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(54) Title: SPLICING APPARATUS AND HOSE ASSEMBLY INCLUDING SAME

(57) Abstract: **A** splicing apparatus and a method of splicing are disclosed, which may be used in a variety of wire splice applications. In an embodiment, the splicing apparatus includes a first splicing member having a first conductive section having a sharp first end configured for insertion into a first wire, and a second end; and a second conductive section coupled to the first conductive section. The second conductive section includes a first end configured for coupling to a second wire, and a second end connected to the second end of the first conductive section.

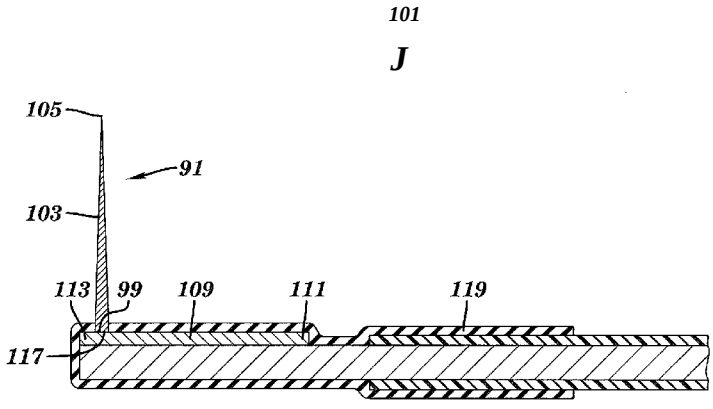

FIG. 1

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SPLICING APPARATUS AND HOSE ASSEMBLY INCLUDING SAME

BACKGROUND OF THE INVENTION

[0001] The disclosure relates generally to electrical connections between wires, and in particular, wire splices. More particularly, the disclosure relates to a splicing apparatus for conductive wires, and a heated hose assembly including wires spliced using a splicing apparatus.

[0002] Electrical splices are commonly used to electrically connect a first wire with a second wire, and may be used in a wide variety of applications.

[0003] One such application is in a heated hose assembly. A heated hose assembly may be used, for example, in agricultural settings to supply water to livestock, in construction settings to supply water to outdoor worksites, and in residential settings to supply water for washing cars and other equipment. When the temperature is below 0°C (32°F), a heated hose assembly may be used to prevent water from freezing in the hose. A heated hose assembly may include a number of wires embedded in the wall of the hose. These wires may be placed in electrical connection with one another through the use of splices.

BRIEF DESCRIPTION OF THE DISCLOSURE

[0004] A first aspect of the disclosure provides a splicing apparatus including a first splicing member. The first splicing member includes a first conductive section having a sharp first end configured for insertion into a first wire, and a second end; and a second conductive section having a first end configured for coupling to a second wire, and a second end coupled to the second end of the first conductive section.

[0005] A second aspect of the disclosure provides a wire splice. The wire splice includes a first wire; a second wire, and a splicing apparatus for splicing the first wire to the second wire. The splicing apparatus includes a first conductive section having a sharp first end, the sharp first end being inserted into an end of the first wire, and a second end opposite the first end. The first splicing member further includes a second conductive section, also having a sharp first end and a second end opposite the first end. The second end of the first section is connected to the second end of the second section. The sharp first end of the second conductive section is inserted into an end of the second wire.

[0006] A third aspect of the disclosure provides a heated hose assembly. The heated hose assembly includes a flexible hose body having an inner wall and an outer wall, and a first, a

second, and a third wire extending longitudinally and axially along the hose body and within the inner wall. The hose assembly further includes a cord set, and at least one splicing apparatus for splicing a wire in the inner wall to a wire in the cord set. The splicing apparatus includes a first conductive section having a sharp first end configured for insertion into a first wire within the inner wall, and a second end, and a second conductive section having a first end configured for coupling to a first wire in the cord set, and a second end coupled to the second end of the first conductive section. The sharp first end of the first conductive section is inserted into a first end of the first wire within the inner wall, and the first end of the second conductive section is coupled to the first wire in the cord set, thereby splicing the two wires.

[0007] These and other aspects, advantages and salient features of the invention will become apparent from the following detailed description, which, when taken in conjunction with the annexed drawings, where like parts are designated by like reference characters throughout the drawings, disclose embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1 shows a side view of a splicing apparatus according to an embodiment of the disclosure.

[0009] FIGS. 2-9 show side perspective views of splicing apparatuses according to various embodiments of the disclosure.

[0010] FIGS. 10-13 depict aspects of a wire splice using the splicing apparatus of FIGS. 2 and 9 according to embodiments of the disclosure.

[001 1] FIGS. 14-29 depict views of a heated hose assembly according to embodiments of the disclosure.

[0012] It is noted that the drawings of the disclosure are not necessarily to scale. The drawings are intended to depict only typical aspects of the disclosure, and therefore should not be considered as limiting the scope of the disclosure. In the drawings, like numbering represents like elements between the drawings.

DETAILED DESCRIPTION OF THE INVENTION

[0013] As indicated above, FIGS. 1-29 show, and aspects of the disclosure provide a splicing apparatus, a wire splice, a heated hose assembly including the splicing apparatus, and a method for splicing a first wire and a second wire.

[0014] FIGS. 1-13 show aspects of a splicing apparatus according to a number of embodiments of the invention. As shown in, e.g., FIGS. 1-13, splicing apparatus 101 includes a first splicing member 91. First splicing member 91 includes first conductive section 103 having a first end 105 and a second end 99. First end 105 may be sharp, and is configured for insertion into a first wire (203, labeled in FIGS. 10-13). Splicing apparatus 101 further includes a second conductive section 109 having a first end 111 and a second end 113. Second end 113 of second conductive section 109 is electrically connected to second end 99 of first conductive section 103, while first end 111 of second conductive section 109 is configured for coupling to a second wire (207, labeled in FIGS. 10-11). In some embodiments, first conductive section 103 and second conductive section 109 may be unitarily formed, i.e., may be a single member with a first section 103 and a second section 109. In other embodiments, first conductive section 103 and second conductive section 109 may be separately formed, and second end 99 of first conductive section 103 may be joined to second end 113 of second conductive section 109 at joint member 117 by soldering or other methods as known in the art. Joint member 117 may be substantially disk- or plate-shaped in various embodiments. First splicing member 91, including first conductive section 103, second conductive section 109, and joint member 117, may be made of any electrically conductive material such as, for example, copper, silver, gold, aluminum, calcium, tungsten, zinc, nickel, lithium, iron, platinum, tin, lead, titanium, Manganin, constantan, mercury, or nichrome.

[0015] In some embodiments, first conductive section 103 may be substantially pin or pushpin shaped, and first end 105 may be shaped substantially like a pin point as shown in FIGS. 1-3 and 6-9. In other embodiments, first conductive section 103 may be substantially flat and blade shaped, and first end 105 may be shaped substantially like a razor edge as shown in FIG. 4. In still further embodiments, first conductive section 103 may be shaped substantially like a pair of laterally spaced scissor blades, having opposing and diagonally oriented razor edges at sharp first end 105 as shown in FIG. 5. In any event, first end 105 is shaped so as to cut through a first wire 203 (FIG. 10) to facilitate splicing of first wire 203 (FIG. 10).

[0016] As shown in FIG. 1, in some embodiments, first end 111 of second conductive section 109 may be substantially blunt in shape, while in other embodiments (FIGS. 2-9), first end 111 of second conductive section 109 may be sharp, similar to first end 105. First end 111 may take any of the forms described above relative to first end 105. In some embodiments, second conductive section 109 may be substantially pin or pushpin shaped, and first end 111 may be shaped substantially like a pin point as shown in FIGS. 2, 3, and 6-9. In other embodiments, second conductive section 109 may be substantially flat and blade shaped, and first end 111 may

be shaped substantially like a razor edge as shown in FIG. 4. In still further embodiments, second conductive section 109 may be shaped substantially like a pair of laterally spaced scissor blades, having opposing and diagonally oriented razor edges at sharp first end 111 as shown in FIG. 5. In some embodiments, first end 105 and first end 111 are shaped substantially the same as one another (FIGS. 2-6), however, in other embodiments (FIG. 1), they may be shaped differently. Each first end 105, 111 shape may be independently selected from the various first end embodiments depicted in FIGS. 1-6, as well as shapes which may be known in the art.

[0017] In various embodiments, first conductive section 103 and second conductive section 109 may be positioned at any of a number of angles with respect to one another. For example, first conductive section 103 and second conductive section 109 may be connected at joint member 117 in a substantially axially end-to-end relationship, such that they are substantially straight, i.e., having an angle of about 180°, as shown in FIGS. 2 and 4-9. In other embodiments, first conductive section 103 and second conductive section 109 may be connected at joint member 117 such that first conductive section 103 and second conductive section 109 form an angle of between about 1° and about 179°. Any angle within these ranges may also be possible, such as between about 45° and about 135°, or more particularly about 90°, depending on the intended application. The embodiment shown in FIG. 3 illustrates a splicing apparatus 101 in which first conductive section 103 and second conductive section 109 form an angle of about 90°.

[0018] Splicing apparatus 101 may further include non-conductive covering 119 disposed over first splicing member 91. Non-conductive covering 119 may be, e.g., plastic, rubber, PVC, silicon, ethylene propylene diene monomer (EPDM) or any other insulating or non-conductive material. In some embodiments, non-conductive covering 119 may be wrapped or deposited over first splicing member 91 (FIG. 1). In other embodiments, non-conductive covering 119 may be substantially sleeve-shaped, and may be disposed around first splicing member 91. As shown in FIGS. 2-10, joint member 117 may be provided within non-conductive covering 119, and may be affixed in an axially middling position within non-conductive covering 119. An outer diameter of joint member 117, which as noted above may be substantially plate- or disk-shaped, may be substantially the same as the inner diameter of non-conductive covering 119. Thus, when joint member 117 is positioned within non-conductive covering 119, joint member may fully occlude a sleeve-shaped non-conductive covering 119, and may be lodged in place.

[0019] In further embodiments, a groove 115 (FIG. 9) may be provided on an inner circumference of non-conductive covering 119, for retaining joint member 117 in its axial position. Joint member 117 thus has a substantially stable position with respect to non-conductive covering 119, and retains first splicing member 91 in position. In some

embodiments, as shown in FIGS. 2-9, non-conductive covering 119 may have an axial length that is greater than the axial length of first splicing member 91, such that each of first end 105 of first conductive section 103 and first end 111 of second conductive section 109 are disposed within non-conductive covering 119.

[0020] In some embodiments, as shown in FIGS. 2-3 and 6-9, at least one gripping member 121 may be disposed on an inner surface of non-conductive covering 119. As illustrated in the figures, each gripping member 121 may be a projection made of a non-conductive material that extends radially inwardly and toward an axial midpoint of non-conductive covering 119 from a point on the inner surface of non-conductive covering 119. Gripping members 121 may be made of the same material as non-conductive covering 119 or a different material. The points on the inner surface of non-conductive covering 119 from which gripping members 121 extend may be near one of first ends 105, 111 of first or second conductive section 103, 109.

