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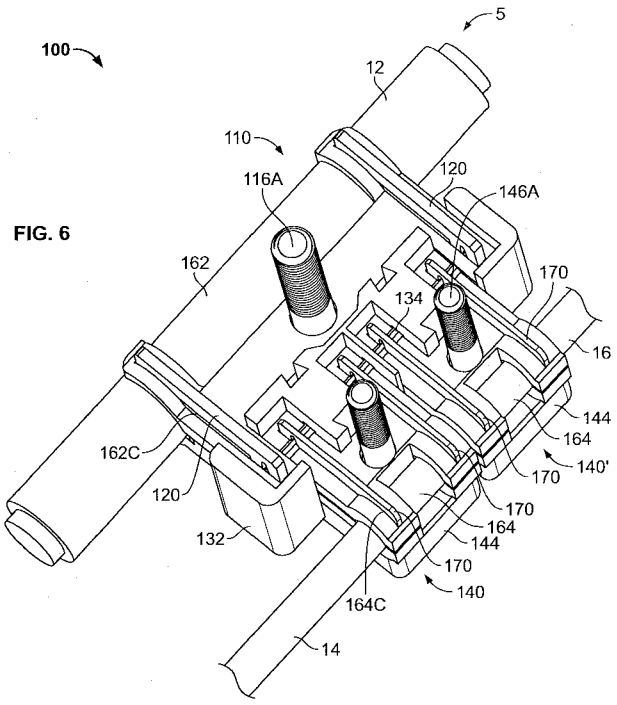
FIG. 6



(57) Abstract: An electrical connector assembly for mechanically and electrically connecting first and second cables each including an elongate electrical conductor covered by an insulation layer includes a housing, an electrically conductive bus member, an electrically conductive first blade member, and an electrically conductive second blade member. The housing is configured to receive each of the first and second cables. The bus member is disposed in the housing. The first blade member is disposed in the housing and has an inner end, an outer end and an insulation piercing feature on the outer end. The inner end is coupled to the bus member and the insulation piercing feature includes at least one tooth configured to pierce through the insulation cover of the first cable and electrically engage the conductor of the first cable. The second blade member is disposed in the housing and has an inner end, an outer end and an insulation piercing feature on the outer end. The inner end is coupled to the bus member and the insulation piercing feature includes at least one tooth configured to pierce through the insulation cover of the second cable and electrically engage the conductor of the second cable. The bus member provides electrical continuity between the first and second blade members and thereby the conductors of the first and second cables when the conductors are engaged by the insulation piercing feature of the first and second blade members.

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INSULATION PIERCING CONNECTOR ASSEMBLIES AND METHODS AND CONNECTIONS INCLUDING SAME

FIELD OF THE INVENTION

The present invention relates to electrical connectors and, more particularly, to power utility electrical connectors and methods and connections including the same.

BACKGROUND OF THE INVENTION

Electrical utility firms constructing, operating and maintaining overhead and/or underground power distribution networks and systems utilize connectors to tap main power transmission conductors and feed electrical power to distribution line conductors, sometimes referred to as tap conductors. The main power line conductors and the tap conductors are typically high, medium or low voltage cables that are relatively large in diameter, and the main power line conductor may be differently sized from the tap conductor, requiring specially designed connector components to adequately connect tap conductors to main power line conductors.

Insulation piercing (IP) connectors are commonly used to form mechanical and electrical connections between insulated cables. Typically, an IP connector includes metal piercing blades with sets of teeth on either end thereof. The piercing blades are mounted in housing members (*e.g.*, along with environmental sealing components). The housing members are clamped about the insulated main and tap cables so that one set of teeth of a piercing blade engages the main cable and the other set of teeth of the piercing blade engages the tap cable. The teeth penetrate the insulation layers of the cables and make contact with the underlying conductors, thereby providing electrical continuity between the conductors through the piercing blade.

SUMMARY OF THE INVENTION

According to embodiments of the present invention, an electrical connector assembly for mechanically and electrically connecting first and second cables each including an elongate electrical conductor covered by an insulation layer includes a housing, an electrically conductive bus member, an electrically conductive first blade member, and an electrically conductive

second blade member. The housing is configured to receive each of the first and second cables. The bus member is disposed in the housing. The first blade member is disposed in the housing and has an inner end, an outer end and an insulation piercing feature on the outer end. The inner end is coupled to the bus member and the insulation piercing feature includes at least one tooth configured to pierce through the insulation cover of the first cable and electrically engage the conductor of the first cable. The second blade member is disposed in the housing and has an inner end, an outer end and an insulation piercing feature on the outer end. The inner end is coupled to the bus member and the insulation piercing feature includes at least one tooth configured to pierce through the insulation cover of the second cable and electrically engage the conductor of the second cable. The bus member provides electrical continuity between the first and second blade members and thereby the conductors of the first and second cables when the conductors are engaged by the insulation piercing feature of the first and second blade members.

According to method embodiments of the present invention, a method for mechanically and electrically connecting first and second cables each including an elongate electrical conductor covered by an insulation layer includes providing an electrical connector assembly including: a housing configured to receive each of the first and second cables; an electrically conductive bus member disposed in the housing; an electrically conductive first blade member disposed in the housing and having an inner end, an outer end and an insulation piercing feature on the outer end, wherein the inner end is coupled to the bus member and the insulation piercing feature includes at least one tooth configured to pierce through the insulation cover of the first cable and electrically engage the conductor of the first cable; and an electrically conductive second blade member disposed in the housing and having an inner end, an outer end and an insulation piercing feature on the outer end, wherein the inner end is coupled to the bus member and the insulation piercing feature includes at least one tooth configured to pierce through the insulation cover of the second cable and electrically engage the conductor of the second cable. The method further includes: placing the first cable in

the housing and forcing the first blade member into engagement with the first cable such that the at least one tooth of the first blade member pierces through the insulation cover of the first cable and electrically engages the conductor of the first cable; and placing the second cable in the housing and forcing the second blade member into engagement with the second cable such that the at least one tooth of the second blade member pierces through the insulation cover of the second cable and electrically engages the conductor of the second cable, wherein the bus member provides electrical continuity between the first and second blade members and thereby the conductors of the first and second cables.

According to embodiments of the present invention, an electrical connector assembly for mechanically and electrically connecting first and second cables each including an elongate electrical conductor covered by an insulation layer includes a housing, an electrically conductive first contact member, and an electrically conductive second contact member. The housing is configured to receive each of the first and second cables. The first contact member is disposed in the housing. The first contact member includes an insulation piercing feature including at least one tooth configured to pierce through the insulation cover of the first cable and electrically engage the conductor of the first cable. The second contact member is disposed in the housing. The second contact member includes an insulation piercing feature including at least one tooth configured to pierce through the insulation cover of the second cable and electrically engage the conductor of the second cable. The electrical connector assembly further includes an integral electrical protection functional component disposed in the housing and electrically connecting the first and second contact members.

Further features, advantages and details of the present invention will be appreciated by those of ordinary skill in the art from a reading of the figures and the detailed description of the preferred embodiments that follow, such description being merely illustrative of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of a connection including a con-

nector assembly according to embodiments of the present invention.

Figure 2 is an exploded perspective view of the connector assembly of Figure 1.

Figure 3 is a perspective view of a bus member assembly forming a part of the connector assembly of Figure 1.

Figure 4 is a perspective view of a main blade member forming a part of the connector assembly of Figure 1.

Figure 5 is a perspective view of a tap blade member forming a part of the connector assembly of Figure 1.

Figure 6 is a fragmentary, perspective view of the connection of Figure 1 with main and tap subhousings of the connector assembly removed for the purpose of explanation.

Figure 7 is a fragmentary, perspective view of the connection of Figure 1 with only cables, and a bus member, main blade members and tap blade members of the connector assembly being shown, for the purpose of explanation.

Figure 8 is a fragmentary, cross-sectional, end view of the connection of Figure 1 showing a main cable, the bus member, and a pair of the main blade members.

Figure 9 is a fragmentary, perspective view of a connection including a connector assembly according to further embodiments of the present invention.

Figure 10 is a fragmentary, perspective view of a connection including a connector assembly according to further embodiments of the present invention.

Figure 11 is a fragmentary, perspective view of a connection including a connector assembly according to further embodiments of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which illustrative embodiments of the invention are shown. In the drawings, the relative sizes of re-

gions or features may be exaggerated for clarity. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art.

It will be understood that when an element is referred to as being "coupled" or "connected" to another element, it can be directly coupled or connected to the other element or intervening elements may also be present. In contrast, when an element is referred to as being "directly coupled" or "directly connected" to another element, there are no intervening elements present. Like numbers refer to like elements throughout.

In addition, spatially relative terms, such as "under", "below", "lower", "over", "upper" and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is turned over, elements described as "under" or "beneath" other elements or features would then be oriented "over" the other elements or features. Thus, the exemplary term "under" can encompass both an orientation of over and under. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly.

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

pression "and/or" includes any and all combinations of one or more of the associated listed items.

Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of this disclosure and the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

As used herein, "monolithic" means an object that is a single, unitary piece formed or composed of a material without joints or seams.

With reference to **Figures 1-8**, a multi-tap or multi-cable insulation piercing connector assembly **100** according to embodiments of the present invention is shown therein. The connector assembly **100** can be used to form an insulation piercing connector (IPC) connection **5** (**Figure 1**) including elongate electrical cables **12**, **14**, **16** (*e.g.*, electrical power lines) mechanically and electrically coupled by the connector assembly **100**. The connector assembly **100** may be adapted for use as a tap connector for connecting one or more elongate tap cables **14**, **16** to an elongate main cable **12** of a utility power distribution system, for example.

Each tap cable **14**, **16**, sometimes referred to as a distribution conductor, may be a known electrically conductive metal high, medium or low voltage cable or line having a generally cylindrical form in an exemplary embodiment. The main cable **12** may also be a generally cylindrical high, medium or low voltage cable line. The tap cable **14** includes a metal electrical conductor **14A** surrounded by an insulation layer **14B**. The tap cable **16** includes a metal electrical conductor **16A** surrounded by an insulation layer **16B**. The main cable **12** includes a metal electrical conductor **12A** surrounded by an insulation layer **12B**. The conductors **12A, 14A, 16A** may be solid cylindrical conductors (solid wire) as illustrated in the figures. Alternatively, one or more of the conductors **12A, 14A, 16A** may be formed of multiple

strands (*e.g.*, twisted strands). Multi-strand conductors may be easier to handle with better bending characteristics. Suitable materials for the conductors **12A, 14A, 16A** may include aluminum or copper. The insulation layers **12B, 14B, 16B** may be formed of a polymeric material such as PVC, polypropylene, polyethylene, or cross-linked polyethylene. The tap conductors **14A, 16A** and the main conductor **12A** may be of the same wire gauge or different wire gauge in different applications and the connector assembly **100** is adapted to accommodate a range of wire gauges for each of the tap conductors **14A, 16A** and the main conductor **12A**. The cable **12** has a lengthwise axis **D-D**, the cable **14** has a lengthwise axis **E-E** and the cable **16** has a lengthwise axis **F-F**.

