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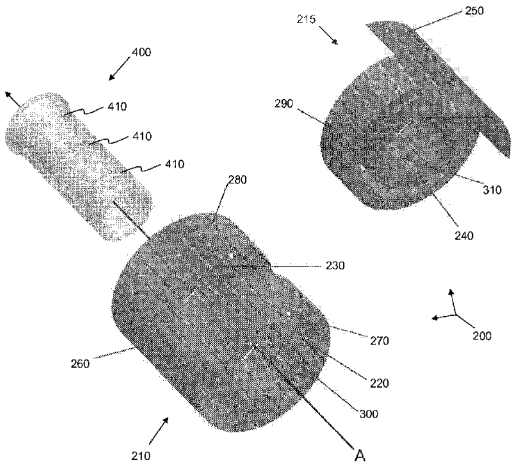


FIG. 3

(57) Abstract: A lead retention assembly includes first, second and third retention members. The first retention member defines a first opening configured to receive a lead body. The second retention member is longitudinally spaced apart from the first retention member and defines a second opening configured to receive the lead body. The first and second retention members are substantially aligned along a first axis. The third retention member defines a third opening configured to receive the lead body. The third retention is disposed between the first and second retention members and is biased in a position such that the third opening is substantially centered on a second axis. Upon application of a compressive force, the third retention member is moveable to a position such that the first, second, and third openings are substantially aligned along a common axis, allowing the lead body to be inserted within the first, second and third openings.

WO 2008/130819 A2

LEAD RETENTION ASSEMBLY

FIELD

This application relates to medical devices, more particularly implantable leads and retention assemblies for coupling leads to lead extensions or electrical signal generators.

BACKGROUND

Implantable electrical signal generators, such as pacemakers, defibrillators, neurostimulators, and the like, have been used to treat a variety of diseases. Such devices generate electrical signals that are transferred to a patient's tissue through electrodes disposed on a distal end portion of a lead. The proximal end portion of the lead typically contains a number of connector rings corresponding to the number of electrodes. Conductors run within and along the lead body and electrically couple the connectors to the electrodes. The proximal end portion of the lead is inserted into connector of a signal generator such that electrical contact is made between discrete contacts in the connector portion and the connector rings of the lead. Alternatively, the lead is inserted into connector region of a lead extension. Like the connector portion of a signal generator, the lead extension connector region is configured such that electrical contact is made between discrete contacts in the connector region and the connector rings of the lead. The proximal portion of the lead extension contains electrical connections that are electrically coupled to the contacts in the connector region and serve to electrically couple electrodes of a lead to the signal generator when the lead is connected to the lead extension and the extension is inserted into the connector of the signal generator.

Regardless of whether the lead is inserted into an extension or an electrical signal generator, the lead is secured in place with a set screw to prevent the lead from being unintentionally pulled out of the signal generator or lead extension. A torque wrench is typically employed to ensure proper tightening of the set screw. Use of a torque wrench to tighten a set screw of a device implanted in a patient can be awkward. If the set screw, whether used with the connector portion of an electrical signal generator or lead extension, serves to electrically couple the signal generator or extension to the lead, a polymeric boot is sutured on either end of the connector region to prevent stimulation of the tissue in proximity to the set screw.

BRIEF SUMMARY

Lead retention assemblies that may be used to secure leads without the use of a torque wrench are described herein. A compressive force is applied to the connector assembly to allow the lead to be inserted into the connector assembly. Upon release of the compressive force, the connector assembly engages and retains the lead.

In various embodiments, a lead retention assembly having first, second and third retention members is described. The first retention member defines a first opening configured to receive a lead body. The second retention member is longitudinally spaced apart from the first retention member and defines a second opening configured to receive the lead body. The first and second retention members are substantially aligned along a first axis. The third retention member defines a third opening configured to receive the lead body. The third retention is disposed between the first and second retention members and is biased in a position such that the third opening is substantially centered on a second axis. Upon application of a compressive force, the third retention member is moveable to a position such that the first, second, and third openings are substantially aligned along a common axis, allowing the lead body to be inserted within the first, second and third openings. Devices, such as implantable signal generators, lead extensions or other adaptors having the lead retention assembly are also described.

In various embodiments, a system including a lead and an implantable medical device having a connector for receiving and operbaly coupling the lead is described. The lead has a lead body, a proximal end portion, and a distal end portion. The proximal end portion has a recipient feature. The connector of the implantable medical device includes first, second and third retention members. The first retention member defines a first opening configured to receive the lead body. The second retention member is longitudinally spaced apart from the first retention member and defines a second opening configured to receive the lead body. The first and second openings are substantially aligned along a first axis. The third retention member defines a third opening configured to receive the lead body and is disposed between the first and second retention members. The third retention member is biased in a position such that the third opening is substantially centered on a second axis. One or more of the first, second or third retention members includes a protruding element extending into a portion of the first, second or third opening. Upon application of a compressive force, the third retention member is moveable to a position such that the first, second and third openings are substantially aligned along a common axis, allowing the lead body to be inserted within the first, second and third openings. Upon relaxing the compressive force, the protruding element is received by the recipient feature of the lead, longitudinally securing the lead relative to the implantable medical device.

By providing a lead retention assembly that (i) allows a lead to be inserted upon application of a compressive force and (ii) engages and retains the lead upon release of the compressive force, surgical steps during implantation of an electrical signal generator system may be reduced. For example, steps of tightening a small set screw with a torque wrench and electrically isolating the set screw by suturing a boot may be eliminated. These and other advantages will be readily understood from the following detailed descriptions when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic representation of an environment of a representative spinal cord stimulation (SCS) system implanted in a patient..

FIG. 2 a diagrammatic representation of an exploded view of a representative implantable electrical signal therapy system.

FIG. 3 is a diagrammatic representation of an exploded view of a representative lead retention assembly.

FIGs. 4A-B are diagrammatic representations of isolated head-on views of retention members of a representative lead assembly in an uncompressed (**4A**) and compressed (**4B**) state.

FIG. 5 is a diagrammatic representation of a longitudinal section of some components of a representative lead assembly with a secured lead.

FIGs. 6-8b are line drawings of exploded views of representative lead retention assemblies or components thereof.

The drawings are not necessarily to scale. Like numbers used in the figures refer to like components, steps and the like. However, it will be understood that the use of a number to refer to a component in a given figure is not intended to limit the component in another figure labeled with the same number.

