(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 226 360 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
**30.01.2019 Bulletin 2019/05**

(51) Int Cl.:
***H01R 13/629*** *(2006.01)*

(21) Application number: **17156870.2**

(22) Date of filing: **20.02.2017**

(54) **ELECTRICAL CONNECTOR**

ELEKTRISCHER VERBINDER

CONNECTEUR ÉLECTRIQUE

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

(30) Priority: **29.03.2016 JP 2016066268**

(43) Date of publication of application:
**04.10.2017 Bulletin 2017/40**

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## Description

BACKGROUND OF THE INVENTION:

**[0001]** This invention relates to a connector, in particular, to a connector which is changeable, by turning a lever, between a mated state that the connector is mated with a mating connector and a removable state that the connector is removable from the mating connector.

**[0002]** JP 2006-331991 A and EP 0 665 799 A1 disclose a connector according to the preamble of claim 1.

**[0003]** US 2003/017026 A1 discloses a connector having a connector housing with supporting walls and support shafts projecting in from the inner side surfaces of supporting walls. The connector further comprises a lever having arms disposed inwardly of the supporting walls. Bearing holes formed in the arms are mounted rotatably on the support shafts. The arms try to move wider apart upon the engagement of cam grooves on the arms with cam pins on a mating connector. However, the arms are displaced in directions to move the bearing holes from the projecting ends toward the base ends of the support shafts.

**[0004]** GB 2 318 925 A discloses a lever-type connector including a lever and slides which are attached to a cap housing. The lever has gears, and the slides have racks and cam grooves through that engage with cam followers of the mating connectors. The racks are driven by the gears of the lever. These racks and the cam grooves are respectively formed on opposite sides of the slides.

**[0005]** Referring to Figs. 16 and 17, a connector 900 disclosed in JPA2015-122182 (Patent Literature 1) has a housing 910, a cover 920, a lever 930 and sliders 940. The cover 920 is attached to the housing 910. The lever 930 is attached to the cover 920 to be rotatable within a predetermined range. The sliders 940 are accommodated in the housing 910 at least in part to be movable in a front-rear direction. The lever 930 and the sliders 940 are combined with each other to be interlocked with each other. In detail, the lever 930 and the sliders 940 are combined so that turning the lever 930 in a rotational direction moves the sliders 940 in the front-rear direction.

**[0006]** As understood from Fig. 17, the sliders 940 are formed with a plurality of cam grooves 942 (one of them is shown in Fig. 17). On the other hand, a mating connector 950 is formed with a plurality of bosses 952. The cam grooves 942 correspond to the bosses 952, respectively. When the connector 900 is mated with the mating connector 950, the bosses 952 of the mating connector 950 are inserted into the cam grooves 942 of the sliders 940. In this state, turning the lever 930 in a predetermined direction along the rotational direction moves the sliders 940 in one direction of the front-rear direction and makes the cam grooves 942 move the bosses 952 upward. Thus, the mating connector 950 is drawn toward the connector 900 and mated with the connector 900. Furthermore, turning the lever 930 in an opposite direction opposite to the predetermined direction along the rotational direction moves the sliders 940 in the other direction of the front-rear direction and moves the bosses 952 downward. Thus, the mating connector 950 is pushed in a direction away from the connector 900 and becomes removable from the connector 900.

SUMMARY OF THE INVENTION:

**[0007]** In the connector 900 disclosed in Patent Literature 1, the lever 930 is attached to the cover 920 while the sliders 940 are accommodated in the housing 910. Accordingly, attaching the cover 920 to the housing 910 must be executed so that the lever 930 and the sliders 940 are correctly interlocked with each other. Therefore, the connector 900 described in Patent Literature 1 requires that the cover 920 has a structure to maintain the lever 930 in a predetermined lever position and that the housing 910 has a structure to accommodate the sliders 940 in predetermined slider positions. However, in a case where those structures do not correspond to each other with high accuracy, the lever 930 and the sliders 940 cannot be interlocked with each other when the cover 920 is attached to the housing 910. Accordingly, the connector 900 has a possibility that the lever 930 cannot be turned.

**[0008]** Therefore, it is an object of the present invention to provide a connector having a structure that allows the lever and the slider to be interlocked with each other easily and certainly.

**[0009]** This object of the present invention is achieved by the connector according to claim 1. Further developments of the present invention are given in the dependent claims.

**[0010]** When the lever is positioned in the first position, moving the slider forward in the front-rear direction makes the press portion of the slider press the pressed portion to turn the lever toward the second position. As a result of this, a relative position between the lever and the slider is decided to be able to engage easily and appropriately the pinion portion of the lever and the rack portion of the slider with each other. Thus, the relationship that the lever and the slider are interlocked with each other is easily and certainly achieved.

**[0011]** An appreciation of the objectives of the present invention and a more complete understanding of its structure may be had by studying the following description of the preferred embodiment and by referring to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS:

**[0012]**

Fig. 1 is an exploded perspective view showing a connector according a first embodiment of the present invention. A cover is not shown in the figure.
Fig. 2 is an exploded bottom plan view showing the

connector of Fig. 1.
Fig. 3 is an exploded cross-sectional view showing the connector of Fig. 2, taken along A-A line.
Fig. 4 is an exploded cross-sectional view showing the connector of Fig. 2, taken along B-B line.
Fig. 5 is another exploded perspective view showing the connector of Fig. 1. A lever is attached to a housing and positioned in a first position. The cover is not shown in the figure.
Fig. 6 is a perspective view showing the connector of Fig. 1. The lever is attached to the housing and positioned in the first position. A slider is inserted in the housing in part and positioned in a pressing start position. The cover is not shown in the figure.
Fig. 7 is a bottom plan view showing the connector of Fig. 6.
Fig. 8 is a cross-sectional view showing the connector of Fig. 7, taken along C-C line.
Fig. 9 is another perspective view showing the connector of Fig. 6. The lever is positioned in a second position. The slider is positioned in a mated position. The cover is not shown in the figure.
Fig. 10 is a bottom plan view showing the connector of Fig. 9.
Fig. 11 is a cross-sectional view showing the connector of Fig. 10, taken along D-D line.
Fig. 12 is another perspective view showing the connector of Fig. 9. The housing is attached with the cover.
Fig. 13 is another perspective view showing the connector of Fig. 12. The lever is positioned in a third position. The slider is positioned in a removable position.
Fig. 14 is a bottom plan view showing the connector of Fig. 13.
Fig. 15 is a cross-sectional view showing the connector of Fig. 14, taken along E-E line.
Fig. 16 is an exploded perspective view showing a connector disclosed in Patent Literature 1.
Fig. 17 is a perspective view showing the connector and a mating connector which are disclosed in Patent Literature 1.

**[0013]** While the invention is susceptible to various modifications and alternative forms, specific embodiments thereof are shown by way of example in the drawings and will herein be described in detail. It should be understood, however, that the drawings and detailed description thereto are not intended to limit the invention to the particular form disclosed, but on the contrary, the intention is to cover all modifications, equivalents and alternatives falling within the spirit and scope of the present invention as defined by the appended claims.

DESCRIPTION OF PREFERRED EMBODIMENTS:

[First Embodiment]

**[0014]** Referring to Figs. 1 to 3, a connector 10 according to a first embodiment of the present invention is provided with a housing 100, a lever 200 and a slider 300. The connector 10 further has a plurality of contacts not shown. The connector 10 is a connector that is mateable with and removable from a mating connector, which is not shown, along an up-down direction. As shown in Figs. 12 to 15, the connector 10 is attached with a cover 400 when used. In the present embodiment, the up-down direction is a Z-direction. A positive Z-direction is upward while a negative Z-direction is downward.

**[0015]** As understood from Figs 1 and 2, the housing 100 has a contact holding portion 110 and a wall portion 120 surrounding a periphery of the contact holding portion 110. As understood from Figs. 1 to 4, the contact holding portion 110 has an approximately rectangular parallelepiped shape which is long in a front-rear direction orthogonal to the up-down direction. In the present embodiment, the front-rear direction is an X-direction. A positive X-direction is forward while a negative X-direction is rearward. As shown in Figs. 1, 2 and 4, the contact holding portion 110 is further provided with a plurality of holding holes 112. As shown in Fig. 4, the holding holes 112 pierce the contact holding portion 110 and open in both of an upper surface 116 and a lower surface 118 of the contact holding portion 110. The holding holes 112 are used for holding the contacts not shown. In detail, the contacts are held in the holding holes 112 of the contact holding portion 110, respectively. The contacts are connected with wirings not shown, respectively. The wirings are routed upward from above the upper surface 116 of the contact holding portion 110. The contacts are visible from under the lower surface 118 of the contact holding portion 110. In the present embodiment, the connector 10 is a socket connector.

**[0016]** As understood from Figs. 1 to 4, the wall portion 120 has a front wall 130, a rear wall 140, a pair of inner sidewalls 150 and a pair of outer sidewalls 160. The wall portion 120 further has a plurality of bottom plates 170 and a plurality of connection portions 180. The front wall 130 covers a front surface 113 of the contact holding portion 110 and connects front ends of the inner sidewalls 150 and front ends of the outer sidewalls 160 with one another. The rear wall 140 covers a back surface 115 of the contact holding portion 110 and connects rear ends of the inner sidewalls 150 with each other. The inner sidewalls 150 cover side surfaces 114 of the contact holding portion 110 at least in part. As shown in Figs. 2 to 4, each of the inner sidewalls 150 is provided with a rotational shaft 152 protruding outward in a right-left direction orthogonal to both of the front-rear direction and the up-down direction. In the present embodiment, the right-left direction is a Y-direction. As shown in Fig. 4, the outer sidewalls 160 are located apart from and outward of the

inner sidewalls 150 in the right-left direction. The outer sidewalls 160 cover not only the inner sidewalls 150 but also the side surfaces 114 of the contact holding portion 110 in part.

**[0017]** As understood from Fig. 4, the pair of the inner sidewalls 150 is connected to the contact holding portion 110 at an upper side than a middle of the contact holding portion 110 in the up-down direction. Similarly, the front wall 130 and the rear wall 140 are connected to the contact holding portion 110. As understood from Figs 1, 2 and 4, a receiving portion 122 is formed between the contact holding portion 110 and the surrounding walls, i. e. the front wall 130, the rear wall 140 and the pair of the inner sidewalls 150, and is positioned below connecting parts between the contact holding portion 110 and surrounding walls. The receiving portion 122 receives a mating housing (not shown) of the mating connector in part when the connector is mated with the mating connector. As understood from Figs. 1 to 4, between the inner sidewalls 150 and the outer sidewalls 160, lever accommodation portions 124 and slider accommodation portions 126 are formed. Each of the lever accommodation portions 124 accommodates the lever 200 in part so that the lever 200 is rotatable. Each of the slider accommodation portions 126 accommodates the slider 300 in part so that the slider 300 is movable in the front-rear direction. The lever accommodation portions 124 and the slider accommodation portions 126 communicate with each other in the up-down direction except for some parts.

**[0018]** As understood from Figs. 1, 2 and 4, each of the bottom plates 170 connects a lower end of the inner sidewall 150 to a lower end of the outer sidewall 160 adjacent thereto. As understood from Figs. 1 to 4, the bottom plates 170 function as guides when the slider 300 accommodated in the slider accommodation portions 126 in part is moved in the front-rear direction. As understood from Figs. 1, 3 and 4, each of the connection portions 180 is located on a boundary between the lever accommodation portion 124 and the slider accommodation portion 126 and connects between the inner sidewall 150 and the outer sidewall 160 which are adjacent to each other. The connection portions 180 function as guides together with the bottom plates 170 when the slider 300 accommodated in the slider accommodation portions 126 in part is moved in the front-rear direction.

**[0019]** The front wall 130, the rear wall 140, the inner sidewalls 150, the outer sidewalls 160, the bottom plates 170 and the connection portions 180 are integrally molded using a resin (a third resin). This is for reducing the number of parts, simplifying the manufacturing process and reducing a manufacturing cost. The wall portion 120 may be molded integrally with at least a part of the contact holding portion 110 using a common material. As shown in Fig. 4, the wall portion 120 is molded integrally with a part of the contact holding portion 110 using a common material in the present embodiment. It should be noted that the contact holding portion 110 consists of three parts made of three different materials, respectively. The three parts forming the contact holding portion 110 are stacked on one another in the up-down direction and integrated.

