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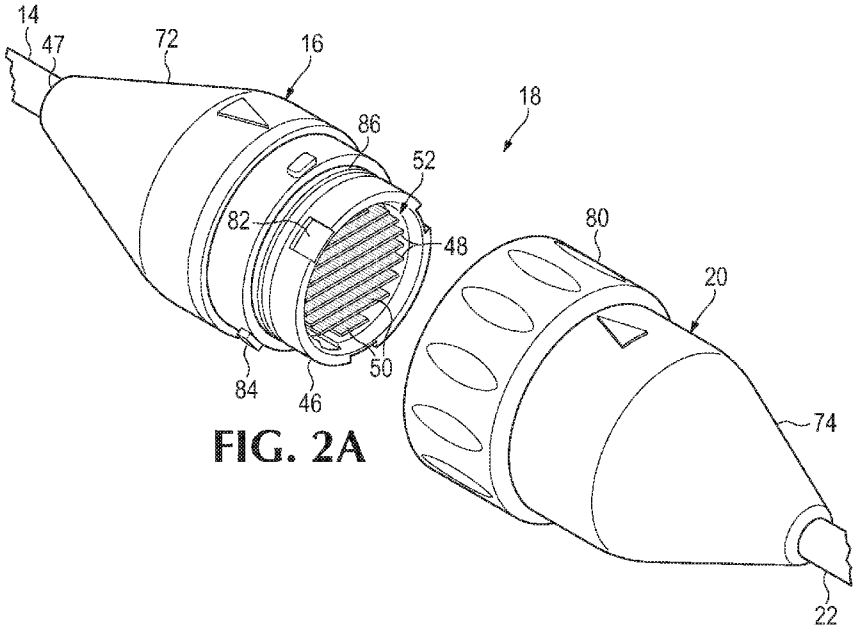


FIG. 2A

(57) Abstract: A multi-line electrical assembly that includes a multi-line cable (14), including a multiplicity of insulated conductive wires (59); and a multi-line electrical plug (16), physically connected to the cable. The plug has a housing (56) and a plurality of spaced-apart printed circuit boards (PCBs, 48), housed in the housing and having a first end (47) that is connected to the cable and having a second end (46), separated from the first end. Further, the PCBs bear a plurality of conductive traces (50), at least some of the traces being electrically connected to the wires proximal to the first end. The traces terminate proximal to the second end.

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COMPACT MULTI-LINE CONNECTOR

Technical Field

The present invention is in the field of electrical connectors. More specifically it is in the field of high contact density electrical connectors.

Background Art

As biological measurement and monitoring systems become more complex, the desired number of electrical conductive paths into and out of catheters and other patient monitoring devices and equipment, increases. A catheter that includes an array of electrophysiological mapping electrodes, for example, may include multiple electrical signal lines, in order to produce precise imagery of an interior portion of the body. At some point, the catheter must be connected to a further cable, or to a device, thereby necessitating a multi-line or multi-position connector. A few difficulties have limited the number lines that can be accommodated with a connector. First there is the difficulty of constructing a connector with many different connection points, which are typically pins and sockets, for a great many different lines. It appears that typical high contact density electrical connectors have a maximum number of positions between 60 and 80 contacts.

Three more requirements create difficulties. First, there is the need for wiping action, as the connection is made and disengaged. That is, the plug portion of the connector must wipe against the socket portion, in order to wipe away oxidation that forms between instances of use. In the familiar two prong plug used in most American homes and offices, the two prongs slide past the socket contacts while being plugged in, and then while being plugged out. This causes enough oxide to be wiped off so that in almost all cases a robust electrical contact is made. But it also requires somewhat more force than would otherwise be necessary, both in the act of plugging in and plugging out. The second requirement is that the insertion force be low enough so that a person can easily perform these functions. When multiplied many times for a multi-line connector, this force can amount to an insurmountable barrier to use.

The third requirement is that the connector must be able to survive intact from a sterilization cycle through a steam autoclave, ethylene oxide sterilization, gamma sterilization, or other common medical device sterilization procedures. Many materials used in familiar connectors would be destroyed when exposed to such sterilization conditions and atmospheres. All of the materials used must be able to survive intact through sterilization cycles, and the construction best

serves the needs of users if it does not present recesses in which microbial life could survive through the process.

Summary

The following embodiments and aspects thereof are described and illustrated in conjunction with systems, tools and methods which are meant to be exemplary and illustrative, not limiting in scope. In various embodiments, one or more of the above-described problems have been reduced or eliminated, while other embodiments are directed to other improvements.

In a first separate aspect, the present invention may take the form of a multi-line electrical assembly that includes a multi-line cable, including a multiplicity of insulated conductive wires; and a multi-line electrical plug, physically connected to the cable. The plug has a housing and a plurality of spaced-apart printed circuit boards (PCB), housed in the housing and having a first end that is connected to the cable and having a second end, separated from the first end. Further, the PCBs bear a plurality of conductive traces, at least some of the traces being electrically connected to the wires proximal to the first end. The traces terminate proximal to the second end.

In a second separate aspect, the present invention may take the form of an electrical connector assembly that includes a socket having a plurality of socket electrical contacts. Also, a plug, which is advanced in a forward direction in order engage to the socket, and having a forward-most front and a rear, opposed to the front. The plug includes a housing and a set of printed circuit boards, each one having a set of traces terminating in forward-positioned plug electrical contacts, at least some of which are connected to further conductors that exit from the rear of the plug. Finally, the plug electrical contacts and the socket electrical contacts are arranged and configured to slide into contact to one another as the plug is advanced in a forward direction into the socket.

In a third separate aspect, the present invention may take the form of a catheter assembly that includes a catheter having a distal portion adapted to be inserted into a human or animal body and that further includes electrical signal lines and has a proximal portion supporting the distal portion and the electrical signal lines, and that also has a proximal end. An electrical connector plug is fixed to the proximal end and has a housing and at least one printed circuit board (PCB), housed in the housing and that has a first end that is connected to the cable and a second end, separated from the first end. The PCB bears a plurality of conductive traces, at least some of the traces each being electrically connected to one of the electrical signal lines, proximal to the first end, the traces terminating proximal to the second end. Further, the catheter assembly is made entirely of materials that can withstand an autoclave cycle without being damaged.

In addition to the exemplary aspects and embodiments described above, further aspects and embodiments will become apparent by reference to the drawings and by study of the following detailed descriptions.

Brief Description of the Drawings

Exemplary embodiments are illustrated in referenced drawings. It is intended that the embodiments and figures disclosed herein are to be considered illustrative rather than restrictive.

FIG. 1 depicts a catheter assembly connected to a mated connector assembly via electrical signal cables.

FIG. 2A illustrates the unmated plug component of the connector assembly of FIG. 1.

FIG. 2B illustrates an unmated plug component, like that of FIG. 2A, but mounted into a panel.

FIG. 3 shows the inner lattice of the unmated receptacle component of the connector assembly of FIG. 1.

FIG. 4 is a cross-section of the mated connector assembly of FIG. 1.

FIG. 5 is a cross-section of unmated traces and leaf springs of connector assembly of FIG. 4.

FIG. 6 is a cross-section of mated traces and leaf springs of the connector assembly of FIG. 4

FIG. 7 depicts the plug component of an unmated connector assembly having a protruding element and sockets in place of several stacks of printed circuit boards.

FIG. 8 depicts the receptacle of the unmated connector assembly of FIG. 7 having a protruding sleeve to accept a protruding element.

FIG. 9 is a cross-section of the mated connector assembly of FIGS. 7 and 8.

FIG. 10 depicts a plug component of an unmated connector assembly having stacks of identically-sized printed circuit boards.