When installed to the tap cables **14, 16** and the main cable **12**, the connector assembly **100** provides electrical connectivity between the main conductor **12A** and the tap conductors **14A, 16A** to feed electrical power from the main conductor **12A** to the tap conductors **14A, 16A** in, for example, an electrical utility power distribution system. The power distribution system may include a number of main cables of the same or different wire gauge, and a number of tap cables of the same or different wire gauge.

With reference to **Figures 1** and **2**, the connector assembly **100** includes a main subassembly **110**, a bus subassembly **130**, a first tap subsassembly **140** and a second tap subassembly **140'**. The connector assembly **100** includes a housing **102** formed collectively by a main subhousing **112** (which forms a part of the main subassembly **110**), a bus subhousing **132** and tap subhousings **142** (which form parts of the tap subsassemblies **140, 140'**). The connector assembly **100** also includes an environmental seal system **160** formed collectively by main seal members **162** and tap seal members **164**, which form parts of the main subassembly **110** and the tap subsassemblies **140, 140'**, respectively. The subassemblies **110, 130, 140, 140'** can be used to cooperatively mechanically capture the cables **12, 14, 16** therebetween and electrically connect the conductors **12A, 14A, 16A** to one another.

With reference to **Figures 2** and **3**, the bus subassembly **130**

includes the subhousing **132** and a busbar or bus member **134** mounted therein.

The subhousing **132** includes a body **132A** having bus member slots **132B**, main guide slots **132C**, tap guide slots **132D**, main blade slots **132E** and tap blade slots **132F** defined therein. The subhousing **132** may be formed of any suitable material. According to some embodiments, the subhousing **132** is formed of a polymeric material. In some embodiments, the polymeric material is selected from the group consisting of polyamide (PA) 6.6, PA 6.6 reinforced with glass fibers or talc, polycarbonate, or polycarbonate blend. The subhousing **132** may be formed using any suitable technique. According to some embodiments, the subhousing **132** is molded. According to some embodiments, the subhousing **132** is monolithic and unitarily formed.

The bus member **134** is mounted in the bus member slots **132B**. According to some embodiments and as illustrated, the bus member **134** may be shaped as an elongate flat rod or plate having opposed lateral sides **134A** and **134B**. The bus member **134** defines a slide axis **A-A** (**Figures 7** and **8**).

The bus member **134** may be formed of any suitable electrically conductive material. According to some embodiments, the bus member **134** is formed of metal. According to some embodiments, the bus member **134** is formed of aluminum, aluminum or copper and may be galvanized. The bus member **134** may be formed using any suitable technique. According to some embodiments, the bus member **134** is monolithic and unitarily formed. According to some embodiments, the bus member **134** is extruded and cut, stamped (*e.g.*, die-cut), cast and/or machined. According to some embodiments, the subhousing **132** is molded (*e.g.*, insert molded) about the bus member **134**.

The main subassembly **110** (**Figures 1** and **2**) includes the subhousing **112**, the two main seal members **162**, a compression mechanism or fastener assembly **116**, and upper and lower pairs of blade members **120** (four total).

The subhousing **112** (**Figure 2**) includes upper and lower subhousing members **114**. Each subhousing member **114** includes a body **114A** and integral legs **114G**. The body **114A** and legs **114G** have a cable groove **114B**, a fastener bore **114C**, guide features (rails) **114D**, a pair of blade slots **114E**, and a pair of bus member slots **114F** defined therein. The cable groove **114B** has a lengthwise groove axis **B-B**.

The subhousing members **114** may be formed of any suitable material. According to some embodiments, the subhousing members **114** are formed of a polymeric material. In some embodiments, the polymeric material is selected from the group consisting of polyamide (PA) 6.6, PA 6.6 reinforced with glass fibers or talc, polycarbonate, or polycarbonate blend. The subhousing members **114** may be formed using any suitable technique. According to some embodiments, the subhousing members **114** are molded. According to some embodiments, each of the subhousing members **114** is monolithic and unitarily formed.

Each main seal member **162** (**Figure 2**) includes legs **162D** and has a cable groove **162A**, a fastener bore **162B**, and a pair of blade slots **162C**. The main seal members **162** may be formed of any suitable material. According to some embodiments, the main seal members **162** are formed of an elastomeric material. In some embodiments, the elastomeric material is selected from the group consisting of rubber, polypropylene, PVC, silicone, neoprene, santoprene, EPDM, or EPDM and polypropylene blend. The main seal members **162** may be formed using any suitable technique. According to some embodiments, the main seal members **162** are molded. According to some embodiments, each of the main seal members **162** is monolithic and unitarily formed.

According to some embodiments and as illustrated, the blade members **120** are identically formed. However, in some embodiments, the blade members **120** may be configured differently from one another. With reference to **Figure 4**, a representative one of the blade members **120** includes a body **122** having an outer end **122A** and an inner end **122B**. An integral cable engagement or insulation piercing feature **124** is located on the

outer end **122A** and an integral bus member coupling feature **126** is located on the inner end **122B**.

The insulation piercing feature **124** includes a plurality of teeth **124A** (as shown, three) separated by slots **124C** and having terminal points **124B**. The points **124B** collectively lie on an arc generally corresponding to the profile of the arcuate outer surface of the cable conductor **12A**.

The coupling feature **126** includes opposed spring fingers **126A**, **126B** defining a receptacle or slot **126C** therebetween and joined to the body **122** at pivot ends **126D**. Teeth **126E** extend into the slot **126C** from the finger **126A** and a tooth **126F** extends into the slot **126C** from the finger **126B**.

According to some embodiments, the length **L1** of the blade member **120** is at least ten times its thickness **T1**. According to some embodiments, the thickness **T1** of the blade member is between about 0.20 mm and 5.0 mm.

The blade members **120** may be formed of any suitable electrically conductive material. According to some embodiments, the blade members **120** are formed of metal. According to some embodiments, the blade members **120** are formed of aluminum, aluminum alloy, or copper and may be galvanized. The blade members **120** may be formed using any suitable technique. According to some embodiments, each blade members**120** is monolithic and unitarily formed. According to some embodiments, each blade member **120** is extruded and cut, stamped (*e.g.*, die-cut), cast and/or machined.

The compression mechanism **116** includes a bolt **116A** and a shear nut **116D** mounted on a threaded shank **116C** of the bolt **116A**. The shear nut **116D** may include a shear head **116B** and a base **116E**. The head **116B** may be configured to operably engage a driver to be forcibly driven by the driver. The nut **116D** includes a breakaway section between the base **116E** and the head **116B**. The head **116B** is configured to shear off of the base **116E** at the breakaway section when subjected to a prescribed torque. According to some embodiments, the bolt **116A** is formed of steel, galvanized steel or stainless steel, and the nut **116D** is formed of aluminum alloy,

plastic or zinc alloy.

With reference to **Figures 2-3** and **6**, the seal members **162** are each seated in a respective one of the subhousing members **114**. The blade members **120** are each seated in a respective blade member slot **162C** (of the seal member **162**) and the adjacent blade member slot **114E** (of the subhousing member **114**) such that the slot **126C** aligns with the corresponding slot **114F**. These subassemblies are each mounted on the bus member subassembly **130** such that the legs **114G**, **162D** extend into the slots **132E**, the guide rails **114D** are slidably seated in the guide slots **132B**, and the bus member **134** is slidably received in the blade member slot **126C** of each blade member **120** (*see* **Figure 6**). More particularly, each finger **126A, 126B** engages a respective side **134A, 134B** of the bus member **134**. According to some embodiments and with reference to **Figure 8**, the thickness **T3** of the bus member **134** is greater than the width **W3** between the teeth **126E** and the tooth **126F** so that one or both of the fingers **126A, 126B** of each blade member **120** is or are elastically deflected away from the another and, as a result, the fingers **126A, 126B** exert a compressive force on the bus member **134** when installed on the bus member **134**.

The tap subassemblies **140, 140'** may be constructed in the same manner or identically, or may be differently constructed. The tap subassembly **140** will be described hereinbelow in more detail, it being appreciated that this description may likewise apply to the tap subassembly **140'**.

With reference to **Figure 2**, the tap subassembly **140** includes the subhousing **142**, the two tap seal members **164**, a compression mechanism or fastener assembly **146**, and upper and lower pairs of blade members **170**.

The subhousing **142** includes upper and lower subhousing members **144**. Each subhousing member **144** includes a body **144A** and legs **144G**. The body **144A** and legs **144G** have a cable groove **144B**, a fastener bore **144C**, a guide feature (rail) **144D**, a pair of blade slots **144E**, and a pair of bus member slots **144F** defined therein. The cable groove **144B** has a lengthwise groove axis **C-C**.

The subhousing members **144** may be formed of a suitable material and in a manner as described above with respect to the subhousing members **114**. According to some embodiments, each of the subhousing members **144** is monolithic and unitarily formed.

Each tap seal member **164** includes legs **164D** and has a cable groove **164A**, a fastener bore **164B**, and a pair of blade slots **164C**. The tap seal members **164** may be formed of a suitable material and in a manner as described above with regard to the main seal members **162**. According to some embodiments, each of the tap seal members **164** is monolithic and unitarily formed.

According to some embodiments and as illustrated, the blade members **170** are identically formed. However, in some embodiments, the blade members **170** may be configured differently from one another. With reference to **Figure 5**, a representative one of the blade members **170** includes a body **172** having an outer end **172A** and an inner end **172B**. An integral cable engagement or insulation piercing feature **174** is located on the outer end **172A** and an integral bus member coupling feature **176** is located on the inner end **172B**. The insulation piercing feature **174** can be configured in the same manner as the insulation piercing feature **124** as described above. The coupling feature **176** can be configured in the same manner as the coupling feature **126** as described above.

The insulation piercing feature **174** includes a plurality of teeth **174A** separated by slots **174C** and having terminal points **174B**. The points **174B** collectively lie on an arc generally corresponding to the profile of the arcuate outer surface of the cable conductor **14A**.

The coupling feature **176** includes opposed spring fingers **176A, 176B** defining a receptacle or slot **176C** therebetween and joined to the body **172** at pivot ends **176D**. Teeth **176E** extend into the slot **176C** from the finger **176A** and a tooth **176F** extends into the slot **176C** from the finger **176B**.

The blade members **170** may be formed of any suitable electrically conductive material. According to some embodiments, the blade members **170** are formed of metal. According to some embodiments, the blade

members **170** are formed of aluminum, aluminum alloy, or copper and may be galvanized. The blade members **170** may be formed using any suitable technique. According to some embodiments, each blade members **170** is monolithic and unitarily formed. According to some embodiments, each blade member **170** is extruded and cut, stamped (*e.g.*, die-cut), cast and/or machined.

According to some embodiments, the blade members **170** have the same relative dimensions as the blade members **120** described above. According to some embodiments, the blade members **170** are smaller than the blade members **120**.

According to some embodiments, the length **L1** of the blade member **170** is at least ten times its thickness **T1**. According to some embodiments, the thickness **T1** of the blade member is between about 0.20 mm and 5.0 mm.

The compression fastener **146** includes a bolt **146A** and a shear nut **146D** corresponding to and operable in the same manner as the bolt **116A** and the shear nut **116D**.