**[0020]** As shown in Figs. 1 to 4, the lever 200 has an operation portion 210 and a pair of arm portions 220. The operation portion 210 extends in the right-left direction. The arm portions 220 extend from both ends of the operation portion 210 in a direction orthogonal to the right-left direction. As understood from Figs. 1 and 3, the lever 200 is partly reduced in thickness to reduce weight thereof in the present embodiment. Accordingly, the lever 200 has a lattice pattern on a surface thereof.

**[0021]** As shown in Figs. 1, 3 and 4, each of the arm portions 220 is formed with a shaft hole 222 piercing the arm portion 220 in the right-left direction at a vicinity of an end of the arm portion 220. Furthermore, each of the arm portions 220 is formed with a guide groove 224 extending from an edge of the arm portion 220 to the shaft hole 222 in an inner surface thereof in the right-left direction. The guide grooves 224 extend in a direction orthogonal to the extending direction of the arm portions 220. In other words, the guide grooves 224 extend in the up-down direction when the arm portions 220 extend in the front-rear direction. The guide grooves 224 guide the rotational shafts 152 provided to the housing 100 to the shaft holes 222 upon attaching of the lever 200 to the housing 100.

**[0022]** As understood from Figs. 1, 2 and 4, each of the arm portions 220 further has a pinion portion 230 having a plurality of teeth 232. The teeth 232 are arranged to surround partly a periphery of the shaft hole 222 when seen along the right-left direction. As mentioned later, one of the teeth 232 functions as a pressed portion 233. As shown in Figs. 1 and 3, each of the arm portions 220 further has a plate-like member 234 connecting the teeth 232 of the pinion portion 230 to one another to reinforce the teeth 232. The plate-like member 234 is provided on one of side surfaces of the pinion portion 230. In other words, the plate-like members 234 are located inward of two sets of the teeth 232 in the right-left direction. The operation portion 210, the arm portions 220, the pinion portions 230 and the plate-like members 234 are integrally molded using a resin (a first resin). This is for reducing the number of parts, simplifying the manufacturing process and reducing a manufacturing cost. The first resin may be same as or different from the third resin.

**[0023]** As shown in Figs. 1 to 4, the slider 300 has a pair of side plate portions 310 and a connection plate portion 320. The side plate portions 310 extend in the front-rear direction. The connection plate portion 320 connects rear ends of the side plate portions 310 to each other. As shown in Fig. 1, the slider 300 is partly reduced in thickness to reduce weight thereof in the present embodiment. Accordingly, the slider 300 has a lattice pattern on a surface thereof.

**[0024]** As shown in Figs. 1 to 3, the slider 300 is provided with two pairs of cam grooves (force transmission portions) 312 in the side plate portions 310 thereof. One of the pairs of the cam grooves 312 and the other pair of

the cam grooves 312 are located apart from each other in the front-rear direction. In other words, each of the side plate portions 310 is formed with two of the cam grooves 312 which belong to different pairs and are apart from each other in the front-rear direction. Each of the cam grooves 312 opens downward at one end (a lower end) thereof. The cam groove 312 extends upward from the one end, then diagonally extends rearward and upward and further extends rearward. In the present embodiment, the cam groove 312 pierces the side plate portion 310 in the right-left direction except for a part (a lower end portion) of the side plate portion 310. However, the cam groove 312 may be closed at a side located outside of the slider 300 in the right-left direction. In other words, the cam groove 312 may be a groove having a bottom.

**[0025]** As shown in Figs. 1 and 3, each of the side plate portions 310 further has a rack portion 314 having a plurality of teeth 316 arranged along the front-rear direction. The side plate portion 310 further has a plate-like member 318 connecting the teeth 316 of the rack portion 314 to one another to reinforce the teeth 316. The plate-like members 318 are provided on outside surfaces of two sets of the teeth 316 in the right-left direction. The rack portion 314 is formed in a vicinity of an upper front end of the side plate portion 310. When the slider 300 as a single body is seen from the front thereof, the tooth 316 positioned in the most forward position is visible. As mentioned later, the tooth 316 positioned in the most forward position functions as a press portion 317. The side plate portions 310, the connection plate portion 320, the rack portions 314 and the plate-like members 318 are integrally molded using a resin (a second resin). This is for reducing the number of parts, simplifying the manufacturing process and reducing a manufacturing cost. The second resin may be same as at least one of the first resin and the third resin or may be different from both of the first resin and the third resin.

**[0026]** Next, the description will be made for assembling the connector 10. At first, the lever 200 is attached to the housing 100 as shown in Fig. 5. In detail, the rotational shafts 152 of the housing 100 are inserted into the guide grooves 224 of the lever 200 from one end of the guide grooves 224, and the lever 200 is pressed toward the housing 100. At this time, it is desirable that the lever 200 takes a position so that the arm portions 220 extend in the front-rear direction. This is because it becomes easy to attach the lever 200 to the housing 100 since the guide grooves 224 extend in the up-down direction. When the lever 200 is pressed toward housing 100, the rotational shafts 152 are guided by the guide grooves 224 and inserted into the shaft holes 222. With reference to Fig. 4, each of the guide grooves 224 is provided with a slope portion 226. The slope portion 226 is formed so that the guide groove 224 becomes shallower towards the shaft hole 222. Consequently, upon attaching the lever 200 to the housing 100, the rotational shafts 152 enlarge gradually the arm portions 220 of the lever 200 in the right-left direction and thereby deforming elastically the lever 200 and the housing 100. As a result, the rotational shafts 152 are inserted in the shaft holes 222. Once the rotational shafts 152 are inserted into the shaft holes 222, the lever 200 and the housing 100 return to original shapes. Accordingly, the rotational shafts 152 cannot come out from the shaft holes 222 easily.

**[0027]** As understood from Figs. 8 and 11, in a state that the lever 200 is attached to the housing 100, the lever 200 is rotatable about the rotational shafts 152 between a first position and a second position. As shown in Fig. 8, the first position is a position where the arm portions 220 extends along the front-rear direction approximately and the operation portion 210 is positioned forward. As shown in Fig. 11, the second position is a position where the arm portions 220 extend along the front-rear direction approximately and the operation portion 210 is positioned rearward. When the lever 200 is positioned in the first position, the arm portion 220 is supported by the front wall 130. In other words, the front wall 130 of the housing 100 is formed with a stopper 132 to stop the lever 200 in the first position. The stopper 132 is molded integrally with at least a part of the housing 100 (the wall portion 120). This is for reducing the number of parts. On the other hand, when the lever 200 is positioned in the second position, front edges of the side plate portions 310 of the slider 300 are brought into abutment with the front wall 130. Thus, in a state that the cover 400 is not attached to the housing 100 yet, the lever 200 is attached to the housing 100 to be rotatable between the first position and the second position. When the lever 200 is positioned in the second position, the guide grooves 224 extend in the up-down direction and open upward. Accordingly, in this state, the lever 200 cannot be detached from the housing 100. Moreover, the operation portion 210 is formed with a hook 212 to maintain the lever 200 in the second position. On the other hand, the housing 100 is formed with a stop portion 142 corresponding to the hook 212. When the lever 200 is positioned in the second position, the hook 212 is caught in the stop portion 142. Unless the hook 212 is operated, the lever 200 cannot turn toward the first position from the second position.

**[0028]** Next, as shown in Figs. 6 to 8, the side plate portions 310 of the slider 300 are inserted into the slider accommodation portions 126 of the housing 100 in a state that the lever 200 is positioned in the first position. The side plate portions 310 of the slider 300 are inserted forward from behind the housing 100. At this time, the bottom plates 170 and the connection portions 180 serves as guides to guide the side plate portions 310. In a state that the side plate portions 310 are partly accommodated in the slider accommodation portions 126, when the slider 300 is moved forward in the front-rear direction, the tooth 316 positioned in the most forward position among the teeth 316 (the press portion 317) of each of the rack portions 314 is brought into abutment with the tooth 232 nearest to the guide groove 224 among the teeth 232 (the pressed portion 233) of each of the pinion portions

230 as shown in Fig. 8. At this time, the slider 300 is in a pressing start position. In other words, the tooth 316 positioned in the most forward position among the teeth 316 of each of the rack portions 314 functions as the press portion 317, and the tooth 232 nearest to the guide groove 224 among the teeth 232 of each of the pinion portions 230 functions as the pressed portion 233. Thus, the slider 300 has the press portions 317 while the lever 200 has the pressed portions 233 in the present embodiment.

**[0029]** As understood from Fig. 8, when the slider 300 positioned in the pressing start position is further moved forward, the press portions 317 press the pressed portion 233 to turn the lever 200 toward the second position. Consequently, the rack portions 314 and the pinion portions 230 are engaged with each other to bring a state that the lever 200 and the slider 300 can be interlocked with each other. In that state, turning the lever 200 moves the slider 300 in the front-rear direction and, on the other hand, moving the slider 300 in the front-rear direction turns the lever 200. Thus, in the present embodiment, by merely inserting the slider 300 into the slider accommodation portions 126 of the housing 100 when the lever 200 is positioned in the first position, relative positions of the lever 200 and the slider 300 are defined so that the rack portions 314 and the pinion portions 230 can be appropriately engaged with each other. In other words, the pinion portions 230 of the lever 200 and the rack portions 314 of the slider 300 are engaged with each other and thereby forming a relation that turn of the lever 200 and front-rear direction movement of the slider 300 are exchanged with each other. In this manner, the slider 300 is attached to the housing 100 to be movable in the front-rear direction.

**[0030]** In the present embodiment, one of the teeth 316 forming the rack portion 314 is used as the press portion 317 while one of the teeth 232 forming the pinion portion 230 is used as the pressed portion 233. This is because shapes of the lever 200 and the slider 300 are simplified and their design and manufacturing are facilitated. The present invention, however, is not limited thereto. The press portion 317 may be provided separately from the teeth 316 of the rack portion 314. Similarly, the pressed portion 233 may be provided separately from the teeth 232 of the pinion portion 230. In such a case, the shapes of the press portion 317 and the pressed portion 233 may be freely decided. For example, each of the press portion 317 and the pressed portion 233 may be rectangular in shape when seen along the light-left direction. Furthermore, an interval between the press portion 317 and the tooth 316 of the rack portion 314 adjacent to the press portion 317 may be different from an interval between the teeth 316 of the rack portion 314 adjacent to each other. Similarly, an interval between the pressed portion 233 and the tooth 232 of the pinion portion 230 adjacent to the pressed portion 233 may be different from an interval between the teeth 232 of the pinion portion 230 adjacent to each other. At any rate, the press portion 317 and the pressed portion 233 may be any portions provided that when the lever 200 is in the first position, moving the slider 300 forward makes the press portion 317 press the pressed portion 233 to turn the lever 200 toward the second position and to define the relative positions of the lever 200 and the slider 300. For that purpose, the press portion 317 is provided in the slider 300 to be visible when the slider 300 as a single body is seen from forward along the front-rear direction. It should be noted that the defined relative positions are necessary to allow the rack portion 314 and the pinion portion 230 to be appropriately engaged with each other.

**[0031]** Next, the lever 200 is put in the second position as shown in Figs. 9 and 11. This situation can be achieved by either moving the slider 300 more forward or turning the lever 200 to the second position after the lever 200 and the slider 300 are changed into the state that they are interlocked with each other. Since the side plate portion 310 of the slider 300 is brought into abutment with the front wall 130 of the housing 100, the lever 200 is stopped in the second position. At this time, the slider 300 is positioned in a mated position.

**[0032]** Subsequently, as shown in Fig. 12, the cover 400 is attached to the housing 100. The cover 400 is attached to an upper part of the housing 100 to lead wires (not shown) forward. The cover 400 is attached to the housing 100 by moving the cover 400 forward from behind the housing 100. The cover 400 protrudes forward of the housing 100 in part in the state that the cover 400 is attached to the housing 100. As understood from Fig. 13, a rotatable range of the lever 200 is limited by the cover 400 attached to the housing 100. In detail, in a state that the cover 400 is attached to the housing 100, the turn of the lever 200 toward the first position is limited to a position (a third position) where the arm portions 220 are brought into abutment with the regulation portions 402. In other words, in the state that the cover 400 is attached, the lever 200 is regulated so as not to be rotatable toward the first position from the third position positioned between the first position and the second position. This is because the arm portions 220 are brought into abutment with the regulation portions 402 and the lever 200 cannot be turned even if it is intended to be turned toward the first position. In this state, the lever 200 is rotatable between the third position and the second position. The cover 400 (or the regulation portions 402) regulates the turn of the lever 200 from the third position to the first position, and thereby the lever 200 is prevented from coming into contact with the wires connected to the connector 10. In the present embodiment, "the third position" represents not a specified point but a predetermined range. That is, "the third position" includes a range from a position, where the arm portions 220 are brought into abutment with the regulation portions 402, to a position where the arm portions 220 are slightly apart from the regulation portions 402 as shown in Fig. 15. In detail, "the third position" represents a rotatable range of the lever 200 that allows the cam grooves 312 of the con-

nector 10 receive cam shafts (force receiving portion, not shown) of the mating connector. In addition, though the regulation portions 402 are provided to be brought into abutment with the arm portions 220 of the lever 200 in the present embodiment, the regulation portions 402 may be provided to be brought into abutment with the operation portion 210.