FIG. 11 shows the receptacle of the unmated connector assembly of FIG. 10 having a lattice structured to accept the printed circuit boards of the plug component of FIG. 10.

Best Modes of Carrying Out the Invention

For the purpose of promoting an understanding of the principles of the invention, reference will now be made to the embodiments illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended. Any alterations and further modifications in the described

embodiments, and any further applications of the principles of the invention as described herein are contemplated as would normally occur to one skilled in the art to which the invention relates.

Referring to FIG. 1, in a preferred embodiment a catheter assembly 10 according to the present invention, includes a catheter 12 having a handle 13, a distal electrical signal cable 14 terminating in a plug 16 that is part of a connector assembly 18, which further includes a socket 20, and finally a proximal electrical signal cable 22. In an alternative preferred embodiment (not shown), socket 20 is mounted on the panel of a device for driving catheter 12 receiving and processing and/or displaying signals generated in catheter 12. In a further alternative embodiment cable 14 terminates in socket 20, which connects to plug 16, either leading into proximal cable 22 or as modified plug 16', being mounted on the panel of a device FIG. 2B). In one preferred embodiment catheter 12 includes an electrophysiological mapping array having over 100 imaging elements. In the embodiment shown catheter 12 includes an electrophysiological mapping head 23, but many other embodiments of catheters exist, for other medical purposes, as many catheter applications exist that can benefit from a large number of signal lines.

Referring to FIGS. 2A, 3 and 4, in one preferred embodiment a connector assembly 18, includes a plug 16 and a socket 20. The plug 16 has a front end 46 and a back end 47, thereby defining a forward direction from back end 47 to front end 46. Further, plug 16 includes a plurality of printed circuit boards (PCBs) 48, each of which include a multiplicity of conductive traces 50 generally extending from back to front of each PCB 48. A stack 52 of PCBs 48 is held together by spacing elements 54, and is press fit into a plug housing 56. The back side of traces 50 are each generally connected by solder 58 to some conductor of cable 22. In some embodiments, some traces 50 will be left unused, whereas in other embodiments all traces 50 will be connected to a conductor of cable 22. Conductors 59 of cable 14 may include center conductors and shields of coaxial cables, wires, and shields (that are not part of a coaxial cable). These solder connections are potted after stack 52 is press fit into housing 56, with housing 56 and spacing elements 54 helping to hold the liquid potting material in place as it cures, to create a layer of cured potting material 60. Crimping and welding may alternatively be used for these connections. In one embodiment, a housing, otherwise like housing 56, forms a portion of a catheter handle, otherwise like handle 13.

In a preferred embodiment, defining the top to coincide with the orientation of FIGS. 2A, 3 and 4, the top and bottom PCBs 48 are more narrow than the middle PCBs, so that stack 52 is roughly circular in cross-section, thereby matching the circular interior of plug housing 56. FIG. 2B shows a plug 16' similar to plug 16 of FIG. 2A, but forming a part of a panel of a device, such as a signal processing and display assembly. In this embodiment, it is cable 14, from the medical device, that terminates in a socket, that attaches to plug 16'. In an alternative embodiment, a socket similar

to socket 20 is mounted in the panel of a signal processing and display device, and cable 14 terminates in plug 16, which mates with this socket.

A socket 20 generally includes a leaf spring contact 62 for each trace 50 of plug 16. As plug 16 and socket 20 are moved together, each leaf spring 62 slides over a trace 50, to form an electrical connection. The wiping action of this contact removes oxide that might otherwise prevent the formation of a robust electrical connection. Leaf springs are formed of a beryllium copper alloy that is formed in sheets, die cut and bent, to form a series of individual leaf springs 62, which are then threaded through vias 61 formed through conductive traces 63 on flex circuits 64. The leaf springs 62 are press fit into a receptacle housing 66, that includes a front protective lattice 68, that permits entrance of PCBs 48, while generally protecting leaf springs from unintended contact from outside elements when the socket 20 is free of the plug 16. Wires 70 are soldered to a grid of contacts. Both housing 56 and housing 66 may be made of a broad range of materials, including polymeric materials and metals. In an alternative preferred embodiment (not shown) either the socket or the plug is connected to a wireless transceiver, for sending signals from a sensor suite to a wireless receiver.

Referring to FIGS. 5 and 6, both sides of each PCB 48 support traces 50, with top traces 50A and bottom traces 50B being interleaved, with a bottom trace 50B, as shown in FIGS. 5 and 6 being slightly displaced in the dimension orthogonal to the section plane shown, so that it does not appear in cross-section as does top trace 50A. Likewise, bottom leaf spring 62B, which contacts conductive trace 50B is shown as being displaced from the section plane, and partially obscured by lattice 68. As part of assembly a plug strain relief housing 72 and a receptacle strain relief housing 74 are molded onto plug housing 56 and leaf spring holder 66, respectively. Housing 72 and 74 prevent forces applied to cable 14 or cable 22 from causing wires 59 from pulling on PCBs 48 or wires 70 from pulling on flex circuits 64 and potentially damaging or breaking the solder joints.

Socket 20 further includes a freely rotatable locking ring 80 that has three evenly spaced, inwardly facing channels 82 each of which accepts a rectangular post 84 on plug 16. Channels 82 each include a helical portion so that as ring 80 is rotated counter-clockwise (facing the front of socket 20) plug 16 and socket 20 are drawn together. This provides mechanical advantage to overcome the insertion force, thereby permitting a human user to electrically connect plug 16 and socket 20, without having to apply a degree of force that might strain some users. In a preferred embodiment, the insertion force is less than 3 lbs, and in a more specific preferred embodiment it is less than 1.5 lbs, including the mechanical advantage provided by the locking ring. An O-ring 86 positioned on the plug 16 seals the joined connector to an IP67 level of protection. In a preferred embodiment, socket 20 includes a return spring (not shown), which moves the locking ring 80 to an

unlocked position, ready to be locked onto posts 84, when socket 20 is not in use. In an additional alternative embodiment, a plug, otherwise like plug 16, is equipped with a locking ring, similar to ring 80, and a socket, otherwise like socket 20 includes mating posts 84. Visual alignment guides may be included, such as the triangles shown in the drawings, to inform the user of when the plug 16 and socket 20 are aligned so as to be mated together. Also, a visual guide may be provided on the lock ring 80, to inform the user of when the lock ring is in a rotational position to mate for channels 82 to mate with posts 84. In another alternative, there is no lock ring. In this alternative, the plug and socket may have any transverse shape. Various devices for gaining mechanical advantage may be used, or no device for gaining mechanical advantage may be used.

Referring to FIGS 7-9, in a second preferred connector embodiment 118, the PCB 48 portion of plug 16 and mating portion of socket 20 are the same as for connector 18, except for that the bottom two (and top one) PCBs are missing and replaced by a subassembly 112 adapted to permit the connection of conductive lines 114 specially adapted to protect very delicate signals that must be shielded against magnetic fields having frequency of less than 150,000 Hz (including a constant magnetic field). Signals of this delicate nature may originate from a catheter designed to detect electrostatic emissions of the heart from inside a heart chamber, for cardiac mapping. Such signals could easily be corrupted by being placed on the traces of the PCBs 48, either from larger signals on neighboring traces or from a signal from outside connector 18. Accordingly these signal lines are terminated in a set of sockets 116 defined in a protruding element 120, that mates into a protruding sleeve 122, electromagnetically shielding a set of pins 124 that mate into sockets in a standard manner. Sleeve 122 includes a layer of material having a relative permeability of greater than 1,000, such as a mu-metal, as well as other shielding to prevent corruption from higher frequency signals. In an alternative preferred embodiment, the entire plug and socket assemblies are covered with a material having a relative permeability of greater than 1,000.

