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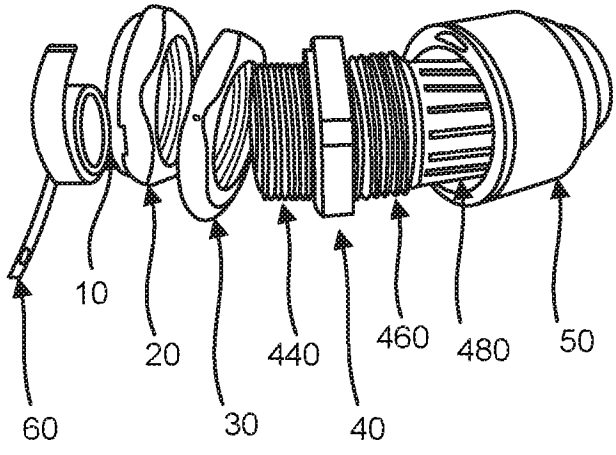
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(54) Title: CABLE GLAND AND METHOD AND APPARATUS FOR EARTHING A CABLE



(57) Abrégé/Abstract:
A cable gland 100 and method for earthing, bonding, and electromagnetic capability with armored, metal-clad, and metallic-sheathed cable types. The cable gland 100 includes an adjustable earthing coil 60 arranged internally in a gland body 40 of the cable gland 100 that secures around a cable inserted in the cable gland 100. When fully coiled, the adjustable earthing coil 60 is relaxed and as the adjustable earthing coil 60 is expanded it generates a restoring force. An earthing strap 1620 attached to the adjustable earthing coil 60 in the cable gland 100, provides grounding capabilities to the cable gland 100.

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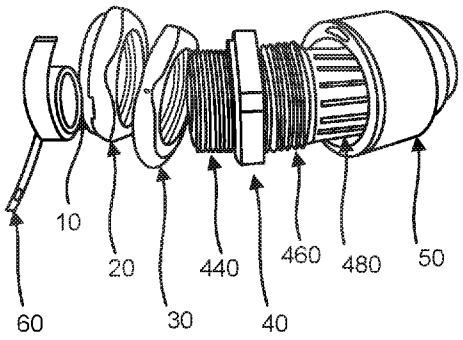


FIG. 1B

(57) Abstract: A cable gland 100 and method for earthing, bonding, and electromagnetic capability with armored, metal-clad, and metallic-sheathed cable types. The cable gland 100 includes an adjustable earthing coil 60 arranged internally in a gland body 40 of the cable gland 100 that secures around a cable inserted in the cable gland 100. When fully coiled, the adjustable earthing coil 60 is relaxed and as the adjustable earthing coil 60 is expanded it generates a restoring force. An earthing strap 1620 attached to the adjustable earthing coil 60 in the cable gland 100, provides grounding capabilities to the cable gland 100.

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CABLE GLAND AND METHOD AND APPARATUS FOR EARTHING A CABLE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims benefit of U.S. Provisional Application Serial No. 62/409,720, filed October 18, 2016, titled CABLE CONNECTOR (CABLE GLAND) FOR EARTHING, BONDING & ELECTROMAGNETIC CAPABILITY WITH ARMORED OR METAL CLAD CABLES which is hereby incorporated by reference in its entirety.

BACKGROUND

[0002] 1. Field of the Invention

[0003] The present invention and disclosed subject matter relate generally to cable glands, also referred to as cable connectors, and the invention more particularly relates to cable glands for earthing, bonding, and electromagnetic capability with armored, metal-clad, and metallic-sheathed cable types.

[0004] 2. Background

[0005] Industrial project designs and installations utilize armored, metal-clad, and metallic-sheathed cables as replacements to fixed rigid-conduit type installations. Conduit systems have historically been used to provide mechanical and environmental protection for cables. These metallic conduit systems are required to be earthed or bonded to provide protection against electrical short-circuit faults. Many different earthing and bonding products exist to meet these needs.

[0006] Armored, metal clad and metallic-sheathed cables are an alternative to these rigid-conduit systems, providing flexible metallic jackets which contain the individual cable conductors, providing mechanical and environmental protection, much the same as traditional rigid conduit systems. Armored, metal-clad, and metallic-sheathed cables must also be connected to a device to provide sealing at the point of the cable connection to an electrical enclosure such as a junction box or terminal box. The general purposes of these devices known as cable glands or cable connectors are 1) to protect the cable and the enclosure from environmental elements

such as rain and dust, 2) to provide strain relief through cable retention, 3) to provide earthing or bonding as protection against potential short-circuit faults, and 4) to provide electromagnetic capability (EMC), which involves addressing all the issues that may cause unwanted effects such as electromagnetic interference or even physical damage in operational equipment (i.e. interference mitigation). To provide this protection against short-circuit faults and to provide EMC, only metallic cable glands meet these market needs, and there is resistance to the use of non-metallic components in this field. Thus, buyers are left with the high price, heavy weight, and cumbersome installation requirements of using metallic cable glands.

SUMMARY

[0007] In accordance with an aspect of the present invention a cable gland is provided comprising: a washer sealant; a second washer; a first washer; an adjustable earthing coil; an outer housing; a gland body; wherein the gland body comprises—a sealing connector disposed in the gland body; a tapered area to be received in the outer housing; and a first set of threads adjacent to the tapered area on the gland body—wherein the outer housing has one or more apertures; and wherein the outer housing, once connected to the gland body, and rotated around the first set of threads on the gland body, is configured to compress the tapered area, allowing the sealing connector to tighten around a cable inserted into the cable gland. The cable gland provides the functions of an environmental seal and also provides for cable retention and strain relief that is critical for the sustained connection of the cable conductors to the termination point(s).

[0008] In accordance with another aspect of this invention a method of grounding cables threaded through a non-metallic cable gland that is comprised of a gland body, an outer housing, one or more washers, and an adjustable earthing coil, is provided comprising the steps of: inserting the adjustable earthing coil in one end of the cable gland, allowing an integrated tab of the adjustable earthing coil to protrude out of the cable gland; opening cable receiving apertures at each end of the cable gland; expanding the adjustable earthing coil to a circumference wide enough to receive a cable; inserting the cable through a first aperture of the cable gland, through the cable gland, and out a second aperture of the cable gland; tightening the cable

receiving aperture that is opposite of the end where the adjustable earthing coil was inserted, tight enough to hold and secure the cable gland in place on the cable; inserting an anti-short bushing around the cable, but between the armor, metal-cladding, or metal-sheathing of the cables and the individual conductors of the cable, in the area that will connect with the adjustable earthing coil; contracting the adjustable earthing coil inside the cable gland so that it tightens around the cable in the area on the cable that is exposed for grounding; and connecting the integrated tab of the adjustable earthing coil to a grounding element outside of the cable gland.

[0009] Thus an object of the present invention is to provide an improved cable gland. Another object of the present invention is to provide an improved earthing coil to assist in grounding cables. Yet another object of the invention is to provide an improved method for earthing cables.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The invention will now be illustrated in more detail, but not limited, by reference to the specific embodiment shown in the accompanying drawings, with greater emphasis being placed on clarity rather than scale:

[0011] FIG. 1(a) is a perspective view of an assembled cable gland according to an embodiment of the present invention;

[0012] FIG. 1(b) is a perspective view of a disassembled cable gland according to an embodiment of the present invention;

[0013] FIG. 1(c) is another perspective view of a disassembled cable gland according to an embodiment of the present invention;

[0014] FIG. 2(a) is a perspective view of the double washer combo—i.e. the washer sealant and the second washer—according to an embodiment of the present invention;

[0015] FIG. 2(b) is another perspective view of the double washer combo—i.e. the washer sealant and the second washer—according to an embodiment of the

present invention;

[0016] FIG. 3(a) depicts a washer according to an embodiment of the present invention;

[0017] FIG. 3(b) depicts another perspective of the washer according to an embodiment of the present invention;

[0018] FIGs. 4(a)-4(e) are different perspective views of a gland body according to an embodiment of the present invention;

[0019] FIG. 5(a) depicts a side view of an outer housing according to an embodiment of the present invention;

[0020] FIG. 5(b) depicts an aerial view of an outer housing according to an embodiment of the present invention;

[0021] FIG. 6(a) depicts an adjustable earthing coil according to an embodiment of the present invention;

[0022] FIG. 6(b) depicts another perspective of the adjustable earthing coil according to an embodiment of the present invention;

[0023] FIG. 6(c) depicts an expanded adjustable earthing coil according to an embodiment of the present invention;

[0024] FIGs. 7(a)-7(d) are different perspective views of the assembled cable gland with a cable wire running through it, according to an embodiment of the present invention;

[0025] FIGs. 8(a) and 8(b) depict views of an earthing insert clamp.

[0026] FIG. 8(c) depicts a closer view of the gland body where the earthing insert clamp is inserted and the groove on the gland body that the insert clamp connects to.

[0027] FIG. 9(a) & 9(b) are two perspective views of an adjustable earthing

insert clamp according to an embodiment of the present invention;

[0028] FIGs. 9(c) - (e) are different perspective views of the cable gland with the adjustable earthing insert clamp inserted into cable gland and a cable wire running through the cable gland, according to an embodiment of the present invention;

[0029] FIGs. 10(a) - (e) are different perspective views of an alternate adjustable earthing coil according to another embodiment of the present invention;

[0030] FIGs. 11(a) - (d) are different perspective views of yet another alternate adjustable earthing coil according to another embodiment of the present invention;

[0031] FIGs. 10(a) - (e) different perspective views of an alternate adjustable earthing coil according to another embodiment of the present invention;

[0032] FIG. 12 is a view of the cable gland in a disassembled state according to an embodiment of the present invention;

[0033] FIG. 13 is a side view of a cable gland according to an embodiment of the present invention;

[0034] FIGs. 14(a) & (b) are side views a gland body and a cable gland, respectively, according to an embodiment of the present invention;

[0035] FIG. 15 is a perspective view of a gland body of a cable gland according to yet another embodiment of the present invention;

[0036] FIG. 16 is front view of constant force spring, an earthing strap, and an integrated tab, according to an embodiment of the present invention;

[0037] FIG. 17 is a perspective view of a cable gland as it is used with the constant force spring according to yet another embodiment of the present invention; and

[0038] FIG. 18 is a perspective view of an assembled cable gland, according to an embodiment of the present invention.

DETAILED DESCRIPTION

[0039] The present disclosure relates generally to cable glands, also referred to in the industry as cable connectors, and more particularly to cable glands for earthing, bonding, and electromagnetic capability with armored, metal-clad, and metallic-sheathed cable types.

[0040] In FIG. 1(a) a perspective top view of an embodiment of an assembled cable gland **100** according to one embodiment is represented. The cable gland **100** comprises a gland body **40**, an outer housing **50** arranged externally at a tapered end **460** of the gland body **40**, a first washer **30** arranged externally on the gland body **40**, a second washer **20** arranged externally on the gland body **40**, a washer sealant **10** arranged externally on the gland body **40**, and an adjustable earthing coil **60** arranged internally in the gland body **40**. The gland body **40** comprises a second set of threads **440** connected to one end of the gland body **40** and a first set of threads **460** connected to the opposite end of the gland body **40**. The gland body **40** further comprises a tapered area **480** adjacent to the first set of threads that interacts with the outer housing **50**, see FIG. **1**(b) and FIG. **1**(b). FIG. **4**(c) depicts a sealing connector **482** disposed within the tapered area **480** of the gland body **40**. The gland body **40**, also has at least one release mechanism **420** disposed on the first set of threads **460** on the gland body **40**. In an embodiment, the gland body **40** further comprises one or more grooves or notches **442** around inside perimeter of the gland body **40**, see FIG. **4**(d). In an embodiment, the grooves or notches **442** around the inside perimeter of the gland body **40** are formed from different shapes, depths, and widths. In another embodiment, the gland body **40** further comprises a thin ledge or shelf **446** wrapping around the inner circumference of the gland body **40**. FIG. **5** depicts the outer housing **50** that interacts with the gland body **40**. The inside of the outer housing **50** is comprised of threads **510**. The outer housing **50** if further comprised of at least one or more apertures **520**. In another embodiment, the cable gland **100** further comprises an anti-short bushing **700**, see FIG. **8**.