**[0033]** As shown in Figs. 13 to 15, in a state that the lever 200 is positioned in the third position, a lower end of each of the cam grooves 312 is positioned between adjacent two of the bottom plates 170 when seen along the up-down direction. In this state, the cam grooves 312 can receive the cam shafts (not shown) of the mating connector. In other words, the connector 10 is in a mateable state (or removable state) that the connector 10 is mateable with the mating connector (not shown). When the mating housing (not shown) of the mating connector is partly inserted into the receiving portion 122 of the connector 10 which is in the mateable state, the cam shafts of the mating connector are inserted into the cam grooves 312. Then the cam shafts of the mating connector are brought into abutment with upper walls 342 of the cam grooves 312 and stopped in mating start positions.

**[0034]** As understood from Figs. 11 to 15, when the cam shafts (not shown) of the mating connector are positioned in the mating start positions of the cam grooves 312, turning the lever 200 toward the second position moves the slider 300 forward according to the turn of the lever 200. Then, lower walls 344 of the cam grooves 312 push the cam shafts diagonally upward as the slider 300 is moved forward. The mating housing of the mating connector is received by the receiving portion 122 of the connector 10 in part. Accordingly, the mating connector cannot be moved forward. Also, the cam shafts cannot be moved forward. As a result, the cam shafts pushed by the lower walls 344 of the cam grooves 312 are moved upward. In other words, upward force is transmitted from the cam grooves 312 to the cam shafts. When the cam shafts receive the upward force from the cam grooves 312, the mating connector is pulled up toward the connector 10. When the lever 200 reaches the second position, the cam shafts reach the other ends of the cam grooves 312, and the connector 10 and the mating connector are brought into the mated state.

**[0035]** Conversely, when the connector 10 and the mating connector (not shown) are in the mated state that they are mated with each other, turning the lever 200 toward the third position from the second position moves the slider 300 rearward as understood from Figs. 11 and 15. As the slider 300 is moved rearward, the upper walls 342 of the cam grooves 312 push the cam shafts (not shown) diagonally downward. At this time, the mating connector cannot be moved rearward. Accordingly, the cam shafts pushed by the upper walls 342 of the cam grooves 312 are moved downward. In other words, downward force is transmitted from the cam grooves 312 to the cam shafts. Thus, the mating connector is pushed down in a direction away from the connector 10. When the lever 200 reaches the third position, the cam shafts reach the mating start positions of the cam grooves 312. In this manner, the mating connector is brought into the removable state (or the mateable state) that the mating connector is removable from the connector 10. Thus, the connector 10 can easily be removed from the mating connector.

**[0036]** Although the specific explanation about the present invention is made above referring to the embodiments, the present invention is not limited thereto but susceptible to various modifications and alternative forms. For example, though the housing 100 is provided with the rotational shafts 152 while the lever 200 is provided with the shaft holes 222 and the guide grooves 224 in the aforementioned embodiment, the housing 100 may be provided with shaft holes and guide grooves while the lever 200 may be provided with rotational shafts. In such a case, the guide grooves also function to guide the rotational shafts to the shaft holes upon attaching the lever 200 to the housing 100. Furthermore, in a case where the guide grooves are provided in the housing 100, the guide grooves extend in the up-down direction and open upward. In the aforementioned embodiment, the connector 10 is provided with the cam grooves 312 while the mating connector is provided with the cam shafts (not shown). However, the connector 10 may be provided with cam shafts while the mating connector may be provided with cam grooves.

## Claims

**1.** A connector (10) mateable with and removable from a mating connector along an up-down direction (Z), the connector (10) being attached with a cover (400) when used, wherein:

the mating connector comprises a cam shaft;
the connector (10) comprises a housing (100), a lever (200) and a slider (300);
the lever (200) is configured to be attached to the housing (100) to be rotatable between a first position and a second position in a state before the cover (400) is attached to the housing (100);
the cover (400) comprises a regulation portion (402) which is configured to regulate the turn of the lever (200) in a state that the cover (400) is attached to the housing (100) so as not to be rotatable toward the first position from a third position positioned between the first position and the second position but to be rotatable between the third position and the second position by being brought into abutment with arm portions (220) or an operation portion (210) of the lever (200) when it is intended to be turned toward the first position;
the slider (300) is attached to the housing (100) to be movable in a front-rear direction (X) or-

thogonal to the up-down direction (Z);
the lever (200) has a pinion portion (230) and a pressed portion (233);
the pinion portion (230) has a plurality of teeth (232);
the slider (300) has a rack portion (314), a press portion (317) and a cam groove (312);
the rack portion (314) has a plurality of teeth (316);
the pinion portion (230) and the rack portion (314) translate turn of the lever (200) into front-rear direction movement of the slider (300) by mutually engaging;
the cam groove (312) transmits up-down direction force to the cam shaft of the mating connector according to the front-rear direction movement of the slider (300);
the slider(300), the cam groove (312) and the cam shaft are configured so that, when the lever (200) is turned from the third position to the second position, the slider (300) is moved forward in the front-rear direction (X), and the cam groove (312) moves the cam shaft of the mating connector upward in the up-down direction (Z), and thereby the connector (10) and the mating connector are brought into a mated state; and
the slider (300), the cam groove (312) and the cam shaft are configured so that, when the lever (200) is turned from the second position to the third position, the slider (300) is moved rearward in the front-rear direction (X), and the cam groove (312) moves the cam shaft of the mating connector downward in the up-down direction (Z), and thereby the connector (10) and the mating connector are brought into a removable state.
the press portion (317) is configured to be visible when the slider (300) as a single body is seen from a front thereof along the front-rear direction (X); and
the press portion (317) is configured to press the pressed portion (233) to turn the lever (200) toward the second position when the slider (300) is moved forward in the front-rear direction provided that the lever (200) is positioned in the first position.

**2.** The connector (10) as recited in claim 1, wherein:

the pressed portion (233) is one of the teeth (232) of the pinion portion (230); and
the press portion (317) is one of the teeth (316) of the rack portion (314).

**3.** The connector (10) as recited in claim 2, wherein:

the pinion portion (230) is molded integrally with the lever (200) using first resin; and
the rack portion (314) is molded integrally with the slider (300) using second resin.

**4.** The connector (10) as recited in claim 3, wherein:

the pinion portion (230) has a side surface;
the connector (10) further comprises a plate-like member (234) provided on the side surface of the pinion portion (230) and connecting the teeth (232) of the pinion portion (230) to one another;
the pinion portion (230) and the plate-like member (234) are molded integrally with the lever (200) using the first resin.

**5.** The connector (10) as recited in any one of claims 1 to 4, wherein the housing (100) is provided with a stopper (132) to stop the lever (200) in the first position.

**6.** The connector (10) as recited in claim 5, wherein the stopper (132) is molded integrally with the housing (100) using a third resin.

**7.** The connector (10) as recited in any one of claims 1 to 6, wherein:

the slider (300) has a pair of side plate portions (310);
the side plate portions (310) are provided with two pairs of the cam grooves (312); and
one of the pairs of the cam grooves (312) and a remaining one of the pairs of the cam grooves (312) are located apart from each other in the front-rear direction (X).

**8.** The connector (10) as recited in any one of claims 1 to 7, wherein:

the cam groove (312) receives the cam shaft upon mating of the connector (10) with the mating connector.

**9.** The connector (10) as recited in any one of claims 1 to 8, wherein:

one of the lever (200) and the housing (100) is provided with a rotational shaft (152);
a remaining one of the lever (200) and the housing (100) is provided with a bearing hole (222) and a guide groove (224);
the bearing hole (222) receives the rotational shaft (152) when the lever (200) is attached to the housing (100);
the guide groove (224) guides the rotational shaft (152) to the bearing hole (222) when attaching the lever (200) to the housing (100);
in a case where the guide groove (224) is provided in the housing (100), the guide groove

(224) extends in the up-down direction (Z) and opens upward; and
in another case where the guide groove (224) is provided in the lever (200), the guide groove (224) extends in the up-down direction (Z) and opens upward provided that the lever (200) is positioned in the second position.

**Patentansprüche**

**1.** Ein Stecker (10) steckbar mit und trennbar von einem Gegenstecker entlang einer Oben-Unten-Richtung (Z), wobei der Stecker (10) während der Verwendung mit einer Abdeckung (400) befestigt wird, wobei:

der Gegenstecker eine Nockenwelle aufweist;
der Stecker (10) ein Gehäuse (100) einen Hebel (200) und einen Schieber (300) aufweist;
der Hebel (200) so ausgestaltet ist, dass er an dem Gehäuse (100) befestigbar ist, um zwischen einer ersten Position und einer zweiten Position in einem Zustand, bevor die Abdeckung (400) an dem Gehäuse (100) befestigt wird, drehbar zu sein.
das Gehäuse (400) ein Regelteil (402) umfasst, dazu ausgebildet, die Drehung des Hebels (200) in einem Zustand in dem die Abdeckung (400) an dem Gehäuse (100) befestigt ist, zu regulieren, sodass er nicht drehbar ist in Richtung der ersten Position aus einer dritten Position, die zwischen der ersten und der zweiten Position positioniert ist, aber zwischen der dritten und der zweiten Position drehbar ist, indem er mit Armabschnitten (220) oder Betätigungsabschnitten (210) des Hebels (200) in Anlage bringbar ist, wenn beabsichtigt wird, dass er in Richtung der ersten Position gedreht wird;
der Schieber (300) mit dem Gehäuse verbunden ist (100), um in einer Vor-Rück-Bewegung (X) orthogonal zu der Oben-Unten-Bewegung (Z) bewegbar zu sein;
der Hebel (200) einen Ritzelabschnitt (230) und einen gepressten Abschnitt (233) aufweist;
der Ritzelabschnitt (230) eine Vielzahl an Zähnen aufweist (232);
der Schieber (300) einen Rackabschnitt (314), einen Pressabschnitt (317) und eine Nockennut (312) aufweist;
der Rackabschitt (314) eine Vielzahl an Zähnen aufweist (316);
der Ritzelabschnitt (230) und der Rackabschnitt (314) eine Drehung des Hebels (200) in eine Vor-Rück-Bewegung des Schiebers (300) umwandeln indem sie ineinander greifen;
die Nockennut (312) eine Kraft in Oben-Unten-Richtung auf die Nockenwelle des Gegensteckers entsprechend der Bewegung des Schiebers (300) in Vor-Rück-Richtung überträgt;
der Schieber (300), die Nockennut (312) und die Nockenwelle so ausgestaltet sind, dass wenn der Hebel (200) aus der dritten Position in die zweite Position gedreht wird, der Schieber (300) vorwärts in die Vor-Rück-Richtung (X) bewegt wird, und die Nockennut (312) die Nockenwelle des Gegensteckers aufwärts in die Oben-Unten-Richtung (Z) bewegt und dabei der Stecker (10) und der Gegenstecker in einen Steckzustand gebracht werden; und
der Schieber (300), die Nockennut (312) und die Nockenwelle so ausgeführt sind, dass wenn der Hebel (200) aus der zweiten in die dritte Position gedreht wird, der Schieber (300) rückwärts in die Vor-Rück-Richtung (X) bewegt wird und die Nockennut (312) die Nockenwelle des Gegensteckers abwärts in die Oben-Unten-Richtung (Z) bewegt und dabei der Stecker (10) und der Gegenstecker in einen abnehmbaren Zustand gebracht werden;
der Pressabschnitt (317) so ausgestaltet ist, dass er sichtbar ist, wenn der Schieber (300) als einzelner Körper gesehen wird von einer Vorderansicht dessen entlang der Vor-Rück-Richtung (X); und
der Pressabschnitt (317) so ausgestaltet ist, dass er den gepressten Abschnitt (233) drückt, um den Hebel (200) in Richtung der zweiten Position zu drehen, wenn der Schieber (300) vorwärts in die Vor-Rück-Richtung bewegt wird, vorausgesetzt, dass der Hebel (200) in der ersten Position positioniert ist.

