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(54) **MEDICAL DEVICE ASSEMBLY HAVING FREEDOM OF ROTATION**

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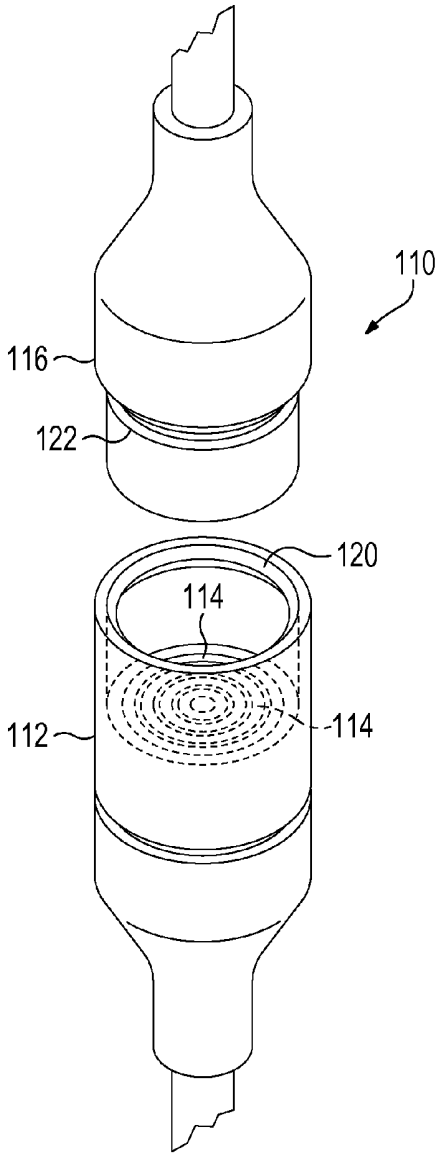
(52) **U.S. Cl.** **600/585**; 439/18; 606/41; 604/22; 606/45

(57) **ABSTRACT**

A method of performing a surgical procedure using an electrical surgical device, which utilizes an electrical surgical assembly including the surgical device connected to a base station by a cable having a plurality of mutually electrically insulated conductors, and an electrical adapter interposed at a point between the base station and the device. The adapter is comprised of a first half and a second half that have freedom of rotation relative to each other. The first half is equipped with a first connector-half and the second half is equipped with a second connector-half. While the surgical procedure is performed, the adapter permits relative rotation between the first half and the second half, thereby avoiding a problem of cable twisting.