[0021] As shown in FIG. 10, when first wire 203 is inserted into splicing apparatus 101 and onto first end 105 of first conductive section 103, gripping members 121 may grip first wire 203. In particular, gripping members 121 may grip a non-conductive covering 205 on first wire 203, without piercing the full thickness of non-conductive covering 205 to reach a conductive portion of first wire 203, which may be made of, e.g., copper. Gripping members 121 may extend radially inwardly and toward an axial mid point (e.g., toward joint member 117) of first splicing member 91. Gripping members 121 thus resist movement of first wire 203 in an axial direction outward of splicing apparatus 101. Gripping members 121 may similarly grip second wire 207 when it is inserted into splicing apparatus 101 and onto first end 111 of second conductive section 109.

[0022] With reference to FIGS. 6-7, in some embodiments, splicing apparatus 101 may facilitate side by side splicing of more than one pair of wires. For example, the embodiment shown in FIG. 6 includes a first splicing member 91 having first and second conductive sections 103, 109 as described above, and a second splicing member 93. Like first splicing member 91, second splicing member 93 also includes a first conductive section 123 having a sharp first end 127 configured for insertion into a third wire (not shown in FIG. 6 for simplicity) and a second end 129, as well as a second conductive section 125 having a second end 131 and a sharp first end 133 configured for insertion into a fourth wire (not shown in FIG. 6 for simplicity). As with first and second conductive sections 103, 109, second end 131 of second conductive member 125 is connected to second end 129 of first conductive member 123. First splicing member 91 may be substantially parallel to second splicing member 93. Non-conductive covering 119 may be disposed over first splicing member 91 and second splicing member 93, such that each splicing member 91, 93 is circumferentially enclosed separately from the other splicing member, to

electrically isolate each of splicing members 91, 93. In such an embodiment, non-conductive covering 119 may be in the form of a pair of sleeves surrounding each of first and second splicing members 91, 93, the pair of sleeves being affixed to one another as shown in FIG. 6. In such an embodiment, non-conductive covering 119 may be formed as two separate sleeves or tubes that are joined together, or may be co-extruded and unitarily formed. As further shown in FIGS. 6-7, non-conductive covering 119 may include gripping members 121 for gripping wires inserted into splicing apparatus 101 onto any or each of first ends 105, 111, 127, 133 of first and second splicing members 91, 93 respectively.

[0023] In a further embodiment, shown in FIG. 7, splicing apparatus 101 may additionally include a third splicing member 95. Like first and second splicing members 91, 93, third splicing member 95 may include a first conductive section 141 having a sharp first end 143 configured for insertion into a fifth wire (not shown in FIG. 7 for simplicity) and second end 145, and second conductive section 147 having a sharp first end 149 configured for insertion into a sixth wire (not shown in FIG. 7 for simplicity), and second end 151 configured to be connected to second end 145 of first conductive section 141 at a joint member 117. Third splicing member 95 may be substantially parallel to first and second splicing members 91, 93. Non-conductive covering 119 may be disposed over each of first, second, and third splicing members 91, 93, 95 as described above such that each of splicing members 91, 93, 95 is electrically isolated from each other splicing member.

[0024] In some embodiments, as shown in FIGS. 8 and 11, splicing apparatus 101 may further include a silicone bead 161 for sealing a splice. Silicone bead 161 may be, for example, injected into non-conductive covering 119 on one or both sides of joint member 117. First and second conductive sections 103, 109 of first splicing member 91 may pass through the respective silicone beads 161. When, e.g., first wire 203 and second wire 207 are inserted into non-conductive covering 119 and onto first splicing member 91 (FIG. 11), first and second wires 203, 207 pierce the respective silicone beads 161 (FIG. 8), and cause the beads to burst and provide a seal over wire splice 201.

[0025] In further embodiments, splicing apparatus 101 may be sized to accommodate either a specific wire gauge or a range of wire gauges as are known in the art. Non-conductive covering 119 may also be sized such that a diameter of the sleeve may be specific to either a specific wire gauge or a range of wire gauges. For example, where splicing apparatus 101 is used to splice very small gauge wires, an inner diameter of non-conductive covering 119 may be smaller, an outer diameter of joint member 117 may be smaller, and first splicing member 91 may be thinner than may be used in a splicing apparatus 101 intended for splicing a larger gauge wire.

[0026] As referred to previously, in a further aspect of the invention, a wire splice 201 is

provided as shown in FIGS. 10 and 11, for splicing a first wire 203 and a second wire 207 using the above-described splicing apparatus 101. As discussed above, splicing apparatus 101 includes a first splicing member 91 having a first conductive section 103 with sharp first end 105 and second end 99. Sharp first end 105 of first conductive section 103 may be inserted into an end of first wire 203 such that sharp first end 105 contacts conductive portion 209 of first wire 203. When inserted, sharp first end 105 may extend axially into conductive portion 209 of first wire 203, as shown in detail in FIG. 12, such that sharp first end 105 is substantially immersed within conductive portion 209 of first wire 203. In other embodiments, sharp first end 105 may be inserted into an end of first wire 203 such that sharp first end 105 pierces and is inserted into conductive portion 209 of first wire 203 such that it extends substantially between conductive portion 209 and non-conductive covering 205 of first wire 203, as shown in FIG. 13. FIGS. 12 and 13 are merely illustrative, however; any arrangement in which at least part of first conductive section 103, such as sharp first end 105, contacts some part of conductive portion 209 of first wire 203 may be used. Referring back to FIG. 10, second conductive section 109 in splicing apparatus 101, and particularly first end 111 thereof, may be inserted into an end of second wire 207 in a similar fashion.

[0027] As further described above, splicing apparatus 101 may include a non-conductive covering 119. In wire splice 201, non-conductive covering 119 may be disposed over first conductive section 103 and second conductive section 109 as discussed above, as well as an end portion of each of first wire 203 and second wire 207. As shown in FIG. 10, the end portions of each of first and second wires 203, 207, into which first and second conductive sections 103, 109 are inserted respectively, are disposed within non-conductive covering 119 of splicing apparatus 101. In some embodiments, these end portions of each of first and second wires 203, 207 are retained within splicing apparatus 101 at least in part by gripping members 121 (FIG. 10). In further embodiments, as shown in FIG. 11, together with silicone beads 161, non-conductive covering 119 provides a seal around wire splice 201.

[0028] With reference to the previously described drawings, a method is also provided for splicing a first wire and a second wire using splicing apparatus 101.

[0029] Initially, splicing apparatus 101 including a first splicing member 91 is provided as described above and shown in any of FIGS. 1-9. As previously described, first splicing member 91 includes a first conductive section 103 having a sharp first end 105 and a second end 99 opposite first end 105, and a second conductive section 109 having a first end 111 and a second end 113 opposite the first end. The second end 113 of second conductive section 109 is connected to second end 99 of first conductive section 103, e.g., by joint member 117. As shown in FIG. 10, a first wire 203 and second wire 207 are also provided. First wire 203 is inserted

onto sharp first end 105 of first conductive section 103 such that it either is substantially immersed within conductive portion 209 of first wire 203, or extends substantially between conductive portion 209 and non-conductive covering 205 of first wire 203. Second wire 207 is then inserted onto first end 111 of second conductive section 109 in a similar fashion.

[0030] In embodiments such as pictured in FIG. 1, first splicing member 91 may then be covered by non-conductive covering 119, which in such an embodiment may be wrapped or deposited around splicing member 91, first wire 203, and second wire 207 such that no conductive portions remain exposed.

[0031] In other embodiments, such as those pictured in FIGS. 2-9, splicing apparatus 101 further includes a substantially tube-like or sleeve-like non-conductive covering 119 into which first and second wires 203, 207 were inserted when they were inserted onto the respective first ends 105, 111 of first and second conductive sections 103, 109. In further such embodiments, such as described above relative to FIG. 8, silicone bead 161 may burst upon the insertion of first and/or second wire 203, 207 and, together with non-conductive covering 119, form a seal around splice 201 (FIG. 11).

[0032] With respect to FIGS. 14-29, an electrically heated hose assembly 301 (FIG. 27) and a method of assembling the same are also provided.

[0033] As shown in FIG. 14, hose body 303 is provided. Hose body 303 includes inner wall 305 and outer wall 307. In some embodiments, outer wall 307 may provide thermal insulation to hose body 303. It is noted that hose body 303 may include one or more hose segments axially connected to one another in any known fashion. Three conductive wires 309, 311, 313 may be embedded within inner wall 305 of hose body 303, such that each conductive wire 309, 311, 313 is electrically insulated from each other conductive wire, and from interior flow path 308 in hose body 303. Conductive wires 309, 311, 313 may be made of, e.g., copper alloy or other alloys, and may run parallel to each other wire and to longitudinal axis 306 (FIGS. 15, 17) of hose body 303, along the axial extent of hose body 303. In some embodiments, conductive wires 309, 311, 313 may have a diameter of about 1.9 mm and a resistance of about ten ohms per meter.

[0034] Conductive wires 309, 311 may be arranged as a pair of diametrically-opposed current-carrying heating wires, for example, "hot" wire 309 and "neutral wire" 311, with conductive wire 313 disposed circumferentially midway between wires 309 and 311 to act as a ground. In some embodiments, three conductive wires 309, 311, 313 may be spaced within inner wall 305 of hose body 303 such that first wire 309 is opposite, i.e., about 180 degrees from, second wire 311. Third wire 313 may be disposed halfway between first wire 309 and second wire 311. Thus, if first wire 309 is at a 3 o'clock position, second wire 311 is approximately at a 9 o'clock position, and third wire 313 is at one of an approximate 6 o'clock or 12 o'clock position.

[0035] In some embodiments, hose body 303 may be extruded, and conductive wires 309, 311, 313 may be co-extruded within hose body 303. In other embodiments, conductive wires 309, 311, 313 may be insert molded or otherwise embedded within hose body 303. Hose body 303 may be any suitable length, such as twelve to fifteen meters (forty to fifty feet) in length or more and can have any suitable internal flow path 308 diameter, such as, for example, 1.5875 cm (5/8 inch). Hose body 303 may have a first end 319, and a second end 321.

[0036] As shown in FIG. 15, a ferrule 315 may be placed over first end 319 of hose body 303. Ferrule 315 may be substantially cylindrical in shape, and may include a stack of ribs or rings along the axial length of the cylinder. In some embodiments, ferrule 315 may include a tab or a plurality of tabs disposed on an end of ferrule 315, to act as a depth stop, preventing ferrule 315 from being inserted too far onto hose body 303.