**2.** Der Stecker (10) nach Anspruch 1, wobei:

der gepresste Abschnitt (233) einer der Zähne (232) des Ritzelabschnitts (230) ist; und
der Pressabschnitt (317) einer der Zähne (316) des Rackabschnitts (314) ist;

**3.** Der Stecker (10) nach Anspruch 2, wobei:

der Ritzelabschnitt (230) mit dem Hebel (200) unter Verwendung eines ersten Harzes einteilig vergossen wird; und
der Rackabschnitt (314) mit dem Schieber (300) unter Verwendung eines zweiten Harzes einteilig vergossen wird.

**4.** Der Stecker (10) nach Anspruch 3, wobei:

der Ritzelabschnitt (230) eine Seitenfläche aufweist;
der Stecker (10) des Weiteren ein plattenförmiges Element (234), bereitgestellt auf der Seitenfläche des Ritzelabschnitts (230) und die Zähne

(232) des Ritzelabschnitts miteinander verbindend, aufweist;
der Ritzelabschnitt (230) und das plattenförmige Element (234) unter Verwendung des ersten Harzes mit dem Hebel (200) einteilig vergossen werden.

**5.** Der Stecker (10) nach einem der Ansprüche 1 bis 4, wobei das Gehäuse (100) mit einem Stopper (132) versehen ist, um den Hebel (200) in der ersten Position zu stoppen.

**6.** Der Stecker (10) nach Anspruch 5, wobei der Stopper (132) mit dem Gehäuse (100) unter Verwendung eines dritten Harzes einteilig vergossen wird.

**7.** Der Stecker (10) nach einem der Ansprüche 1 bis 6, wobei:

der Schieber (300) ein Paar Seitenplattenabschnitte (310) aufweist;
die Seitenplattenabschnitte (310) mit zwei Paar Nockennuten (312) versehen sind; und
das eine Paar Nockennuten (312) und ein verbleibendes Paar Nockennuten (312) getrennt voneinander in der Vor-Rück-Richtung (X) angeordnet ist.

**8.** Der Stecker (10) nach einem der Ansprüche 1 bis 7, wobei:

die Nockennut (312) die Nockenwelle beim Verbinden des Steckers (10) mit dem Gegenstecker aufnimmt.

**9.** Der Stecker (10) nach einem der Ansprüche 1 bis 8, wobei:

einer der Hebel (200) und das Gehäuse (100) mit einer Rotationswelle (152) versehen sind;
ein verbleibender Hebel (200) und das Gehäuse (100) mit einer Aufnahmebohrung (222) und einer Nutführung (224) versehen sind;
die Aufnahmebohrung (222) die Rotationswelle (152) aufnimmt, wenn der Hebel (200) mit dem Gehäuse (100) verbunden wird;
die Nutführung (224) die Rotationswelle (152) zu der Aufnahmebohrung (222) führt, wenn der Hebel (200) mit dem Gehäuse (100) verbunden wird;
in dem Fall, dass die Nutführung (224) im Gehäuse (100) vorgesehen ist, sich die Nutführung (224) in die Oben-Unten-Richtung (Z) erstreckt und sich nach oben öffnet; und
in einem anderen Fall, in dem die Nutführung (224) in dem Hebel (200) vorgesehen ist, sich die Nutführung (224) in der Oben-Unten-Richtung (Z) erstreckt und sich nach oben öffnet, unter der Voraussetzung, dass der Hebel (200) in der zweiten Position positioniert ist.

## Revendications

**1.** Connecteur (10) pouvant être accouplé avec et retiré d'un connecteur d'accouplement le long d'une direction haut-bas (Z), le connecteur (10) étant fixé à un cache (400) quand il est utilisé, dans lequel :

le connecteur d'accouplement comprend un arbre à cames ;
le connecteur (10) comprend un boîtier (100), un levier (200) et un coulisseau (300) ;
dans lequel le levier (200) est configuré pour être fixé au boîtier (100) pour pouvoir tourner entre ladite première position et ladite deuxième position dans un état avant que le cache (400) ne soit fixé au boîtier (100) ;
le cache (400) comprend une partie de régulation (402) qui est configurée pour réguler la rotation du levier (200) dans un état dans lequel le cache (400) est fixé au boîtier (100) de manière à ne pas pouvoir tourner vers la première position depuis une troisième position étant positionnée entre la première et la deuxième position mais à pouvoir tourner entre la troisième position et la deuxième position en étant amené en butée avec des parties bras (220) ou une partie d'actionnement (210) du levier (200) quand il est destiné à être tourné vers la première position,
le coulisseau (300) est fixé au boîtier (100) pour être mobile dans une direction avant-arrière (X) orthogonale à la direction haut-bas (Z) ;
le levier (200) comporte une partie pignon (230) et une partie pressée (233) ;
la partie pignon (230) comporte une pluralité de dents (232) ;
le coulisseau (300) comporte une partie crémaillère (314), une partie presse (317) et une rainure de came (312) ;
la partie crémaillère (314) possède une pluralité de dents (316) ;
la partie pignon (230) et la partie crémaillère (314) translatent la rotation du levier (200) dans un déplacement de direction avant-arrière du coulisseau (300) par entrée en prise mutuelle ;
la rainure de came (312) transmet une force de direction haut-bas à l'arbre à cames du connecteur d'accouplement selon le déplacement de direction avant-arrière du coulisseau (300) ;
le coulisseau (300), la rainure de came (312) et l'arbre à cames sont configurés de telle sorte que, quand le levier (200) est tourné de la troisième position à la deuxième position, le coulisseau (300) est déplacé vers l'avant dans la di-

rection avant-arrière (X), et la rainure de came (312) déplace l'arbre à cames du connecteur d'accouplement vers le haut dans la direction haut-bas (Z), et ainsi le connecteur (10) et le connecteur d'accouplement sont amenés dans un état accouplé ; et
le coulisseau (300), la rainure de came (312) et l'arbre à cames sont configurés de telle sorte que, quand le levier (200) est tourné de la deuxième position à la troisième position, le coulisseau (300) est déplacé vers l'arrière dans la direction avant-arrière (X), et la rainure de came (312) déplace l'arbre à cames du connecteur d'accouplement vers le bas dans la direction haut-bas (Z), et ainsi le connecteur (10) et le connecteur d'accouplement sont amenés dans un état amovible,
la partie presse (317) est configurée pour être visible quand le coulisseau (300) en tant que corps unique est vu depuis un avant de celui-ci le long de la direction avant-arrière (X) ; et
la partie presse (317) est configurée pour presser la partie pressée (233) pour faire tourner le levier (200) vers la deuxième position quand le coulisseau (300) est déplacé vers l'avant dans la direction avant-arrière (X) à condition que le levier (200) soit positionné dans la première position .

**2.** Connecteur (10) selon la revendication 1, dans lequel :

la partie pressée (233) est l'une des dents (232) de la partie pignon (230) ; et
la partie presse (317) est l'une des dents (316) de la partie crémaillère (314).

**3.** Connecteur (10) selon la revendication 2, dans lequel :

la partie pignon (230) est moulée d'un seul tenant avec le levier (200) en utilisant une première résine ; et
la partie crémaillère (314) est moulée d'un seul tenant avec le coulisseau (300) en utilisant une deuxième résine.

**4.** Connecteur (10) selon la revendication 3, dans lequel :

la partie pignon (230) comporte une surface latérale ;
le connecteur (10) comprend en outre un élément de type plaque (234) disposé sur la surface latérale de la partie pignon (230) et connectant les dents (232) de la partie pignon (230) entre elles ;
la partie pignon (230) et l'élément de type plaque (234) sont moulés d'un seul tenant avec le levier (200) en utilisant la première résine.

**5.** Connecteur (10) selon l'une quelconque des revendications 1 à 4, dans lequel le boîtier (100) est pourvu d'une butée (132) pour arrêter le levier (200) dans la première position.

**6.** Connecteur (10) selon la revendication 5, dans lequel la butée (132) est moulée d'un seul tenant avec le boîtier (100) en utilisant une troisième résine.

**7.** Connecteur (10) selon l'une quelconque des revendications 1 à 6, dans lequel :

le coulisseau (300) comporte une paire de parties plaques latérales (310) ;
les parties plaques latérales (310) sont pourvues de deux paires des rainures de came (312) ; et
l'une des paires des rainures de came (312) et l'autre des paires des rainures de came (312) sont espacées l'une de l'autre dans la direction avant-arrière (X).

**8.** Connecteur (10) selon l'une quelconque des revendications 1 à 7, dans lequel :

la rainure de came (312) reçoit l'arbre à cames lors de l'accouplement du connecteur (10) avec le connecteur d'accouplement.

**9.** Connecteur (10) selon l'une quelconque des revendications 1 à 8, dans lequel :

l'un parmi le levier (200) et le boîtier (100) est pourvu d'un arbre rotatif (152) ;
l'autre parmi le levier (200) et le boîtier (100) est pourvu d'un trou de support (222) et d'une rainure de guidage (224) ;
le trou de support (222) reçoit l'arbre rotatif (152) quand le levier (200) est fixé au boîtier (100) ;
la rainure de guidage (224) guide l'arbre rotatif (152) vers le trou de support (222) lors de la fixation du levier (200) au boîtier (100) ;
dans un cas où la rainure de guidage (224) est disposée dans le boîtier (100), la rainure de guidage (224) s'étend dans la direction haut-bas (Z) et s'ouvre vers le haut ; et
dans un autre cas où la rainure de guidage (224) est disposée dans le levier (200), la rainure de guidage (224) s'étend dans la direction haut-bas (Z) et s'ouvre vers le haut à condition que le levier (200) soit positionné dans la deuxième position.

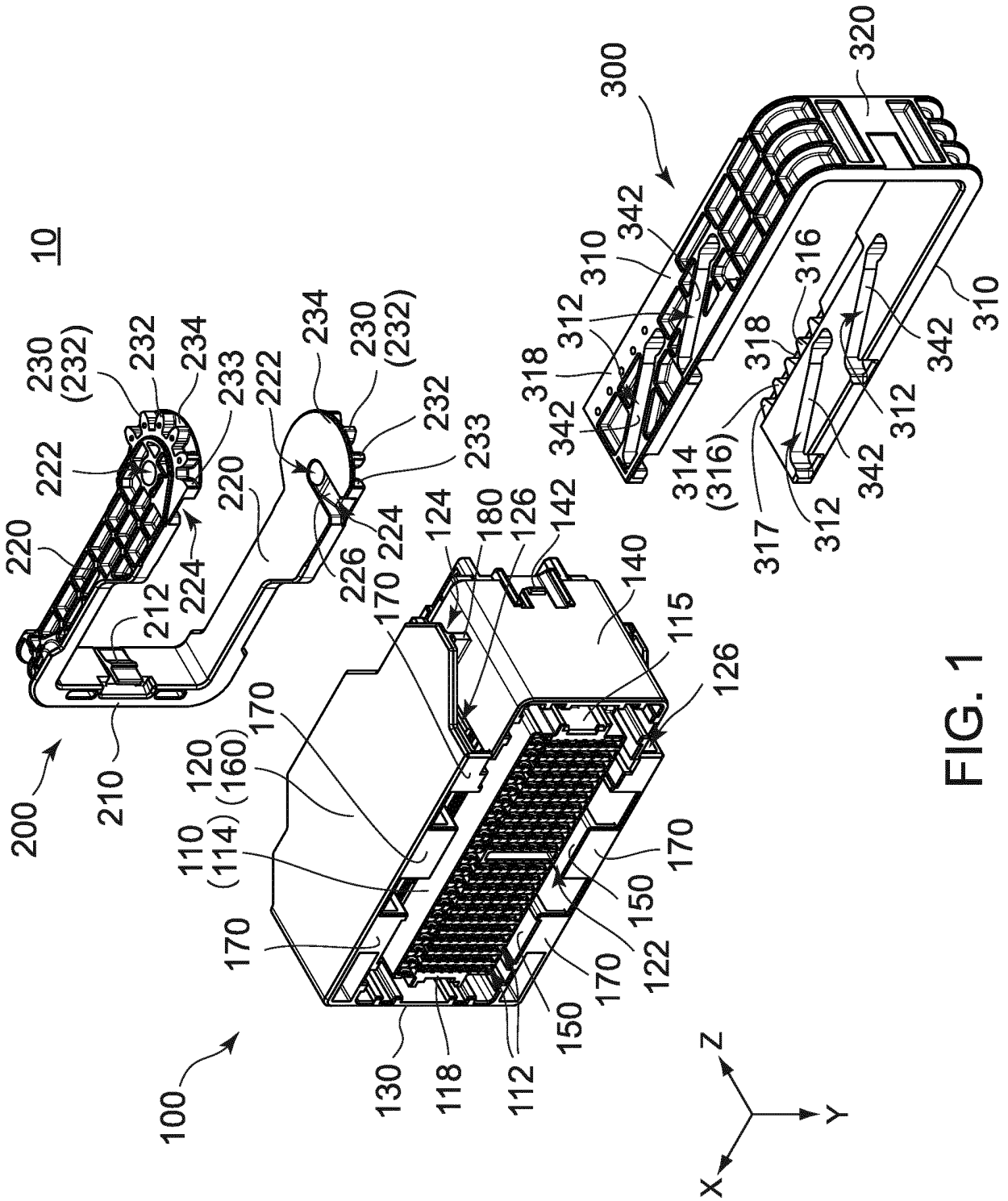

10
200
210
212
220
222
230
(232)
232
233
234
224
226
170
220
222
230
(232)
234
232
233
224
124
180
126
142
140
115
126
170
120
(160)
110
(114)
170
150
122
170
170
150
130
118
112
100
300
320
342
310
312
318
316
342
310
314
(316)
317
312
342
312
342
Z
Y
X

