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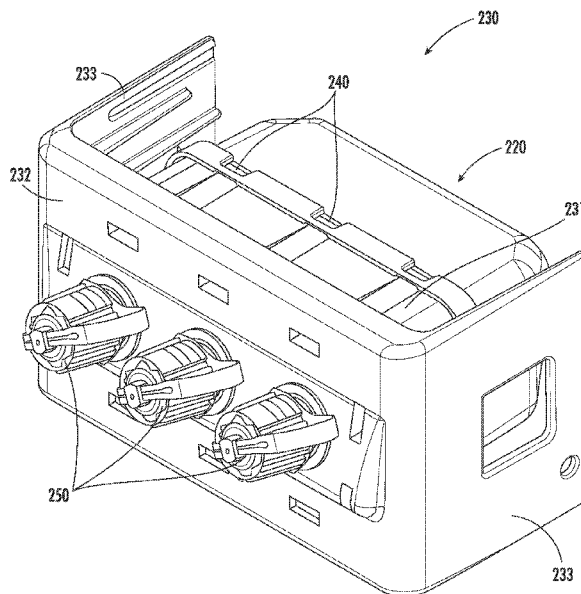


FIG. 3A

(57) Abstract: The present application is directed to a connection interface assembly. The assembly includes a base module including a back wall defining the back of the base module and first and second opposite side walls that project forwardly from the back wall to a front of the base module, a cable connection module configured to be inserted into a module mounting location through the front of the base module, the cable connection module having a main body coupled to or integral with a front wall to which a plurality of cable connection components are mounted, and an enclosure including a fiber tray and a cover that is configured to engage the cable connection module to form an interior cavity and seal the fiber tray therein.

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CONNECTION INTERFACES AND RELATED ASSEMBLIES

Related Application(s)

[0001] The present application claims priority from and the benefit of U.S. Provisional Patent Application Serial No. 63/353,050, filed June 17, 2022, the disclosure of which is hereby incorporated herein in its entirety.

Field

[0002] The present invention relates to telecommunications equipment, and in particular, connection interfaces suitable for managing cables and related assemblies.

Background

[0003] Antenna towers are increasingly used in communications network to provide cellular or other wireless services. Remote radio heads (RRH) coupled to or integrated with the antennas at the top of the towers transmit signals through the antennas. *See, e.g., FIG. 2*. Typically, a feeder cable is routed up the tower to the RRH from a network base station at the bottom of the tower. The feeder cable carries transmission signals and optionally power between the base station and the RRH.

[0004] Increasingly, the antenna towers are part of a Fiber to the Antenna (FTTA) network — the feeder cable is an optical cable including optical fibers carrying optical signals to the RRH. In some cases, each RRH receives a separate feeder cable (*e.g.*, a hybrid cable). In certain cases, each RRH receives a separate signal feeder cable (*e.g.*, an optical cable) and a separate power cable (*e.g.*, a coaxial cable). In other cases, a common cable (*e.g.*, a hybrid cable) can be routed up the tower and separated near the top of the tower into pigtails or additional cables routed to the respective RRH.

[0005] **FIG. 1** illustrates a known connection interface assembly **100** suitable for use in managing cables on an antenna tower in a FTTA network. Some exemplary connection interface assemblies are shown and described in U.S. Patent Publication No. 2021/0218233 to Bran de León et al., the disclosure of which is hereby incorporated herein by reference in its entirety. As shown

in **FIG. 1**, the assembly includes multiple bracket modules **170** that may be stacked together to form a base bracket **110**. Each bracket module **170** is configured to receive a cable connection module **130**. A plurality of cable connection components **150** is mounted on the cable connection module **130**. The cable connection components may include fiber optic adapters **152** which each include a first end for mating with a first fiber optic connector **154** and a second end for mating with a second fiber optic connector **154**. In addition, each bracket module **170** includes a respective mechanism **121** for attaching the module **170** to another structure **120** such as a pole, wall, rail, or other surface. Improvements to connection interface assemblies for use in a FTTA network may be desired.

Summary

[0006] A first aspect of the present invention is directed to a connection interface assembly. The assembly includes a base module, a connection module, and an enclosure. The base module has a front and a back and includes a back wall defining the back of the base module and first and second opposite side walls that project forwardly from the back wall to a front of the base module. The base module defines a module mounting location between the first and second side walls. The cable connection module has a main body coupled to or integral with a front wall to which a plurality of cable connection components are mounted. The cable connection module also includes first and second opposite side walls that project rearwardly from the front wall. The cable connection module is configured to be inserted into the module mounting location through the front of the base module. The enclosure includes a fiber tray and a cover. The cover is configured to engage the cable connection module to form an interior cavity and seal the fiber tray therein.

[0007] Another aspect of the present invention is directed to a connection interface assembly. The assembly includes a base module, a cable connection module, and an extension cover. The base module has a front and a back and includes a back wall defining the back of the base module and first and second opposite side walls that project forwardly from the back wall to a front of the base module. The base module defines a module mounting location between the first and second side walls. The cable connection module has a main body coupled to or integral with a front wall to which a plurality of cable connection components are mounted. The cable connection module also includes first and second opposite side walls that project rearwardly from the front wall. The cable connection module is configured to be inserted into the module mounting location through

the front of the base module. The extension cover includes a top member and a bottom member. The top and bottom members are configured to cooperate together to form an inner cavity sized and configured to contain the cable connection components that extend outwardly from the cable connection module when the top and bottom members are joined together.

[0008] Another aspect of the present invention is directed to a connection interface assembly. The assembly includes a base module, a cable connection module, and a mounting bracket assembly. The base module has a front and a back and includes a back wall defining the back of the base module and first and second opposite side walls that project forwardly from the back wall to a front of the base module. The base module defines a module mounting location between the first and second side walls. The cable connection module has a main body coupled to or integral with a front wall to which a plurality of cable connection components are mounted. The cable connection module also includes first and second opposite side walls that project rearwardly from the front wall. The cable connection module is configured to be inserted into the module mounting location through the front of the base module. The mounting bracket assembly is configured to secure the base module and a cable connection module to a mounting structure. The mounting bracket assembly includes a main bracket body and one or more attachment mechanisms. The main bracket body includes a plurality of protruding members extending outwardly therefrom, each protruding member configured to engage a corresponding aperture defined in the back wall of the base module.

[0009] It is noted that aspects of the invention described with respect to one embodiment, may be incorporated in a different embodiment although not specifically described relative thereto. That is, all embodiments and/or features of any embodiment can be combined in any way and/or combination. Applicant reserves the right to change any originally filed claim and/or file any new claim, accordingly, including the right to be able to amend any originally filed claim to depend from and/or incorporate any feature of any other claim or claims although not originally claimed in that manner. These and other objects and/or aspects of the present invention are explained in detail in the specification set forth below. Further features, advantages and details of the present invention will be appreciated by those of ordinary skill in the art from a reading of the figures and the detailed description of the preferred embodiments that follow, such description being merely illustrative of the present invention.

Brief Description of the Drawings

- [0010] FIG. 1 is a schematic representation of a known connection interface.
- [0011] FIG. 2 is a schematic representation of an antenna tower site in a communications network in which connection interfaces according to embodiments of the present invention may be utilized.
- [0012] FIG. 3A is a top perspective view of a connection interface according to embodiments of the present invention.
- [0013] FIG. 3B is a bottom perspective view of the connection interface of FIG. 3A.
- [0014] FIG. 3C is an exploded view of an enclosure of the connection interface of FIG. 3A.
- [0015] FIG. 4 is a photograph of an exemplary connection interface according to embodiments of the present invention with the enclosure opened.
- [0016] FIG. 5A is a bottom view of a connection interface assembly according to embodiments of the present invention.
- [0017] FIG. 5B is an exploded top perspective view of the connection interface assembly of FIG. 5A.
- [0018] FIG. 5C is an exploded bottom perspective view of the connection interface assembly of FIG. 5A.
- [0019] FIG. 5D is a cross-sectional side view of the connection interface assembly of FIG. 5A.
- [0020] FIG. 6A is a top perspective view of a connection interface assembly including an extension cover according to embodiments of the present invention.
- [0021] FIG. 6B is a side view of the connection interface assembly of FIG. 6A.
- [0022] FIG. 6C is a bottom perspective view of the connection interface assembly of FIG. 6A.
- [0023] FIG. 6D is an exploded top perspective view of the connection interface assembly of FIG. 6A.
- [0024] FIG. 6E is an exploded side view of the connection interface assembly of FIG. 6A.
- [0025] FIG. 6F is a cross-sectional side view of the connection interface assembly of FIG. 6A.
- [0026] FIG. 7A is a front perspective view of a connection interface assembly including a mounting bracket according to embodiments of the present invention.
- [0027] FIG. 7B is a rear perspective view of the connection interface assembly of FIG. 7A.
- [0028] FIG. 7C is an exploded perspective view of the connection interface assembly of FIG. 7A.

[0029] FIG. 8 is a perspective view of the mounting bracket for the connection interface assembly of FIGS. 7A-7C.

[0030] FIG. 9A is a side view of the connection interface assembly of FIGS. 7A-7C secured to a mounting structure according to embodiments of the present invention.

[0031] FIG. 9B is a top view of the connection interface assembly of FIG. 9A.

[0032] FIG. 10A is a photograph of an exemplary connection interface assembly secured to a mounting structure according to embodiments of the present invention

[0033] FIG. 10B is a photograph of exemplary connection interface assemblies stacked together and secured to a mounting structure according to embodiments of the present invention.

Detailed Description

[0034] The present invention now is described more fully hereinafter with reference to the accompanying drawings, in which embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art.

[0035] In the figures, certain layers, components, or features may be exaggerated for clarity, and broken lines illustrate optional features or operations unless specified otherwise. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art.

[0036] It will be understood that, although the terms first, second, etc. may be used herein to describe various elements, components, regions, layers and/or sections, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms are only used to distinguish one element, component, region, layer or section from another region, layer, or section. Thus, a first element, component, region, layer, or section discussed below could be termed a second element, component, region, layer or section without departing from the teachings of the present invention. The sequence of operations (or steps) is not limited to the order presented in the claims or figures unless specifically indicated otherwise.

[0037] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the specification and relevant art and should not be interpreted in an idealized or overly formal sense unless expressly so defined herein. Well-known functions or constructions may not be described in detail for brevity and/or clarity.

[0038] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising", when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

[0039] As used herein, phrases such as "between X and Y" and "between about X and Y" should be interpreted to include X and Y. As used herein, phrases such as "between about X and Y" mean "between about X and about Y." As used herein, phrases such as "from about X to Y" mean "from about X to about Y."

[0040] It will be understood that when an element is referred to as being "on", "attached" to, "connected" to, "coupled" with, "contacting", etc., another element, it can be directly on, attached to, connected to, coupled with or contacting the other element or intervening elements may also be present. In contrast, when an element is referred to as being, for example, "directly on", "directly attached" to, "directly connected" to, "directly coupled" with or "directly contacting" another element, there are no intervening elements present. It will also be appreciated by those of skill in the art that references to a structure or feature that is disposed "adjacent" another feature may have portions that overlap or underlie the adjacent feature.

[0041] Spatially relative terms, such as "under", "below", "lower", "over", "upper", "lateral", "left", "right" and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the

device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is inverted, elements described as "under" or "beneath" other elements or features would then be oriented "over" the other elements or features. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the descriptors of relative spatial relationships used herein interpreted accordingly.

[0042] The connection interfaces and interface assemblies according to embodiments of the present invention and described herein are suitable for use in managing cables on an antenna tower in a FTTA network. **FIG. 2** illustrates an example antenna tower site **10** in a communications network, such as a FTTA network. The site **10** includes an antenna tower **20** at which one or more antennas and one or more remote radio heads (RRH) **25** can be mounted. Each RRH **25** is adapted to transmit and receive signals to and from devices (*e.g.*, mobile phone, smartphones, devices with wireless internet connectivity, etc.) of subscribers to the communications network. In certain examples, the RRH **25** may be integrated into the antennas.

[0043] In certain examples, one or more of the connection interface assemblies (or connection interface) **100, 200, 300, 400, 600** shown and described herein are mounted to the antenna tower **20**. One or more feeder cables **50** (*e.g.*, fiber optic cables, electrical cables, hybrid cables) extend between the connection interface assemblies **100, 200, 300, 400, 600** and the network base station. One end of the one or more cables **50** engages inner/rear ports of the cable connection components **150, 250** of the connection interface assemblies **100, 200, 300, 400, 600**. Additional cables **55** connect each RRH **25** to outer/front ports of the cable connection components **150, 250** of the connection interface(s) **100, 200, 300, 400, 600**.

[0044] According to some embodiments, the additional cables **55** can be routed from the RRH **25** to the connection interface **100, 200, 300, 400, 600** during an initial installation of the RRH **25**, even if a feeder cable **50** has not yet been routed to the antenna tower **20**. Subsequently, one or more feeder cables **50** can be routed to the antenna tower **20** to the connection interface **100, 200, 300, 400, 600** to connect to the additional cables **55**. Accordingly, such a design reduces the amount of cable routing performed on the antenna tower **20** during subsequent installation of a feeder cable **50**. The connection interface **100, 200, 300, 400, 600** can also be used at other positions in a communications network.

[0045] Referring now to **FIGS. 3A-4**, a cable connection module **230** according to embodiments of the present invention is illustrated. The cable connection module **230** is a component of a

connection interface assembly **200** according to embodiments of the present invention and illustrated in **FIGS. 5A-5D**. The connection interface assembly **200** is similar to the assembly **100** and module **130** described herein. The assembly **200** differs from assembly **100** in that the assembly **200** includes an enclosure **220** integrated into the cable connection module **230**. In some embodiments, the cable connection module **230** comprises a coarse wave division multiplexing (CWDM) module **255** (*see, e.g., FIG. 7*). In other embodiments, the cable connection module **230** comprises a dense wave division multiplexing (DWDM) module. The connection interface assembly **100** described above utilizes hardened (ruggedized) connectors **154** (*e.g., IP-16 LC connectors*) at both ends of the cable connection module **130** which are specifically designed for outdoor applications and harsh environments. In contrast, the CWDM or DWDM modules **255** utilized in the connection interface assembly **200** of the present invention are not designed for outdoor applications. The CWDM or DWDM module **255** allows one fiber optic cable **258** to be split into multiple fiber optic cables **258** (*e.g., 2, 3, 4, ... 12, 16, etc.*), and thus, additional protection from certain environmental conditions (*e.g., moisture, rain, snow, etc.*) is needed. As discussed in further detail below, the connection interface assembly **200** of the present invention (*i.e., the cable connection **230** and enclosure **220***) provides a watertight seal to help protect the fiber optic cables **258** and CWDM or DWDM module **255** contained within the enclosure **220** from harsh environmental conditions (*see, e.g., FIG. 4*).

[0046] As shown in **FIGS. 3A-3C** and **FIG. 4**, the cable connection module **230** includes a main body (or bulkhead) **231** coupled to or integral with a front wall **232**. The main body **231** defines an interior cavity **235**. The cable connection module **230** also includes opposite first and second side walls **233** that project rearwardly from the front wall **232**. In some embodiments, the front wall **232** and the first and second side walls **233** of the cable connection module **230** cooperate to define a C-shaped configuration when viewed from an end of the cable connection module **230**. A rear of the cable connection module **230** is open. The main body **231** (and front wall **232**) includes one or more openings or apertures **231a** for receiving one or more of the cable connection components **250** (*see, e.g., FIG. 3C*). In other embodiments, the cable connection components **250** can be otherwise secured to the cable connection module **230**. The cable connection components **250** may include, for example, fiber optic adapters **252** configured to connect to a fiber optic connector **256**. In other examples, the cable connection components **250** include plug connectors (*e.g., optical plug connectors, electrical plug connectors, hybrid plug connectors, etc.*),

optical cable fanouts, splice holders for optical and/or electrical splices, or other such cable interfaces. In some embodiments, the cable connection module **230** may be formed from a polymeric material, for example, polycarbonate. As mentioned above and discussed in further detail below, the cable connection module **230** further includes an enclosure **220**. The enclosure **220** is configured to engage the main body **231**.