With reference to **Figures 2** and **6**, the seal members **164** are each seated in a respective one of the subhousing members **144**. The blade members **170** are each seated in a respective blade member slot **164C** (of the seal member **164**) and the adjacent blade member slot **144E** (of the subhousing member **144**) such that the slot **176C** aligns with the corresponding slot **144F**. These subassemblies are each mounted on the bus member subassembly **130** such that the legs **144G, 164D** extend into the slots **132F**, the guide rails **144D** are slidably seated in the guide slots **132D**, and the bus member **134** is slidably received in the blade member slot **176C** of each blade member **170**. More particularly, each finger **176A, 176B** engages a respective side **134A, 134B** of the bus member **134**. According to some embodiments, the thickness **T3** of the bus member **134** is greater than the width between the teeth **176E** and the tooth **176F** (**Figure 7**) so that one or both of the fingers **176A, 176B** of each blade member **170** are elastically deflected away from the other and, as a result, the fingers **176A, 176B** exert a com-

pressive force on the bus member **134** when installed on the bus member **134**.

With reference to **Figures 1**, **2** and **6-8**, exemplary methods for assembling and using the connector assembly **100** in accordance with embodiments of the present invention will now be described.

If necessary, the compression mechanism **116** is loosened or opened to permit the subhousing members **114** (and thereby the blade members **120**) to be separated. The main cable **12** (with the insulation layer **12B** covering the conductor **12A**) is inserted in or between the cable grooves **114B**. The shear nut **116D** is then driven to compress the compression mechanism **116** and thereby drive the subhousing members **114** together. As a result, the insulation piercing features **124** of the opposed pairs of the blade members **120** are driven to converge on and capture the cable **12** therebetween. More particularly, the teeth **124A** of each blade member **120** are forced through the insulation layer **12B** and into mechanical and electrical contact with the conductor **12A**. The teeth **124A** embed in the insulation layer **12B**. According to some embodiments, the teeth **124A** embed in the conductor **12A** as shown in **Figure 8**. According to some embodiments, the teeth **124A** embed into the conductor **12A** a distance of at least about 0.5 mm. The seal members **162** engage and form an environmental seal about the section of the cable **12** in the subhousing **112**.

According to some embodiments, as the blade members **120** are displaced or repositioned relative to one another during the steps of opening and closing the subassembly **110**, the blade members **120** slide up and down along the bus member **134** while the spring legs **126A, 126B** maintain constant contact with the opposed sides **134A, 134B** of the bus member **134**. This contact may be ensured by the spring action or loading of the fingers **126A, 126B**. The guide features **114D, 132C** cooperate to ensure that the blade members **120** slide in parallel to one another and the slide axis **A-A** (**Figures 7** and **8**).

The shear nut **116D** is driven until a prescribed torque is applied, whereupon the shear head **116B** will break off, thereby helping to ensure that

the proper load is applied to the blade members **120**. In the foregoing manner, the connector assembly **100** is operatively connected to the main cable **12** without stripping the insulation layer **12B**.

Because the main subassembly **110** employs blade members **120** that move and engage the main cable **12** independently of the tap subassemblies **140, 140'** and the blade members **170** thereof, the main subassembly **110** can be configured to properly engage a range of main cable sizes independent of the ranges of cable sizes for which the tap subassemblies **140, 140'** are adapted. The tap subassemblies **140, 140'** can likewise be adapted to engage different tap cable size ranges from one another.

Independently of connecting the connector assembly **100** to the main cable **12**, the connector assembly **100** can be connected to the tap cable **14** as follows using the first tap subassembly **140**. If necessary, the compression mechanism **146** is loosened or opened to permit the subhousing members **144** (and thereby the blade members **170**) to be separated. The tap cable **14** (with the insulation layer **14B** covering the conductor **14A**) is inserted in or between the cable grooves **144B**. The shear nut **146D** is then driven to compress the compression mechanism **146** and thereby drive the subhousing members **144** together. As a result, the insulation piercing features of the opposed pairs of the blade members **170** are driven to converge on and capture the cable **14** therebetween. More particularly, the teeth **174A** of each blade member **170** are forced through the insulation layer **14B** and into mechanical and electrical contact with the conductor **14A**. The teeth **174A** embed in the insulation layer **14B**. According to some embodiments, the teeth **174A** embed in the conductor **14A**. According to some embodiments, the teeth **174A** embed into the conductor **14A** a distance of at least about 0.5 mm. The seal members **164** engage and form an environmental seal about the section of the cable **14** in the subhousing **142**.

According to some embodiments, as the blade members **170** are displaced or repositioned relative to one another during the steps of opening and closing the subassembly **140**, the blade members **170** slide up and down along the bus member **134** while the spring legs **176A**, **176B** maintain con-

stant contact with the opposed sides **134A, 134B** of the bus member **134**. The spring loading of the fingers **176A, 176B** may ensure contact between the fingers **176A, 176B** and the bus member **134**. The guide features **144D, 132D** cooperate to ensure that the blade members **170** slide in parallel to one another and the slide axis **A-A**. The shear nut **146D** may be driven until a prescribed torque is applied and the head thereof breaks off. In the foregoing manner, the connector assembly **100** is operatively connected to the tap cable **14** without stripping the insulation layer **14B** from the section of the cable **14** engaged by the connector assembly **100**.

Independently of connecting the connector assembly **100** to the main cable **12** using the subassembly **110** and connecting the connector assembly **100** to the tap cable **14** using the first tap subassembly **140**, the connector assembly **100** can be connected to the tap cable **16** using the subassembly **140'** in the same manner as described for connecting the subassembly **140** to the tap cable **14**.

In the foregoing manner, the connection **5** (**Figures 1**, **6** and **7**) can be formed. The blade members **120, 170** and the bus member **134** provide electrical continuity (*i.e.*, a path for electrical current flow) between the conductors **12A, 14A, 16A** of the cables **12, 14, 16**. The connection assembly **100** mechanically secures the cables **12, 14, 16** relative to one another. Moreover, the connection assembly **100** provides environmental protection for the locations in the insulation layers **12B, 14B, 16B** pierced by the blade members **120, 170**.

With reference to **Figure 9**, a multi-tap or multi-cable insulation piercing electrical connector assembly **200** according to further embodiments of the present invention is shown therein connecting cables **12, 14, 16,** and **18** to form a connection **7**. The connector assembly **200** includes a bus member **235**, main blade members **220** and tap blade members **270**. The connector assembly **200** may be constructed and operable in the same manner as the connector assembly **100**, except as follows. For the purpose of explanation, only the cables **12, 14, 16, 18**, the bus member **234**, and the blade members **220, 270** are shown in **Figure 9**. Although not shown, the

connector assembly **200** may further include a main subhousing corresponding to the main subhousing **112**, main seal members corresponding to the seal members **162**, and a compression mechanism corresponding to the compression mechanism **116**, a bus member subhousing corresponding to the subhousing **132**, and, for each of the pairs of blades **270** associated with a respective tap cable **14, 16, 18**, a subhousing corresponding to the subhousing **144**, tap seal members corresponding to the seal members **164**, and a compression mechanism corresponding to the compression mechanism **146**.

The bus member **235** includes a main section **234** corresponding to the bus member **134** having a lengthwise axis **H-H**. The bus member **235** further includes three tap sections or legs **236** integral with the main section **234**. Each leg **236** has a lengthwise axis **I-I, J-J, K-K** transverse to the axis **H-H**. According to some embodiments, the axes **I-I, J-J, K-K** are substantially perpendicular to the axis **H-H**. When the cables **12, 14, 16, 18** are installed in the connector assembly **200**, the cable lengthwise axes **D-D, E-E, F-F** and **G-G**, will extend substantially parallel to the axes **H-H, I-I, J-J** and **K-K**, respectively.

The blade members **220** correspond to the blade members **120** and are slidably mounted on the section **234** in the same manner and to the same effect as described above with regard to the blade members **120**. Each set of two opposed pairs of blade members **270** corresponds to a set of the tap blade members **170**, and is slidably mounted on a respective leg **236** in the same manner and to the same effect as described above with regard to the blade members **170**.

It will be appreciated that the connector assembly **200** can be used in similar manner as the connector assembly **100** except that the tap cables **14, 16, 18** are oriented at a transverse or perpendicular angle relative to the main cable **12** in the completed connection **7**. While three legs **236** and tap cables are shown, according to further embodiments, more or fewer legs **236** and tap subassemblies can be provided in a given connector assembly (*e.g.*, by extending the main section **234** and adding legs **236**).

The bus member **235** can be formed in any suitable manner, such as by bending and/or welding a bar or bars of metal.

With reference to **Figure 10**, a multi-tap or multi-cable insulation piercing electrical connector assembly **300** according to further embodiments of the present invention is shown therein connecting cables **12, 14, 16,** and **18** to form a connection **9**. The connector assembly **300** includes a multi-piece bus assembly **335**, main blade members **320**, tap blade members **370**, and three modular electrical protection functional components **380** (one of which is removed for the purpose of explanation). The connector assembly **300** may be constructed and operable in the same manner as the connector assembly **100**, except as follows. For the purpose of explanation, only the cables **12, 14, 16, 18**, the bus assembly **335**, the blade members **320, 370**, and the electrical protection functional components **380** are shown in **Figure 10**. Though not shown, the connector assembly **300** may further include a main subhousing corresponding to the main subhousing **112**, main seal members corresponding to the seal members **162**, and a compression mechanism corresponding to the compression mechanism **116**, a bus member subhousing corresponding to the subhousing **132**, and, for each of the pairs of blades **370** associated with a respective tap cable **14, 16, 18**, a subhousing corresponding to the subhousing **144**, tap seal members corresponding to the seal members **164**, and a compression mechanism corresponding to the compression mechanism **146**.

The bus assembly **335** includes a primary bus member **333** and three tap bus members **337**. The primary bus member **333** includes a main section **334** corresponding to the bus member **134** having a lengthwise axis. The bus member **333** further includes three tap sections or legs **336** integral with the main section **234**. Each leg **336** has a lengthwise axis transverse to the lengthwise axis of the section **334**. According to some embodiments, the leg axes are substantially perpendicular to the lengthwise axis of the section **334**. Each leg **336** also has a male connection feature or tab **331A** on its terminal end. Each tap bus member **337** similarly has a male connection feature or tab **331B** on a terminal end thereof.

The blade members **320** correspond to the blade members **120** and are slidably mounted on the section **334** in the same manner and to the same effect as described above with regard to the blade members **120**. Each set of two opposed pairs of blade members **370** corresponds to a set of the tap blade members **170**, and is slidably mounted on a respective leg **336** in the same manner and to the same effect as described above with regard to the blade members **170**.

Each electrical protection functional component **380** is mounted on and bridges a respective leg **336** and a respective bus member **337**. The components **380** each have a pair of female connection sockets **380A, 380B** that receive respective ones of the connection tabs **331A, 331B**. In this manner, electrical continuity is provided between the main blade members **320** and the tap blade members **370** (and thereby between the main cable **12** and the tap cables **14, 16, 18**) through the respective electrical protection functional components **380**.

The electrical protection functional components **380** may be any suitable electrical protection functional components. According to some embodiments, the electrical protection functional components **380** are fuses such as slow blow fuses. If desired, the components **380** can be used as current interrupt switches between the cable **12** and selected cables **14, 16, 18** by removing and replacing the components **380** on the connection features **331A, 331B**.