[0037] As shown in FIG. 16, a cord set 401 may be provided. Cord set 401 may include three wires 409, 411, 413 encased in an insulated covering 415. At one end, cord set may terminate in a standard two or three prong outdoor electrical plug 417. At the opposite end of cord set 401, insulated covering 415 may terminate, leaving first wire 409, second wire 411, and third wire 413 extending from an end of insulated covering 415. The portions of first wire 409 and second wire 411 which extend beyond insulated covering 415 may be insulated. At least a terminal portion of third wire 413 extending beyond insulated covering 415 may not be insulated.

[0038] As shown in FIG. 17, a splicing apparatus 101, as previously described with respect to FIG. 1, may be provided for splicing an end of first wire 409 of cord set 401 (FIG. 16) such that it is placed in electrical connection with first wire 309 embedded in hose body 303 (FIGS. 14-15). Specifically, sharp first end 105 of first conductive section 103 of splicing apparatus 101 (FIG. 1) may be inserted into an end of embedded first wire 309 (FIG. 14) such that first conductive section 103 is substantially parallel to, in electrical connection with, and substantially embedded in or alongside first wire 309. A first insulated wire 409 (FIGS. 16-17) may be coupled to splicing apparatus 101 at first end 111 of second conductive section 109 (FIG. 1). Splicing apparatus 101 may be covered, with the exception of first conductive section 103 (FIG. 1), with a non-conductive covering 119. First conductive section 103 is inserted as far as possible into first wire 309 in hose body 303, such that non-conductive covering 119 substantially abuts first end 319 of hose body 303. As a result, substantially no conductive portion of wire 309, splicing apparatus 101, or insulated wire 409 is exposed. As shown in FIG. 18, a second splicing apparatus 101 may be provided for splicing each of second wire 311 to second wire 411, in a similar fashion. In this manner, the hot- and neutral current carrying wires 409, 411 in cord set 401 are electrically coupled with the hot- and neutral current carrying wires 309, 311 in hose body 303.

[0039] A third splicing apparatus 101 may further be provided for insertion into third wire 313 in hose body 303, in a substantially similar fashion. Third wire 313 differs from first and second wires 309, 311, however, in that it is a ground wire. With reference to FIG. 1, first end 111 of second conductive section 109 of splicing apparatus 101 is coupled not to a current-carrying wire in cord set 401, but rather, to ground wire 413 (FIG. 18). As shown in FIG. 19, third wire 413 in cord set 401 may include a conductive wire portion that extends beyond third splicing apparatus 101. This portion may be tucked or folded into flow path 308 of hose body 303, where it will serve to ground the assembled hose as described further below.

[0040] As shown in FIG. 20, insulating sleeve 505 may be provided over first end 319 (FIGS. 17-19, 24) of hose body 303. In one embodiment, sleeve 505 may be a heat-shrinkable tube made of, e.g., polyolefm, having sufficient length to cover and encapsulate any exposed conductive ends of wires 409, 411, 413; ferrule 315; and the end of insulated covering 415 over cord set 401, which exposes wires 409, 411, 413 (FIG. 19). Heat may then be applied to sleeve 505 to shrink sleeve 505 tightly over the foregoing assembly as shown in FIG. 21, forming a secure, protective, watertight seal over first end 319 of hose body 303, leaving an opening 507 over flow path 308 through hose body 303. Sleeve 505 securely clamps wires 409, 411, 413 against ferrule 315.

[0041] As shown in FIGS. 22-23, one of an expansion fitting 501, such as a stem, or a compression fitting 503, such as a barb, may be provided. Expansion fitting 501 and compression fitting 503 each include a substantially cylindrical hollow shaft member 509 shaped and dimensioned to be insertable into hose body 303 (FIG. 19), and end member 511 having an outer diameter approximately equal to or greater than that of outer wall 307 of hose body 303 (FIG. 14). Both shaft member 509 and end member 511 include flow path 308 therethrough which, when inserted into hose body 303, allows water or fluid to flow continuously through hose body 303 and expansion fitting 501 or compression fitting 503. Expansion fitting 501 and compression fitting 503 may be formed of, e.g., brass, but can be formed of any other electrically conductive material.

[0042] Regardless of which fitting is provided, shaft member 509 of expansion fitting 501 (FIGS. 22, 24) or compression fitting 503 (FIG. 23) may be inserted into first end 319 of hose body 303, through opening 507 in sleeve 505 (FIG. 21). Expansion fitting 501 or compression fitting 503 is inserted, shaft member 509 first, into first end 319 of hose body 303 until end member 511 contacts sleeve 505 and/or splicing apparatuses 101, which are disposed on first end 319 of hose body 303.

[0043] In embodiments using an expansion fitting 501, such as in FIGS. 22 and 24, once shaft member 509 is fully inserted into first end 319 of hose body 303 as shown in FIG. 24, an

expansion tool, such as an axially-tapered plug or mandrel is axially inserted into expansion fitting 501 so as to radially-outwardly expand and plastically deform each shaft member 509 against inner wall 305 of hose body 303. In this manner, the mounting of the expansion fitting 501 or compression fitting 503 to hose body 303 also completes an electrical connection between expansion fitting 501 or compression fitting 503 and the conductive portion of ground wire 413 that is folded into flow path 308 of hose body 300 and against its inner wall 305.

[0044] This radially outward expansion of expansion fitting 501 is constrained by ferrule 315, and causes outer wall 307 of hose body 303 (FIG. 19) to be pressed radially outwardly into the inner surface of ferrule 315. Ferrule 315 and expansion fitting 501 are thus axially fixed in place with respect to hose body 303. In this position, splicing apparatuses 101 (FIG. 19), which are disposed on first end 319 of hose body 303 and may be covered by sleeve 505, are sandwiched between first end 319 of hose body 303 and end member 511 of expansion or compression fitting 501 or 503. In this manner, expansion or compression fitting 501 or 503 secures splicing apparatuses 101, and prevents them from sliding out of position.

[0045] In various embodiments, shown in FIGS. 25-26, expansion or compression fitting 501 or 503 may further be fitted with a conventional, annular, internally-threaded female hose fitting 513 or an externally threaded male hose fitting 515. In the example shown in FIGS. 22 and 24, expansion fitting 501 is fitted with a female hose fitting 513. FIGS. 25-26 show a female hose fitting 513 at first end 319, and male hose fitting 515 at second end 321 of hose body 303.

[0046] Turning now to second end 321 of hose body 303, the same process may be performed as described above relative to first end 319. However, unlike first end 319, where hose body 303 may be electrically coupled to cord set 401, at second end 321, hose body 303 may be electrically coupled to a thermostat 603. Thermostat 603 may be, e.g., a creep action thermostat.

[0047] As shown in in FIG. 27, thermostat 603 may include two electrical leads 609, 611. Electrical leads 609, 611 may each be coupled to a splicing apparatus 101, and may be spliced using the same to each of hot and neutral wires 309, 311 (FIG. 18) respectively. As at first end 319, embedded grounding wire 313 in hose body 303 may be spliced using a splicing apparatus 101 to a length of ground wire 413, an end of which may be tucked or folded into flow path 308 at second end 321 in the same fashion as at first end 319 (FIG. 19).

[0048] Thermostat 603 may be positioned on an external surface of flexible hose body 303. In some embodiments, thermostat 603 may be located within housing 615 as in FIGS. 28-29. Housing 615 may include any material known in the art, and may further include at least one groove 617 for attaching housing 615 to the external surface of hose body 303, as in FIG. 28.

[0049] In FIG. 29, the bottom of housing 615, i.e., the face of housing 615 which is against hose body 303 (FIG. 27) in the installed position, for thermostat 603 is shown. At each groove 617 of

housing 615, a curvature 619 is provided for positioning the housing 615 against the external surface of flexible hose body 303. Further, a pad 621 is provided for positioning against the surface of flexible hose body 303 to support housing 615 against the flexible hose body 303.

[0050] As seen in FIG. 27, straps 623 may be positioned within grooves 617 (FIG. 28) in order to secure thermostat 603 and/or housing 615 to flexible hose body 303. Straps 623 may include any material known in the art. Further, other connecting means may be provided, besides straps 623. For example, thermostat 603 may be secured to the flexible hose body 303 by rope, rubber bands, and/or metal or plastic clips. Regardless, since thermostat 603 is external to flexible hose body 303, thermostat 603 may be replaced easily without destroying or replacing any portions of flexible hose body 303. In some embodiments, thermostat 603 may be sealed under sleeve 505.

[0051] Following electrical coupling of thermostat 603 as shown in FIG. 27, an expansion or compression fitting 501, 503 may be inserted into second end 321 in the same manner as described previously relative to FIG. 24, and as shown in FIGS. 25-26. Expansion or compression fitting 501, 503 may further be fitted with a conventional, annular, externally-threaded male hose fitting 515, which may be made of, e.g., brass.

[0052] As used herein, the terms "first," "second," and the like, do not denote any order, quantity, or importance, but rather are used to distinguish one element from another, and the terms "a" and "an" herein do not denote a limitation of quantity, but rather denote the presence of at least one of the referenced item. The modifier "about" used in connection with a quantity is inclusive of the stated value and has the meaning dictated by the context (e.g., includes the degree of error associated with measurement of the particular quantity). The suffix "(s)" as used herein is intended to include both the singular and the plural of the term that it modifies, thereby including one or more of that term (e.g., the metal(s) includes one or more metals). Ranges disclosed herein are inclusive and independently combinable (e.g., ranges of "up to about 25 mm, or, more specifically, about 5 mm to about 20 mm," is inclusive of the endpoints and all intermediate values of the ranges of "about 5 mm to about 25 mm," etc.).

[0053] While various embodiments are described herein, it will be appreciated from the specification that various combinations of elements, variations or improvements therein may be made by those skilled in the art, and are within the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims.

CLAIMS

What is claimed is:

1. A splicing apparatus comprising:

a first splicing member including:

a first conductive section having a sharp first end configured for insertion into a first wire, and a second end; and

a second conductive section having a first end configured for coupling to a second wire, and a second end coupled to the second end of the first conductive section.

2. The splicing apparatus of claim 1, further comprising a non-conductive covering disposed over at least a portion of the splicing apparatus.

3. The splicing apparatus of claim 1, wherein the non-conductive covering further comprises a sleeve, the sleeve comprising a non-conductive material.

4. The splicing apparatus of claim 3, further comprising a joint member,

wherein the joint member is substantially disk-shaped, the disk having an outer diameter that is substantially the same as an inner diameter of the sleeve,

wherein the joint member is lodged within the sleeve at an approximate axial midpoint within the sleeve, and is disposed between and adjoins the second end of the first conductive section and the second end of the second conductive section.

5. The splicing apparatus of claim 4, further comprising at least one gripping member disposed on an interior surface of the sleeve for gripping at least one of the first wire or the second wire.