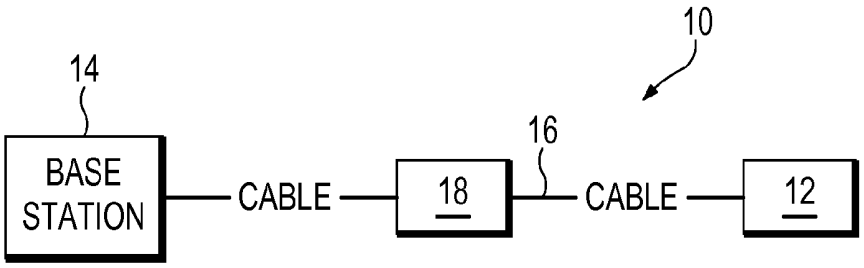


FIG.1

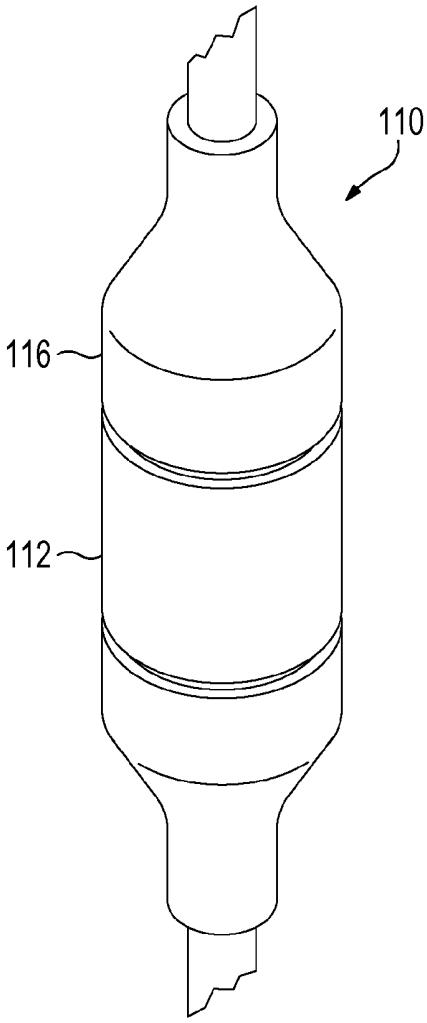


FIG.2A

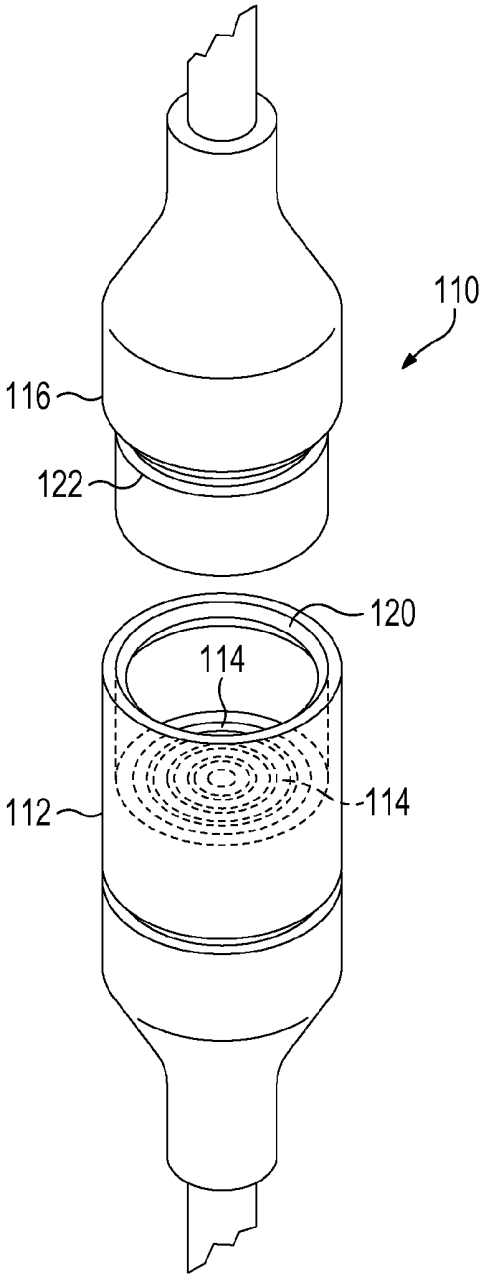


FIG.2B

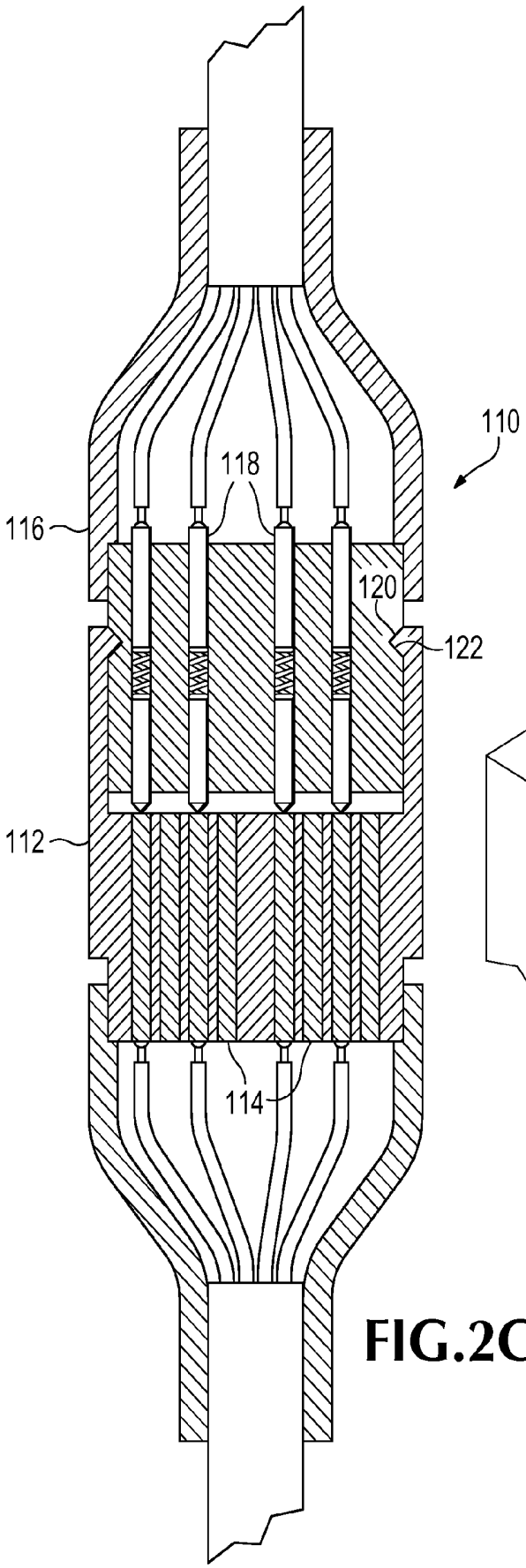