[0041] FIG. **6**(a) depicts the adjustable earthing coil **60** in a relaxed coiled form, while FIG. **6**(c) depicts the adjustable earthing coil **60** in an expanded form. The adjustable

earthing coil **60** is a flat, tapered rectangular piece of material that is wound in a circular shape, each coil laying over the previous coil forming a flat curled ribbon. The wider end **640** of the tapered rectangular material forms the inner layer of the coil while the narrower end **650** of the tapered rectangular material forms the outer layer of the coil. A slight bend **620** is formed at the end of the coil and bent in the opposite direction the coil is curled in, and an integrated tab **610** is attached to the adjustable earthing coil **60** at a connection point **630**.

[0042] The adjustable earthing coil **60** is held in place in the cable gland **100** by a double-washer-sealant-combo **230**, see FIG. **2**. The double-washer-sealant-combo comprises a flat side of the washer sealant **10**, abutted to a flat side of second washer **20**, leaving no space between the washers, except for a small thin aperture **220**. The small thin aperture **220** is a fraction of the circumference of the two washers and drilled between the two abutting washers, from the outside perimeter of both washers through and into the inside perimeter of both washers, at a location along the circumference of the washer sealant **10** and the second washer **20**. In an alternate embodiment, the double-washer-sealant-combo comes already manufactured as one component, by way of injection molding.

[0043] In an alternate embodiment, the adjustable earthing coil **1010** is a flat circular material with an integrated tab **1030** attached to it as well as a star shaped hole **1020** cut through the center of the circular material and pushed out forming a star-shaped hole, see FIG. **10**(a)-(e).

[0044] In another embodiment, the adjustable earthing coil **1100** is a short cylinder with open end, wherein one end of the cylinder has several cuts made lengthwise towards the opposite end of the cylinder where there are no cuts, forming several flaps **1250**, wherein each flap except one is folded approximately **45** degrees towards the opening at the end of the cylinder where the cuts were made, see FIG. **11**. The one flap **1200**, not folded towards the opening at the end of the cylinder where the cuts were made, is folded outwards approximately **90** degrees in the opposite direction away from the opening at the end of the cylinder where the cuts were made, forming an integrated tab **1200**. In another

embodiment, each flap except one is folded in the range of approximately **35** to **55** degrees. In another embodiment, the one flap is folded outwards approximately **80-100** degrees in the opposite direction away from the opening at the end of the cylinder where the cuts were made.

[0045] In yet another embodiment, an adjustable earthing insert **800** is used in the cable gland **108**, see FIG. **8**(a)-**8**(c). The cable gland **108** is comprised of the washer **30**, the outer housing **50**, the adjustable earthing insert **800**, the gland body **40**, and the anti-short bushing **700**. In another embodiment, cable gland **108** further comprises a release mechanism **420** on the gland body **40**, see FIG. **4**(c), and a release mechanism **520** on the outer housing **50**, see FIG. **5** (a).

[0046] In an embodiment, the adjustable earthing insert **800** is comprised of a constant force spring **860** which is further comprised of a flat, rectangular piece of material that is wound in a circular shape along the inside perimeter of a cable clamp insert, each coil wrapping around the previous coil forming a flat curled ribbon . In an embodiment, the constant force spring **860** is mechanically attached to the cable clamp insert of the adjustable earthing insert **800**. In another embodiment, the constant force spring **860** fits into a groove or opening in the cable clamp insert of the adjustable earthing insert **800** and is fixed into place. In another embodiment, an integrated tab **810** is attached to the constant force spring **860** at a connection point. In an embodiment, the integrated tab **810** is attached to the connection point via a mechanical, soldered, or adhesive connection point. In yet another embodiment, an earthing strap **1620** is attached to the integrated tab **810**. In an embodiment, an earthing strap **1620** is attached to the constant force spring **860**, see FIG. **16**. In an embodiment, a first end of the earthing strap **1620** is attached to the integrated tab (not pictured) at a connection point. In another embodiment, the first end of the earthing strap **1620** is attached to the constant force spring **860** at a connection point. In an embodiment the earthing strap **1620** is attached via a mechanical, soldered, or adhesive connection. In an embodiment, the earthing strap **1620** is an earthing braid or earthing cable and is made out of conductive metals. In another embodiment, an anti-short bushing **700** is

also attached to the adjustable earthing insert **800**. The anti-short bushing **700** is attached to the edge circumference of the constant force spring **860** that comes into contact with a cable that is threaded through the cable gland.

[0047] In yet another embodiment, an adjustable earthing insert clamp **900** is used in the cable gland **109**, see FIG. **9**(a)-**9**(e). The cable gland **109** is comprised of the washer **30**, the outer housing **50**, the adjustable earthing insert clamp **900**, the gland body **40**, and the anti-short bushing **700**. In another embodiment, cable gland **109** further comprises a release mechanism **420** on the gland body **40**, see FIG. **4**(c), and a release mechanism **520** on the outer housing **50**, see FIG. **5** (a).

[0048] In an embodiment, the adjustable earthing insert clamp **900** is comprised of an adjustable cable insert clamp. In an embodiment, the adjustable earthing insert clamp **900** further comprises an integrated tab **910** attached to the adjustable earthing insert clamp **900** at a connection point. In an embodiment, the integrated tab **910** is attached to the connection point via a mechanical, soldered, or adhesive connection point. In yet another embodiment, the integrated tab **910** is attached to the adjustable earthing insert clamp **900**. In an embodiment, an earthing strap **1770** is attached to the adjustable earthing insert clamp **900**. In an embodiment, a first end of the earthing strap **1760** is attached to the integrated tab **910** at a connection point. In another embodiment, the first end of the earthing strap **1760** is attached to the adjustable earthing insert clamp **900** at a connection point. In an embodiment the earthing strap is attached via a mechanical, soldered, or adhesive connection. In an embodiment, the earthing strap is an earthing braid or earthing cable and is made out of conductive metals. In an embodiment, an anti-short bushing **700** is also attached to the adjustable earthing insert clamp **900** to the edge circumference of the clamp **900** that comes into contact with a cable that is threaded through the cable gland.

[0049] In one embodiment, the cable gland **100** is assembled by connecting the outer housing **50** to the tapered area **480** of the gland body **40** and rotating the outer housing **50** around the first set of threads **460** on the gland body **40**. The outer housing **50** is configured to compress the tapered area **480** of the gland body, allowing the sealing

connector gland **482** inside the gland body, to tighten around a cable. In another embodiment, the release mechanism **420** on the gland body **40** is a spring button. Once the outer housing **50** has been torqued to a predetermined tightness, the aperture **520** in the outer housing **50** will align with the release mechanism **420** on the gland body. The spring button **420** interacts with the aperture **520** on the outer housing **50** and changes from a depressed position to a raised position. The spring button **420** further aids in maintaining the outer housing's **50** location in relation to the gland body **40**. In an embodiment, the raised position of the spring button **420** provides a visual indicator that the cable gland **100** has been sufficiently tightened.

[0050] In another embodiment, the release mechanism **420** on the gland body **40** is one or more apertures in the tapered area **480**. The outer housing **50** also has one or more apertures **520**. The outer housing **50** interacts with the gland body **40** and is torqued to a predetermined tightness; the one or more apertures **520** in the outer housing **50** are configured to align with the one or more apertures **420** in the gland body **40** and configured to receive at least one set screw. When the apertures align, at least one set screw is installed and holds the outer housing **50** and the gland body **40** together in place. In an embodiment, the at least one set screw serves as a visual indicator that the cable gland **100** has been sufficiently torqued and serves as a visual indicator that the assembly is complete. If a set screw is not properly engaged, the set screw will protrude and an installer can ascertain that the set screw has not been properly engaged or the cable gland **100** has not been sufficiently torqued.

[0051] In another embodiment, the at least one set screw will have a dip or a pain bubble on the threads to provide another visual indication as to whether or not the cable gland **100** has been sufficiently torqued. The threads of the at least one set screw is painted a bright color, and when sufficiently tightened, the threads would no longer be visible, thus providing a visual indicator that the cable gland **100** has been sufficiently torqued and the at least one set screw sufficiently tightened. In yet another embodiment, the at least one set screw is hollow with a paint bubble at the end of the threads.

[0052] In another embodiment, the gland body **40** has an alternate method of visually indicating that the cable gland **100** has been sufficiently torqued. Referring to FIG. **15**, there is a length **1524** of threads **1522** of the cable body **1520** that is colored. This colored length **1524** corresponds to a minimum tightness that is needed to secure the cable gland **100** to a cable inserted in the cable gland **100**. An installer would tighten the outer housing **50** past the colored length **1524**. This would serve as a visual indicator that the cable gland **100** has been sufficiently tightened. These colored lengths will vary depending on the outside diameter of the cable.

[0053] After sufficiently tightening the cable gland **100** around a cable, the first washer **30** is connected to the gland body **40**. In an embodiment, the first washer **30** has threads **330** around the inner circumference of the first washer **30**. To connect the first washer **30** to the gland body **40**, the threads **330** of the first washer **30** interact with a second set of threads **440** located on the gland body **40**. After the first washer **30** is connected to the gland body **40**, the double-washer-sealant-combo **230** is connected to the gland body **40**. In an embodiment, the double-washer-sealant-combo **230** has threads **240** around the inner circumference of the double-washer-sealant-combo **230**. To connect the double-washer-sealant-combo **230** to the gland body **40**, these threads **240** also interact with the second set of threads **440** located on the gland body **40**. Once the double-washer-sealant-combo **230** is connected to the gland body **40**, the adjustable earthing coil **60** is inserted inside the double-washer-sealant-combo **230** and also inside the gland body **40**. The adjustable earthing coil **60** is held in place by first inserting the integrated tab **610** of the adjustable earthing coil **60** into the thin aperture **220** in the double-washer-sealant-combo, from the inside circumference of the double-washer-sealant-combo, through the double-washer-sealant-combo, and out, so that the integrated tab **610** protrudes out on the outside of the cable gland **100** while the remainder of the adjustable earthing coil **60** is held in place inside the cable gland **100**, see FIG. **7**(A)-**7**(D). The adjustable earthing coil **60** is held in place secondly, when the bend **620** at the end of its coil lodges into the at least one or more grooves **442** in the gland body.

[0054] In an embodiment, the adjustable earthing coil **60** expands and contracts when the bend **620** at the end of the adjustable earthing coil **60** lodges into the at least one or more grooves **442** in the gland body **40** as the double-washer-sealant-combo **230** is rotated around the second set of threads **440** on the gland body **40**. The adjustable earthing coil **60** expands as force is applied rotating the double-washer-sealant-combo **230** around the second set of threads **440** on the gland body **40** in the direction opposite of the direction the adjustable earthing coil **60** is coiled. The adjustable earthing coil **60** automatically contracts once the force being applied rotating the double-washer-sealant-combo **230** is released. One that force is released, the adjustable earthing coil **60** immediately contracts and coils back up to its original tightness, snapping firmly around the cable armor, metal-cladding, or metal-sheathing to provide the connection for proper earthing or bonding, that is in the cable gland **100**, rotating the double-washer-sealant-combo **230** back in the opposite direction the force was being applied. In an embodiment, an anti-short bushing **700** is connected to the cable to prevent the cable from cutting or shorting over time from repeated expanding or contracting of the adjustable earthing coil **60** or from repeated contact with edges of different parts of the cable gland **100**. In an embodiment, the cable gland **100** is made up of a non-metallic material.

[0055] In one embodiment, the adjustable earthing coil **60** is a constant force spring. When the constant force spring is fully rolled up, the constant force spring is relaxed. When the constant force spring is unrolled, a restoring force is generated working to force the constant force spring back into its relaxed rolled up position.

[0056] In another embodiment, the first washer **30** is connected to the gland body **40**, and then the adjustable earthing insert **800** is inserted into the gland body **40** of the cable gland **100**. In an embodiment, the adjustable earthing insert **800** is held in place first by the firm fit and snap in of the adjustable earthing insert **800** into the gland body **40**, and secondly by lodging into the ledge or shelf **446** in the inner circumference of the gland body.

[0057] In another embodiment, the constant force spring **860** in the adjustable earthing insert **800** expands and contracts the constant force spring **860** is rotated around the inside of the adjustable earthing insert **800** and the gland body **40**. More specifically the adjustable earthing insert **800** expands as force is applied rotating the constant force spring **860** around the inside of the gland body **40** in the direction opposite of the direction the constant force spring **860** or adjustable earthing coil **60** is coiled. The constant force spring **860** and adjustable earthing coil **60** are similar and can be referenced interchangeably. The constant force spring **860** automatically contracts once the force rotating it is released. One that force is released, the constant force spring immediately contracts and coils back up to its original tightness, snapping firmly around the cable that is in the cable gland **100**. In an embodiment, the maximum force generated when the coil is completely rolled out remains constant no matter how many times the coil has been rolled and unrolled. In its relaxed state, the material's inner circumference coil rolls up to as small as the circumference the smallest available cable diameter. In another embodiment, the material's inner circumference coil rolls up to as small as approximately **2-4** millimeters.