6. The splicing apparatus of claim 4, further comprising a silicon bead for sealing a splice, the silicon bead being disposed within the sleeve on at least one side of the joint member.

7. The splicing apparatus of claim 4, further comprising a groove on an inner diameter of the sleeve for retaining the joint member in an axial position.

8. The splicing apparatus of claim 3, further comprising:

a second sleeve comprising a non-conductive material, the second sleeve being

affixed to, parallel with, and axially aligned with the first sleeve;

a second splicing member disposed within the second sleeve, the second splicing member including:

a first conductive section having a sharp first end configured for insertion into a third wire, and a second end;

a joint member disposed within the second sleeve at an approximate axial midpoint within the second sleeve, wherein the joint member is substantially disk-shaped, the disk having an outer diameter that is substantially the same as an inner diameter of the second sleeve, the joint member being connected to the second end of the first conductive section; and

a second conductive section having a first end configured for coupling to a fourth wire, and a second end coupled to the joint member.

9. The splicing apparatus of claim 8, further comprising:

a third sleeve comprising a non-conductive material, the third sleeve being affixed to, parallel with, and axially aligned with the first sleeve and the second sleeve;

a third splicing member disposed within the third sleeve, the third splicing member including:

a first conductive section having a sharp first end configured for insertion into a fifth wire, and a second end;

a joint member disposed within the second sleeve at an approximate axial midpoint within the second sleeve, wherein the joint member is substantially disk-shaped, the disk having an outer diameter that is substantially the same as an inner diameter of the second sleeve, the joint member being connected to the second end of the first conductive section; and

a second conductive section having a first end configured for coupling to a sixth wire, and a second end coupled to the joint member.

10. The splicing apparatus of claim 1, wherein the first end of the second conductive section is sharp.

11. The splicing apparatus of claim 10, wherein at least one of the first conductive section and the second conductive section is substantially pin shaped.

12. The splicing apparatus of claim 10, wherein at least one of the first conductive section

and the second conductive section is a substantially flat blade, and includes a razor edge at the sharp first end.

13. The splicing apparatus of claim 10, wherein at least one of the first conductive section and the second conductive section includes:

a pair of blades having opposing and diagonally oriented razor edges at the sharp first end.

14. The splicing apparatus of claim 1, wherein the first conductive section and the second conductive section are connected in a substantially axially end-to-end relationship, and form an angle of about 180°.

15. The splicing apparatus of claim 1, wherein the first conductive section and the second conductive section are connected such that the first conductive section and the second conductive section form an angle of greater than 1° and less than 179°.

16. The splicing apparatus of claim 15, wherein the first conductive section and the second conductive section are connected such that the first conductive section and the second conductive section form an angle of about 45° to about 135°.

17. A wire splice comprising:

a first wire;

a splicing apparatus including:

a splicing member including a first conductive section having a sharp first end inserted into an end of the first wire, and a second end; and

a second conductive section having a first end configured for coupling to a second wire, and a second end coupled to the second end of the first conductive section; and

the second wire, wherein the second wire is coupled to the first end of the second conductive section of the splicing apparatus.

18. The wire splice of claim 17, wherein the first end of the second conductive section is sharp, and is inserted into an end of the second wire.

19. The wire splice of claim 17, further comprising a non-conductive covering disposed over

at least a portion of the splicing apparatus.

20. The wire splice of claim 19, wherein the non-conductive covering further comprises a sleeve, the sleeve comprising a non-conductive material.

21. The wire splice of claim 20, wherein the splicing apparatus further comprises a joint member,

wherein the joint member is substantially disk-shaped, the disk having an outer diameter that is substantially the same as an inner diameter of the sleeve,

wherein the joint member is lodged within the sleeve at an approximate axial midpoint within the sleeve, and is disposed between and adjoins the second end of the first conductive section and the second end of the second conductive section.

22. The wire splice of claim 20, further comprising at least one gripping member disposed on an interior surface of the sleeve for gripping at least one of the first wire or the second wire.

23. The wire splice of claim 21, further comprising a silicon bead on each side of the joint member for sealing the wire splice, each silicon bead being disposed within the sleeve.

24. The wire splice of claim 18, wherein the first conductive section and the second conductive section are substantially pin shaped.

25. The wire splice of claim 18, wherein at least one of the first conductive section and the second conductive section is a substantially flat blade, and includes a razor edge at the sharp first end.

26. The wire splice of claim 18, wherein at least one of the first conductive section and the second conductive section includes: a pair of blades having opposing and diagonally oriented razor edges at the sharp first end.

27. A heated hose assembly comprising:

a hose body including an inner wall, an outer wall, and a first wire, a second wire, and a third wire extending longitudinally and axially along the hose body within the inner wall;

a cord set including a first wire, a second wire, and a third wire; and

at least one splicing apparatus, each of the at least one splicing apparatuses including:

a splicing member having:

a first conductive section having a sharp first end configured for insertion into a first wire within the inner wall, and a second end, and

a second conductive section having a first end configured for coupling to a first wire in the cord set, and a second end coupled to the second end of the first conductive section;

the sharp first end of the first conductive section being inserted into a first end of the first wire within the inner wall, and the first end of the second conductive section being coupled to the first wire in the cord set.

28. The heated hose assembly of claim 27, wherein the first wire and the second wire are circumferentially spaced from one another by about 180 degrees, and the third wire is circumferentially spaced about midway between the first wire and the second wire.

29. The heated hose assembly of claim 27, wherein the at least one splicing apparatus further comprises a second splicing apparatus, wherein the second splicing apparatus splices the second wire within the inner wall of the hose body and the second wire in the cord set together.

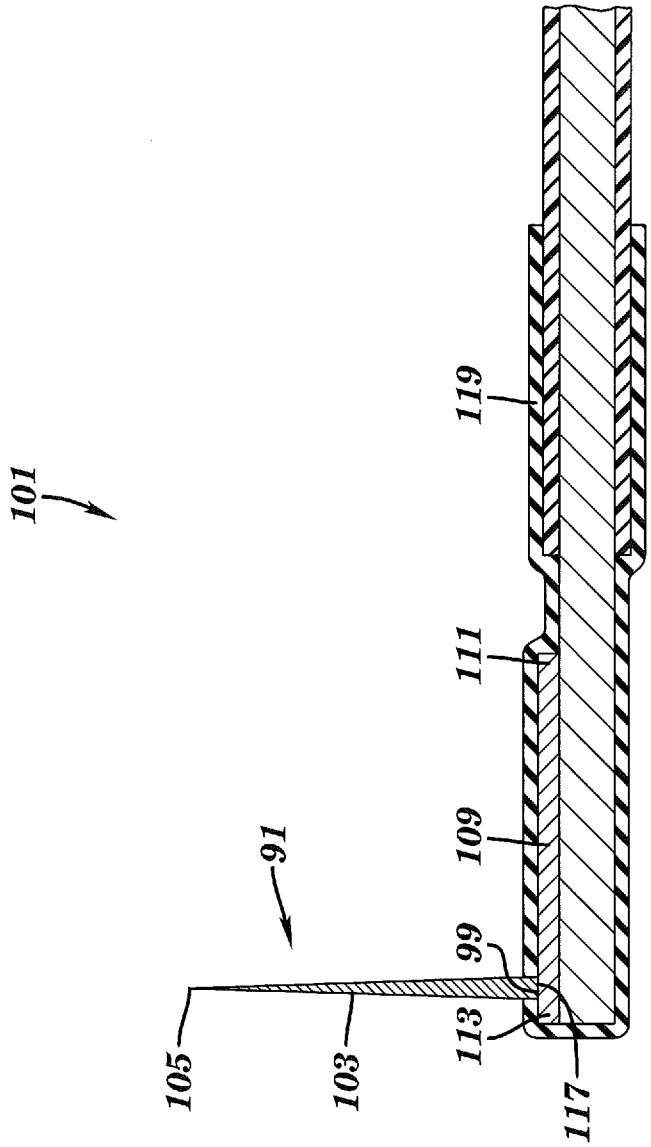

FIG. 1

FIG. 3

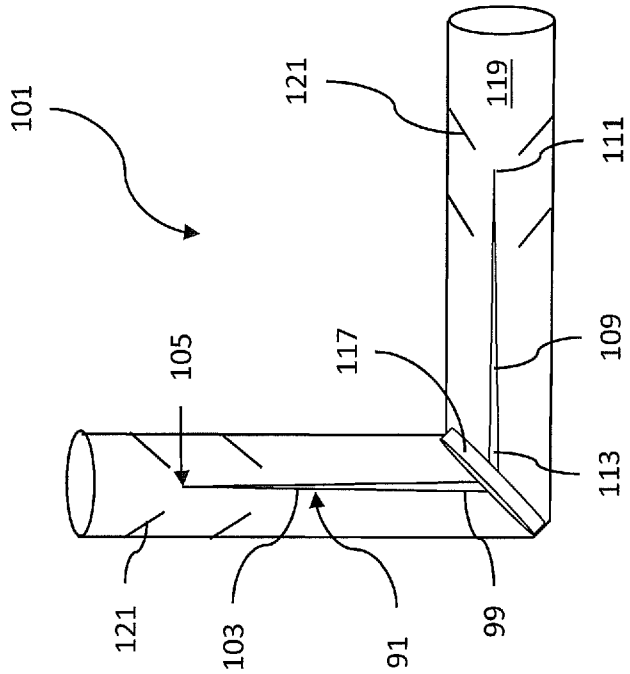
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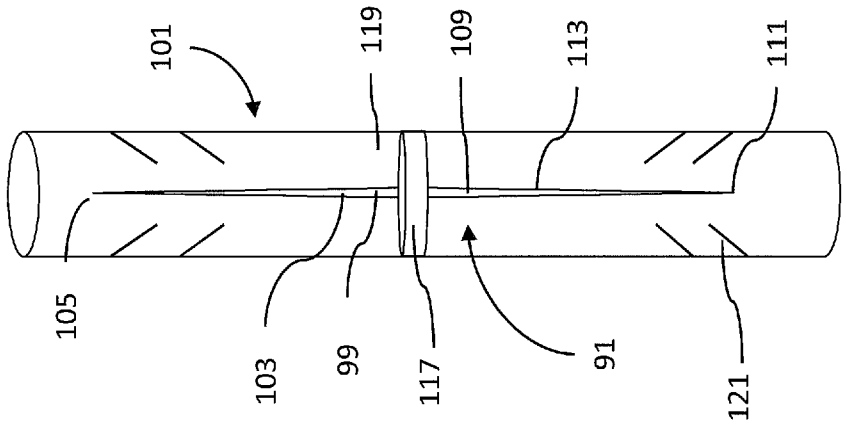
FIG. 2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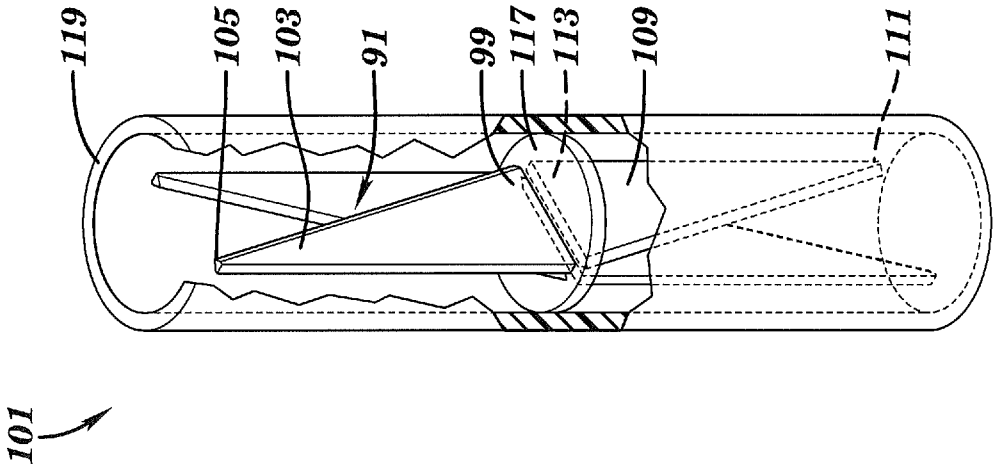
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FIG. 5