Referring to FIGS. 10 and 11, a third preferred connector embodiment 218 is just the same as the first connector 18 except for that the PCBs 48' used in connector 218 are all the same size. The leaf spring contacts and the lattice 68' are arranged to matingly engage with plug 16. By using PCBs that are mutually identical, manufacturing costs are reduced.

In preferred embodiments all of the materials of catheter assembly 10 and, if considered separately, plug 14, are made of materials that can withstand an autoclave cycle and other methods of sterilization, such as low-temperature, hydrogen peroxide gas plasma sterilization (marketed under the trademark STERRAD®), dry heat sterilization, gamma radiation sterilization and Ethylene Oxide sterilization. For example, the use of industry designation FR-4 material, or some other fiberglass for PCBs 48 or 48'. In a preferred embodiment connector 18 has an outer diameter

of 35 mm and includes over 200 electrical connections. Embodiment 218 has an outer diameter of 50 and includes over 250 electrical connections. In addition to the card edge connectors, other types of connectors may be included in a connector, according to the present invention, to connect a broad range of signal types. Further, a connector, in accordance with the present invention, may be constructed to permit the passage of a fluid, such as air or a liquid, light, further electrical connectors or a wireless signal, may also be passed between plug and socket in either direction.

Industrial Applicability

The present invention finds industrial applicability in the manufacture and supply of electrical connectors. Some embodiments find industrial applicability in the supply of medical equipment and parts for medical equipment.

While a number of exemplary aspects and embodiments have been discussed above, those possessed of skill in the art will recognize certain modifications, permutations, additions and sub-combinations thereof. It is therefore intended that the following appended claims and claims hereafter introduced are interpreted to include all such modifications, permutations, additions and sub-combinations as are within their true spirit and scope.

Claims

1. A multi-line electrical assembly, comprising:
   (a) a multi-line cable, including a multiplicity of insulated conductive wires; and
   (b) a multi-line electrical plug, physically connected to said cable and including:
      (i) a housing;
      (ii) a plurality of spaced-apart printed circuit boards (PCB), housed in said housing and having a first end that is connected to said cable and having a second end, separated from said first end, said PCBs bearing a plurality of conductive traces, at least some of said traces being electrically connected to said wires proximal to said first end, said traces terminating proximal to said second end.
2. The assembly of claim 1, wherein said second end of said PCBs is opposed to said first end of said PCBs.
3. The assembly of claim 1, wherein at least some of said wires are shielded by a shield, and wherein at least some of said shields are connected to one of said traces.
4. The assembly of claim 3, wherein at least one of said shielded wires is a center conductor of a coaxial cable.
5. The assembly of claim 1, wherein said housing is round in transverse dimension.
6. The assembly of claim 1, further being a catheter assembly, and including a catheter at an end of said electrical cable opposed to said plug, said catheter including sensing elements that generate signals on said wires of said cable.
7. The assembly of claim 1, wherein said plug is a panel-mounted plug.
8. The assembly of claim 6, wherein said catheter assembly includes an electrophysiological mapping electrode array.
9. The assembly of claim 1, wherein said assembly can withstand an autoclave cycle, hydrogen peroxide gas plasma sterilization, dry heat sterilization, gamma radiation sterilization and ethylene oxide sterilization.
10. The assembly of claim 1, wherein said PCBs are separated and held in place by a set of spacers.
11. The assembly of claim 10, wherein said wires are soldered to said traces at soldering joints, and wherein said soldering joints are covered by a layer of potting material that contacts said spacers.
12. The assembly of claim 1, wherein said PCBs are all identical, and are arranged in rows, with some rows having two identical PCBs, but having two outermost rows, each having a single PCB only.
13. The assembly of claim 1, wherein said PCBs are arranged in a stack, and wherein the outermost PCBs in said stack are more narrow than the innermost PCBs in said stack.

14. An electrical connector assembly, comprising:
    (a) a socket having a transversely round housing and a plurality of socket electrical contacts;
    (b) a plug, wherein said plug is advanced in a forward direction in order engage to said socket, and having a forward-most front and a rear, opposed to said front, said plug including;
        (i) a housing, being round, transversely to said forward direction, in its forward most part;
        (ii) a set of printed circuit boards, each one having a set of traces terminating in forward-positioned plug electrical contacts, at least some of which are connected to further conductors that exit from said rear of said plug; and
    (c) said plug electrical contacts and said socket electrical contacts being arranged and configured to slide into contact with one another as said plug is advanced in a forward direction into said socket.
15. The assembly of claim 14, wherein said socket electrical contacts are leaf spring contacts.
16. The assembly of claim 14, wherein said plug and said socket are engaged by way of a lock ring, having a first half that defines a set of helical grooves and a second half that defines a set of tabs sized, shaped and spaced apart to fit into said set of helical grooves, so that when said first half and second half are rotated relative to each other, said tabs are drawn pushed along said helical grooves, causing said plug and socket to be drawn together, so that said plug electrical contacts connect to said socket electrical contacts.
17. The assembly of claim 16, wherein said tabs are keyed to said grooves, to prevent incorrect relative positioning of plug and socket.
18. A catheter assembly, comprising:
    (a) a catheter having a distal portion adapted to be inserted into a human or animal body and including electrical signal lines and having a proximal portion supporting said distal portion and said electrical signal lines, and having a proximal end; and
    (b) an electrical connector plug fixed to said proximal end and having:
        (i) a housing;
        (ii) at least one printed circuit board (PCB), housed in said housing and having a first end that is connected to said cable and having a second end, separated from said first end, said PCB bearing a plurality of conductive traces, at least some of said traces each being electrically connected to one of said electrical signal lines. proximal to said first end, said traces terminating proximal to said second end
    (c) wherein said catheter assembly is made entirely of materials that can withstand an autoclave cycle without being damaged.

19. The catheter assembly of claim 18, wherein said catheter includes electrostatic mapping electrodes.
20. The catheter assembly of claim 18, wherein said electrical connector plug, further includes a portion wherein some of said signal lines are protected against low frequency magnetic fields, by shielding of a material having relative permeability of greater than 1,000.
21. The catheter assembly of claim 18, wherein said catheter includes an ultrasound array having at least 64 elements.
22. The catheter assembly of claim 18, wherein said catheter includes an ultrasound array having at least 128 elements.
23. The catheter assembly of claim 18, wherein said housing forms a portion of a handle of said catheter.