[0058] In an embodiment, the adjustable earthing coil **60** serves as the electrical connection point to a cable. The integrated tab **610** serves as a connection point between the adjustable earthing coil **60** and an earthing strap **1620**, see FIG. **16**. The earthing strap **1620** is attached to integrated tab **610** of the adjustable earthing coil **60** at a first end of the earthing strap **1620**. The second end **1630** of the earthing strap **1620** is attached to an earthing or bonding point of an electrical equipment. In an embodiment, the earthing strap **1620** is attached to the adjustable earthing coil **60** via a mechanical, soldered, or adhesive connection point creating a single, integrated earthing and bonding device. In an embodiment, the earthing strap **1620** is a braided material or earthing braid or earthing cable and is made out of conductive metals. In an embodiment, the adjustable earthing coil **60** is a constant force spring. In another embodiment, the adjustable earthing coil **60** is configured to create a spiral cone upwards within the body of the cable gland **100**, along the cable inserted in the cable gland **100**. The spiral cone of the adjustable earthing coil **60** forms a cone or a sleeve. The sleeve is configured to receive sealant. Alternatively, an

independent sleeve is used to receive a sealant. The purpose of the cone or sleeve is to hold the sealant and to inhibit the potential migration of flammable gases or liquids into and through the interior of the cable to an area that has exposed electrical arcing, mitigating a potential explosion. In an embodiment, the sealant is an epoxy, resin, putty, or a different type of sealant.

[0059] FIG. **17** shows a fully assembled cable gland **1700** in one embodiment. The earthing strap **1770** has a first end that is attached to the integrated tab (not pictured) of the adjustable earthing coil **1760** that is fitted inside the gland body **1720**, and a second end **1760** that will be attached to the earthing or bonding point of an electrical equipment. In another embodiment, the adjustable earthing coil **1760** extends along the cable inserted in the cable gland **1700**, and forms a cone or a sleeve. The sleeve is configured to receive epoxy or a different type of sealant. Alternatively, an independent sleeve is used to receive a sealant.

[0060] In another embodiment, a method for grounding a cable passing through the cable gland **100** that is comprised of a washer sealant **10**, a second washer **20**, a first washer **30**, an adjustable earthing coil **60**, an outer housing **50**, a gland body **40**; wherein the gland body **40** comprises a sealing connector **482** disposed in the gland body **40**, a tapered area **480** to be received in the outer housing **50**, and a first set of threads **460** adjacent to the tapered area on the gland body; wherein the outer housing has one or more apertures; comprises the steps of:

1) inserting the adjustable earthing coil **60** in one end of the assembled cable gland **100**, allowing an integrated tab **610** attached to the adjustable earthing coil **60** to protrude out of the cable gland **100**;

2) opening cable receiving apertures at each end of the cable gland **100**;

3) expanding the adjustable earthing coil **60** to a circumference wide enough to receive a cable;

4) inserting the cable through a first aperture in the cable gland **100**, threading the cable through the cable gland **100**, and out of a second aperture in the cable gland **100**;

5) tightening the cable receiving aperture that is opposite of the end where the adjustable earthing coil **60** was inserted, tight enough to hold and secure the cable gland **100** in place on the cable;

6) inserting an anti-short bushing **700** around the cable in the area that will interact with the adjustable earthing coil **60**;

7) contracting the adjustable earthing coil **60** inside the cable gland **100** so that it tightens around the cable in the area on the cable that is exposed for grounding; and

8) connecting the adjustable earthing coil **60** to a grounding element outside of the cable gland **100**.

[0061] In another embodiment, the method of expanding the adjustable earthing coil **60** comprises lodging the end of the adjustable earthing coil **60** into at least one or more grooves **442** in the gland body **40** of the cable gland **100** and rotating the cable gland in the direction opposite of the direction the adjustable earthing coil is curled in.

[0062] In another embodiment, the method of tightening the end of the cable gland **100** that is opposite to where the adjustable earthing coil **60** is inserted comprises rotating the outer housing **50** of the cable gland **100** around the first set of threads **460**.

[0063] In another embodiment, the method of contracting the adjustable earthing coil **60** comprises lodging the end of the adjustable earthing coil **60** into the at least one or more grooves **442** in the gland body **40** of the cable gland **100** and releasing and pressure being applied to the adjustable earthing coil **60** that is forcing it to rotate in the direction opposite of the direction the adjustable earthing coil **60** is curled in. In another embodiment one or more grooves **442** are in the gland body. In another embodiment the grooves are comprised of different shapes, depths, and widths.

[0064] In another embodiment, the method of contracting the adjustable earthing coil **60** comprises lodging the end of the adjustable earthing coil **60** into the at least one or more grooves **442** in the gland body **40** of the cable gland **100** and rotating second washer **20** around the second set of threads **440** on the cable gland **100**, in the same direction that the adjustable earthing coil **60** is curled in.

[0065] In another embodiment, the method of connecting the adjustable earthing coil **60** to a grounding element outside the cable gland **100** comprises attaching a first end of an earthing strap **1620** to an integrated tab **610** that is attached to the adjustable earthing coil **60**, and attaching the second end of the earthing strap **1630** to an earthing point outside the cable gland **100**.

[0066] In another embodiment, the method of connecting the adjustable earthing coil **60** to a grounding element outside the cable gland **100** comprises attaching the first end of an earthing strap **1620** to the adjustable earthing coil **60** via a mechanical, soldered, or adhesive connection point creating a single, integrated earthing and bonding device, and attaching the second end of the earthing strap **1630** to an earthing point outside the cable gland **100**.

EMBODIMENTS IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A cable gland comprising:

a gland body;

an outer housing having at least one aperture for connection to a first end of the gland body;

a washer capable of being arranged externally on opposite end of the gland body;

and an adjustable earthing insert arranged internally in the gland body;

wherein the gland body comprises:

a sealing connector disposed in the gland body;

a tapered area that is configured to be received in the at least one aperture of the outer housing; and

a first set of threads adjacent to the tapered area on the gland body;

wherein the outer housing has one or more apertures; and

wherein the outer housing, once connected to the gland body, and rotated around the first set of threads on the gland body, is configured to compress the tapered area, forcing the sealing connector to contract in circumference.

2. The cable gland of claim **1**, wherein a portion of the length of the first set of threads on the gland body are colored.

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3. The cable gland of claim **1**, wherein the adjustable earthing insert is a constant force spring comprised of a rectangular flat piece of material wound in a circular shape inside the perimeter of a cylindrical insert, each coil wrapping around the previous coil forming a flat curled ribbon, with an end of the coil forming a slight bend in the opposite direction the coil is curled in.

4. The cable gland of claim **3** wherein an integrated tab is attached to the adjustable earthing insert.

5. The cable gland of **4**, wherein an anti-short bushing is attached to the adjustable earthing insert.

6. The cable gland of claim **5**, wherein the washer is first arranged on the gland body, then the adjustable earthing insert is inserted into the gland body.

7. The cable gland of claim **6**, wherein the adjustable earthing insert is secured in the gland body by lodging the bend at the end of the adjustable earthing insert into at least one or more grooves in the gland body.

8. The cable gland of claim **6** wherein the adjustable earthing insert is inserted by fitting the adjustable earthing insert into a circular ledge around the inside perimeter of the gland body.

9. The cable gland of claim **6**, wherein the adjustable earthing insert expands as force is applied to rotate the adjustable earthing insert inside the gland body, and contracts when that force is released.

10. The cable gland of claim **1**, wherein the cable gland is made up of a non-metallic material.

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11. A cable gland comprising:

a gland body;

an outer housing having at least one aperture for connection to one end of the gland body;

a washer capable of being arranged externally on the gland body;

and an adjustable earthing coil arranged internally in the gland body;

wherein the gland body comprises:

a sealing connector disposed in the gland body;

a tapered area that is configured to be received in the outer housing; and

a first set of threads adjacent to the tapered area on the gland body;

wherein the outer housing has one or more apertures; and

wherein the outer housing, once connected to the gland body, and rotated around the first set of threads on the gland body, is configured to compress the tapered area, forcing the sealing connector to contract in circumference.

12. The cable gland of claim **11**, wherein a portion of the length of the first set of threads on the gland body are colored.

13. The cable gland of claim **11**, wherein the adjustable earthing coil comprises an adjustable cable insert clamp.

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14. The cable gland of claim **13** wherein an integrated tab is attached to the adjustable earthing coil.

15. The cable gland of **14**, wherein an anti-short bushing is attached to the adjustable earthing coil.

16. The cable gland of claim **15**, wherein the washer is first arranged externally about a second set of threads on the gland body and then the adjustable earthing coil is inserted into the gland body at an end of the gland body where the second set of threads are housed.

17. The cable gland of claim **16**, wherein the adjustable earthing coil is secured in the gland body by fitting the adjustable earthing coil into a circular ledge around the inside perimeter of the gland body.

18. The cable gland of claim **11**, wherein the cable gland is made up of a non-metallic material.

19. A method for grounding a cable passing through a cable gland comprised of a washer sealant, a second washer, a first washer, an adjustable earthing coil, an outer housing, and a gland body; wherein the gland body comprises a sealing connector disposed in the gland body, a tapered area to be received in the outer housing, and a first set of threads adjacent to the tapered area on the gland body; and wherein the outer housing has one or more apertures; comprises the steps of:

inserting the adjustable earthing coil in one end of the cable gland, allowing an integrated tab attached to the adjustable earthing coil to protrude out of the cable gland;

opening cable receiving apertures at each end of the cable gland;

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expanding the adjustable earthing coil to a circumference wide enough to receive a cable;

inserting the cable through a first aperture in the cable gland, threading the cable through the cable gland, and out of a second aperture in the cable gland; tightening the cable receiving aperture that is opposite of the end where the adjustable earthing coil was inserted, tight enough to hold and secure the cable gland in place on the cable;

contracting the adjustable earthing coil inside the cable gland so that it tightens around the cable in the area on the cable that is exposed for grounding; and

connecting the adjustable earthing coil to a grounding element outside of the cable gland.

20. The method of claim **19**, wherein inserting the adjustable earthing coil comprises:

inserting the adjustable earthing coil in between two washers at one end of the cable gland; and

rotating the adjustable earthing coil so that the end of the coil lodges into at least one or more grooves in the body of the cable gland.

21. The method of claim **19**, wherein expanding the adjustable earthing coil comprises lodging the end of the adjustable earthing coil into the at least one or more grooves in the gland body of the cable gland and rotating the cable gland in the direction opposite of the direction the adjustable earthing coil is curled in.

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22. The method of claim **19**, wherein tightening the end of the cable gland opposite to where the adjustable ground coil is inserted comprises rotating the outer housing of the cable gland around the first set of threads adjacent to the tapered area on the gland body.

23. The method of claim **19**, wherein contracting the adjustable earthing coil comprises lodging the end of the adjustable earthing coil into the at least one or more grooves in the gland body of the cable gland and releasing any pressure being applied to the adjustable earthing coil that is forcing it to rotate in the direction opposite of the direction the adjustable earthing coil is curled in.

24. The method of claim **19**, wherein contracting the adjustable earthing coil comprises lodging the end of the adjustable earthing coil into at least one or more grooves in the gland body of the cable gland and rotating the second washer around a second set of threads on the gland body in the same direction that the adjustable earthing coil is curled in

25. The method of clam **24**, wherein contracting the adjustable earthing coil further comprises extending the coil along the inside of the cable gland forming a sleeve configured to receive a sealant.

26. The method of claim **19**, wherein connecting the adjustable earthing coil to a grounding element outside the cable gland comprises attaching a first end of an earthing strap to an integrated tab that is attached to the adjustable earthing coil, and attaching the second end of the earthing strap to an earthing point outside the cable gland.

27. The method of claim **19**, wherein connecting the adjustable earthing coil to a grounding element outside the cable gland comprises attaching a first end of an

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earthing strap to the adjustable earthing coil and attaching the second end of the earthing strap to an earthing point outside the cable gland.