DETAILED DESCRIPTION

In the following detailed description, reference is made to the accompanying drawings that form a part hereof, and in which are shown by way of illustration several specific embodiments of devices, systems and methods. It is to be understood that other embodiments are contemplated and may be made without departing from the scope of spirit of the present invention. The following detailed description, therefore, is not to be taken in a limiting sense.

All scientific and technical terms used herein have meanings commonly used in the art unless otherwise specified. The definitions provided herein are to facilitate understanding of certain terms used frequently herein and are not meant to limit the scope of the present disclosure.

As used in this specification and the appended claims, the singular forms “a”, “an”, and “the” encompass embodiments having plural referents, unless the content clearly dictates otherwise. As used in this specification and the appended claims, the term “or” is generally employed in its sense including “and/or” unless the content clearly dictates otherwise.

As used herein, “proximal” and “distal” refer to position relative to an implantable electrical signal generator. For example, a proximal portion of a lead is a portion nearer a signal generator, and a distal portion is a portion further from the signal generator.

As used herein, “substantially align”, as it refers to retention members along an axis, means that the retention members are positioned such that a portion of a lead may be inserted in openings formed by the substantially aligned retention members. When not substantially aligned, the lead is prevented from being inserted in openings.

As used herein, “active electrical device” means a device having a power source and electronics operably coupled to the power source, where the electronics are capable of generating or receiving an electrical signal.

The present disclosure relates to implantable medical devices, such as implantable electrical signal generators and lead extensions that are used to secure and electrically couple leads so that electrical stimulation signals may be reliably applied to a patient tissue via electrodes of the lead. More particularly, the disclosure relates to lead retention assemblies that may be used to secure leads relative to signal generators, lead extensions or adaptors. The retention assemblies form a part of, or are connected to, the signal generators, lead extensions or other adaptors. A compressive force is applied to the assemblies to allow the lead to be inserted into the assembly. Upon release of the compressive force, the lead is retained by the retention assembly and thus relative to the signal generator, lead extension or adaptor.

Referring to **FIG. 1**, a spinal cord stimulation (SCS) system, is shown implanted in a patient **6**. For SCS, an implantable electrical signal generator **10** is typically placed in the abdominal region of patient **6** and lead **20** is placed at a desired location along spinal cord **8**. A lead extension **30** operably couples signal generator **10** to lead **20**. Connector block **40** of signal generator **10** electrically couples and secures lead extension **30**. Connector region **60** of lead extension **30** electrically couples and secures lead **20**. Signal generator **10** contains a power source and electronics for sending electrical signals to the spinal cord **8** via electrodes **90** of lead **20** to provide a desired therapeutic or diagnostic effect. Such a system, or any system including an active electrical device **10** as described herein, may also include a programmer (not shown), such as a physician programmer or a patient programmer capable of wireless communicating with signal generator **10**.

It will be appreciated that systems other than SCS systems employing active electrical devices and therapeutic uses thereof are contemplated. For example, active electrical device **10** may be any electrical signal generator or receiver useful for delivering therapy to a patient or for patient diagnostics. By way of example, active electrical device **10** may be a monitoring device; hearing implant; a cochlear implant; a sensing device; a signal generator such as a cardiac pacemaker or defibrillator, a neurostimulator (such as a spinal cord stimulator, a brain or deep brain stimulator, a peripheral nerve stimulator, a vagal nerve stimulator, an occipital nerve stimulator, a subcutaneous stimulator, etc.), a gastric stimulator; or the like.

Referring to **FIG. 2**, an exploded view of a representative implantable active electrical system **100** is shown. In the system shown in **FIG. 2**, implantable active electrical device **10** comprises a connector block **40** configured to receive proximal end portion **50** of extension **30**. The distal end portion of extension **30** comprises a connector region **60** configured to receive proximal end of lead **20**. Connector region **60** comprises internal electrical contacts **70** configured to electrically couple extension **30** to lead **20** via electrical contacts **80** disposed on the proximal end portion of lead **20**. Electrodes **90** are disposed on distal end portion of lead **20** and are electrically coupled to electrical contacts **80**, typically through conductors (not shown). Lead **20** may include any number of electrodes **90**, *e.g.* one, two, three, four, five, six, seven, eight, sixteen, thirty-two, or sixty-four. Typically, each electrode **90** is electrically coupled to a discrete electrical contact **80**.

While not shown in **FIGs. 1** or **2**, it will be understood that lead **20** may be coupled to active electrical device **10** without lead extension **30** or other adaptor. It will be further understood that more than one lead **20** may be operably coupled to one active electrical device **10** or one extension **30** or that more than one extension **30** may be operably coupled to one active electrical device **10**.

Referring to **FIG. 3**, a diagrammatic representation of an exploded view of a representative lead retention assembly **200** is shown. Lead retention assembly **200** includes first **220**, second **230**, and third **240** retention members. First retention member **220** defines a first opening configured to receive a lead body. Second retention member **230** is longitudinally spaced apart from first retention member **220** and defines a second opening configured to receive the lead body. Alignment element **260** aligns first **220** and second **230** retention members such that the first and second openings are substantially aligned along a first axis (*e.g.*, as shown by the line **A** in **FIG. 3**). Third retention member **240** defines a third opening configured to receive the lead body and is longitudinally disposed between first **220** and second **230** retention members in use.

Referring to **FIGs. 4A-B**, head-on views (*e.g.*, along the axis shown by line **A** in **FIG. 3**) of retention members **220**, **230**, **240** of representative lead assembly in an uncompressed (**4A**) and a compressed (**4B**) state are shown. As shown in **FIG. 4**, in use, third retention member **240** is biased (in its relaxed state **4A**) in a position such that the third opening is substantially centered on a second axis, different from the first axis on which the first and second openings of first **220** and second **230** members are aligned. Upon application of a compressive force (*e.g.*, in the direction shown by the arrows in **FIG. 4A**), third retention member **240** is moveable to a position such that the first, second and third openings are aligned along a common axis (see **FIG. 4B**), allowing the lead body to be inserted within the first, second and third openings. Upon release of the compressive force, third retention member **240** returns or is biased towards the uncompressed configuration (**FIG. 4A**) to secure lead body within retention assembly **200**.