With reference to **Figure 11**, a multi-tap or multi-cable insulation piercing electrical connector assembly **400** according to further embodiments of the present invention is shown therein connecting cables **12, 14, 16,** and **18** to form a connection **11**. The connector assembly **400** includes a multi-piece bus assembly **435**, main blade members **420**, tap blade members **470**, three electrical protection functional components **480** (as shown, electrical switches, such as microswitches), and three electrical protection functional components **482** (as shown, tube fuses). The connector assembly **400** may be constructed and operable in the same manner as the connector assembly **100**, except as follows. For the purpose of explanation, only the cables **12,**

14, 16, 18, the bus assembly **435**, the blade members **420, 470**, and the electrical protection functional components **480, 482** are shown in **Figure 11**. Though not shown, the connector assembly **400** may further include a main subhousing corresponding to the main subhousing **112**, main seal members corresponding to the seal members **162**, and a compression mechanism corresponding to the compression mechanism **116**, a bus member subhousing corresponding to the subhousing **132**, and, for each of the pairs of blades **470** associated with a respective tap cable **14, 16, 18**, a subhousing corresponding to the subhousing **144**, tap seal members corresponding to the seal members **164**, and a compression mechanism corresponding to the compression mechanism **146**.

The bus assembly **435** includes a primary bus member **434**, three tap bridge bus members **438**, three intermediate bus members **439**, and three tap bus members **437**. Each of the bus members **434, 437, 438, 439** may be formed of any suitable electrically conductive material, as described above with regard to the bus member **134**.

The primary bus member **434** corresponds to the bus member **134** and has a lengthwise axis. The blade members **420** correspond to the blade members **120** and are slidably mounted on the bus member **434** in the same manner and to the same effect as described above with regard to the blade members **120**.

Each tap bridge bus member **438** has an integral coupling feature **438A** on one end and an integral component mounting feature **438B** on its opposite end. The coupling feature **438A** may be constructed and operate in the manner described for the bus member coupling features **126** above. The component mounting feature **438B** may be of any suitable configuration to operatively engage a component **482**. As shown, the component mounting feature **438B** is a female connection feature defining a slot sized and shaped to form a spring biased and/or interference fit with an electrical end contact **482A** of the component **482**. Each tap bridge member **438** is slidably mechanically and electrically coupled to the primary bus member **434** by its coupling feature **438A**. The tap bridge bus members **438** extend transversely

and, according to some embodiments, perpendicularly, to the primary bus member **434**.

Each intermediate bus member **439** has an integral component mounting feature **439A** of a first type on one end and an integral component mounting feature **439B** of a second type on its opposite end. The component mounting feature **439A** may be of any suitable configuration to operatively engage a component **482**. As shown, the component mounting feature **439A** defines a slot sized and shaped to form a spring biased and/or interference fit with an electrical end contact **482B** of the component **482**. Similarly, the component mounting feature **439B** may be of any suitable configuration to operatively engage a component **480**. As shown, the component mounting feature **439B** defines a slot sized and shaped to form a spring biased and/or interference fit with an electrical male contact tab **480A** of the component **480**. Each intermediate bus member **439** is directly electrically connected to a respective tap bridge bus member **438** by a respective electrical protection functional component **482** (tube fuse).

Each tap bus member **437** includes a body **437A** having an integral component mounting feature **437B** on one end. The component mounting feature **437B** may be configured as described for the integral component mounting feature **439B**. Each tap bus member **437** is directly electrically connected to a respective intermediate bus member **439** by a respective electrical protection functional component **480** (switch). More particularly, the component mounting feature **437B** receives and holds an electrical male contact tab **480B** of the component **480**.

Each set of two opposed pairs of blade members **470** corresponds to a set of the tap blade members **170**, and is slidably mounted on a respective tap bus member **437** in the same manner and to the same effect as described above with regard to the blade members **170**.

Electrical continuity is provided between the main blade members **420** and the tap blade members **470** (and thereby between the main cable **12** and the tap cables **14, 16, 18**) through the primary bus member **434** and the respective tap bridge bus members **438**, electrical protection func-

tional components **482**, the intermediate bus members **439**, the electrical protection functional components **480**, and the tap bus members **437**.

While the electrical protection functional components **380, 480** and **482** as disclosed above are fuses or switches and packaged as modules with male contacts, modules with female contacts, and tubular modules, any suitable electrical protection functional components and/or combination of electrical protection functional components may be integrated into electrical connector assemblies as described herein in accordance with embodiments of the invention.

Connector assemblies as disclosed herein can be designed and assembled using a modular system according to embodiments of the present invention. Various components as disclosed herein can be assembled together in various combinations and numbers depending on the requirements for the connector assembly. Such assembly may be executed at the factory.

While shear nuts **116D, 146D** have been shown and described herein, alternatively shear bolts may be used.

While various housing configurations have been shown and described herein for the connector assemblies **100, 200, 300, 400**, housings having other shapes, sizes and components may be employed instead.

The foregoing is illustrative of the present invention and is not to be construed as limiting thereof. Although a few exemplary embodiments of this invention have been described, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention. Therefore, it is to be understood that the foregoing is illustrative of the present invention and is not to be construed as limited to the specific embodiments disclosed, and that modifications to the disclosed embodiments, as well as other embodiments, are intended to be included within the scope of the invention.

CLAIMS:

1. An electrical connector assembly for mechanically and electrically connecting first and second cables each including an elongate electrical conductor covered by an insulation layer, the electrical connector assembly comprising:

a housing configured to receive each of the first and second cables;

an electrically conductive bus member disposed in the housing;

an electrically conductive first blade member disposed in the housing and having an inner end, an outer end and an insulation piercing feature on the outer end, wherein the inner end is coupled to the bus member and the insulation piercing feature includes at least one tooth configured to pierce through the insulation cover of the first cable and electrically engage the conductor of the first cable; and

an electrically conductive second blade member disposed in the housing and having an inner end, an outer end and an insulation piercing feature on the outer end, wherein the inner end is coupled to the bus member and the insulation piercing feature includes at least one tooth configured to pierce through the insulation cover of the second cable and electrically engage the conductor of the second cable;

wherein the bus member provides electrical continuity between the first and second blade members and thereby the conductors of the first and second cables when the conductors are engaged by the insulation piercing feature of the first and second blade members.

2. The electrical connector assembly of Claim 1 wherein the first blade member has a coupling feature on its inner end coupling the first blade member to the bus member, and the coupling feature is configured differently than the insulation piercing feature of the first blade member.

3. The electrical connector assembly of Claim 2 wherein the coupling feature includes a receiver slot defined by at least one integral, deflectable finger, wherein the coupling feature is configured to receive the bus member such that the finger is deflected and exerts a persistent compressive

load on the bus member to maintain electrical engagement between the first blade member and the bus member.

4. The electrical connector assembly of Claim 3 wherein the coupling feature includes teeth on opposed sides of the receiver slot to engage opposed sides of the bus member.

5. The electrical connector assembly of Claim 3 wherein:

the second blade member has a second coupling feature on its inner end coupling the second blade member to the bus member;

the second coupling feature is configured differently than the insulation piercing feature of the second blade member; and

the second coupling feature includes a receiver slot defined by at least one integral, deflectable finger, wherein the second coupling feature is configured to receive the bus member such that the finger is deflected and exerts a persistent compressive load on the bus member to maintain electrical engagement between the second blade member and the bus member.

6. The electrical connector assembly of Claim 1 further including:

an electrically conductive third blade member disposed in the housing opposite the first blade member and having an inner end, an outer end and an insulation piercing feature on the outer end, wherein the inner end is coupled to the bus member and the insulation piercing feature includes at least one tooth configured to pierce through the insulation cover of the first cable and electrically engage the conductor of the first cable; and

an electrically conductive fourth blade member disposed in the housing opposite the second blade member and having an inner end, an outer end and an insulation piercing feature on the outer end, wherein the inner end is coupled to the bus member and the insulation piercing feature includes at least one tooth configured to pierce through the insulation cover of the second cable and electrically engage the conductor of the second cable.

7. The electrical connector assembly of Claim 1 including:

a first compression mechanism operable to force the insulation piercing feature of the first blade member into engagement with the conductor of the first cable; and

a second compression mechanism operable to force the insulation piercing feature of the second blade member into engagement with the conductor of the second cable independently of the first compression mechanism.

8. The electrical connector assembly of Claim 7 wherein each of the first and second compression mechanisms includes a shear bolt or shear nut.

9. The electrical connector assembly of Claim 7 wherein the first blade member has a coupling feature on its inner end coupling the first blade member to the bus member, and the coupling feature slides along and in contact with the bus member when the insulation piercing feature of the first blade member is forced into engagement with the first cable.

10. The electrical connector assembly of Claim 1 wherein the housing includes:

a first subhousing containing the first blade member and configured to receive a portion of the first cable, the first subhousing including a seal member to provide an environmental seal between the first cable and the first subhousing; and

a second subhousing containing the second blade member and configured to receive a portion of the second cable, the second subhousing including a seal member to provide an environmental seal between the second cable and the second subhousing.

11. The electrical connector assembly of Claim 10 including a third subhousing containing the bus member, wherein the first subhousing is movable relative to the third subhousing.

12. The electrical connector assembly of Claim 1 including an electrically conductive third blade member disposed in the housing and having an inner end, an outer end and an insulation piercing feature on the outer end, wherein the inner end is coupled to the bus member and the insulation piercing feature includes at least one tooth configured to pierce through an insulation cover of a third cable and electrically engage a conductor of the third cable.

13. The electrical connector assembly of Claim 1 wherein:

the bus member includes a first leg and a second leg adjoining and disposed at an angle with respect to the first leg;

the inner end of the first blade member engages the first leg; and

the inner end of the second blade member engages the second leg.

14. The electrical connector assembly of Claim 1 including an integral electrical protection functional component disposed in the housing and electrically connecting the first and second blade members.

15. A method for mechanically and electrically connecting first and second cables each including an elongate electrical conductor covered by an insulation layer, the method comprising:

providing an electrical connector assembly comprising:

a housing configured to receive each of the first and second cables;

an electrically conductive bus member disposed in the housing;

an electrically conductive first blade member disposed in the housing and having an inner end, an outer end and an insulation piercing feature on the outer end, wherein the inner end is coupled to the bus member and the insulation piercing feature includes at least one tooth configured to pierce through the insulation cover of the first cable and electrically engage the conductor of the first cable; and

an electrically conductive second blade member disposed in the housing and having an inner end, an outer end and an insulation piercing feature on the outer end, wherein the inner end is coupled to the bus member and the insulation piercing feature includes at least one tooth configured to pierce through the insulation cover of the second cable and electrically engage the conductor of the second cable;

placing the first cable in the housing and forcing the first blade member into engagement with the first cable such that the at least one tooth of the first blade member pierces through the insulation cover of the first cable and electrically engages the conductor of the first cable; and

placing the second cable in the housing and forcing the second blade member into engagement with the second cable such that the at least

one tooth of the second blade member pierces through the insulation cover of the second cable and electrically engages the conductor of the second cable, wherein the bus member provides electrical continuity between the first and second blade members and thereby the conductors of the first and second cables.