FIG.2C

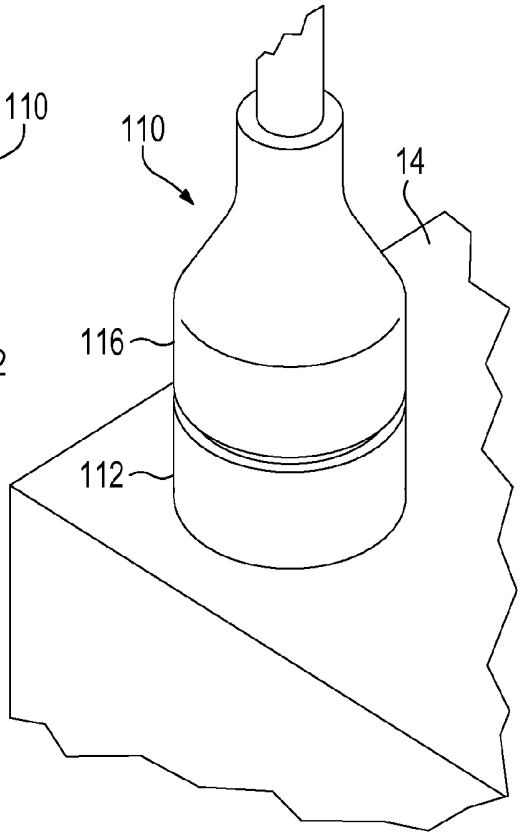


FIG.2D

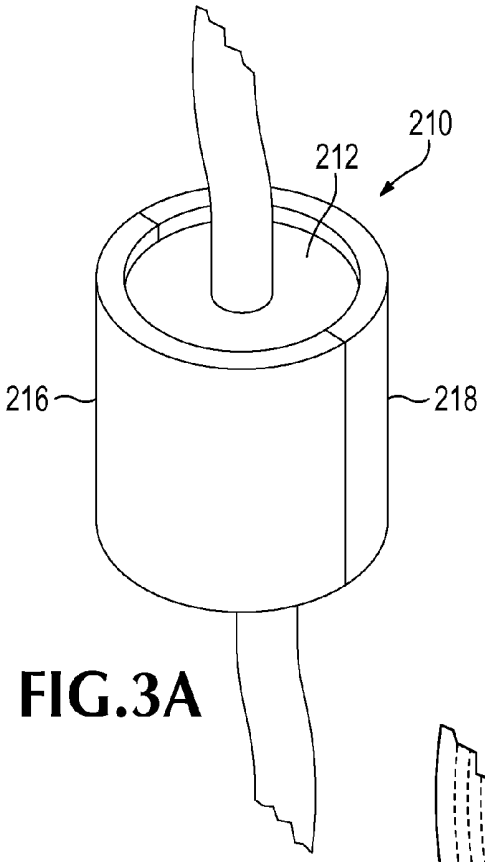


FIG.3A

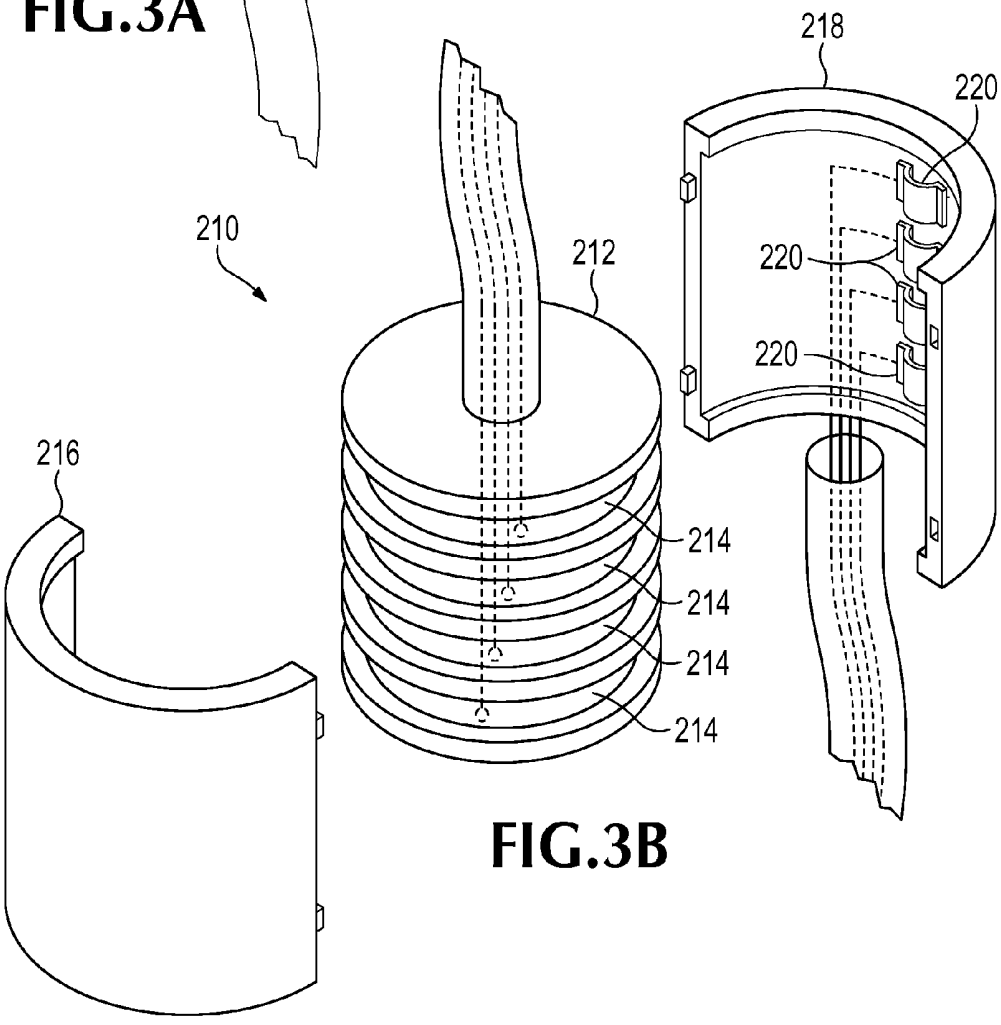


FIG.3B