Third retention member **240** may be biased in the position such that the third opening is substantially centered on a second axis (other than the first axis on which the first and second openings are substantially aligned) by any suitable biasing element. For example, and referring to **FIG. 3**, a deformable third outer member **290** may be disposed about and operably coupled to third retention member **240**. In the embodiment depicted in **FIG. 3**, third deformable outer member **290** is attached to or formed with third retention member **240** along a surface in contact with or formed by an extension element **250**. Extension element **250** may be pressed such that third outer member **290** (i) contacts alignment member **260** between first **220** and second **230** retention members and (ii) deforms to allow the openings of the first **220**, second **230**, and third **240** retention members to substantially align along a common axis, allowing a portion of lead to be inserted into the first, second and third openings. Lead retention assembly **200** may further include deformable first **270** or second **280** outer members disposed about and operably coupled to first **220** or second **230** retention members, respectively. In use, extension element **250** as depicted in **FIG. 3** engages a portion of first **270** and second **280** deformable outer member such that compressive force applied to extension element **250** relative to first **270** and second **280** outer deformable members causes first **270** or second **280** outer members to deform, allowing alignment of the openings defined by first **220**, second **230**, and third **240** retention members. First **270**, second **280**, and third **290** deformable outer members may act cooperatively to bias third retention member **240** such that its opening is substantially centered on the second axis. Alternative configurations for biasing third retention member **240** such that its opening is substantially centered on the second axis are described in more detail with regard to **FIG. 8**.

In the embodiment shown in **FIG. 3**, lead retention assembly **200** contains two parts, a first part **210** and a second part **215**. First **210** or second **215** parts may contain a plurality of pieces or may be formed of a single piece. First part **210** includes first **220** and second **230** retention members and alignment member **260**. First part **210** may also include first **280** or second **290** outer deformable members. Second part **215** includes third retention member **240** and extension element **250** and may also include third outer deformable member **290**. Retention members and deformable outer members may be molded or extruded together from the same or different material, may be welded, adhered, bonded or otherwise connected. In various embodiments, one or more retention members are formed from conductive material. Any suitable conductive material may be used to form retention members. For example, the retention member may be formed from a nickel-cobalt base alloy, such as MP35N. Of course, the components of first part **210** or second part **215** may be formed of conductive material, non-conductive material, or a composite of materials. In an embodiment, the entire retention assembly **200** is formed from a conductive metal alloy. One of skill in the art will readily understand which materials may be selected to form retention assembly **200** or components thereof based on the functions performed by the various components. For example, outer members **270**, **280**, **290** should be made of material capable of deforming sufficiently to allow openings of first **220**, second **230**, and third **240** retention members to substantially align along a common axis.

Referring now to **FIGs. 3-5**, one or more retention members **220**, **230**, **240** may contain one or more protruding elements that extend into the openings defined by the retention members. For example, first retention member **220** may contain a first protruding element **300**, second retention element **230** may contain a second protruding element **320**, and third retention member **240** may contain a third protruding element **310**. Protruding elements **310**, **320**, **330** are configured to be received by recipient features **410**, such as a groove, of a portion **400** of lead **20**. While protruding elements **300**, **310**, **330** shown in **FIG. 4** are roughly equally radially spaced, it will be understood that nearly any radial spacing of protruding elements **300**, **310**, **330** will serve to secure lead **20** relative to retention assembly **200**. However, in embodiments employing more than one protruding element **300**, **310**, **330**, it may be desirable for at least two of the protruding elements **300**, **310**, **330** to be at least somewhat radially spaced apart to more securely retain the lead. **FIG. 5** is a diagrammatic representation of a longitudinal section of some components of a representative lead retention assembly **200** with a portion **400** of lead **20** secured. Lead retention assembly **200** is shown in the embodiment depicted in **FIG. 5** as being located in a connector **500** of an implantable device. Connector **500** may be, for example, connector block **40** of active electrical device **10** or connector region **60** of lead extension **30** as depicted in **FIG. 1** or **FIG. 2**. Lead retention assembly **200** is shown in **FIG. 5** in a compressed state, with protruding elements **310**, **320** being received by recipient features **410** (groves) of portion **400** of lead **20**. Body material **510** of connector **500** serves to keep the first part **210** and second part **215** of retention assembly **200** from separating. Of course, it will be understood that a polymeric sleeve or the like may also serve such a purpose. In various embodiments (not shown), retention assembly **200** is not entirely covered by body material **510** or sleeve of connector **500** but is bonded, adhered, fastened, molded into or otherwise affixed to body material **510** of connector **500** of device, which once lead **20** is captured in retention assembly **200** serves to secure the lead relative to the device. Regardless, the portion of connector 500 in the region of retention assembly 200 is compressibly deformable. While lead retention assembly **200** will serve to secure lead **200** without protruding elements **300**, **310**, **320** (and corresponding recipient features **410** on lead), the ability to longitudinally retain lead **20** by assembly **200** is greatly enhanced by the presence of protruding elements **300**, **310**, **320** (and corresponding recipient features **410** on lead).

In various embodiments, lead retention assembly **200** or portion thereof is electrically coupled to a device of which it forms a part. For example, and as shown in **FIG. 5**, a conductor **600** within connector **500** of the device may be electrically coupled to a retention member (shown as connected to first retention member **220**). In such embodiments, the retention member is made of a conductive material. If connector **500** is a part of an implantable active electrical device **10**, a conductor **600** may be fed through a feedthrough (not shown) to electrically couple assembly **200** to electronics of the device **10**. If connector is part of a lead extension **30**, connector may be an internal contact **70** of extension **30**.