16. An electrical connector assembly for mechanically and electrically connecting first and second cables each including an elongate electrical conductor covered by an insulation layer, the electrical connector assembly comprising:

a housing configured to receive each of the first and second cables;

an electrically conductive first contact member disposed in the housing, the first contact member including an insulation piercing feature including at least one tooth configured to pierce through the insulation cover of the first cable and electrically engage the conductor of the first cable;

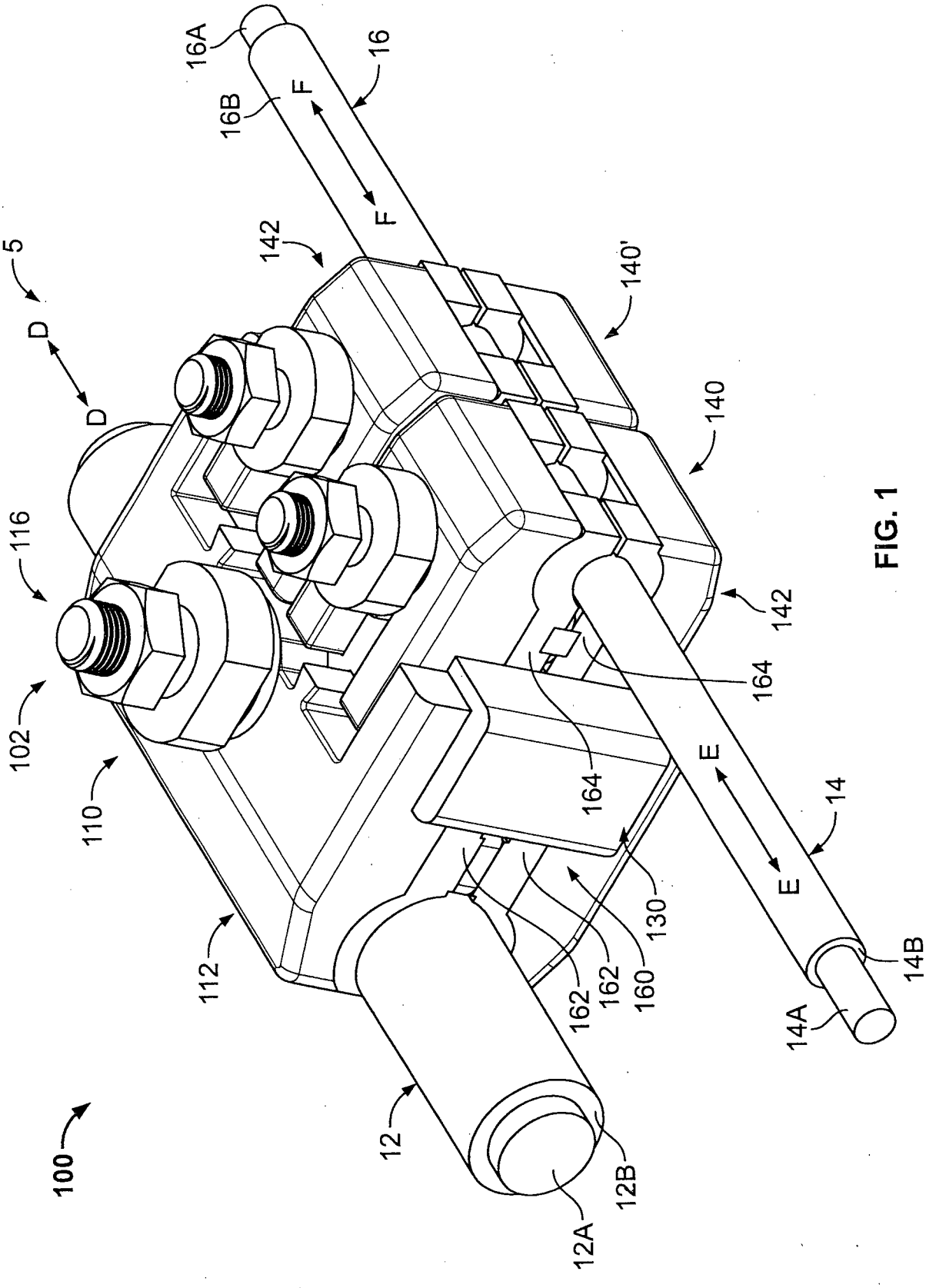
an electrically conductive second contact member disposed in the housing, the second contact member including an insulation piercing feature including at least one tooth configured to pierce through the insulation cover of the second cable and electrically engage the conductor of the second cable; and

an integral electrical protection functional component disposed in the housing and electrically connecting the first and second contact members.

17. The electrical connector assembly of Claim 16 wherein the electrical protection functional component includes a fuse.

18. The electrical connector assembly of Claim 17 wherein the electrical protection functional component includes a tubular fuse.

19. The electrical connector assembly of Claim 16 wherein the electrical protection functional component includes a switch.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16B
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F
F
142
140'
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D
D
140
116
142
102
164
110
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E
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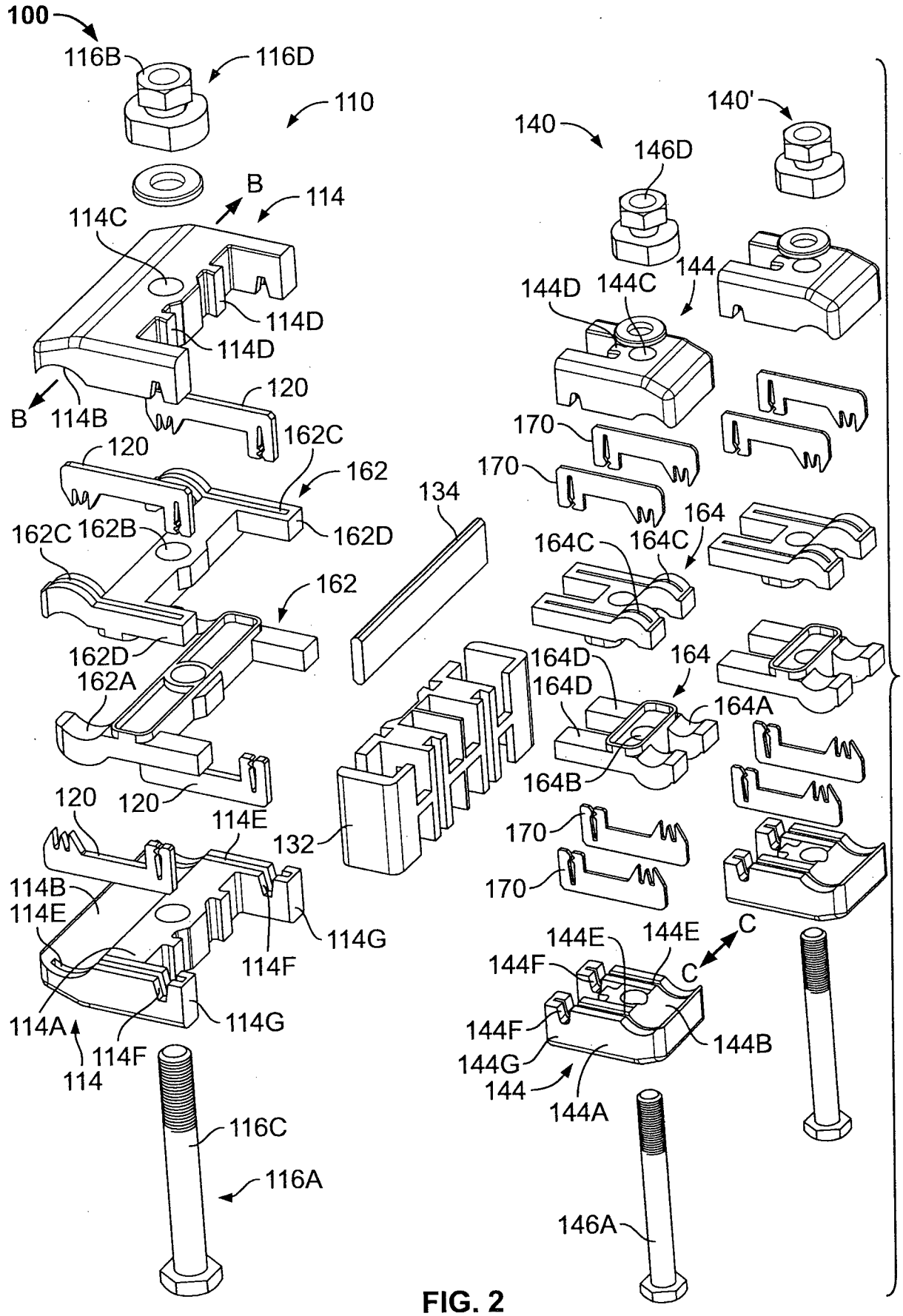
130
112
162
162
160
14B
14A
12
12B
12A
100

FIG. 1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116B
116D
110
B
114
114C
114D
114D
120
B
114B
162C
120
162
162C
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134
162
162D
162A
120
120
114E
132
114B
114E
114G
114F
114A
114F
114G
114
116C
116A
140
140'
146D
144
144D
144C
170
170
164
164C
164C
164D
164D
164
164A
164B
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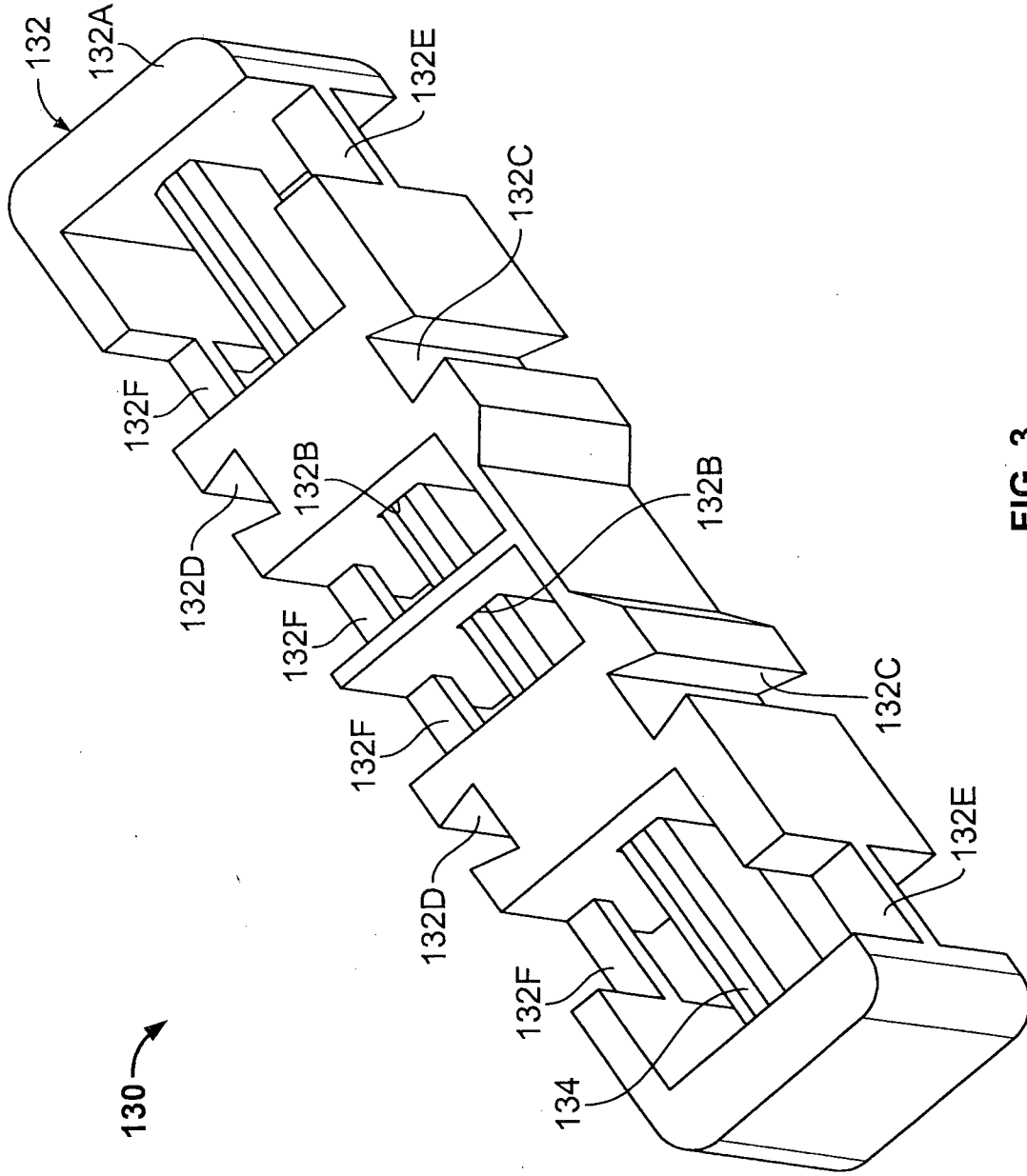
144F
144B
144G
144
144A
146A