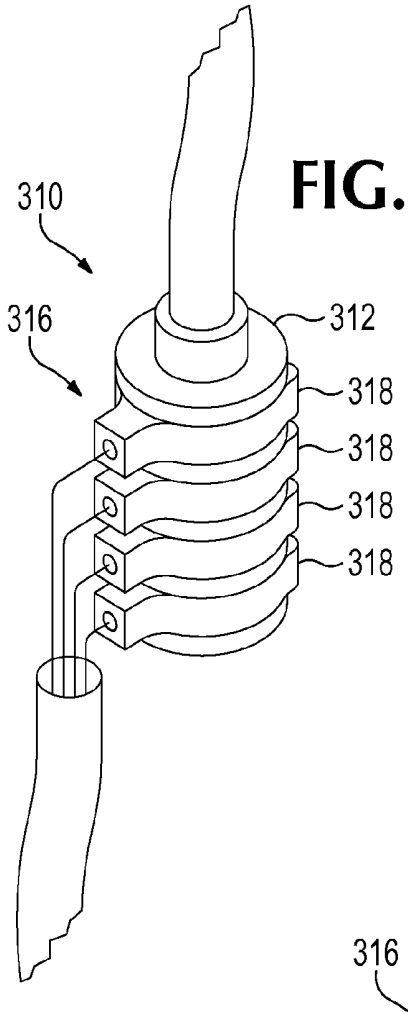


FIG.4A

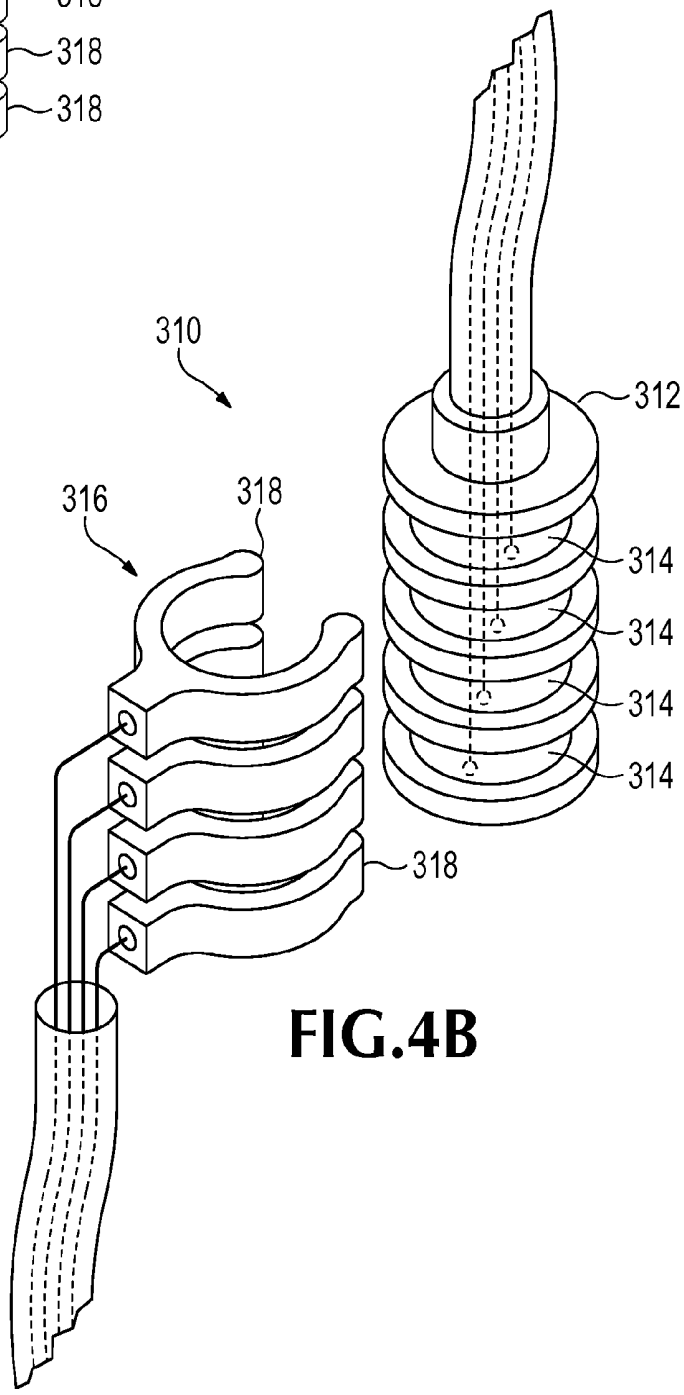


FIG.4B

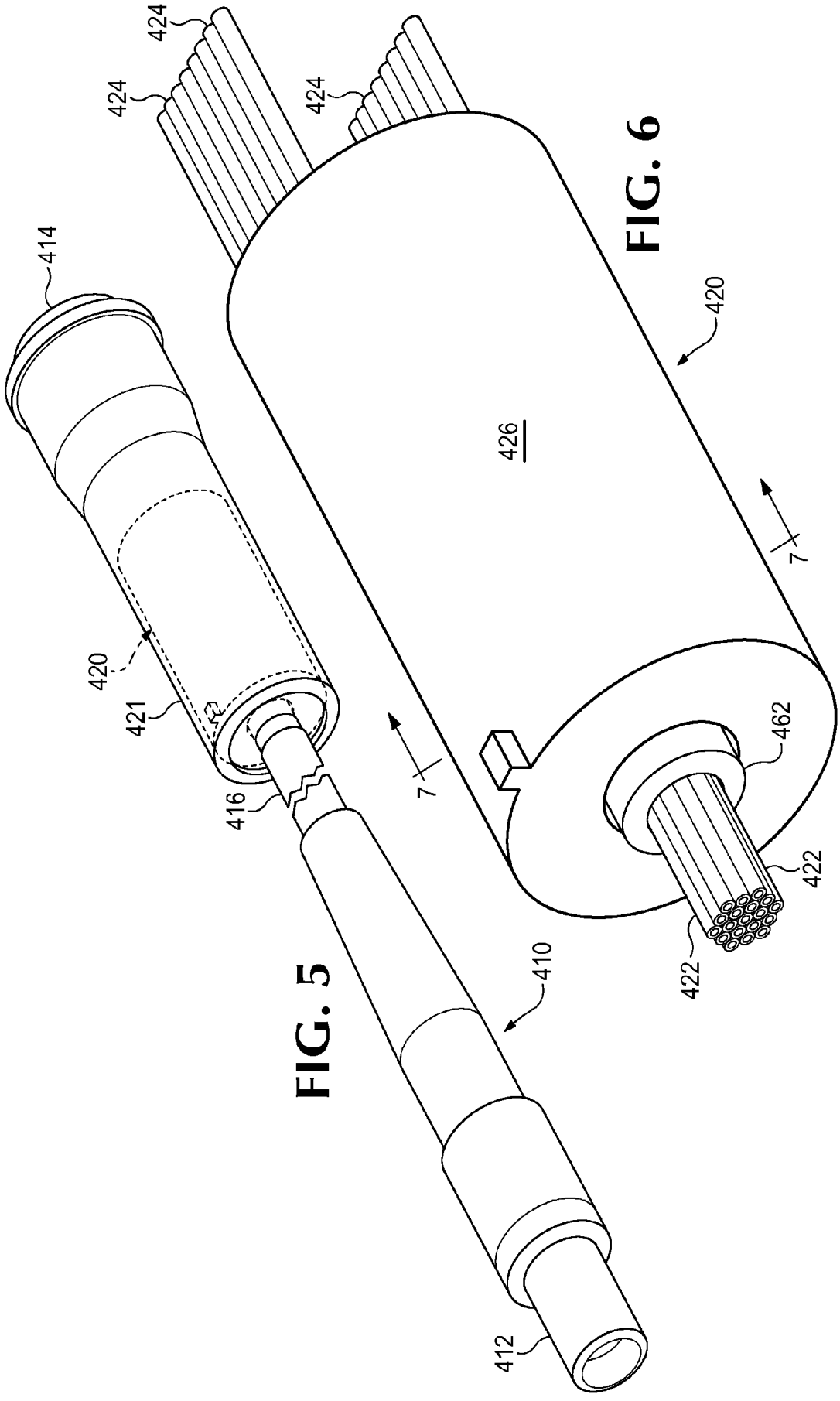


FIG. 6

FIG. 5

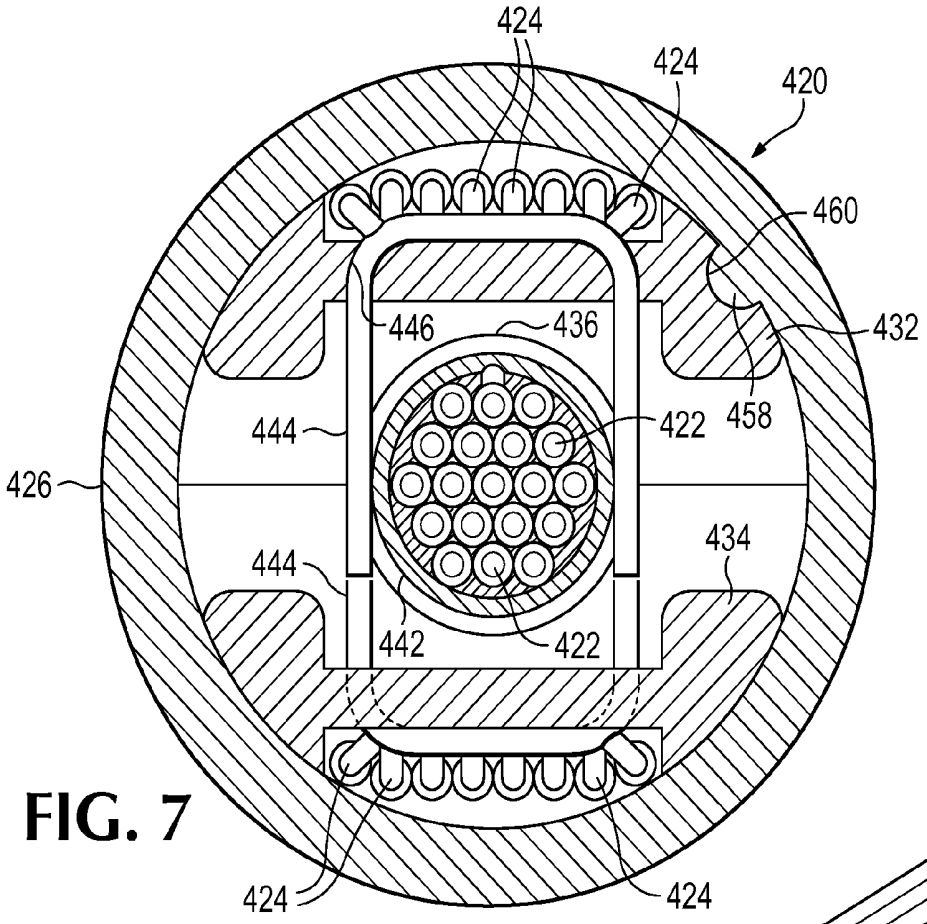

