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(54) **WIRING SYSTEM ARCHITECTURE**

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(22) Filed: **Feb. 25, 2022**

Related U.S. Application Data

(63) Continuation of application No. 16/231,314, filed on Dec. 21, 2018, now Pat. No. 11,260,809.

(60) Provisional application No. 62/618,681, filed on Jan. 18, 2018.

Publication Classification

(51) **Int. Cl.**

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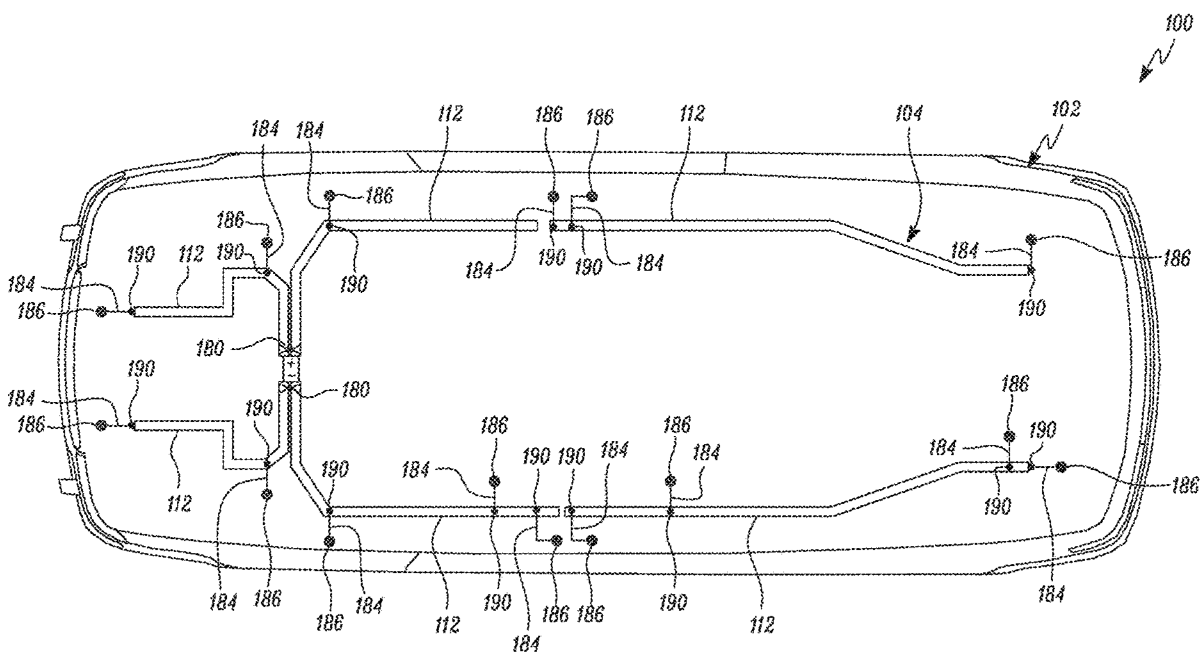
B60R 16/03 (2006.01)
H05K 9/00 (2006.01)
H05K 1/02 (2006.01)
B60R 16/02 (2006.01)

(52) **U.S. Cl.**

CPC ***B60R 16/0238*** (2013.01); ***B60R 16/03*** (2013.01); ***H05K 9/003*** (2013.01); *H01R 13/50* (2013.01); ***B60R 16/0207*** (2013.01); ***H05K 9/0098*** (2013.01); ***H05K 1/0216*** (2013.01)

(57) **ABSTRACT**

A new wiring and power and communications system for an automobile that includes a plurality of devices, wherein the devices are connected to a backbone section that has an outer sheathing, a first conductor disposed within the outer sheathing, a second conductor disposed within the outer sheathing, a pair of inner sheathing members disposed within the outer sheathing and located on opposing sides of the at least one conductor, the inner sheathing members configured to electrically insulate the first conductor from the second conductor, and a shield member disposed within the outer sheathing.



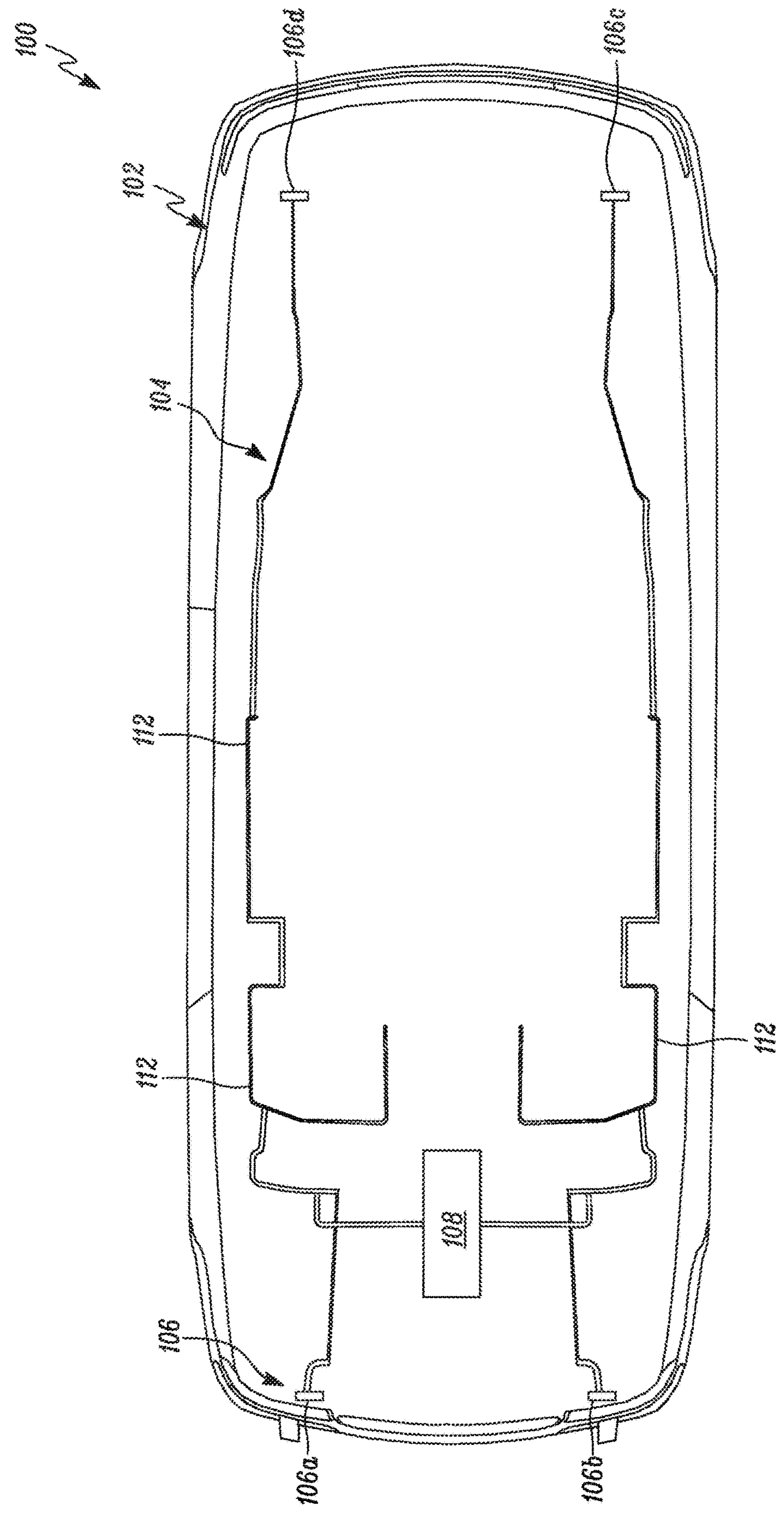


FIG. 1a

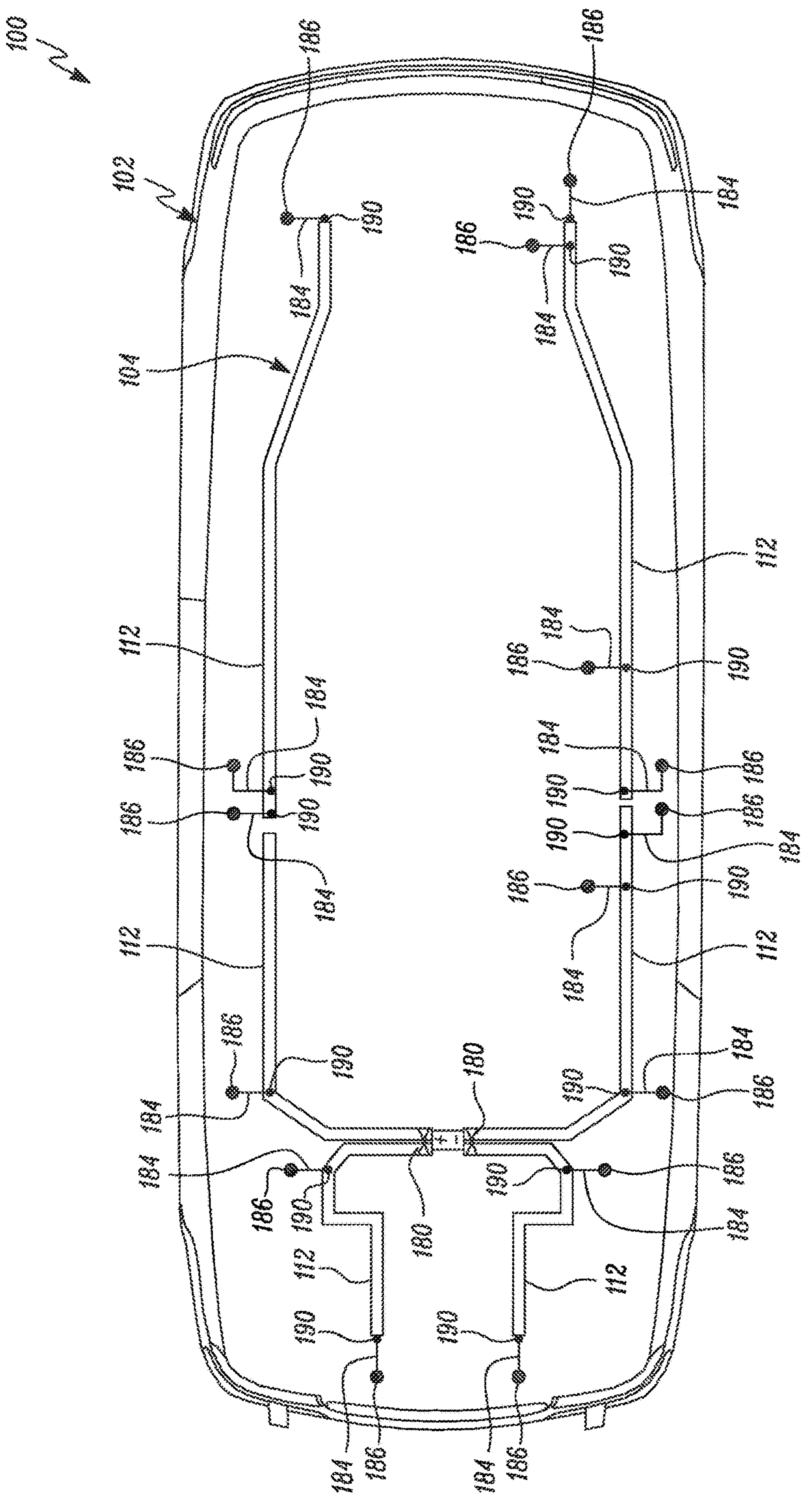


FIG. 1b

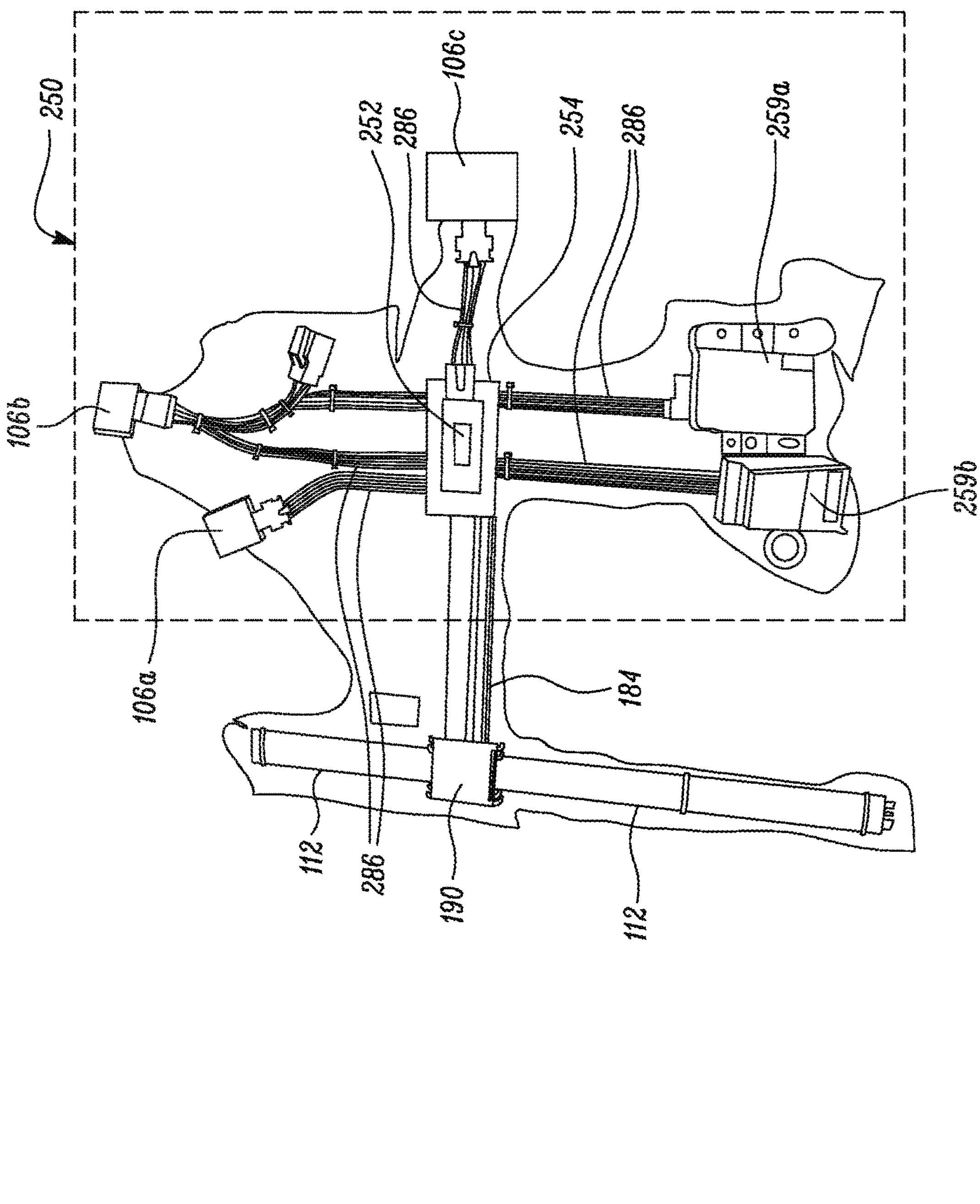

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FIG. 2

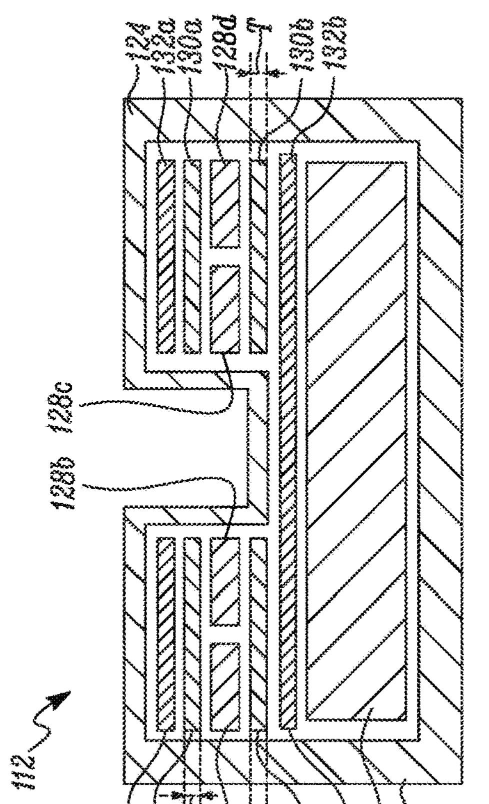

FIG. 4

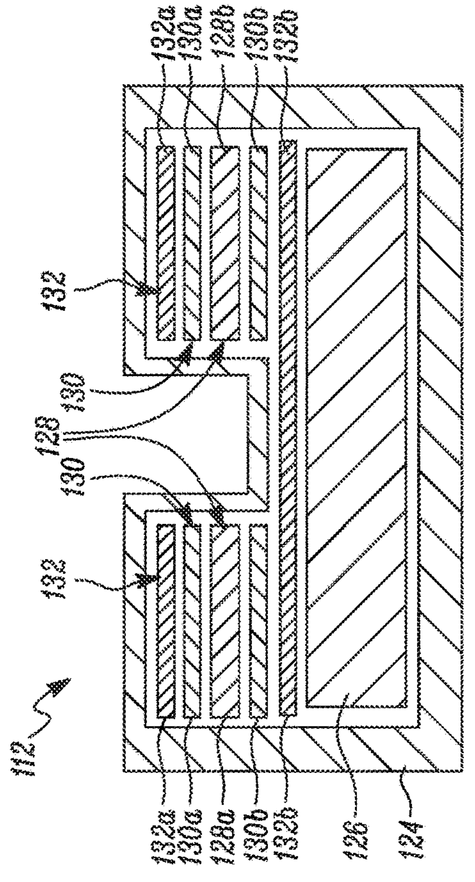

FIG. 3

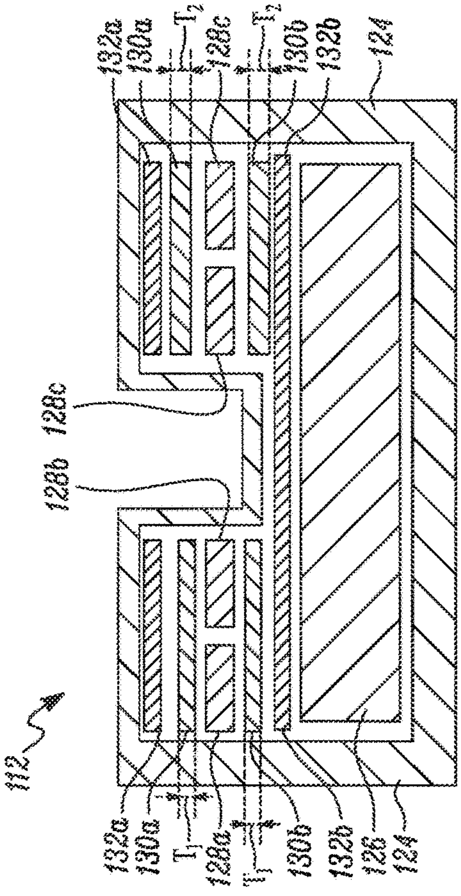

FIG. 5

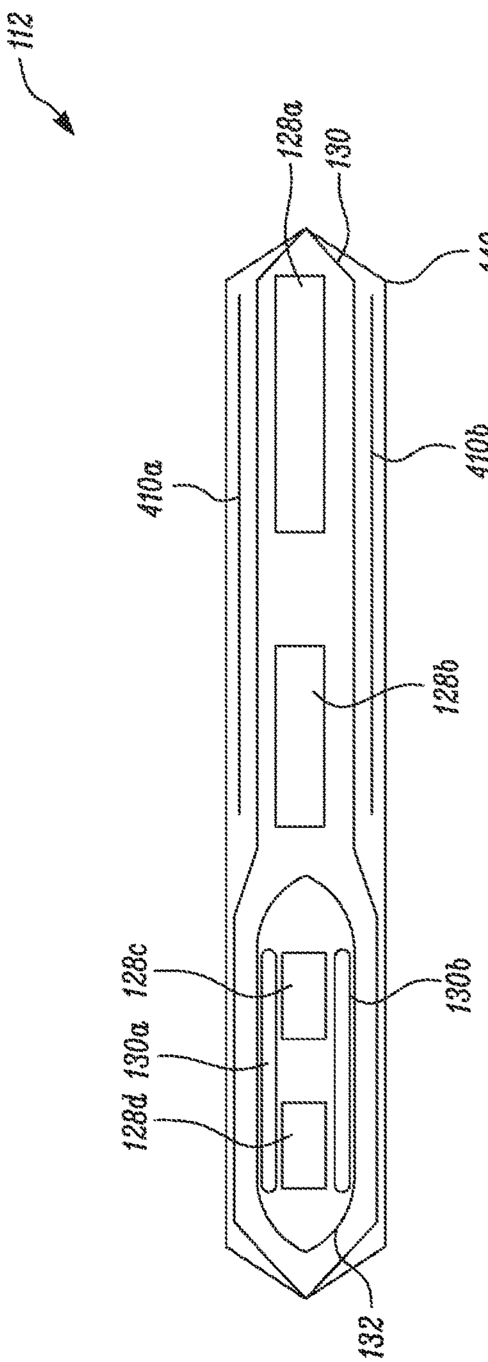
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FIG. 6a

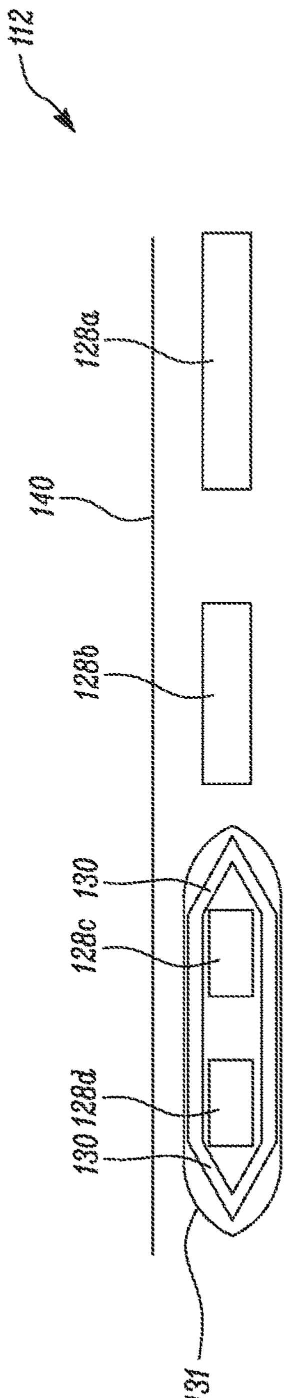
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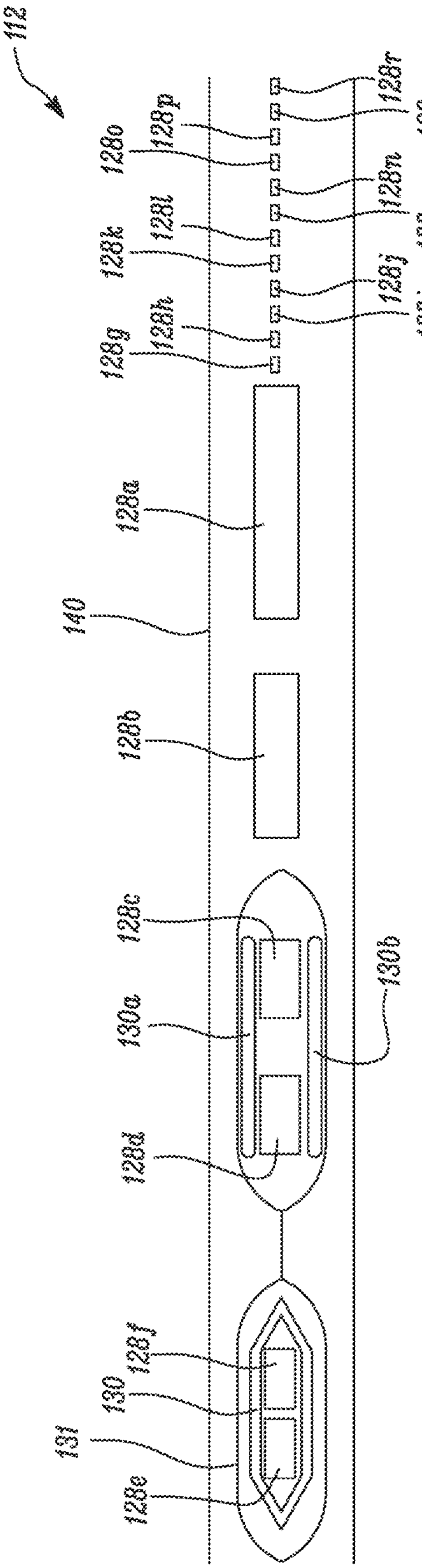
FIG. 6b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128f
128e

FIG. 6c

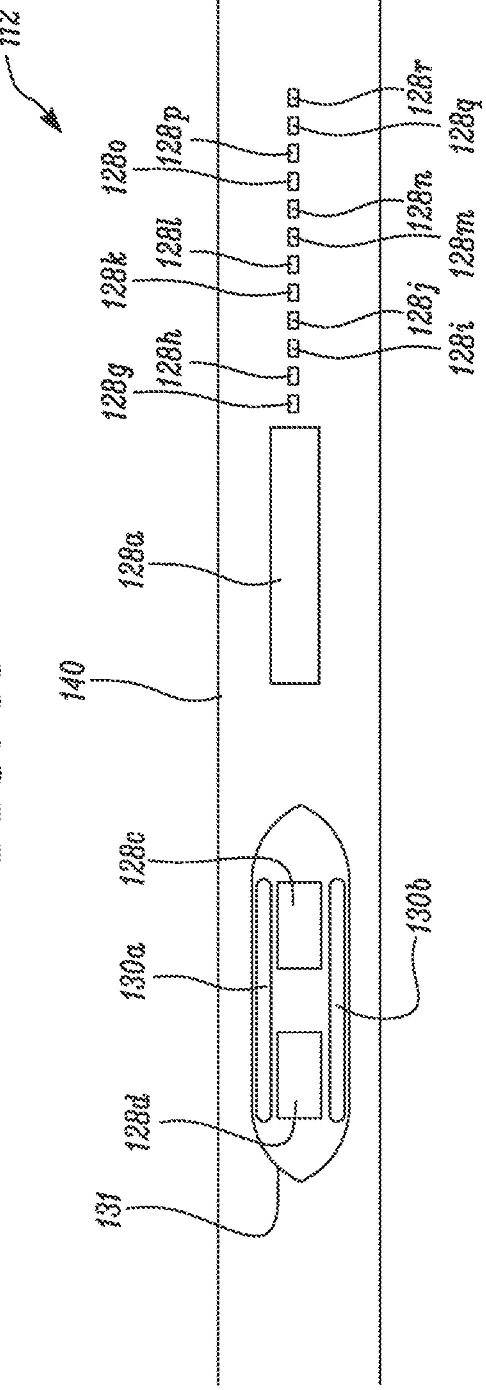
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FIG. 6d