[0047] **FIG. 3C** illustrates an exploded view of the cable connection module **230** and the enclosure **220**. As shown in **FIG. 3C**, the enclosure **220** includes a fiber tray **222** and a cover **224**. The fiber tray **222** includes a bottom **222b** and one or more side walls **221**. A front of the fiber tray **222** is open and at least a portion of a rear of the fiber tray **222** has an opening **226** sufficient to allow one or more fiber optic cables **258** from a cable connection component **250** to be routed into the tray **222**. As shown in **FIG. 4**, the fiber tray **222** is sized and configured to hold the CWDM or DWDM module **255** and fiber optic cables **258** being routed and split therefrom.

[0048] At least a portion of the fiber tray **222** is configured to be slidably received and secured within the interior cavity **235** of the main body **231**. For example, as shown in **FIG. 4**, in some embodiments, about half of the fiber tray **222** is received within the interior cavity **235** of the main body **231**. In some embodiments, to assist in sliding the fiber tray **222** into the main body **231**, the fiber tray **222** may comprise a rail **222r** extending outwardly from the bottom **222b** (*see, e.g., FIG. 3C*) which is configured to be received by a corresponding slot (not shown) along an inner surface of the main body **231**.

[0049] In some embodiments, the fiber tray **222** may further include one or more cable organizing members **223**. As shown in **FIG. 3C**, the cable organizing members **223** may extend inwardly and generally perpendicularly from the bottom portion **222b** of the tray **222**. As shown in **FIG. 4**, the cable organizing members **223** are positioned such that any excess length of the fiber optic cables **258** may be wrapped around the cable organizing members **223**. In some embodiments, as shown in **FIG. 3C** and **FIG. 4**, each cable organizing member **223** may include an arm member **223a** extending outwardly therefrom. The respective arm members **223a** may help to contain or hold any excess length of the fiber optic cables **258** wrapped around the cable organizing members **223** and within the tray **222**. In some embodiments, additional arm members **221a** may extend inwardly from the one or more side walls **221**. Similar to the arm members **223a** extending from the cable organizing members **223**, the additional arm

members **221a** extending from the side walls **221** may further help to contain or hold any excess length of the fiber optic cables **258** within the boundaries of the tray **222**.

[0050] The cover **224** of the enclosure **220** has an outer wall that defines an interior cavity **225**. The outer wall of the cover **224** has an opening or aperture **224a** for receiving a cable connection components **250** (*see, e.g., FIG. 3B*). The cover **224** is configured to engage the main body **231** to surround the fiber tray **222** such that the fiber tray **222** is contained within the interior cavities **225**, **235** of the cover **224** and the main body **231**.

[0051] The enclosure **220** further includes an annular sealing gasket **228** that resides between the cover **224** and the main body **231** when secured together. The sealing gasket **228** helps form a watertight seal between the cover **224** and main body **231** to further protect the fiber optic cables **258** and CWDM or DWDM module **255** within the enclosure **220** from environmental conditions.

[0052] The cover **224** is secured to the main body **231** via one or more securing features **240**. In some embodiments, the securing features **240** may comprise a snap-fit mechanism. For example, as shown in **FIG. 3C** and **FIG. 4**, in some embodiments, the cover **224** may include one or more recesses or apertures **227** and the main body **231** may include one or more corresponding latches or protrusions **237** that are configured to engage the one or more recesses or apertures **227** to secure the cover **224** to the main body **231**. In other embodiments, the one or more recesses or apertures **227** may reside on the main body **231** and the corresponding latches or protrusions **237** may reside on the cover **224**. In some embodiments, the components of the enclosure **220** (*i.e.*, the fiber tray **222** and/or cover **224**) may be formed from a polymeric material, for example, polycarbonate.

[0053] Referring now to **FIGS. 5A-5D**, in some embodiments, the cable connection module **230** is adapted to be inserted into a base module **270** which together define the connection interface assembly **200** according to embodiments of the present invention. Similar to the cable connection module **230**, the base module **270** may be formed from a polymeric material, for example, polycarbonate. The base module **270** includes a back wall **272** and opposite first and second side walls **273** that project forwardly from the back wall **272**. Similar to the cable connection module **230**, the back wall **272** and the first and second side walls **273** of the base module **270** cooperate to define a C-shaped configuration when viewed from an end of the base module **270**. The back wall **272** may comprise a plurality of mounting apertures **276** which may be used to

secure the connection interface assembly **200** to a mounting structure **120** (*e.g.*, a mounting pole) (*see, e.g.*, **FIG. 1** and **FIGS. 9A-10B**).

[0054] The cable connection module **230** is sized and configured to be inserted through the open front of the base module **270**. In some embodiments, the base module **270** defines a pair of module mounting locations **274** between the first and second side walls **273** for receiving the cable connection module **230**. In some embodiments, each of the module mounting locations **274** of the base module **270** may include a flexible finger **274f** with an end or stop member. The flexible finger **274f** is configured to snap into an aperture **233a** defined in each side wall **233** of the cable connection module **230** as the cable connection module **230** is inserted into the base module **270**. The snap-fit type securing mechanism (*i.e.*, flexible finger **274f** and corresponding aperture **233a**) secures the cable connection module **230** to the base module **270**. In other examples, the side walls **273** may define apertures and the cable connection module **230** may include the deflectable stop members. In other examples, the cable connection module **230** may otherwise secure the base module **270**.

[0055] In addition, in some embodiments, the side walls **273** of the base module **270** include first and second receptacles **275** at the module mounting locations **274** for respectively receiving the side walls **233** of the cable connection module **230**. In some embodiments, the first and second receptacles **275** are bounded by guide walls **274w** that protrude inwardly from the side walls **273** of the base module **270**. The guide walls **274w** help to guide the side walls **233** of the cable connection module **230** as the cable connection module **230** is being inserted into the base module **270**.

[0056] Still referring to **FIGS. 5A-5D**, in some embodiments, the connection interface assembly **200** of the present invention may further include a top cover **210**. The top cover **210** is configured to engage the connection module **230** and/or the base module **270** to further protect the enclosure **220** residing therebetween. For example, in some embodiments, a front edge of the top cover **210** may be angled upwardly to define a lip or flanged edge **210e**. The flanged front edge **210e** is configured to engage a corresponding edge or lip **231e** residing along a top inner surface of the cable connection module **230**. In addition, in some embodiments, the top cover **210** further comprises a pair of deflectable arms **212**, each arm **212** extending outwardly from opposite sides of the top cover **210**. Each arm **212** is configured to snap into a corresponding aperture or slot **271** defined in each side wall **273** of the base module **270**. After the cable connection

module **230** has been inserted into and secured to the base module **270**, the flanged front edge **210e** of the top cover **210** may be engaged with the edge or lip **231e** of the cable connection module **230**. The top cover **210** may then be pressed downwardly to snap each deflectable arm **212** into engagement with the respective slot **271** in the side wall **273** of the base module **270** (*see also, e.g., FIGS. 6A-6B*).

[0057] Referring now to **FIGS. 6A-6F**, a connection interface assembly **300** according to embodiments of the present invention is illustrated. Properties and/or features of the connection interface assembly **300** may be as described above in reference to the connection interface assembly **200** shown in **FIGS. 5A-5D** and duplicate discussion thereof may be omitted herein for the purposes of discussing **FIGS. 6A-6F**. In some embodiments, the connection interface assembly **300** differs from the connection interface assembly **200** described herein in that the connection interface assembly **300** includes an extension cover **350**. As described in further detail below, the extension cover **350** is configured to protect the cable connection components **250** extending outwardly from the front wall **232** of the cable connection module **230** of connection interface assembly **300**.

[0058] As shown in **FIGS. 6A-6F**, the extension cover **350** includes a top member **352** and a bottom member **354**. The top and bottom members **352, 354** cooperate together to form an inner cavity **355**. The inner cavity **355** is sized and configured to contain the cable connection components **250** that extend outwardly from the cable connection module **230** therein (*i.e.*, when the top and bottom members **352, 354** are joined together).

[0059] In some embodiments, the top and bottom members **352, 354** of the extension cover **350** may be releasably secured together via one or more securing features **360**. Similar to other securing features described herein, the one or more securing features **360** of the extension cover **350** may comprise a snap-fit mechanism, such as cantilevered latches. For example, as shown in **FIGS. 6D-6E**, the top member **352** may include one or more cantilever beams with tapered hooks **362**. The cantilever beams/hooks **362** are each configured to deflect and snap into a corresponding recess **364** defined in opposing side walls of the bottom member **354** as the top member **352** and bottom member **354** are joined together. The snap-fit securing mechanism locks the top and bottom members **352, 354** together with the cable connection components **250** residing therebetween (*i.e.*, within the formed inner cavity **355**). In other examples, the side walls of the top member **352** may define recesses and the bottom member **354** may include the deflectable

cantilever beams/hooks. In other examples, the top member **352** may otherwise be secured to the bottom member **354**.

[0060] In some embodiments, the extension cover **350** may be configured to be secured to the cable connection module **230** of the connection interface assembly **300**. As shown in **FIG. 6B**, **FIG. 6D**, **FIG. 6E**, and **FIG. 6F**, in some embodiments, the top and bottom members **352**, **354** of the extension cover **350** may include respective hooking members **351**, **353** extending outwardly therefrom. The hooking members **351**, **353** are configured to engage corresponding recesses **301**, **303** in the cable connection module **230**. The hooking members **351**, **353** (when engaged with a corresponding recess **301**, **303**) help prevent the extension cover **350** from being pulled away from the cable connection module **230** (and connection interface assembly **300**). In some embodiments, the hooking members **351**, **353** may extend along the width of the top and bottom members **352**, **354** and the corresponding recesses **301**, **303** may extend along the width of the cable connection module **230**. In some embodiments, the hooking members **351**, **353** and corresponding recesses **301**, **303** may form a snap-fit mechanism. For example, the hooking members **351**, **353** may be configured to deflect and snap into the recesses **301**, **303** defined in the cable connection module **230**.

[0061] As shown in **FIG. 6C**, in some embodiments, the top and bottom members **352**, **354** may comprises a plurality of apertures **352a** and/or slots **354a**. The apertures and slots **352a**, **354a** help prevent dirt, debris, bugs, etc. from getting trapped within the extension cover **350**. The apertures and slots **352a**, **354a** also help to reduce the overall weight of the extension cover **350**. While **FIG. 6C** illustrates apertures **352a** in the top member **352** and slots **354a** in the bottom member **354**, any configuration of apertures **352a** and/or slots **354a** may be used in the top and bottom members **352**, **354** of the extension cover **350**.

[0062] Referring now to **FIGS. 7A-7C**, a connection interface mounting assembly **400** according to embodiments of the present invention is illustrated. The connection interface mounting assembly **400** includes a separate mounting bracket assembly **500** that is configured to mount and secure the connection interface assemblies **200**, **300** described herein to a mounting structure **120** (e.g., a mounting pole) (see, e.g., **FIGS. 9A-10B**). As discussed in further detail below, the mounting bracket assembly **500** provides additional space behind the connection interface assembly **300** (i.e., between the connection interface assembly **300** and the mounting

structure **120**). The additional space may allow telecommunications equipment to be mounted on the back side of the mounting structure **120**.

[0063] The mounting bracket assembly **500** is illustrated in **FIG. 8**. As shown in **FIG. 8**, the mounting bracket assembly **500** includes a main bracket body **510** and one or more attachment mechanisms **520**. In some embodiments, the attachment mechanism **520** may include a cable tie, zip tie, or other such wrap-style fastener than can be threaded through apertures **502** in the main bracket body **510** and wrapped around the mounting structure **120** (*see, e.g.*, **FIGS. 9A-10B**). In other embodiments, the attachment mechanism **520** may include screws, peg-type fasteners, latches, tabs, flanges, or other structures to aid in securing the connection interface assembly **200**, **300** to the mounting structure **120**.

[0064] The main bracket body **510** includes a plurality of protruding members **505** extending outwardly therefrom. The protruding members **505** are each configured to engage a corresponding aperture **276** defined in the back wall **272** of the base module **270** (*see, e.g.*, **FIG. 5B** and **FIG. 5C**) to secure the main bracket body **510** to the base module **270**. In some embodiments, one or more of the protruding members **505** and apertures **276** may form a snap-fit mechanism, such as the cantilevered latches described herein. For example, as shown in **FIG. 8**, some of the protruding members **505** may include tapered hooks **505a**. As the main bracket body **510** and base module **270** are joined together, the protruding members **505** (and hooks **505a**) are configured to deflect and snap into a respective aperture **276** in the back wall **272** of the base module **270**, thereby securing the mounting bracket assembly **500** to the connection interface assembly **200**, **300** (*i.e.*, base module **270**).

[0065] In some embodiments, the main bracket body **510** may further include one or more recesses **503** configured to receive a portion of the mounting structure **120**. The recesses **503** may increase the contact surface area between the mounting bracket assembly **500** and the mounting structure **120**, and thus, allowing for a more secure fit against the mounting structure **120**. For example, in some embodiments, the recesses **503** may be concave to receive a cylindrical mounting pole **120**. However, other shape profiles for the recesses **503** may be used. Similar to the cable connection module **230** and base module **270** described herein, the main bracket body **510** may be formed from a polymeric material, for example, polycarbonate.

[0066] **FIGS. 9A-9B** and **FIGS. 10A-10B** illustrate the mounting bracket assembly **500** securing the connection interface assembly **300** to the mounting structure **120** according to embodiments of

the present invention. **FIGS. 10A-10B** are photographs of an exemplary connection interface assembly **300** secured to a mounting structure **120** utilizing an exemplary mounting bracket assembly **500**. **FIG. 10A** shows a single connection interface assembly **300** secured to a mounting structure **120** according to embodiments of the present invention. In some embodiments, as shown in **FIG. 10B**, multiple connection interface assemblies **300-1**, **300-2** may be stacked together and secured to the mounting structure **120**. In some embodiments, the stacked connection interface assemblies **300-1**, **300-2** may be secured to the mounting structure **120** by the mounting bracket assembly **500** described herein. In other embodiments, one of the connection interface assembly **300-1** may be secured to the mounting structure **120** utilizing the mounting bracket assembly **500** described herein and the other connection interface assembly **300-2** may contact the mounting structure **120** utilizing a mounting bracket assembly **500'** having an alternative main bracket body **510'**. As shown in **FIG. 10B**, in some embodiments, the alternative main bracket body **510'** may not include apertures **502** for threading the wrap-style fastener, but instead may include opposing arm members **512'** that brace the mounting bracket assembly **500'** (and connection interface assembly **300-2**) against the mounting structure **120**.

[0067] The foregoing is illustrative of the present invention and is not to be construed as limiting thereof. Although a few exemplary embodiments of this invention have been described, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention as defined in the claims. The invention is defined by the following claims, with equivalents of the claims to be included therein.