FIG. 1

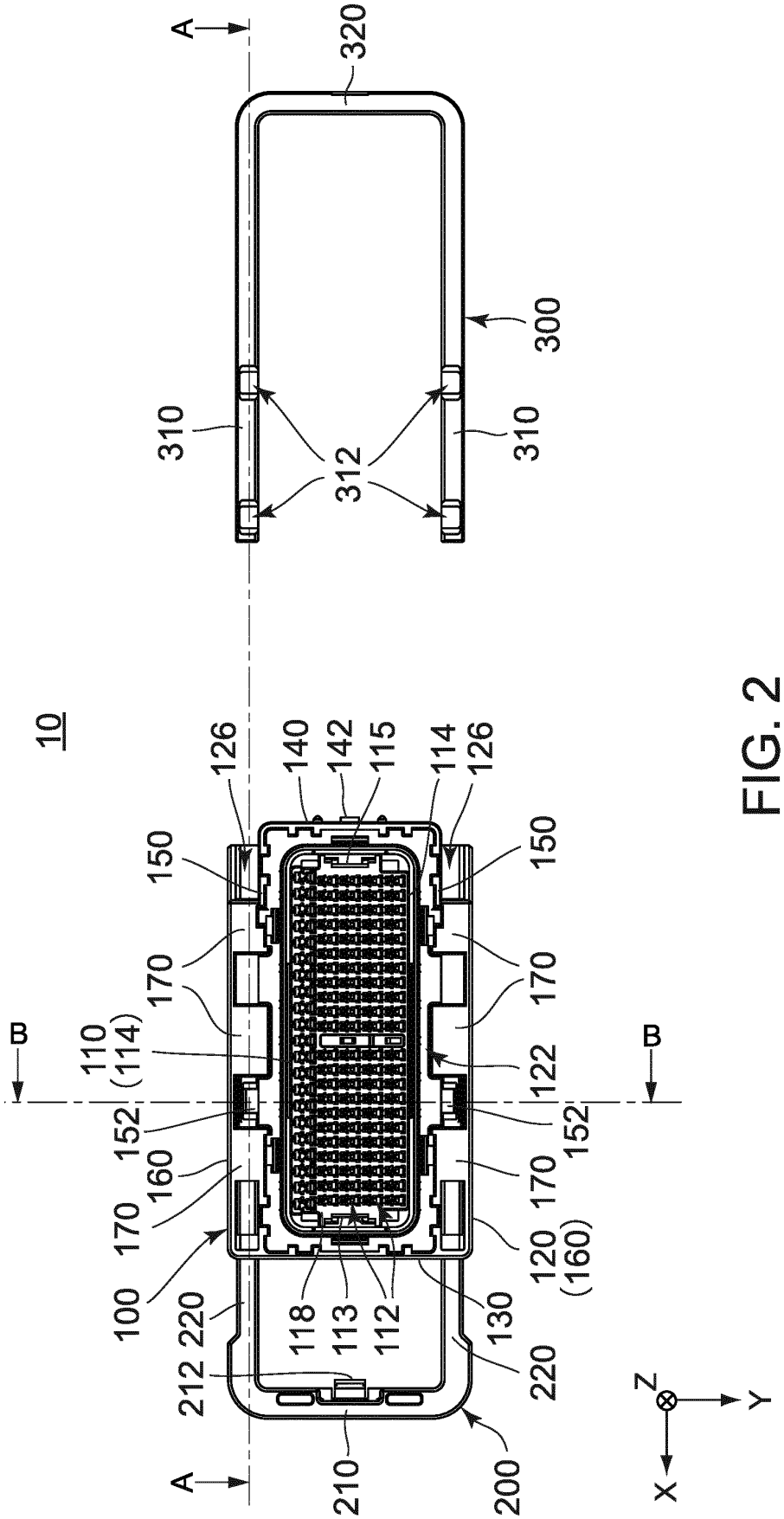

A
320
300
310
312
310
10
126
140
142
115
114
126
150
150
170
170
B
110
(114)
122
B
152
152
160
170
170
120
(160)
100
220
118
113
112
130
212
220
210
200
A
Z
Y
X

FIG. 2

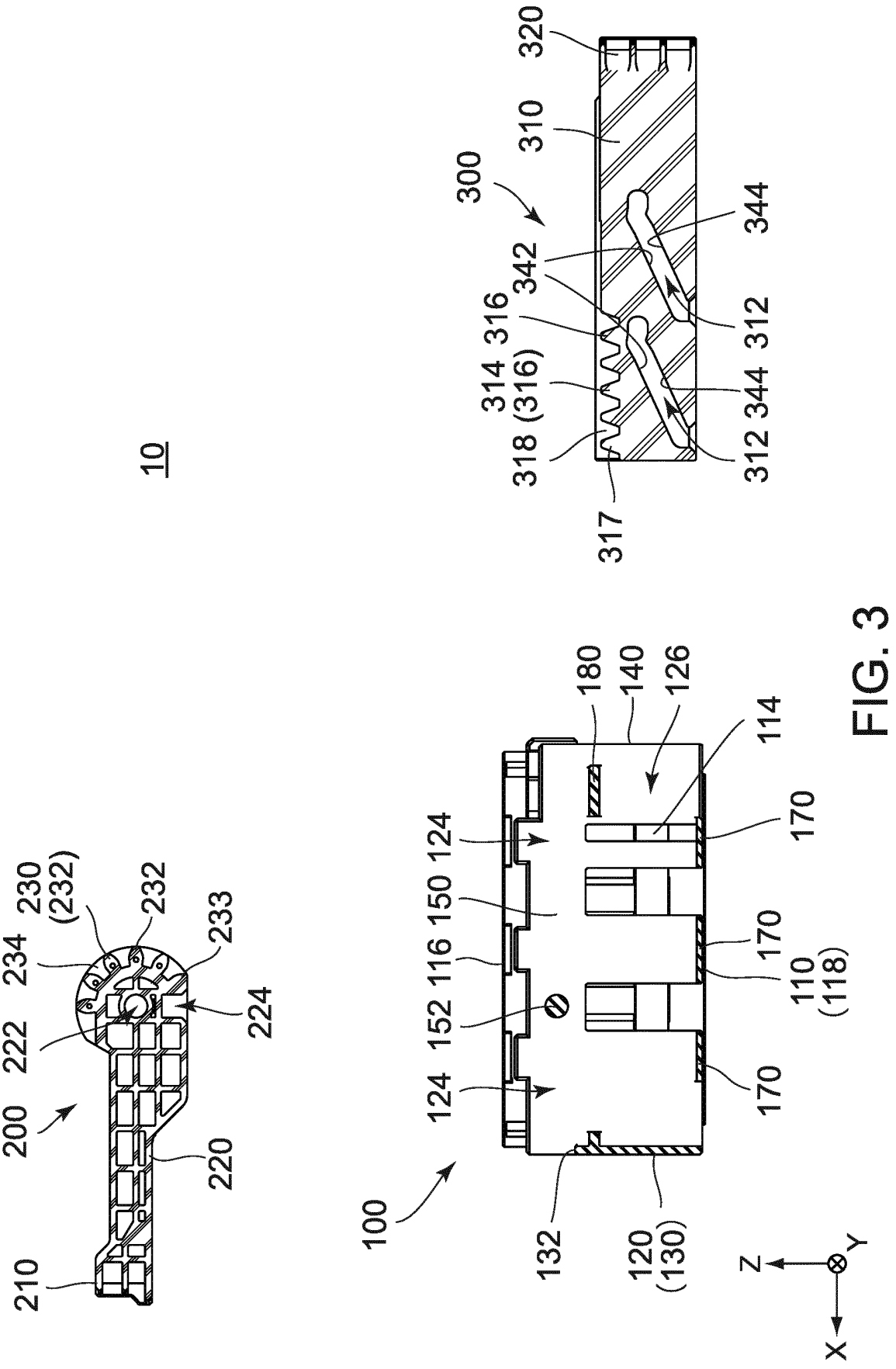

10
200
210
220
222
224
230
(232)
232
233
234
100
120
(130)
132
110
(118)
114
116
124
126
140
150
152
170
180
300
310
312
314
316
317
318
320
342
344
X
Y
Z

FIG. 3

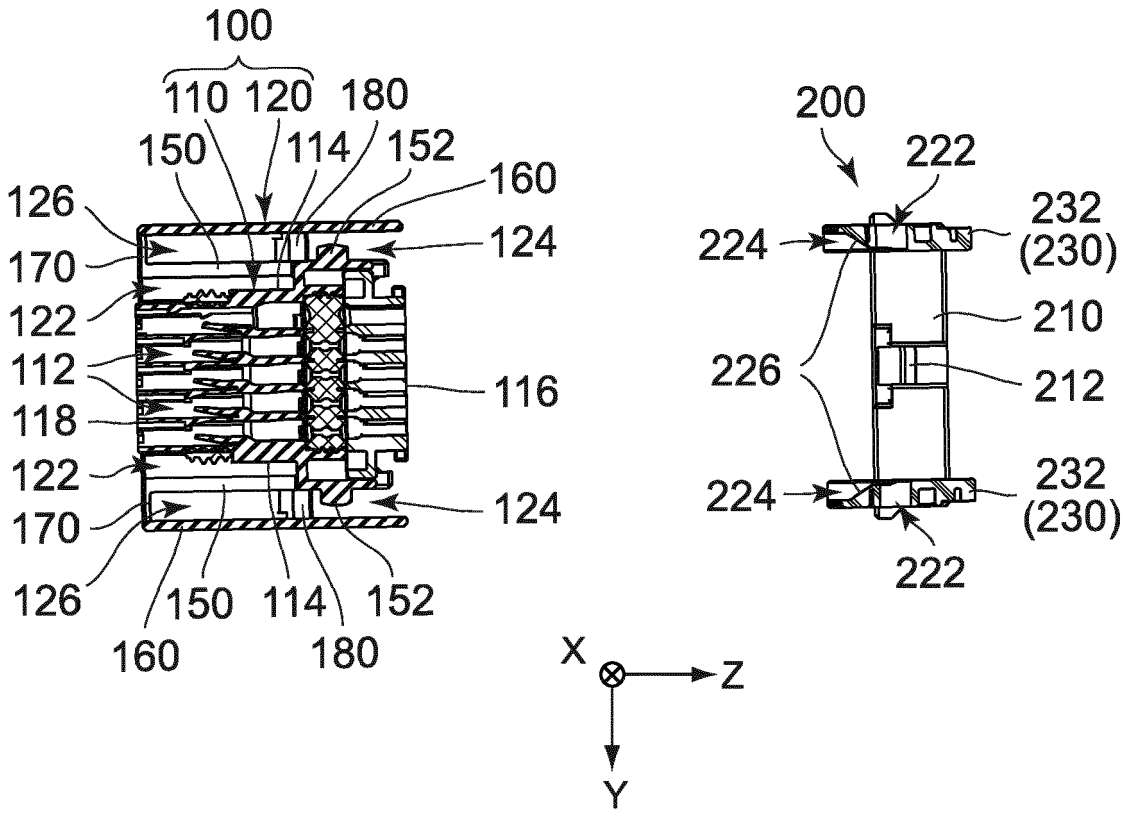

100
110
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180
150
114
152
160
126
124
170
122
112
116
118
122
170
124
126
150
114
152
160
180
200
222
232
(230)
224
210
226
212
224
232
(230)
222
X
Z
Y