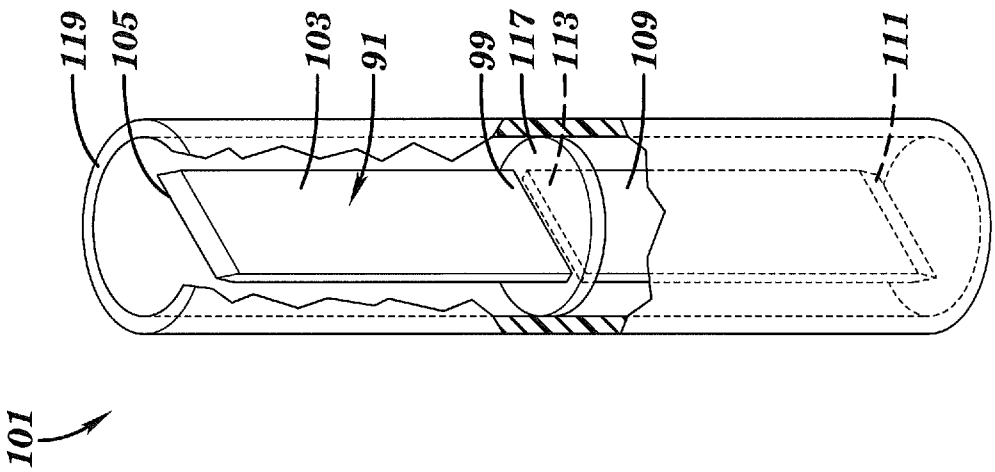
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FIG. 4