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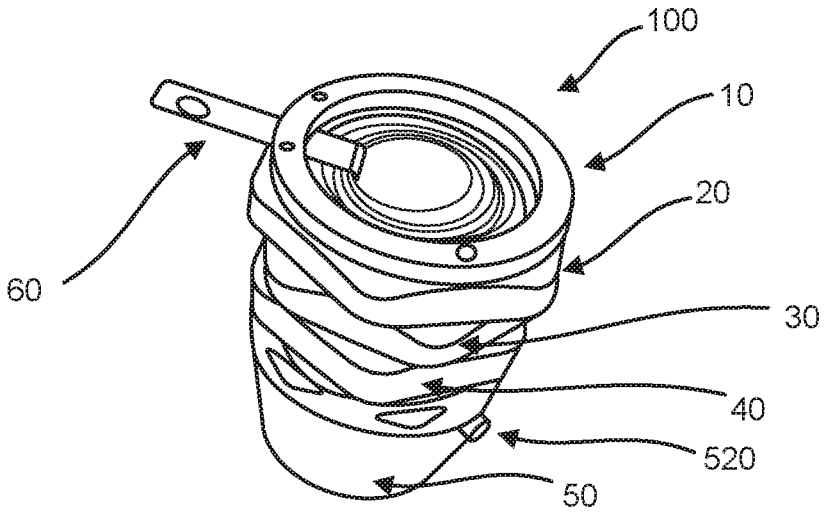