That which is claimed is:

1. A connection interface assembly, the assembly comprising:
a base module having a front and a back, the base module including a back wall defining the back of the base module and first and second opposite side walls that project forwardly from the back wall to a front of the base module, the base module defining a module mounting location between the first and second side walls;
a cable connection module having a main body coupled to or integral with a front wall to which a plurality of cable connection components are mounted, the cable connection module also including first and second opposite side walls that project rearwardly from the front wall, wherein the cable connection module is configured to be inserted into the module mounting location through the front of the base module; and
an enclosure, the enclosure comprising a fiber tray and a cover, wherein the cover is configured to engage the cable connection module to form an interior cavity and seal the fiber tray therein.
2. The connection interface assembly according to Claim 1, wherein the enclosure further comprises an annular sealing gasket residing between the cover and the cable connection module.
3. The connection interface assembly according to any one of the preceding claims, wherein the fiber tray includes a bottom and one or more side walls, a front of the fiber tray is open and at least a portion of a rear of the fiber tray has an opening sufficient to allow one or more fiber optic cables from a cable connection component to be routed into the tray.
4. The connection interface assembly according to any one of the preceding claims, wherein at least a portion of the fiber tray is configured to be slidably received and secured within an interior cavity of the main body.

5. The connection interface assembly according to any one of Claims 3 or 4, wherein the fiber tray comprises a rail extending outwardly from the bottom, the rail being configured to be received by a corresponding slot along an inner surface of the main body.

6. The connection interface assembly according to any one of the preceding claims, wherein the fiber tray further comprises one or more cable organizing members.

7. The connection interface assembly according to Claim 6, wherein the one or more cable organizing members extend inwardly and generally perpendicularly from the bottom portion of the tray and are positioned such that any excess length of the fiber optic cables within the fiber tray can be wrapped around the cable organizing members.

8. The connection interface assembly according to any one of Claims 6 or 7, wherein each cable organizing member comprises an arm member extending outwardly therefrom, the respective arm members configured to hold any excess length of the fiber optic cables wrapped around the cable organizing members within the tray.

9. The connection interface assembly according to any one of the preceding claims, further comprising one or more arm members extending inwardly from the one or more side walls, the one or more arm members configured to hold any excess length of the fiber optic cables within the tray.

10. The connection interface assembly according to any one of the preceding claims, wherein the cover of the enclosure comprises an outer wall that defines an interior cavity, the outer wall having an opening for receiving a cable connection component.

11. The connection interface assembly according to any one of the preceding claims, wherein the cover is secured to the main body via one or more securing features.

12. The connection interface assembly according to Claim 11, wherein the one or more securing features comprise a snap-fit mechanism.

13. The connection interface assembly according to any one of Claims 11 or 12, wherein the cover comprises one or more recesses or apertures and the main body of the cable connection module comprises one or more corresponding latches or protrusions that are configured to engage the one or more recesses or apertures to secure the cover to the main body.

14. The connection interface assembly according to any one of the preceding claims, wherein a pair of module mounting locations reside between the first and second side walls for receiving the cable connection module.

15. The connection interface assembly according to any one of the preceding claims, wherein the module mounting location includes one or more flexible fingers configured to snap into an aperture defined in each side wall of the cable connection module as the cable connection module is inserted into the base module.

16. The connection interface assembly according to any one of the preceding claims, wherein the side walls of the base module include first and second receptacles at the module mounting location for respectively receiving the side walls of the cable connection module.

17. The connection interface assembly according to Claim 16, wherein the first and second receptacles are bounded by guide walls that protrude inwardly from the side walls of the base module.

18. The connection interface assembly according to any one of the preceding claims, further comprising a top cover.

19. The connection interface assembly according to Claim 18, wherein the top cover is configured to engage the connection module and/or the base module.

20. The connection interface assembly according to Claim 19, wherein a front edge of the top cover may be angled upwardly to define a lip or flanged edge, the flanged front

edge being configured to engage a corresponding edge or lip residing along a top inner surface of the cable connection module.

21. The connection interface assembly according to any one of Claims 19 or 20, wherein the top cover comprises a pair of deflectable arms, each arm extending outwardly from opposite sides of the top cover and configured to snap into a corresponding aperture or slot defined in each side wall of the base module.

22. The connection interface assembly according to any one of the preceding claims, wherein the base module, the cable connection module and/or the enclosure are formed from a polymeric material.

23. A connection interface assembly, the assembly comprising:
a base module having a front and a back, the base module including a back wall defining the back of the base module and first and second opposite side walls that project forwardly from the back wall to a front of the base module, the base module defining a module mounting location between the first and second side walls;
a cable connection module having a main body coupled to or integral with a front wall to which a plurality of cable connection components are mounted, the cable connection module also including first and second opposite side walls that project rearwardly from the front wall, wherein the cable connection module is configured to be inserted into the module mounting location through the front of the base module; and
an extension cover comprising a top member and a bottom member, the top and bottom members being configured to cooperate together to form an inner cavity sized and configured to contain the cable connection components that extend outwardly from the cable connection module when the top and bottom members are joined together.

24. The connection interface assembly according to Claim 23, wherein the top and bottom members of the extension cover are releasably secured together via one or more securing features comprising a snap-fit mechanism.

25. The connection interface assembly according to Claim 24, wherein the snap-fit mechanism comprises cantilever shape joints.

26. The connection interface assembly according to any one of Claims 23-25, wherein the extension cover is configured to be secured to the cable connection module.

27. The connection interface assembly according to Claim 26, wherein the top and bottom members of the extension cover comprise respective hooking members extending outwardly therefrom and configured to engage corresponding recesses in the cable connection module.

28. The connection interface assembly according to any one of Claim 23-27, wherein the top and bottom members of the extension cover comprises a plurality of apertures and/or slots.

29. The connection interface assembly according to any one of Claims 23-28, further comprising an enclosure, the enclosure comprising a fiber tray, an annular sealing gasket, and a cover, wherein the cover is configured to engage the cable connection module with the annular sealing gasket residing therebetween to form an interior cavity, the fiber tray being sealed within the interior cavity.

30. The connection interface assembly according to Claim 29, wherein the fiber tray includes a bottom and one or more side walls, a front of the fiber tray is open and at least a portion of a rear of the fiber tray has an opening sufficient to allow one or more fiber optic cables from a cable connection component to be routed into the tray.

31. The connection interface assembly according to any one of Claims 29 or 30, wherein the fiber tray further comprises one or more cable organizing members.

32. The connection interface assembly according to any one of Claims 29-31, wherein the cover of the enclosure comprises an outer wall that defines an interior cavity, the outer wall having an opening for receiving a cable connection component.

33. The connection interface assembly according to any one of Claims 29-32, wherein the cover is secured to the main body via one or more securing features comprising a snap-fit mechanism.

34. The connection interface assembly according to any one of Claims 23-33, further comprising a top cover configured to engage the connection module and/or the base module.

35. The connection interface assembly according to Claim 34, wherein a front edge of the top cover may be angled upwardly to define a lip or flanged edge, the flanged front edge being configured to engage a corresponding edge or lip residing along a top inner surface of the cable connection module, and wherein the top cover comprises a pair of deflectable arms, each arm extending outwardly from opposite sides of the top cover and configured to snap into a corresponding aperture or slot defined in each side wall of the base module.

36. The connection interface assembly according to any one of Claims 23-35, wherein the base module, the cable connection module, the enclosure, and/or the extension cover are formed from a polymeric material.

37. A connection interface assembly, the assembly comprising:
a base module having a front and a back, the base module including a back wall defining the back of the base module and first and second opposite side walls that project forwardly from the back wall to a front of the base module, the base module defining a module mounting location between the first and second side walls;
a cable connection module having a main body coupled to or integral with a front wall to which a plurality of cable connection components are mounted, the cable connection module also including first and second opposite side walls that project rearwardly from the front wall,

wherein the cable connection module is configured to be inserted into the module mounting location through the front of the base module; and

a mounting bracket assembly configured to secure the base module and a cable connection module to a mounting structure, the mounting bracket assembly comprising a main bracket body and one or more attachment mechanisms, the main bracket body including a plurality of protruding members extending outwardly therefrom, each protruding member configured to engage a corresponding aperture defined in the back wall of the base module.

38. The connection interface assembly according to Claim 37, wherein the main bracket body comprises one or more apertures, and wherein the attachment mechanism comprises a cable tie, zip tie, or other such wrap-style fastener than can be threaded through the one or more apertures and wrapped around the mounting structure.

39. The connection interface assembly according to any one of Claims 37 or 38, wherein one or more of the protruding members and apertures in the base module form a snap-fit mechanism.

40. The connection interface assembly according to any one of Claims 37-39, wherein each of the protruding members include tapered hooks configured to deflect and snap into a respective aperture in the back wall of the base module, thereby securing the mounting bracket assembly to the base module.

41. The connection interface assembly according to any one of Claims 37-40, wherein the main bracket body further includes one or more recesses configured to receive a portion of the mounting structure.

42. The connection interface assembly according to any one of Claims 37-41, further comprising an extension cover comprising a top member and a bottom member, the top and bottom members being configured to cooperate together to form an inner cavity sized and configured to contain the cable connection components that extend outwardly from the cable connection module when the top and bottom members are joined together.

43. The connection interface assembly according to any one of Claims 37-42, further comprising an enclosure, the enclosure comprising a fiber tray, an annular sealing gasket, and a cover, wherein the cover is configured to engage the cable connection module with the annular sealing gasket residing therebetween to form an interior cavity, the fiber tray being sealed within the interior cavity.

44. The connection interface assembly according to any one of Claims 37-43, further comprising a top cover having a pair of deflectable arms extending outwardly from opposite sides, wherein a front edge of the top cover may be angled upwardly to define a lip or flanged edge, the flanged front edge being configured to engage a corresponding edge or lip residing along a top inner surface of the cable connection module, and wherein each deflectable arm is configured to snap into a corresponding aperture or slot defined in each side wall of the base module.

45. The connection interface assembly according to any one of Claims 37-44, wherein the base module, the cable connection module, the enclosure, the extension cover, and/or the mounting bracket assembly are formed from a polymeric material.

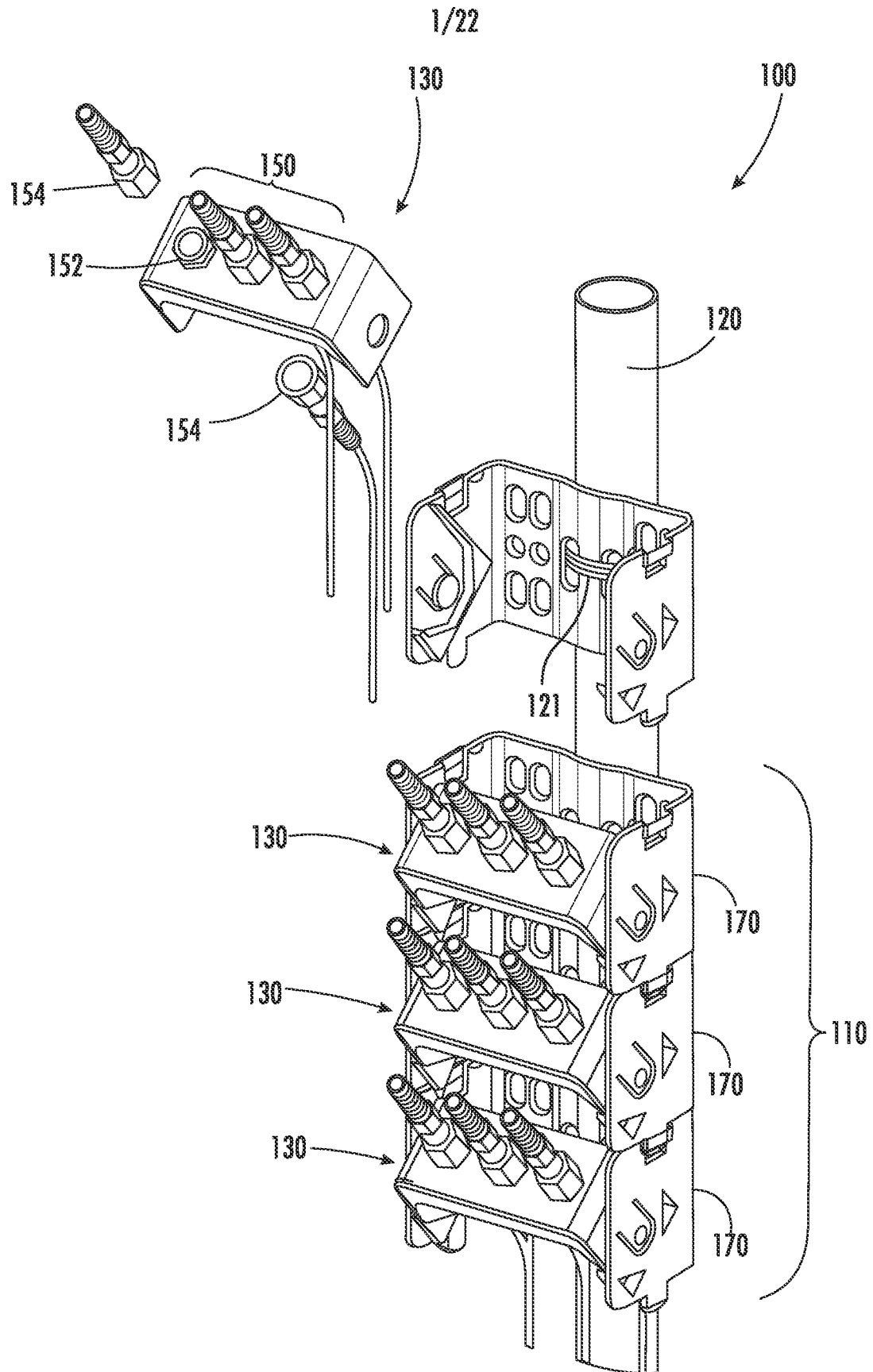


FIG. 1
(PRIOR ART)

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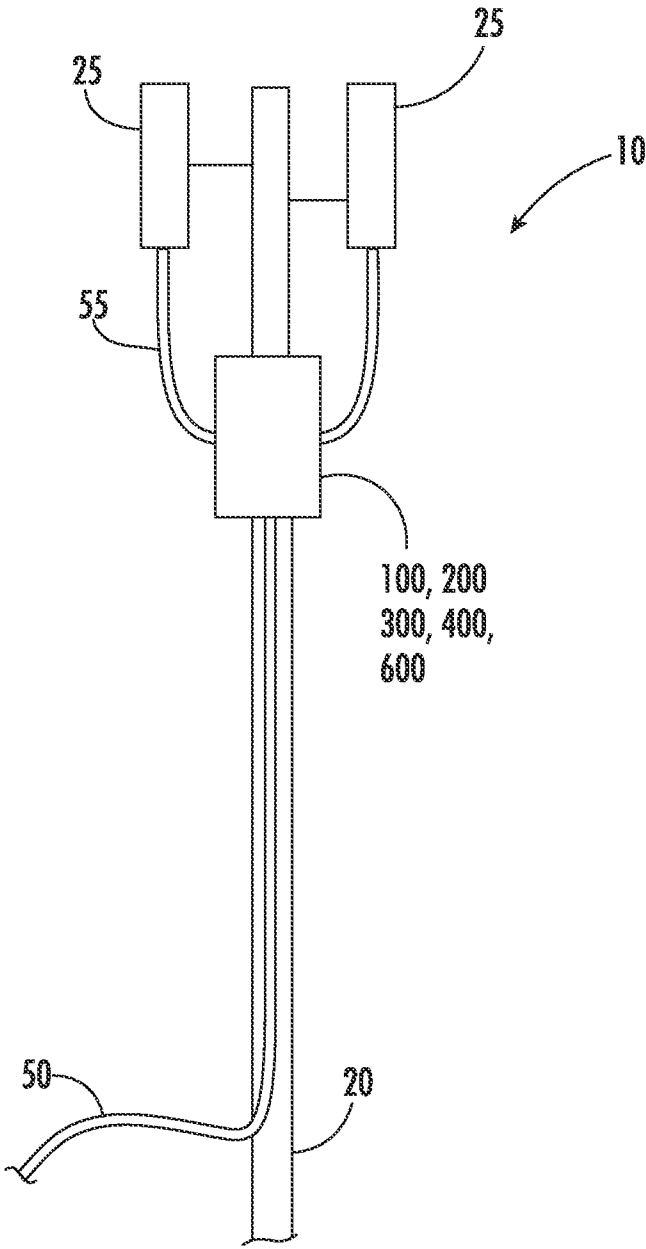