FIG. 2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132B
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132F
132C
132D
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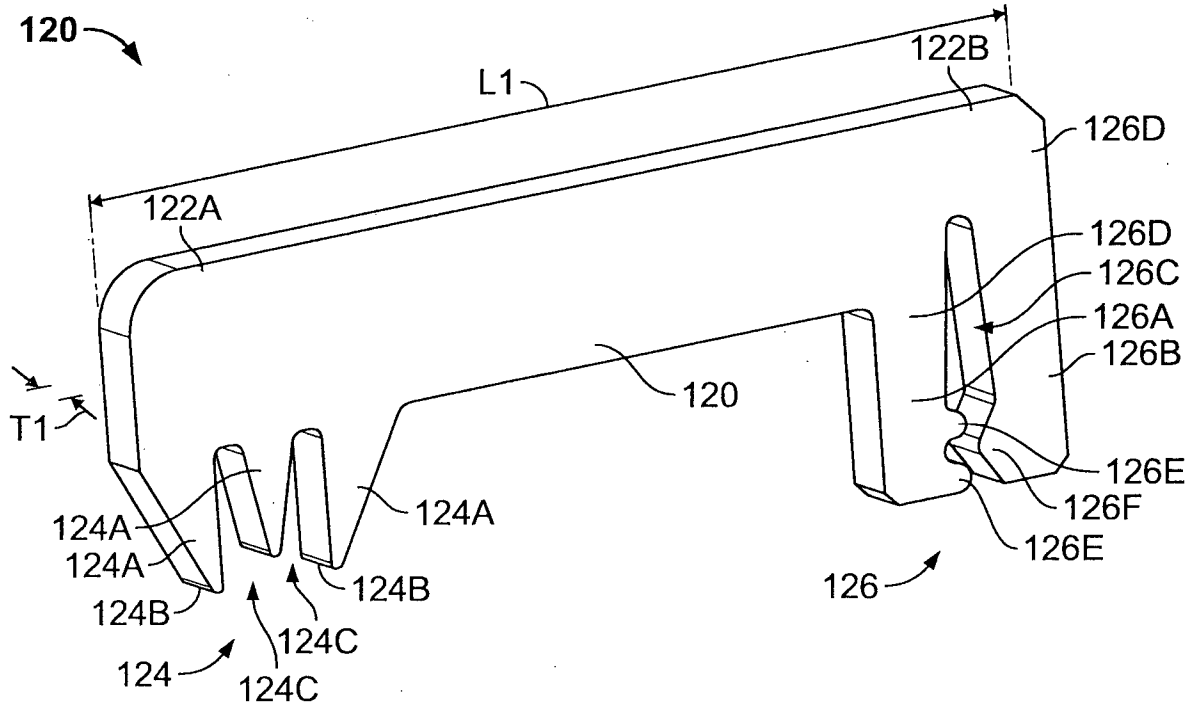
132F
134
130

FIG. 3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L1
122B
126D
122A
126D
126C
126A
126B
T1
120
126E
126F
124A
124A
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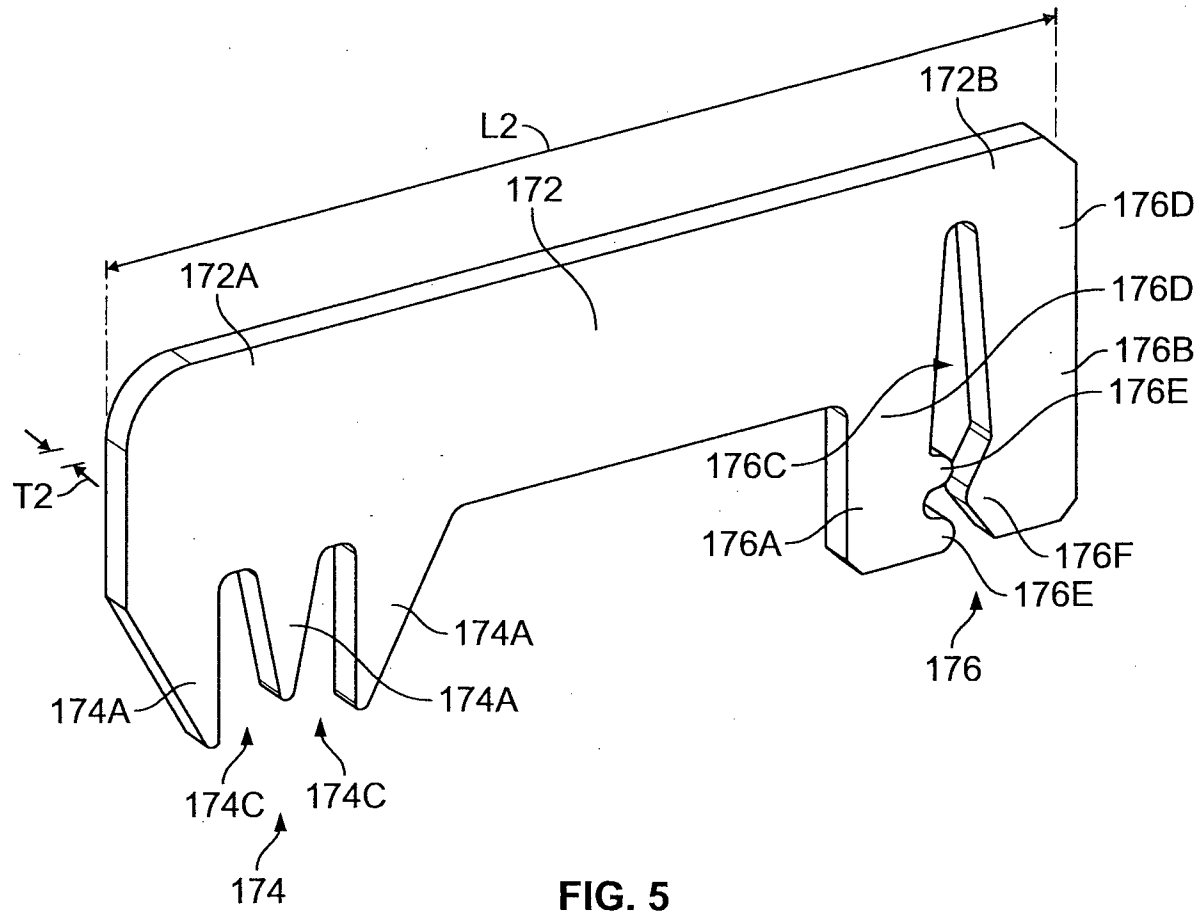
124B
124B
126
124C
124
124C

FIG. 4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176D
172A
176D
176B
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T2
176C
176A
176F
176E
174A
176
174A
174A
174C
174C
174