FIG. 1A

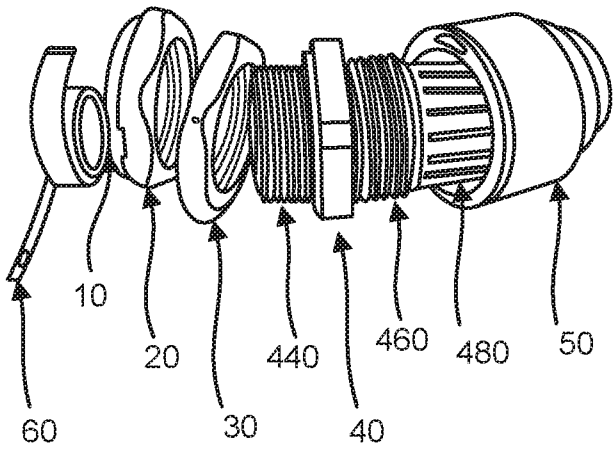


FIG. 1B

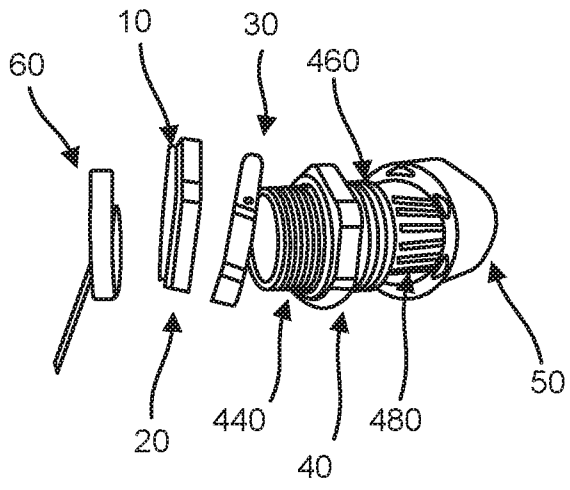


FIG. 1C

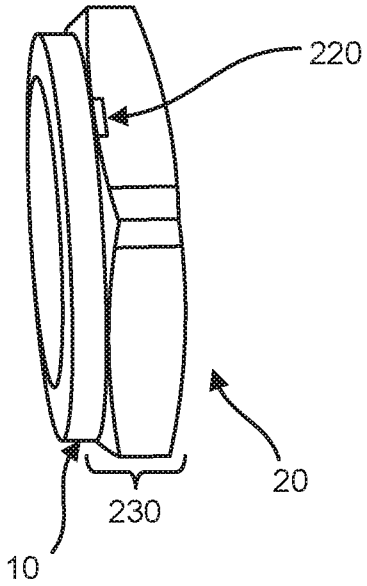


FIG. 2A

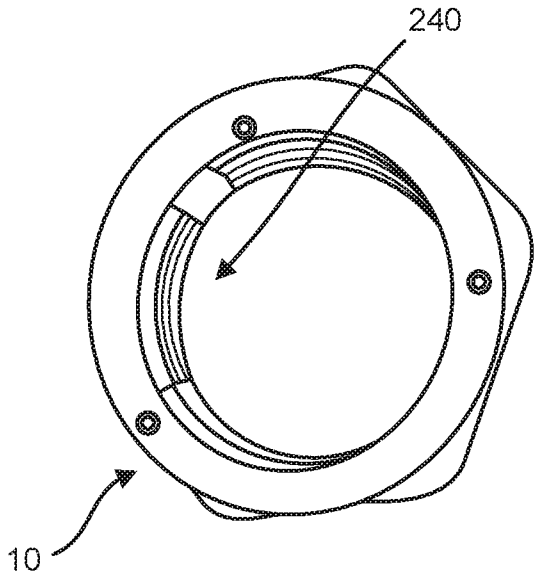


FIG. 2B

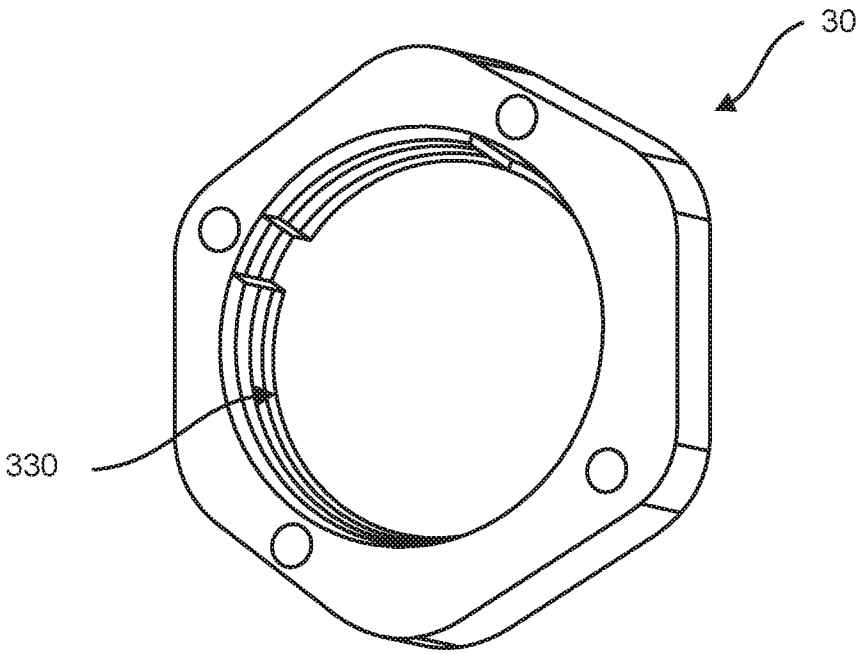


FIG. 3A

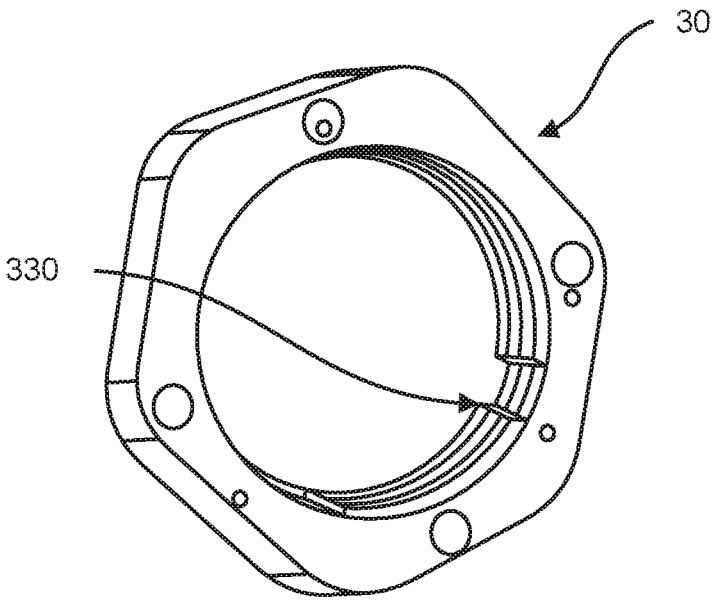


FIG. 3B

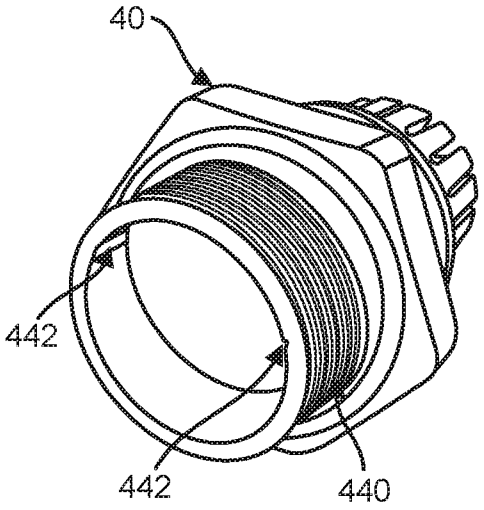


FIG. 4A

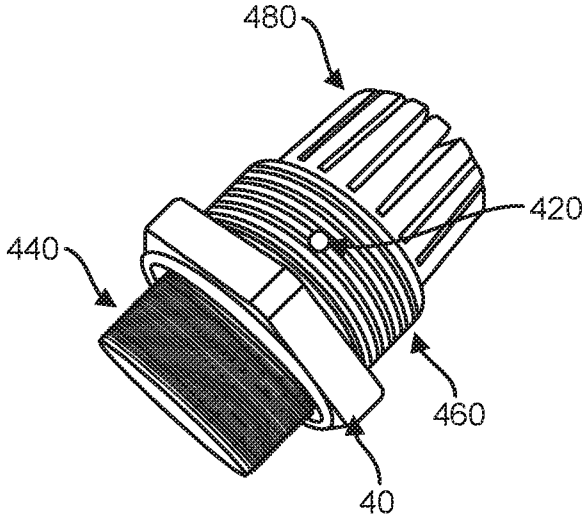


FIG. 4B

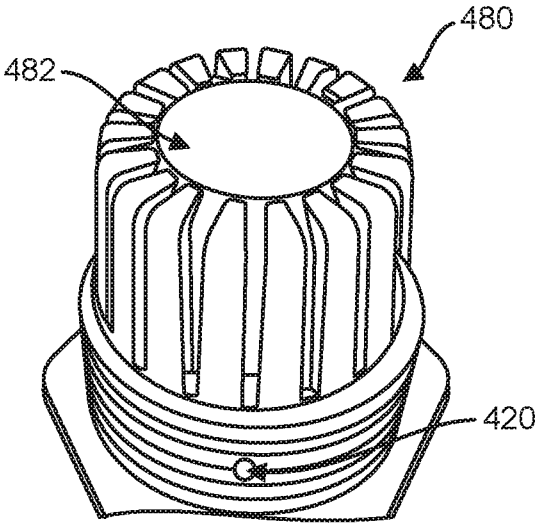


FIG. 4C

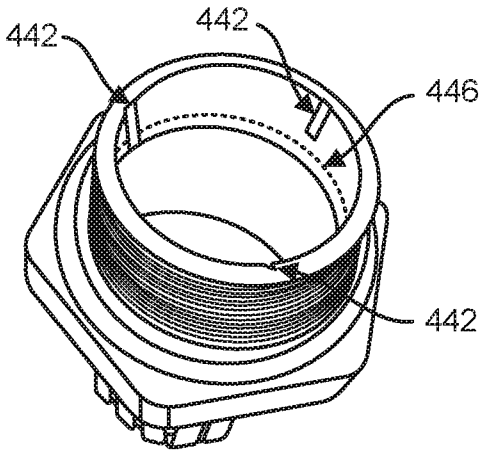


FIG. 4D

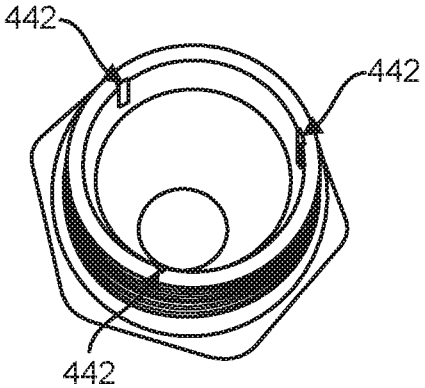


FIG. 4E

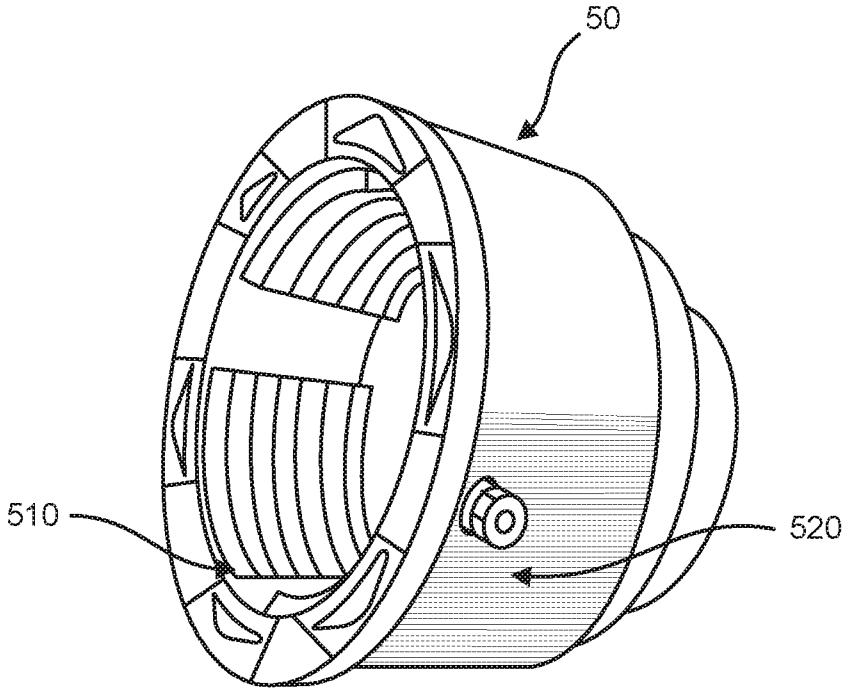


FIG. 5A