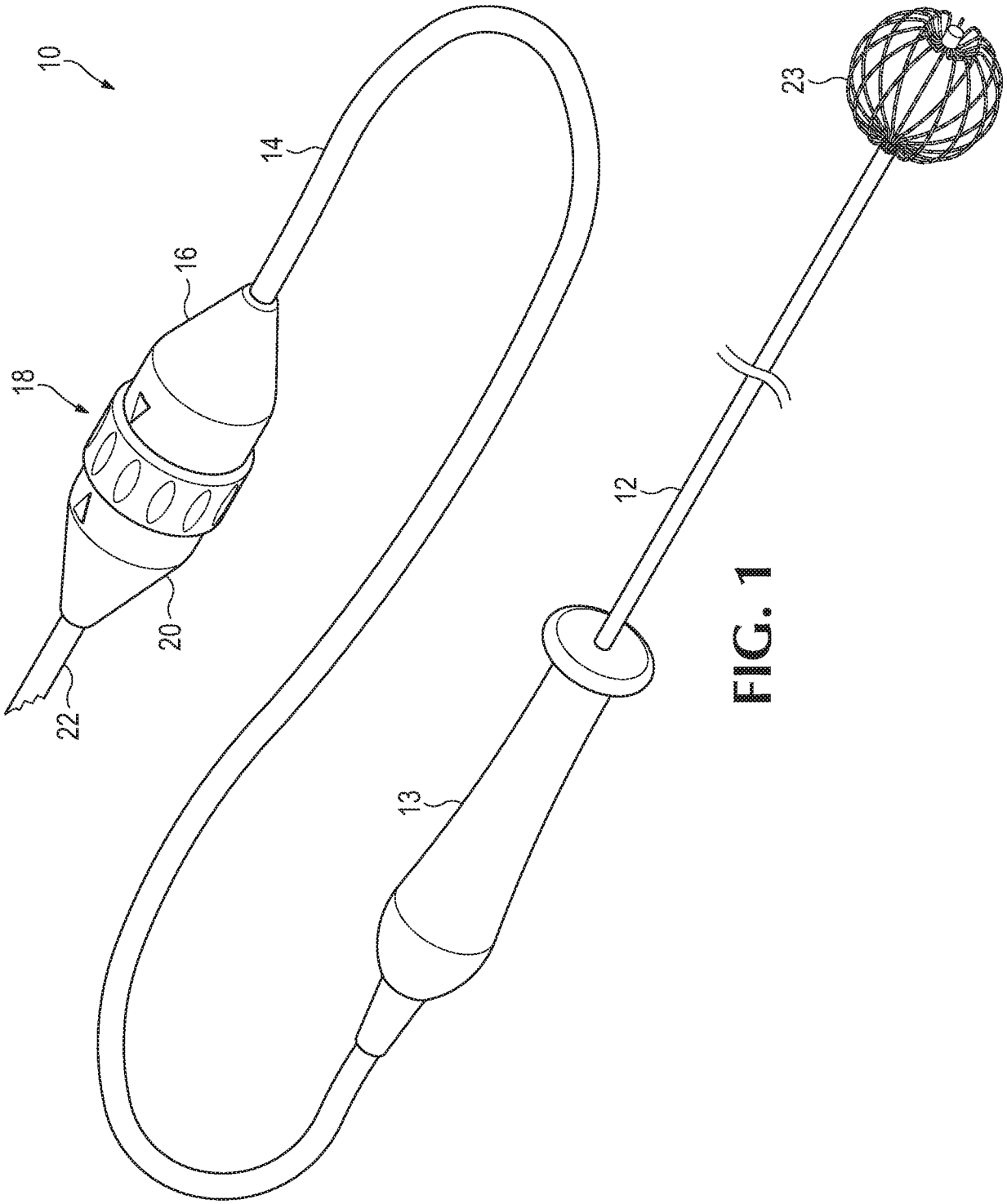


FIG. 1

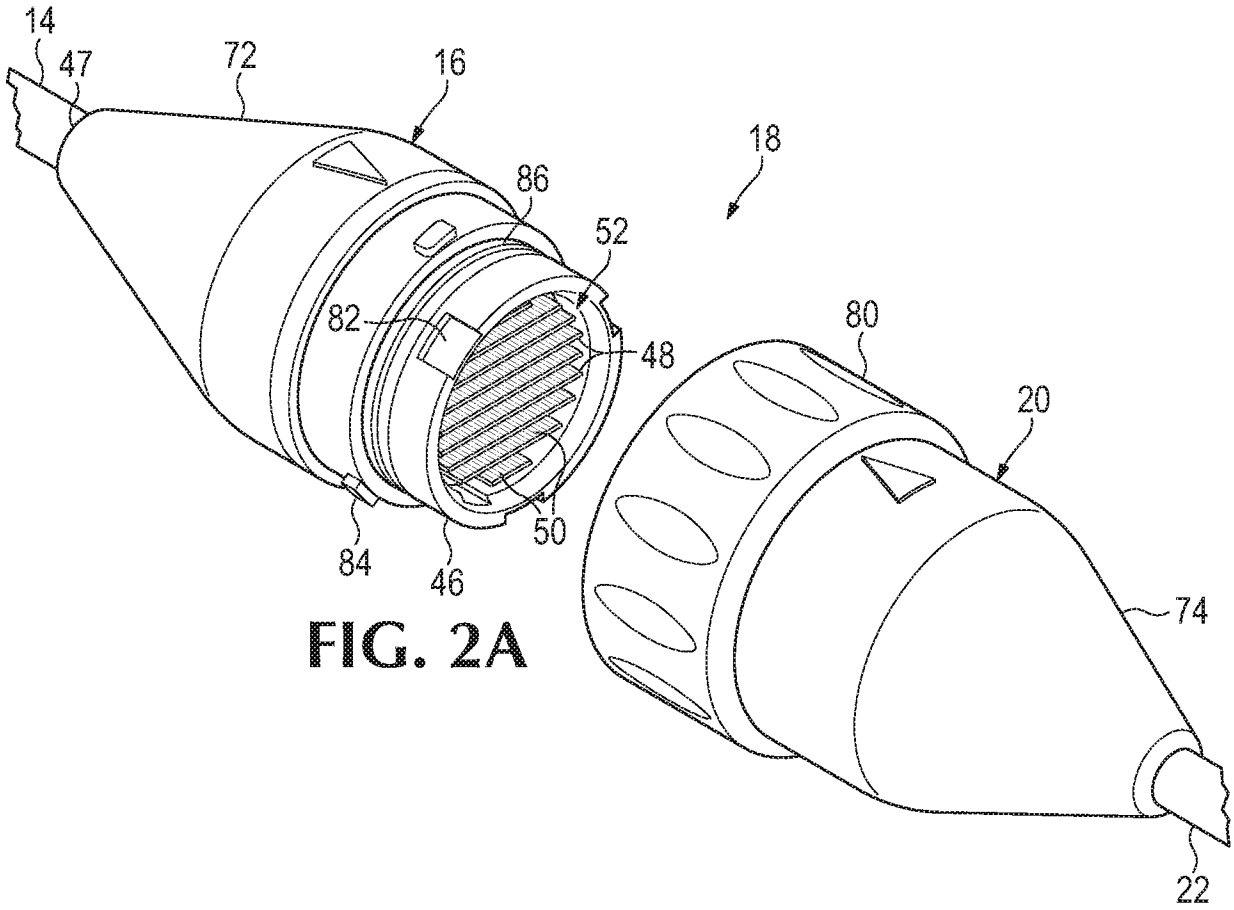


FIG. 2A

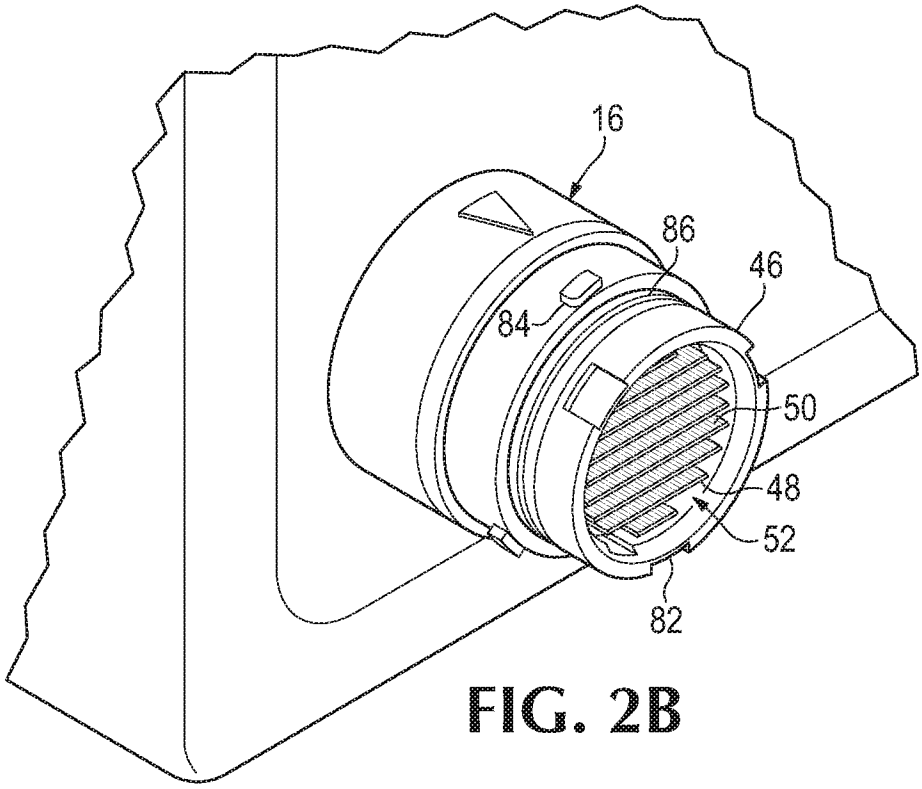


FIG. 2B

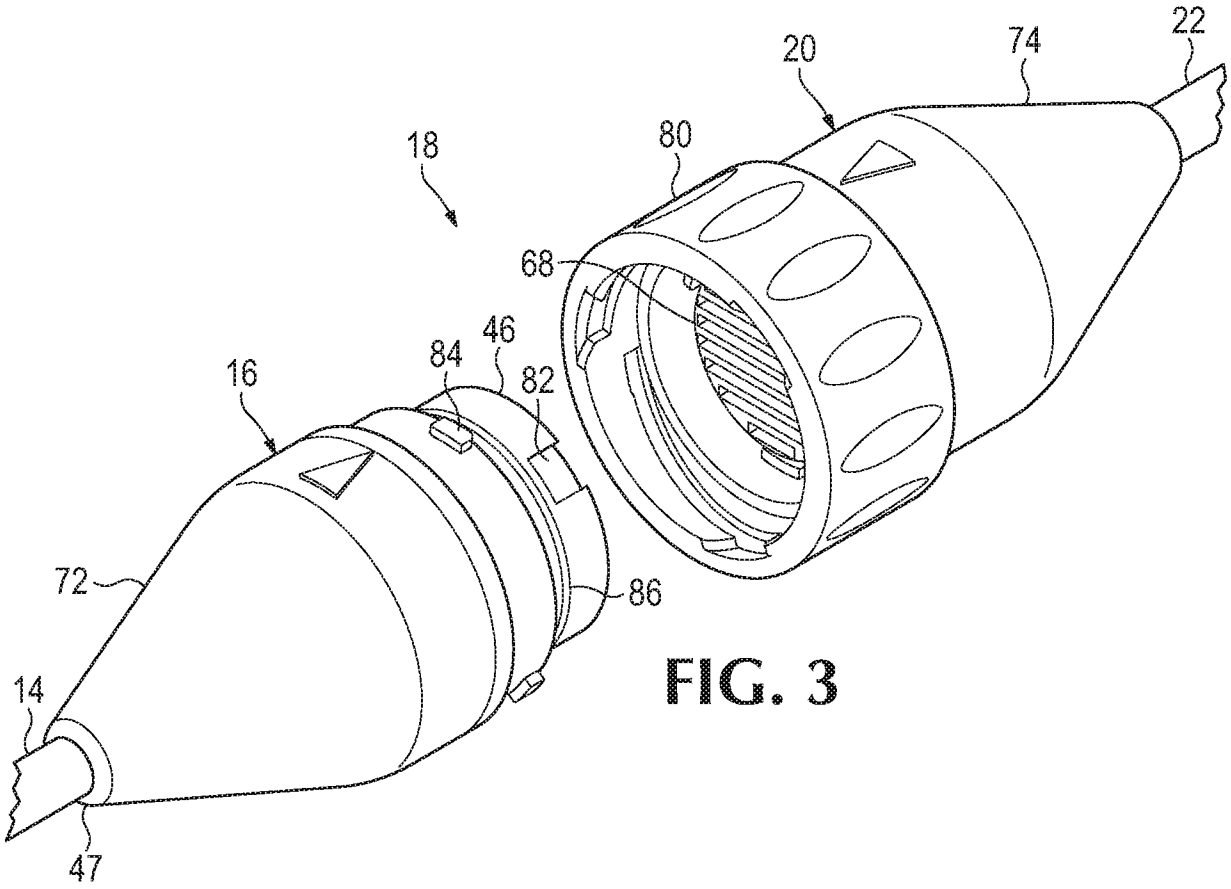


FIG. 3

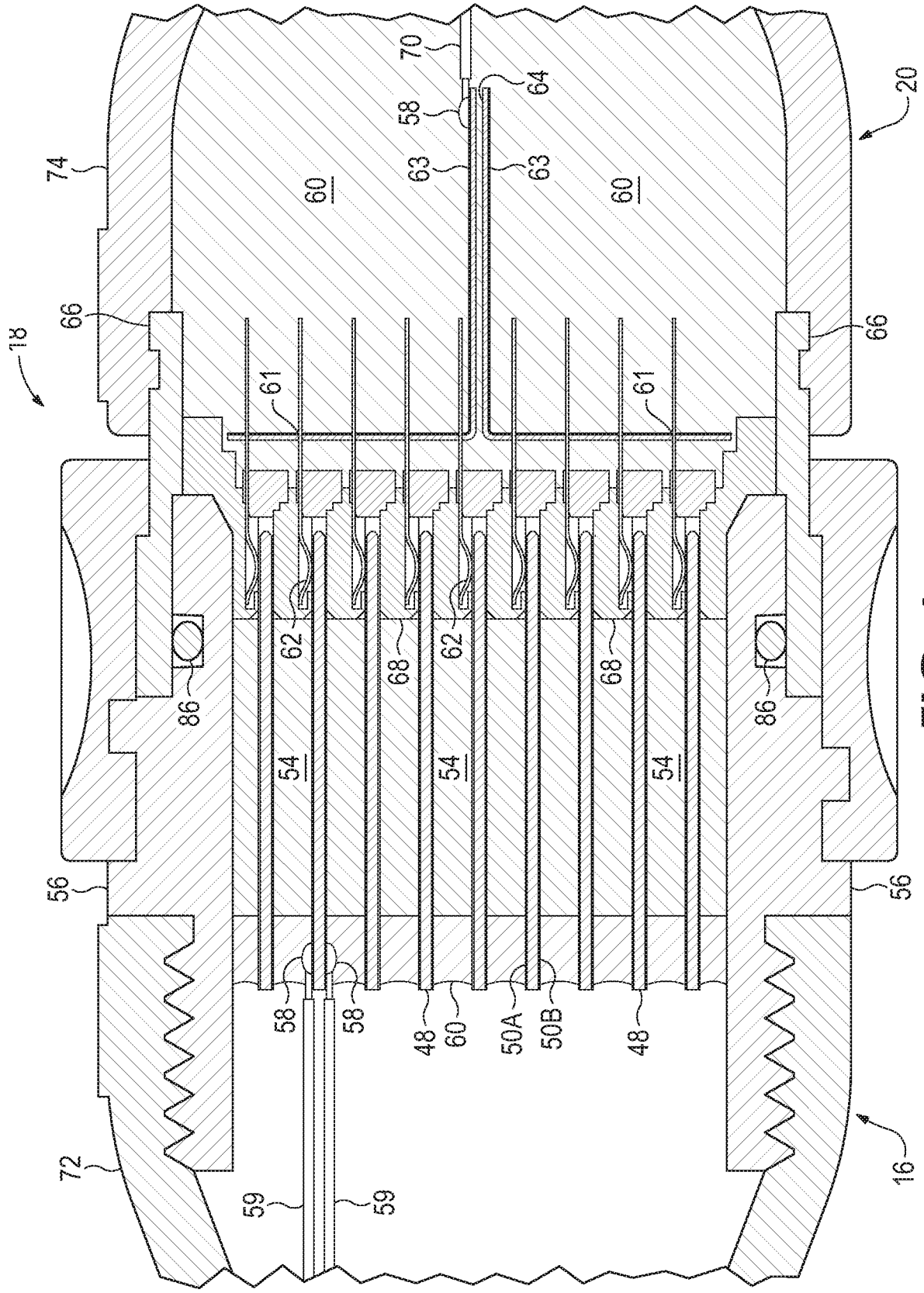

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FIG. 4

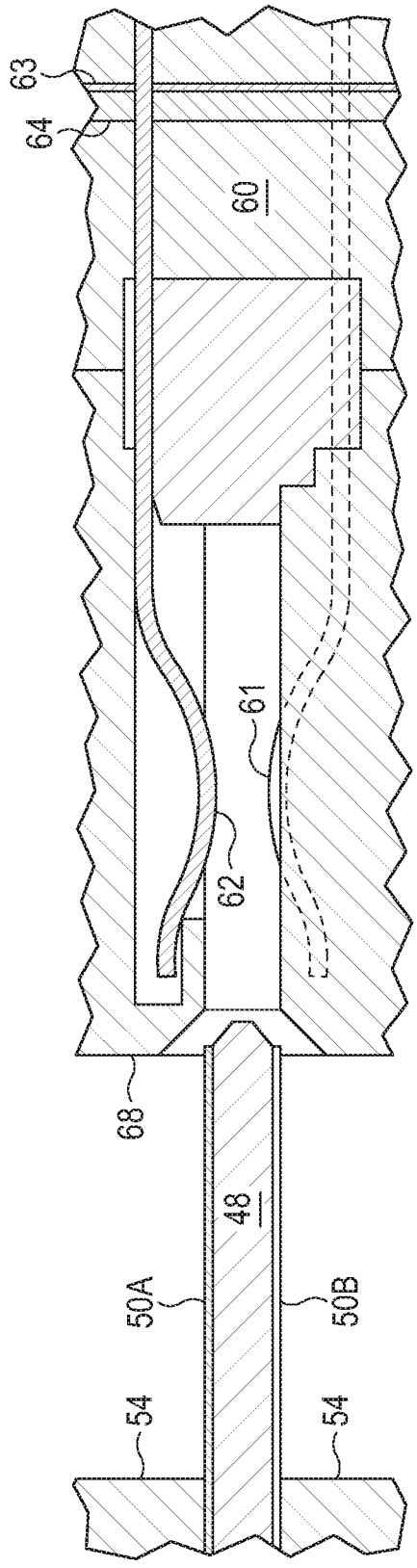


FIG. 5

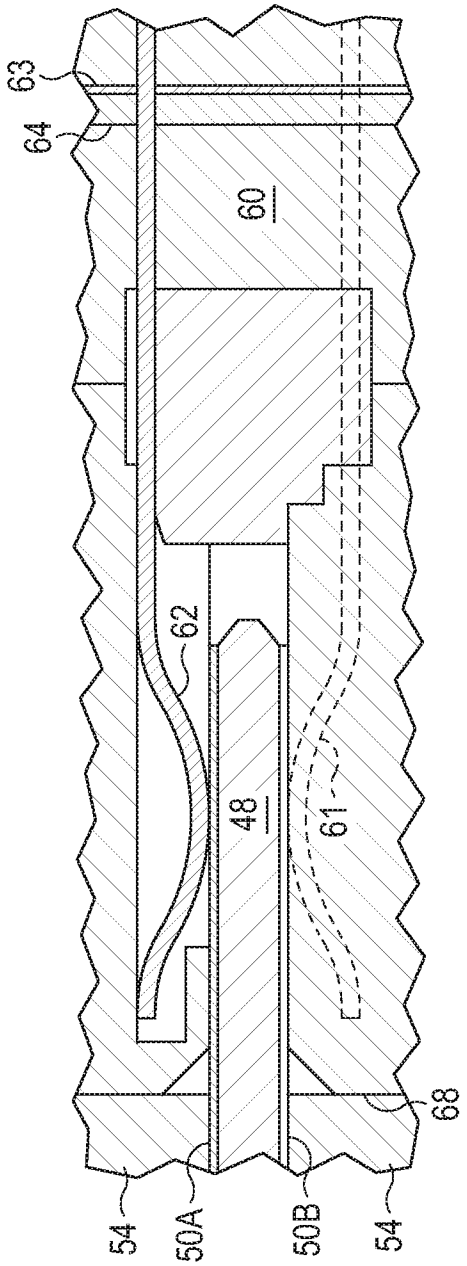


FIG. 6

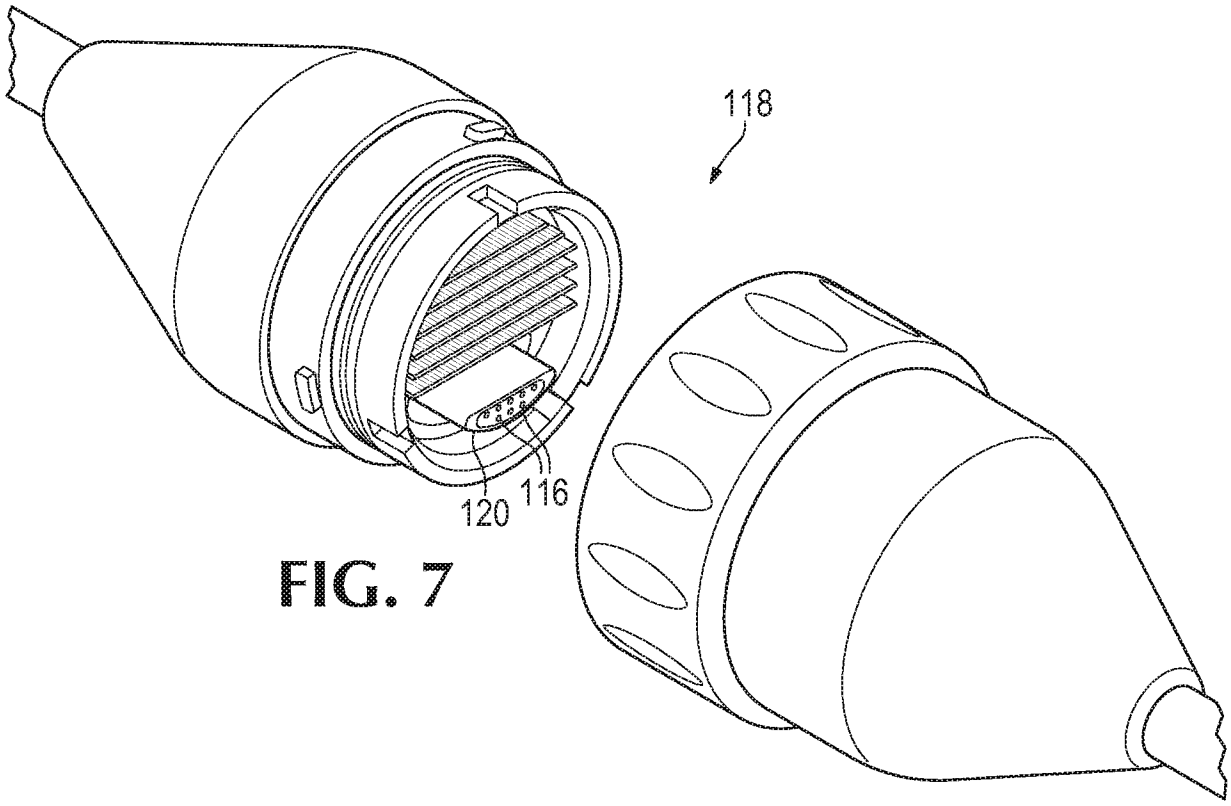


FIG. 7

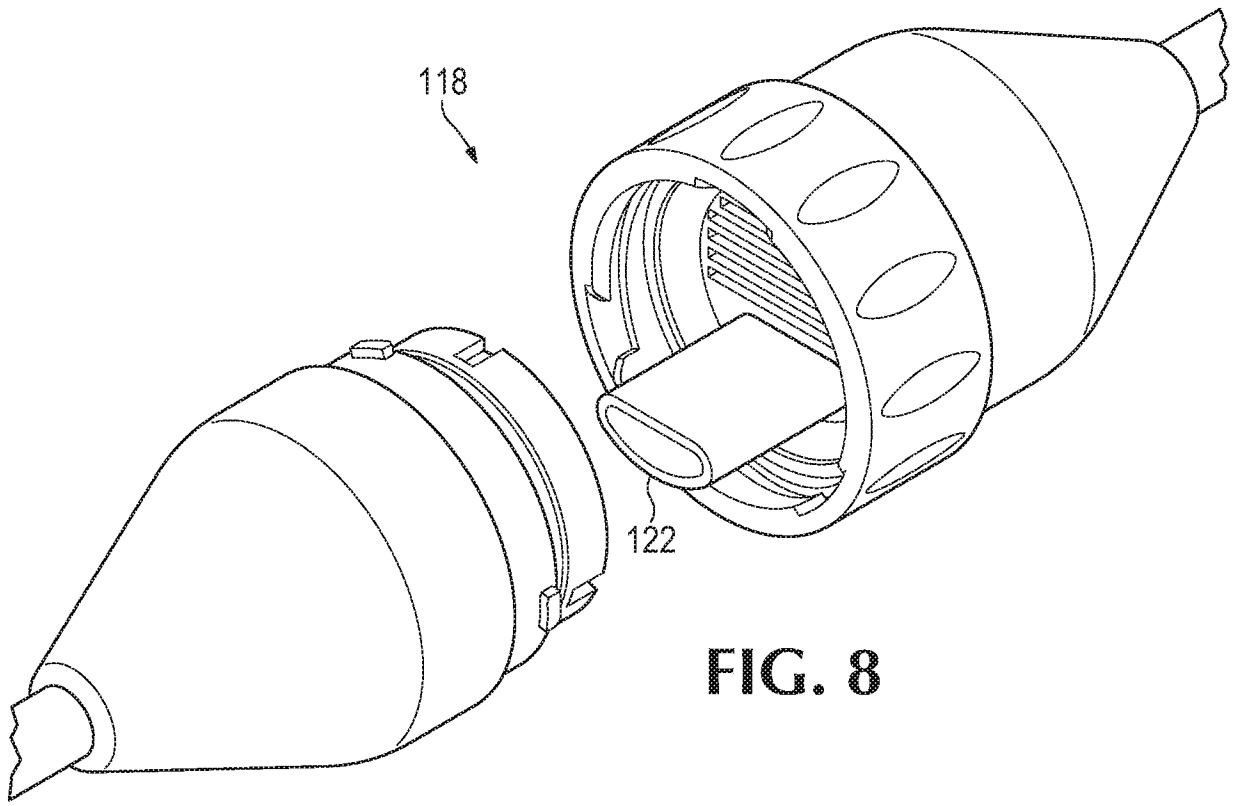


FIG. 8