FIG. 2

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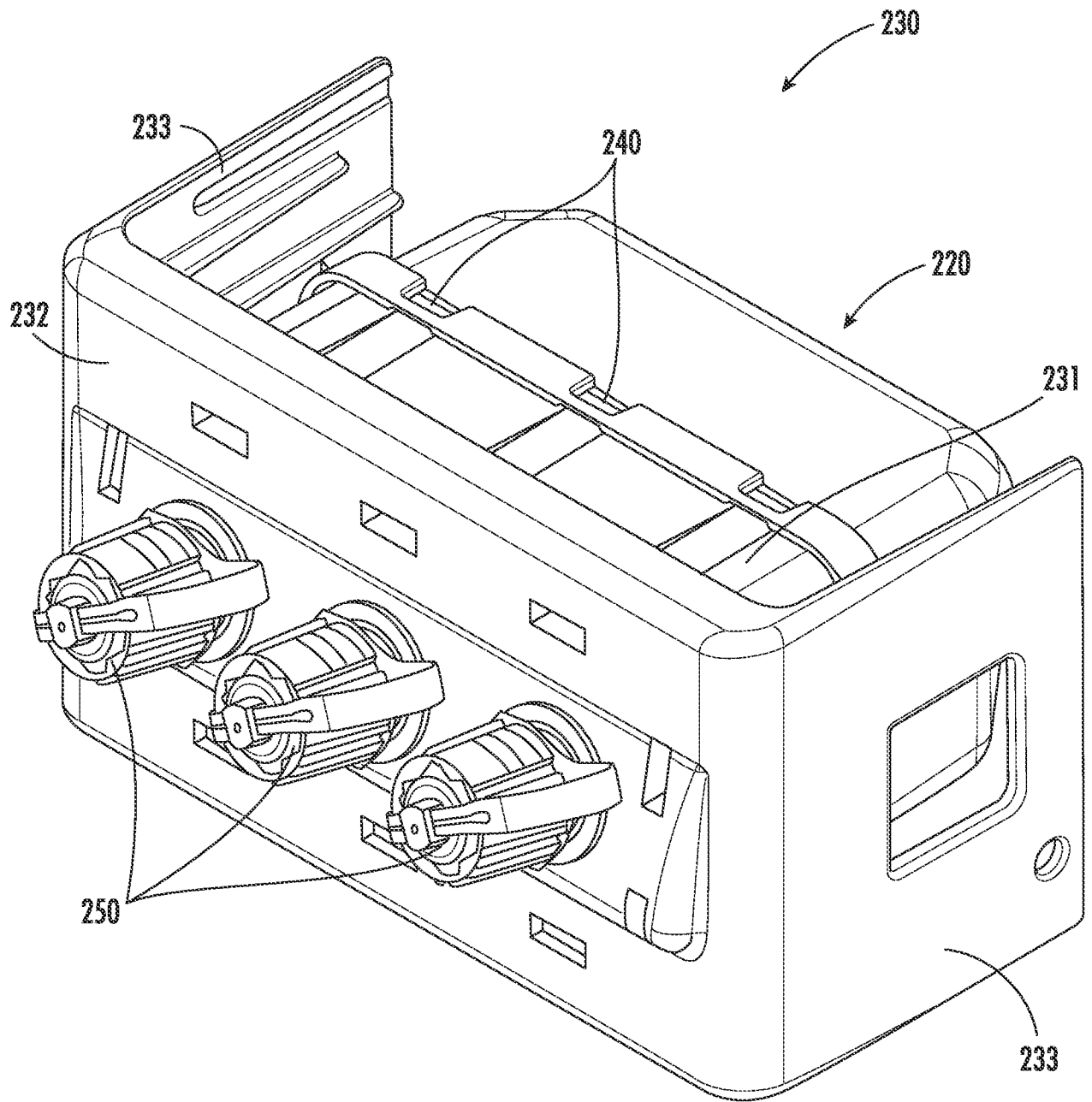


FIG. 3A

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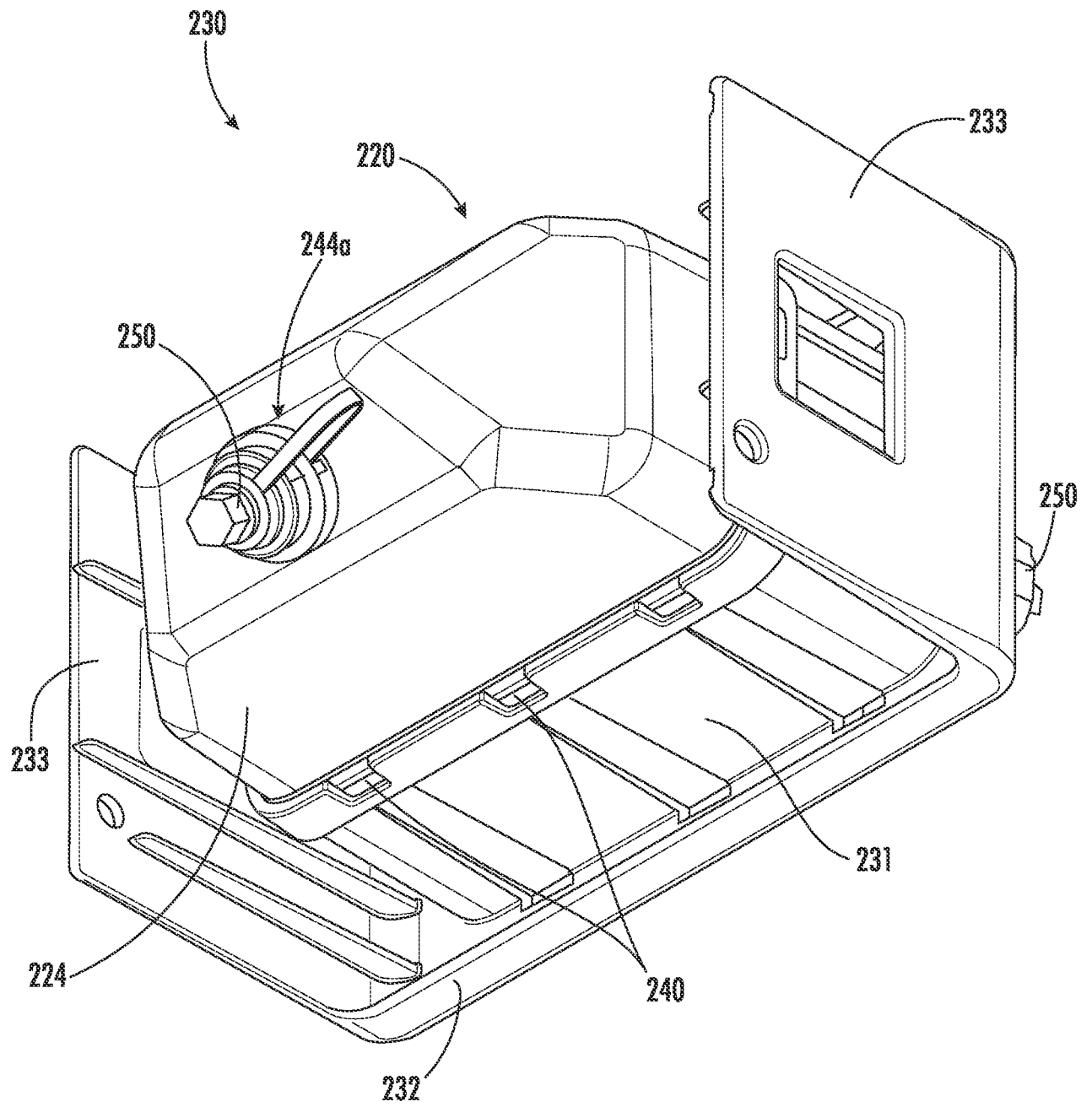


FIG. 3B

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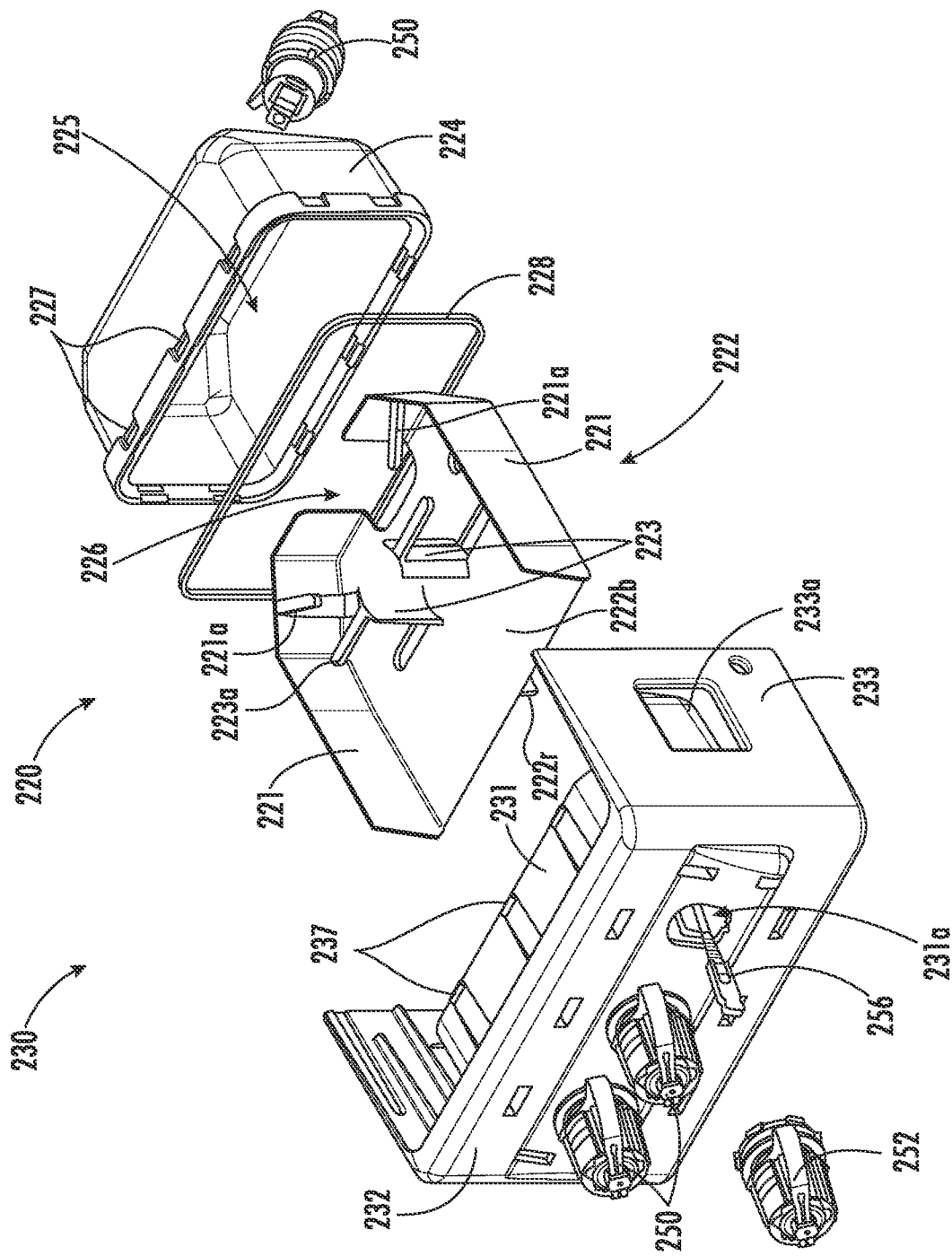


FIG. 3C

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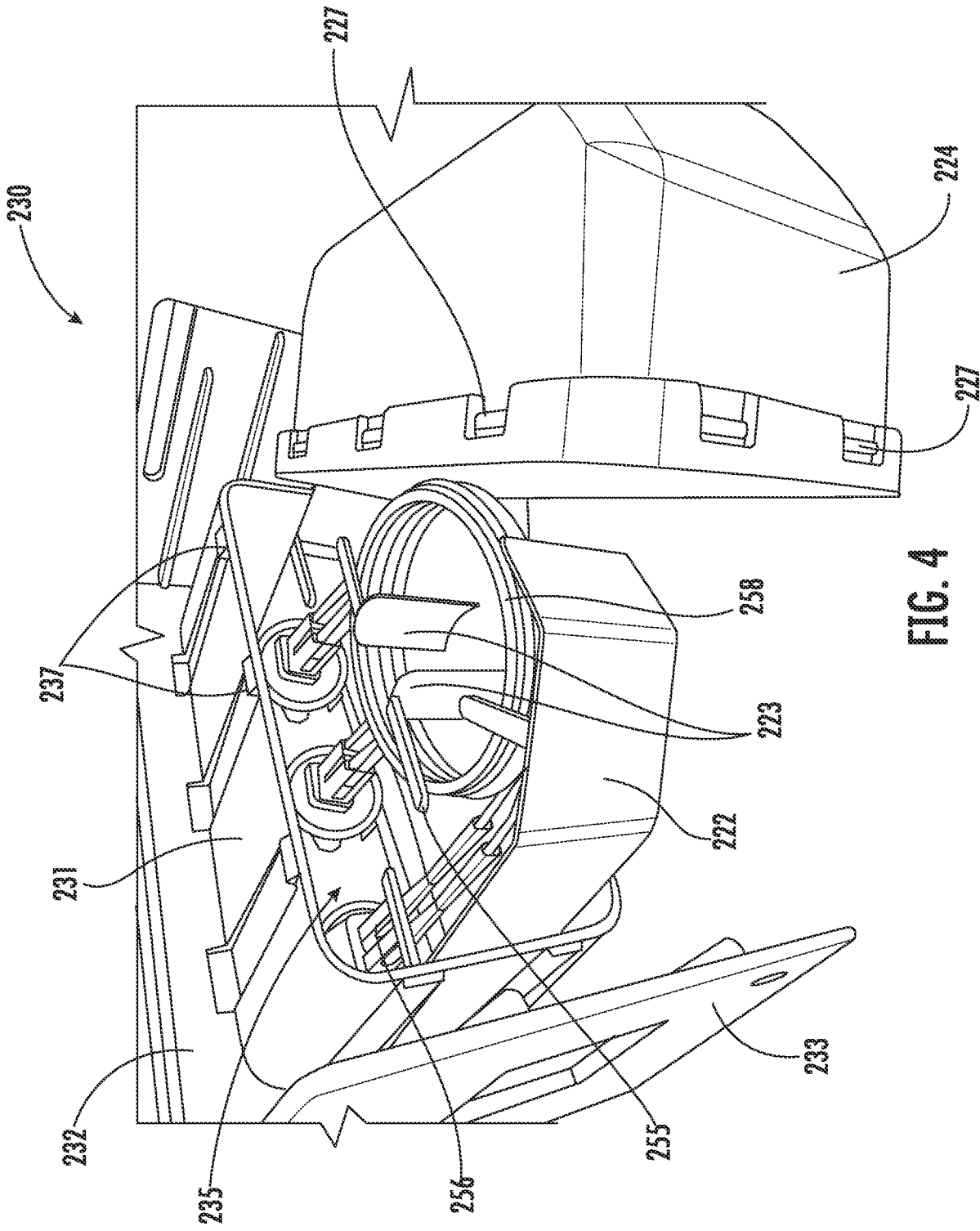