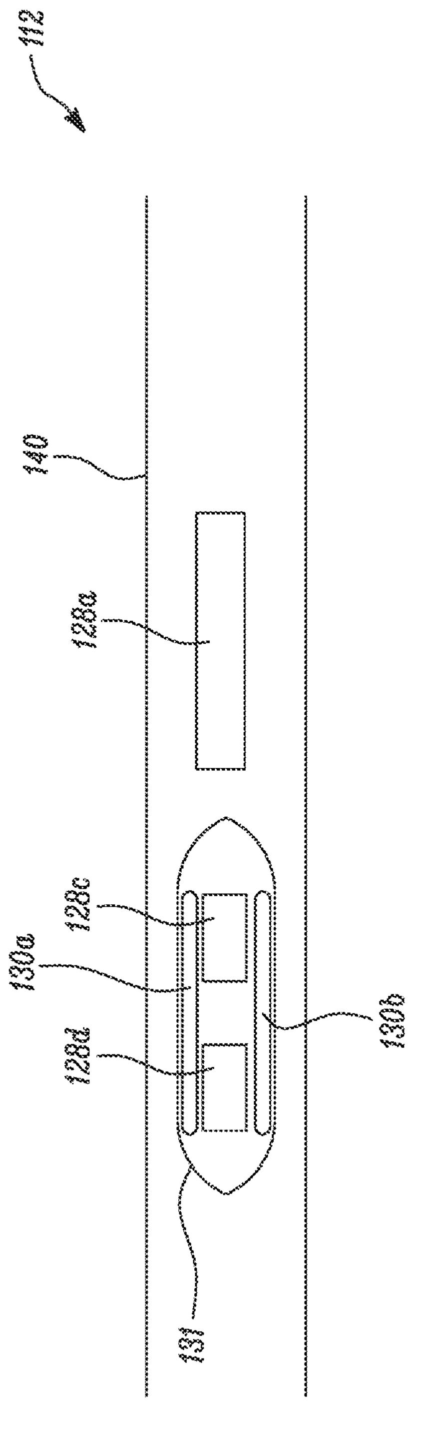
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FIG. 6e

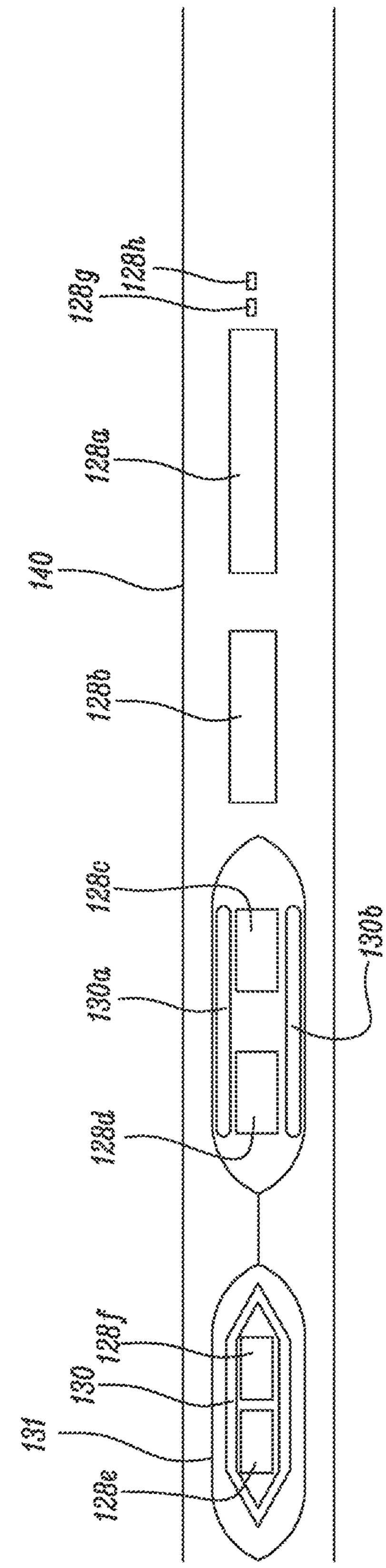
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FIG. 6f

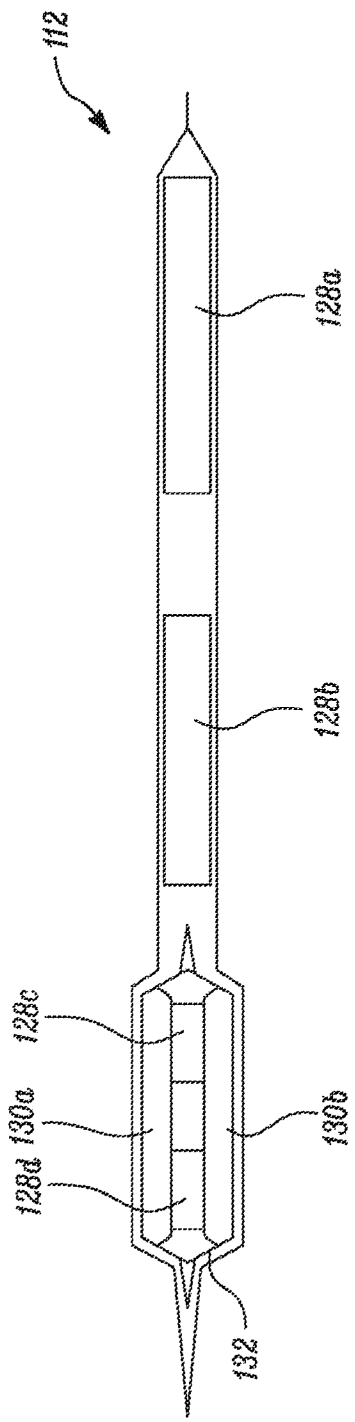

FIG. 7

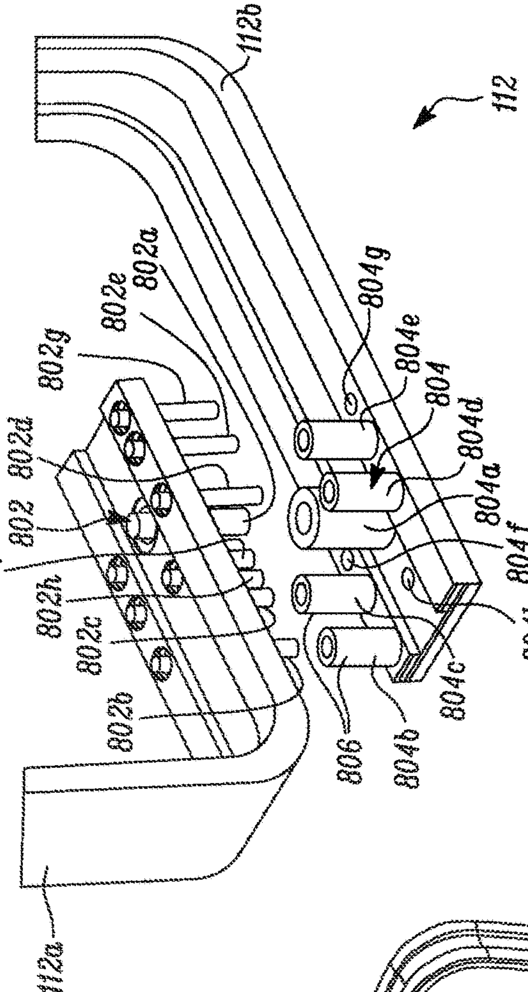
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FIG. 8b

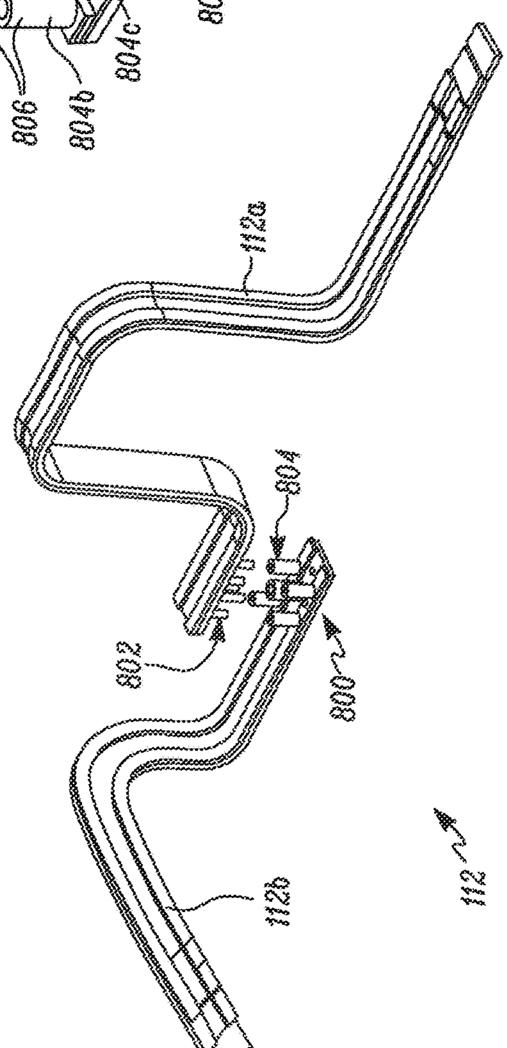
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FIG. 8a

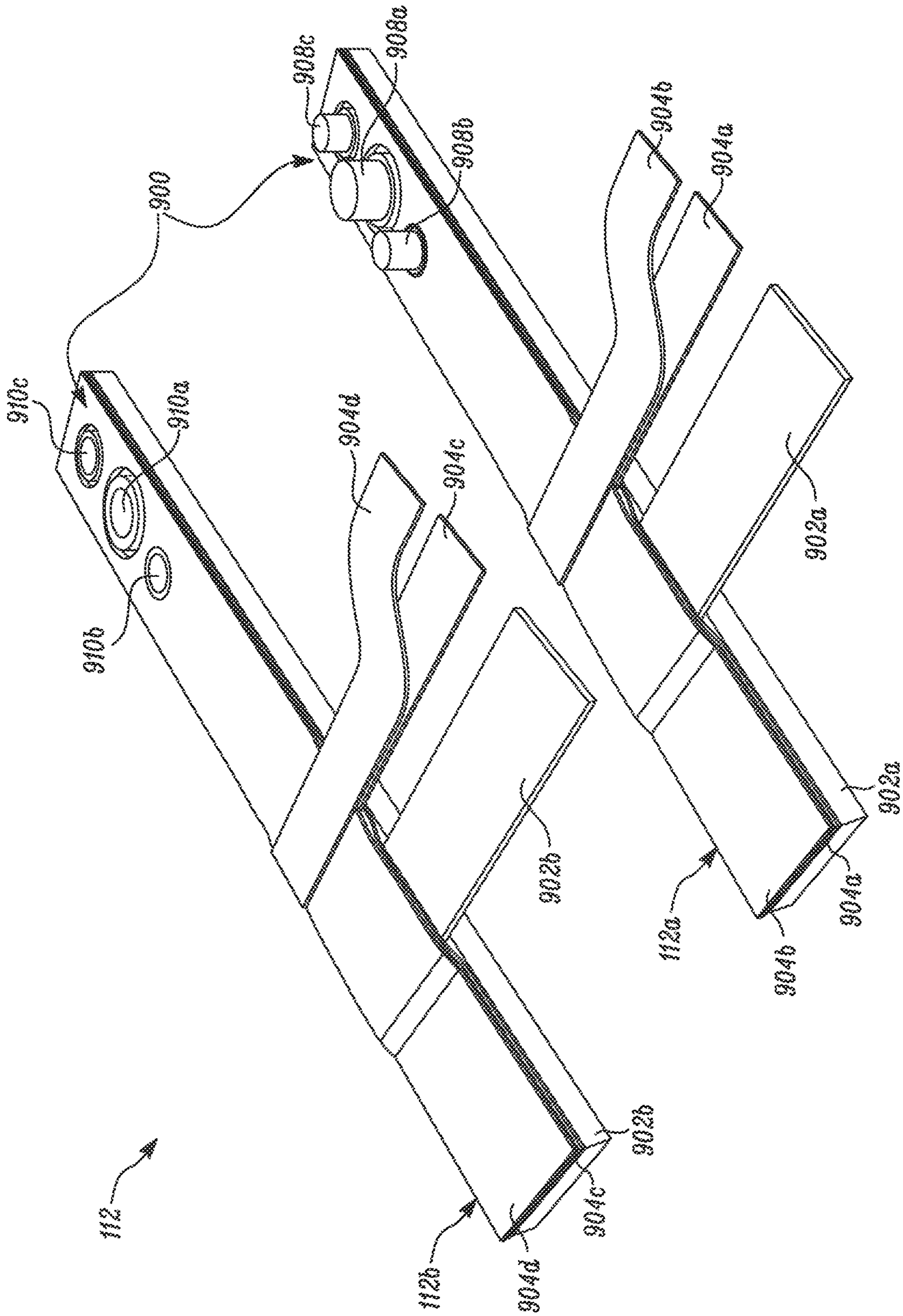
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FIG. 9

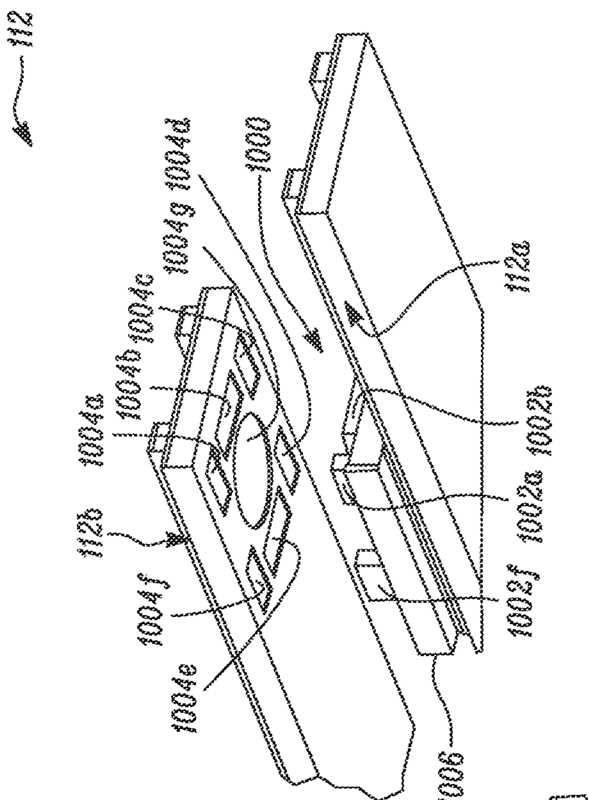

FIG. 10b

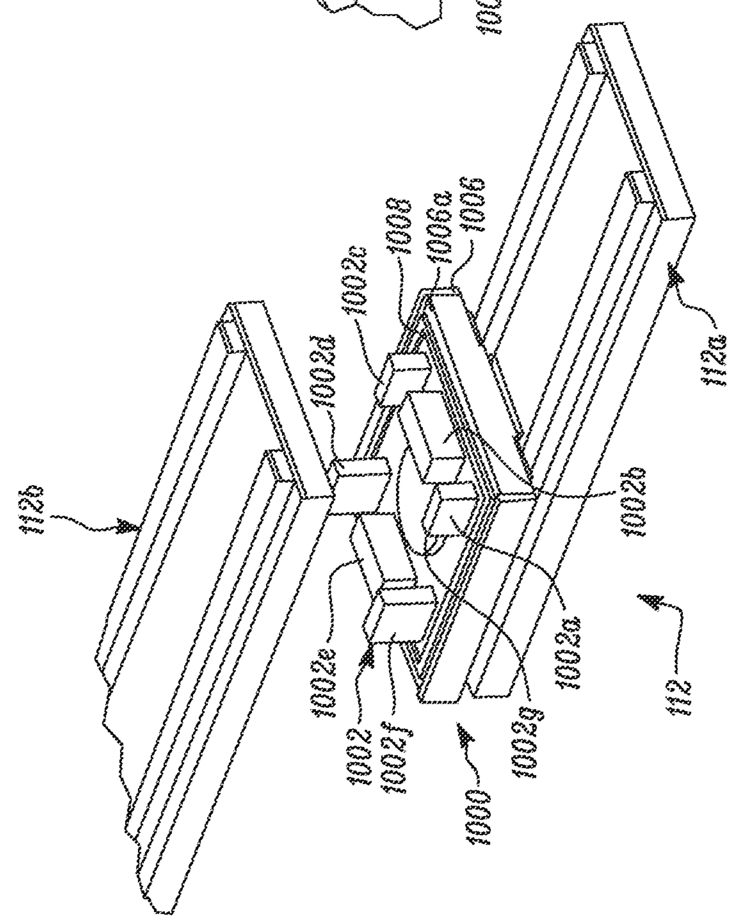

FIG. 10a

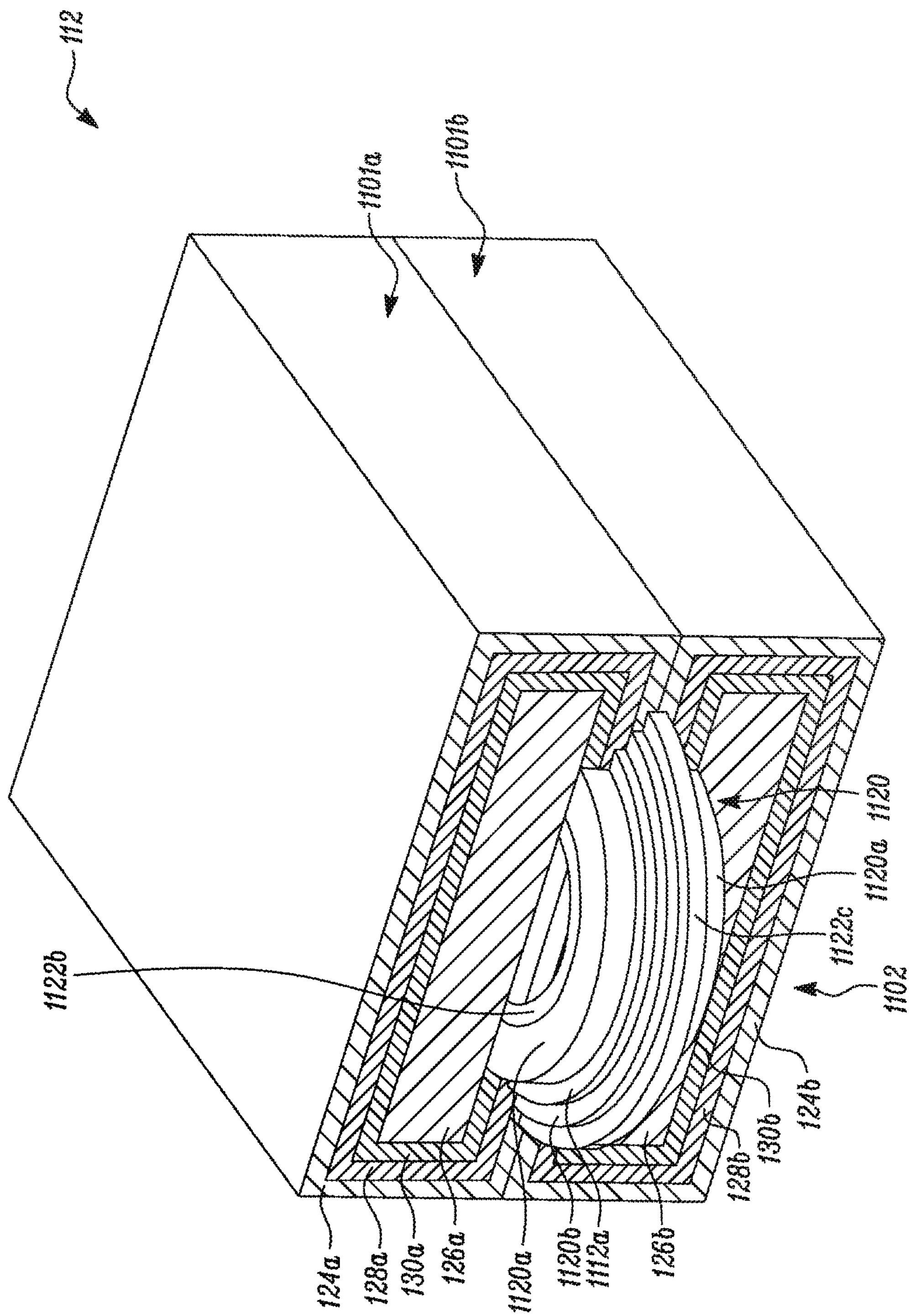
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FIG. 11a

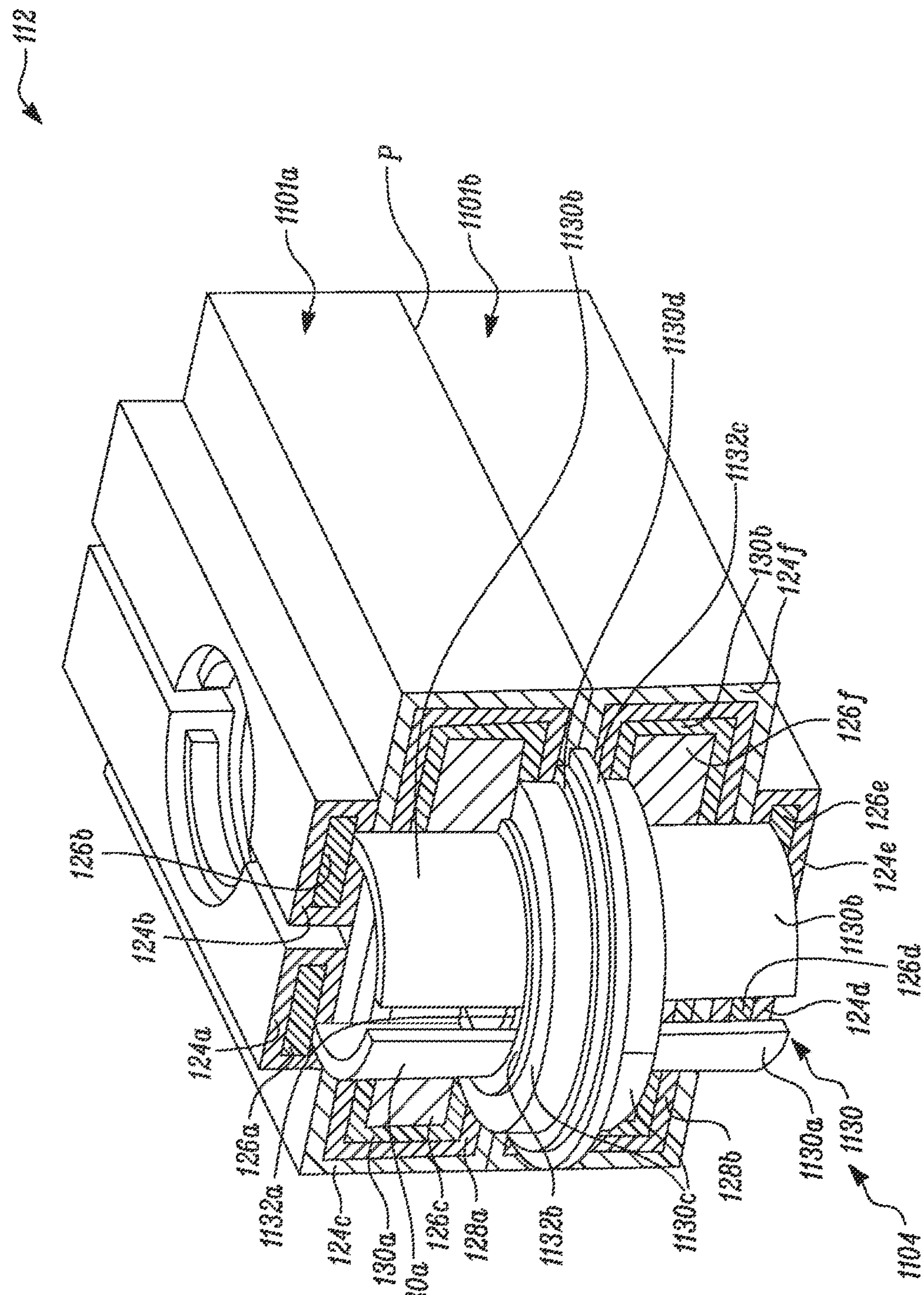
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FIG. 11b