424
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FIG. 7

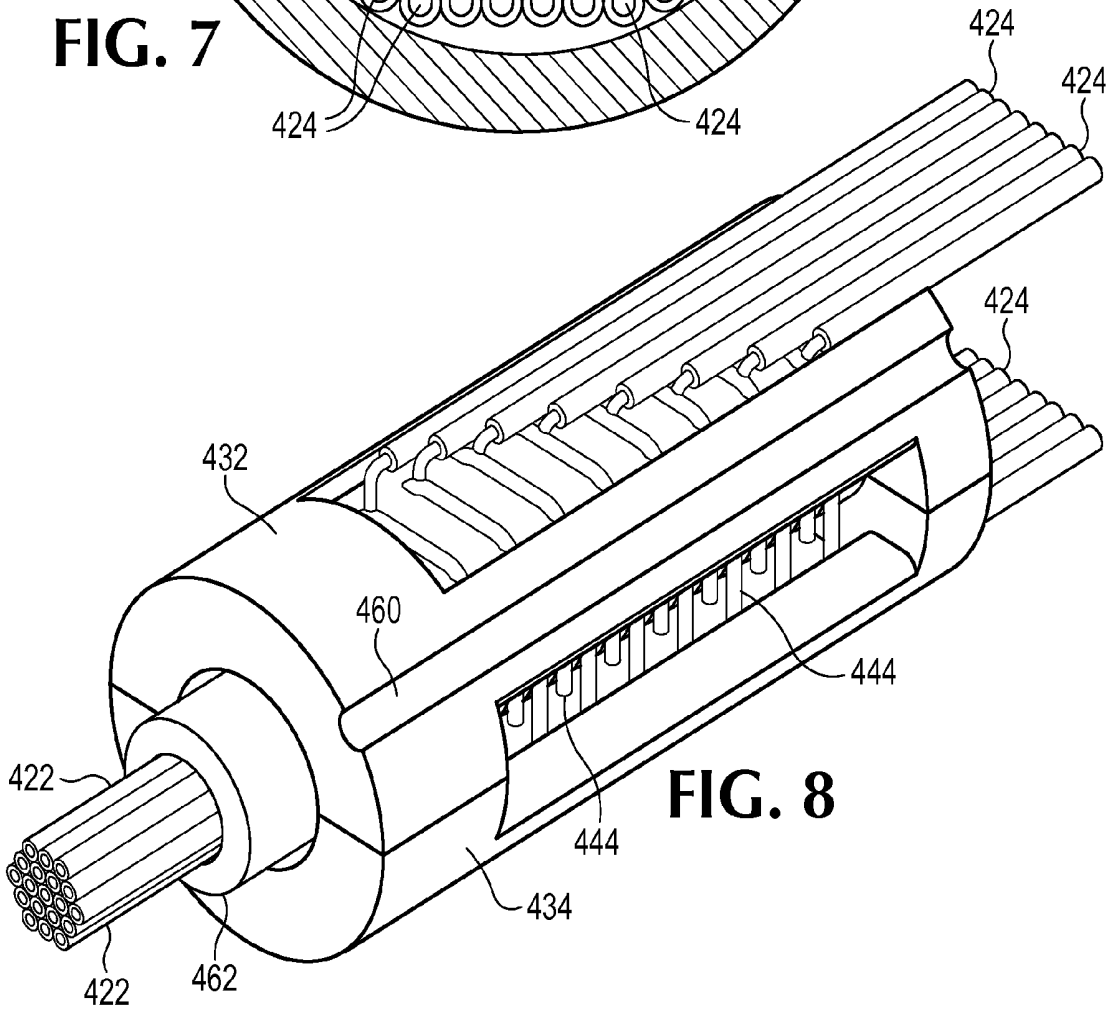
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FIG. 8