FIG. 4

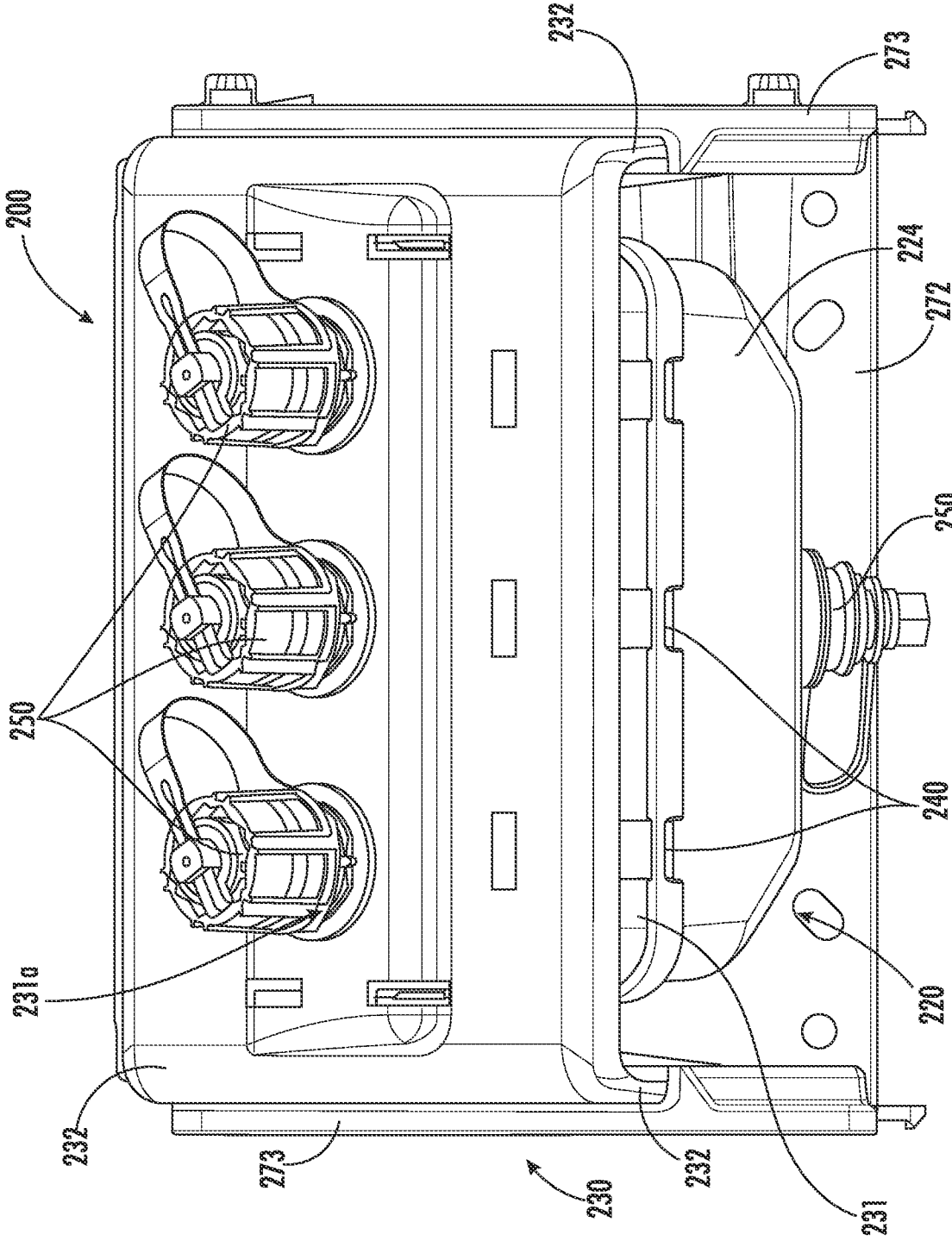


FIG. 5A

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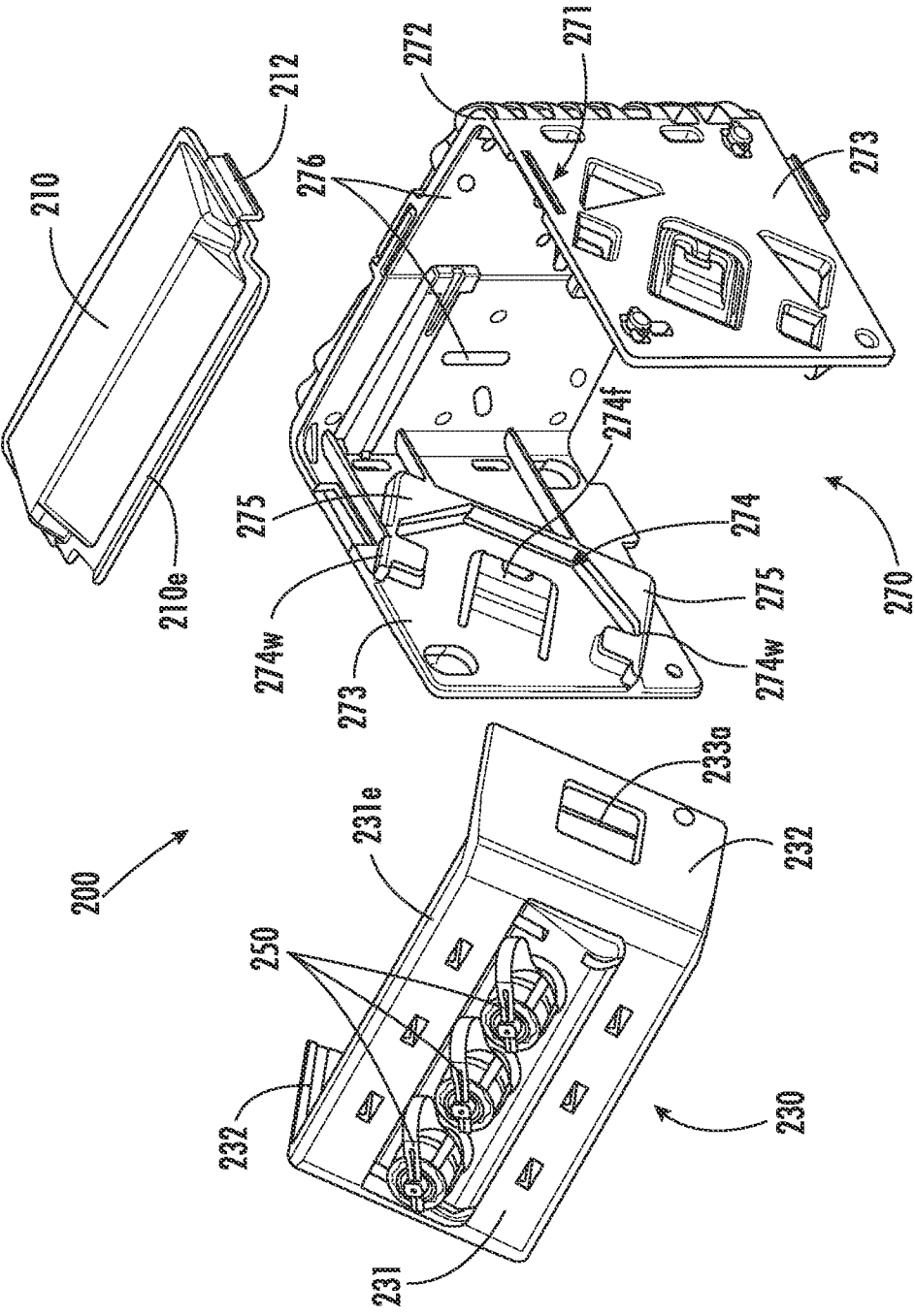


FIG. 5B

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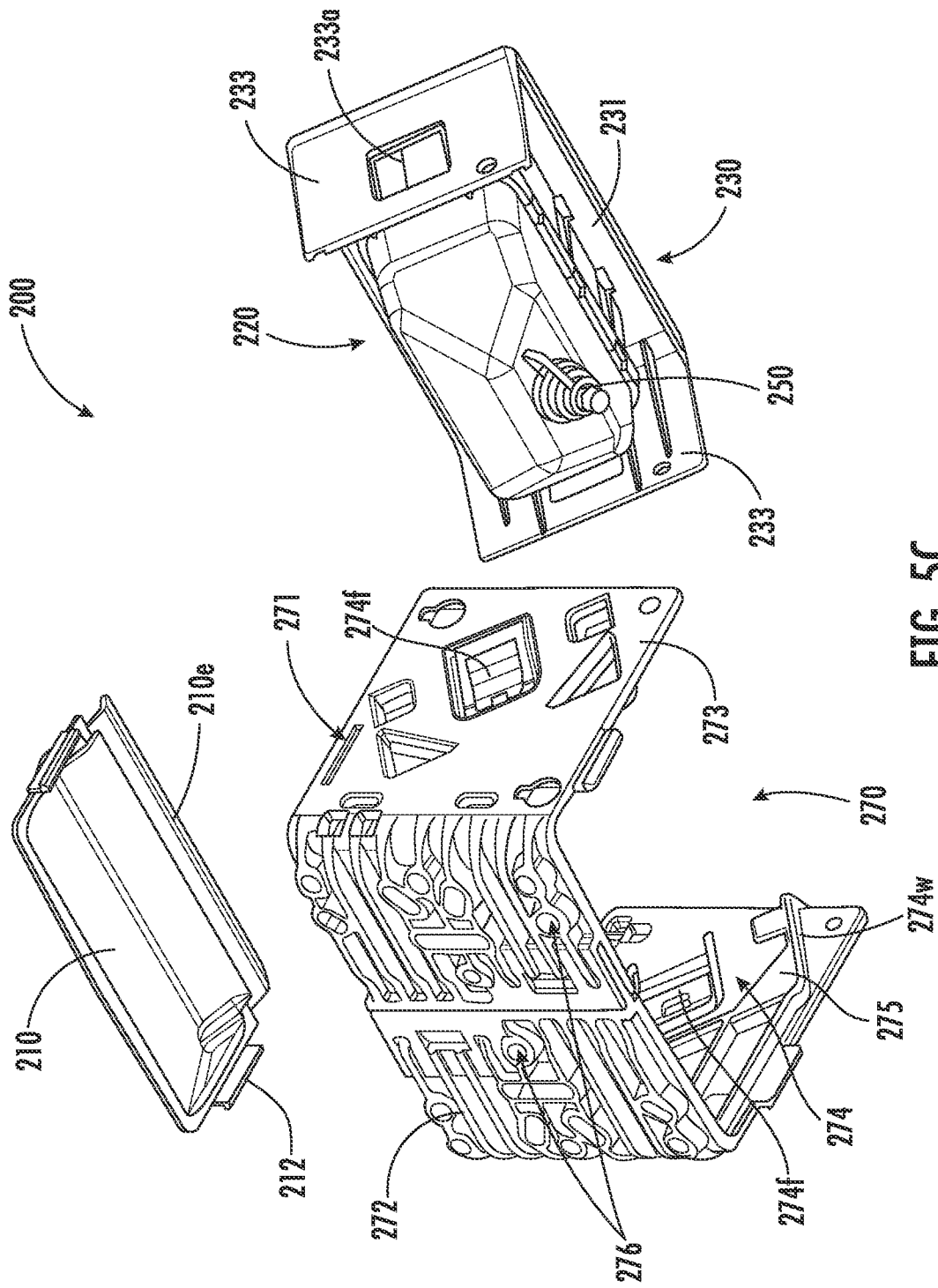
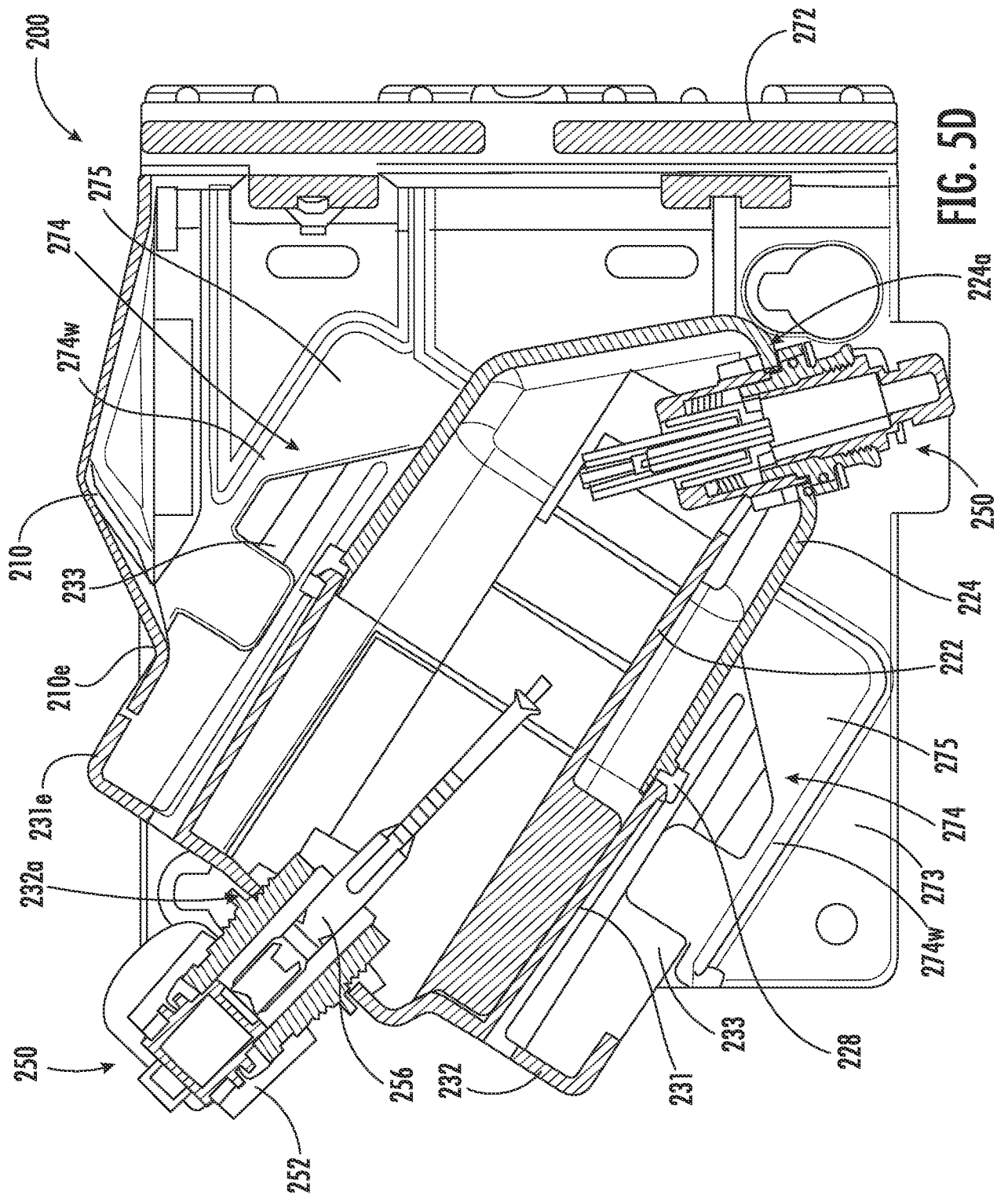