FIG. 8

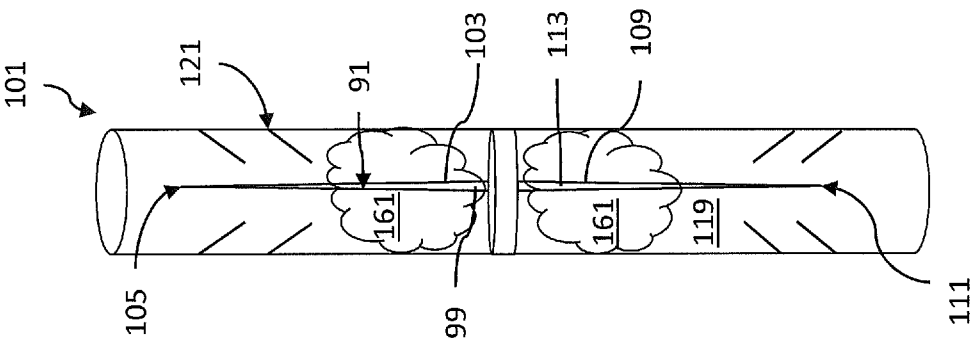


FIG. 7

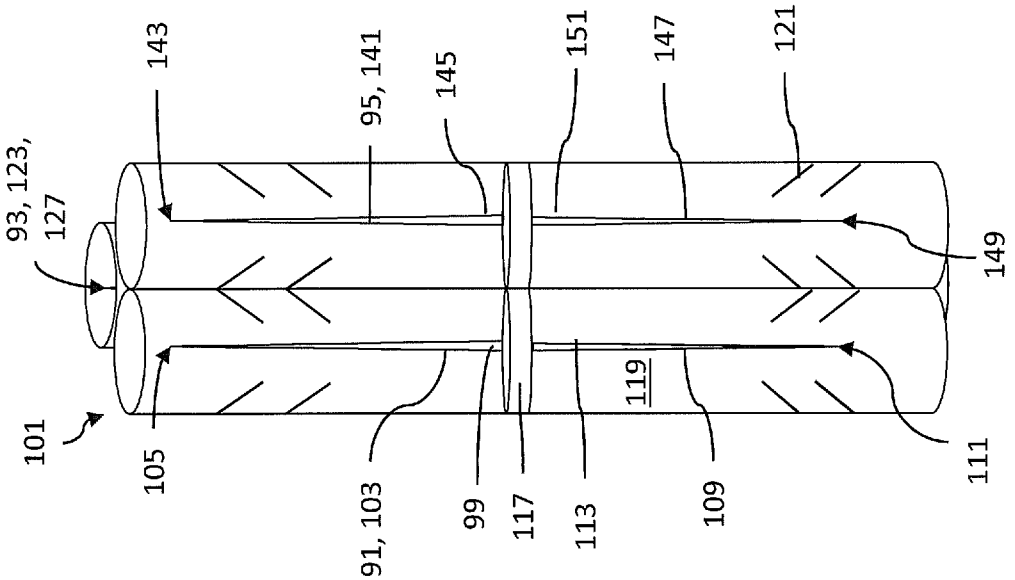


FIG. 6

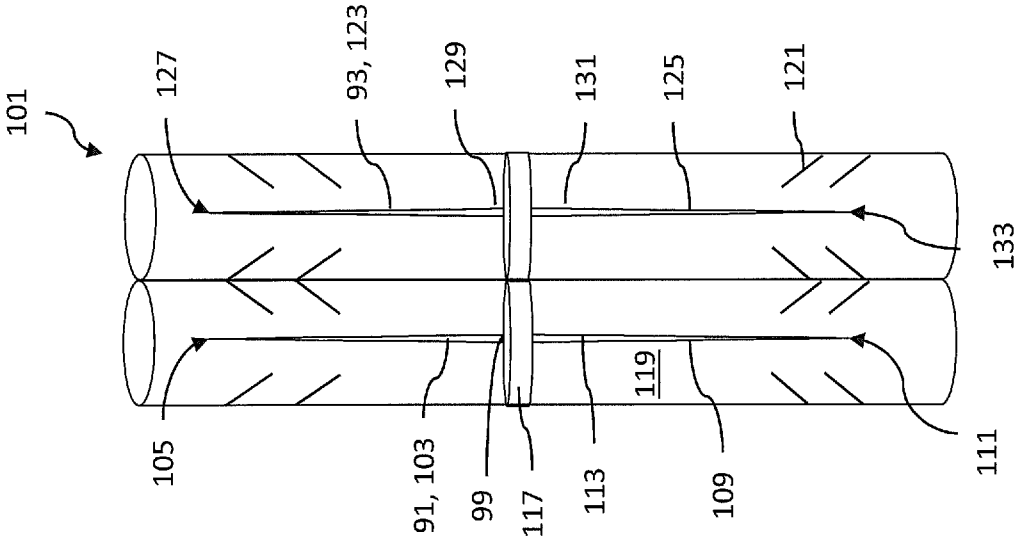


FIG. 11

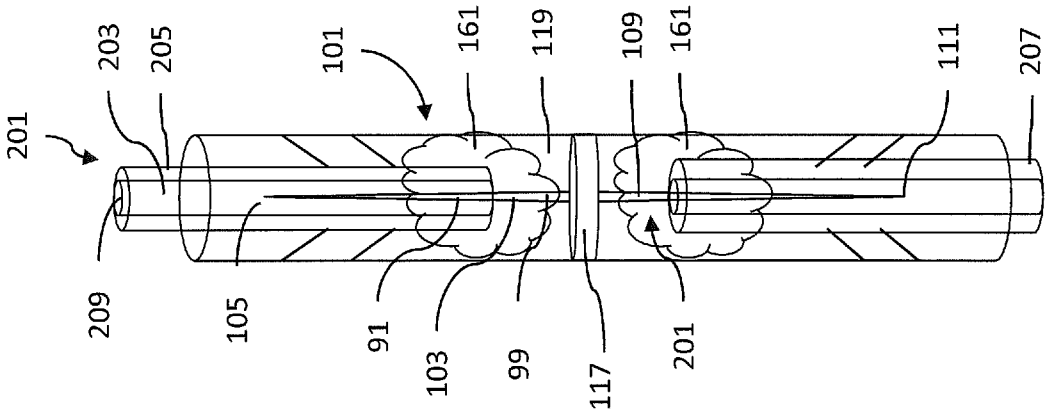


FIG. 10

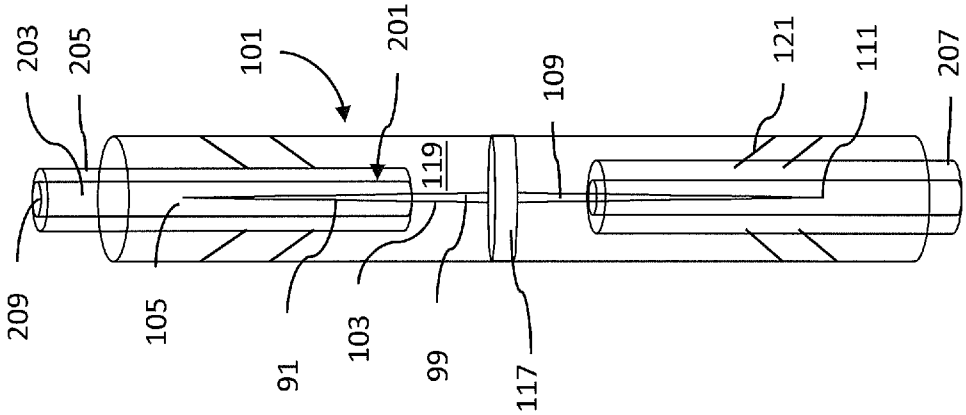


FIG. 9

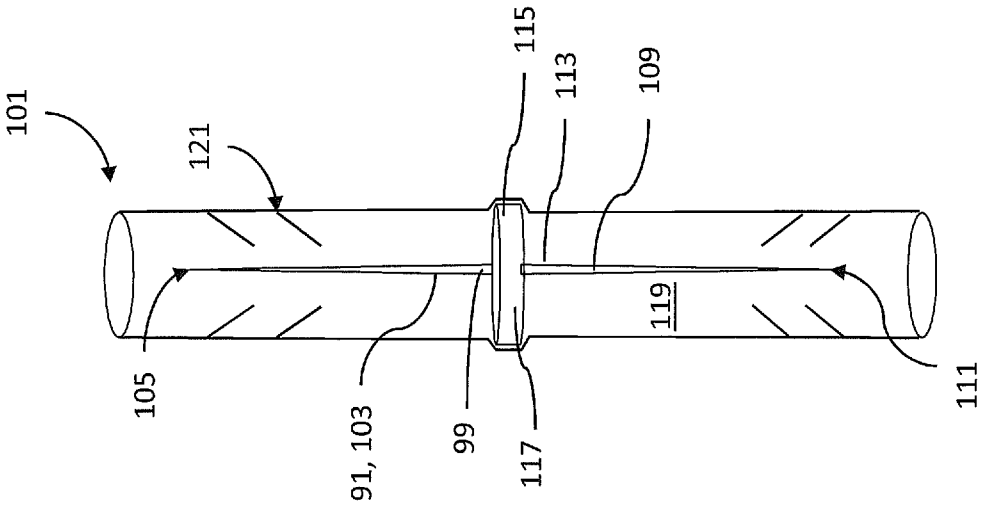


FIG. 13

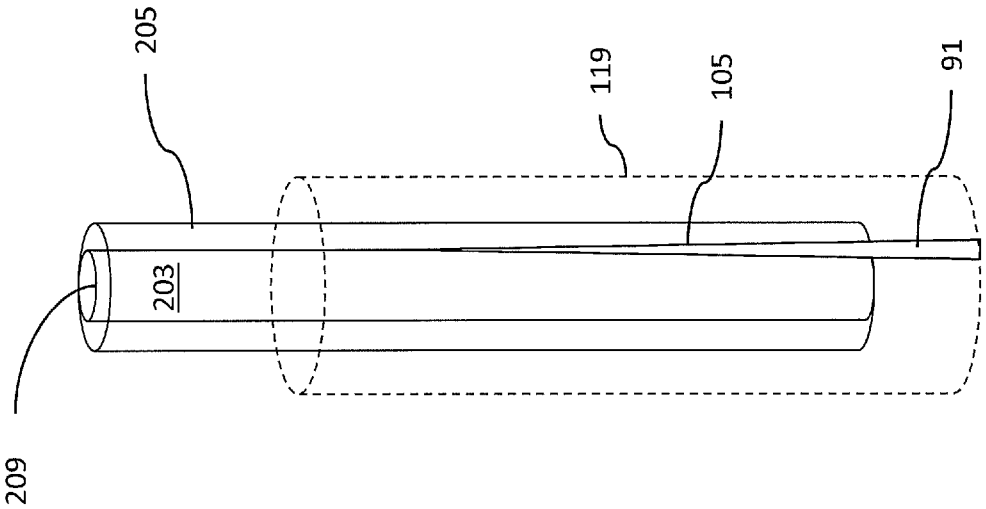
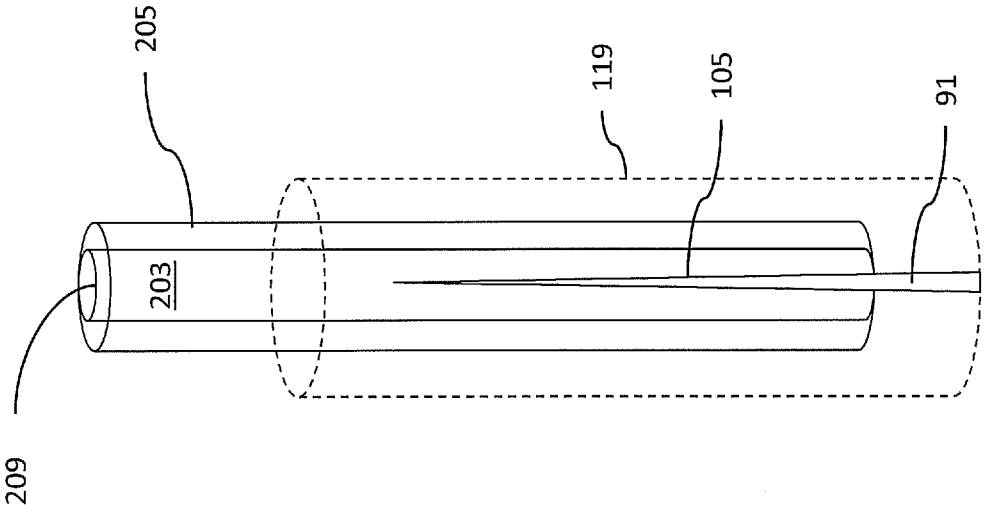