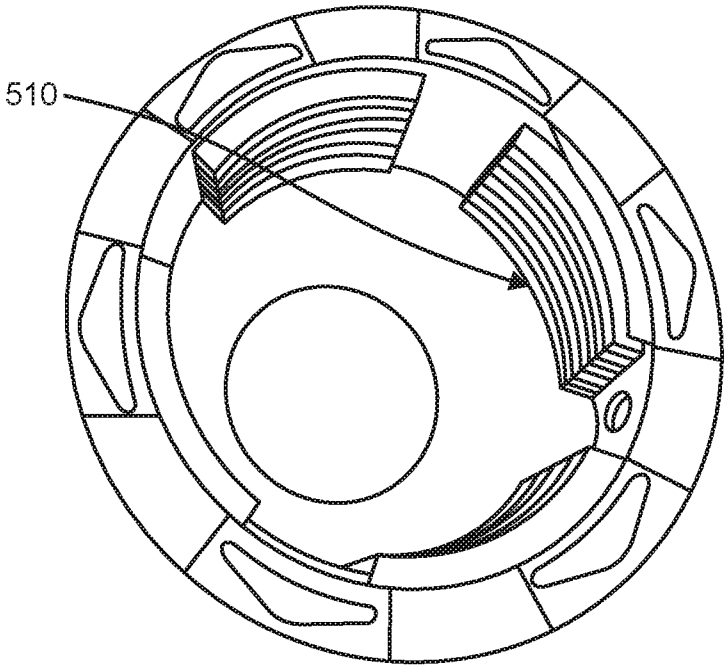


FIG. 5B

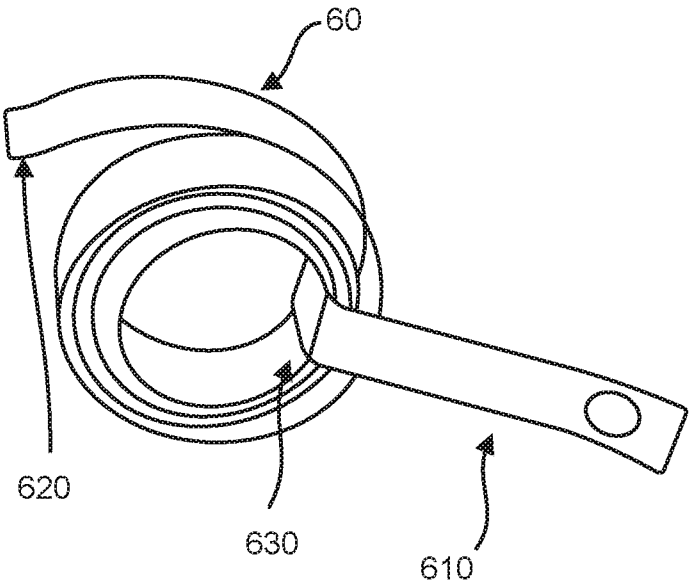


FIG. 6A

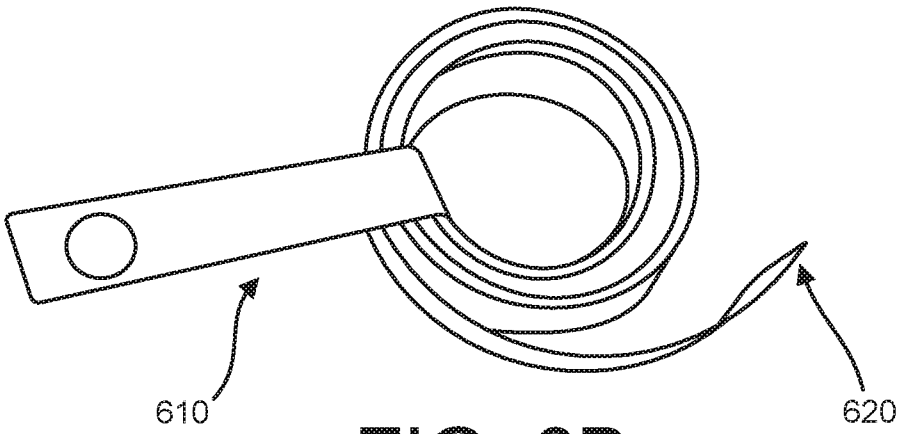


FIG. 6B

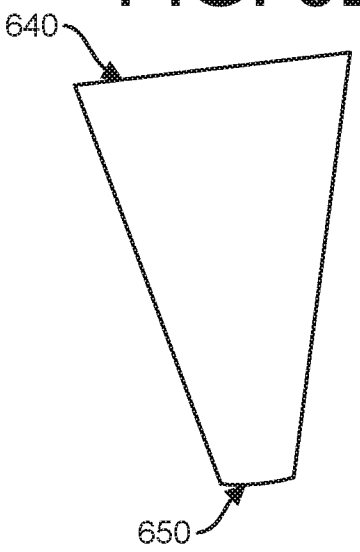


FIG. 6C

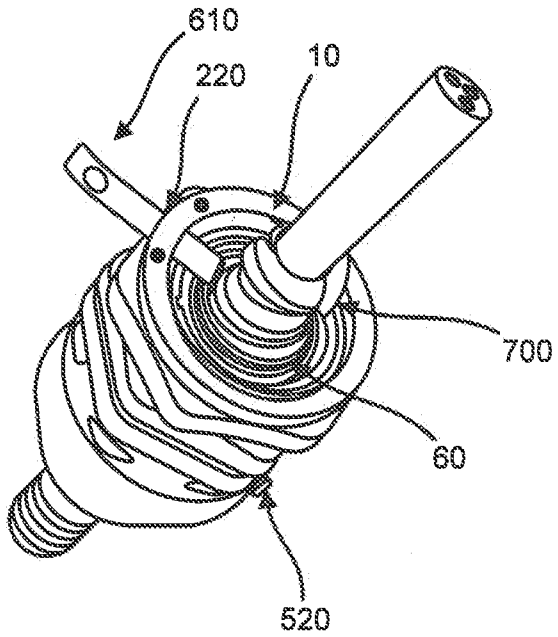


FIG. 7A

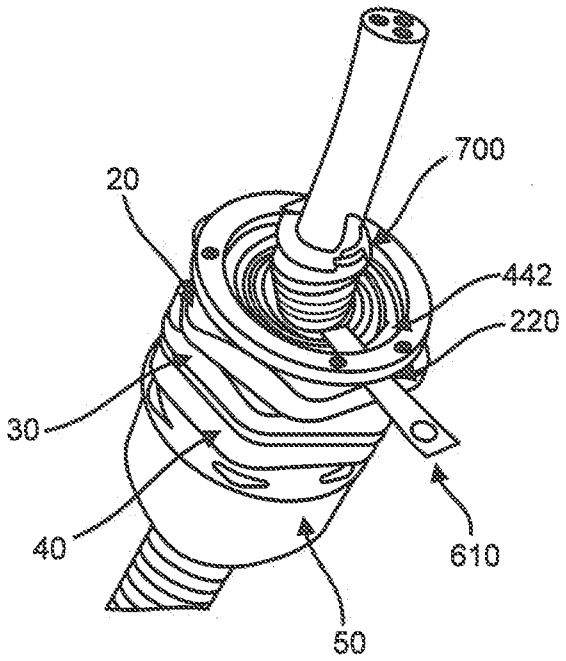


FIG. 7B

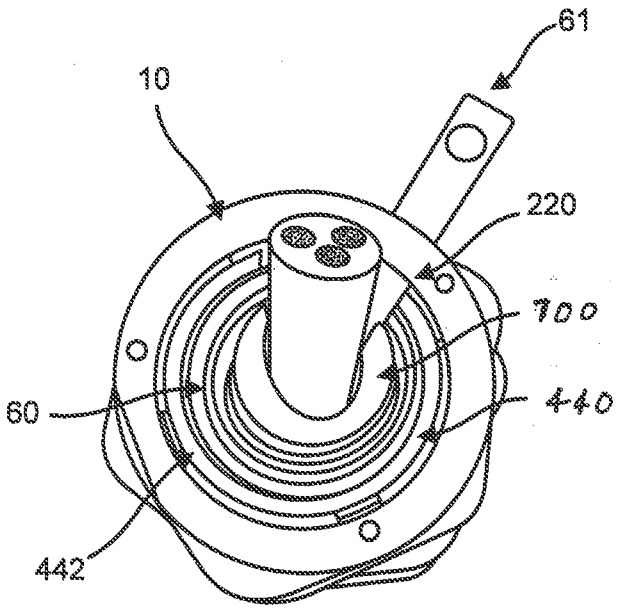


FIG. 7C

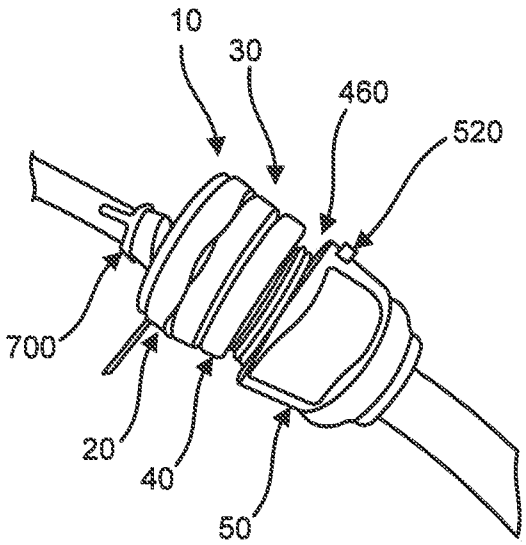


FIG. 7D

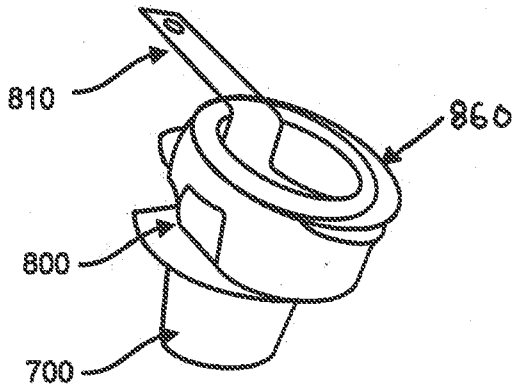


FIG. 8A

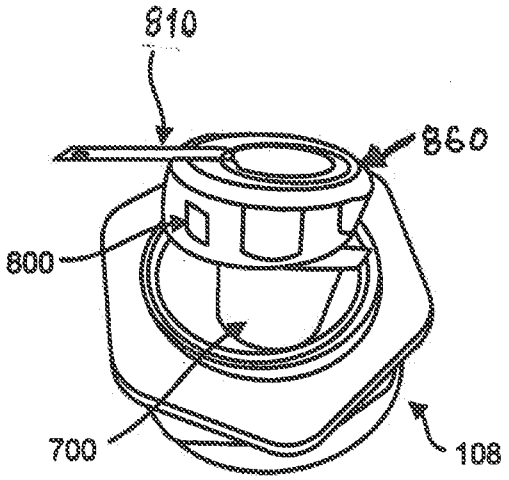


FIG. 8B

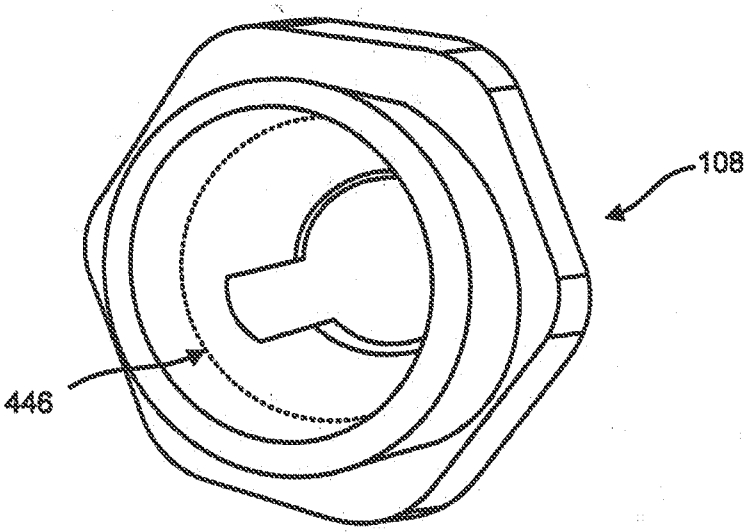


FIG. 8C

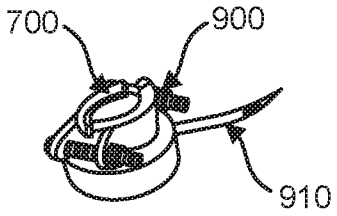


FIG. 9A

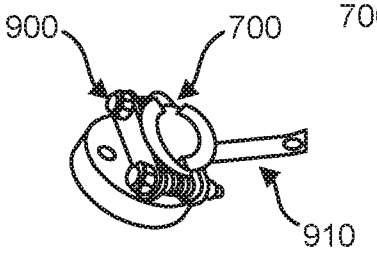