FIG. 4

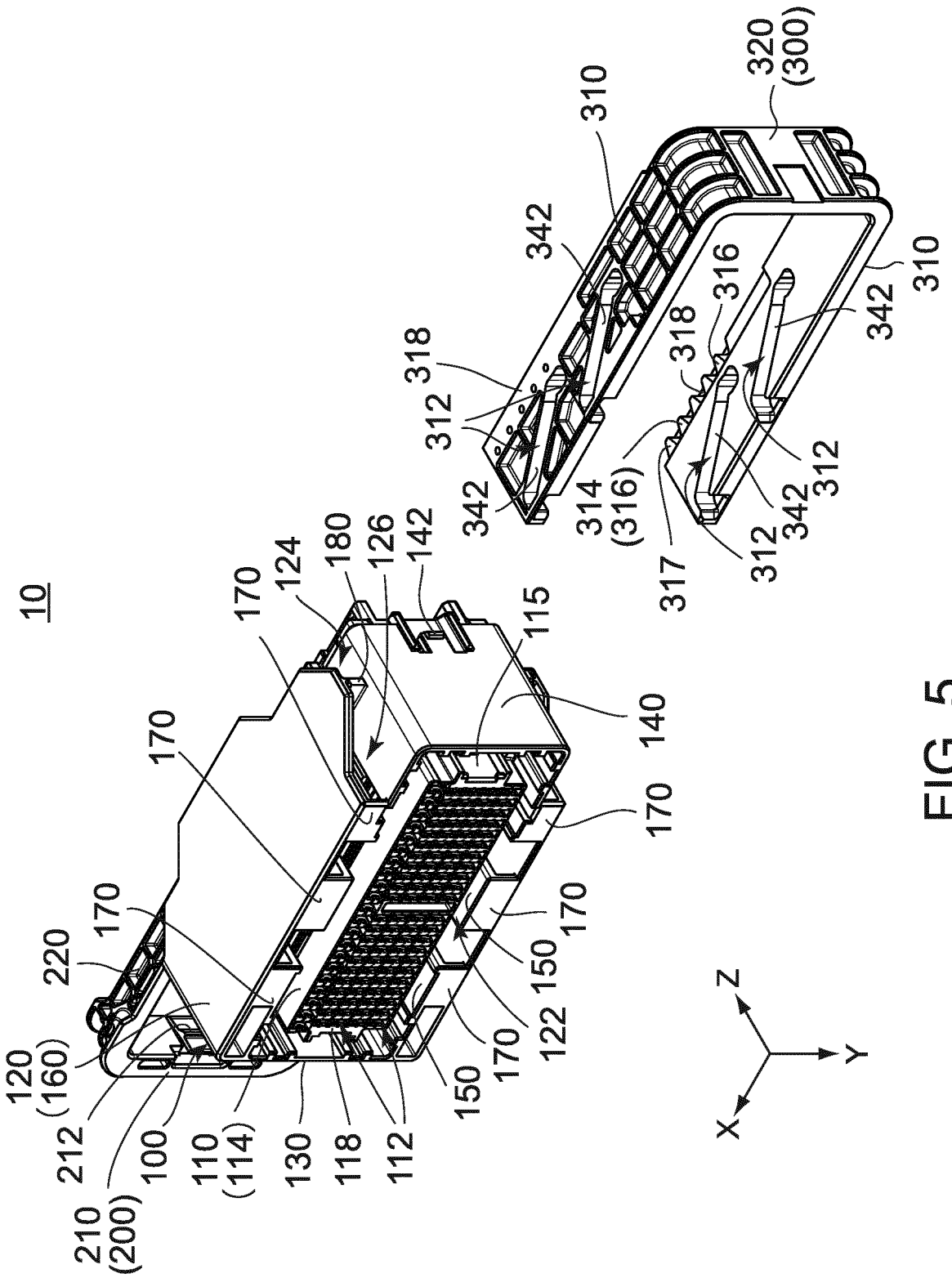

10
320
(300)
310
342
316
318
312
314
(316)
317
120
(160)
212
210
(200)
100
110
(114)
130
118
112
150
122
170
124
180
126
142
115
140
220
Z
Y
X

FIG. 5

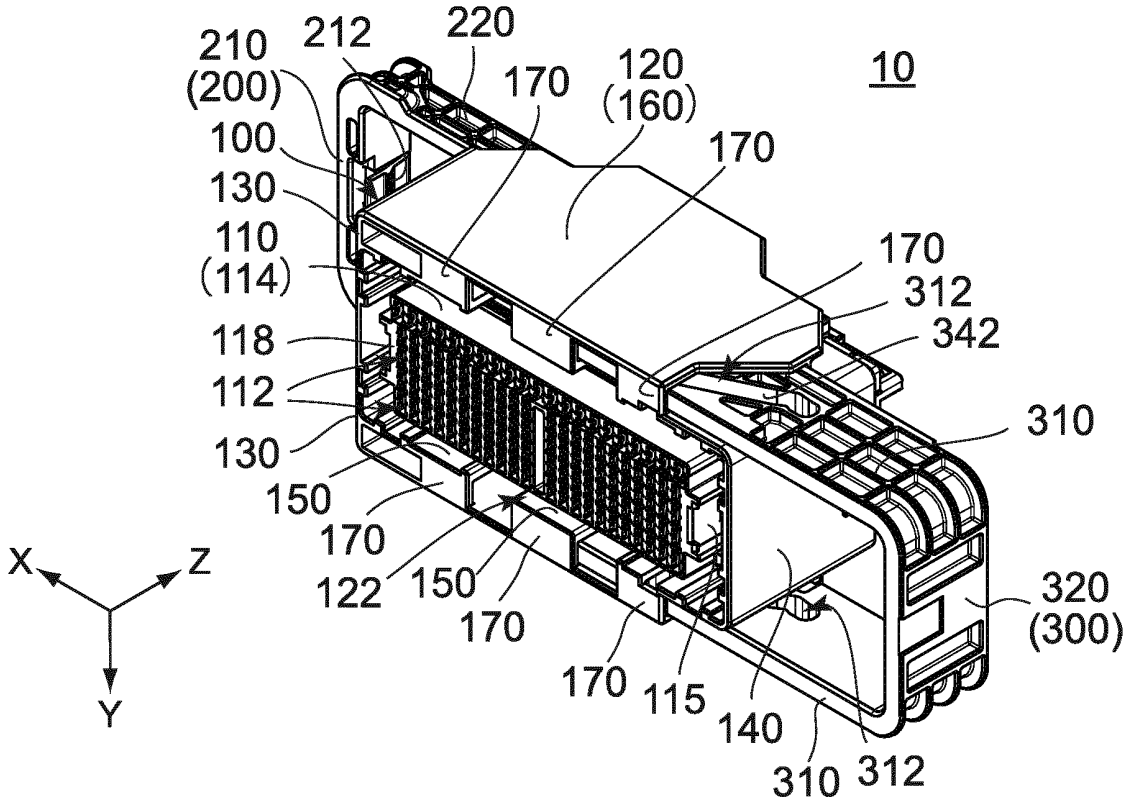

10
210
(200)
212
220
170
120
(160)
100
130
110
(114)
118
112
130
150
170
122
150
170
170
115
140
310
312
170
312
342
310
320
(300)
X
Z
Y

FIG. 6

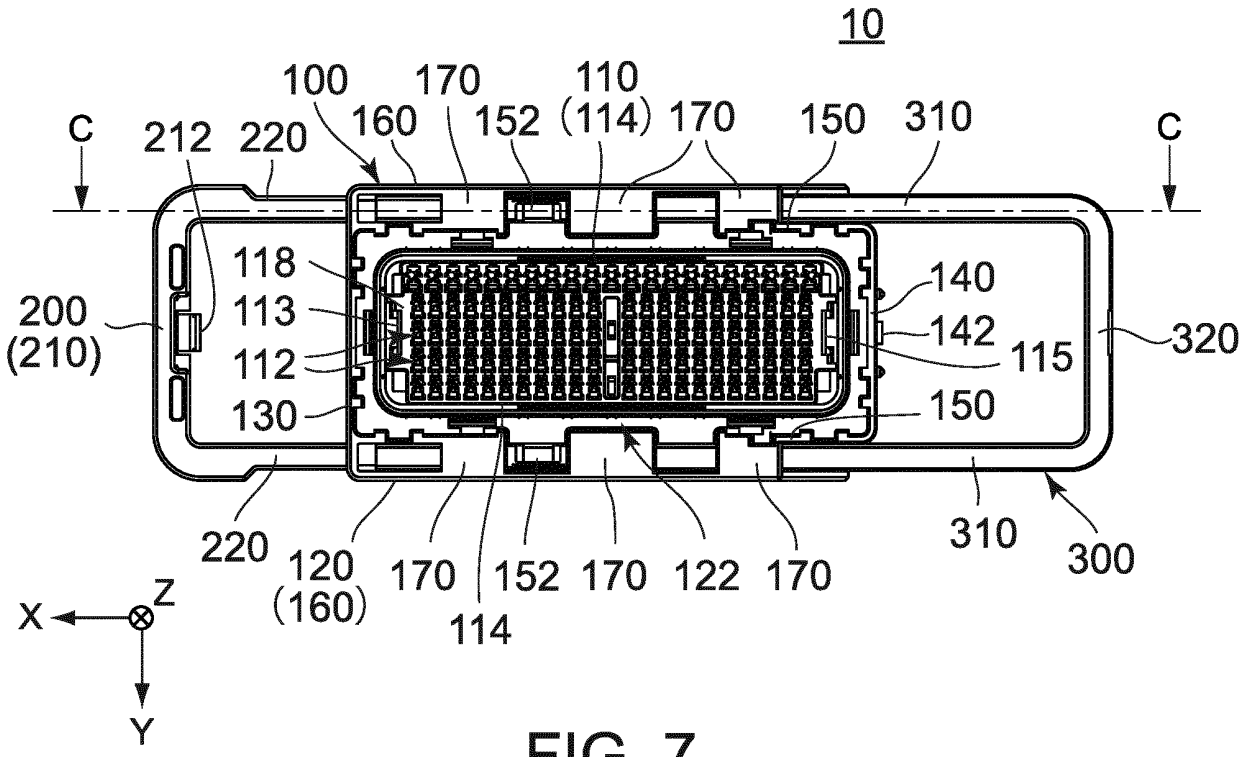

10
C
C
100
160
170
152
110
(114)
170
150
310
212
220
118
113
112
130
200
(210)
140
142
115
150
320
220
120
(160)
170
152
114
170
122
170
310
300
X
Z
Y

FIG. 7

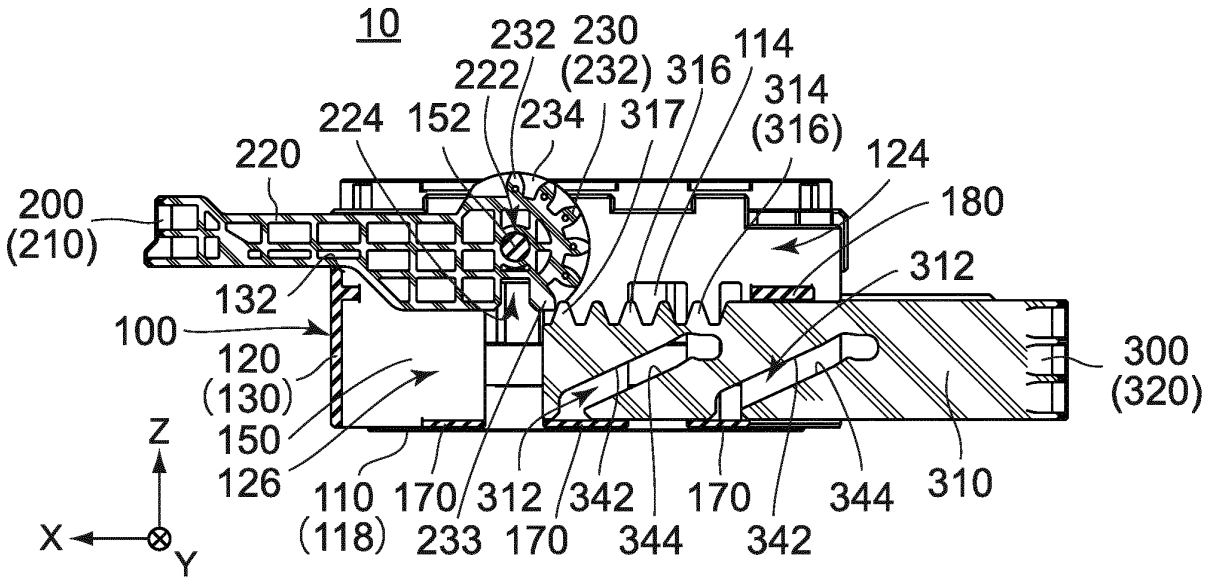

10
232
230
222
(232)
316
114
314
(316)
224
152
234
317
220
124
200
(210)
180
312
132
100
120
(130)
150
126
300
(320)
Z
X
Y
110
(118)
170
233
312
170
342
344
170
342
344
310