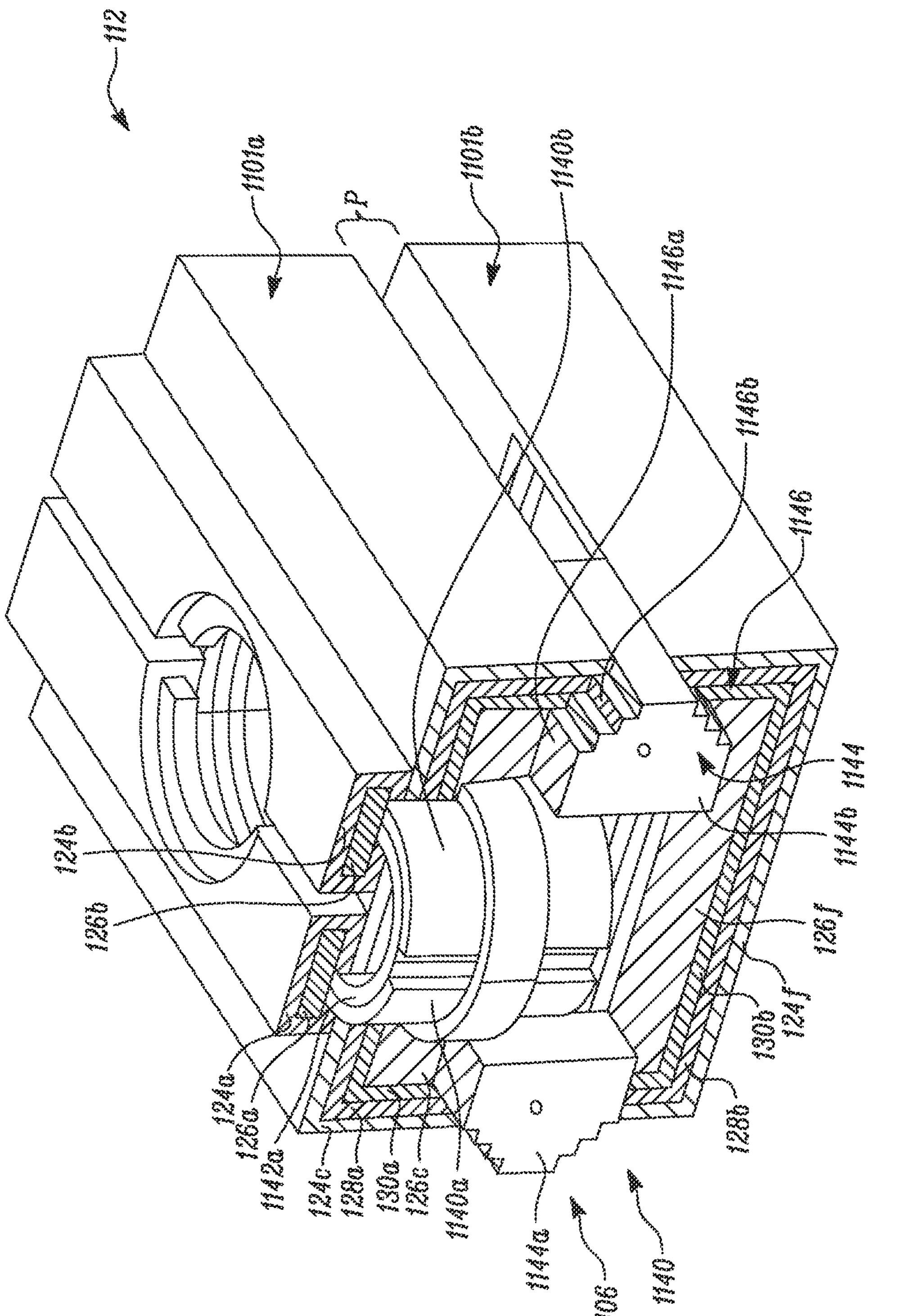
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FIG. 11c

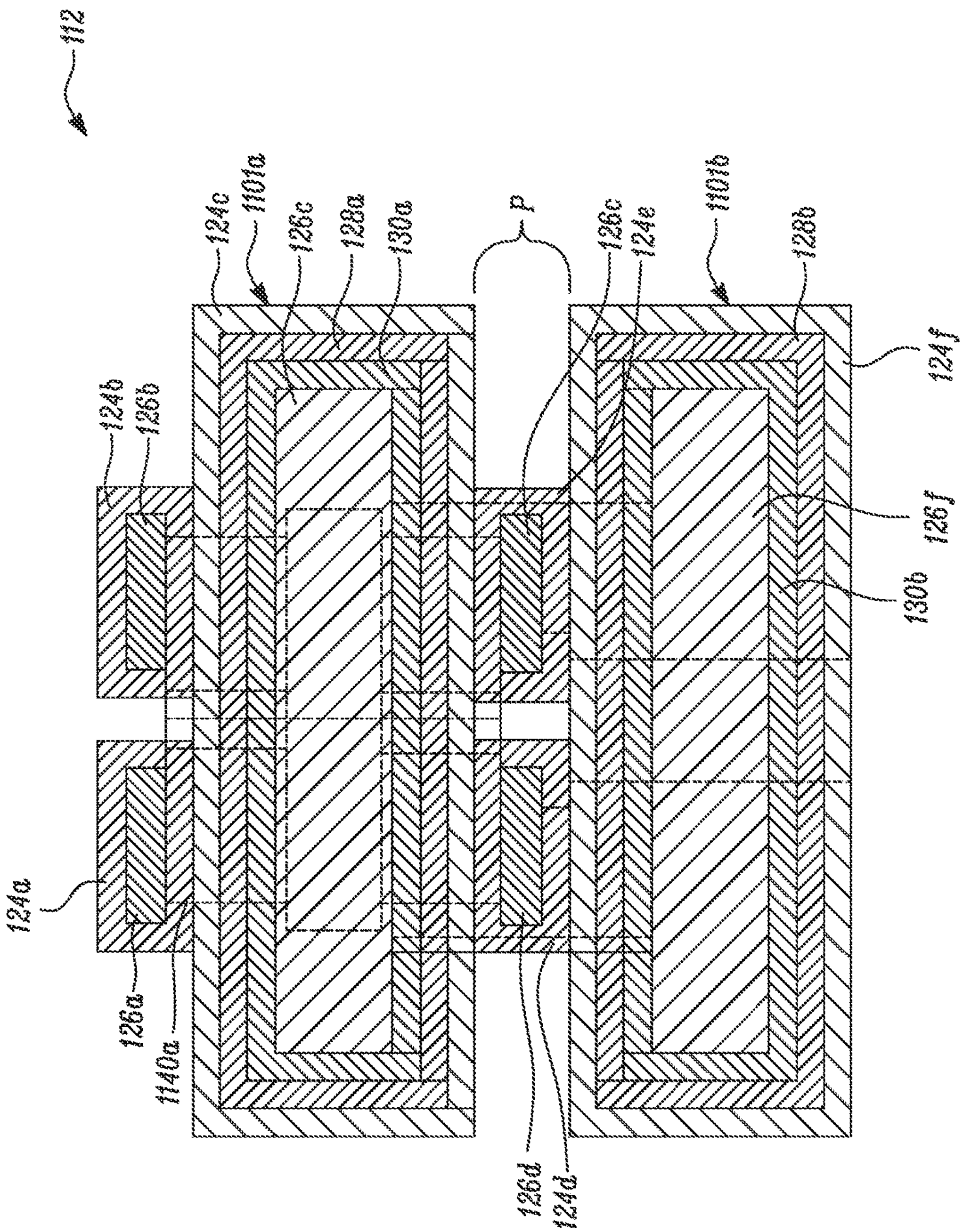
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FIG. 11d

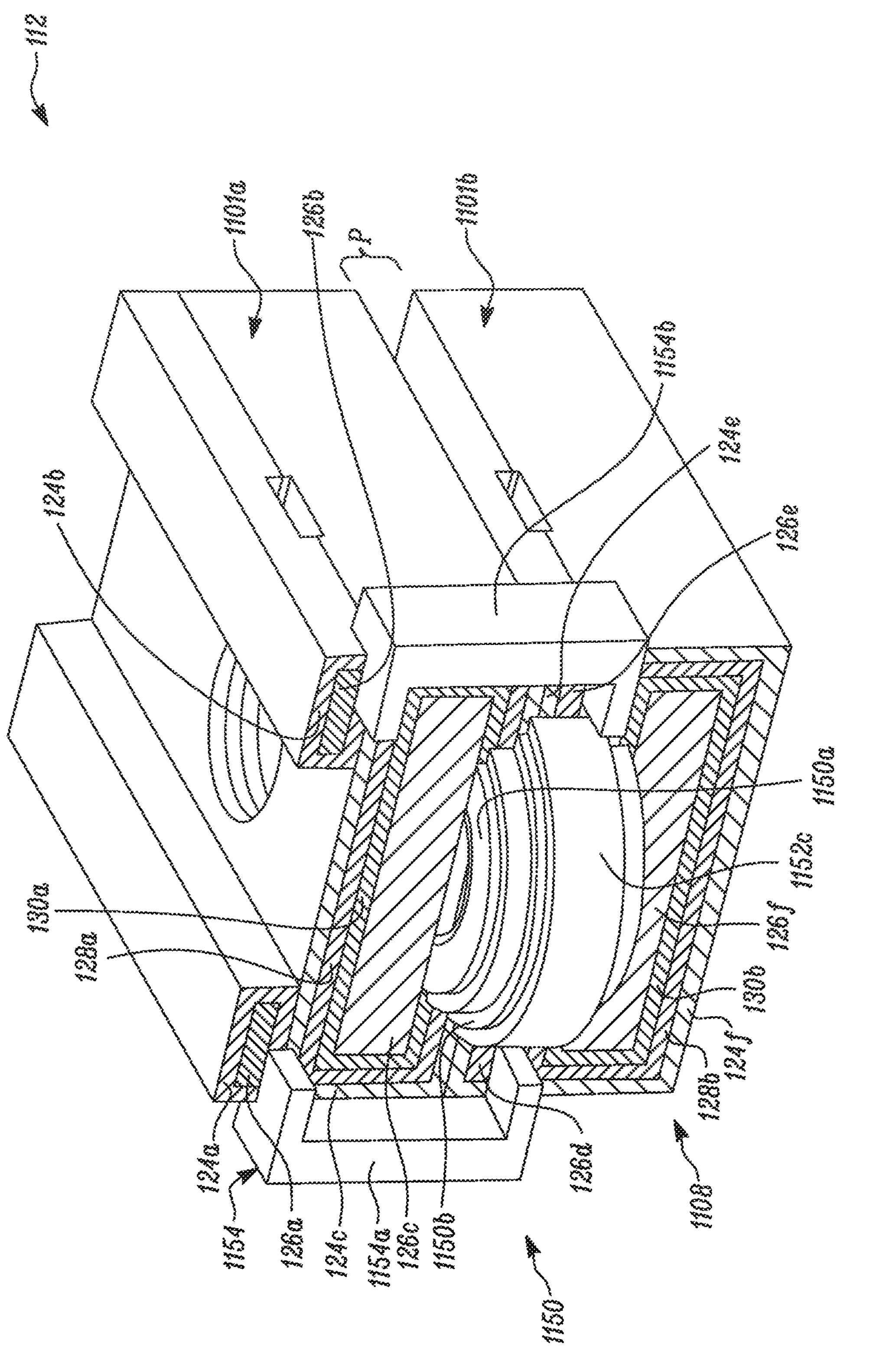
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FIG. 11e

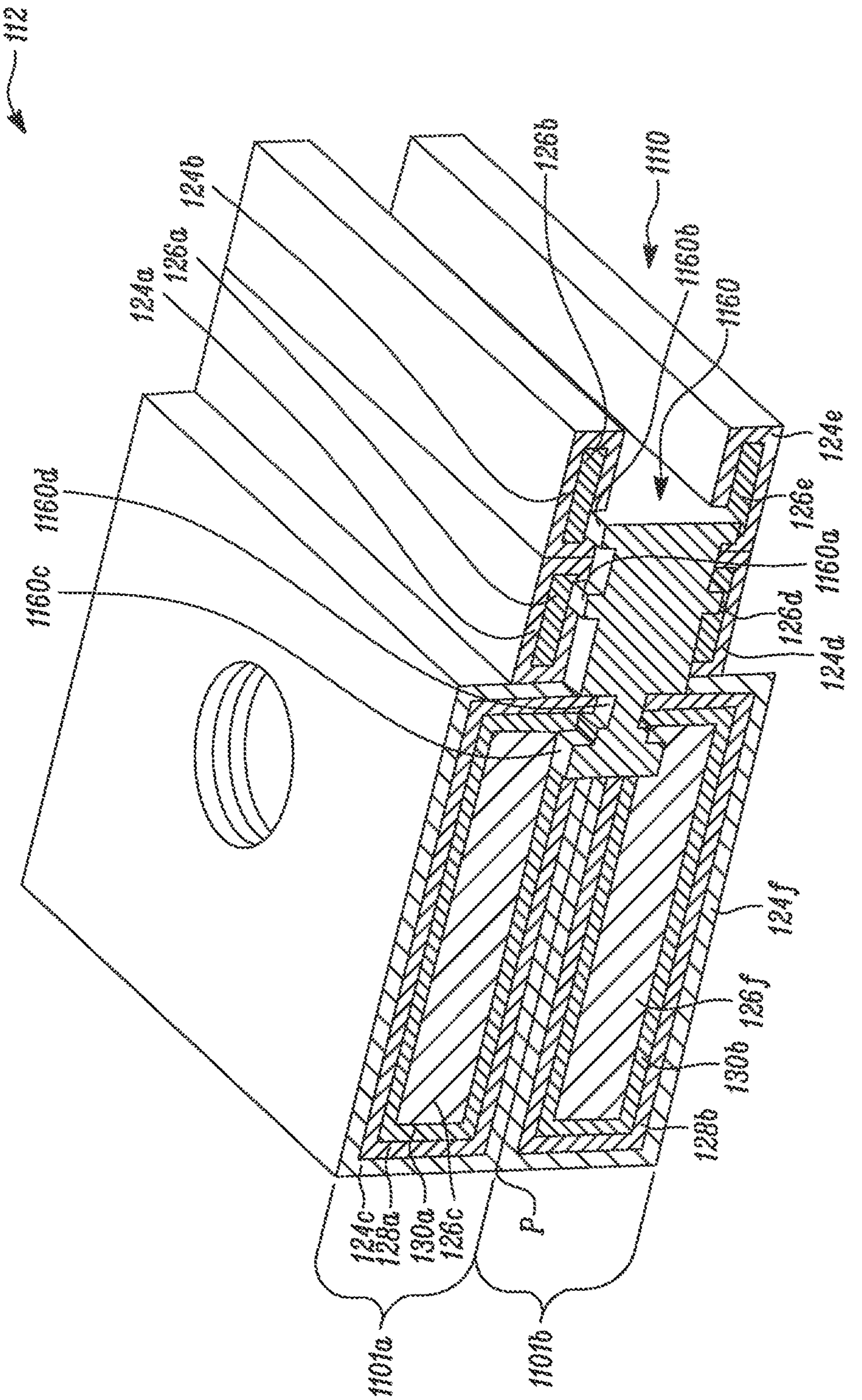
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FIG. 11f