FIG. 9B

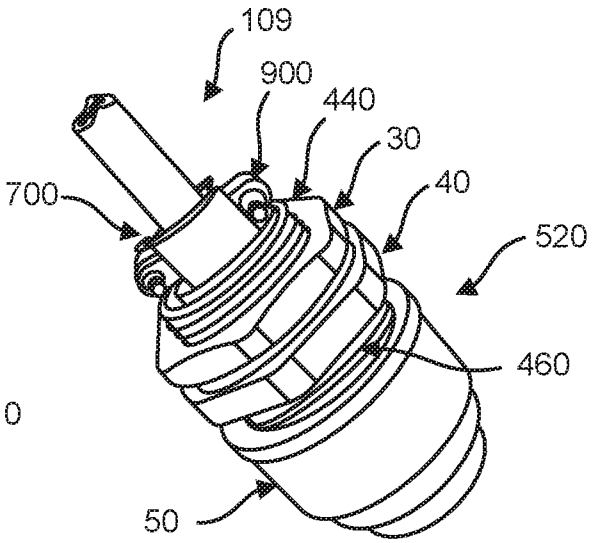


FIG. 9C

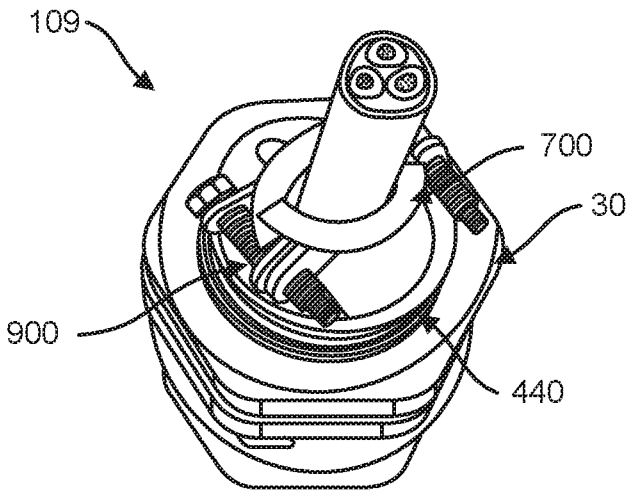


FIG. 9D

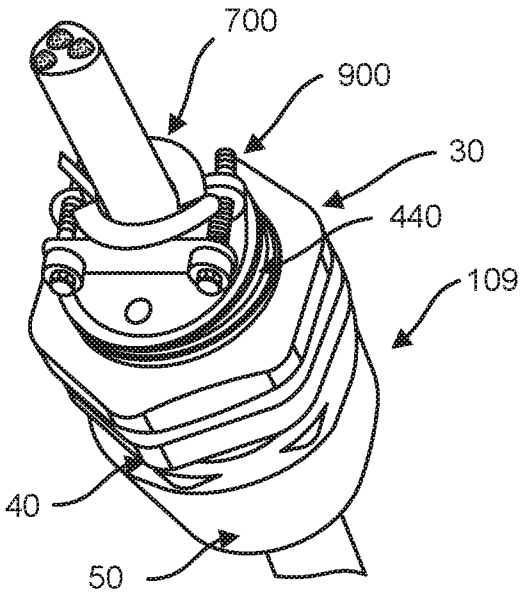


FIG. 9E

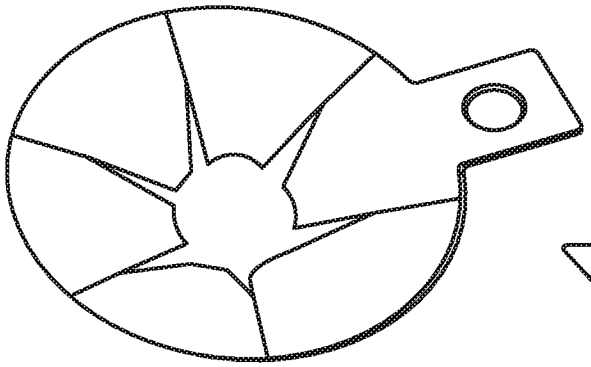


FIG. 10A

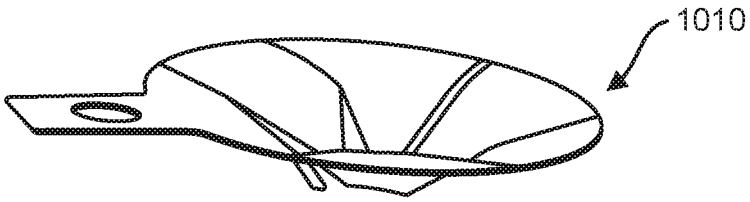


FIG. 10B

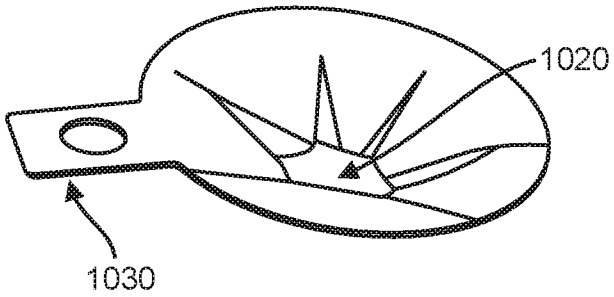


FIG. 10C

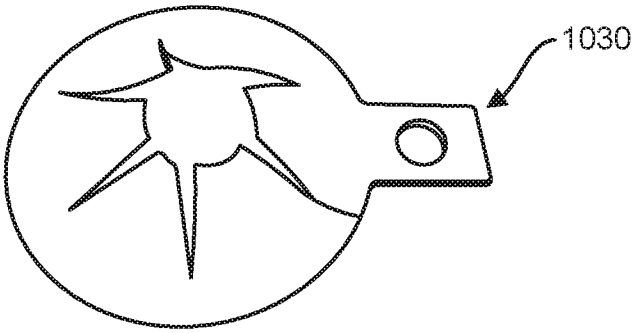


FIG. 10D

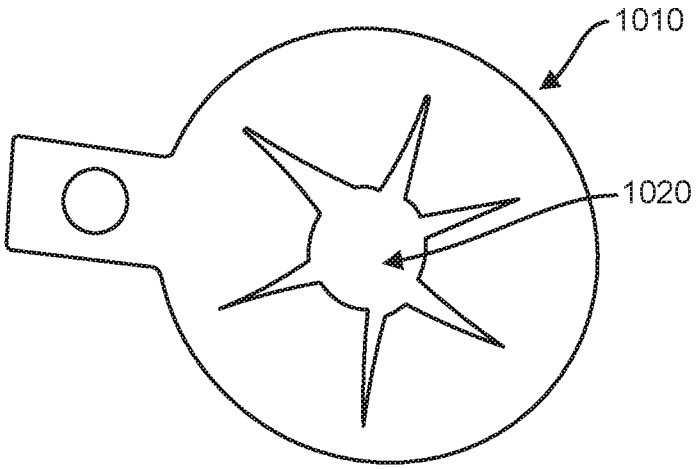


FIG. 10E

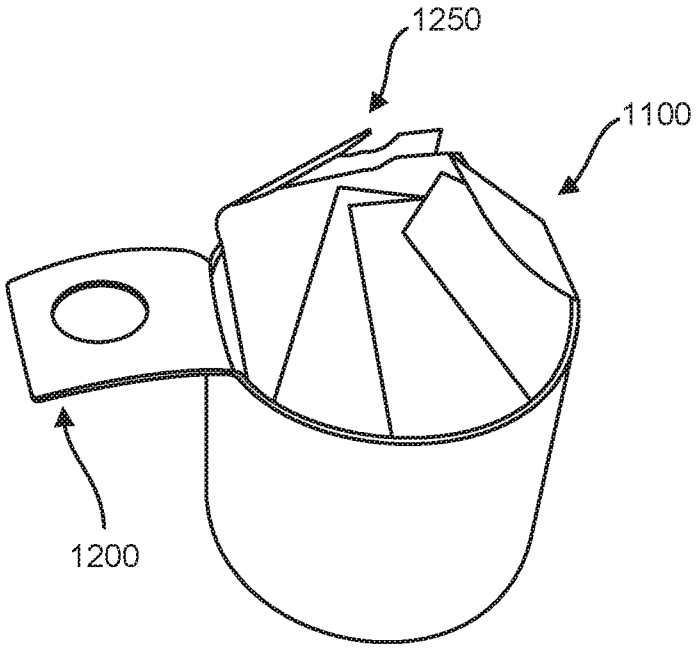


FIG. 11A

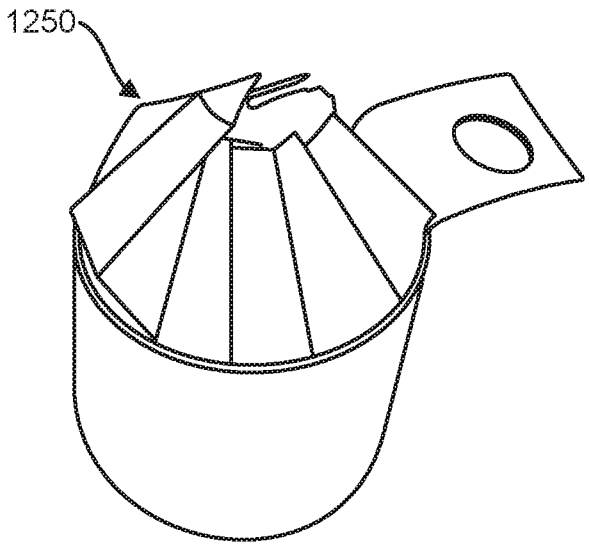


FIG. 11B

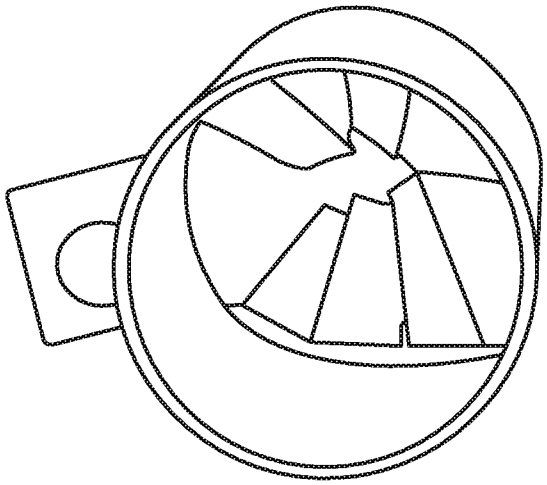


FIG. 11C

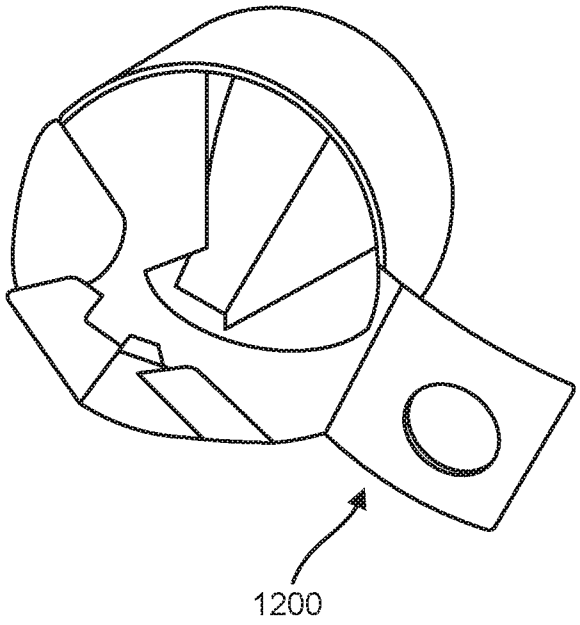