FIG. 5

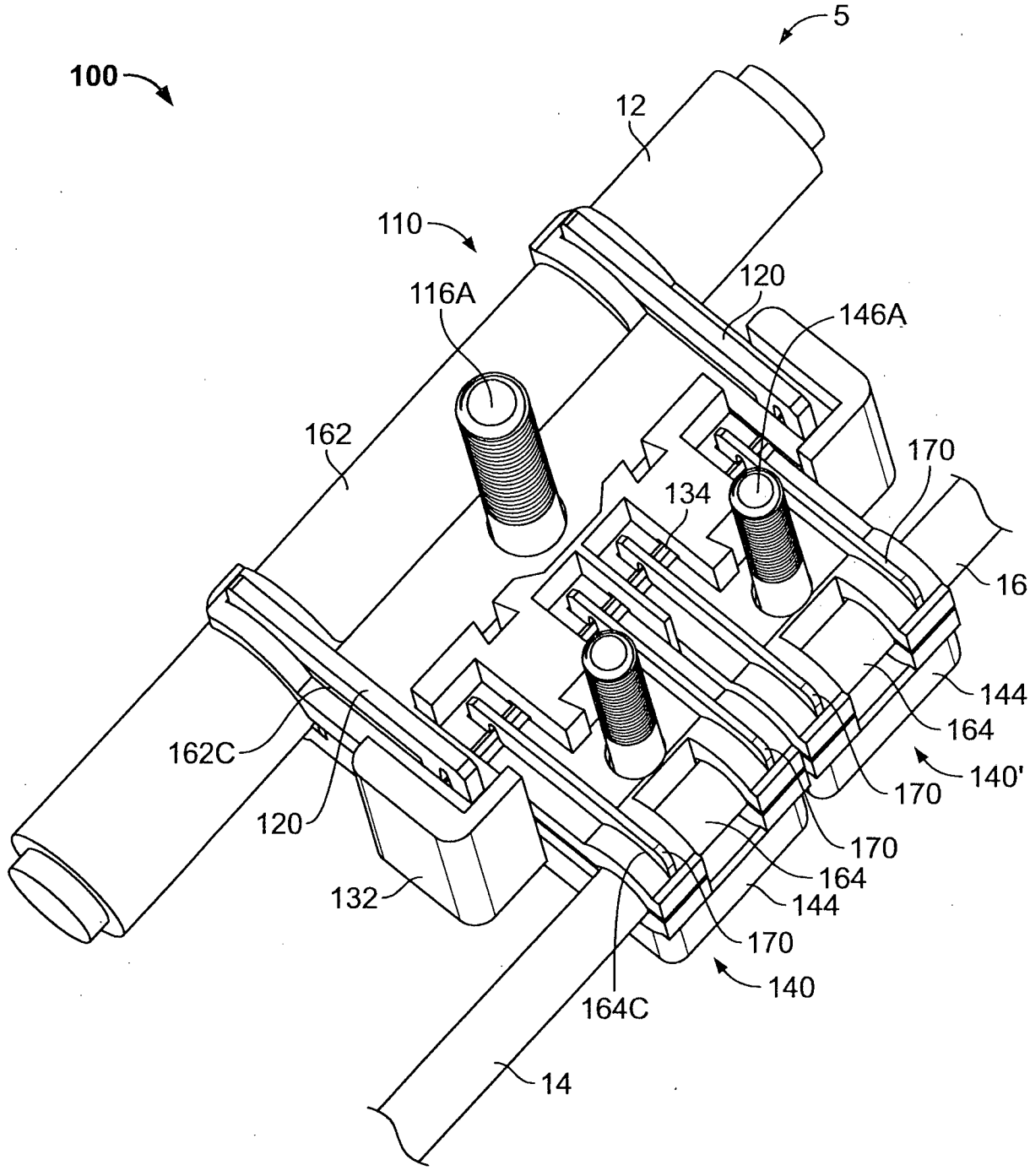

5
100
12
110
116A
120
146A
162
170
134
16
144
164
162C
140'
120
170
170
164
132
144
170
140
164C
14

FIG. 6

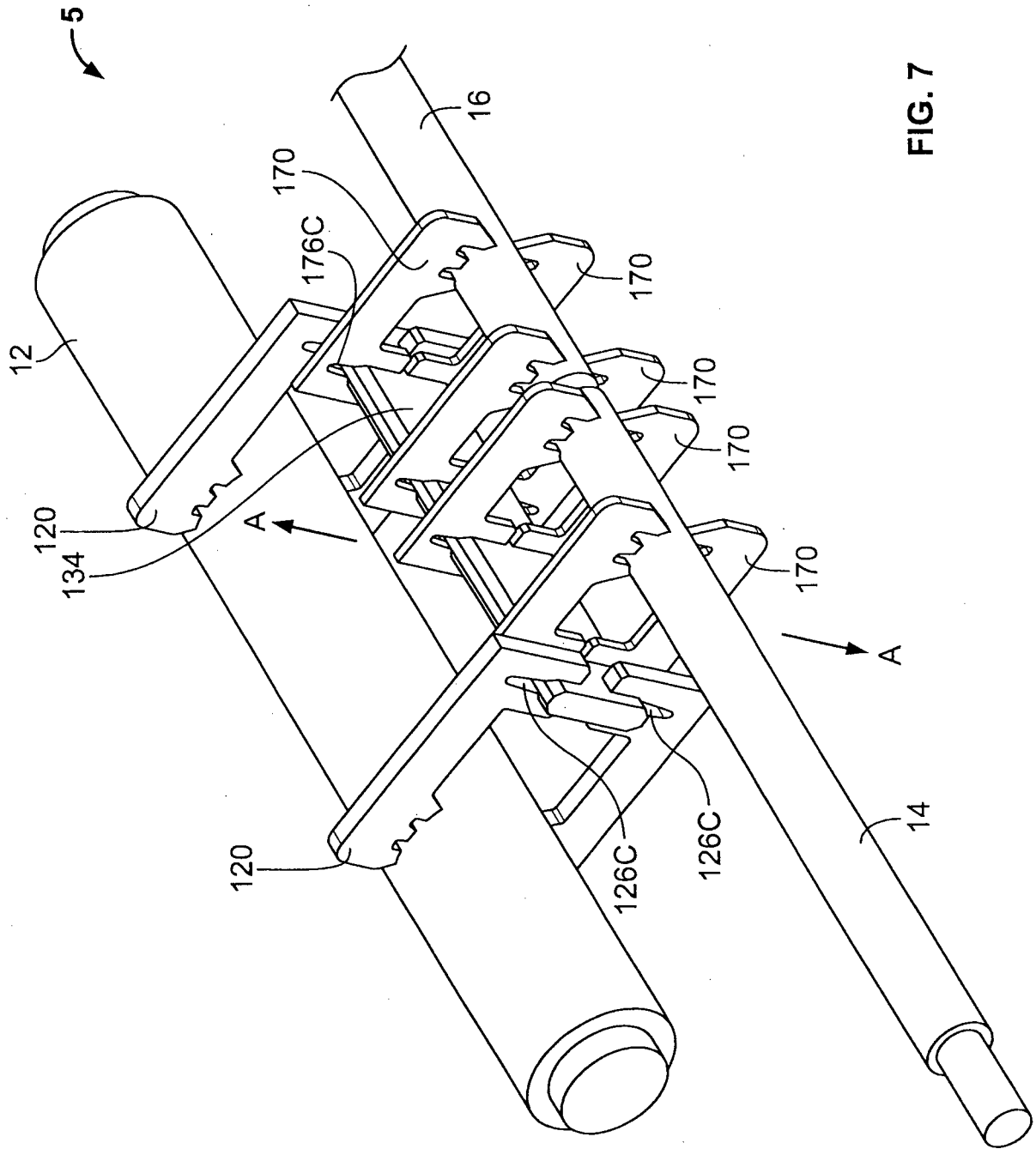


FIG. 7

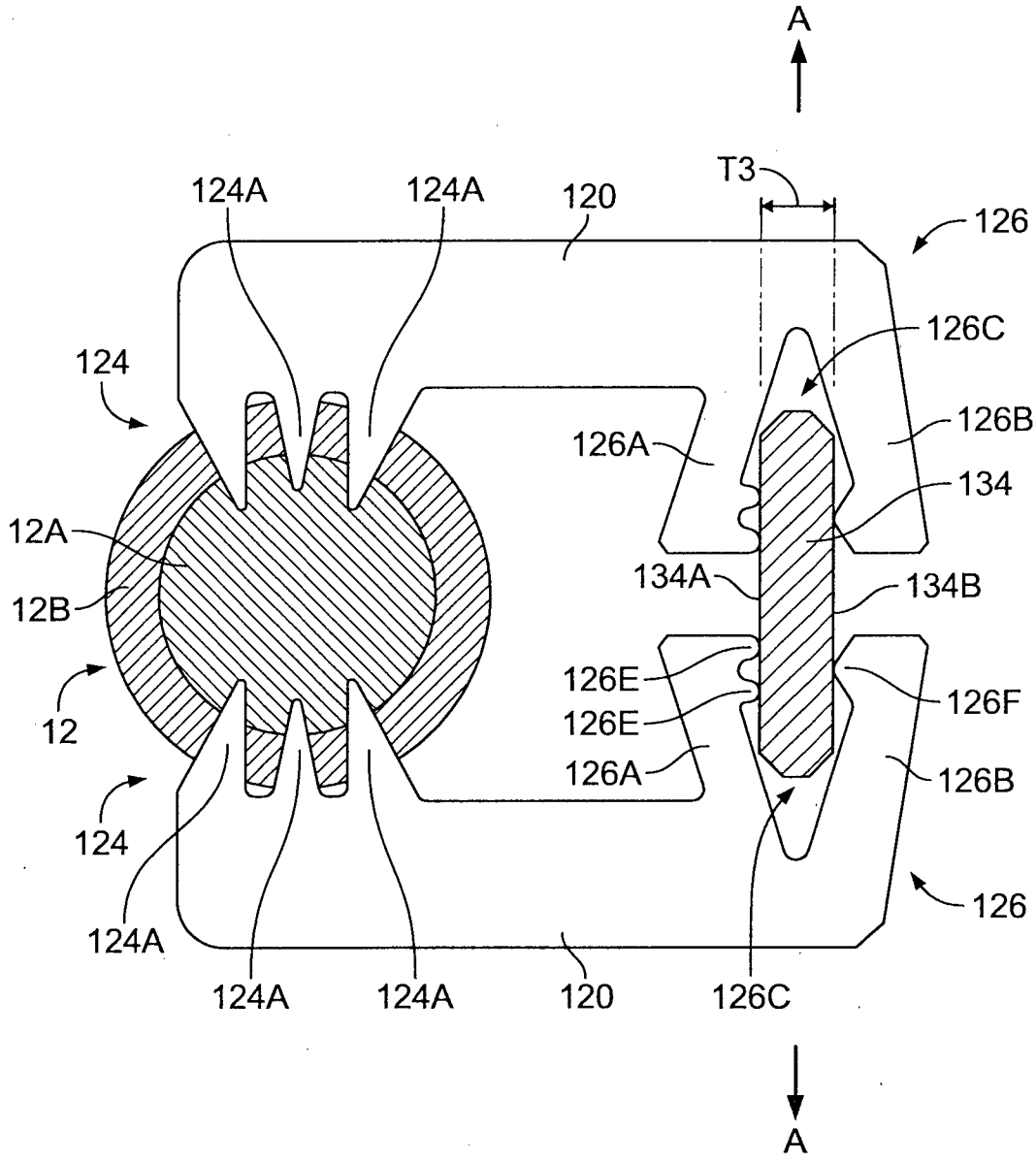

A
T3
124A
124A
120
126
126C
124
126B
126A
134
12A
134A
134B
12B
126E
126F
126E
12
126A
126B
124
126
124A
124A
124A
120
126C
A