While not shown, it will be understood that if the portion **400** of the lead shown in **FIG. 5** is distal to an electrical contact **80** (see, *e.g.*, **FIG. 2**), a conductor will be run through lead body along the portion **400** shown to electrically connect the contact **80** with an electrode **90**. Of course, retention assembly **200** may engage lead **20** at nearly any location relative to contacts **80**. For example, retention assembly may be proximal to, intermediate of or distal to contacts of lead (or serve as proximal, distal or intermediate contact). If portion **400** of lead shown in **FIG. 5** includes a contact **80** (*e.g.*, disposed about at least a portion of surface in contact with a conductive retention member or conductive protruding element), a conductor (not shown) will run along the lead body and connect contact **80** (not shown in **FIG. 5**) to an electrode **90** (See, *e.g.*, **FIG. 2**). In various embodiments where portion **400** of lead **20** includes a contact **80**, the contact **80** is formed into lead body material or bonded, secured, fastened, adhered or otherwise connected to lead body material. The contact **80** may include one or more recipient features **410** configured to receive one or more protruding element **300, 310, 330.**

FIG. 5 depicts retention members **220, 230, 240** and protruding elements **310, 320** as being in contact with portion **400** of lead, which may be desirable for configurations where retention assembly **200** retains lead **20** by compressive biasing force (*e.g.*, in embodiments lacking protruding elements **300, 310, 330**) or where electrical contact between a conductive retention member **220, 230, 240** or protruding element **300, 310, 330** and at least a portion **400** of lead is desired (*e.g.*, in embodiments where portion **40** of lead includes a contact **80**). However, it will be understood that when one or more retention members **220, 230, 240** include one or more protruding elements **300, 310, 330,** retention assembly **200** may secure lead **20** via recipient features **410** without pressing against lead.

Referring to **FIGS. 6-8**, alternative embodiments of lead retention assemblies or components thereof are shown. A lead assembly as described herein may include any number of retention elements. For example, the embodiment depicted in **FIG. 6** includes a total of five retention elements **220, 230, 235, 240, 245**. The first part **210** includes three retention elements **220, 230, 235**, and the second part **215** contains two retention elements **240, 245**. While not shown, the first **210** or second part **215** may include one or more biasing element, such as an outer deformable member as shown in **FIG. 3** or a biasing element as shown in **FIG. 8**.

Retention elements may be in any suitable shape for retaining a lead, depending on the shape of the lead. For example, in the embodiment depicted in **FIG. 7** (only retention elements shown), the openings of retention elements **220, 230, 235, 240, 245** are generally cube-shaped.

Referring to **FIG. 8A**, an embodiment of a retention assembly **200** is shown. First part **210** includes an alignment element **260** that substantially aligns openings of first **220**, second **230**, and fourth **235** retention members along a first axis. Second part **215** includes an extension element **250** that aligns openings of third **240** and fifth **245** retention members along a second axis (different from first axis). In use, the third retention member **240** is disposed between the first **220** and third **230** retention members and the fifth retention member **245** is disposed between the third **230** and fourth **235** retention members. The first part **210** also includes biasing elements **295** disposed on alignment element **260** between the first **220** and third **230** retention members and the third **230** and fourth **235** retention members. The biasing elements **295** are located such that, in use, they engage a portion of the third **240** and fifth **245** retention members. The biasing elements **295** bias the third **240** and fifth **245** retention members to a position such that openings formed by the third **240** and fifth **245** retention members are aligned along an axis different from the axis along which the first **220**, second **230**, and fourth **235** retention members are aligned. Application of a compressive force caused biasing members **295** to deform allowing the openings of the first **220**, second **230**, third **240**, fourth **235**, and fifth **245** retention members to be aligned along a common axis, allowing a lead to be inserted in the openings. Biasing elements **95** may be made of any deformable material and take any suitable form. For example, biasing elements **295** may be in the form of springs or the like.

As shown in **FIG. 8B**, biasing elements **295** may be disposed on first part **210** and second part **215**. Alternatively, biasing element **295** may be on either one of the first part **210** or second part **295**.

While not shown in **FIGs. 6-8**, it will be understood that one or more retention elements **220**, **230**, **235**, **240**, **245** may include one or more protrusion elements.

Thus, embodiments of LEAD RETENTION ASSEMBLY are disclosed. One skilled in the art will appreciate that the present invention can be practiced with embodiments other than those disclosed. The disclosed embodiments are presented for purposes of illustration and not limitation, and the present invention is limited only by the claims that follow.

What is claimed is:

1. A lead retention assembly comprising:

a first retention member defining a first opening configured to receive a lead body;

a second retention member longitudinally spaced apart from the first retention member, the second retention member defining a second opening configured to receive the lead body, wherein the first and second openings are substantially aligned along a first axis; and

a third retention member defining a third opening configured to receive the lead body, the third retention member being disposed between the first and second retention members and being biased in a position such that the third opening is substantially centered on a second axis,

wherein, upon application of a compressive force, the third retention member is moveable to a position such that the first, second and third openings are aligned along a common axis, allowing the lead body to be inserted within the first, second and third openings.

2. The assembly of claim 1, further comprising:

a deformable third outer member disposed about and operably coupled to the third retention member,

wherein the third outer member biases the third retention member in the position such that the third opening is substantially centered on a second axis.

3. The assembly of claim 2, further comprising:

a deformable first outer member disposed about the first retention member; and

a deformable second outer member disposed about the second retention member,

wherein the first, second and third outer members bias the third retention member in the position such that the third opening is substantially centered on a second axis.

4. The assembly of claim 3, further comprising an alignment element operably coupled to first and second outer members, wherein the alignment element maintains the first and second openings in aligned substantially along the first axis.

5. The assembly of claim 4, further comprising an extension element, the extension element operably coupled to the third outer member and configured to engage at least a portion of the first and second outer members in use.

6. The assembly of claim 5, wherein application of the compressive force to the extension element causes the first, second, and third outer members to deform, allowing the third retention member to move to the position such that the first, second and third openings are substantially aligned along the common axis.

7. The assembly of claim 5, wherein the assembly consists of first and second parts, the first part including the first and second retention members, the first and second outer members and the alignment element, the second part including the third retention member, the third outer member, and the extension element.

8. The assembly of claim 1, wherein the first, second or third retention member comprises a protruding element extending into a portion of the first, second or third opening.

9. The assembly of claim 1, wherein the first retention member comprises a first protruding element extending into a portion of the first opening, wherein the second retention member comprises a second protruding element extending into a portion of the second opening, and wherein the third retention member comprises a third protruding element extending into a portion of the third opening.

10. An implantable medical device comprising:

a connector configured to receive and operably couple a lead to the device, the connector including a lead retention assembly according to claim 1,

wherein the connector is compressibly deformable to allow the third retention member to move to the position such that the first, second and third openings are substantially aligned along the common axis, allowing the lead body to be inserted within the first, second and third openings.