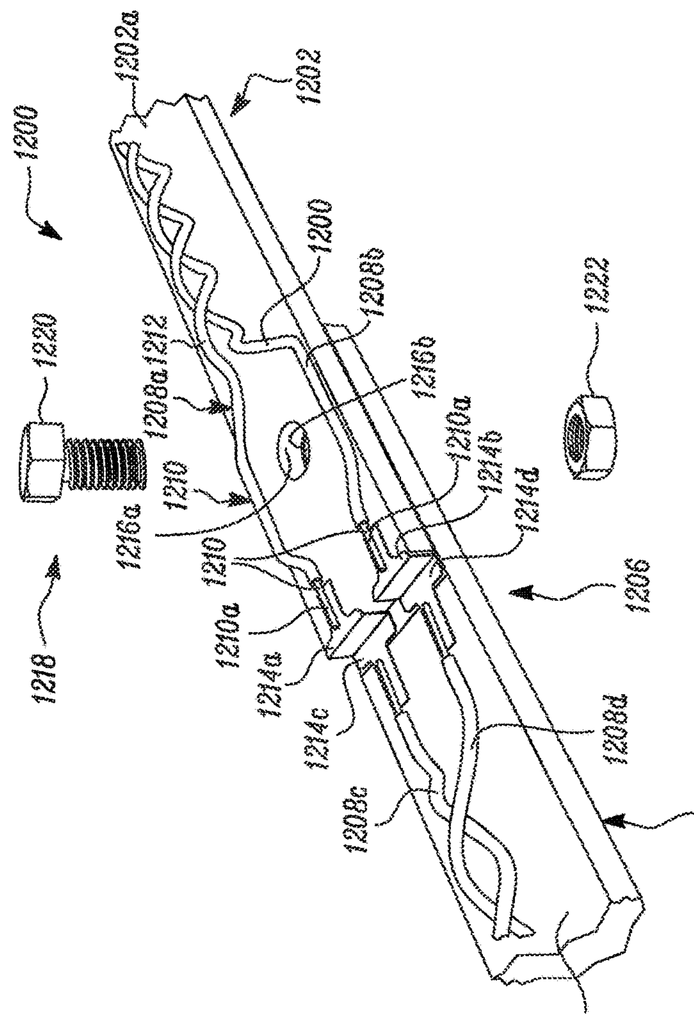

FIG. 12d

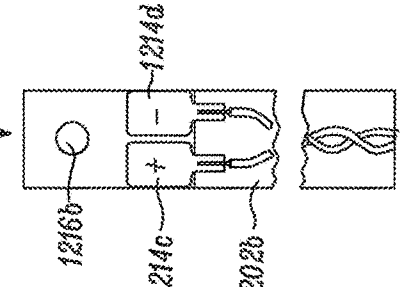

FIG. 12b

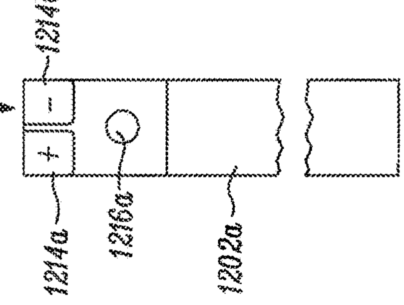

FIG. 12a

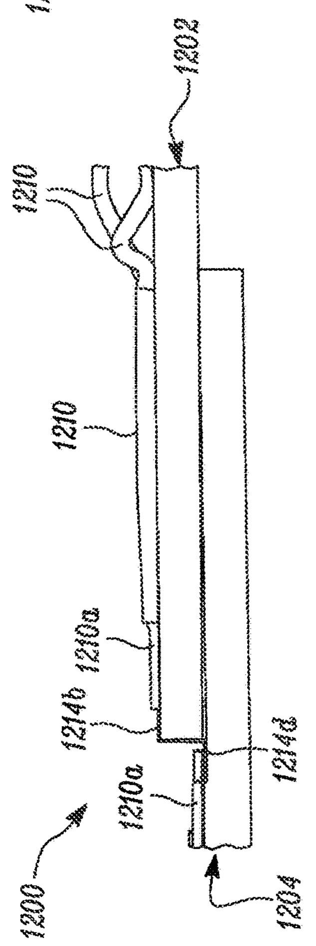

FIG. 12c

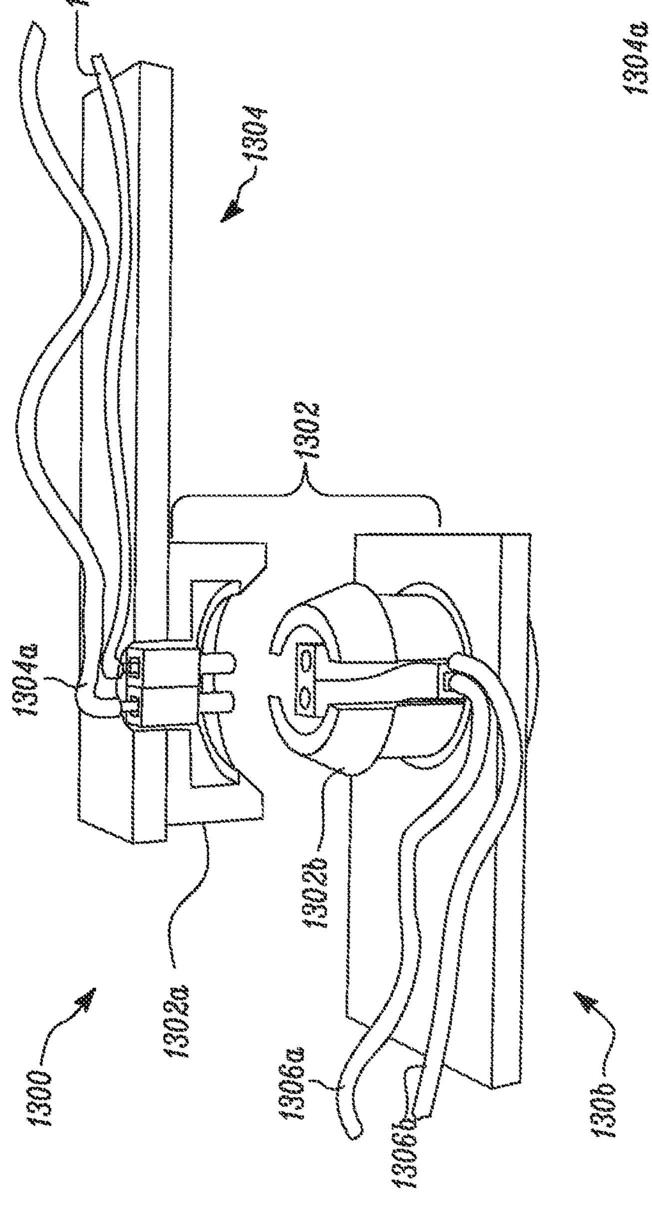

FIG. 13a

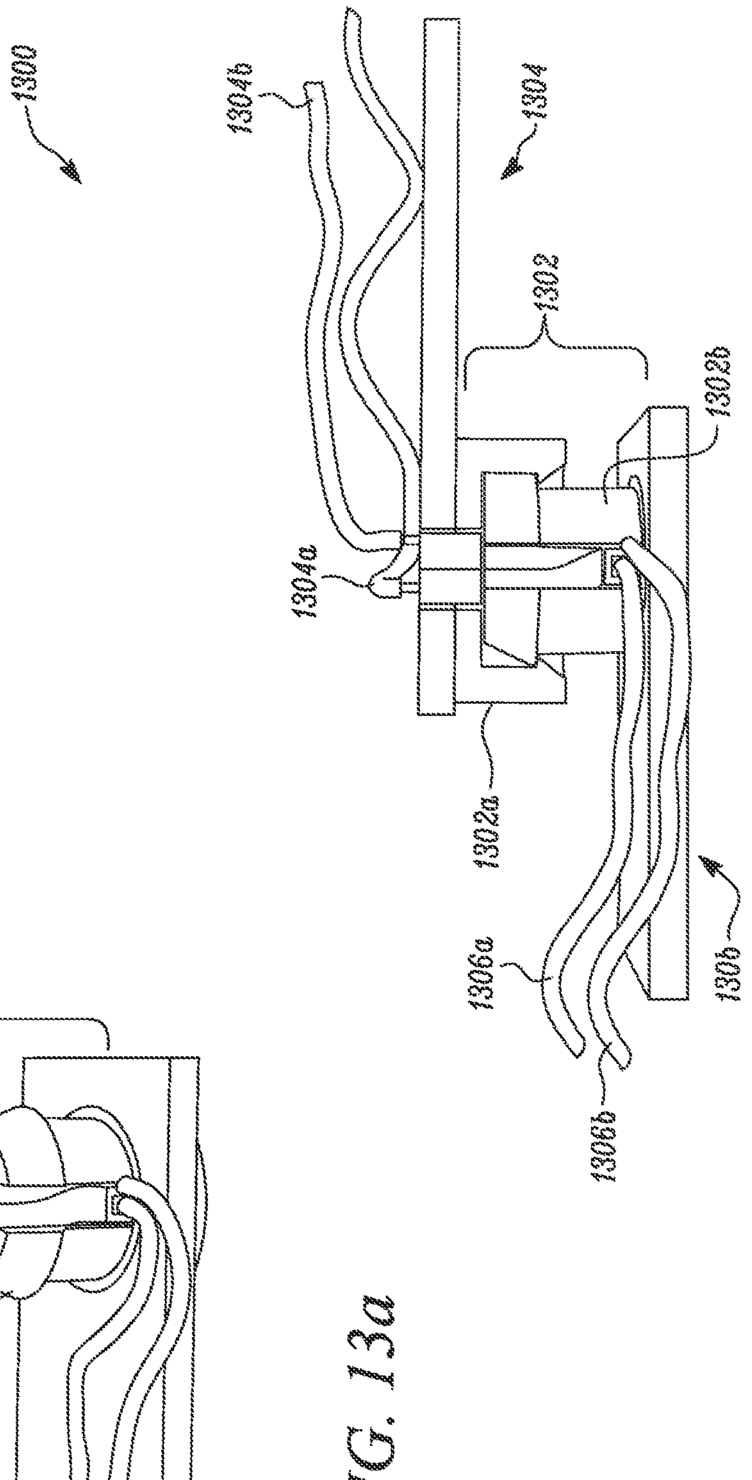

FIG. 13b

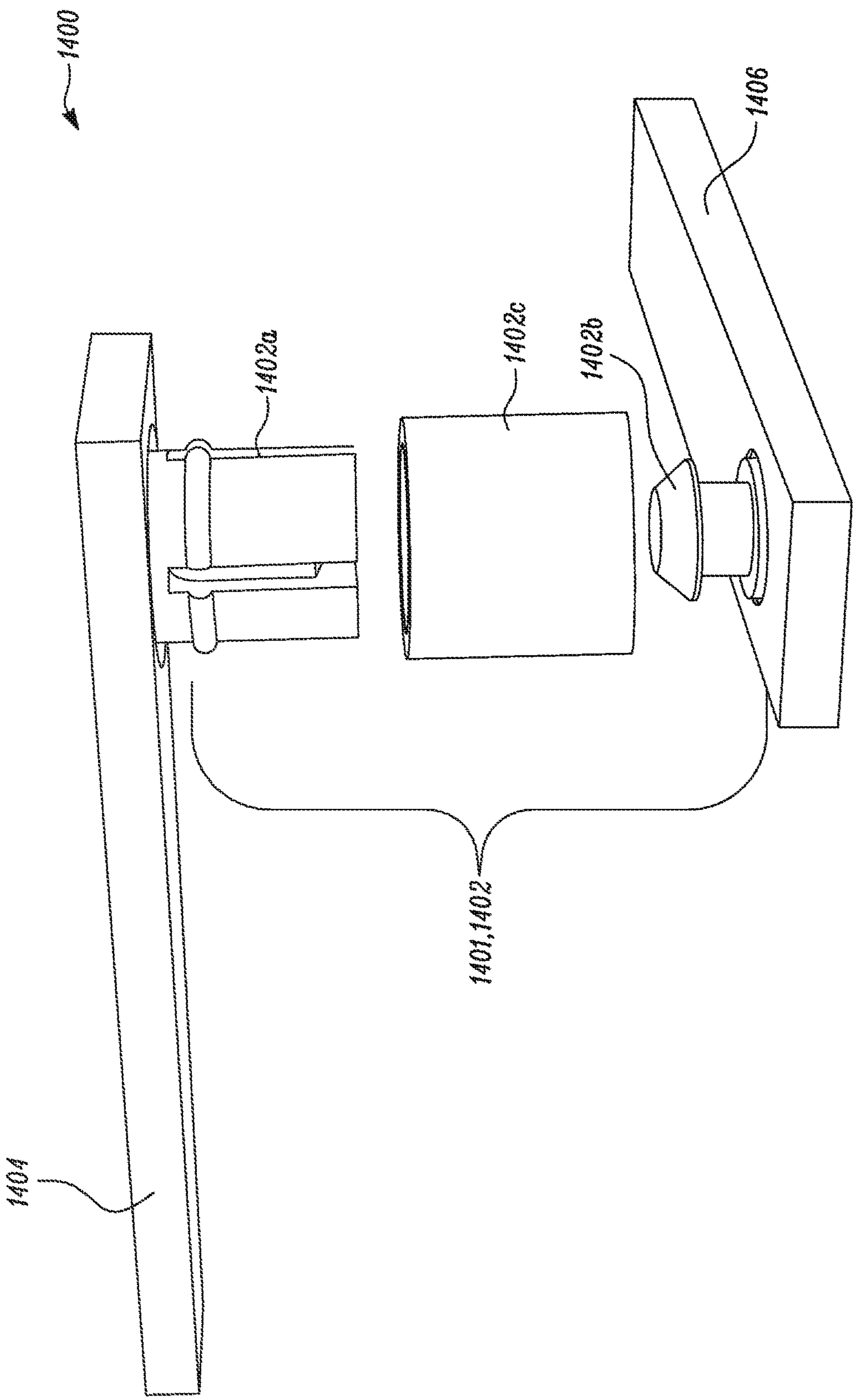

FIG. 14

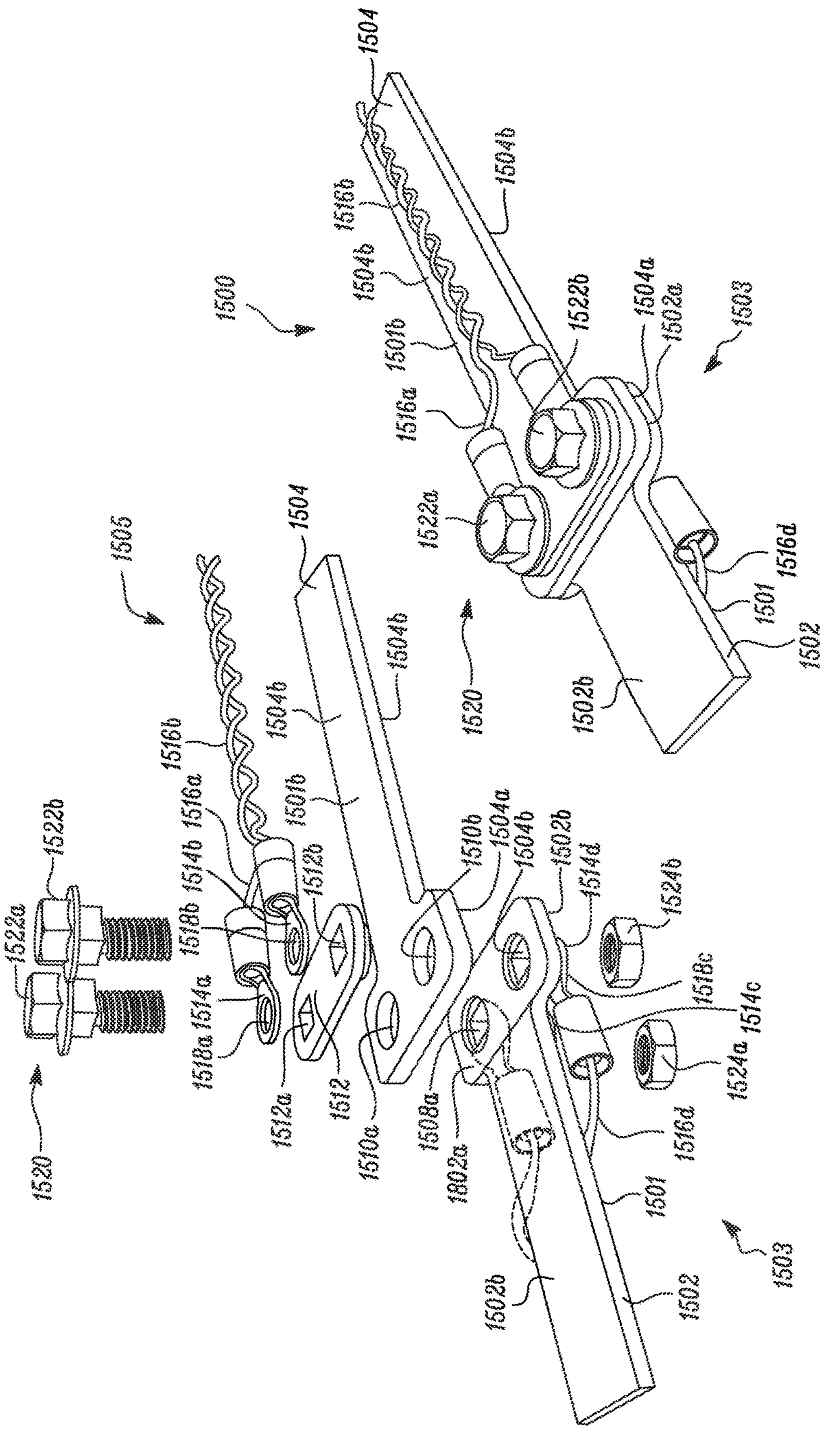

FIG. 15a

FIG. 15b

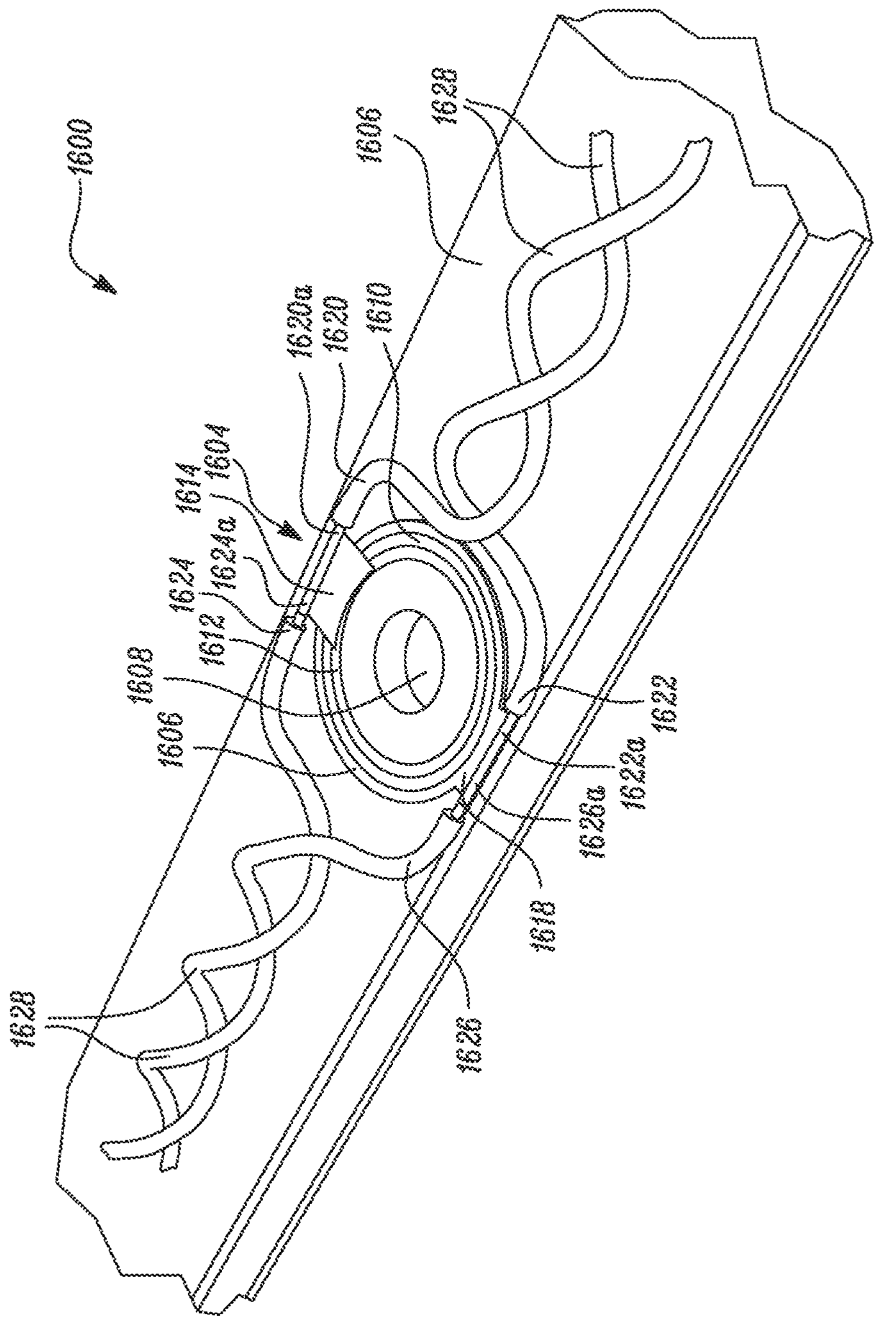
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FIG. 16

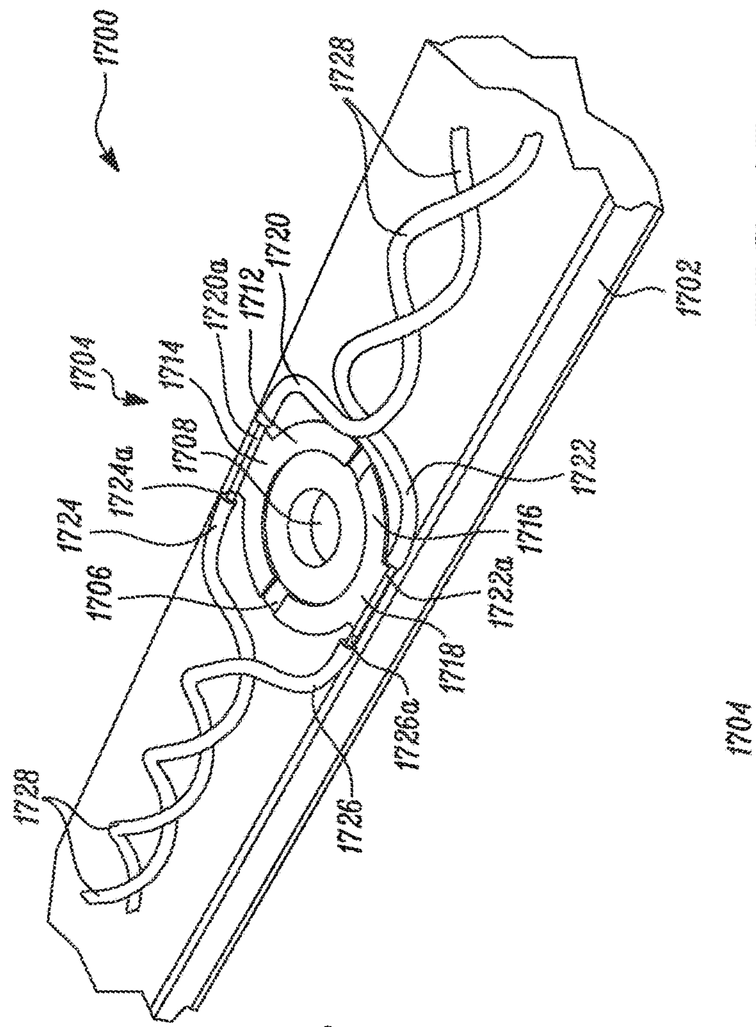

FIG. 17c

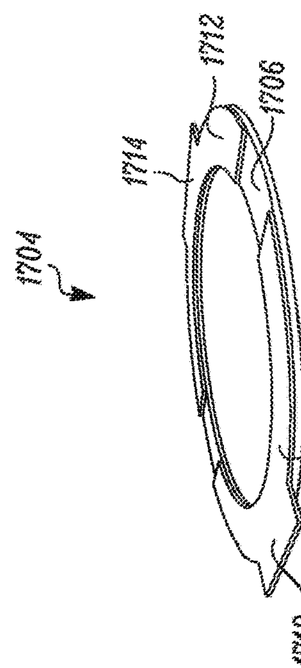

FIG. 17a

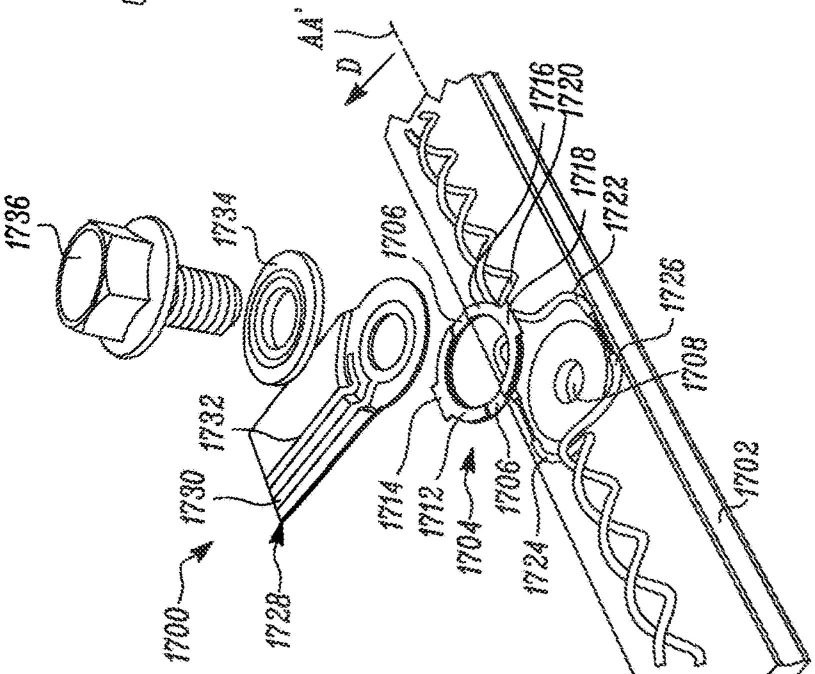

FIG. 17b

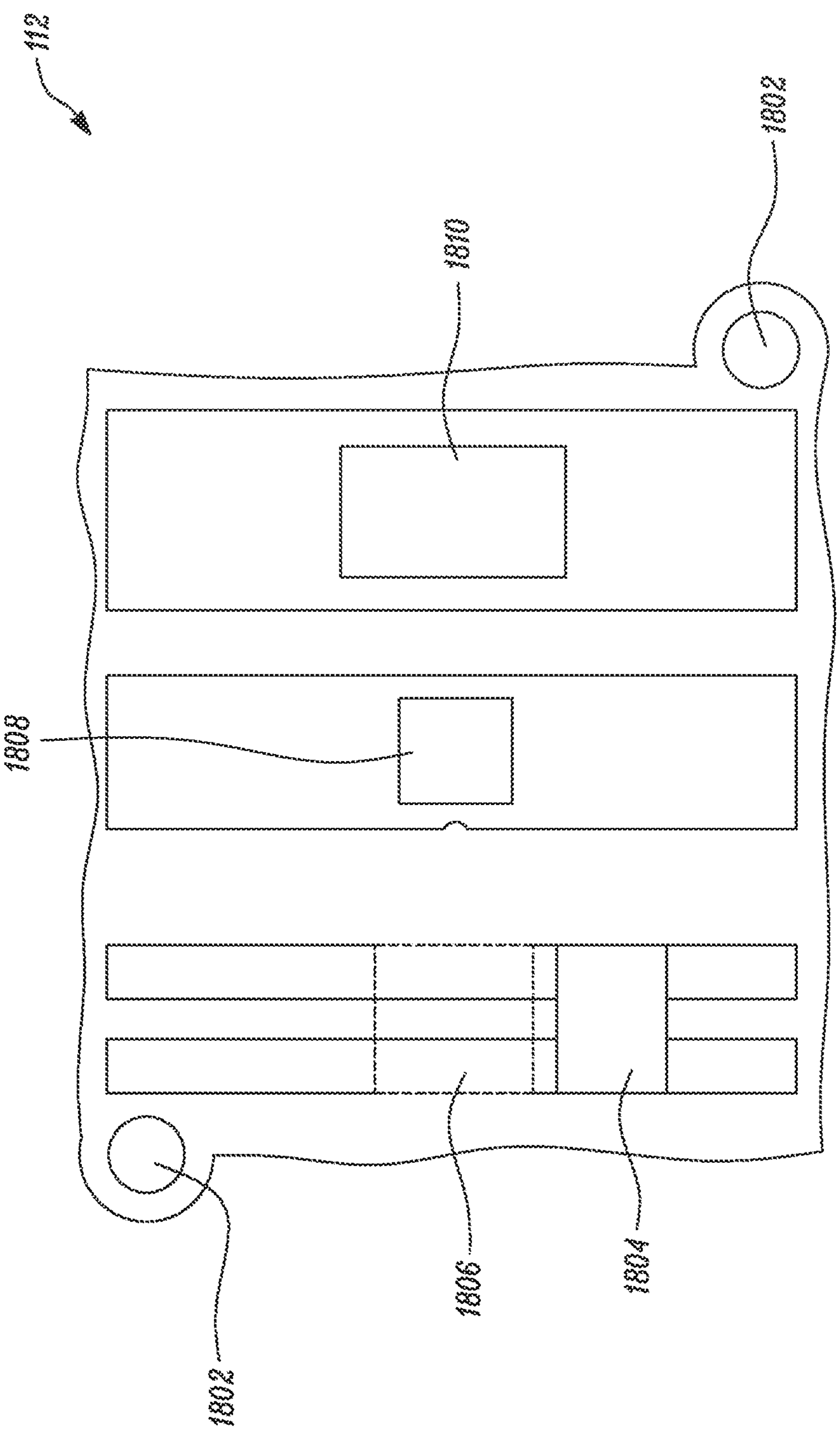

FIG. 18a

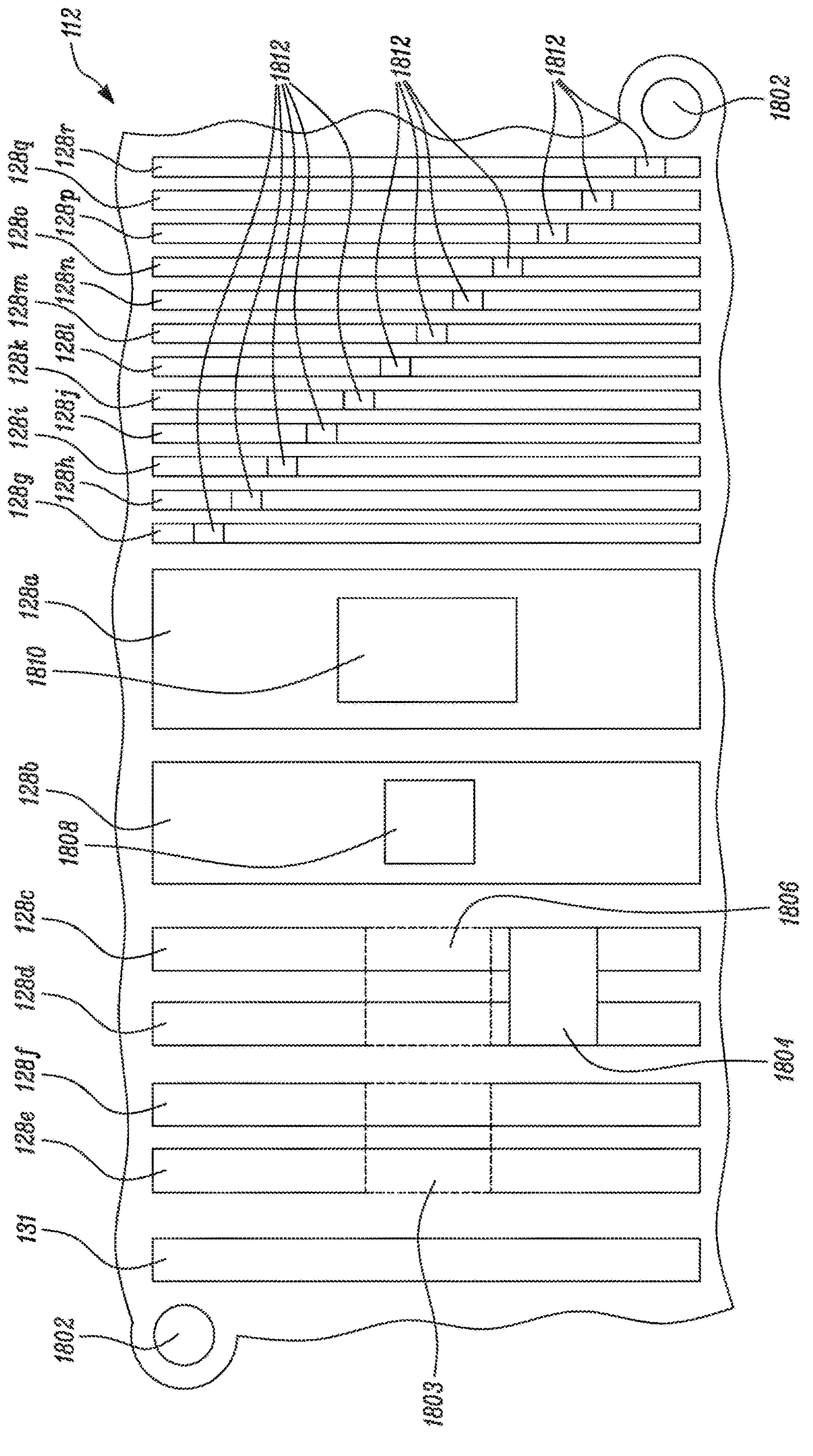
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FIG. 18b