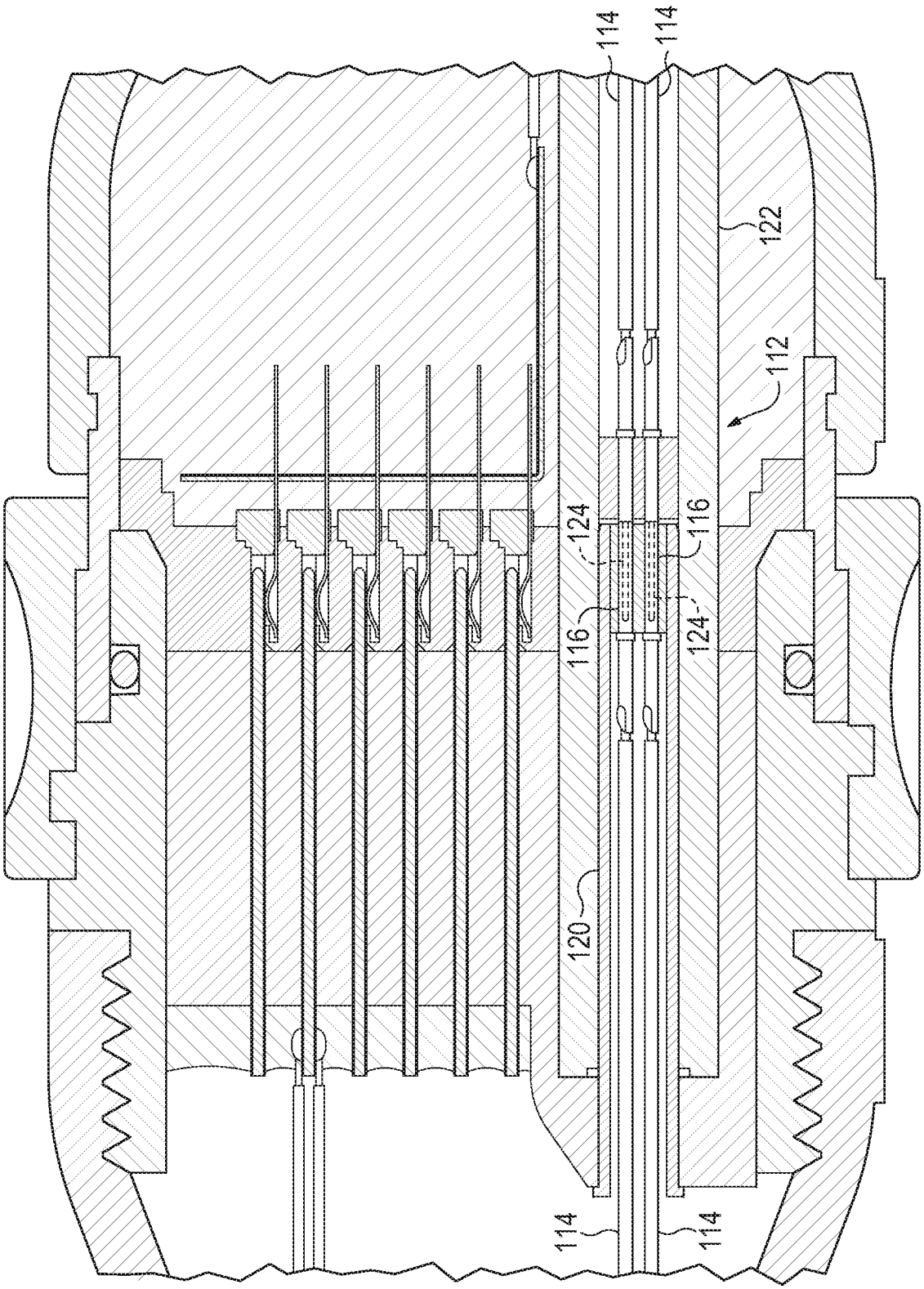


FIG. 9

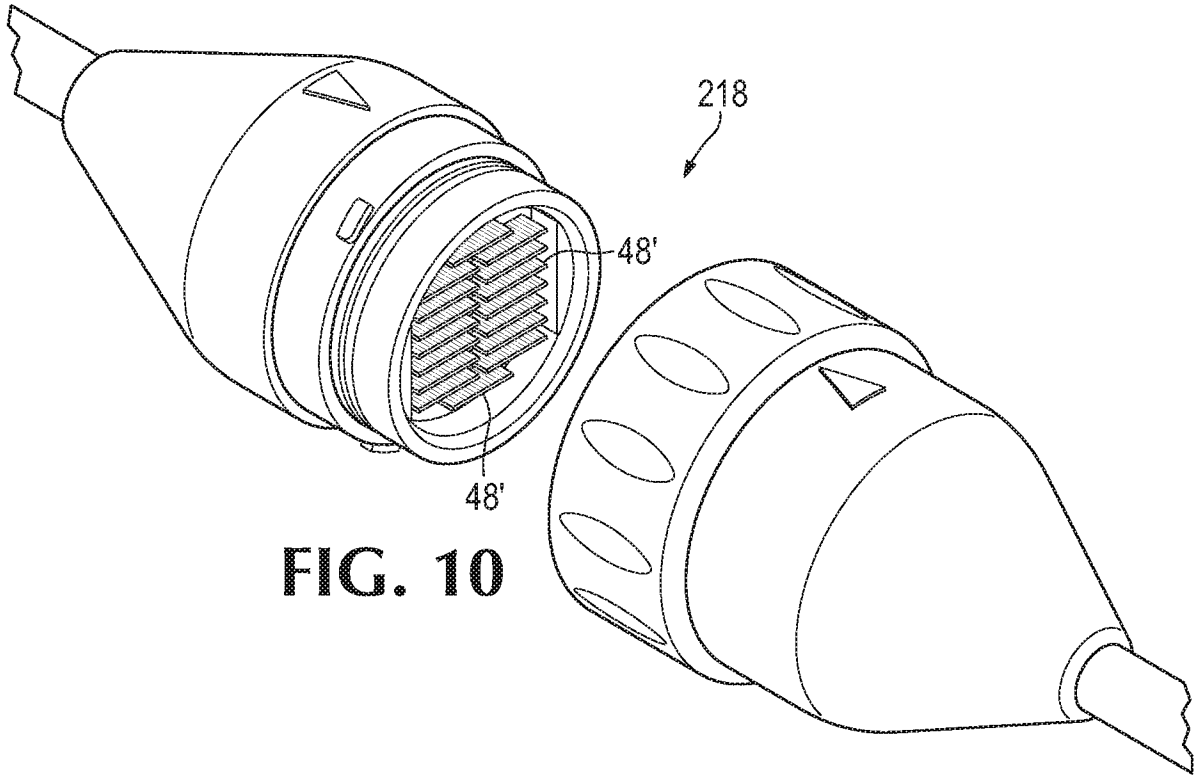


FIG. 10

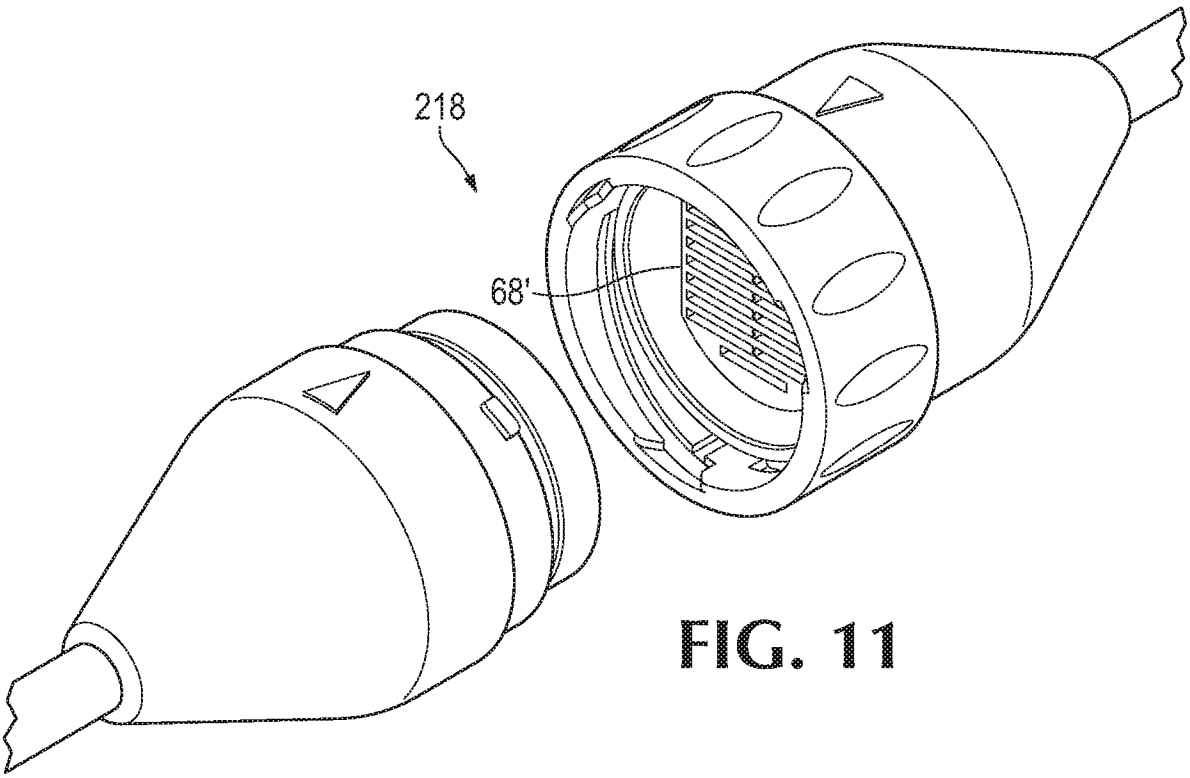


FIG. 11

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2017/020268

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01R24/60
ADD. H01R13/625 H01R12/72 A61B5/00 H01R12/53

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 A61B

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.
X	WO 2010/011753 A1 (MOLEX INC [US]; CASHER PATRICK R [US]; REGNIER KENT E [US]) 28 January 2010 (2010-01-28)	1-4,9-13