FIG. 5C

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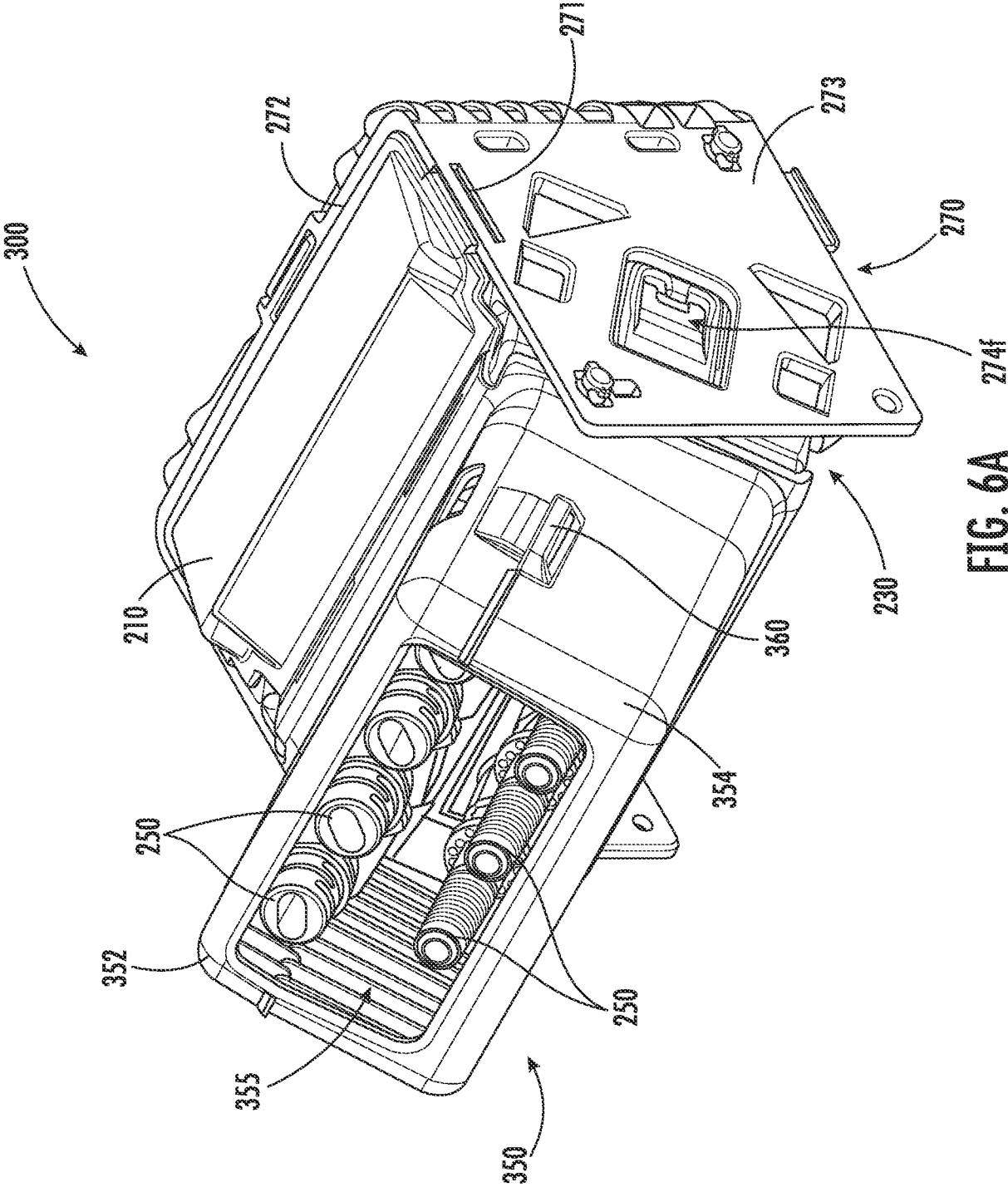


FIG. 6A

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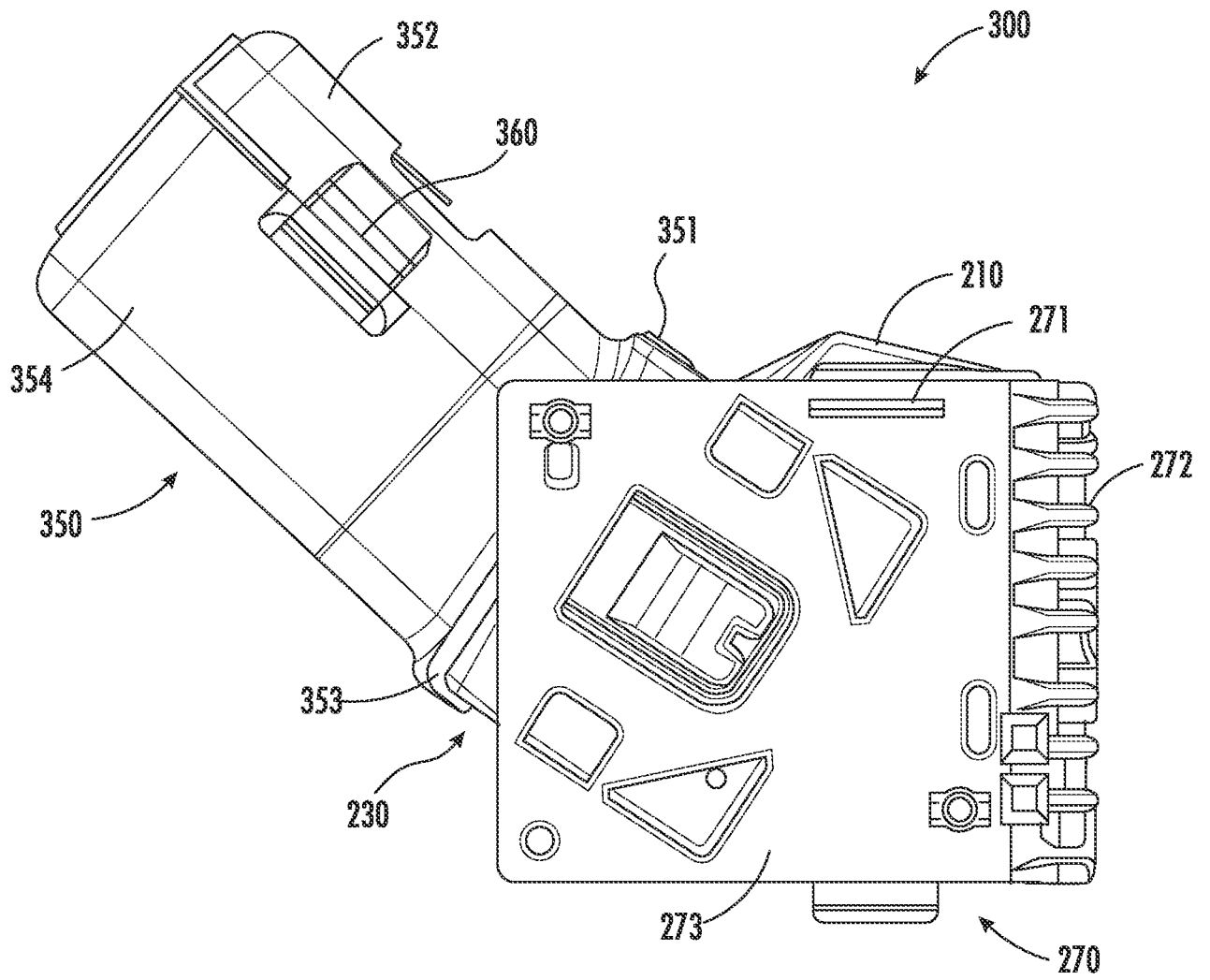


FIG. 6B

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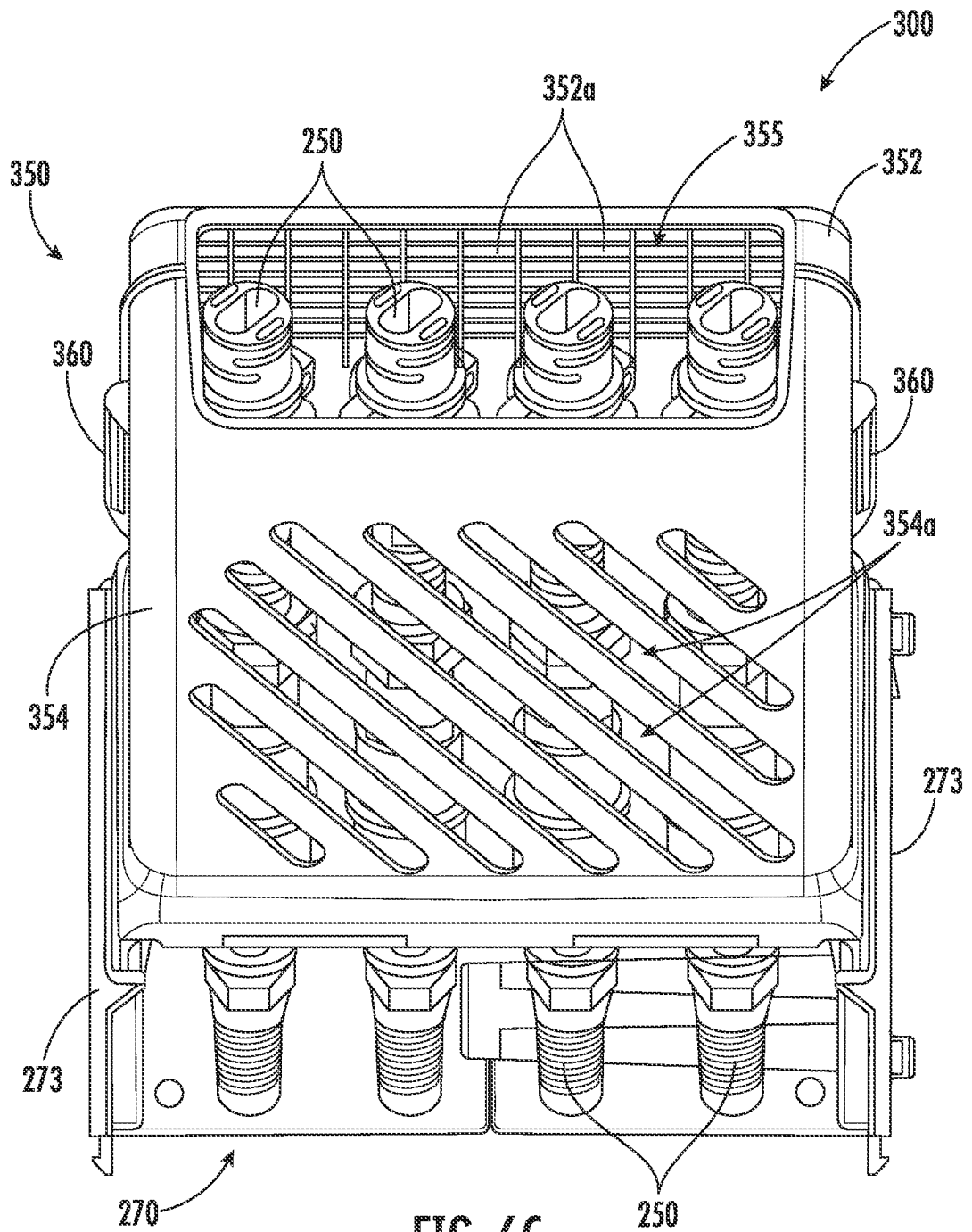


FIG. 6C

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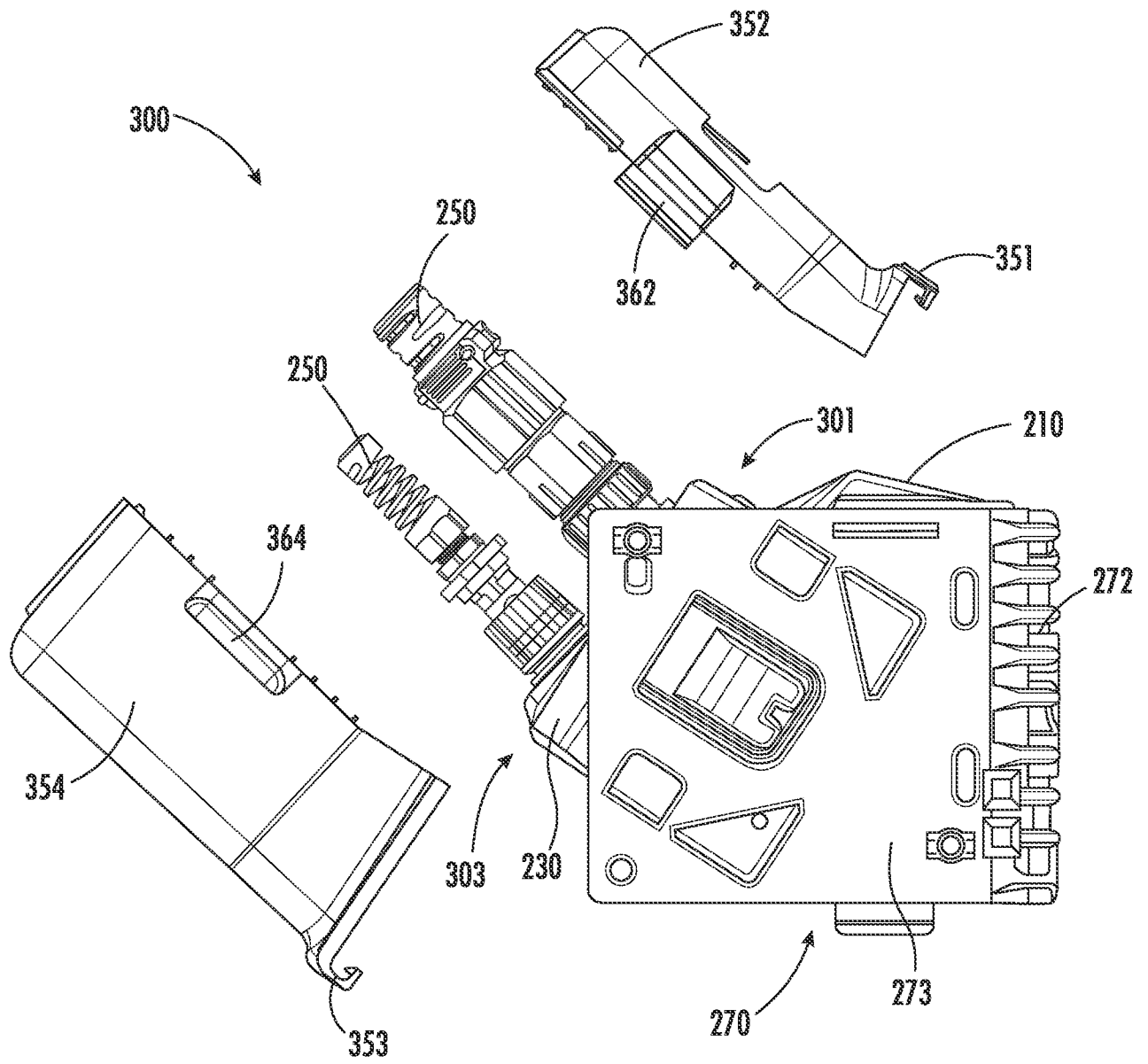