11. The device of claim 10, wherein the device is a lead extension.

12. The device of claim 11, further comprising a conductor operably coupling one or more of the first, second, and third retention members to an electrical contact, the electrical contact being configured to electrically couple the assembly to an implantable electrical signal generator.

13. The device of claim 10, wherein the device is an implantable electrical signal generator.

14. The device of claim 13, further comprising a conductor operably coupling one or more of the first, second, and third retention members to electronics of the electrical signal generator.

15. A system comprising:

a lead having a lead body, a proximal end portion, and a distal end portion, the proximal end portion comprising a recipient feature; and

an implantable medical device having a connector for receiving and operably coupling the lead,

wherein the connector comprises:

a first retention member defining a first opening configured to receive a lead body;

a second retention member longitudinally spaced apart from the first retention member, the second retention member defining a second opening configured to receive the lead body, wherein the first and second openings are substantially aligned along a first axis; and

a third retention member defining a third opening configured to receive the lead body, the third retention member being disposed between the first and second retention members and being biased in a position such that the third opening is substantially centered on a second axis, wherein the first, second or third retention member comprises a protruding element extending into a portion of the first, second or third opening,

wherein, upon application of a compressive force, the third retention member is moveable to a position such that the first, second and third openings are substantially aligned along a common axis, allowing the lead body to be inserted within the first, second and third openings, and

wherein upon relaxing the compressive force, the protruding element is received by the recipient feature of the lead, longitudinally securing the lead relative to the implantable medical device.

16. The system of claim 15, wherein the implantable medical device is a lead extension.

17. The system of claim 15, wherein the implantable medical device is an electrical signal generator.

18. The system of claim 15, wherein the lead further comprises an electrical contact and the recipient feature is formed in the electrical contact.