FIG. 8

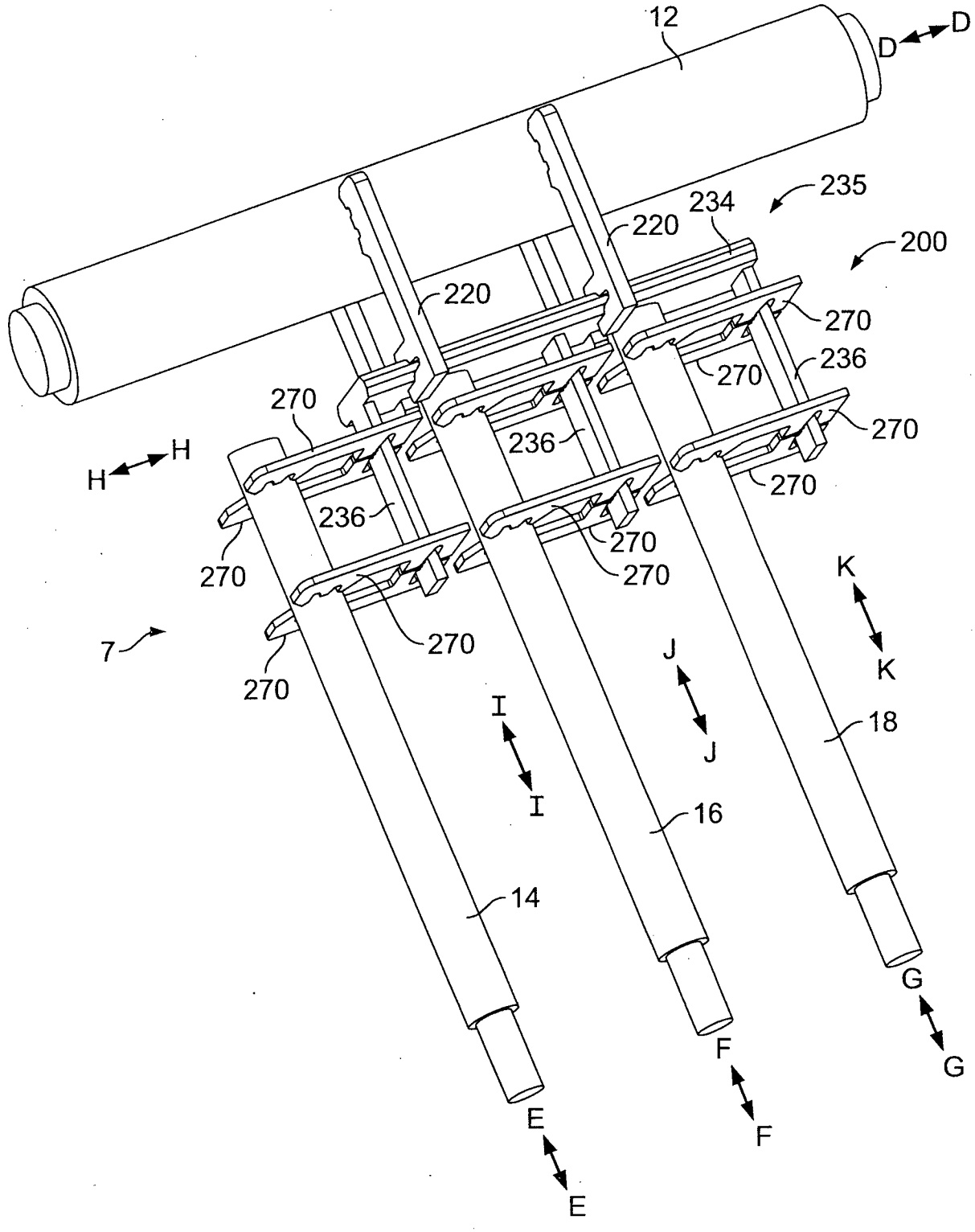

12
D
D
235
234
220
200
220
270
270
236
270
270
H
H
236
270
270
270
270
270
270
7
270
K
K
J
J
I
I
18
16
14
G
G
F
F
E
E

FIG. 9

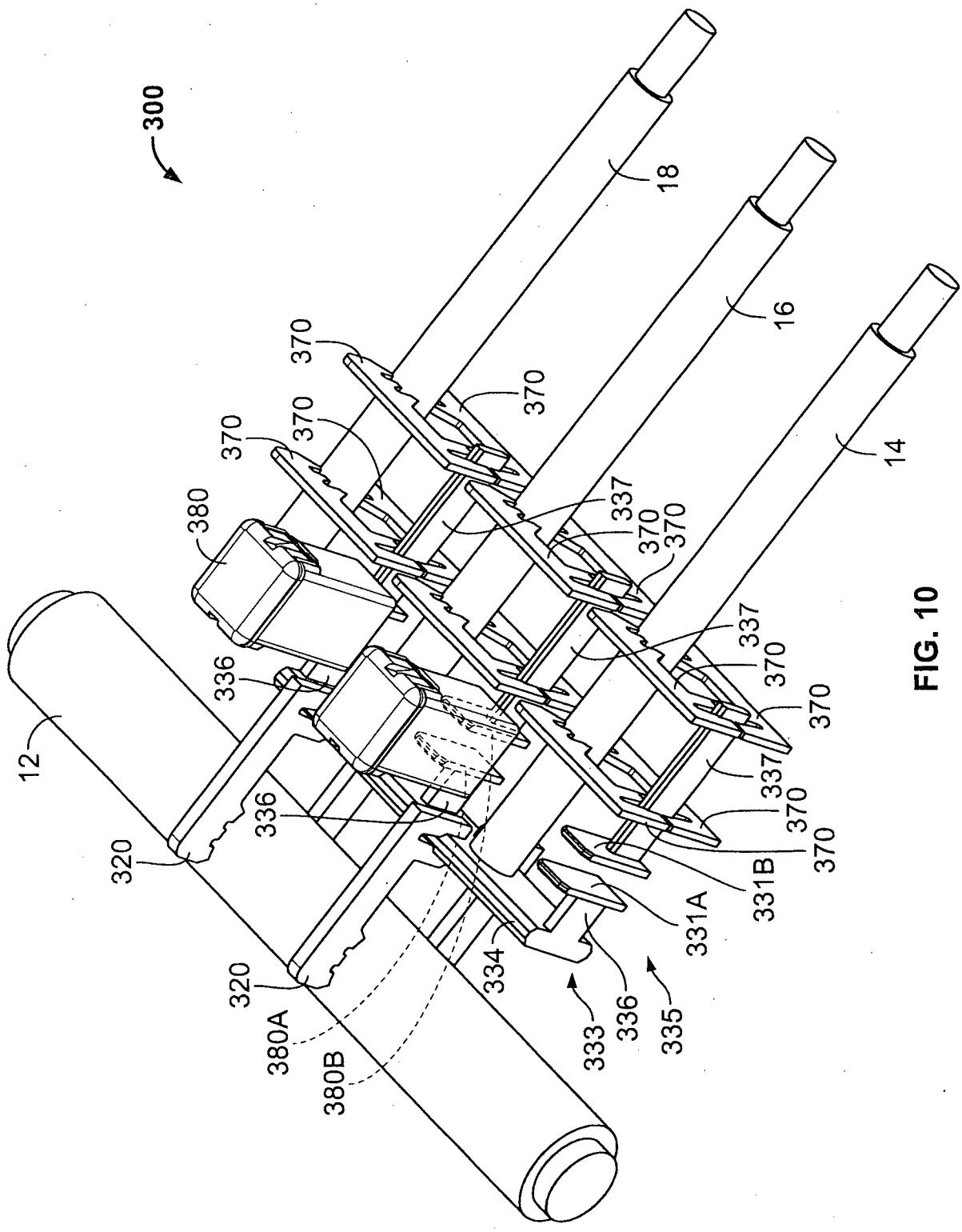
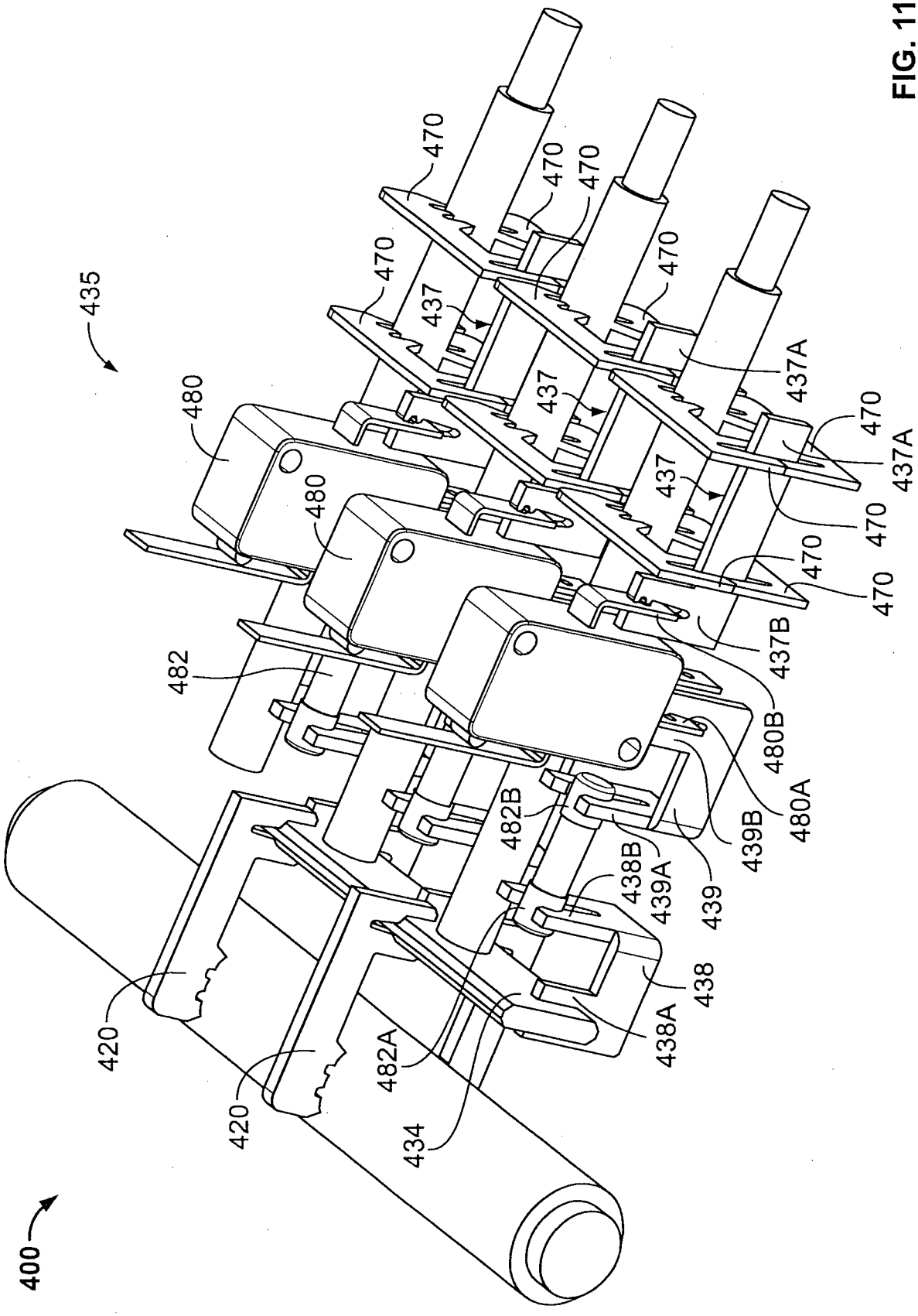

300
18
16
14
370
380
337
336
12
320
331B
331A
334
333
335
380A
380B

FIG. 10


400
420
420
434
482A
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435
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437A
437A
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470
437B
480B
480A
439B
439
439A
438B
438
438A
482B

FIG. 11

INTERNATIONAL SEARCH REPORT

International application No
PCT/BR2012/000440

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01R4/24 H01R25/14 H01R13/684
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01R

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6 780 044 B1 (SAWYER CHARLIE [US] ET AL) 24 August 2004 (2004-08-24) paragraphs [0031] - [0036]; figures 2-4,7	1-19
Y	EP 2 360 790 A1 (TYCO ELECTRONICS SIMEL S A S [FR]; TYCO ELECTRONICS RAYCHEM GMBH [DE]) 24 August 2011 (2011-08-24) paragraphs [0042] - [0044]; figures 1,4	1-19
Y	US 5 429 530 A (ZANDER JEFFREY E [US] ET AL) 4 July 1995 (1995-07-04) abstract; figure 3	14,16,17
A	DE 200 13 482 U1 (CONCEPTION & DEV MICHELIN SA [CH]) 12 October 2000 (2000-10-12) claim 1; figures 1-4	1,15,16

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 January 2013	30/01/2013

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Jiménez, Jesús

INTERNATIONAL SEARCH REPORT

International application No
PCT/BR2012/000440

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 118 715 A (POTRUCH ROBERT A) 21 January 1964 (1964-01-21) claim 1; figures 1-5	1,15,16
A	EP 0 650 220 A2 (MINNESOTA MINING & MFG [US]) 26 April 1995 (1995-04-26) abstract; figures 3,6,7	1,15,16
A	FR 2 930 847 A1 (MICHAUD SA SA [FR]) 6 November 2009 (2009-11-06) claim 1; figure 3	1,15,16

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/BR2012/000440

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		JP 7130409 A	19-05-1995
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FR 2930847 A1	06-11-2009	NONE	