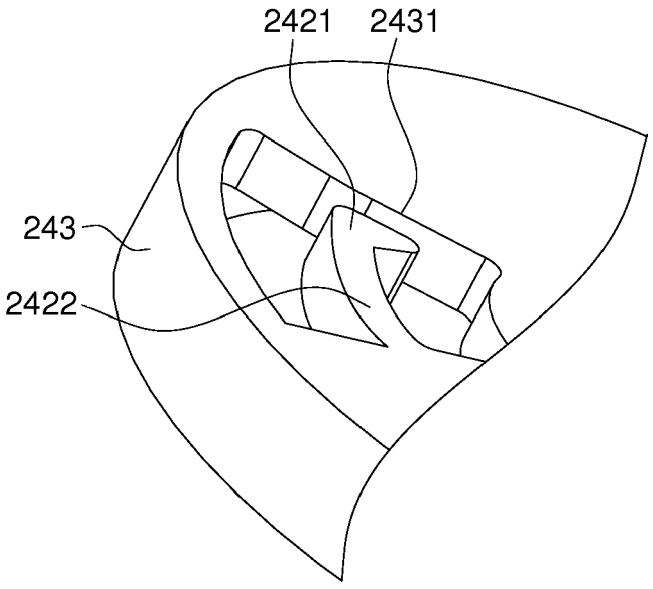

FIG. 10C

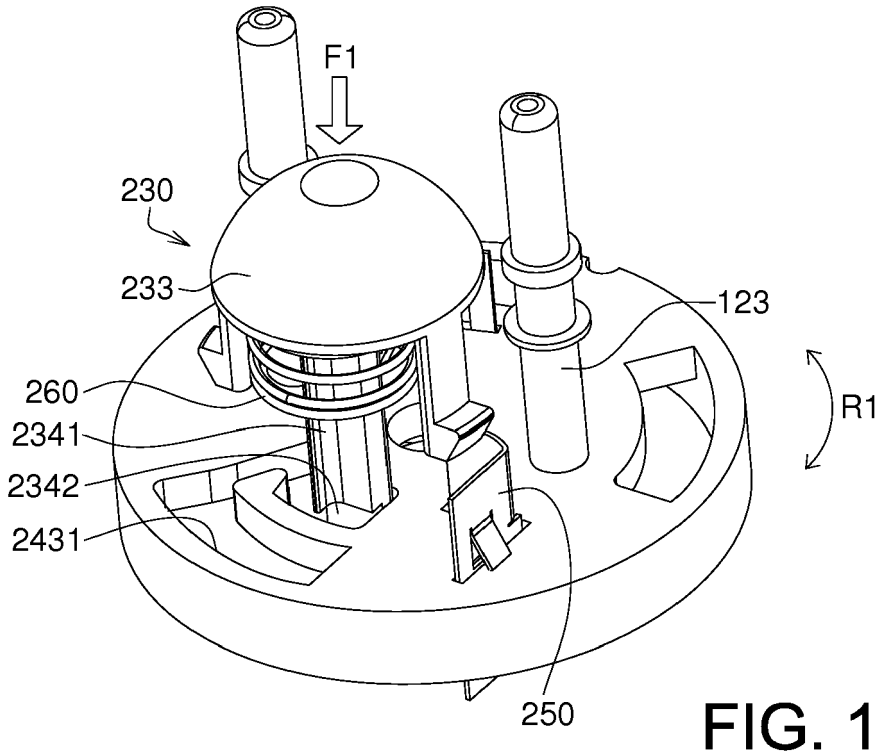

FIG. 11A

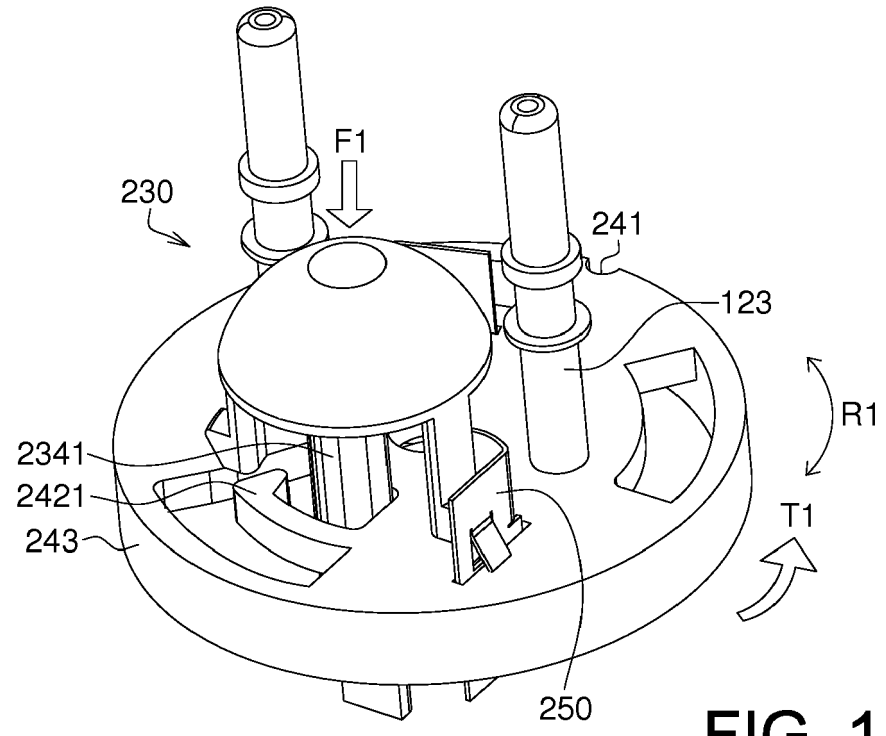

FIG. 11B

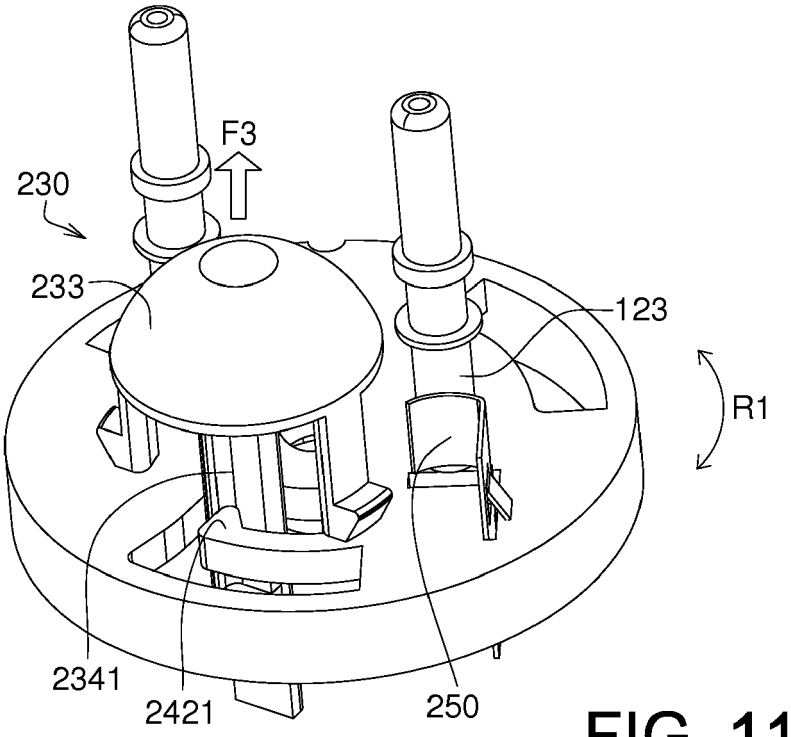

FIG. 11C

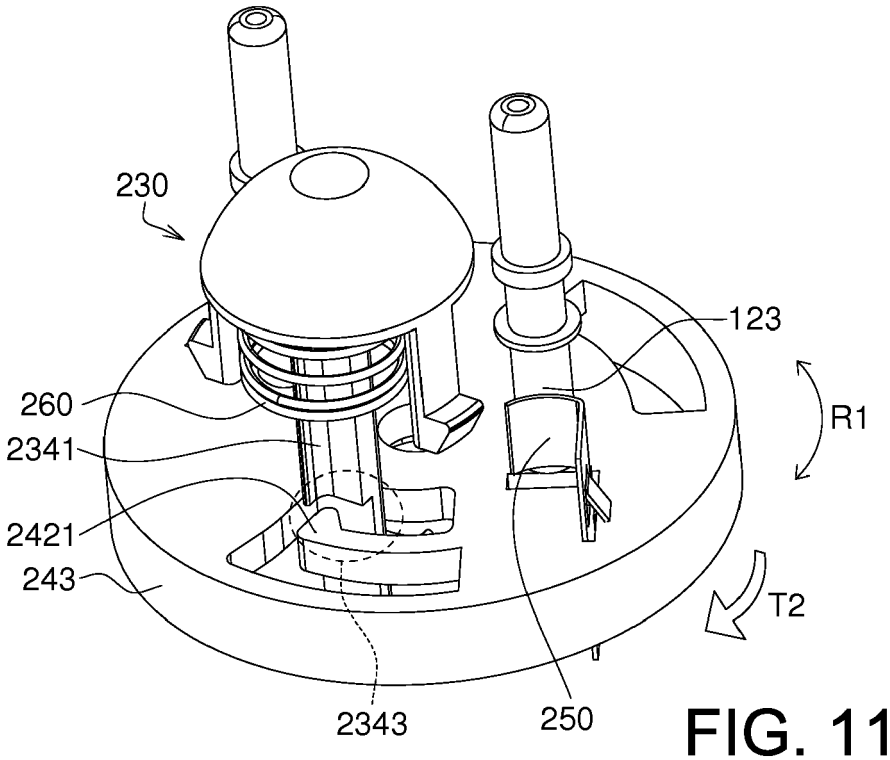

FIG. 11D

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EUROPEAN SEARCH REPORT

Application Number
EP 17 15 1797

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2014/003054 A1 (SIMON DAVID [US] ET AL) 2 January 2014 (2014-01-02) * paragraph [0072] - paragraph [0080]; figures 11A-13 *	1-4, 10-14	INV. F21V25/04 F21K9/272 F21V23/04 F21V23/06 F21V25/00 H01R13/70 H01R33/96 ADD. F21Y115/10 F21Y103/10
X	WO 2015/069101 A1 (SILICON HILL B V [NL]) 14 May 2015 (2015-05-14) * page 19, line 25 - page 30, line 28; figures 12-26 *	1-4, 10-14	
X	WO 2012/131522 A1 (KONINKL PHILIPS ELECTRONICS NV [NL]; VERHOEVEN MARK [NL]; GIELEN VINCE) 4 October 2012 (2012-10-04) * the whole document *	1-4, 10-14	
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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	20 February 2017	Thibaut, Arthur

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