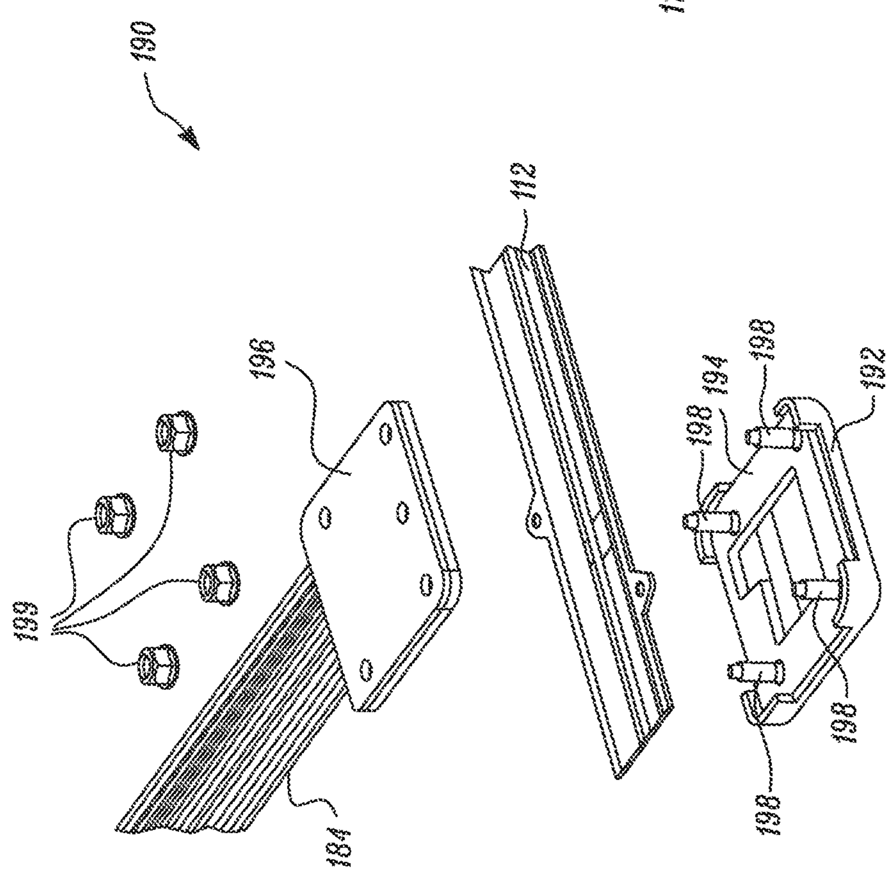

FIG. 19a

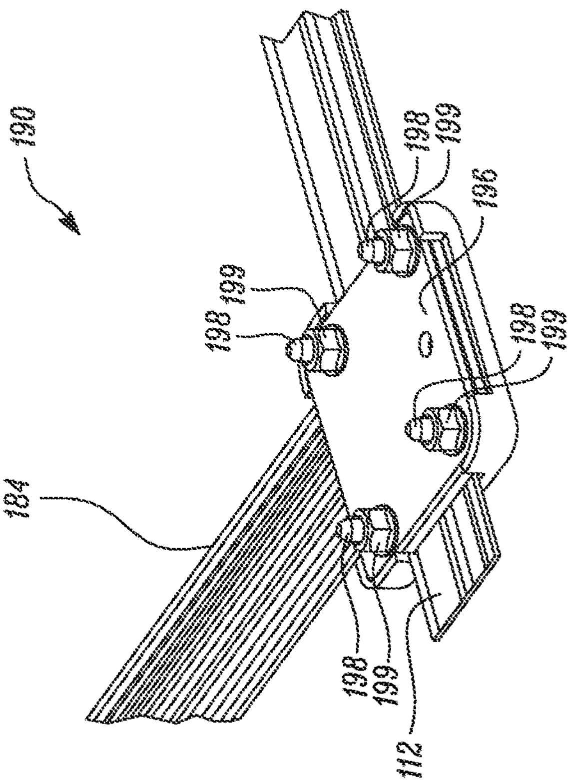

FIG. 19b

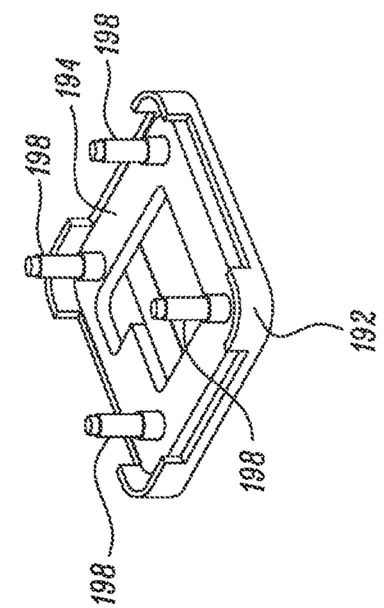

FIG. 19d

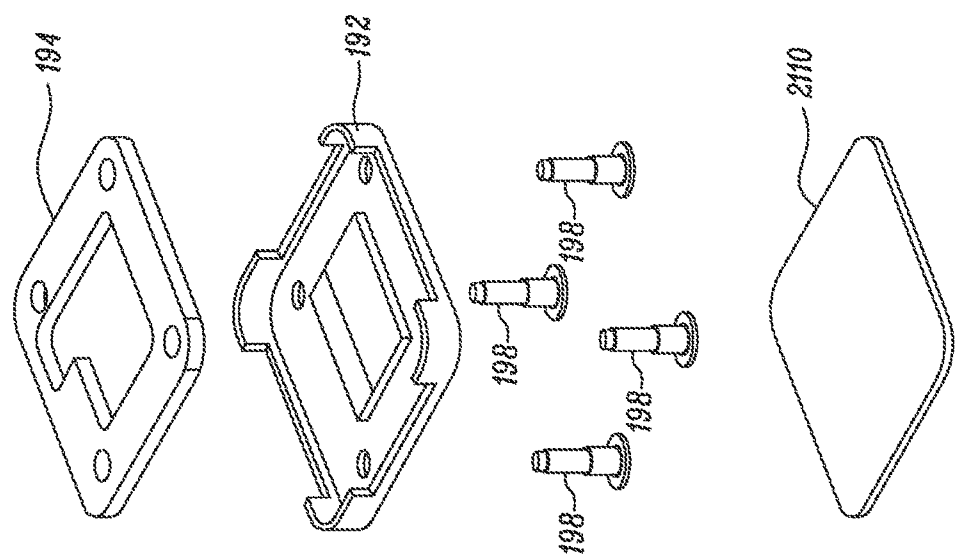

FIG. 19c

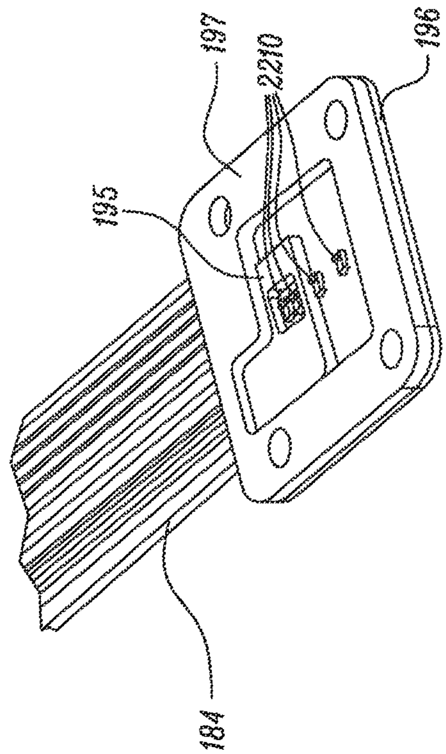

FIG. 20b

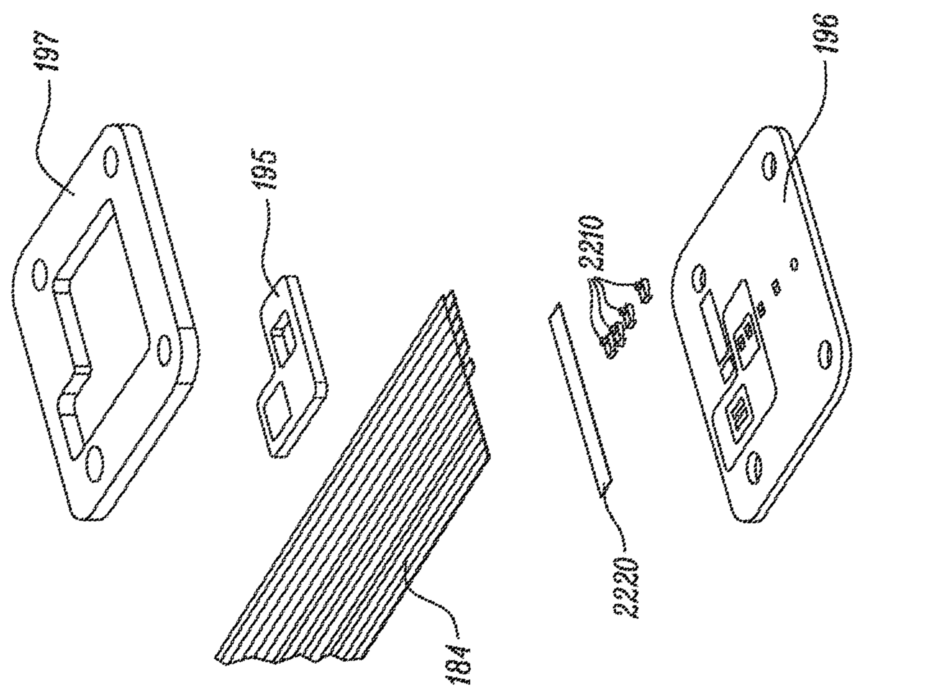

FIG. 20a

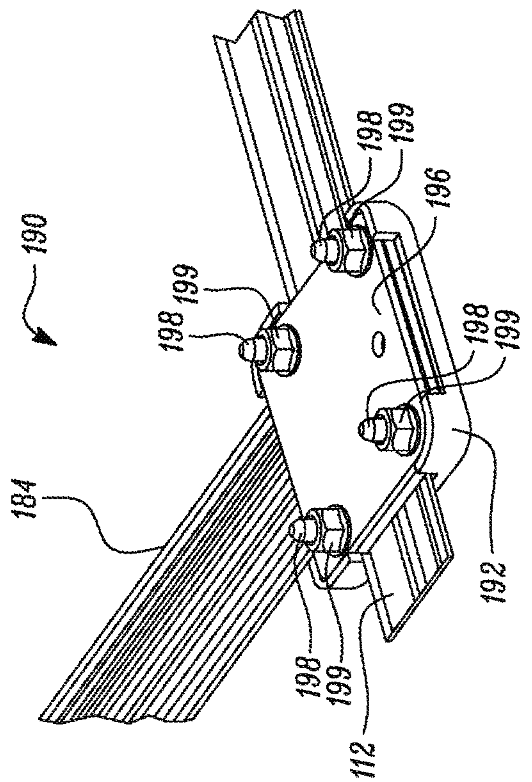

FIG. 24

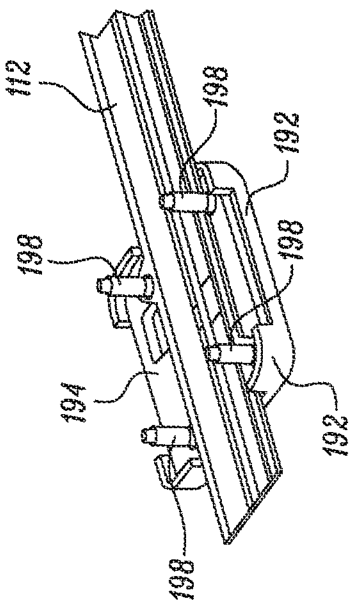

FIG. 22

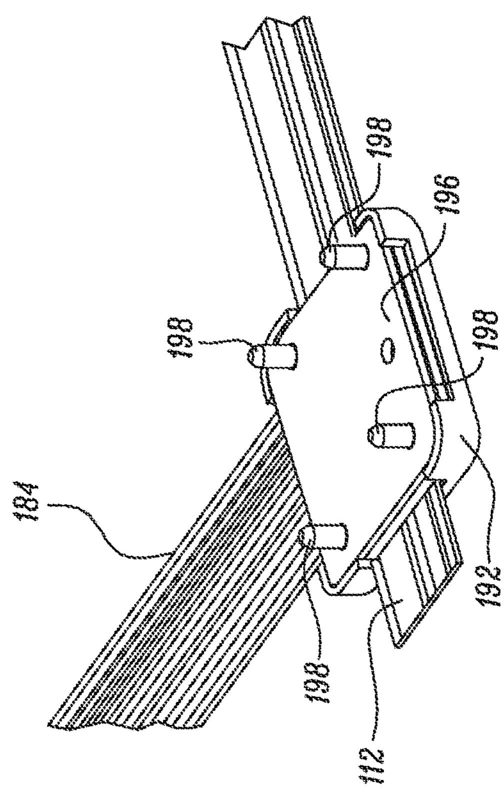

FIG. 23

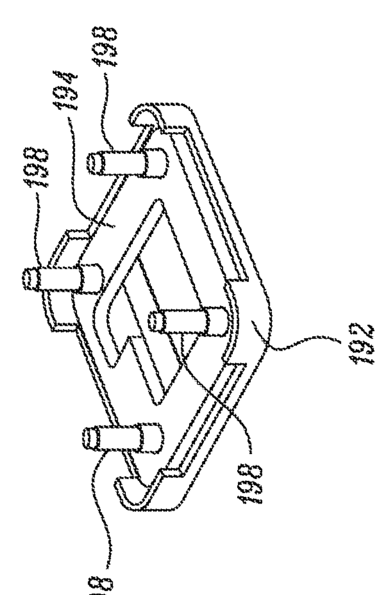

FIG. 21

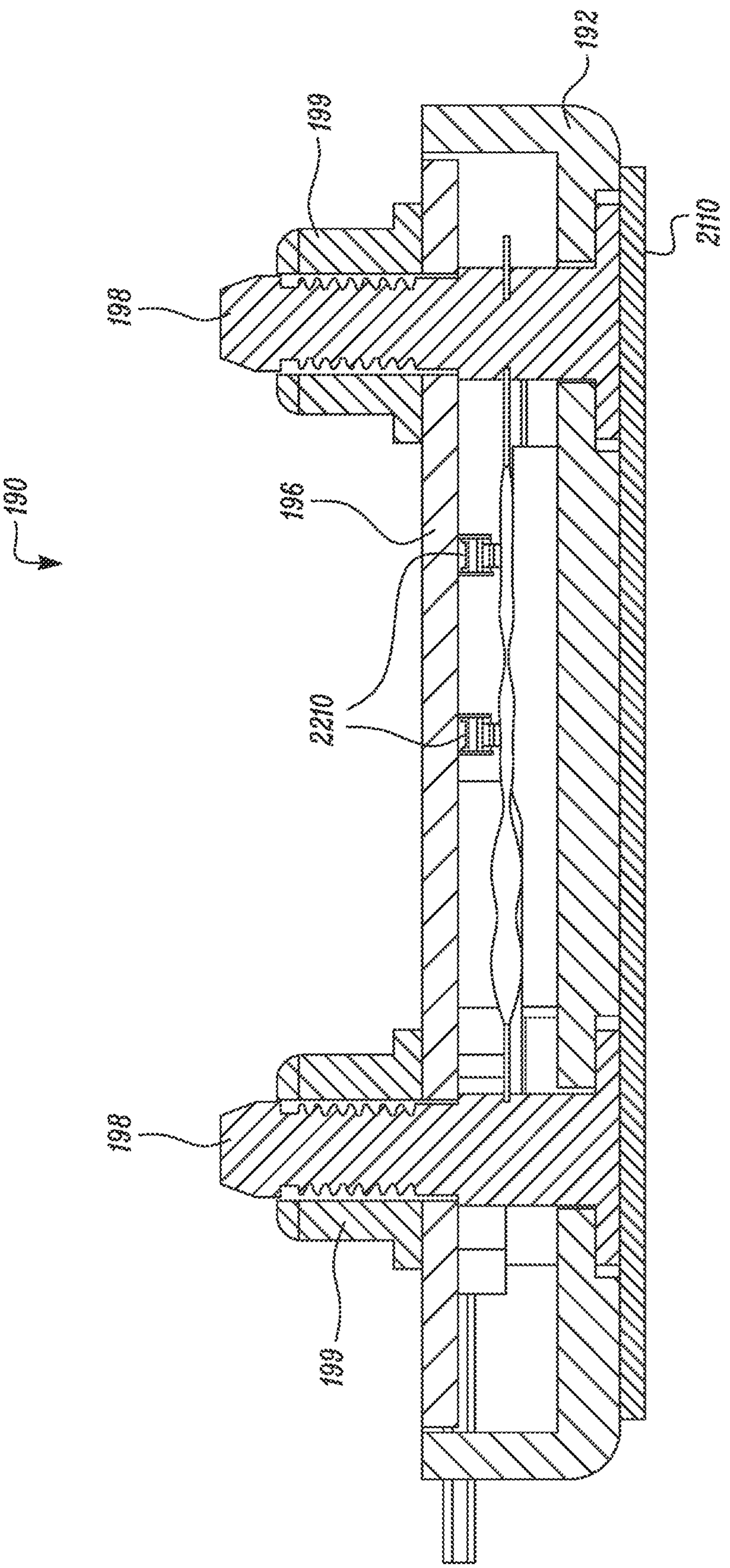

FIG. 25

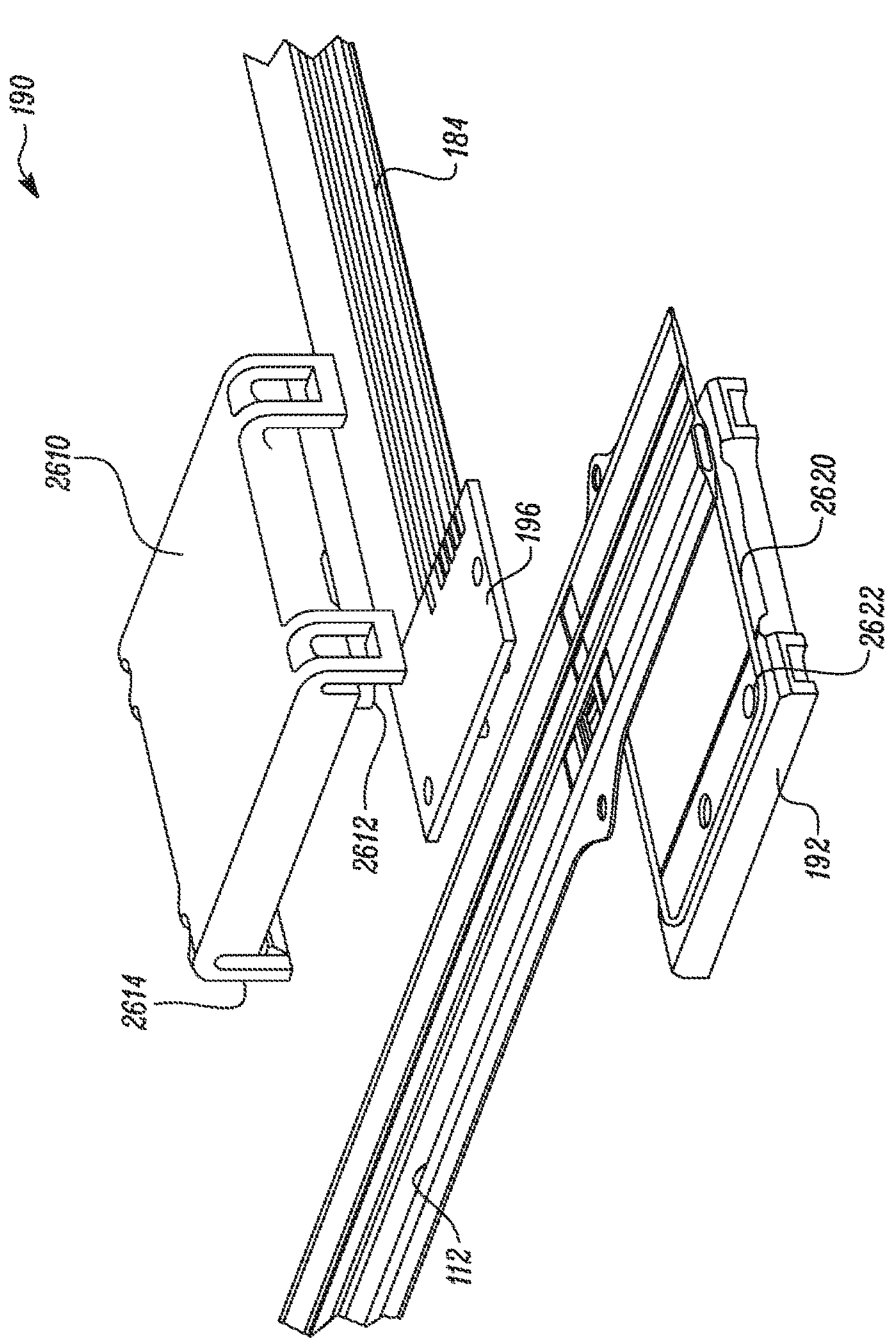

FIG. 26

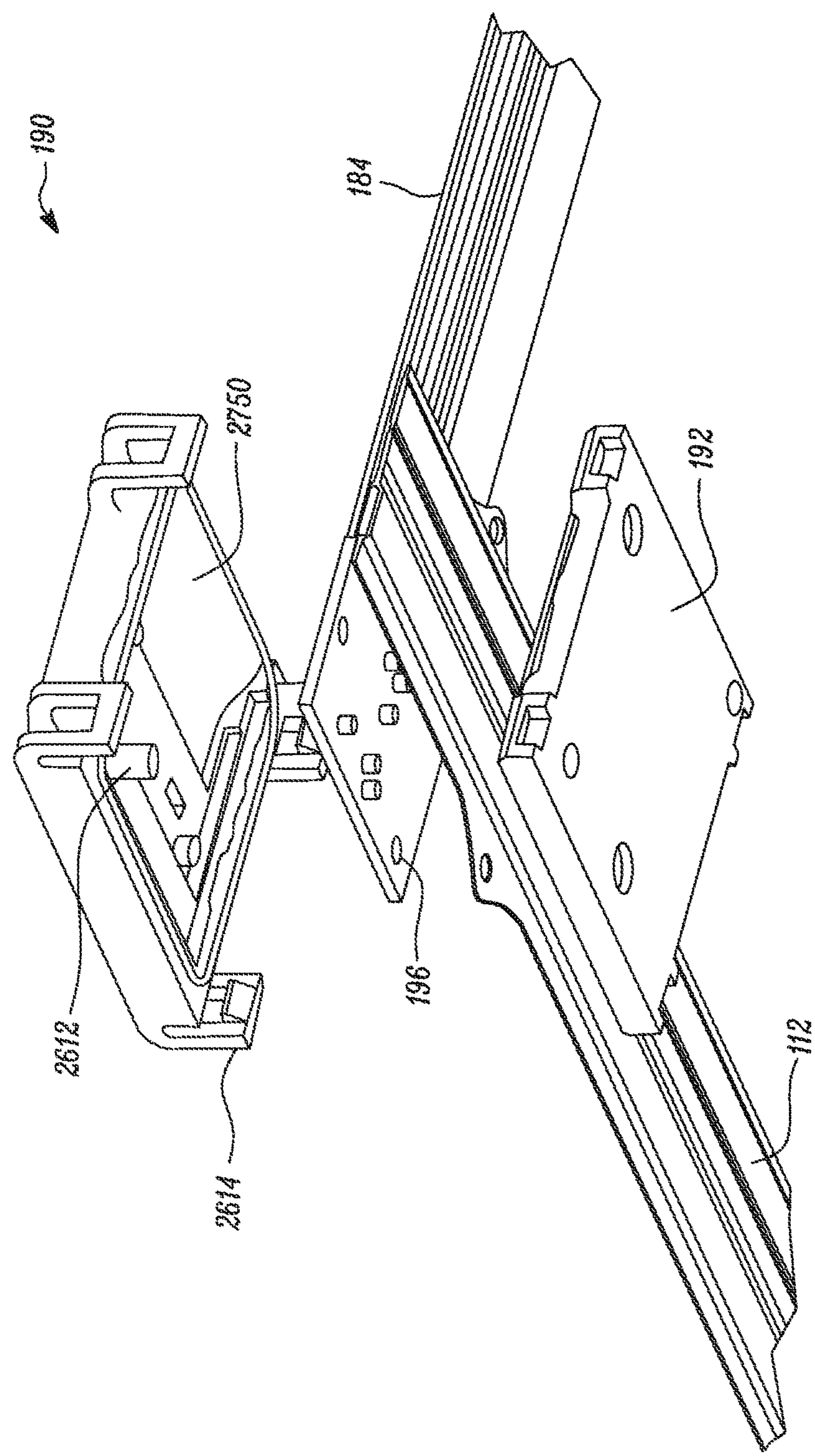

FIG. 27

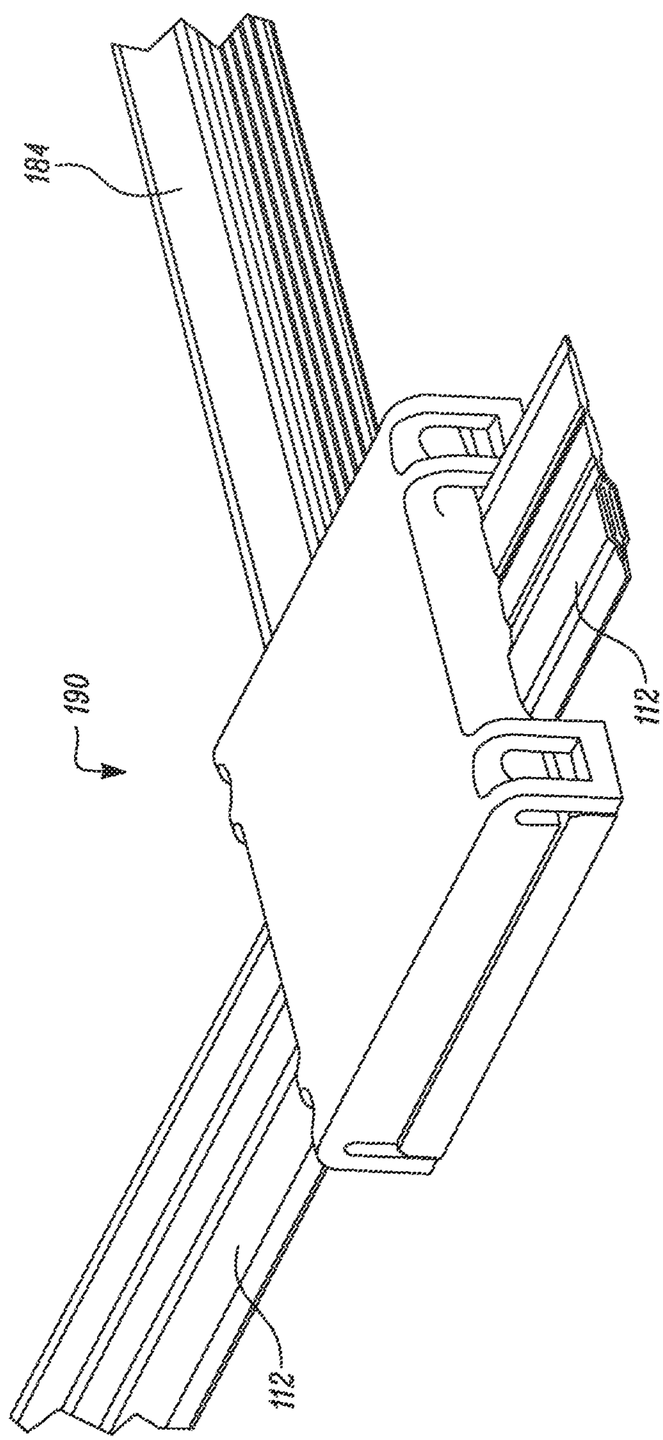

FIG. 28

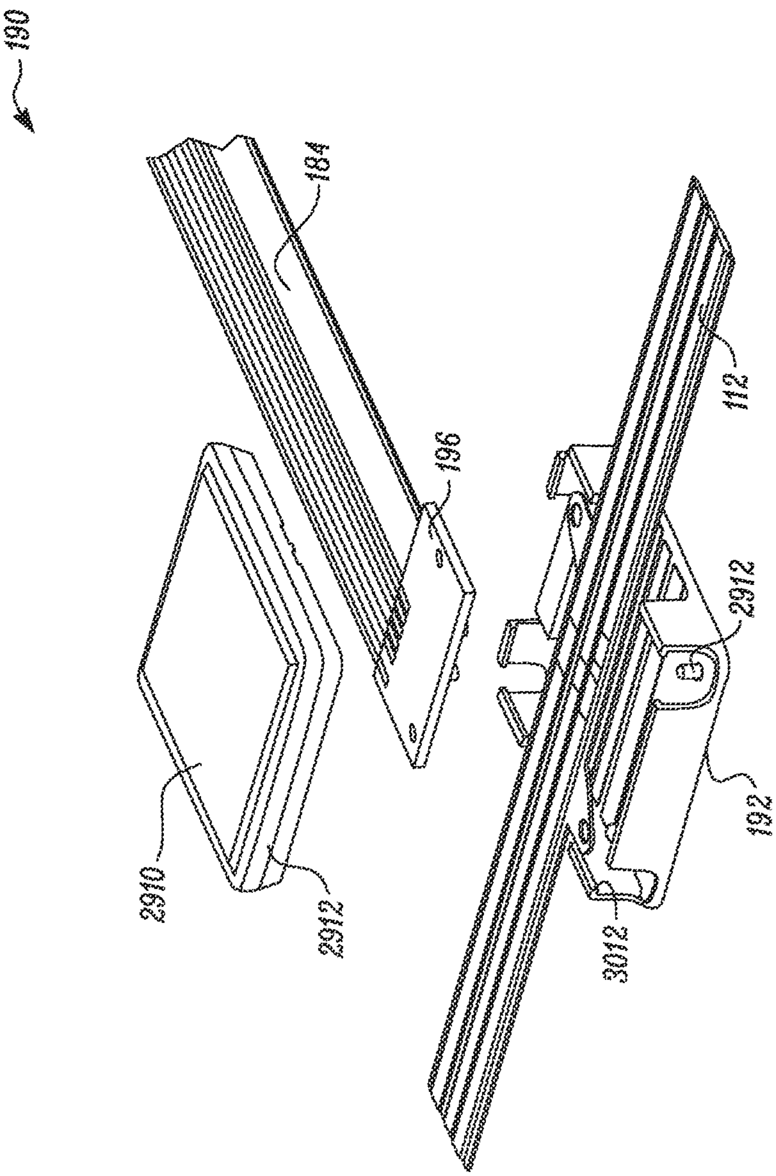

FIG. 29

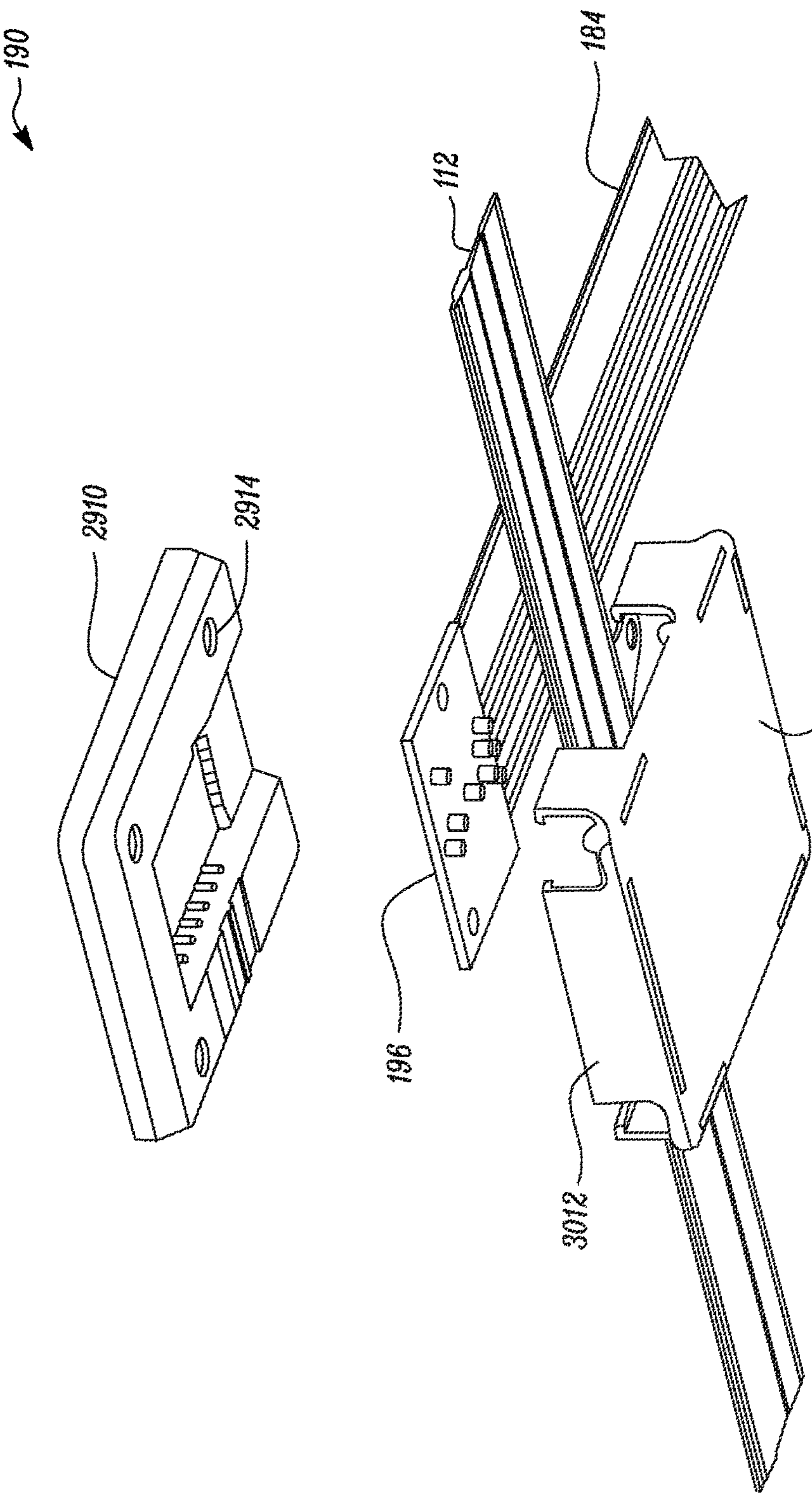

FIG. 30

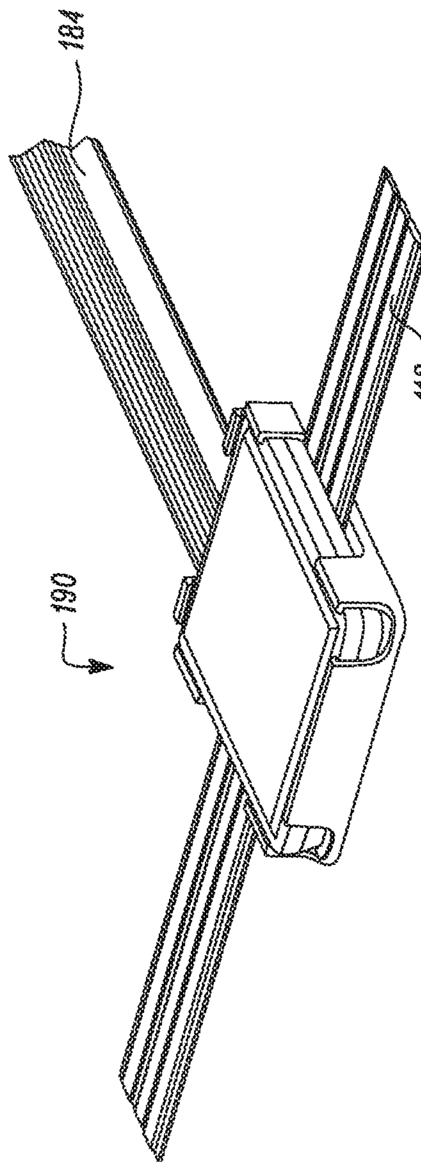

FIG. 31

WIRING SYSTEM ARCHITECTURE

CROSS-REFERENCES TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. patent application Ser. No. 16/231,314, entitled "WIRING SYSTEM ARCHITECTURE", filed Dec. 21, 2018, which claims priority to U.S. Provisional Application No. 62/618,681, entitled "WIRING SYSTEM ARCHITECTURE", filed Jan. 18, 2018, which is hereby incorporated herein by reference in its entirety and made part of the present U.S. Utility patent application for all purposes.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not applicable.

INCORPORATION-BY-REFERENCE OF MATERIAL SUBMITTED ON A COMPACT DISC

[0003] Not applicable.

BACKGROUND

Technical Field

[0004] The present disclosure relates to a new wiring and power and communications distribution system. More particularly, the present disclosure relates to a wiring system for an automobile.

Description of Related Art

[0005] Traditional car wiring for vehicles are piecemeal solutions. Typically, there are different wiring harnesses that connect each different electrical component to a central battery or power source. Each component receives power, but requires multiple wiring harnesses for communication and signals. The total length of the wire may be many miles within a single vehicle. These wiring harnesses typically consist of multiple round conductors that are not rigid. Round conductors are not optimal for transmitting current and the lack of rigidity of traditional wiring harnesses requires assembly into the vehicle using human hands, which can be a slow process. Further, connecting each component to the central battery is not optimized on an automobile level.

[0006] Hence, there is a need for wires and a wiring-system architecture that overcomes the aforementioned drawbacks.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. **1***a* illustrates a top view of an automobile showing a body and a wiring system for connecting a plurality of devices to a backbone according to certain embodiments of the current invention.

[0008] FIG. **1***b* illustrates a top view of an automobile showing a body and a wiring system for connecting a plurality of endpoints to a backbone according to certain embodiments of the current invention.

[0009] FIG. **2** illustrates a subassembly with devices connected to the backbone section via an umbilical cable according to embodiments of the present disclosure.

[0010] FIGS. **3**-**6***e* illustrate different cross-sections of the backbone section that could be implemented in the wiring system according to certain embodiments of the current invention.

[0011] FIG. **6***f* illustrates a cross-section of an umbilical cable that could be implemented in the wiring system for connecting with the backbone section of FIG. **6***c* according to certain embodiments of the current invention.

[0012] FIG. **7** illustrates a different cross-section of the backbone section that could be implemented in the wiring system according to certain embodiments of the current invention.

[0013] FIG. **8***a* illustrates a perspective view of a pair of sections associated with the backbone section that are configured to be mutually connected with the help of an interconnect system according to certain embodiments of the current invention.

[0014] FIG. **8***b* illustrates a zoomed-in perspective view of the interconnect system showing pins on a first section and receptacles on a second section of the backbone section according to certain embodiments of the current invention.

[0015] FIG. **9** illustrates sections of a backbone showing an interconnect system with cylindrical pins and receptacles according to certain embodiments of the current invention.

[0016] FIGS. **10***a*-**10***b* illustrate a section of a backbone showing an interconnect system in which polygonal pins are encased in an overmold bridge according to certain embodiments of the current invention.

[0017] FIGS. **11***a*-**11***f* illustrate different configurations of backbone sections and interconnect systems used to connect the backbone sections according to certain embodiments of the current invention.

[0018] FIGS. **12***a*-**12***d* illustrate yet another interconnect system according to a certain embodiment of the current invention.

[0019] FIGS. **13***a*-**13***b* illustrate exploded and assembled views of an interconnect system having an adapter for connecting backbone sections according to certain embodiments of the current invention.

[0020] FIG. **14** is an exploded view of a backbone with an interconnect system for connecting a pair of backbone sections according to certain embodiments of the current invention.

[0021] FIGS. **15***a*-**15***b* illustrate exploded and assembled views of a wiring system, according to certain embodiments of the current invention.

[0022] FIG. **16** illustrates a backbone section with a compound washer according to a certain embodiment of the current invention.

[0023] FIG. **17***a* illustrates a compound washer according to a certain other embodiment of the current invention.

[0024] FIG. **17***b* is an exploded view of a backbone section employing the compound washer of FIG. **17***a* and a flex plate, according to a certain other embodiment of the current invention.

[0025] FIG. **17***c* illustrates connected backbone sections using the compound washer of FIG. **17***a* according to a certain other embodiment of the current invention.

[0026] FIG. **18***a* illustrates a backbone section with windowed regions to make a connection to another cable according to certain embodiments of the current invention.

[0027] FIG. **18***b* illustrates an umbilical cable with windowed regions to make a connection to the backbone section or another cable, via the PCBA, according to certain embodiments of the current invention.

[0028] FIGS. **19***a-d* illustrate the backbone connector according to certain embodiments of the current invention.

[0029] FIGS. **20***a-b* illustrate the backbone connector according to certain embodiments of the current invention.

[0030] FIG. **21-24** illustrates the installation procedure of connecting a backbone section to an umbilical cable using a backbone connector according to an embodiment of the current invention.

[0031] FIG. **25** illustrates a cross section view of the backbone connector according to an embodiment of the current invention.

[0032] FIGS. **26-28** illustrate the backbone connector according to certain embodiments of the current invention.

[0033] FIGS. **29-31** illustrate the backbone connector according to certain embodiments of the current invention.

[0034] Embodiments of the present disclosure and their advantages are best understood by referring to the detailed description that follows. It should be appreciated that like reference numerals are used to identify like elements illustrated in one or more of the figures, wherein showings therein are for purposes of illustrating embodiments of the present disclosure and not for purposes of limiting the same.

DETAILED DESCRIPTION OF THE DISCLOSURE

[0035] The present disclosure relates to a wiring-system architecture and the cables and connectors necessary to implement the architecture. The overall wiring system disclosed herein approaches wiring in a different manner than traditional automotive wiring architectures. Traditional automotive wiring architectures often have many miles of cables snaking from centralized controllers and power sources to devices through the vehicle. This new architecture reduces the number and length of cables, and moves certain controllers into subassemblies which then control one or multiple devices present in the vehicle. To achieve power and signal transmission, new cables and connectors have been created and described herein.

[0036] In this new wiring architecture, subsystems are packaged and defined in one or multiple assemblies in certain embodiments. For example, a door assembly might contain one controller (or hub) that controls multiple devices, such as locking components, lighting components, audio components, etc. In addition to decreasing the number and length of wiring needed, the ability to create these subassemblies and then connect them to the wiring-architecture backbone will decrease assembly time during general assembly, which is very desirable to increase productivity in a vehicle manufacturing process. The subassembly may be created ahead of general assembly with only the connection between the door subassembly and subsystem made and verified during general assembly.

[0037] Embodiments of the present disclosure are directed at achieving the foregoing objectives.

[0038] Reference will now be made in detail to specific aspects or features, examples of which are illustrated in the accompanying drawings. Wherever possible, corresponding or similar reference numbers will be used throughout the drawings to refer to the same or corresponding parts.

Wiring Architecture

[0039] FIG. **1***a* illustrates a top view of an automobile **100** having a body **102** and a wiring system **104** for connecting a plurality of devices **106** disposed on the body **102** to a central processor **108** located within the body **102**. The wiring system **104** includes a backbone **112** that is used to connect devices **106** to a central battery **180** as shown in FIG. **1***b*. The battery **180** may also be located elsewhere. Devices **106** may be sensors, motors, modules, actuators, or another device. These devices **106** may be directly connected to the backbone **112** as shown in FIG. la, or there may be intermediate connections, connectors, and/or printed circuit board assemblies in between.

[0040] FIG. **1***b* illustrates a top view of an automobile **100** having a body **102** and a wiring system **104** for connecting a plurality of endpoints **186** disposed on or within the body **102** to a central battery **180**. As shown, the wiring system **104** is formed of multiple backbone sections **112**. Although multiple backbone sections **112** are depicted in the illustrated embodiment of FIG. **1***b*, it will be appreciated that in other embodiments of this invention, the wiring system **104** could be formed of a single backbone section **112**. Wiring system **104** may also be located towards the center of the car, and may not necessarily follow the periphery or sides of the car **100** or car body **102**. Backbone sections **112** are connected to battery **180**. Battery **180** may be a 12V battery. In other embodiments, battery **180** may operate at a higher voltage, such as 40V or 48V or 60 V. Umbilical cables **184** are connected to a backbone section **112** via a backbone connector **190**. Backbone connector **190**, in different embodiments of the wiring system **104**, may not be present allowing an umbilical cable **184** to be directly connected to backbone **112**. Each umbilical cable **184** may be typically connected to a hub **252** containing a printed circuit board assembly (PCBA) **254**, as shown in FIG. **2**. In certain embodiments, the umbilical cable **184** need not necessarily be connected to a microcontroller that may reside on the PCBA **254**. In fact, in certain other embodiments, the umbilical cable **184** may not even be connected to the hub **252**, the PCBA **254**, or the microcontroller residing on the PCBA **254**, rather, the umbilical cable **184** may be directly connected to a device, for example, the device **106***a*, **106***b*, or **106***c* shown in FIG. **2**.

[0041] PCBAs may be located within a subassembly, such as a seat, door, or other assembly that may be added or removed from the vehicle frame before, during, or after general assembly. When the umbilical cable **184** is connected to a PCBA, such as the PCBA **254**, it is preferentially hot bar soldered to the PCBA, although the umbilical cable **184** may also be connected to the PCBA in other manners, such as, by means of a connector that is described later herein, by laser soldering, by traditional connectors, ultrasonic soldering, or by using conductive adhesives. The PCBA **254** is then connected to tentacle cables **286** that ultimately terminate in a device, such as the device **106***a*, **106***b*, or **106***c* shown in FIG. **2**. Preferentially, the PCBA **254**, the tentacle cables **286**, and the devices **106** are packaged together to form part of an assembly, such as the subassembly **250** shown in FIG. **2**. Multiple subassemblies **250** may be assembled together, as one larger subassembly, with one subassembly hosting the hub **252** as well as the PCBA **254** and remaining subassemblies having only the PCBA **254**. These assemblies, or portions thereof, can be manufactured separately and then assembled into or with the vehicle frame during general assembly. In an example of a door assembly, the devices **106***a*, **106***b*, **106***c* could include a mirror movement actuating mechanism and/or and a door locking mechanism. If so, the mirror movement actuating mechanism and the door locking mechanism may each be connected to the PCBA, such as the PCBA **254** using tentacle cables, such as, the tentacle cables **286** shown in FIG. **2**. This way, productivity can be increased during the general assembly process as manufacturers of automobiles can do away with the time-consuming processes that used to be performed earlier for accomplishing wiring in automobiles.