FIG. 6E

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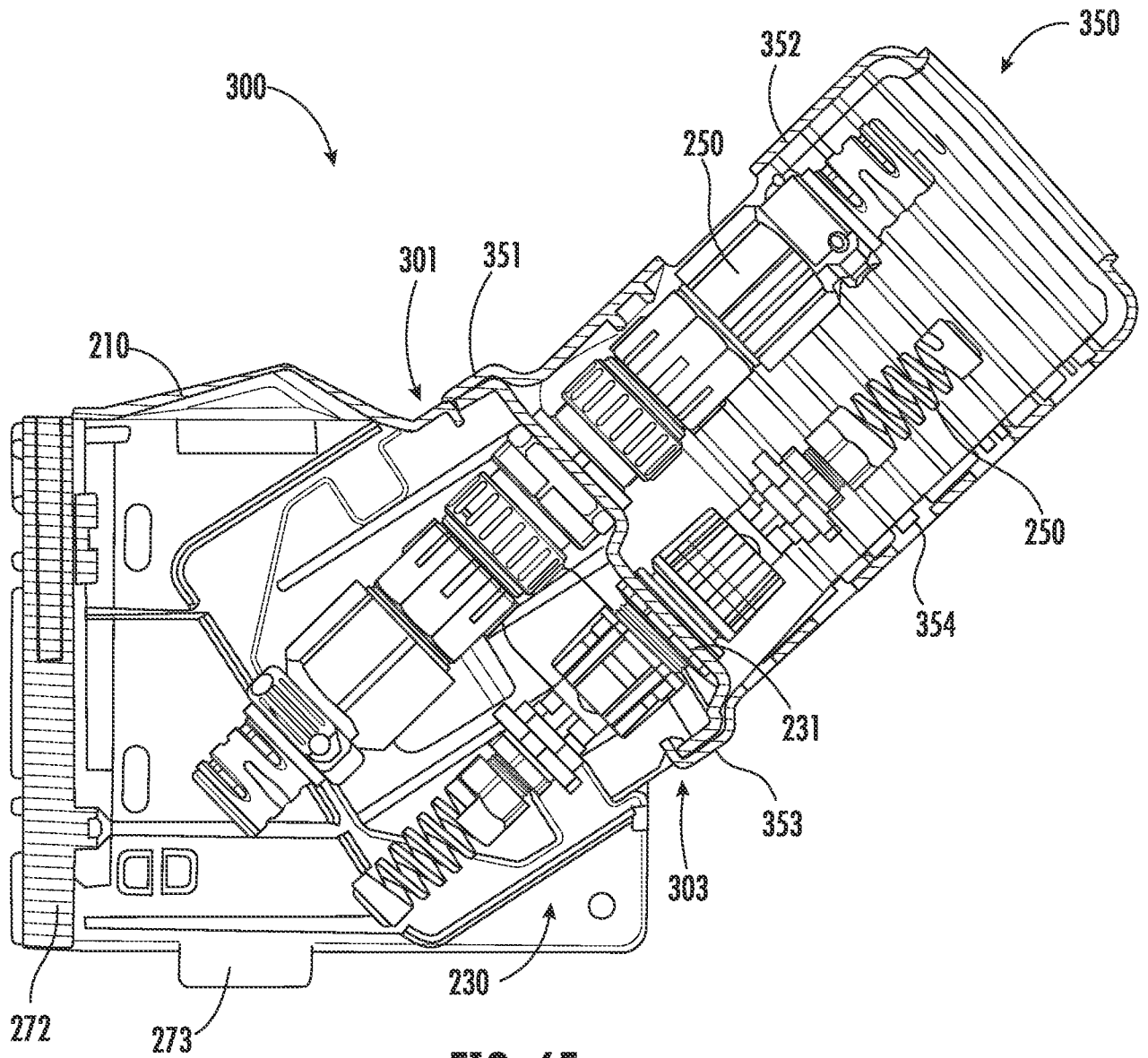


FIG. 6F

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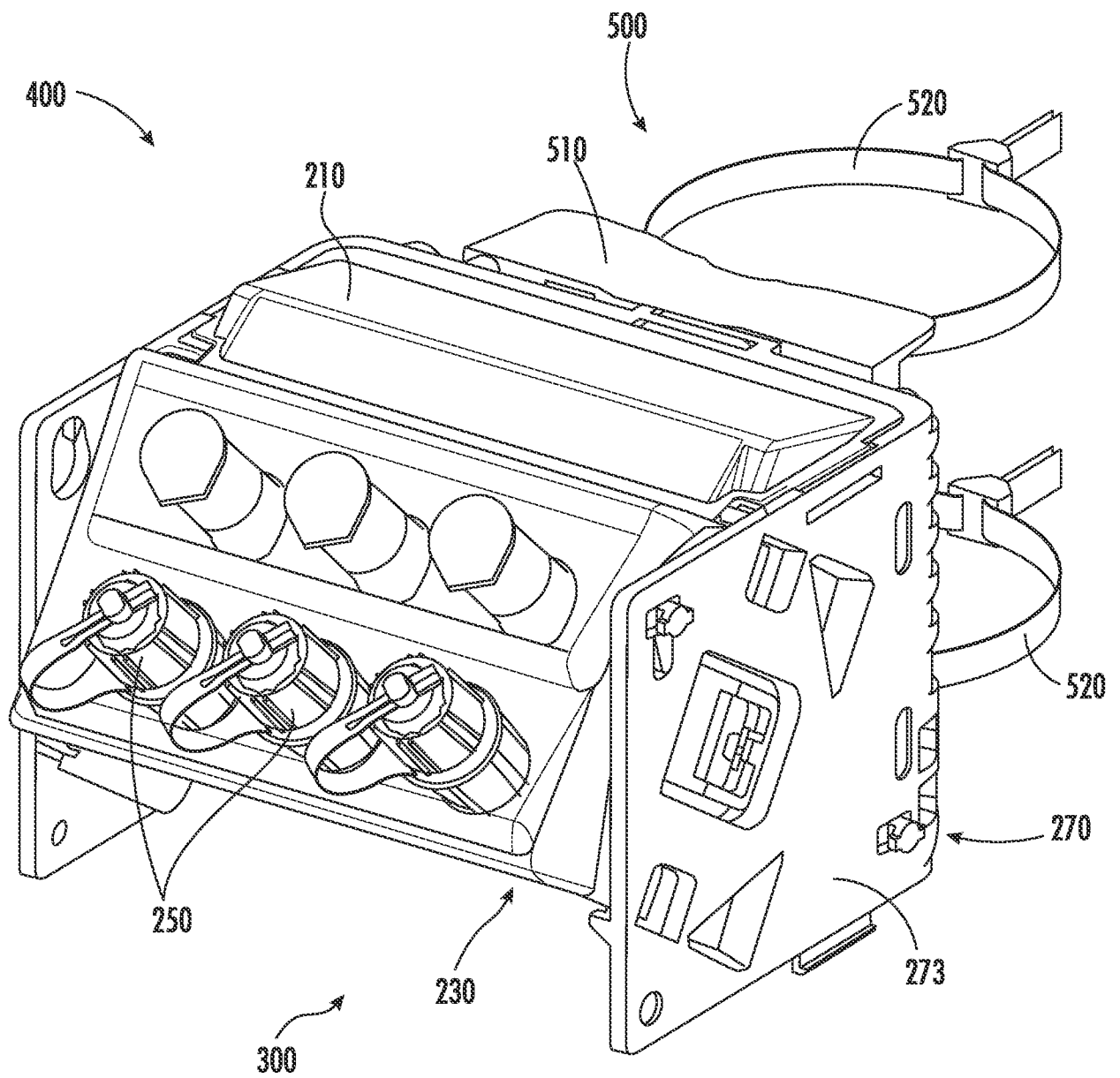


FIG. 7A

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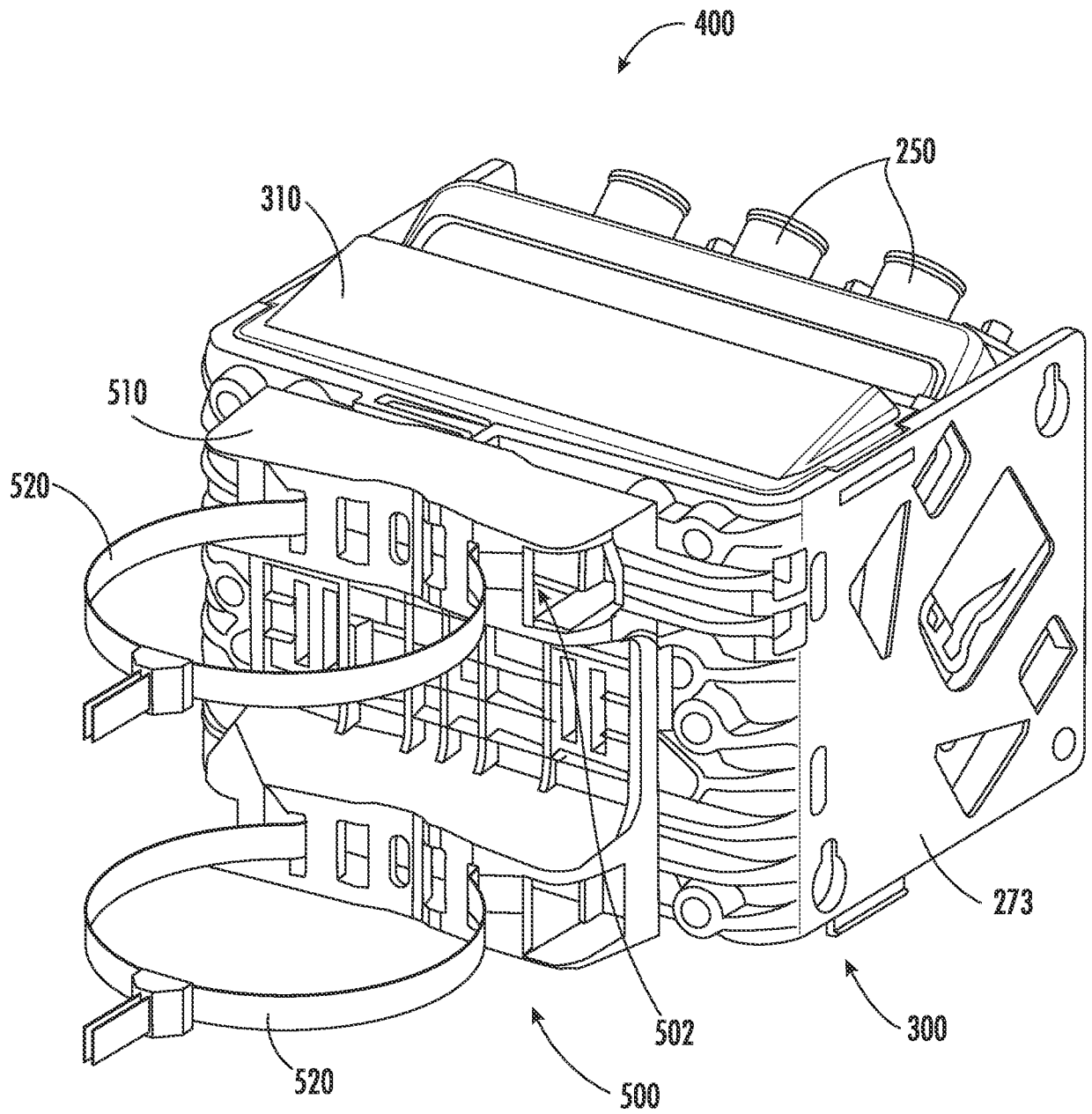


FIG. 7B

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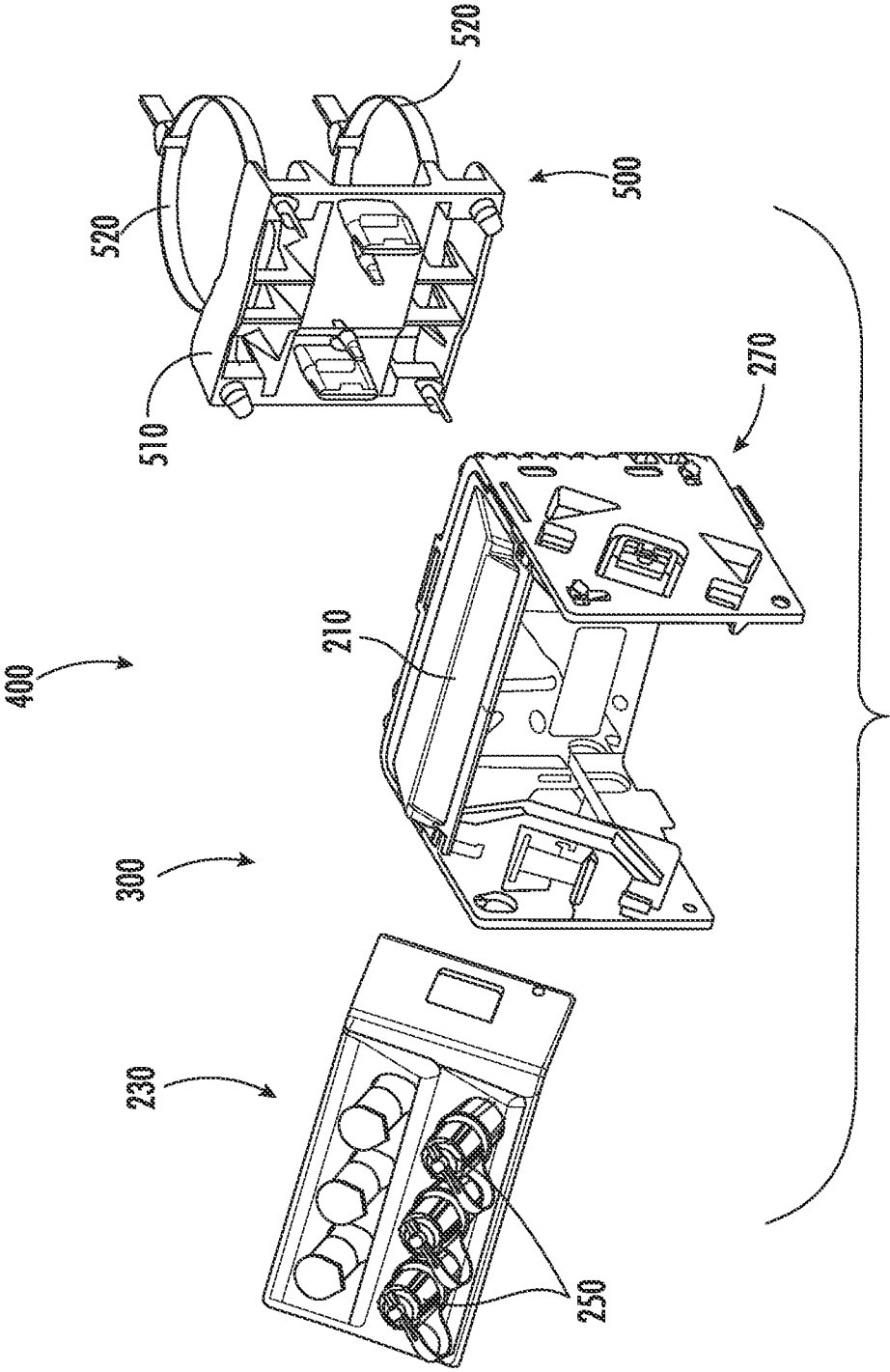