19. The system of claim 15, wherein the recipient feature comprises a groove.

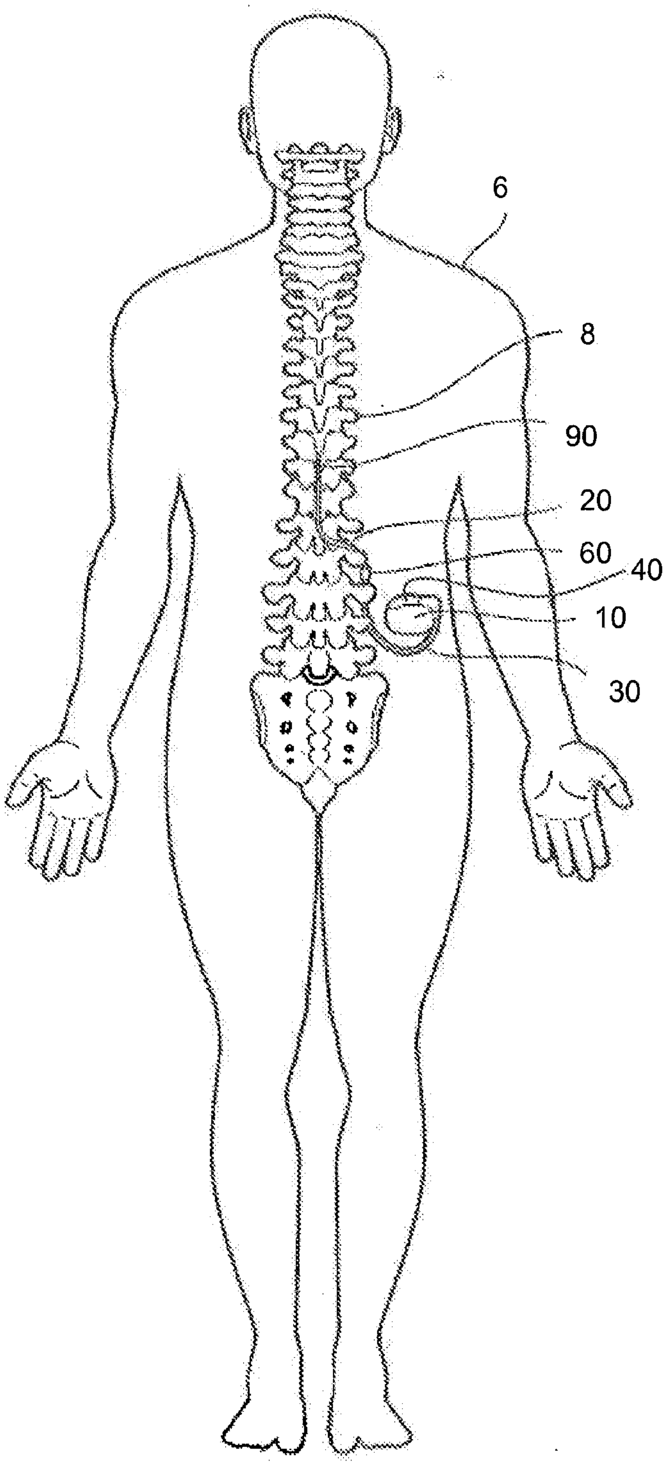


FIG. 1

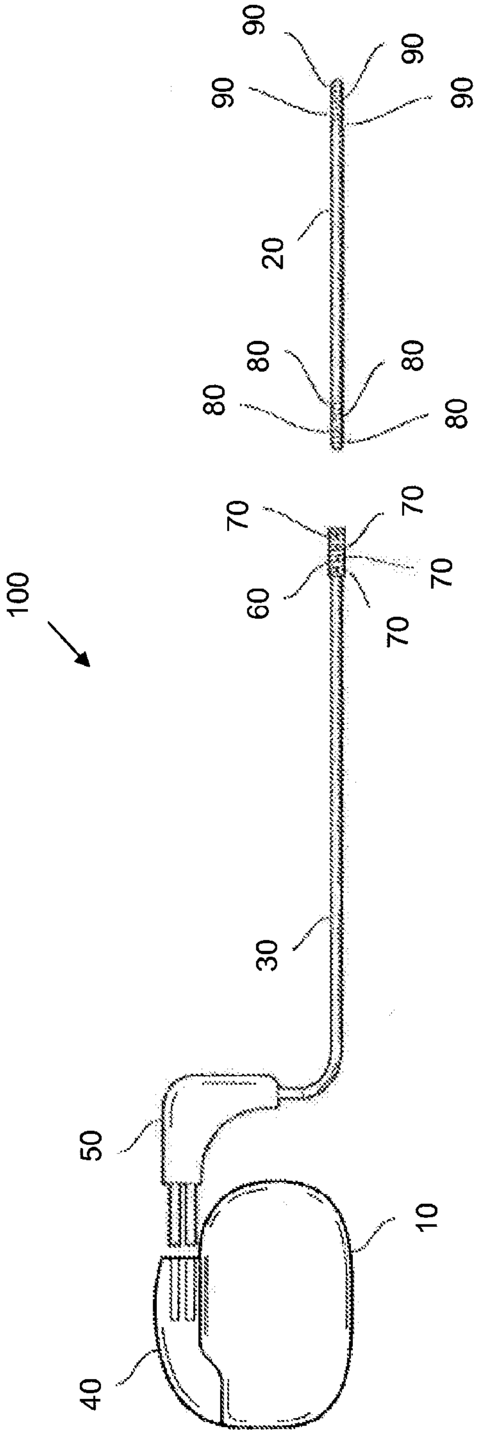
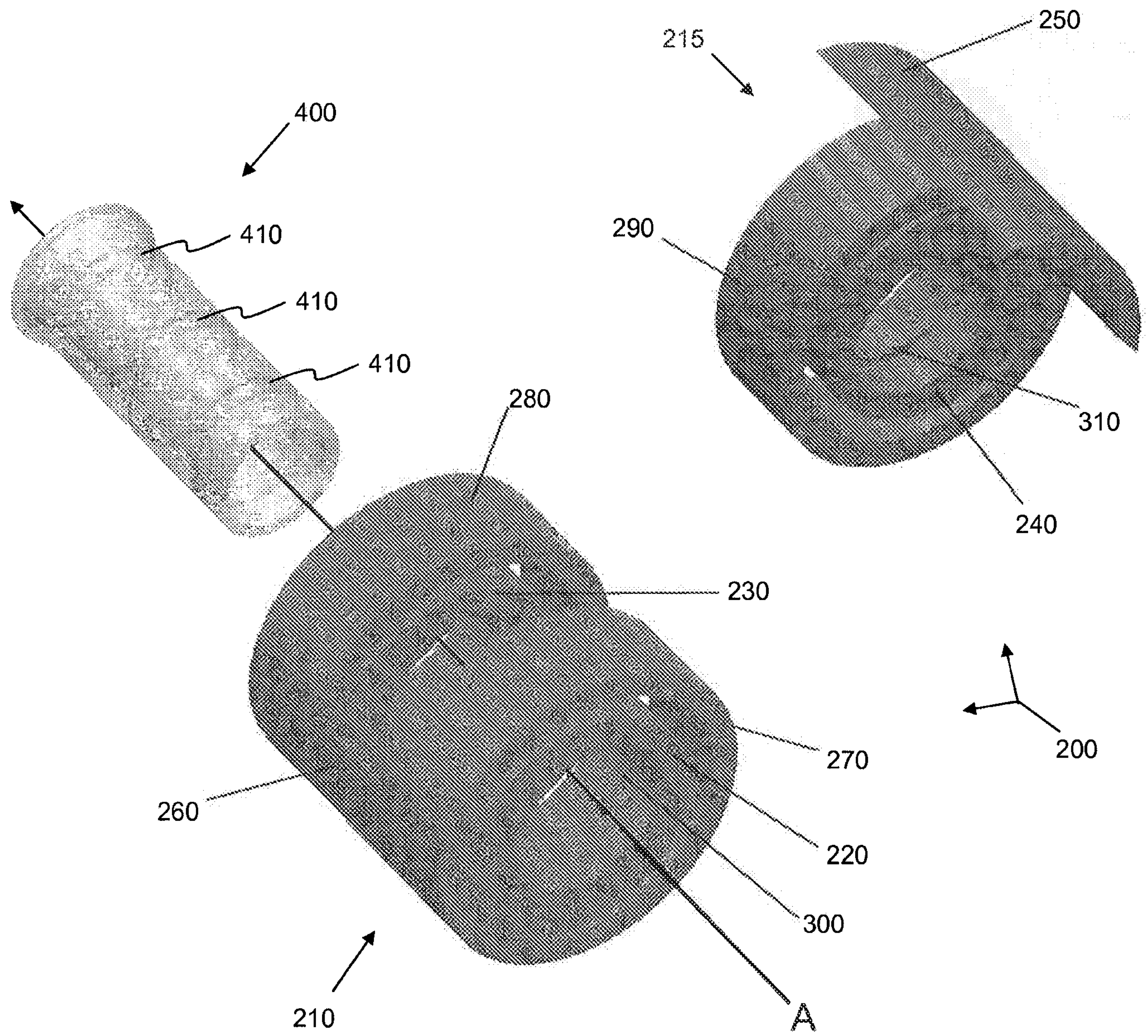


FIG. 2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290
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240
230
270
200
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220
300
210
A