[0042] It may be noted that the tentacle cables **286** disclosed herein may have the same structure as the backbone section **112**, or may have a different number of conductors or conductor geometry in order to appropriately connect to a device, such as the device **106***a*, **106***b*, or **106***c*, or a hub, such as the hub **252** or other hubs **259***a* or **259***b* exemplarily shown in FIG. **2**. In FIG. **2**, the hub **252**, which includes the PCBA **254**, is connected to each of the devices **106***a*, **106***b*, and **106***c* as well as each of the two hubs **259***a* and **259***b*. These hubs **259***a*, **259***b* may be embodied as a USB type or any other type of hub known to persons skilled in the art. Also, as disclosed earlier herein, in certain embodiments, the devices **106** could include sensors and span, generally, a wide array of features and functionality. It is hereby contemplated that alternatively, or additionally, in certain embodiments, the devices **106** could include a mirror actuator, a seat actuator, a power lock actuator, or any other device known for actuating one or more functions within the vehicle.

Backbone and Backbone-to-Backbone Connections

[0043] In certain embodiments, backbone sections **112** are structural cables. Structural cables may be of the type disclosed in U.S. Pat. App. 62/484,198, entitled "Structural Cable," which is herein incorporated by reference. In other embodiments, the backbone sections **112** may have a cross section as shown in any one of the FIGS. **3**-**5**. Backbone sections **112** may also be another type of cable with structural support or a cable without structural support. In certain embodiments, backbone sections **112** have the cross section as shown in FIGS. **6***a*-**6***e* or FIG. **7**. These structural cables may be connected to one another. In certain embodiments, backbone sections **112** lack structure. In certain embodiments, backbone sections are made using conductive ink, conductive coatings, conductive paint, or conductive adhesive applied directly applied to car body **102** to form the wiring system **104**.

[0044] FIG. **3** illustrates a cross-sectional view of the backbone section **112** according to a certain embodiment of the present disclosure. As shown in FIG. **3**, the backbone section **112** has an outer sheathing member **124** within which a bus bar **126** and a pair of conductors **128***a* and **128***b* are located. In certain other embodiments, the backbone section **112** may not contain the bus bar **126**. As shown in FIG. **3**, each of the conductors **128***a*, **128***b* is disposed alongside the bus bar **126** and located in a spaced-apart relation to one another.

[0045] A pair of inner sheathing members **130***a*, **130***b* are located outside of the conductors **128***a*, **128***b*. The inner sheathing members **130***a*, **130***b* electrically insulate each of the conductors **128***a*, **128***b* from the bus bar **126**. The outer sheathing member **124** and the inner sheathing members **130** may be made of non-conductive materials. The material(s) used to form the outer sheathing member **124** and each of the inner sheathing members **130** may be similar or dissimilar. Example materials that could be used to form the outer and inner sheathing members **124**, **130** include polyethylene (PE), polyimide (PI), polypropylene (PP), polyethylene terephthalate (PET), polyethylene naphthalate (PEN), or another insulating material. Various other suitable thermoplastic polymers commonly known to persons skilled in the art may be used to form respective ones of the outer and inner sheathing members **124**, **130** disclosed herein.

[0046] A pair of conductive shield members **132***a*, **132***b* are also within the outer sheathing member **124** and located on opposing sides of the pair of inner sheathing members **130***a*, **130***b* and the conductors **128***a* and **128***b* respectively. These conductive shield members **132** reduce electromagnetic fields in a space adjoining each of the conductors **128***a*, **128***b* and/or the bus bar **126** by blocking the electromagnetic fields produced by one or more of the conductors **128***a*, **128***b* and the bus bar **126** respectively. The conductive shield members **132** may be made from an electrically conductive material such as copper (Cu) or Aluminum (Al), and may have adhesive as well as non-conductive materials pre-attached to the Cu or Al. The conductive shield members **132** may also contact on both sides of conductors **128**, fully wrapping conductors **128**.

[0047] In certain embodiments, the bus bar **126**, the pair of conductors **128**, the pair of inner sheathing members **130**, and the pair of conductive shield members **132** are parallel or substantially parallel to one another and in a stacked configuration within the outer sheathing member **124** of the backbone section **112**. The stacked configuration of the bus bar **126**, the pair of conductors **128**, the pair of inner sheathing members **130**, and the pair of conductive shield members **132** helps to render a compact form to the backbone section **112**. This way, an amount of space required to accommodate the backbone section **112**, for instance, when tight space constraints are encountered may be minimized.

[0048] The bus bar **126** and the conductors **128** are configured to transmit power or data signals to the different endpoints **186**, hubs **252**, **259**, and/or devices **106** (refer to these components in FIGS. **1***a*, **1***b*, and **2**). For instance, the bus bar **126** could transmit power while the conductors **128** may transfer data signals. In other embodiments, the conductors **128** may transmit power, and the bus bar **126** may be only structural in function or may be omitted from the backbone section **112**. In embodiments, if the bus bar **126** or a conductor **128** carries power or data signals, the component has a line impedance in the range of 5-125 Ohms, single-ended or differential. For instance, it is envisioned that the bus bar **126** and each of the conductors **128***a*, **128***b* of the backbone section **112** depicted in the cross-sectional view of FIG. **3** could be configured to exhibit an impedance of 10.OMEGA. (Ohms). In other embodiments, each of the bus bar **126** and the conductors **128***a*, **128***b* may be configured to exhibit or offer an impedance of 50.OMEGA. (Ohms).

[0049] FIGS. **4**-**7** illustrate additional cross sections of the backbone section **112** according to certain embodiments. As shown, each backbone section **112** contains a bus bar **126**. This bus bar **126** may be removed in certain embodiments. In the embodiment shown in FIGS. **4**-**7**, four conductors **128***a*-**128***d* are present. In certain embodiments, the bus bar **126** and each of the conductors **128***a*-**128***d* may have an impedance of 20.OMEGA. (Ohms). In certain other embodiments, the bus bar **126** and each of the conductors **128***a*-**128***d* may exhibit an impedance of 100.OMEGA. (Ohms). Impedance can take a variety of forms and be odd even, common, or differential.

[0050] Further, in different embodiments, the thickness of the inner sheathing members **130***a*, **130***b* may be similar or dissimilar. For example, in the backbone section **112** of FIG. **4**, a thickness T of the inner sheathing member **130***b* associated with the conductors **128***a*, **128***b* is similar to a thickness T of the inner sheathing member **130***b* associated with the conductors **128***c*, **128***d*. However, in another example as shown in FIG. **5**, the thicknesses T.sub.1 of the inner sheathing members **130***a*, **130***b* associated with the pair of conductors **128***a* and **128***b* differ from the thicknesses T**2** of the inner sheathing members **130***a*, **130***b* associated with the pair of conductors **128***c*, **128***d* respectively. Therefore, it may be noted that the thicknesses of the inner sheathing members **130***a*, **130***b* may be varied during manufacture of the backbone section **112** to suit specific requirements of an application.

[0051] FIGS. **6***a*-**6***e* and **7** illustrate additional cross sections of the backbone section **112** according to certain embodiments. In certain embodiments, cross sections of one or more conductors **128***a-d* may be dissimilar. As shown in FIGS. **6***a*-**6***e* and **7**, the cross-sections associated with the conductors **128***c*, **128***d* is smaller and hence, dissimilar to that associated with the conductors **128***a*-**128***b* respectively. In other embodiments, the cross-section of the conductors **128***a*-**128***d* can be similar to one another. Additional conductors (not shown) may also be added in addition to **128***a*-**128***d*, and may be added in the same plane, or alternatively, above or below conductors **128***a*-**128***d*.

[0052] Moreover, as shown in FIGS. **6***a* and **7**, a pair of inner sheathing members **130***a*, **130***b* are outside of conductors **128***a*, **128***b*. These conductors **128***c* and **128***d* are shielded by a conductive shield member **132** that surrounds the pair of inner sheathing members **130***a*, **130***b*. Multiple conductive shield members **132** may exist within the backbone section **112**. For example, more conductors (not shown) alongside conductors **128** may be added, and may also include a conductive shield member **132**. The conductors **128***a* and **128***b* may carry power while the conductors **128***c* and **128***d* may carry data signals. An insulating sheathing layer **130** may additionally be present as shown in the view of FIG. **6***a*. One or more adhesive layers may also be present. FIG. **6***a* shows two adhesive layers **410***a* and **410***b*. An adhesive layer adheres the backbone section **112** to the vehicle, or another desired location. In other embodiments, a sealing layer **140** (also referred to herein as an outer sheating member or outer sheating material) might exist around the conductors **128***a*-**128***d* and the insulating sheathing layer **130**. FIG. **6***a* shows sealing layer **140** that seals the conductors **128***a*-**128***d* from dust and/or water vapor. When present, the adhesive layer **410***a* and **410***b* may be inside the sealing layer **140** (that is, part of the sealing layer **140** could be on the vehicle or component to which the backbone section **112** is adhered). Alternatively, the adhesive layers **410***a* and **410***b* may be outside of the sealing layer **140**.

[0053] In embodiments, conductors **128***a*-**128***d* carry voltages of 6V or less. In other embodiments, one or more conductors **128***a*-**128***d* carry voltages of greater than 5V, for example, one conductor might carry a voltage of approximately 10V, another a voltage of approximately 100V, while third and fourth conductors carry a voltage of approximately 5V.

[0054] FIG. **6***b* illustrates a cross-section of a backbone section **112** in accordance with certain embodiments of the present disclosure. The backbone section **112** includes conductors **128***a*-**128***d*. A non-conductive inner sheathing member **130** insulates one or more of conductors **128***a*-**128***d*. In embodiments, the inner sheathing member **130** surrounds two conductors. In other embodiments, the inner sheathing member **130** surrounds fewer or more than two conductors. Inner sheathing member **130** is necessary to insulate a conductor from shielding layer **131** if shielding layer is present around a conductor. As shown in FIG. **6***b*, conductors **128***c*, **128***d* are surrounded by inner sheathing member **130**. The inner sheathing member **130** is formed from an insulating material, such as polyethylene (PE), polyimide (PI), polypropylene (PP), polyethylene terephthalate (PET), polyethylene naphthalate (PEN), or another insulating material. Various other suitable thermoplastic polymers commonly known to persons skilled in the art may be used to form the inner sheathing member **130** disclosed herein. Conductive shielding layer **131** surrounds and abuts inner sheathing member **130**. In embodiments, conductive shielding layer **131** surrounds fewer or more than two conductors. Conductive shielding layer **131** may be made from Cu, Al, or another conductive metal, and may be plated (or otherwise covered) with Sn, Ni, Au, or another conductive material. In embodiments, conductive shielding layer **131** is formed from a non-conductive material and plated (or otherwise covered) with a conductive material, such as Cu, Al, Sn, Ni, Au, another metal, or another conductive material.