FIG. 7C

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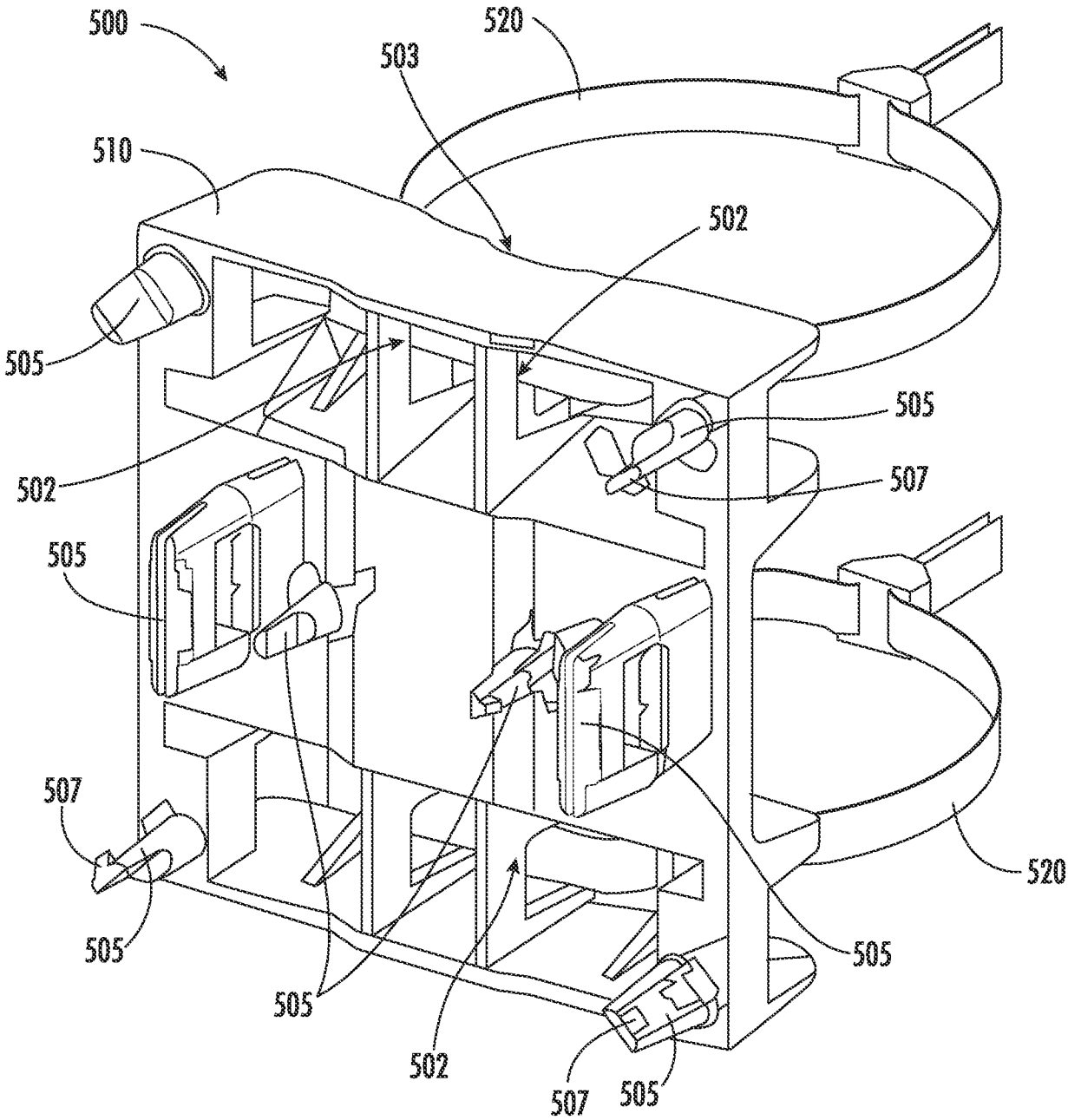
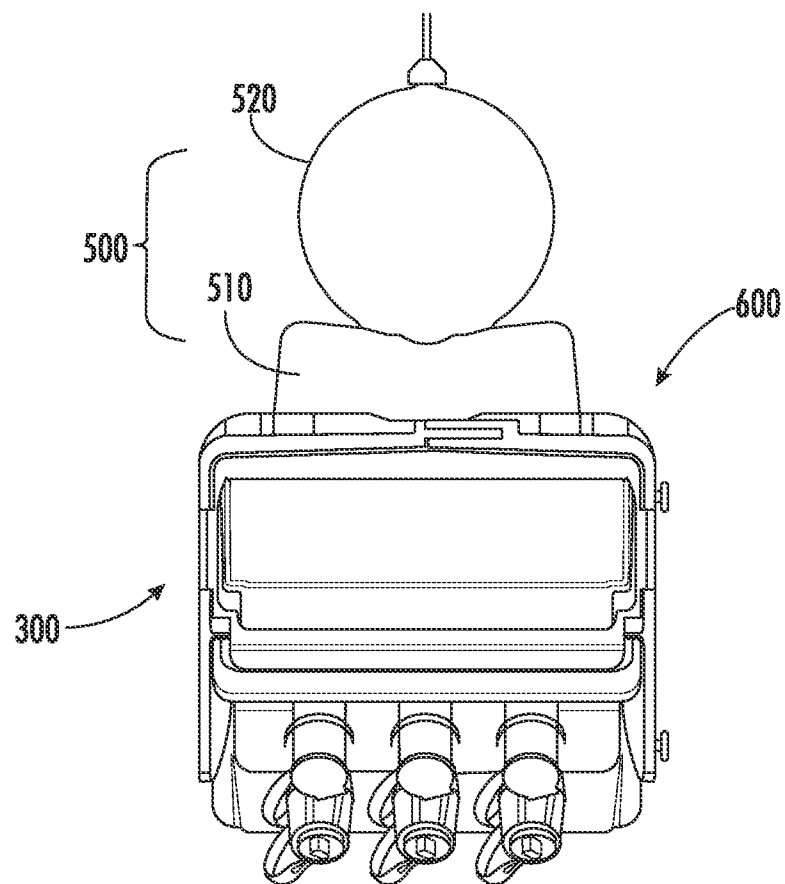
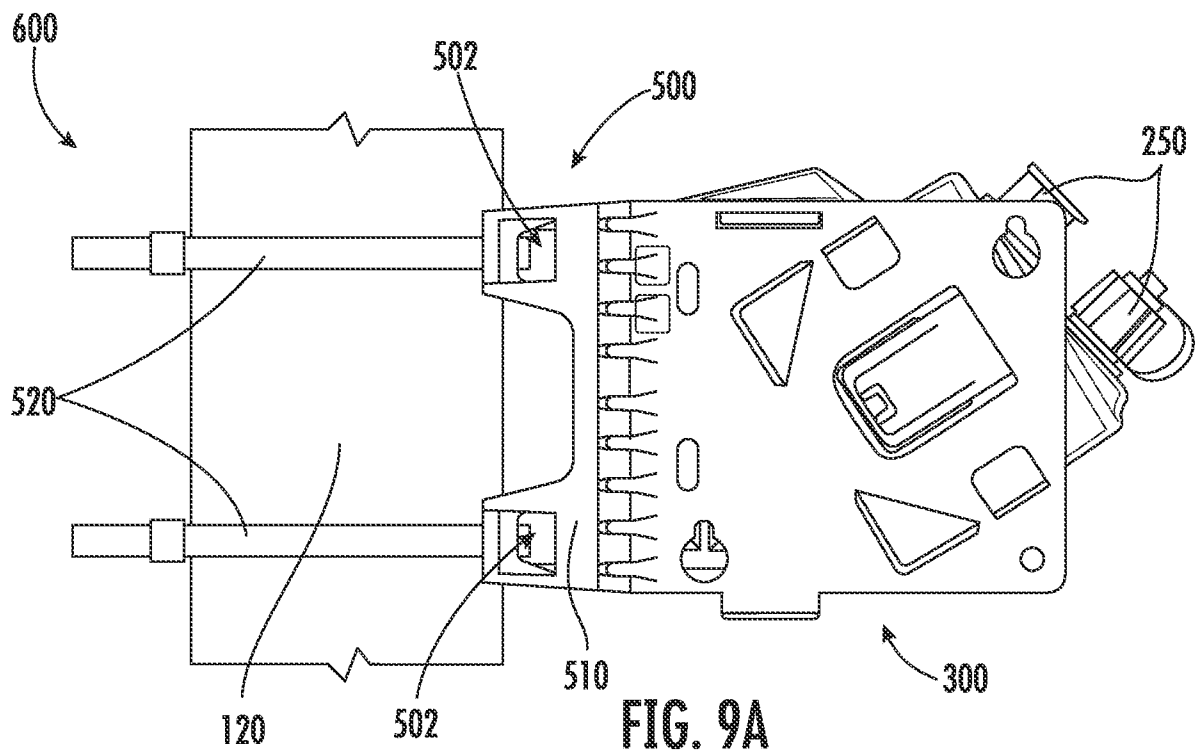
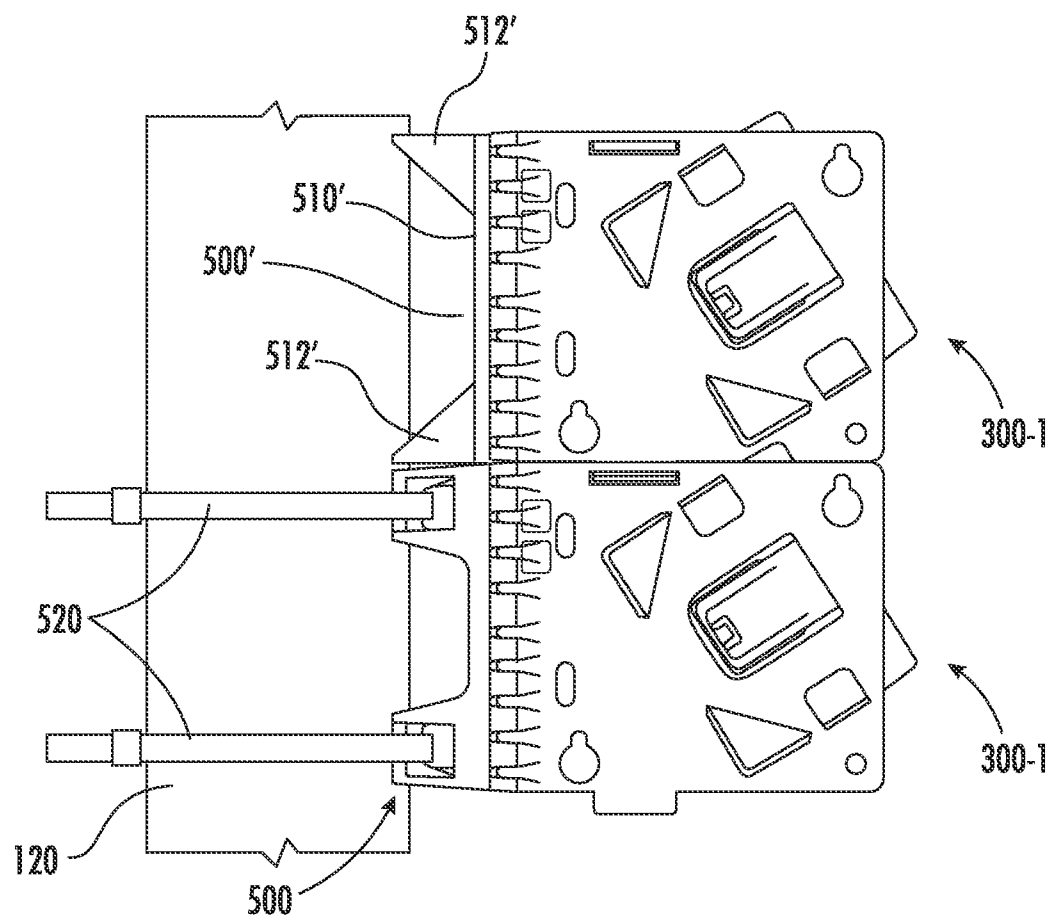
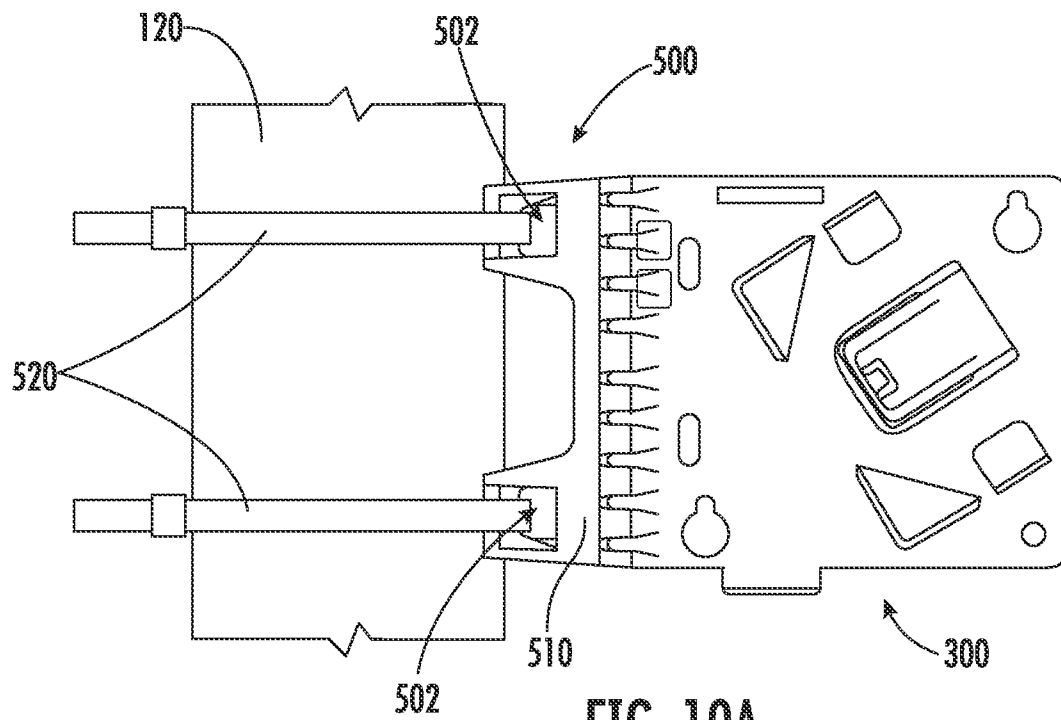


FIG. 8

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2023/021352

A. CLASSIFICATION OF SUBJECT MATTER**H01R 25/16**(2006.01)i; **H01R 25/00**(2006.01)i; **H01R 13/631**(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01R 25/16(2006.01); F16L 3/22(2006.01); G02B 6/38(2006.01); G02B 6/44(2006.01); H02G 3/04(2006.01);
H02G 3/08(2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: connection interface assembly, base module, cable connection module, enclosure,
extension cover, mounting bracket assembly**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
DX	US 2021-0218233 A1 (COMMSCOPE TECHNOLOGIES LLC.) 15 July 2021 (2021-07-15) paragraphs [0049]-[0080]; and figures 21-35	37-38
DY		1-3,23-27,39
Y	US 2005-0142925 A1 (MUGNAINI, CLAUDIA ADRIANA) 30 June 2005 (2005-06-30) paragraphs [0009], [0029]-[0030]; and figures 1-2	1-3
Y	US 2008-0056645 A1 (KEENUM, JOHN A. et al.) 06 March 2008 (2008-03-06) paragraphs [0028]-[0029]; and figure 1	23-27
Y	US 2022-0011530 A1 (COMMSCOPE TECHNOLOGIES LLC.) 13 January 2022 (2022-01-13) paragraphs [0073], [0093]; and figures 3, 5, 10	24-25,39
A	EP 3700035 A1 (PRYSMIAN S.P.A.) 26 August 2020 (2020-08-26) claims 1-14; and figures 1-5	1-3,23-27,37-39

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

“A” document defining the general state of the art which is not considered to be of particular relevance

“D” document cited by the applicant in the international application

“E” earlier application or patent but published on or after the international filing date

“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

“O” document referring to an oral disclosure, use, exhibition or other means

“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

31 August 2023

Date of mailing of the international search report

31 August 2023

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
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35208, Republic of Korea

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Telephone No. +82-42-481-5003

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2023/021352

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: **7, 12, 17, 19-20, 30, 35**
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

Claims 7, 12, 17, 19-20, 30, 35 are not clear because they refer to multiple dependent claims, which do not comply with PCT Rule 6.4(a).

3. ☒ Claims Nos.: **4-6, 8-11, 13-16, 18, 21-22, 28-29, 31-34, 36, 40-45**
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/US2023/021352

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