FIG. 8

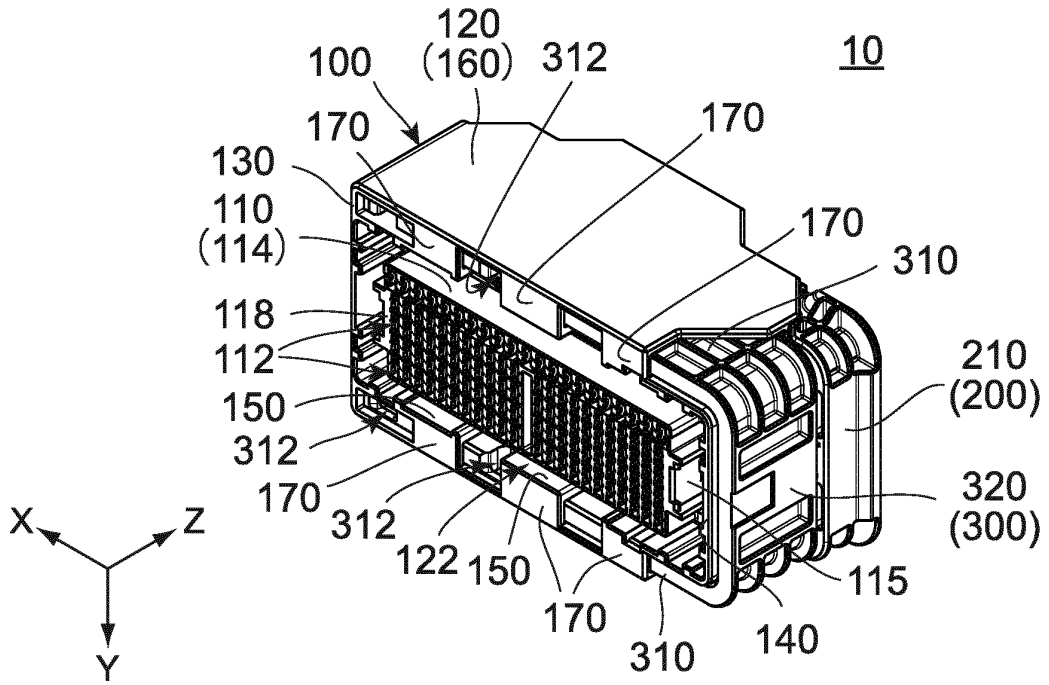

120
(160)
312
100
10
170
170
130
110
(114)
170
310
118
112
150
312
210
(200)
170
320
(300)
312
122
150
170
115
310
140
X
Z
Y

FIG. 9

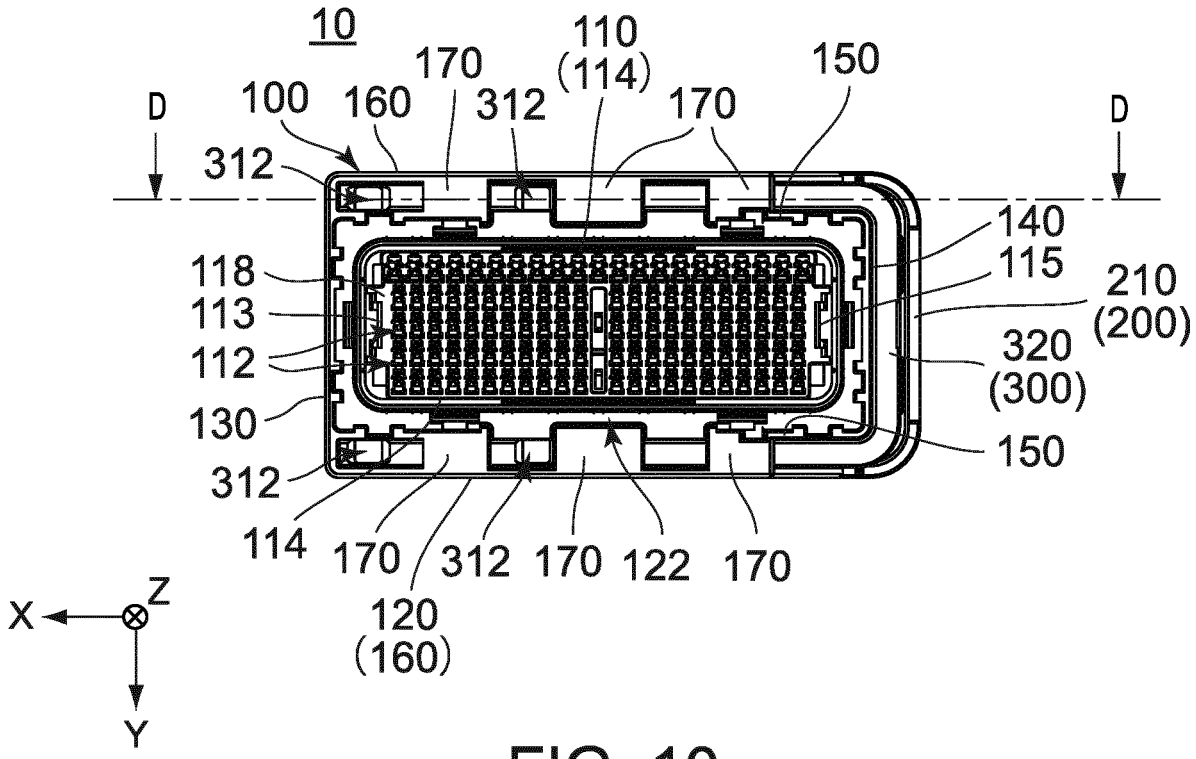

10
110
(114)
170
150
D
100
160
312
170
D
312
140
115
210
(200)
320
(300)
118
113
112
130
150
312
114
170
312
170
122
170
120
(160)
Z
X
Y

FIG. 10

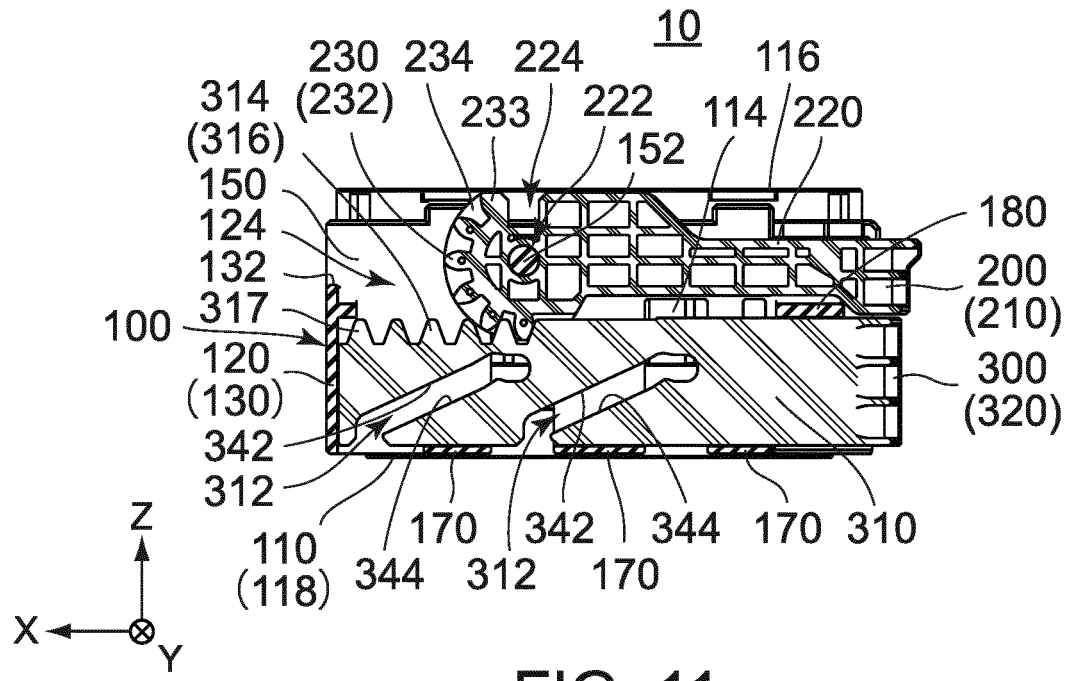

10
230
(232)
234
224
116
314
(316)
233
222
114
220
152
150
124
132
317
100
120
(130)
342
312
180
200
(210)
300
(320)
110
(118)
344
170
312
342
170
344
170
310
Z
X
Y

FIG. 11

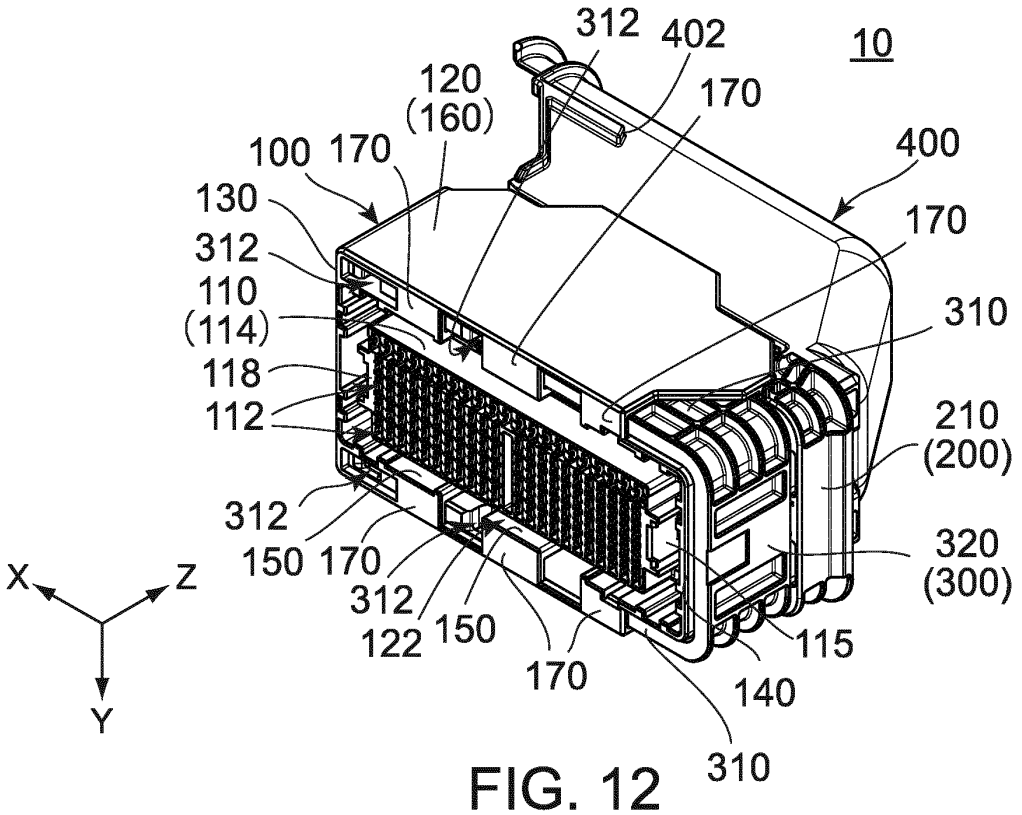

312
402
10
120
(160)
170
100
170
400
130
170
312
110
(114)
310
118
112
210
(200)
312
320
150
170
(300)
312
122
150
115
170
140
310
X
Z
Y