FIG. 12



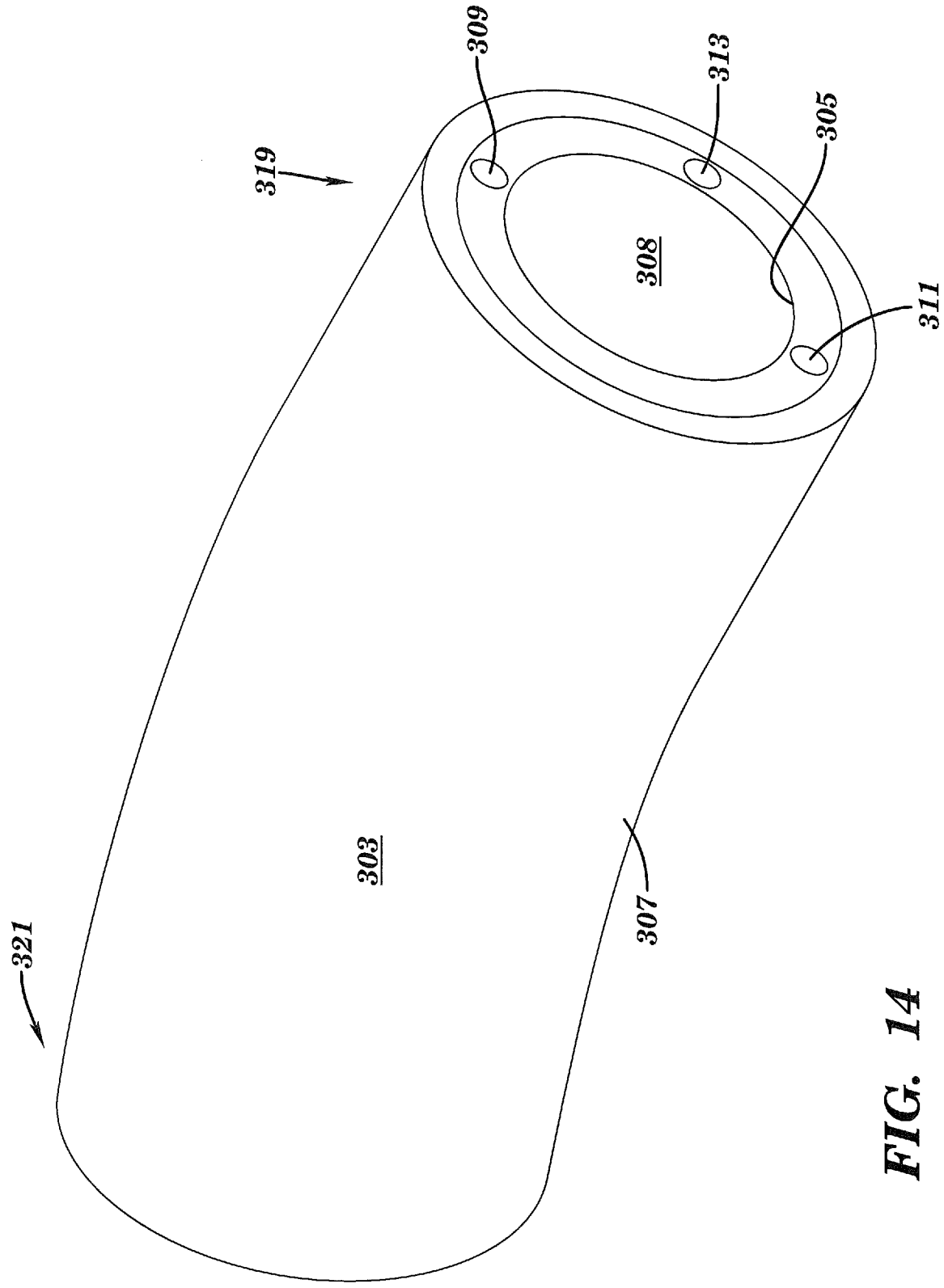


FIG. 14

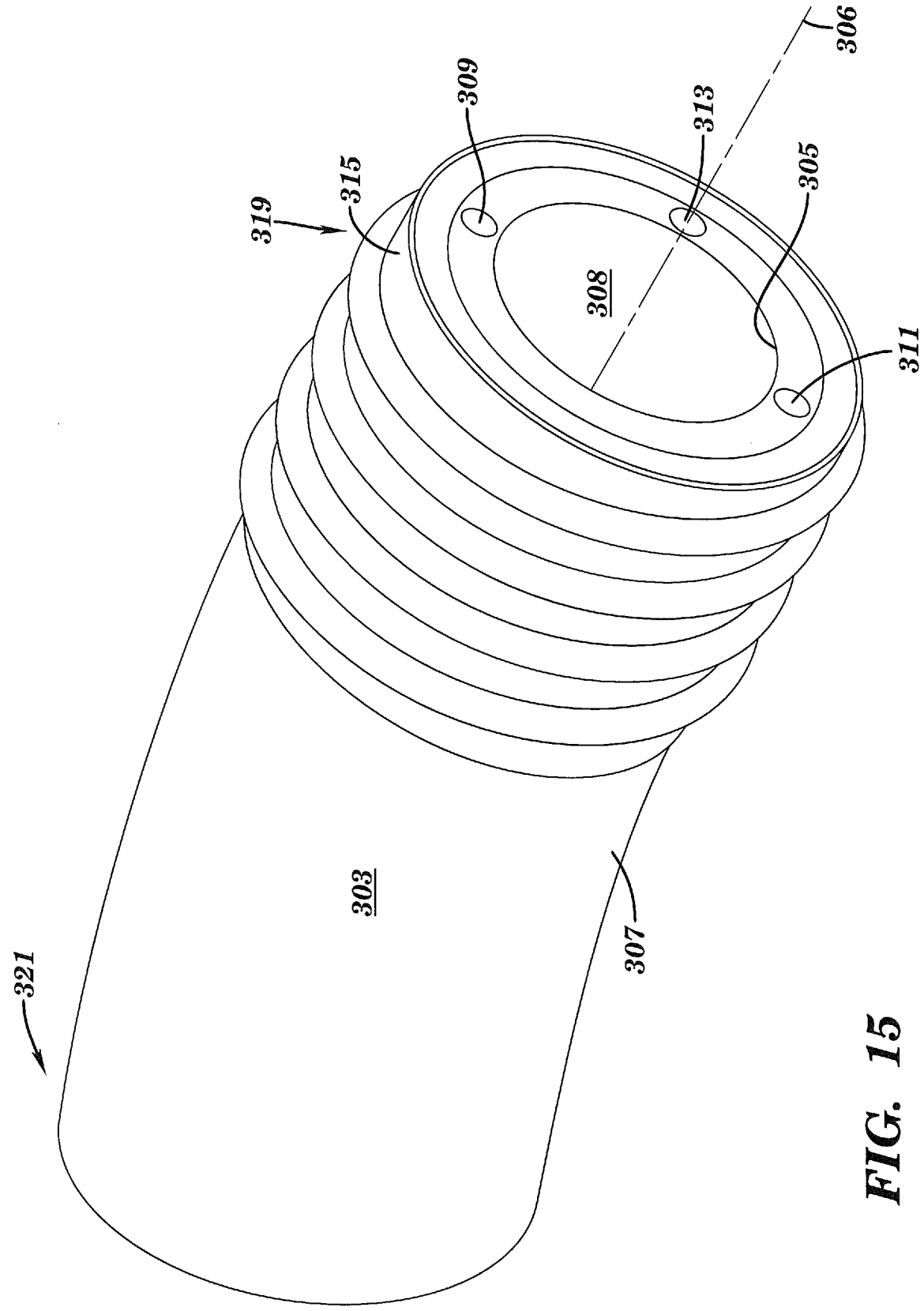
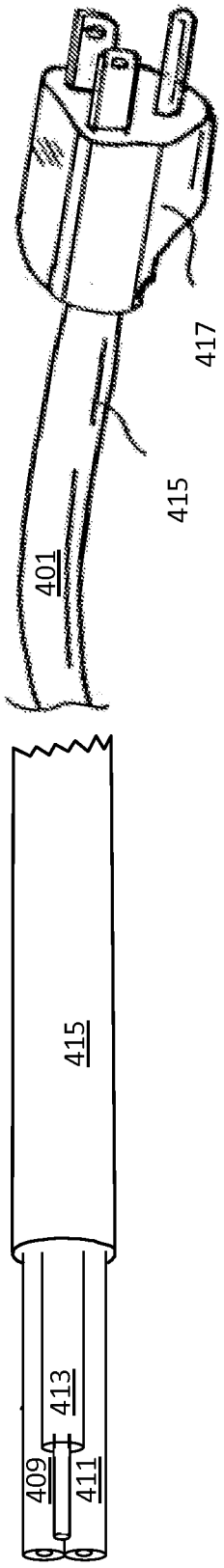