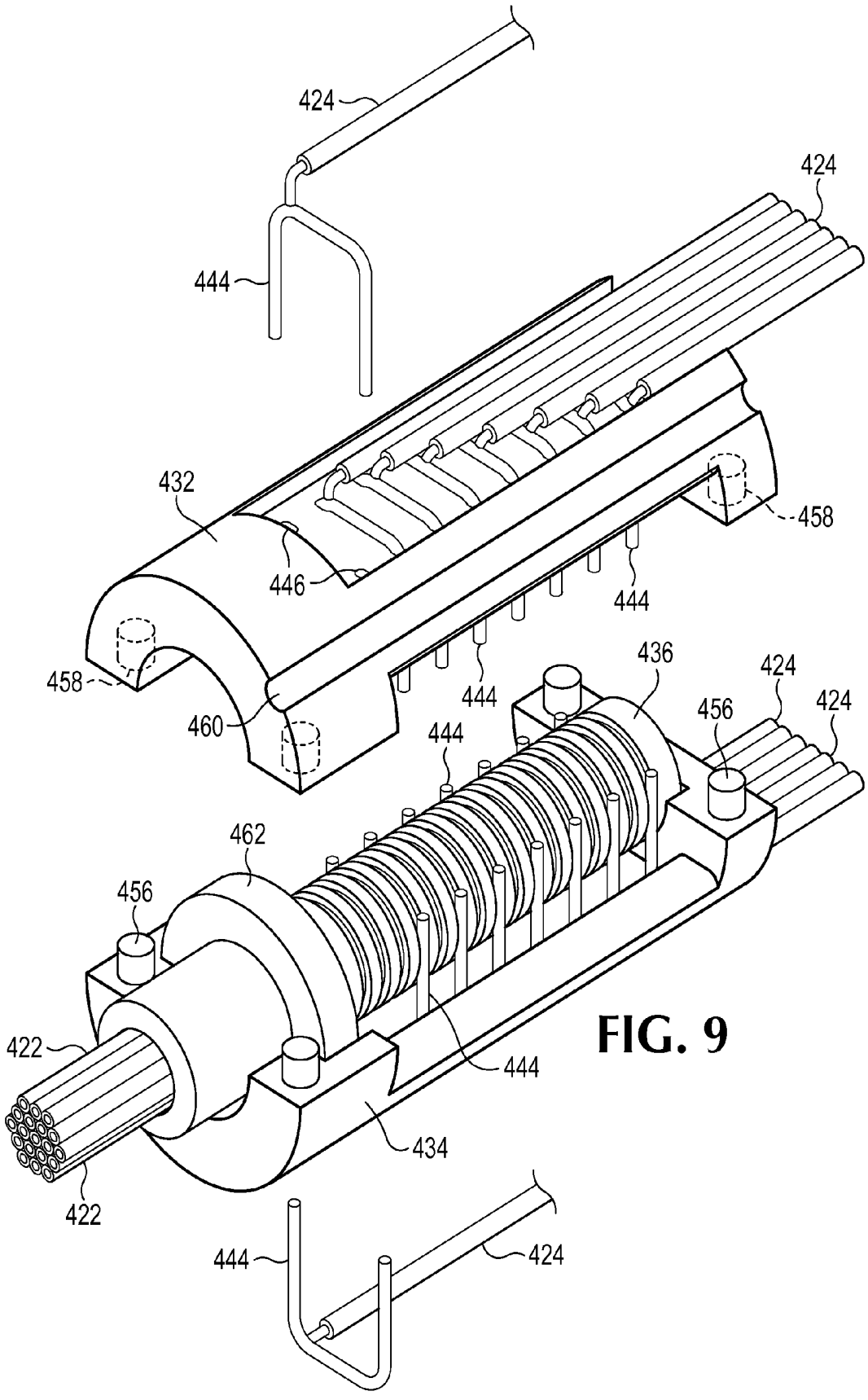
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FIG. 9

MEDICAL DEVICE ASSEMBLY HAVING FREEDOM OF ROTATION

RELATED APPLICATIONS

[0001] This application is a continuation-in-part of application Ser. No. 12/606,150 filed Oct. 26, 2009.

BACKGROUND

[0002] Increasingly, hand held medical devices are connected to a base station with a multi-connector cable ferrying data from the device and commands to the device. Diagnostic or therapeutic catheters, for example, ablation catheters, ultrasound imaging (IVUS) catheters and electrophysiology mapping catheters, all produce data that must be delivered to a base station and may require commands from a base station. Unfortunately, medical devices must often be manipulated by a medical professional who is concentrating deeply about the task at hand. The manipulation may cause a rotation of the device. As a result the cable for the medical device becomes twisted, resisting further rotation and thereby interfering with the procedure. Potential bending of the catheter threatens data and power flow and could harm the cable.

SUMMARY

[0003] 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.

[0004] In a first separate aspect, the present invention may take the form of a method of performing a surgical procedure using an electrical surgical device, which utilizes an electrical surgical assembly including the surgical device connected to a base station by a cable having a plurality of mutually electrically insulated conductors, and an electrical adapter interposed at a point between the base station and the device. The adapter is comprised of a first half and a second half that have freedom of rotation relative to each other. The first half is equipped with a first connector-half and the second half is equipped with a second connector-half. While the surgical procedure is performed, the adapter permits relative rotation between the first half and the second half, thereby avoiding a problem of cable twisting.

[0005] In a second separate aspect, the present invention may take the form of an electrical medical device assembly that includes a handheld unit, adapted to be manipulated by a medical professional and requiring multi-conductor electrical connection to a base unit and a base unit adapted to provide electrical power to the handheld unit. Also, a multi-conductor electrical cable connects the handheld unit to the base unit and a multi-conductor electrical adapter is interposed between the handheld unit and the base unit, the adapter including a first half and a second half and wherein relative rotation is permitted between the first half and the second half and wherein the first half is equipped with a first connector-half and the second half is equipped with a second connector-half.

[0006] In a third separate aspect, the present invention may take the form of an adapter that includes a first half that defines a plurality of contacts having circular conductive surfaces and a second half that includes a set of resilient contacts, each positioned to contact one of the circular conductive surfaces to create an electrical connection.

[0007] 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

[0008] 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.

[0009] FIG. **1** is a diagram of a medical device assembly that may be implemented in accordance with the present invention.

[0010] FIG. **2**A is a top side perspective view of a connector according to the present invention, in closed form.

[0011] FIG. **2**B is a top side perspective view of the connector of FIG. **1**A, in open form.

[0012] FIG. **2**C is a side sectional view of the connector of FIG. **1**A taken along line **1**C-**1**C of FIG. **1**A.

[0013] FIG. **2**D is an alternative preferred embodiment of the connector of the present invention, which is internally the same as the connector of FIG. **1**A, but which is embedded into a base station.