FIG. 3

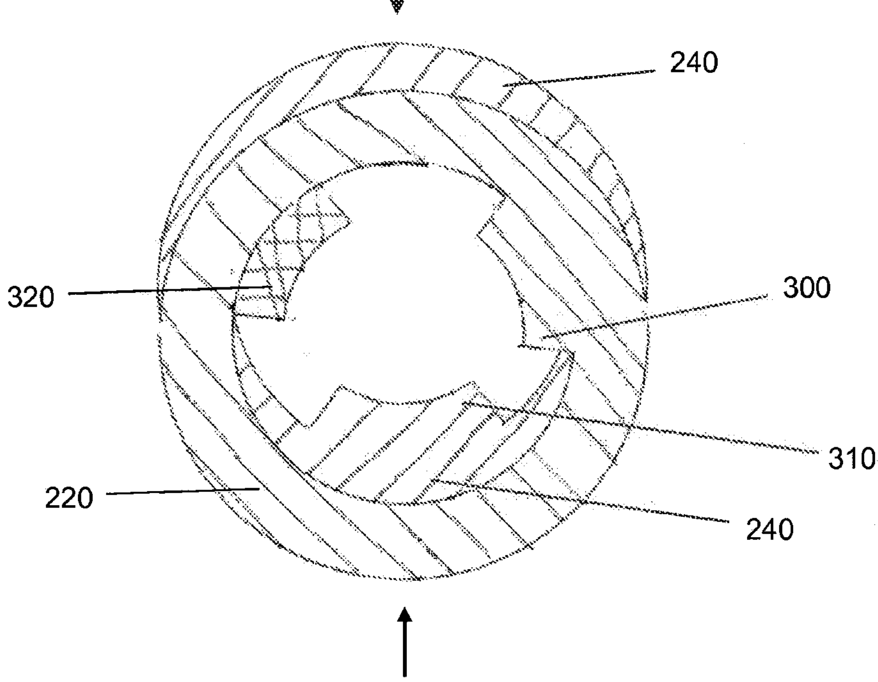


FIG. 4A

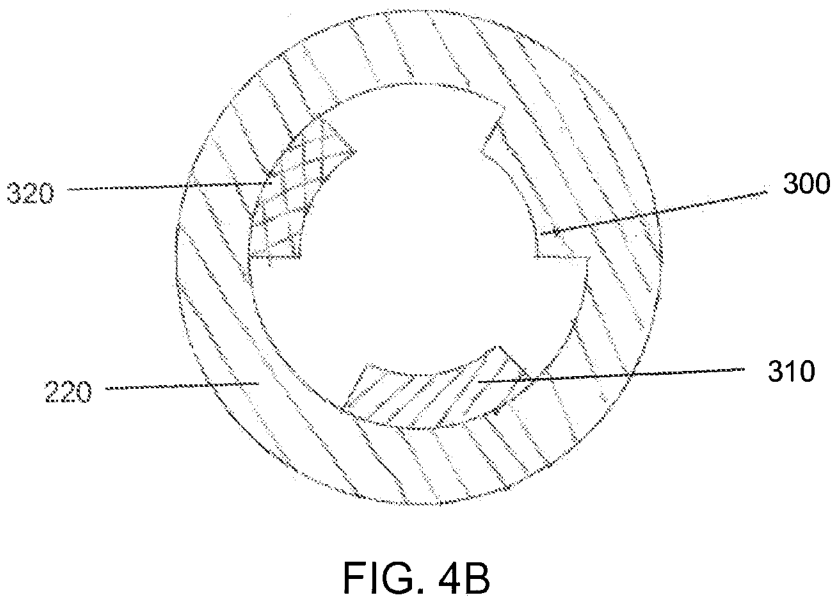
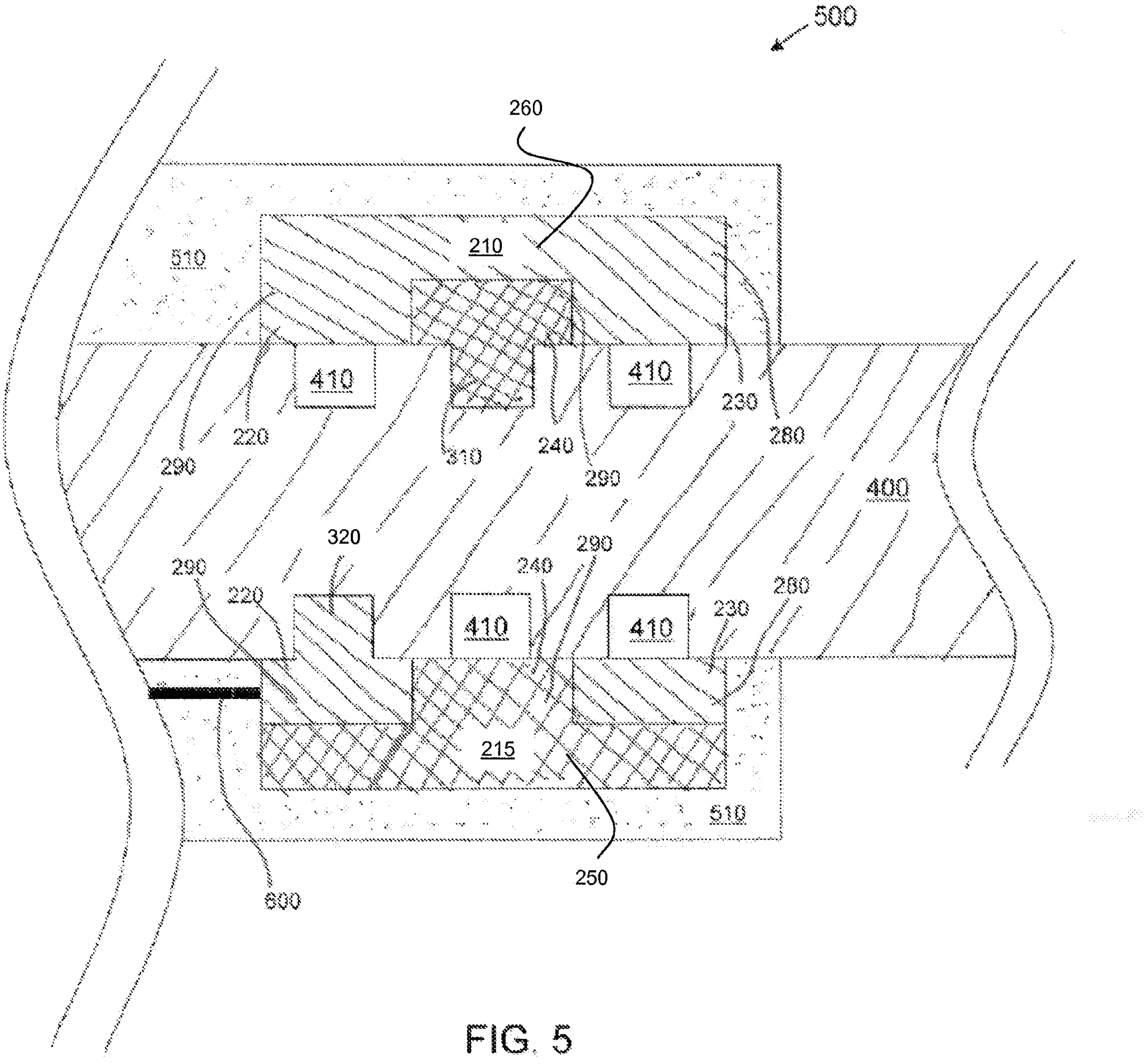


FIG. 4B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220
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410
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215
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600
250