[0055] FIG. **6***c* illustrates a cross-section of a backbone section **112** in accordance with certain embodiments of the present disclosure. The backbone section **112** includes conductors **128***a-r*. The sets of conductors **128***a-b*, and **128***c-d* may exhibit similarity of configuration and function with that disclosed in conjunction with embodiments herein. Conductors **128***c-d* and **128***e-f* are surrounded by the inner sheathing member **130** and the conductive shielding layer **131**. Inner sheathing member **130** may fully encase conductors, as shown in FIG. **6***c*, or alternatively, inner sheathing member **130** may be disjointed and exhibit an open configuration whereby it is not continuous and includes void regions.

[0056] In the embodiments described in this disclosure, conductors **128***e-f* and **128***g-r* may be formed from the same material, or alternatively, they may be formed from dissimilar material. For example, each conductor from the sets of the conductors **128***e-f* and **128***g-r* may be copper while each conductor from the sets of conductors **128***a-b* and **128***c-d* may be aluminum. In certain situations, certain of conductors **128***a-b* and **128***c-d* are used to transmit data in the form of control and/or feedback signals between devices, for example, a PCBA **196** (shown in FIGS. **19***a-d*), a processing unit, or control functionality, and a safety device (not shown) within the automobile **100** (refer to FIGS. **1***a-b*). Such safety device may be an airbag, but is not limited thereto.

[0057] Further, conductors **128***e-f* and **128***g-r* may transmit data in one or both directions between devices. For example, conductors **128***e-f* may transmit control signals from PCBA **196** (or another location) to one or more safety devices, while conductors **128***g-r* may transmit feedback signals from the safety devices to a central processor, control functionality, or another location. In another example, conductors **128***e-f* and **128***g-r* may be capable of transmitting data bi-directionally between devices, for instance, a central processor or control functionality and the safety device.

[0058] Each conductors **128***e-f* may have the same cross sectional dimensions (width and height), or may have different cross sectional dimensions. For example, the width and height of each conductors **128***a-b* may be a specific width and height, while conductors **128***e-f* are only 50-80% of the of the width and height of conductors **128***a* and/or **128***b*. Similarly, the thickness of the inner sheathing member **130** associated with the set of conductors **128***e-f* may be similar or dissimilar to the thickness of the inner sheathing member **130** surrounding the conductors **128***c-d*. When dissimilar thicknesses are present, the inner sheathing member **130** surrounding conductors **128***e-f* may be thicker or thinner than the thickness of inner sheathing member **130** surrounding conductors **128***c-d*. Further, the dimensions of conductors **128***g-r* may be the same or different than the dimension of conductors **128***e-f*. The dimensions and material of the conductors **128***a*-b, **128***c-d*, **128***e-f*, and **128***g-r* may be selected depending on the function the conductors are to perform, for example, transmitting control and/or feedback signals.

[0059] FIGS. **6***d* and **6***e* illustrate additional embodiments backbone section **112**. As depicted in FIG. **6***d*, unshielded conductor **128***a* is not present (compared to FIG. **6***c*). That is two shielded conductors **128***c-d* and unshielded conductor **128***a* are present. In addition, conductors **128***g-r* are also present and conductors **128***e-f* are not present (compared to FIG. **6***c*). In the embodiment shown in FIG. **6***e*, the backbone section **112** includes shielded conductors **128***c-d* and unshielded conductor **128***a*.

[0060] FIG. **6***f* illustrates a cross-section of an umbilical cable **184** that can be connected to the backbone section **112** of FIG. **6***c*, via the PCBA **196** (refer to FIGS. **19***a-d*). The umbilical cable **184** illustrates a similar configuration of the conductors that are included within the backbone section **112** of FIG. **6***c*. The major difference is that fewer conductors **128***g-r* are present, specifically only conductors **128***g-h* are present. When conductors **128***g-h* are used to transmit signals from a safety device, the umbilical cable need only contain two of conductors **128***g-h*, while the backbone section **112** must include more conductors so that it may carry signals from other connected umbilical cables. For example, as shown in FIG. **6***c*, the backbone section has twelve conductors **128***g-r*, while the umbilical cable **184** has two conductors **128***g-h*, as shown in FIG. **6***f*.

[0061] The twelve conductors **128***g-r* within the backbone section (as shown, for example, in FIG. **6***c*), may be grouped into pairs, for example, conductors **128***g-h*, **128***i-j*, **128***k-l* and so on, and establish connections to multiple safety devices via multiple different umbilical cables **184**. For example, with the twelve conductors **128***g-r* shown in the backbone section **112** of FIG. **6***c*, six umbilical cables **184**, as shown in FIG. **6***f* can be connected to the backbone section **112**, with each umbilical cable later connected to a safety device and used to transmit signals from the safety device to a processing unit or control functionality. In certain embodiments, umbilical cables **184** includes more than one pair of conductors, for example, two pairs of conductors **128***g-h* and **128***i-j*. In other embodiments, the backbone section **112** includes fewer or more conductors than those shown in FIG. **6***c* to facilitate connections with more or fewer safety devices.

[0062] FIG. **8***a* illustrates an exploded view of the backbone section **112** with an interconnect system **800** consisting of pins **802** and receptacles **804** connecting a first backbone section **112***a* and a second backbone section **112***b*. Each backbone section **112***a*, **112***b* may be located adjacent and connected to one another with the help of the interconnect system **800**. As shown, the interconnect system **800** includes pins **802** that are disposed on the first backbone section **112***a* and receptacles **804** disposed on the second backbone section **112***b*.

[0063] FIG. **8***b* illustrates a zoomed-in view of interconnect system **800** from FIG. **8***a* showing the pins **802***a*-**802***h* from the first backbone section **112***a* and the receptacles **804***a*-**804***h* from the second backbone section **112***b*. As shown, each pin **802** is connected (usually physically and electrically) with one of the bus bar **126**, one or more conductors **128***a*-**128***d*, or one or more conductive shield members **132***a*-**132***b* (refer to FIG. **5**) of the first section **112***a* of the backbone section **112** shown in FIG. **8***a*. For instance, pin **802***a* may be connected to the bus bar **126** (refer to FIG. **5**) that is part of the first section **112***a*, while pins **802***b*, **802***c*, **802***d*, and **802***e* may be connected to conductors **128***a*, **128***b*, **128***c*, and **128***d* (refer to FIG. **5**) of the first section **112***a* of the backbone section **112** shown in FIG. **8***a*.

[0064] Moreover, pins **802***f*, **802***g* may be connected to conductive shield members **132***a* and **132***b* which provide shielding for conductors **128***a*-b, and **128***c-d* (refer to FIG. **5**) respectively, offering a continuous electrical return path for data signals. Further, pin **802***h* may be connected to conductive shield member **132***b* (refer to FIG. **5**) of the first section **112***a* of the backbone section **112** (refer to FIGS. **8***a*-**8***b*).

[0065] Further, as shown in FIGS. **8***a*-**8***b*, the interconnect system **800** also includes receptacles **804** that are on an end portion of the second section **112***b* (although they could be anywhere along the second section). These receptacles **804** are configured to accept pins **802**, that is, the size and shape of the receptacle opening accept pins **802**. For instance, the receptacle **802***a* may be connected with the bus bar **126** of the second section **112***b* and hence, connects the bus bar **126** of the first section of the first section **112***a* through accepting pin **802***a*. Similarly, receptacles **804***b*, **804***c*, **804***d*, and **804***e* are connected to the conductors **128***a*, **128***b*, **128***c*, and **128***d* of the second section **112***b* and connected to conductors **128***a*, **128***b*, **128***c*, and **128***d* of the first section **112***a* though pins **802***b*, **802***c*, **802***d*, and **802***e* respectively. The pins **802** and receptacles **804** may take alternate shapes, materials, and geometries beyond cylindrical profiles, and pins **802** and receptacles **804** of varying shapes, materials, and geometries may co-exist.

[0066] Also, with continued reference to FIGS. **5** and **8***b*, some portion of the outer sheathing member **124** may be stripped-off to define additional receptacles **804***f*, **804***g*, and **804***h*. The receptacles **804***f* and **804***g* may be connected to conductive shield members **132***a* (refer to FIG. **5**) that are connected to conductors **128***a-b* and **128***c-d* respectively. Further, the receptacle **804***h* may be connected to conductive shield member **132***b*. These receptacles **804***f*, **804***g*, and **804***h* would be configured to accept pins **802***f*, **802***g*, and

802*h* respectively (refer to FIG. **8***b*) and form the desired connection between the first and second sections **112***a*, **112***b*.

[0067] In certain embodiments, the interconnect system **800** may be stabilized with the help of a cumulative force from radial pressure of an engagement between a tubular wall **806** containing each receptacle **804** and its corresponding pin **802** when engaged to one another. That is, the engagement between each pin **802** and the tubular wall **806** of receptacle **804** would be snug such that a radial force would apply to hold the pin **802** into the receptacle **804** and create a contact between the two. The pins **802** and receptacles **804** may also be welded as necessary to increase strength at the connection point.

[0068] FIG. **9** shows an exploded view of a backbone section **112** with a first section **112***a* and a second section **112***b* connected together according to a certain embodiment of the present disclosure. As shown, the first section **112***a* includes a bus bar **902***a* and a pair of conductors **904***a*, **904***b* that are disposed successively over the bus bar **902***a* of the first section **112***a*. Similarly, the second section **112***b* includes a bus bar **902***b* and a pair of conductors **904***c*, **904***d* that are disposed successively over the bus bar **902***b* of the second section **112***b*. An interconnect system **900** for connecting the first and second sections **112***a*, **112***b* includes three pins **908***a-c* located on the first section **112***a* and three receptacles **910***a-c* located on the second section **112***b*. The pin **908***a* is connected to the bus bar **902***a* of the first section **112***a* while the pins **908***b*, **908***c* are connected to the pair of conductors **904***a*, **904***b* associated with the first section **112***a*. Likewise, receptacle **910***a* is connected to the bus bar **902***b* of the second section **112***b* while the receptacles **910***b*, **910***c* are connected to the pair of conductors **904***c*, **904***d* associated with the second section **112***b*. Pins **908***a*, **908***b*, and **908***c* are configured to engage with receptacles **910***a*, **910***b*, and **910***c* respectively. In the illustrated embodiments of FIG. **9**, it may be noted that each of the pins **908** and receptacles **910** are cylindrically shaped so that these cylindrically-shaped pins **908** and receptacles **910** correspond with one another to facilitate a mutual engagement of the pins **908** to the receptacles **910**. The connection method between pins **908** and receptacles **910** may comprise of inductive soldering, press-fitting, brazing, wave soldering, or be conductive adhesive based. Further, it may also be noted that strips of conductive material/s forming each of the bus bars **902***a*, **902***b*, and each of the conductors **904***a-d* may also be disposed laterally with respect to corresponding ones of each of the bus bars **902***a-b*, and each of the conductors **904***a-d* so that power and/or data signals can be transferred in a direction laterally away from one or more points that are located partway along a length of the first and second sections **112***a*, **112***b* of the backbone section **112**.

[0069] According to another embodiment shown in FIGS. **10***a*-**10***b*, the first section **112***a* of the backbone section **112** includes pins **1002**, for instance, pins **1002***a*-**1002***f* that are polygonal in shape, and other pins **1002**, for instance, pin **1002***g* that are cylindrical in shape. Moreover, in additional embodiments, pins **1002** are shown partially encased in an overmold bridge **1006** formed of a non-conducting material, for example, epoxy, acrylic, silicone rubber, or other polymer base material, such as polybutylene terephthalate (PBT). As best shown in FIG. **10***b*, the second section **112***b* defines some receptacles **1004**, for instance, receptacles **1004***a-f* that are polygonal in shape, and other receptacles **1004**, for instance, receptacle **1004***g* that is cylindrical in shape. Each of receptacle **1004** from the second section **112***b* is configured to connect to corresponding pin **1002** from the first section **112***a*. The bridge **1006** can be adhered to the second section **112***b* with the help of a gasket **1008** that could include, for example, a cure-in-place (CIP) gasket or a form-in-place (FIP) as known to persons skilled in the art, for attachment as well as sealing purposes. The gasket **1008** may also be overmolded over the bridge **1006**. As shown best in FIG. **10***a*, the gasket **1008** is applied to a surface **1006***a* of the bridge **1006** facing the second section **112***b* so that the gasket **1008** helps the bridge **1006** to adhere with the second section **112***b* of the backbone section **112** and therefore, stabilize the interconnect system **1000** upon engagement of the pins **1002** to their corresponding receptacles **1004**.

[0070] Referring to FIG. **11***a*, a backbone section **112** according to an embodiment of the present disclosure includes a first half **1101***a* and a second half **110** lb. Moreover, as shown in FIG. **11***a*, first and second halves **1101***a*, **110 1***b* are stacked on top of one another. The first half **1101***a* includes a bus bar **126***a* and a conductor **128***a* that is stacked around the bus bar **126***a* with an inner sheathing member **130***a* positioned between the bus bar **126***a* and the conductor **128***a*. Likewise, the second half **110 1***b* includes a bus bar **126***b* and a conductor **128***b* that is stacked around the bus bar **126***b* with an inner sheathing member **130***b* positioned between the bus bar **126***b* and the conductor **128***b*. An interconnect system **1102** is provided to connect the first and second halves **1101***a*, **110 1***b* to another backbone section. As shown in the illustrated embodiment of FIG. **11***a*, the interconnect system **1102** includes bridging conductors, bridging shield, and insulating layers (**1120***a*, **1120***b*, **1120***c*, **1122***b*, **1122***c*), that serve to connect the bus bars and conductors in the first and second halves **1101***a*, **1101***b* to corresponding halves in another backbone section.

[0071] Referring to FIG. **11***b*, a backbone section **112** according to an embodiment of the present disclosure includes a first half **1101***a*, and a second half **110 1***b* that is placed in a stacked configuration with respect to the first half **1101***a*. As shown, the first and second halves **1101***a*, **110 1***b* are identical to one another and are placed symmetrically about a parting line ‘P’. The first half **1101***a* includes three bus bars **126***a*, **126***b*, **126***c* and a conductor **128***a*. As shown, the conductor **128***a* is disposed about the bus bar **126***c*. Further, the first half **1101***a* also includes three outer sheathing members **124***a*, **124***b*, **124***c* and an inner sheathing member **130***a*. The outer sheathing members **124***a*, **124***b*, **124***c* are configured to insulate the bus bars **126***a*, **126***b* and the conductor **128***a* respectively while the inner sheathing member **130***a* is configured to mutually insulate the bus bar **126***c* and the conductor **128***a* from one another.

[0072] Similarly, the second half **1101***b* includes three bus bars **126***d*, **126***e*, **126***f* and a conductor **128***b*. As shown, the conductor **128***b* is disposed about the bus bar **126***f*. Moreover, the second half **1101***b* also includes three outer sheathing members **124***d*, **124***e*, **124***f* and an inner sheathing member **130***b*. The outer sheathing members **124***d*, **124***e*, **124***f* are configured to insulate the bus bars **126***d*, **126***e* and the conductor **128***b* respectively while the inner sheathing member **130***b* is configured to mutually insulate the bus bar **126***f* and the conductor **128***b* from one another. An interconnect system **1104** is provided to connect the first and second halves **1101***a*, **1101***b* to other backbone sections. As shown, the interconnect system **1104** includes bridging conductors, bridging shield, and insulating layers (**1130***a*, **1130***b*, **1130***c*, **1130***d*, **1132***a*, **1132***b*, **1132***c*), that serve to connect the bus bars and conductors in the first and second halves **1101***a*, **1101***b* to corresponding halves in another backbone section.

[0073] Referring to FIGS. **11***c*-**11***d*, a backbone section **112** according to another embodiment of the present disclosure includes a first half **1101***a* and a second half **1101***b* that is placed in a stacked configuration with respect to the first half **1101***a*. As shown, the first and second halves **1101***a*, **1101***b* are identical to one another. However, the first and second halves **1101***a*, **1101***b* are asymmetrical to one another about a parting region 'P'. The first half **1101***a* includes three bus bars **126***a*, **126***b*, **126***c* and a conductor **128***a*. As shown, the conductor **128***a* is disposed about the bus bar **126***c*. Further, the first half **1101***a* also includes three outer sheathing members **124***a*, **124***b*, **124***c* and an inner sheathing member **130***a*. The outer sheathing members **124***a*, **124***b*, **124***c* are configured to insulate the bus bars **126***a*, **126***b* and the conductor **128***a* respectively while the inner sheathing member **130***a* is configured to mutually insulate the bus bar **126***c* and the conductor **128***a* from one another.

[0074] Similarly, the second half **1101***b* includes three bus bars **126***d*, **126***e*, **126***f* and a conductor **128***b*. As shown, the conductor **128***b* is disposed about the bus bar **126***f*. Moreover, the second half **1101***b* also includes three outer sheathing members **124***d*, **124***e*, **124***f* and an inner sheathing member **130***b*. The outer sheathing members **124***d*, **124***e*, **124***f* are configured to insulate the bus bars **126***d*, **126***e* and the conductor **128***b* respectively while the inner sheathing member **130***b* is configured to mutually insulate the bus bar **126***f* and the conductor **128***b* from one another.

[0075] An interconnect system **1106** is provided to connect the first and second halves **1101***a*, **1101***b*. The interconnect system **1106** includes bridging conductors, bridging shield, and insulating layers (**1140***a*, **1140***b*, **1142***a*, **1144***a*, **1144***b*, **1146***a*, **1146***b*), that serve to connect the bus bars and conductors in the first and second halves **1101***a*, **1101***b* to corresponding halves in another backbone section.

[0076] Referring to FIG. **11***e*, a backbone section **112** according to an embodiment of the present disclosure may include a first half **1101***a*, and a second half **1101***b* that is stacked on top of the first half **1101***a*. The first and second halves **1101***a*, **1101***b* are asymmetrical about region 'P'. The first half **1101***a* includes three bus bars **126***a*, **126***b*, **126***c* and a conductor **128***a*. As shown, the conductor **128***a* is disposed about the bus bar **126***c*. Further, the first half **1101***a* also includes three outer sheathing members **124***a*, **124***b*, **124***c* and an inner sheathing member **130***a*. The outer sheathing members **124***a*, **124***b*, **124***c* are configured to insulate the bus bars **126***a*, **126***b* and the conductor **128***a* respectively while the inner sheathing member **130***a* is configured to mutually insulate the bus bar **126***c* and the conductor **128***a* from one another.

[0077] Similarly, the second half **1101***b* includes three bus bars **126***d*, **126***e*, **126***f* and a conductor **128***b*. As shown, the conductor **128***b* is disposed about the bus bar **126***f*. Moreover, the second half **1101***b* also includes three outer sheathing members **124***d*, **124***e*, **124***f* and an inner sheathing member **130***b*. The outer sheathing members **124***d*, **124***e*, **124***f* are configured to insulate the bus bars **126***d*, **126***e* and the conductor **128***b* respectively while the inner sheathing member **130***b* is configured to mutually insulate the bus bar **126***f* and the conductor **128***b* from one another. An interconnect system **1108** is provided to connect the first and second halves **1101***a*, **1101***b* to another backbone section and includes bridging conductors, bridging shield, and insulating layers.

[0078] Referring to FIG. **11***f*, a backbone section **112** according to another embodiment includes a first half **1101***a* and a second half **1101***b* that are placed in a stacked configuration. The first and second halves **1101***a*, **1101***b* are placed symmetrically about a parting line 'P'. The first half **1101***a* includes three bus bars **126***a*, **126***b*, **126***c* and a conductor **128***a*. As shown, the conductor **128***a* is disposed about the bus bar **126***c*. The bus bars **126***a*, **126***b* are stacked successively and disposed alongside the bus bar **126***c*. Further, the first half **1101***a* also includes three outer sheathing members **124***a*, **124***b*, **124***c* and an inner sheathing member **130***a*. The outer sheathing members **124***a*, **124***b*, **124***c* are configured to insulate the bus bars **126***a*, **126***b* and the conductor **128***a* respectively while the inner sheathing member **130***a* is configured to mutually insulate the bus bar **126***c* and the conductor **128***a* from one another.

[0079] Similarly, the second half **1101***b* includes three bus bars **126***d*, **126***e*, **126***f* and a conductor **128***b*. As shown, the conductor **128***b* is disposed about the bus bar **126***f*. The bus bars **126***d*, **126***e* are stacked successively and disposed alongside the bus bar **126***f*. The second half **1101***b* also includes three outer sheathing members **124***d*, **124***e*, **124***f* and an inner sheathing member **130***b*. The outer sheathing members **124***d*, **124***e*, **124***f* are configured to insulate the bus bars **126***d*, **126***e* and the conductor **128***b* respectively while the inner sheathing member **130***b* is configured to mutually insulate the bus bar **126***f* and the conductor **128***b* from one another. An interconnect system **1110** connects the first and second halves **1101***a*, **1101***b* to another backbone section. As shown, the interconnect system **1110** includes an interconnect member **1160** that is tiered in shape. The interconnect member **1160** includes multiple stepped portions **1160***a*, **1160***b*, **1160***c*, and **1160***d*.

[0080] FIGS. **12***a*-**12***d* illustrate various components of a backbone **1200** according to certain embodiments. Referring to FIGS. **12***c*-**12***d*, the backbone section **1200** includes a first section **1202** and a second section **1204** that are connected to one another. As shown, the first section **1202** includes a first bar **1202***a* and the second section **1204** includes a second bar **1204***a*. Each of these bars **1202***a*, **1204***a* is of a rectangular cross-section. In an embodiment, a backbone section **112** according to any of the embodiments shown in FIGS. **8***a*-**8***b*, FIGS. **10***a*-**10***b*, and each of the FIGS. **11***e*-**11***f* if could be used to form each of the first and second bars **1202***a*, **1202***b* respectively. However, if a backbone section **112** from any of the foregoing embodiments is not required, for instance, when the wiring system **104** is used to only establish power connections between electrical and/or electronic components that are kept apart from one another, then in such cases, the first and second bars **1202***a*, **1202***b* could be made from an electrically non-conductive material. Therefore, depending on specific requirements of an application, one skilled in the art could use the backbone section **112** according to any of the embodiments shown in FIGS. **8***a*-**8***b*, FIGS. **10***a*-**10***b*, and each of the FIGS. **1 1***e*-**11***f* as the first and second bars **1202***a*, **1202***b* in the backbone **1200**, or use electrically non-conductive materials for the first and second bars **1202***a*, **1202***b*. According to the embodiment illustrated in FIGS. **12***a*-**12***d*, each of the first and second bars **1202***a*, **1202***b* is made from an electrically non-conductive material.

[0081] As shown in FIG. **12***d*, the backbone section **1200** also includes four conductors **1208***a*, **1208***b*, **1208***c*, and **1208***d*. Although four conductors **1208***a*-**1208***d* are disclosed, in other configurations of the backbone **1200**, the number of conductors **1208** used in the backbone **1200** can vary depending on specific requirements of an application. For example, six conductors may be used--three conductors on each of the bars **1202***a*, **1204***a*. In an exemplary configuration of the backbone **1200** shown in FIG. **12***d*, two of the four conductors **1208***a*, **1208***b* are associated with the first section **1202** while the remaining two conductors **1208***c*, **1208***d* are associated with the second section **1204**. Each of these conductors **1208***a*-**1208***d* includes an electrical wire **1210** whose end **1210***a* is exposed to an exterior of the associated conductor **1208***a*-**1208***d* by stripping-off a portion of an insulating sheathing member **1212** within which the end **1210***a* of the wire **1210** was previously located. Moreover, the insulating sheathing member **1212** associated with wires **1210** of the conductors **1208** could be affixed to associated bars **1202***a*, **1204***a*, for example, by use of an adhesive (not shown).

[0082] The backbone **1200** includes an interconnect system **1206**. According to this embodiment, the interconnect system **1206** comprises terminals **1214***a*-**1214***d* could be soldered to ends **1210***a* of the wires **1210** from respective ones of the conductors **1208***a*-**120***d*. As shown, each of these terminals **1214***a-d* is formed preferably from thin, stamped sections of metal sheets (for example, metal sheet having thickness in the range of 0.1 millimeter-5 millimeters). Moreover, each of these terminals **1214***a-d* could be either laid out on an associated bar (as shown for terminals **1214***c*-**1214***d* on the first bar **1202***a* in FIG. **12***a*), or bent over edges bounding an end portion of an associated bar (as shown for the terminals **1214***a*-**1214***b* that partially enclose the end portion of the second bar **1202***a* in FIG. **12***b*).

[0083] According to an embodiment shown in FIG. **12***d*, the backbone **1200** also comprises holes **1216***a*, **1216***b* that are defined on the bars **1202***a*, **1202***b* of the first and second sections **1202**, **1204** respectively. The holes **1216***a*, **1216***b* may be sized and shaped to allow use of a securing arrangement **1218** for securing the bars **1202***a*, **1204***a* of the two sections **1202**, **1204**, and also to secure the interconnect system **1206** between the bars **1202***a*, **1204***a* of the two sections **1202**, **1204** so that the terminals **1214***a*, **1214***b* on the first bar **1202***a* can be maintained in contact with respective ones of the terminals **1214***c*, **1214***d* on the second bar **1204***a*.