FIG. 12

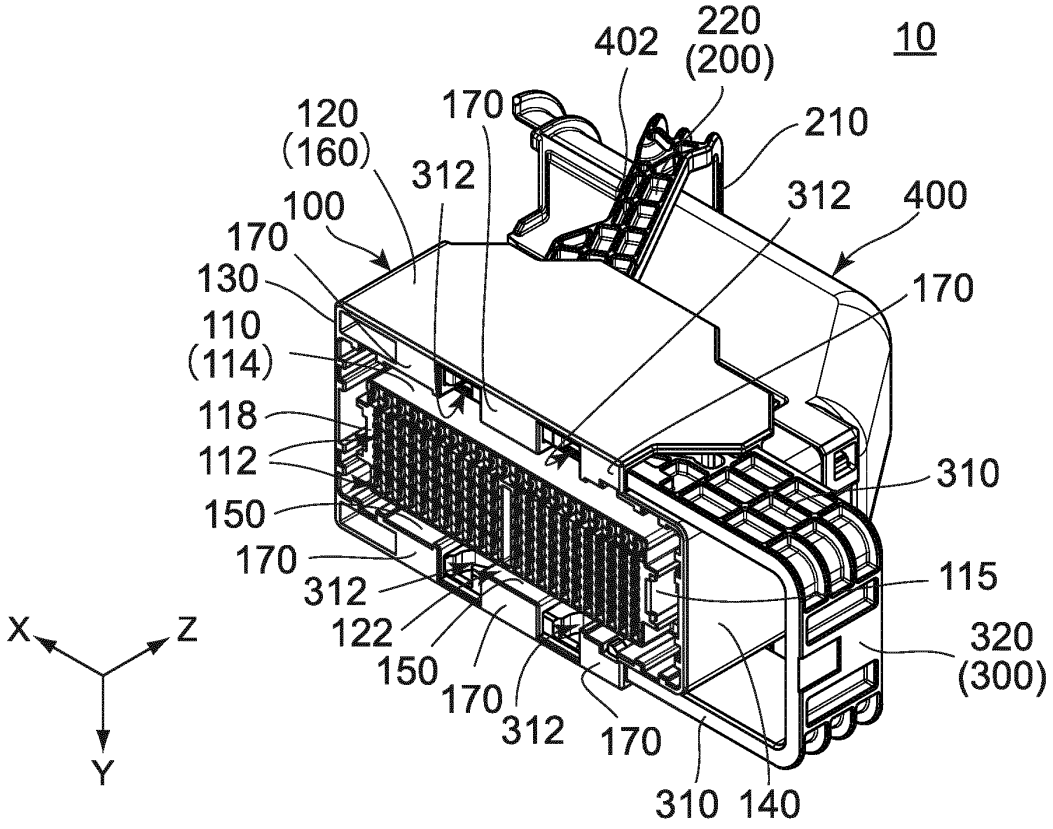

220
(200)
402
10
170
120
(160)
210
312
312
400
100
170
130
170
110
(114)
118
112
310
150
170
115
312
122
320
150
(300)
170
312
170
310
140
X
Z
Y

FIG. 13

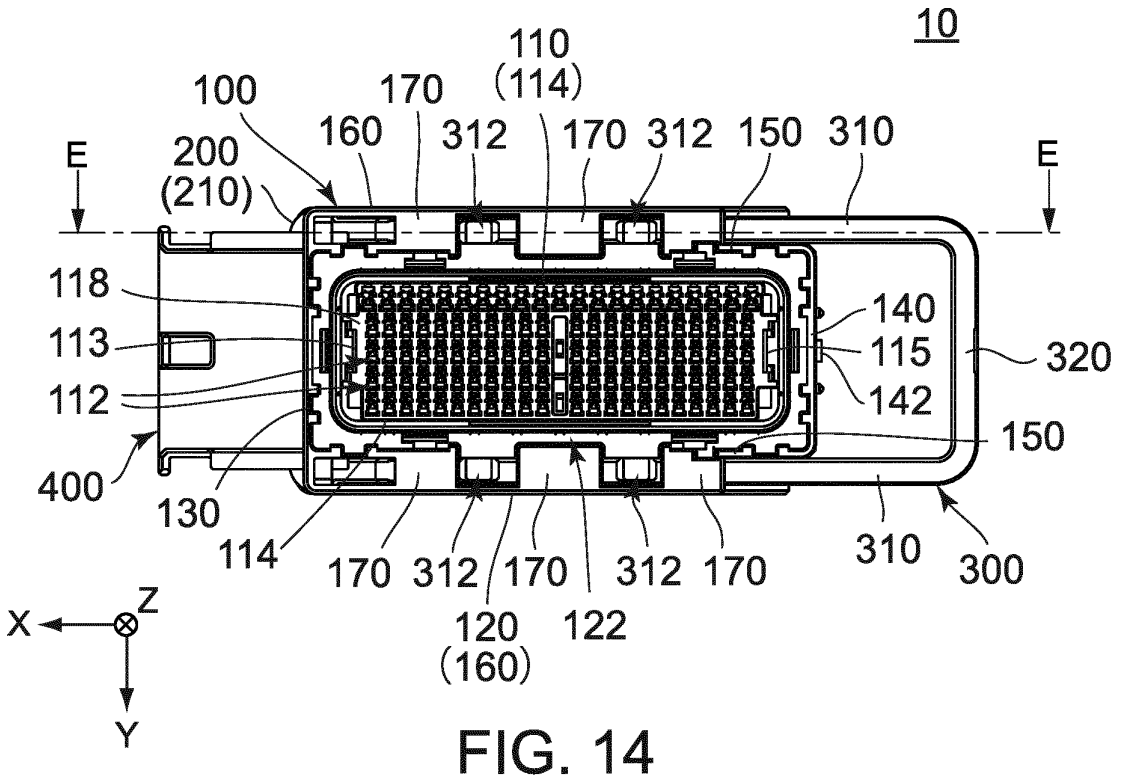

10
110
(114)
100
170
160
312
170
312
150
310
E
E
200
(210)
118
113
112
400
130
114
140
115
142
320
150
310
300
170
312
170
312
170
120
(160)
122
Z
X
Y

FIG. 14

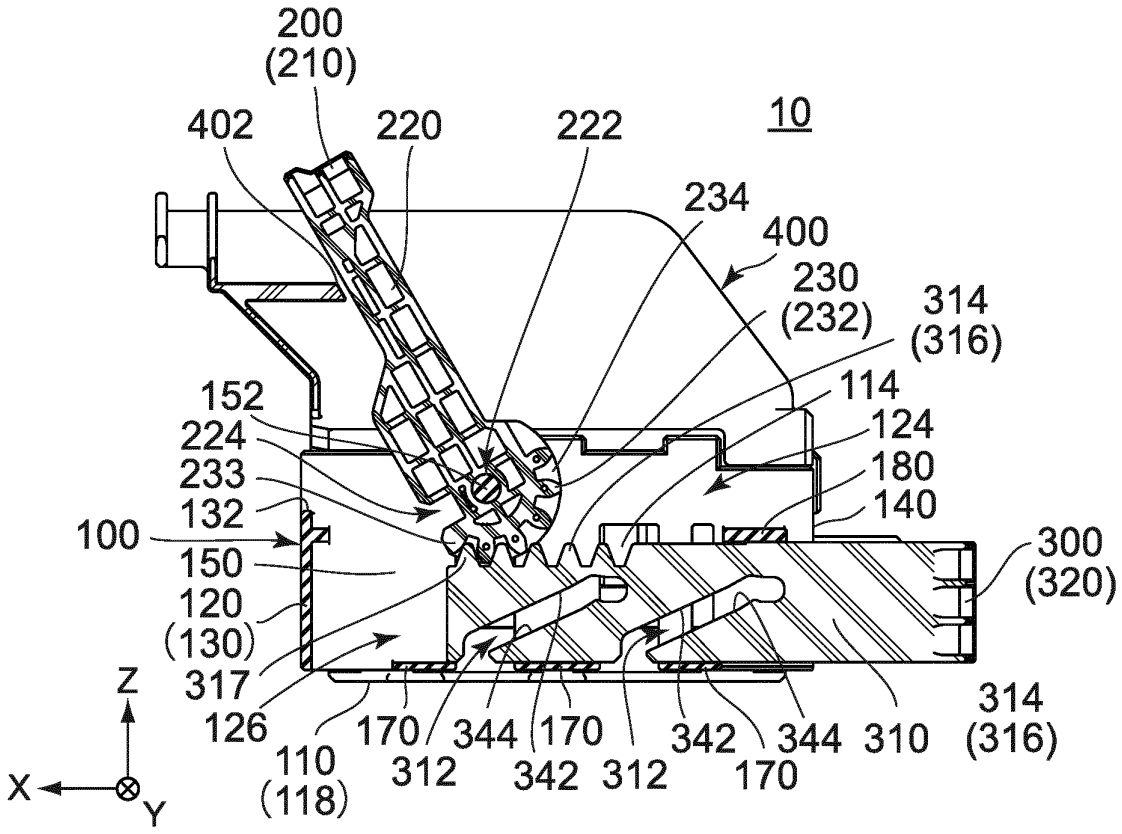

200
(210)
402
220
222
10
234
400
230
(232)
314
(316)
114
124
180
140
152
224
233
132
100
150
120
(130)
317
126
110
(118)
300
(320)
314
(316)
Z
X
Y
170
312
344
170
342
312
342
170
344
310

FIG. 15

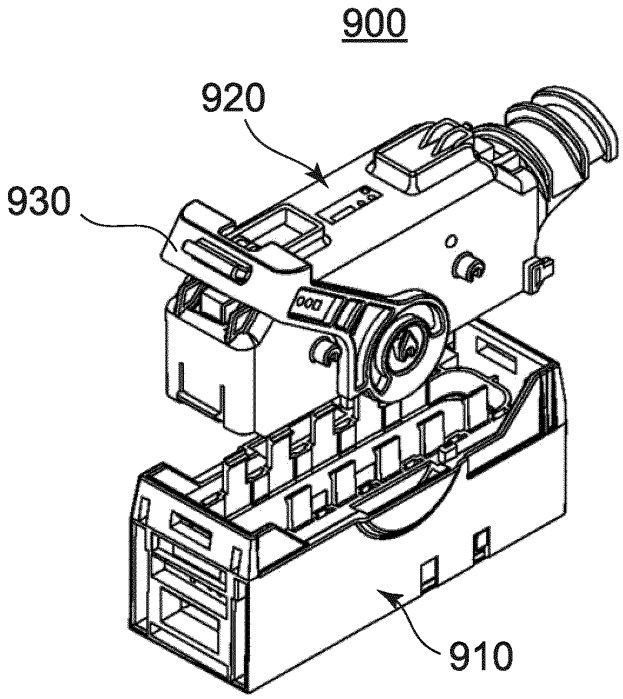

900
920
930
910

FIG. 16

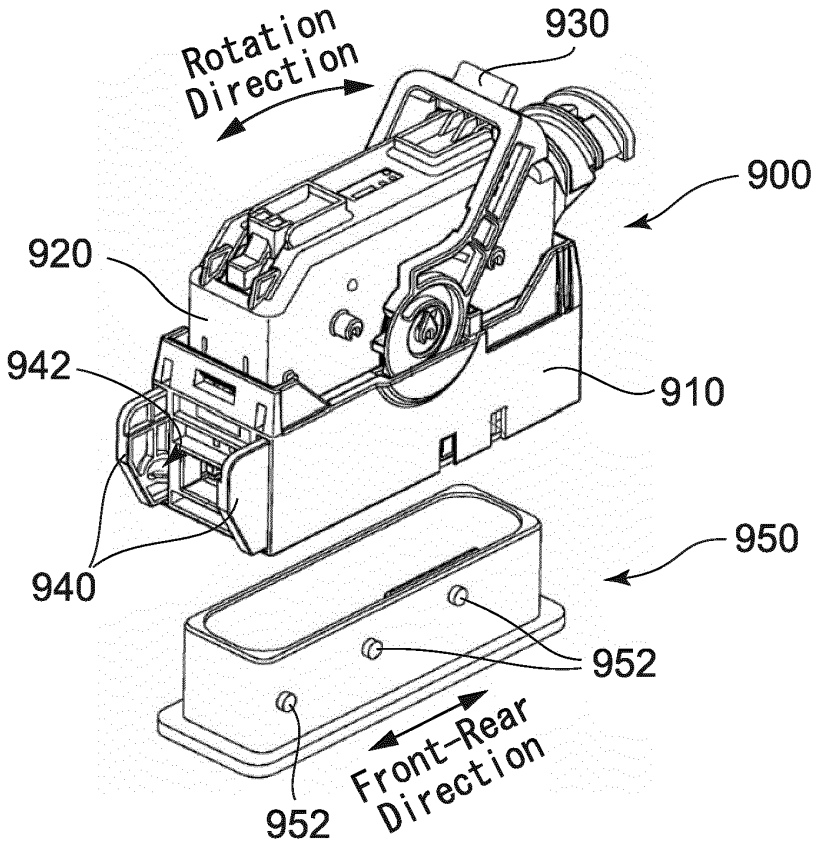

Rotation Direction
930
900
920
942
910
950
940
952
952
Front-Rear Direction

FIG. 17

## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


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