Y	paragraph [0044]; figures 2,3,5A	5,7

Y	WO 2016/022678 A1 (MOLEX INC [US]) 11 February 2016 (2016-02-11) figures 2,3,3A,4,4A	5,7

A	US 2013/296729 A1 (DATTA KESHAVA [US]) 7 November 2013 (2013-11-07) the whole document	6,8

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 May 2017	15/09/2017

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	Esmiol, Marc-Olivier

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2017/020268

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

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

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

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-13

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2017/020268

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2010011753 A1	28-01-2010	CN 102160245 A	17-08-2011
		TW M377827 U	01-04-2010
		US 2011100694 A1	05-05-2011
		US 2014065856 A1	06-03-2014
		WO 2010011753 A1	28-01-2010
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		US 2016043509 A1	11-02-2016
		WO 2016022678 A1	11-02-2016
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		CA 2871939 A1	07-11-2013
		CN 104755038 A	01-07-2015
		EP 2844176 A1	11-03-2015
		JP 2015518411 A	02-07-2015
		US 2013296729 A1	07-11-2013
		US 2016374756 A1	29-12-2016
		WO 2013166397 A1	07-11-2013

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-13

   Multi-line electrical assembly comprising a cable, a plug and PCBs

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2. claims: 14-23

   Assemblies having a plug