FIG. 11D

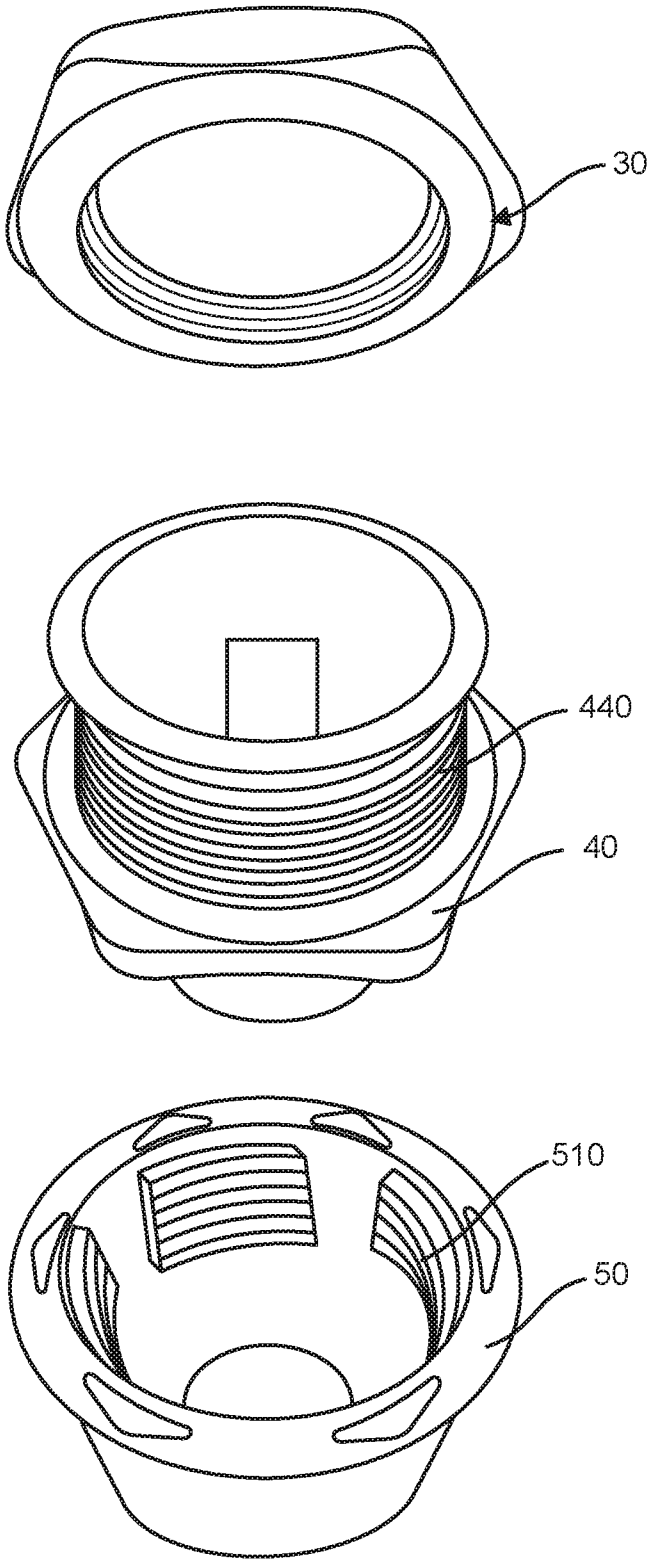


FIG. 12

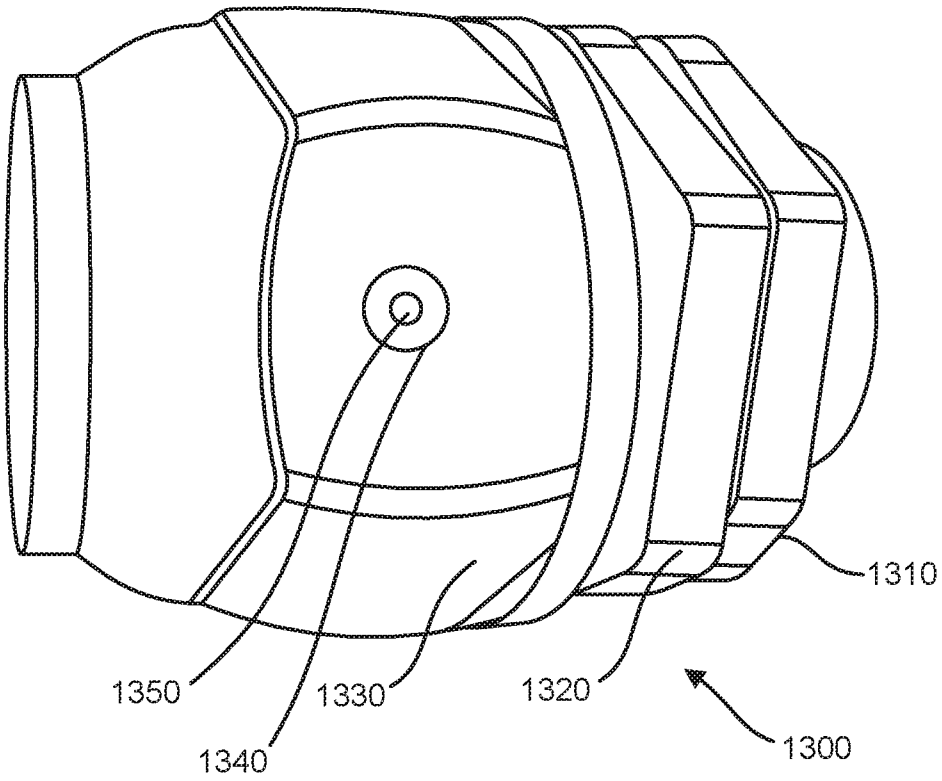


FIG. 13

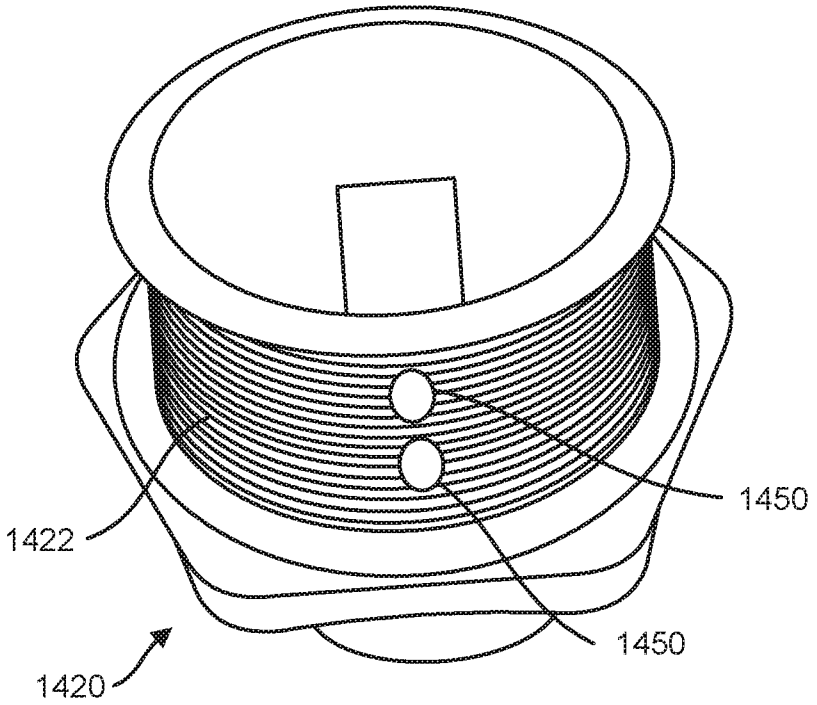


FIG. 14A

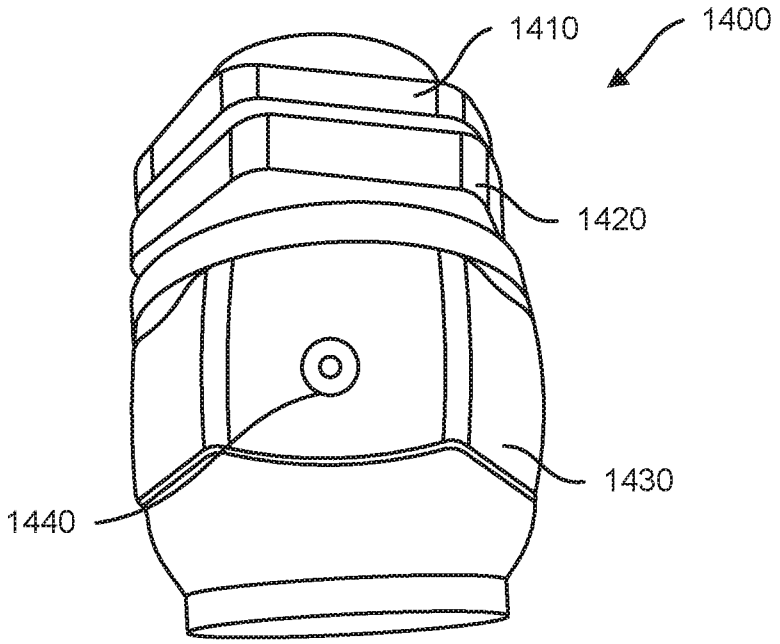


FIG. 14B

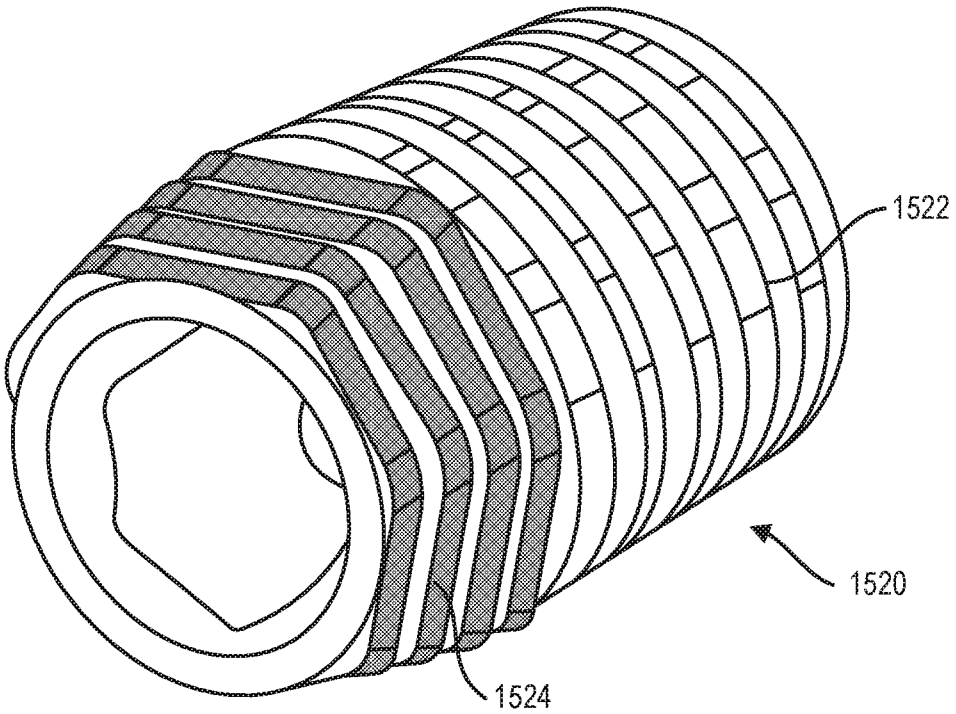


FIG. 15

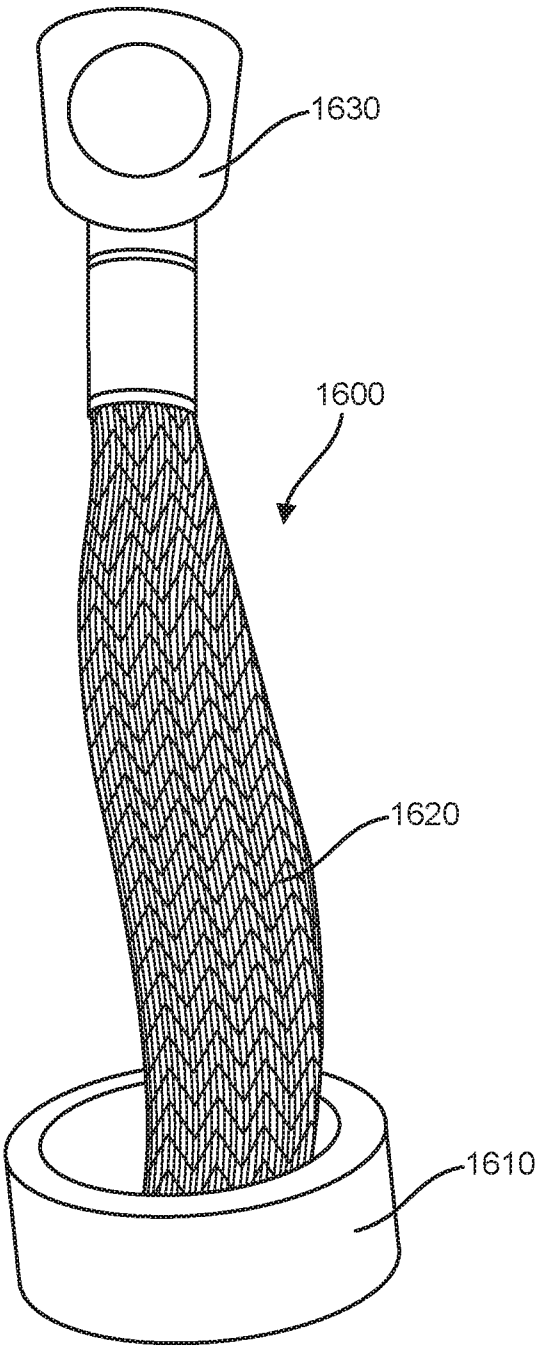


FIG. 16

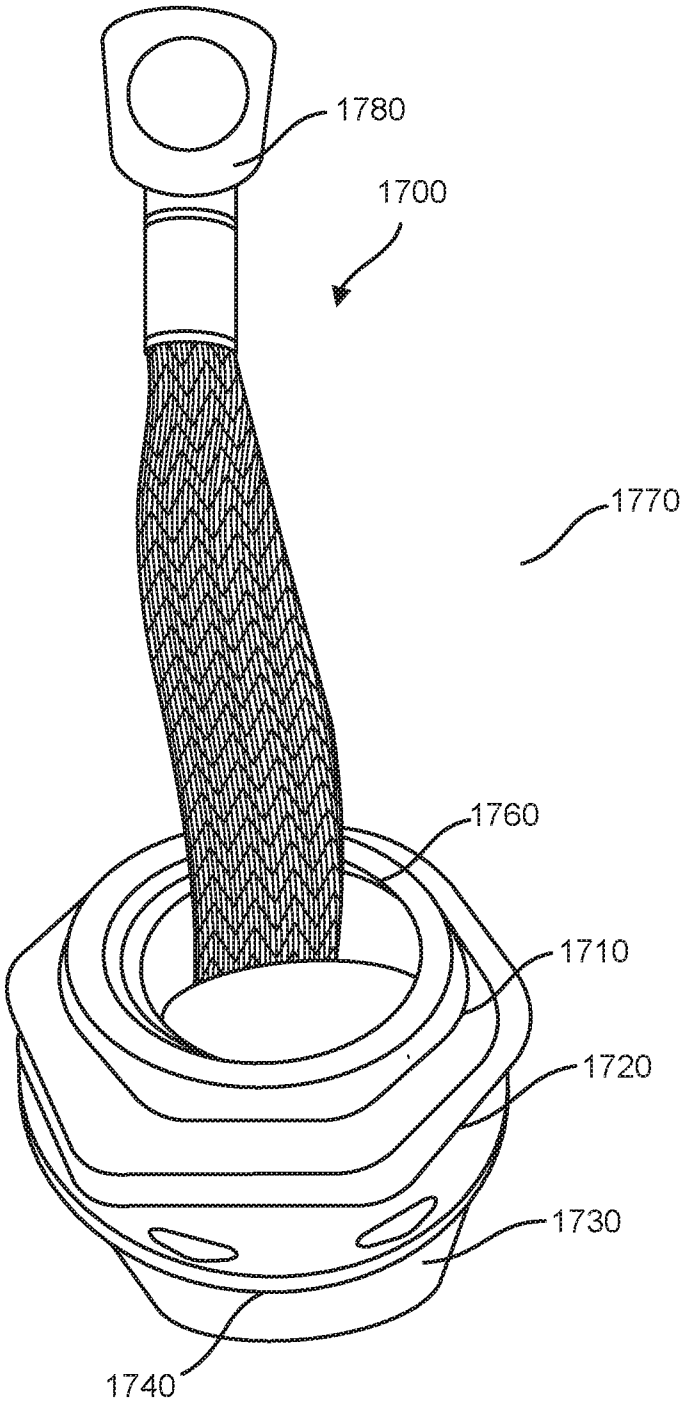


FIG. 17

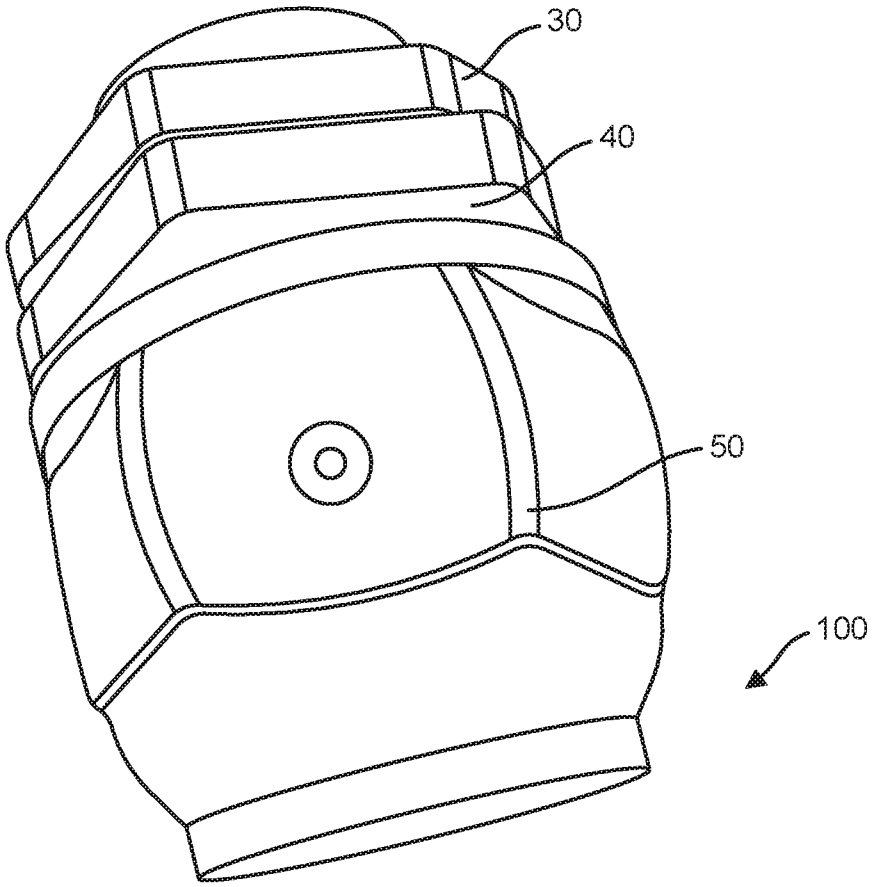
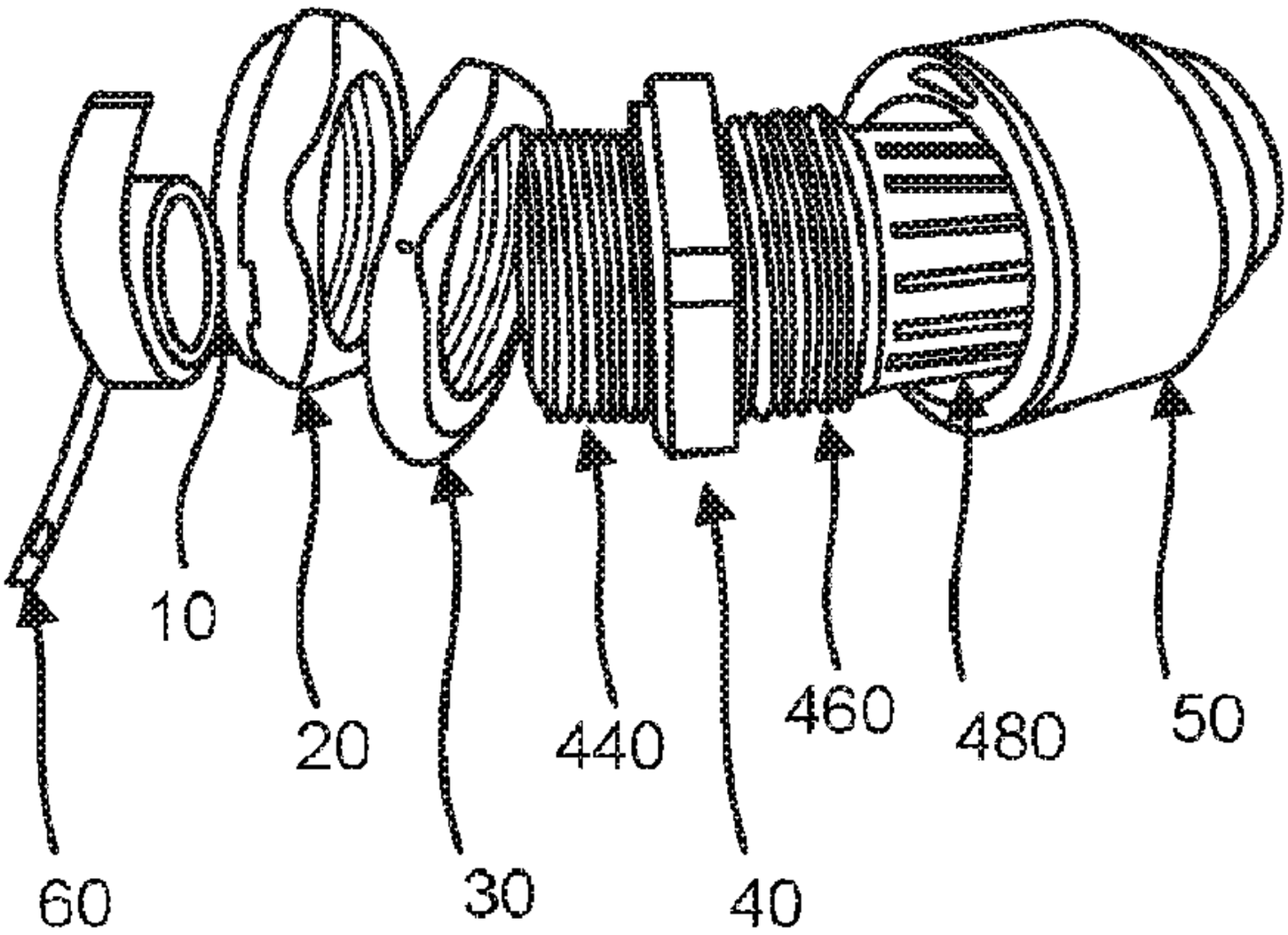


FIG. 18


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440
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460
480
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