[0084] To form the backbone **1200**, the sections **1202**, **1204** are positioned such that the hole **1216***a* on the first bar **1202***a* is in alignment with the hole **1216** on the second bar **1204***a* while the terminals **1214***a*, **1214***b* on the first bar **1202***a* are in abutment with respective ones of the terminals **1214***c*, **1214***d* on the second bar **1202***b* as shown in FIG. **12***d*. The securing arrangement **1218** can then be used to engage with the mutually aligned holes **1216***a*, **1216***b* for securing the first and second bars **1202***a*, **1204***a* with one another. According to an embodiment as shown in FIG. **12***d*, the securing arrangement **1218** includes a bolt **1220** that can be received in the mutually aligned holes **1216***a*, **1216***b* of the first and second bars **1202***a*, **1204***a* and a nut **1222** that can releasably engage with the bolt **1220**. Although, the bolt **1220** and nut **1222** is disclosed herein, it will be appreciated by persons skilled in the art that other types of securing arrangements may be used in lieu of the bolt **1220** and nut **1222** disclosed herein for securing the first and second bars **1202***a*, **1204***a*. Therefore, the bolt **1220** and nut **1222** should not to be construed as being limiting of this disclosure. Rather, the terms “securing arrangement” disclosed herein could extend in scope to include other types of arrangements for securing the two bars **1202***a*, **1204***a* including, but not limited to, adhesion bonding, soldering, crimping or other methods of securement typically known to persons skilled in the art.

[0085] FIG. **13***a*-**13***b* illustrate exploded and assembled views of interconnect system **1300** according to another embodiment. The interconnect system includes an adapter **1302** that can be used to secure a pair of sections **1304**, **1306** carrying conductors **1304***a*-**1304***b* and **1306***a*-**1306***b* respectively. The adapter **1302** includes a first portion **1302***a* that is affixed to the first bar **1304**, and a second portion **1302***b* that is affixed to the second bar **1306**. When coupled to one another, the first and second portions **1302***a*, **1302***b* could establish a mating joint there between such that the conductors **1304***a*-**1304***b* on the first section **1304** can be connected to respective ones of the conductors **1306***a*-**1306***b* on the second section **1306**.

[0086] FIG. **14** illustrates a backbone **1400** having an interconnect system **1401** that includes an adapter **1402** according to another embodiment. In this embodiment, the adapter **1402** includes a first portion **1402***a* that is affixed to a first bar **1404** and a second portion **1402***b* that is affixed to a second bar **1406**. The adapter **1402** also includes an intermediate portion **1402***c* which is configured to engage with each of the first and second portions **1402***a*, **1402***b* respectively.

[0087] Referring to FIGS. **15***a*-**15***b*, a backbone **1500** according to another embodiment. A first bar **1502** is configured to define a conducting surface **1502***a* that is disposed on an end portion of the first bus bar **1502**, and a non-conducting surface **1502***b* that is located on a remnant portion of the first bus bar **1502**. Similarly, a second bus bar **1504** is configured to define a conducting surface **1504***a* that is disposed on an end portion of the second bus bar **1504**, and a non-conducting surface **1504***b* that is located on a remnant portion of the second bus bar **1504**. The non-conducting surfaces **1502***b*, **1504***b* of the first and second bus bars **1502**, **1504** may be obtained by coating the portions remnant or exclusive of the conducting portions **1502***a*, **1504***c* from the respective bus bars **1502**, **1504** with an electrically insulating layer of material/s commonly known to persons skilled in the art. Exemplary material/s include silicone polyethylene complex polymers, which can be malleable as well as retain form, homopolymer high density polyethylene (HDPE), which can achieve good plastic deformation retention, or another polymer. To form specific bends and geometries, localized heat may be used to thermoplastically deform the polymer as long as they may be formed or deformed for covering the desired structure of the associated bus bar **1502**, **1504**.

[0088] The first bus bar **1502** includes a first pair of holes **1508***a*, **1508***b* while the second bus bar **1504** is configured to define a second pair of holes **1510***a*, **1510***b* that correspond to respective ones of the first pair of holes **1508***a*, **1508***b* of the first bus bar **1502**. Each hole from the first pair of holes **1508***a*, **1508***b* extends from the conducting surface

1502*a* to the non-conducting surface **1502***b* located on an opposing side **1501***a* to the conducting surface **1502***a* of the first bus bar **1502**. Likewise, each hole from the second pair of holes **1510***a*, **1510***b* extends from the conducting surface **1504***a* to the non-conducting surface **1504***b* located on an opposing side **1501***b* to the conducting surface **1504***a* of the second bus bar **1504**. As best shown in FIG. **15***b*, when the first and second bus bars **1202**, **1204** are assembled to form the backbone **1500**, the conducting surfaces **1502***a*, **1504***a* from the first and second bus bars **1502**, **1504** are positioned in abutment with one another while the first pair of holes **1508***a*, **1508***b* are positioned in alignment with the second pair of holes **1510***a*, **1510***b*.

[0089] Additionally, a di-electric spacer **1512** containing a pair of holes **1512***a*, **1512***b* is provided. As shown, the holes from this di-electric spacer **1512** is in alignment with the pairs of mutually aligned holes **1508***a*, **1510***a* and **1508***b*, **1510***b* from the first and second bars **1502** and **1504** respectively. A first pair of terminals **1514***a*, **1514***b* are disposed on the di-electric spacer **1512**. A second pair of terminals **1514***c*, **1514***d* is disposed on the non-conducting surface **1502***b* of the first bar **1502**. The terminals **1514***a*-**1514***d* are configured to be coupled to corresponding ones of conductors **1516***a*-**1516***d* disposed on the non-conducting surface **1502***b* of the first bar. Each terminal **1514***a*-**1514***d* has a hole **1518***a*-**1518***d* that is disposed in mutual alignment with the holes **1508***a*, **1510***a* and **1508***b*, **1510***b* from respective ones of the first and second bars **1502**, **1504** and the holes **1512***a*, **1512***b* of the di-electric spacer **1512** respectively. This way, a pair of securing arrangements **1520** comprising a pair of bolts **1522***a*-**1522***b* can be received within the mutually aligned holes **1508***a*, **1510***a*, **1512***a*, **1518***a* and **1508***b*, **1510***b*, **1512***b*, **1518***b* from respective ones of the first bar **1502**, the second bar **1504**, the di-electric spacer **1512** and corresponding pairs of terminals **1514***a*-**1514***d*. The securing arrangements **1520** also include a pair of nuts **1524***a*-**1524***b* corresponding to the pair of bolts **1522***a*-**1522***b* and can releasably engage with the pair of bolts **1522***a*-**1522***b* to secure a first section **1503** and a second section **1505** of the backbone **1500**.

[0090] FIG. **16** illustrates a backbone section **1600** and a compound washer **1604** according to an embodiment. The backbone section **1600** includes a bar **1606** that is configured to define a cut-out portion **1608** therein. The compound washer **1604** is disposed on the bar **1606** and located about the cut-out portion **1608**. The compound washer **1604** is adhered to the bar **1606** with an insulating adhesive. The compound washer **604** is configured to include a di-electric base **1610**. A first ring washer **1612** is disposed on an inner circumference of the di-electric base **1610** and configured to define a first terminal **1614**. A second ring washer **1616** is concentrically disposed about the di-electric base **1610** and is hence, located in a spaced-apart relation to the first ring washer **1612**. The di-electric base **1610** is configured to electrically insulate the first and second ring washers **1612**, **1616** from one another. The second ring washer **1616** is configured to define a second terminal **1618**.

[0091] End portions **1620***a*, **1622***a* of a pair of conductors **1620**, **1622** may be soldered or welded to the first and second terminals **1614**, **1618** respectively. Similarly, end portions **1624***a*, **1626***a* of another pair of conductors **1624**, **1626** may be soldered or welded to the first and second terminals **1614**, **1618** respectively. Therefore, the pair of conductors **1620**, **1622** are connected to the pair of conductors **1624**, **1626** with the help of the terminals **1614**, **1618** vis-a-vis the corresponding pairs of end portions **1620***a*, **1622***a* and **1624***a*, **1626***a* from the pairs of conductors **1620**, **1622** and **1624**, **1626** respectively. Each of the conductors **1620**, **1622**, **1624**, **1626** also include an insulating sheathing member **1628** that can be affixed to the bar **1606**, for example, using an adhesive.

[0092] FIG. **17***a* illustrates a compound washer **1704** according to an embodiment. According to this embodiment, the compound washer **1704** includes an annular di-electric base **1706** that is disposed about a cut-out portion **1708** of a bar **1702** and affixed to the bar **1702**, for example, with the help of an adhesive. A first arcuate washer **1712** is disposed on the annular base **1706** and is configured to define a first terminal **1714**. A second arcuate washer **1716** is disposed on the annular base **1706** and located in a spaced-apart relation to the first arcuate washer **1712**. The second arcuate washer **1716** is configured to define a second terminal **1718**.

[0093] Referring to FIGS. **17***b* and **17***c*, end portions **1720***a*, **1722***a* of a pair of conductors **1720**, **1722** could be soldered to the first and second terminals **1714**, **1718** respectively. Similarly, end portions **1724***a*, **1726***a* of another pair of conductors **1724**, **1726** could be soldered to the first and second terminals **1714**, **1718** respectively. Therefore, the pair of conductors **1720**, **1722** are connected to the pair of conductors **1724**, **1726** with the help of the terminals **1714**, **1718** vis-a-vis the corresponding pairs of end portions **1720***a*, **1722***a* and **1724***a*, **1726***a* from the pairs of conductors **1720**, **1722** and **1724**, **1726** respectively. Each of the conductors **1720**, **1722**, **1724**, **1726** also include an insulating sheathing member **1728** that can be affixed to the bar **1706**, for example, using an adhesive.

[0094] As shown in FIG. **17***b*, the backbone section **1700** may include a flex plate **1728** having a pair of conducting portions **1728**, **1730** that are configured to correspond with the pair of terminals **1714**, **1718** provided on the compound washer **1704** respectively. The pair of conducting portions **1714**, **1718** on the flex plate **1728** is adapted to tap power from the pair of terminals **1714**, **1718** and route such tapped power in a direction D laterally away from a longitudinal axis AA' of the bar **1702**. In this embodiment, the backbone section **1700** would additionally include a Belleville washer **1734** and a bolt **1736** for securing the flex plate **1728** to the bar **1702**.

[0095] Preferentially, the backbone is as continuous as possible to ensure that that as few discontinuities (such as an impedance discontinuity) exist. In certain embodiments, the backbone extends from the battery **180** in continuous segments. For example, as shown in FIG. **1***b*, two of segments **112** are implemented as backbone to backbone connections while four segments **112** may be used without any backbone to backbone connections, only backbone-to-battery connections.

Windowing and Backbone Connector

[0096] When backbone **112** is not formed of multiple preformed segments connected to one another, tap-off or branch-off connections to the backbone must be made in another fashion. FIG. **18***a* illustrates a view of a backbone cable **112** that has been windowed (pocketed on one face) to allow for the connection of the backbone cable **112** to another cable (not shown), such as an umbilical cable **184** (see FIG. **1***b*), at a location along the backbone **112** other than the end of the backbone **112**.

[0097] As shown in FIG. **18***a*, windows have been formed by removing the outer sheathing and any other necessary layers to expose the desired layer. The 2D layout of windows may differ from that shown in FIG. **18***a*. FIG. **18***a* shows a trace window **1806** that exposes conductors, such as conductors **128***c* and **128***d* shown in FIG. **6***a* or FIG. **7**. When creating this window, not only must the outer sheathing be removed, but also any inner sheathing and shielding layers also be removed to expose the conductors and remove any residual sheathing or adhesive residues. Shielding window **1804** is formed by removing the layers above the shielding layer. In certain embodiments, only the outer sheathing layer must be removed. Conductor windows **1808** and **1810** are similarly formed by removing the material above the conductors to expose them. For example, conductors **128***a* and **128***b* as shown in FIGS. **6***a* and **7** are exposed by removing part of shielding layer **132**, part of inner sheathing material **130***a*, and part of outer sheathing material **140**. The outer sheathing material, which is removed to create the windows, may be PE, PP, PET, PEN, PI, another insulating material, or another polymer material. The inner sheathing material may be PE, PP, PET, PEN, PI, another insulating material, or another polymer material. As shown in FIG. **18***a*, the backbone **112** contains alignment holes **1802** near the area where the connection to the backbone **112** is going to be made i.e., proximal to a location of the windows **1804**, **1806**, **1808** and **1810**. In an embodiment as shown in FIG. **18***a*, two alignment holes **1802** are made. However, in some embodiments, fewer or more alignment holes **1802** may be present in varying shapes and sizes, while in other embodiments, no alignment holes may be defined.

[0098] The exposed conductors **128***a-d* and shielding layer **132** from the backbone cable **112**, may be connected to another backbone cable, such as an umbilical cable **184** via a connector, such as a backbone connector **190** as shown in FIG. **2**. Because one or more of the conductors may be communication lines running next to a DC power line, transmitting at for example 48V, the communication lines and consequently, the backbone connector **190** should be shielded. In embodiments, the assembled backbone connector **190** meets IP67 ingress protection. In embodiments, the assembled backbone connector **190** provides shielding of up to 40 dB for electromagnetic interference (EMI) at frequencies up to 100 MHz. In other embodiments, the assembled backbone connector **190** provides shielding of up to 60 dB for EMI at frequencies between 100 MHz and 500 MHz.

[0099] FIG. **18***b* illustrates windowed regions on various conductors that are included in the backbone section **112** of FIG. **6***c*. As shown, trace window **1803** is created by removing a portion of the outer sheathing member **140** (refer to FIG. **6***c*) to expose the conductive shield member **131** associated with the set of conductors **128***e-f*. Similarly, trace window **1806** is created by removing a portion of the outer sheathing member **140** to expose the conductive shield member **131** associated with the set of conductors **128***c-d*. Trace window **1804** is created by removing adjoining portions from the outer sheathing member **140**, the conductive shield member **131**, and the inner sheathing member **130***a* to expose conductors **128***c-d*. Trace windows **1808**, **1810**, **1812** are created by removing of a portion of the outer sheathing member **140** adjacent to each of conductors **128***a*, **128***b*, and **128***g-r*, so that the set of conductors **128***a*, **128***b*, and **128***g-r* are exposed. The exposed portions of each of conductors **128***a-r* and the conductive shield member **131** associated with the conductors **128***e-f* are then connected with the backbone section **112**, for example via the PCBA **196** according to certain embodiments, such as those shown in FIGS. **19***a-d*. In embodiments, the exposed conductors and shielding are directly connected to corresponding conductors or shielding in an umbilical cable **184**. In certain embodiments, when umbilical cable **184** has fewer conductors than the backbone section **112**, then a window (and subsequent connection) need to be created. For example, if umbilical cable **184** only has two of conductors **128***g-r* (specifically, conductors **128***g-h*), then only two trace windows **1812**, those exposing conductors **128***g-h*, need be created, and subsequently, only conductors **128***g-h* in the backbone section are connected to conductors **128***g-h* in the umbilical cable **184**.

[0100] In embodiments the size of the window (width and height of the exposed conductors or shielding) varies depending on the width of the underlying conductors or underlying conductive shield member **131**. Further, as shown in FIG. **18***b* windows may be offset from one another to facilitate connection to the underlying conductor or shielding. This decreases the possibility that two or more conductors, for example **128***g-r*) will inadvertently connect, creating a short. While adjacent windows **1312** are shown in FIG. **18***b* to be offset from one another, this offset may not be required, for example, when the PCBA **196**.

[0101] FIG. **19***a* shows an exploded view of the backbone connector **190** according to certain embodiments of the current invention and FIG. **19***b* shows the same connector **190** closed, connecting a backbone section **112** to an umbilical cable **184**. As shown in FIG. **19***a*, the backbone connector **190** has a base plate **192** that may be formed via plastic injection molding or another molding technique. Base plate **192** may be formed from PE, PP, PET, PBT, Nylon or another polymer. In other embodiments, base plate **192** is a formed of a metallic or a ceramic material. Backbone connector **190** has posts **198** protruding from the base plate **192**. These posts **198** may not be part of the mold, but may be externally attached as a secondary operation. They may also help align backbone section **112**. The other side of backbone connector **190** is PCBA **196**, which is connected to umbilical cable **184**. PCBA **196** and umbilical cable **184** may be hot bar soldered, laser or ultrasonically soldered, adhered using an adhesive, or connected via another method such as Anisotropically Conductive Films or Pastes (ACFs or ACPs). Excluding connectors is desirable from a cost perspective since it removes a connector, driving down cost. PCBA **196** also preferentially has alignment holes that are configured to accept posts **198** for alignment and retention purposes. The addition of nuts **199** forms the backbone connector **190** and allows for an electrical connection to be made from the backbone section **112** to the umbilical cable **184** when the backbone connector **190** is closed as shown in FIG. **19***b*. Torque resulting from a tightening of the nuts **199** with the posts **198** also allows for a proper seal to the exposed windows using ingress protector **194**. The seal prevents dust and water from entering into the backbone connector **190**, whether through leak paths along the nuts **199** or along the edges of the base plate **192**, and shorting any connections or otherwise decreasing lifetime. In embodiments, the PCBA **196** routes data signals and the desired amount of voltage to the appropriate location.

[0102] In certain embodiments, posts **198** are part of the base plate **192** and molded together as one part. In other embodiments, the posts **198** are separate from the base plate **192**, as shown in FIG. **19***c*. FIG. **19***c* also shows a mounting adhesive **2110** affixed to a rear of the base plate **192**, according to certain embodiments. Mounting adhesive **2110** allows for the backbone connector **190** to be affixed to a desired location, such as a specific location in a vehicle. Mounting adhesive **2110** may be of acrylic, epoxy, or silicone types, or hybrid adhesives of complex formulations. FIG. **19***d* shows part of the assembled backbone connector **190** with separate posts **198** (that is posts **198** that are not integrally formed with the base plate **192** as shown in FIG. **19***c*) and ingress protector **194** positioned on top of the base plate **192**.

[0103] In embodiments, spring fingers **2210** are affixed to the PCBA **196** as shown in the exploded view of FIG. **20***a* and the non-exploded view of FIG. **20***b*. Spring fingers **2210** may be of Copper (Cu) or Aluminum (Al) and may be plated with tin (Sn), nickel (Ni), gold (Au), or another conductive material. In other embodiments, spring fingers **2210** may be replaced with Pogo pins (not shown) or other element with a similar "face-contact" mechanism. Also shown in FIG. **20***a* is (1) adhesive seal **2220** that helps adhere the umbilical cable **184** to the PCBA **196**, (2) EMI shield gasket **195** that helps shield conductors used to transmit data signals, such as conductors **128***c* and **128***d* shown in FIGS. **6***a* and **7**, and (3) gasket seal **197**, which helps prevent any dust or water vapor from entering and shorting out the electrical connections. EMI shield gasket **195** may be made of a metal foam, a conductive polymer, or another material (preferably conductive) that shields certain conductors carrying data signals from electrical noise. Additionally, the PCBA **196** may have passive or active electrical components (such as MOSFETS, resistors, op-amps, or microcontrollers) for added performance and control. Consequently, heat sinks (not shown) and other thermal dissipation means may also become part of the backbone connector **190**.

[0104] FIGS. **21-24** illustrate the installation procedure of connecting a backbone section **112** to an umbilical cable **184** using a backbone connector **190** according to an embodiment of the current invention. As shown in FIG. **21**, base plate **192** with posts **198** is installed in the vehicle (using adhesive or otherwise). As shown in FIG. **22**, backbone section **112** is installed over the posts **198**. Alternatively, backbone section **112** could have already have been joined to base plate **192** with posts **198** prior to base plate **192** being installed onto vehicle. As shown in FIG. **23**, the PCBA **196** with attached umbilical cable **184** is aligned over posts **198**. In certain embodiments, the PCBA **196** includes spring fingers **2210**, EMI shield gasket **195** and gasket seal **197** as shown in FIGS. **20***a*-**20***b*. Referring now to FIG. **24**, nuts **199** are attached to secure the PCBA **196** to the base plate **192** and form the electrical connections between backbone **112** and umbilical cable **184**. FIG. **25** illustrates a cross section view of the backbone connector **190** according to an embodiment of the current invention. Spring fingers **2210**, base plate **192**, posts **198**, nuts **199**, PCBA **196**, and other components are shown.

[0105] FIGS. **26-28** illustrate another embodiment of the backbone connector **190**. FIGS. **26** and **27** show an exploded view of the backbone connector **190**. Base plate **192** has a conductive gasket **2620** that when closed helps seal the backbone connector **190** from the environment, including dust and water vapor, as well as provide shielding from EMI for frequencies between 100 MHz to 500 MHz. In certain embodiments, the assembled backbone connector **190** meets IP67 ingress protection. Upper cover **2610** has snap hooks **2614** and pins **2612**. Pins **2612** help align the backbone section **112** and umbilical cable **184** that is connected to PCBA **196**, as well as the upper cover **2610** with the base plate **192**. Upper cover **2610** may contain a conductive surface **2750** on the inside, such as a metal or conductive polymer coating. In other embodiments, the outside of the upper cover **2610** is the conductive surface or the upper cover **2610** is made from a conductive material, such as a metal, conductive polymer, or insulating material dispersed with metal particles (such as silver nanoparticles or Al deposition using vacuum metallization). In certain embodiments, upper cover **2610** is molded. Base plate **192** may also contain a conductive surface on the top side, such as a metal or conductive polymer coating. In other embodiments, the bottom of the base plate **192** is the conductive surface or the base plate **192** is made from a conductive material, such as a metal, conductive polymer, or insulating material dispersed with metal particles (such as silver nanoparticles). In certain embodiments, base plate **192** is molded. FIG. **28** shows the backbone connector **190** fully assembled connecting backbone section **112** to umbilical cable **184**. In embodiments, the PCBA **196** routes data signals and the desired amount of voltage to the appropriate location and may contain active or passive electrical components (such as MOSFETS, resistors, op-amps, or microcontrollers)

[0106] FIGS. **29-31** illustrate another embodiment of the backbone connector **190**. FIGS. **29** and **30** show an exploded view of the backbone connector **190**. Base plate **192** has pins **2912** to help align the connection between the backbone section **112** and umbilical cable **184**. Base plate **192** also contains a snap feature **3012**, preferably around the entire perimeter. Upper cover **2910** has alignment holes **2914**, which are configured to accept pins **2912** from base plate **192**. When assembled, as shown in FIG. **31**, backbone connector **190** seals the PCBA **196** and windowed backbone **112** from the environment, including dust and water vapor. In certain embodiments, the assembled backbone connector **190** meets IP**67** ingress protection. Upper cover **2910** may contain a conductive surface on the inside, such as a metal or conductive polymer coating. In other embodiments, the outside of the upper cover **2910** is the conductive surface or the upper cover **2910** is made from a conductive material, such as a metal, conductive polymer, or insulating material dispersed with metal particles (such as silver nanoparticles). In certain embodiments, upper cover **2910** is molded. Base plate **192** may also contain a conductive surface on the top side, such as a metal or conductive polymer coating. In other embodiments, the bottom of the base plate **192** is the conductive surface or the base plate **192** is made from a conductive material, such as a metal, conductive polymer, or insulating material dispersed with metal particles (such as silver nanoparticles). In certain embodiments, base plate **192** is molded. FIG. **31** shows the backbone connector **190** fully assembled connecting backbone section **112** to umbilical cable **184**. In embodiments, the PCBA **196** routes data signals and the desired amount of voltage to the appropriate location and may contain active or passive electrical components (such as MOSFETS, resistors, op-amps, or microcontrollers)

[0107] The foregoing disclosure is not intended to limit the present disclosure to the precise forms or particular fields of use disclosed. As such, it is contemplated that various alternative embodiments and/or modifications to the present disclosure, whether explicitly described or implied herein, are possible in light of the disclosure. Having thus described embodiments of the present disclosure, a person of ordinary skill in the art will recognize that changes may be made in form and detail without departing from the scope of the present disclosure. For example, reference is made to "wire" or "wires," but a person of ordinary skill in the art will understand that in certain embodiments, one or more conductors (for example, metal without any insulation or outer sheathing) may be substituted. Thus, the present disclosure is limited only by the claims.

[0108] In the foregoing specification, the disclosure has been described with reference to specific embodiments. However, as one skilled in the art will appreciate, various embodiments disclosed herein can be modified or otherwise implemented in various other ways without departing from the spirit and scope of the disclosure. Accordingly, this description is to be considered as illustrative and is for the purpose of teaching those skilled in the art the manner of making and using various embodiments of the present disclosure. It is to be understood that the forms of disclosure herein shown and described are to be taken as representative embodiments. Equivalent elements, or materials may be substituted for those representatively illustrated and described herein. Moreover, certain features of the disclosure may be utilized independently of the use of other features, all as would be apparent to one skilled in the art after having the benefit of this description of the disclosure. Expressions such as "including", "comprising", "incorporating", "consisting of", "have", "is" used to describe and claim the present disclosure are intended to be construed in a non-exclusive manner, namely allowing for items, components or elements not explicitly described also to be present. Reference to the singular is also to be construed to relate to the plural.

[0109] Further, various embodiments disclosed herein are to be taken in the illustrative and explanatory sense, and should in no way be construed as limiting of the present disclosure. All joinder references (e.g., attached, affixed, coupled, connected, and the like) are only used to aid the reader's understanding of the present disclosure, and may not create limitations, particularly as to the position, orientation, or use of the systems and/or methods disclosed herein. Therefore, joinder references, if any, are to be construed broadly. Moreover, such joinder references do not necessarily infer that two elements are directly connected to each other.

[0110] Additionally, all numerical terms, such as, but not limited to, "first", "second", "third", "primary", "secondary", "main" or any other ordinary and/or numerical terms, should also be taken only as identifiers, to assist the reader's understanding of the various elements, embodiments, variations and/or modifications of the present disclosure, and may not create any limitations, particularly as to the order, or preference, of any element, embodiment, variation and/or modification relative to, or over, another element, embodiment, variation and/or modification.

[0111] It will also be appreciated that one or more of the elements depicted in the drawings/figures can also be implemented in a more separated or integrated manner, or even removed or rendered as inoperable in certain cases, as is useful in accordance with a particular application.

What is claimed is:

1. A backbone section comprising:

an outer sheathing;

a first conductor disposed within the outer sheathing;

a second conductor disposed within the outer sheathing;

a busbar component disposed within the outer sheathing;

a pair of inner sheathing members disposed within the outer sheathing and located on opposing sides of at least one of the first and second conductors, the inner sheathing members configured to electrically insulate the first conductor from the second conductor; and

a shield member disposed within the outer sheathing.

* * * * *