[0014] FIG. **3**A is a top side perspective view of an alternative preferred embodiment of a connector according to the present invention, shown in closed form.

[0015] FIG. **3**B is a top side perspective view of the connector of FIG. **2**A, shown in open form.

[0016] FIG. **4**A is a top side perspective view of a connector according to an alternative preferred embodiment of the present invention, shown in closed form.

[0017] FIG. **4**B is a top side perspective view of the connector of FIG. **4**A, shown in open form.

[0018] FIG. **5** is a side perspective view of an multi-conductor adapter, relative rotation permitting adapter, according to a preferred embodiment of the present invention.

[0019] FIG. **6** is a perspective view of a part of the adapter of FIG. **5**, expanded relative to the view of FIG. **5**.

[0020] FIG. **7** is a cross-sectional view of the part of FIG. **6**, taken along line **7**-**7** of FIG. **6**.

[0021] FIG. **8** is a cut-away view of the part of FIG. **6**.

[0022] FIG. **9** is an exploded cut-away view of the part of FIG. **6**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0023] Referring to FIG. **1**, a medical device assembly **10** is made up of a handheld medical device **12** connected to a base station **14** by a multi-conductor cable **16**. A connector **18** is located either at the point where cable **16** meets base station **14**, with one half of the connected being a part of base station **14** (FIG. **2**D), or is located between two longitudinal halves of cable **16**.

[0024] Each one of the following embodiments is shown with only a few contacts for ease of illustration. In reality, however, connectors according to the present invention may have upwards of fifty contacts, which would be necessary to support some of the hand-held devices available today. The contacts are typically have a surface layer of gold plated on nickel, which is plated onto copper. Nickel is used primarily to gain good adhesion of the gold, which does not bond well

directly on copper. Gold is used because it does not oxidize. Oxidation could defeat the formation of robustly conductive connection between contacts. Another material that can be used for the contacts is a platinum-iridium alloy.

[0025] Referring to FIGS. **2**A-**2**C, in one preferred embodiment a rotatable connector **110** is made up of a first half **112** defining a set of circular contacts **114**, arranged concentrically. A second half **116** is made up of a set of spring-loaded, conductive pins **118** (pogo pins, in industry parlance), which are positioned so that each one will touch a circular contact **114** when the first and second halves are joined, thereby forming an electrical connection. when the second half **116** is rotated relative to the first half **112**, the pins **118** move in a circle, with each pin maintaining contact with its corresponding circular contact **114**. A lip defined by the housing for connector-half **112** fits into a groove **122** in the exterior of connector-half **116**, to keep halves **112** and **116** together, but without fitting so tightly as to prevent rotation between the two halves, **112** and **116**.

[0026] Various techniques may be used in constructing the connector described above. One method of creating concentric circle contacts **114** utilizes conductor deposition techniques used for printed circuit boards. In addition pogo-pins **118**, other types of resilient contacts can be made, for example by a wire forming process in which the wire-end is compressed.

[0027] In an alternative preferred embodiment (not shown) each circular contact is broken up into a pair of semicircular contacts, with a pin connecting to each one.

[0028] This alternative embodiment provides twice as many connections, but permits only **180** degree rotation. As noted previously, FIG. **2**D shows the case in which half **112** of connector **110** is embedded in base station **14**. Referring to FIGS. **3**A and **3**B, in an alternative preferred embodiment of a rotatable multi-contact connector **210**, a first half **212** includes a set of circular contacts **214** arranged in stacked form. A second half includes first and a second semi-circular elements **216** and **218**, adapted to lock together about first half **212**. Element **218** has stacked resilient contacts **220** adapted to touch stacked circular contacts **214**.

[0029] Referring to FIG. **4**A and **4**B, a further alternative preferred embodiment of a rotatable multi-conductor connector **310** has a first half **312** similar to first half **212** with stacked circular contacts **314**, but wherein a second half **316** has a plurality of resilient horseshoe contacts **318**, each being sufficiently flexible to snap about the corresponding circular contact **314**. To gain this flexible contacts **318** may be formed of a flexible beryllium copper alloy and may have a thickness of about one millimeter.

[0030] In one preferred embodiment circular contacts **214** and/or **314** are made in modular fashion so that they can be easily fit together to form a connector having as many contacts as is desired.

[0031] One type of problem potentially encountered by the above described systems is that of a distortion of delicate analog signals caused by a variation in the robustness of the connection between two corresponding contacts whether a pin **118** with a circular contact **114**, or a resilient contact **220** with a circular contact **214**. One method of addressing this problem is to have a plurality of pins **118** or resilient contacts **220** per corresponding contact **114** or **214**. The embodiment of FIGS. **4**A and **4**B, each arm of each horseshoe contact **318**, acts largely as an independent contact, ensuring good connectivity.

[0032] In this manner, for a reduction in overall conductivity to occur in a signal path, at least two contact-to-contact paths would have to lose conductivity simultaneously. This amounts to at least two independent events, both of which are fairly rare. If for example, there was a 0.05 chance of either of two contact pairs falling below 50% of normal conductivity, then the chance of both falling below 50% at the same time would be 0.0025.

[0033] Referring to FIG. **5**, the present invention may alternatively take the form of an adapter **410** that can be plugged in between a first cable section, using first connector-half **412**, and a second cable section, using second connector half **414**, to make the first cable section rotatable relative to the second section. A cable section **416** provides flexibility between first connector-half **412** and a rotation-permitting cylinder **420**, which is held within an outer cylindrical housing **421**.

[0034] Referring to FIG. **6**-**9**, rotation-permitting cylinder **420**, permits first connector-half **412** to rotate relative to second connector-half **414**, without interrupting the flow of electrical signals through adapter **410**. A set of first wires **422** enters cylinder **420** from first connector-half **412** and a set of second wires **424** enters cylinder **420** from the second connector-half **414**. An inner cylindrical housing **426** supports and protects inner portions of cylinder **420** described below.