FIG. 5

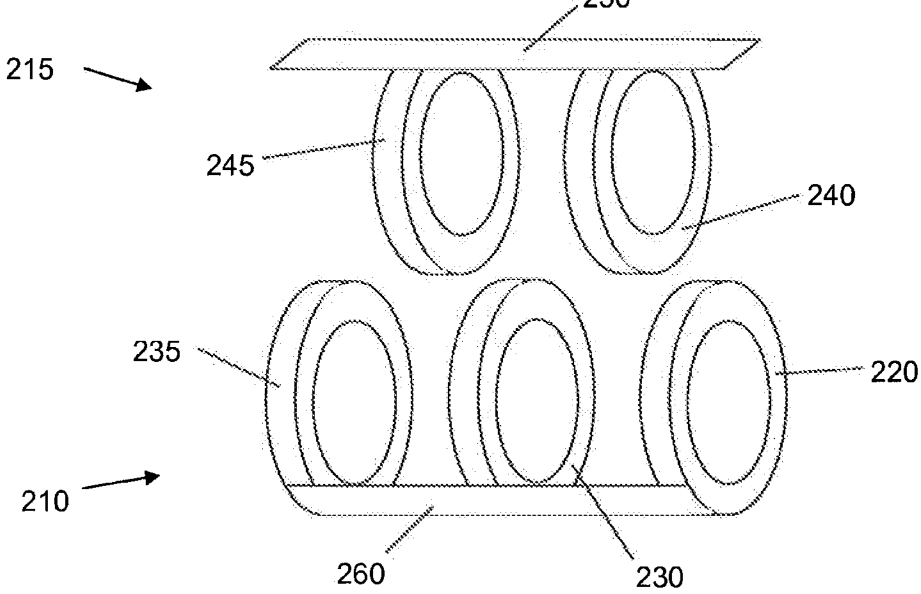


FIG. 6

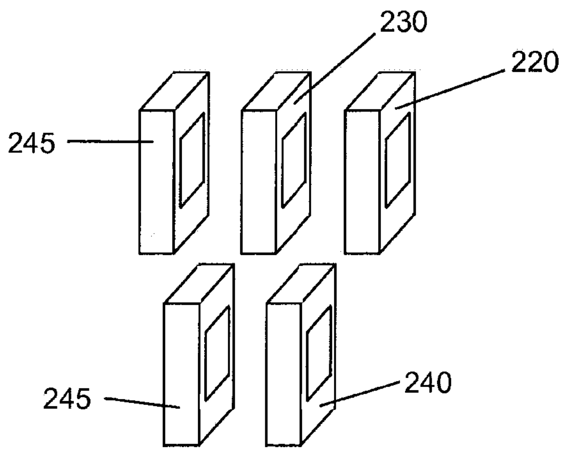
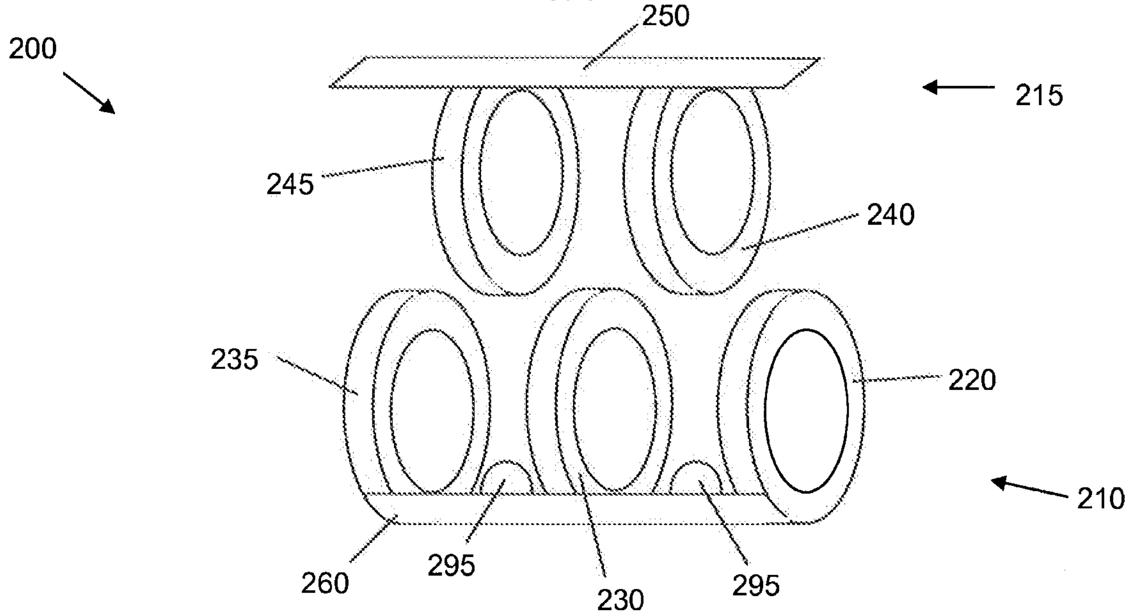


FIG. 7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235
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230
295

FIG. 8A

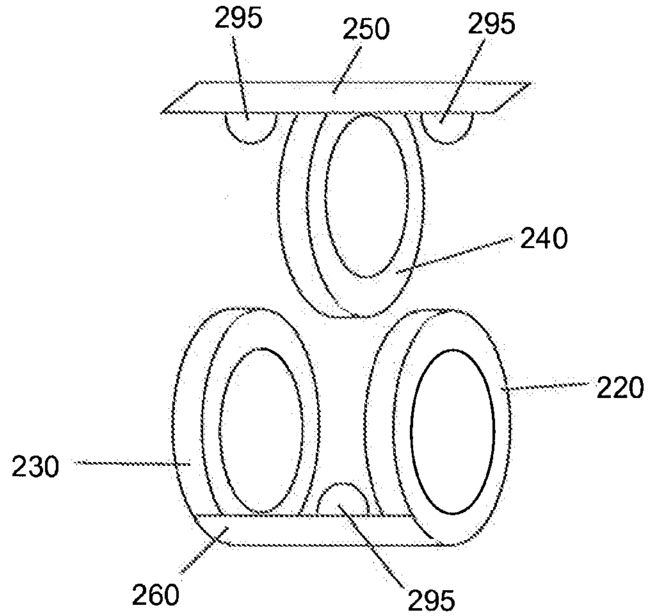
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FIG. 8B