[0035] Cylinder **420** includes a top frame **432** and a bottom frame **434** that fit together about a cylinder **436**, which is permitted to rotate relative to the frame formed from upper and bottom frames **432** and **434**. Each first wire **422** is electrically connected to a conductive ring **442** and each second wire is electrically connected to a conductive staple **444**, which is held by a pair of apertures **446** in frame **432** or **434** so as to be in electrical contact with a ring **442**. In FIG. **8**, top and bottom stapes **444** are transversely aligned, with staples **444** extending downwardly from the top only extending part way down in the side window

[0036] Top and bottom frames **432** and **434** are held together by pegs **456**, which fit into matching holes **458**. Further, frames **432** and **434** are oriented relative to inner cylindrical housing **426** by a ridge **458** (FIG. **7**) that mates into a groove **460**. A toroid bearing **462** (FIG. **9**), helps to maintain the cylinder **436**, in position relative to top and bottom frames **432** and **434**.

[0037] In operation, cylinder **436** and therefore rings **442** are free to rotate relative to staples **444**. Moreover, staples **444** are resilient and are held by frames **432** and **434** so as to press gently against rings **442**, thereby providing a robust electrical contact. Both staples and rings are made of gold plated brass or beryllium copper.

[0038] Cylinder **436** is created by injecting polymer into a mold, with rings in place in the mold at the time the polymer is injected. In a preferred embodiment the polymer used is a low friction material such as Nylon. The first and second connector halves **412** and **414** are industry standard Redel® connectors. Cylinder **420** has a diameter 1.4 cm (0.55 in) and a length of 2.54 cm (1 in).

[0039] 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.

1. A method of performing a surgical procedure using an electrical surgical device, comprising:

(a) providing an electrical surgical assembly including said surgical device connected to a base station by a cable having a plurality of mutually electrically insulated conductors, and an electrical adapter interposed at a point between said base station and said device;

(b) wherein said adapter is comprised of a first half and a second half that have freedom of rotation relative to each other, and wherein said first half is equipped with a first connector-half and said second half is equipped with a second connector-half; and

(c) performing said surgical procedure and permitting said adapter to permit said relative rotation thereby avoiding a problem of cable twisting.

2. The method of claim **1**, wherein said first half of said adapter is connected directly to said base station by said first connector-half.

3. The method of claim **1**, wherein said surgical device is selected from the group consisting of an ablation catheter, an intravenous ultrasound catheter, and an electrophysiology mapping catheter.

4. The method of claim **1**, wherein said surgical device is an electric scalpel.

5. The method of claim **1**, wherein said cable comprises a first cable portion and a second cable portion, in addition to said adapter, said first cable portion having a third connector-half mated to said first connector-half and said second cable portion having a fourth connector-half mated to said second connector-half, so that said adapter is interposed between said first cable portion and said second cable portion.

6. An electrical medical device assembly, comprising:

(a) a handheld unit, adapted to be manipulated by a medical professional and requiring multi-conductor electrical connection to a base unit;

(b) a base unit adapted to provide electrical power to said handheld unit;

(c) a multi-conductor electrical cable connecting said handheld unit to said base unit; and

(d) a multi-conductor electrical adapter interposed between said handheld unit and said base unit, said adapter including a first half and a second half and wherein relative rotation is permitted between said first half and said second half and wherein said first half is equipped with a first connector-half and said second half is equipped with a second connector-half.

7. The assembly of claim **6**, wherein said first half of said adapter is electrically connected to said base station by way of said first connector-half.

8. The assembly of claim **6**, wherein said surgical device is selected from the group consisting of an ablation catheter, intravenous ultrasound catheter, and an electrophysiology mapping catheter.

9. The assembly of claim **6**, wherein said surgical device is an electric scalpel.

10. The assembly of claim **6**, wherein said cable comprises a first cable portion and a second cable portion, in addition to said adapter, said first cable portion having a third connector-half mated to said first connector-half and said second cable portion having a fourth connector-half mated to said second connector-half, so that said adapter is interposed between said first cable portion and said second cable portion.

11. The assembly of claim **6**, wherein said first half of said adapter defines a set of contacts having circular conductive surfaces and wherein said second half of said adapter includes a set of resilient contacts, each positioned to contact one said circular conductive surfaces to create an electrical connection.

12. The assembly of claim **11**, wherein each of said circular conductive surfaces is contacted by a single resilient contact.

13. The assembly of claim **11**, wherein said circular conductive surfaces are stacked and said resilient contacts are U-shaped elements.

14. The assembly of claim **13**, wherein said second half of said connector fits around said first half.

15. The assembly of claim **11**, wherein said first connector half includes an molded polymeric cylinder having embedded conductive ring contacts therein.

16. An adapter comprising:

(a) a first half that defines a plurality of contacts having circular conductive surfaces; and

(b) a second half that includes a set of resilient contacts, each positioned to contact one of said circular conductive surfaces to create an electrical connection.

17. The adapter of claim **16**, wherein said second half of said adapter fits around said first half.

18. The adapter of claim **17**, wherein said circular conductive surfaces are stacked and said resilient contacts are resilient U-shaped elements.

19. The adapter of claim **17**, wherein said first half includes an injection molded polymeric cylinder having embedded conductive ring contacts.

* * * * *

专利名称(译)	具有旋转自由度的医疗装置组件		
公开(公告)号	US20110098601A1	公开(公告)日	2011-04-28
申请号	US12/912661	申请日	2010-10-26
[标]申请(专利权)人(译)	HUYNH KY MIKKELSEN KIRK		
申请(专利权)人(译)	HUYNH KY MIKKELSEN KIRK		
[标]发明人	HUYNH KY MIKKELSEN KIRK		
发明人	HUYNH, KY MIKKELSEN, KIRK		
IPC分类号	A61B18/00 H01R39/00 A61N7/00 A61B5/05		
CPC分类号	A61B8/00 A61B18/14 A61B2018/00178 H01R2201/12 H01R24/58 H01R39/00 A61N7/022		
外部链接	Espacenet USPTO		

摘要(译)

一种使用电外科手术装置执行外科手术的方法，所述外科手术装置利用电手术组件，所述电手术组件包括通过具有多个相互电绝缘的导体的电缆连接到基站的手术装置，以及插入在所述电外科装置之间的点处的电气适配器。基站和设备。适配器包括相对于彼此具有旋转自由度的前半部分和后半部分。前半部分配备有第一连接器半部分，后半部分配备有第二连接器半部分。在进行外科手术时，适配器允许前半部分和后半部分之间的相对旋转，从而避免了电缆扭曲的问题。