FIG. 15

FIG. 16



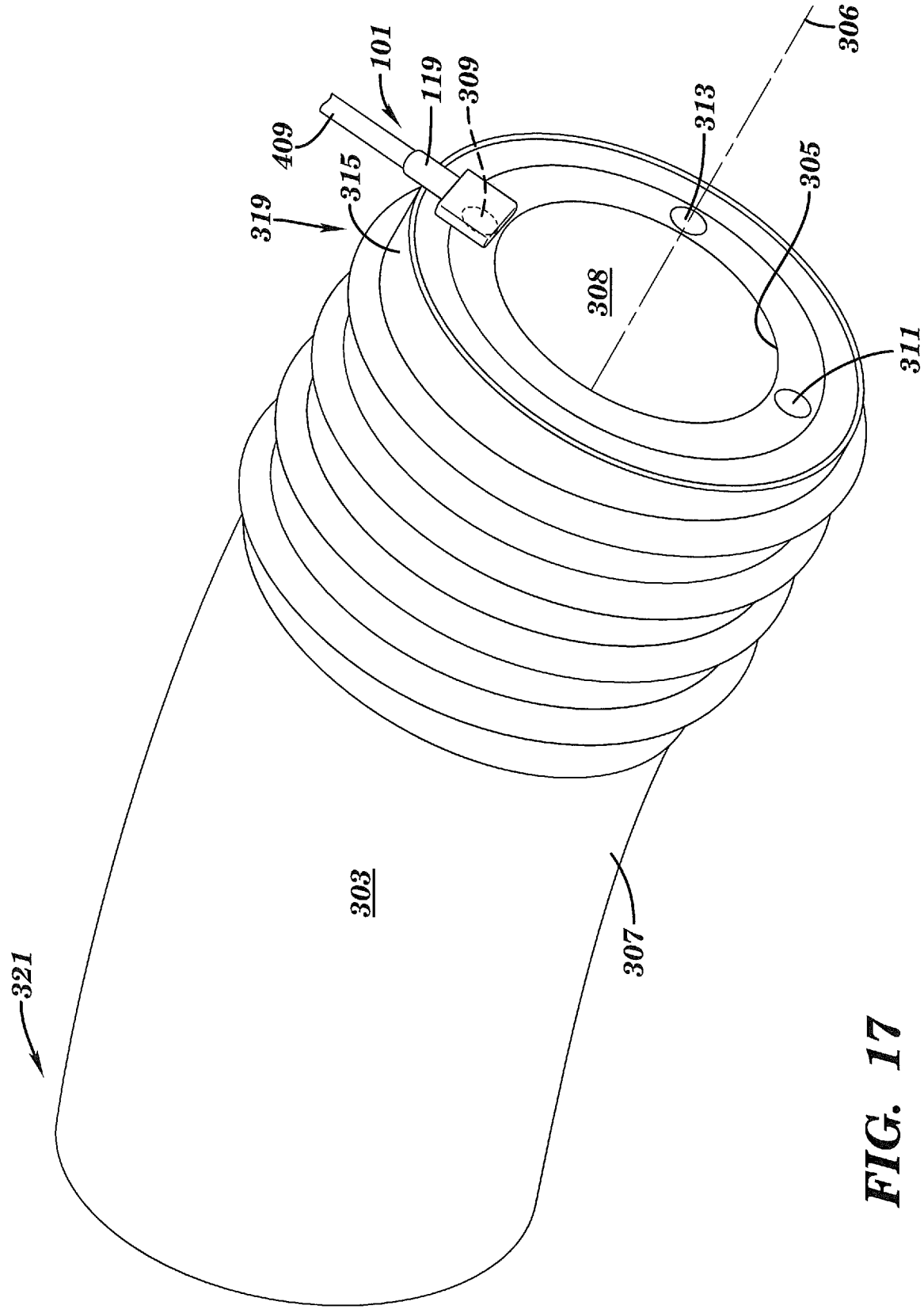


FIG. 17

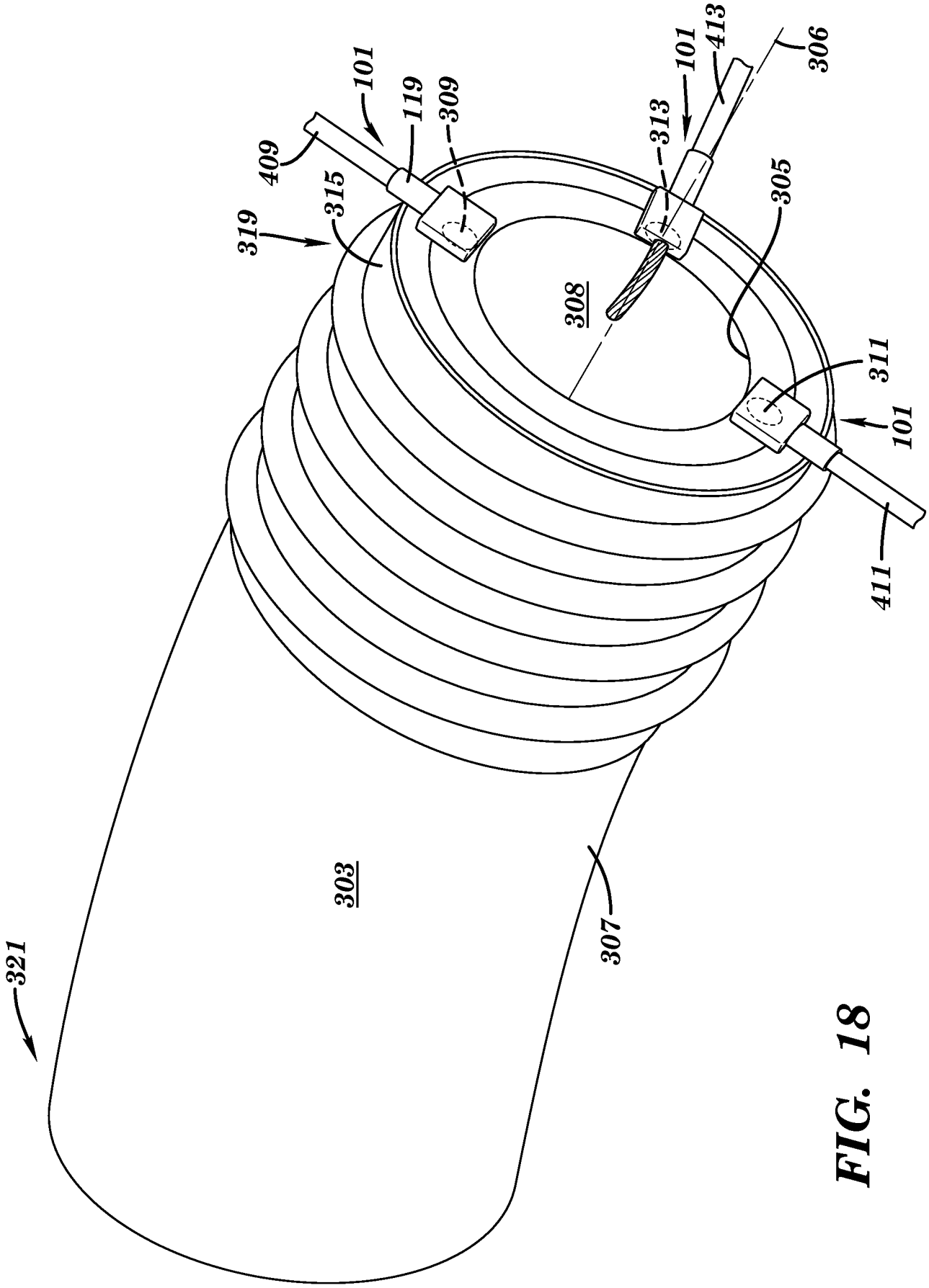

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FIG. 18

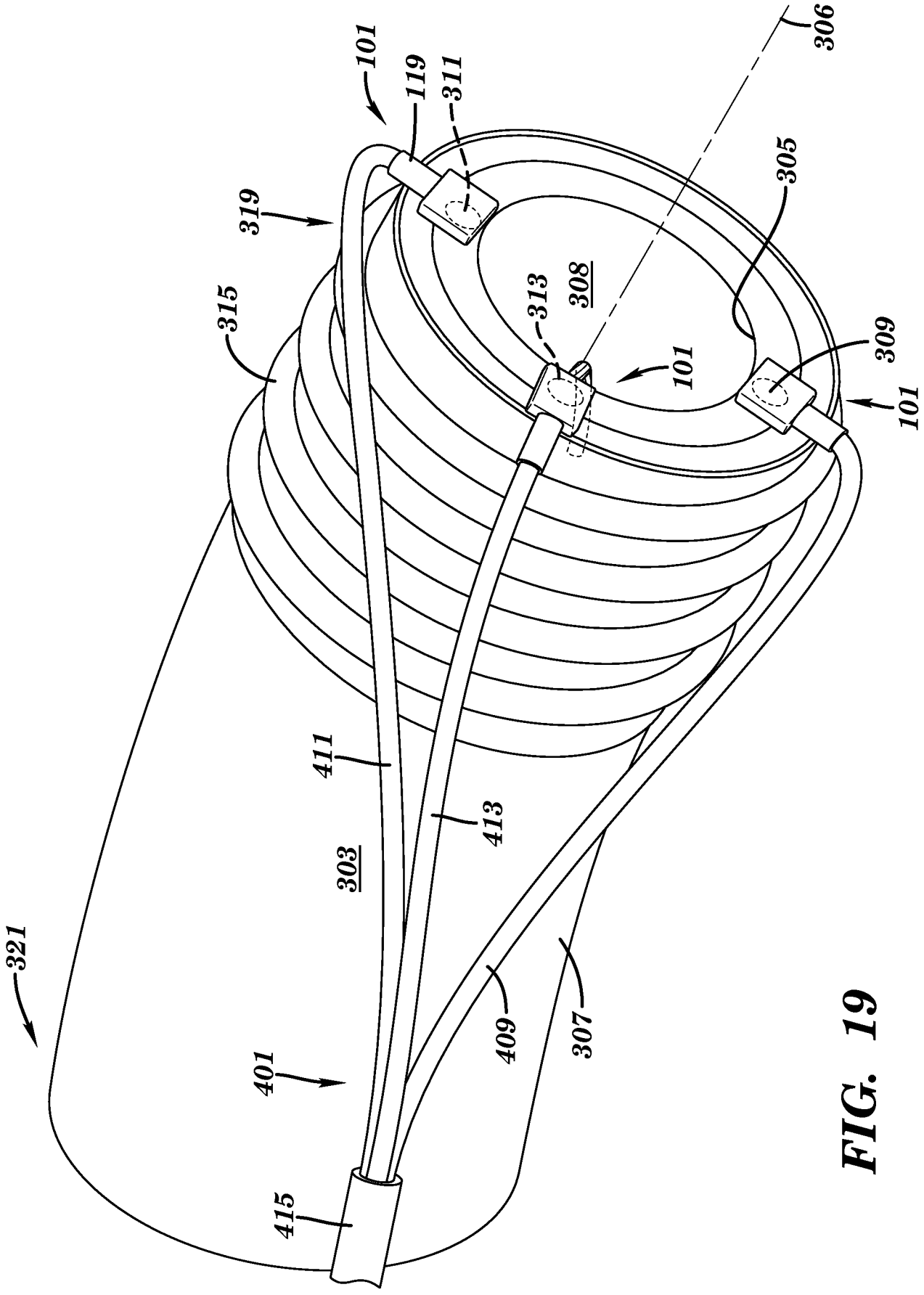
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FIG. 19

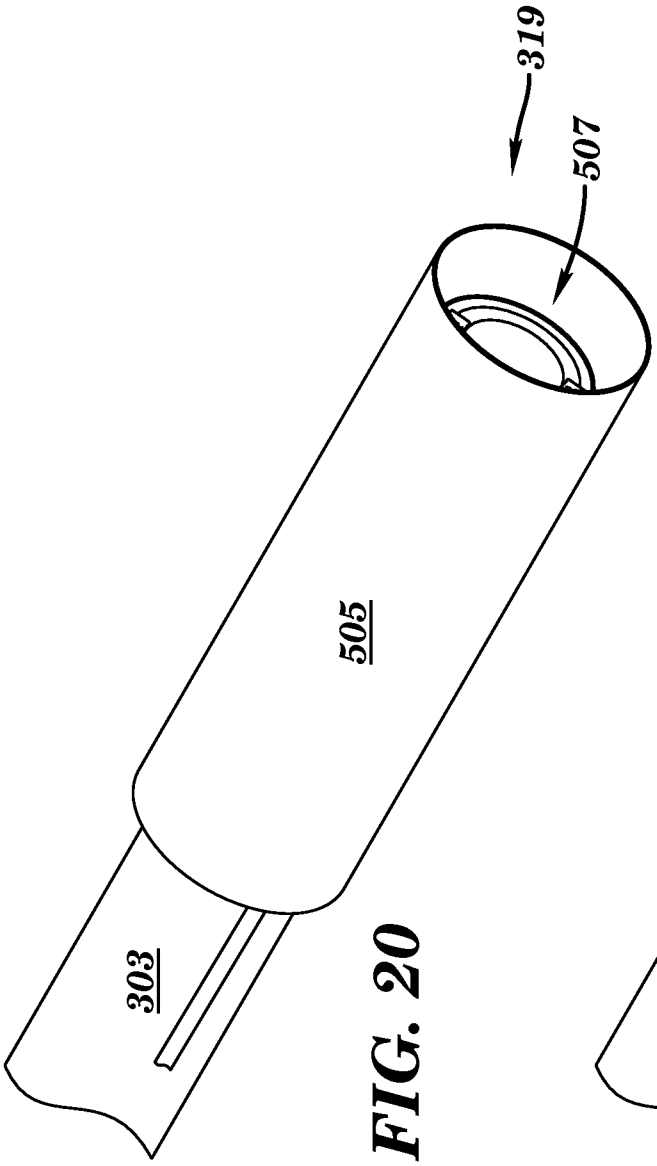

FIG. 20

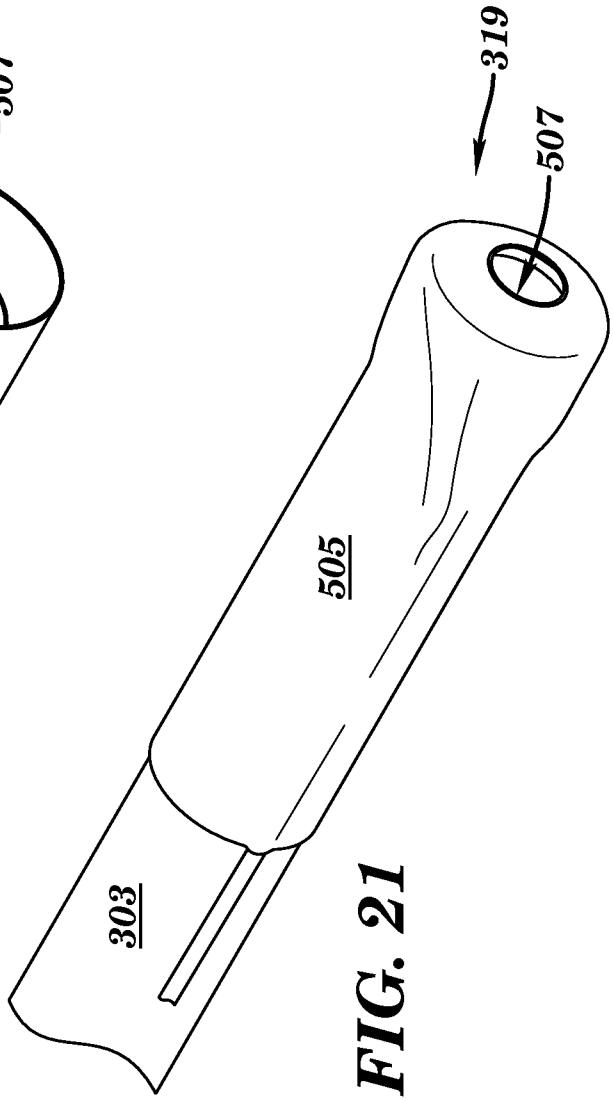

FIG. 21

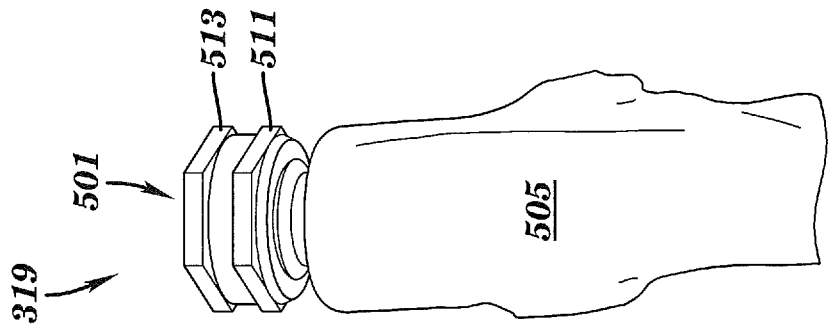

FIG. 24

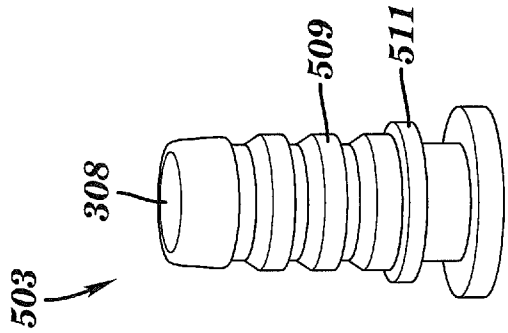

FIG. 23

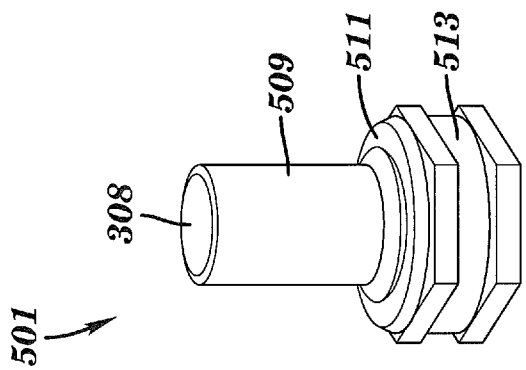

FIG. 22

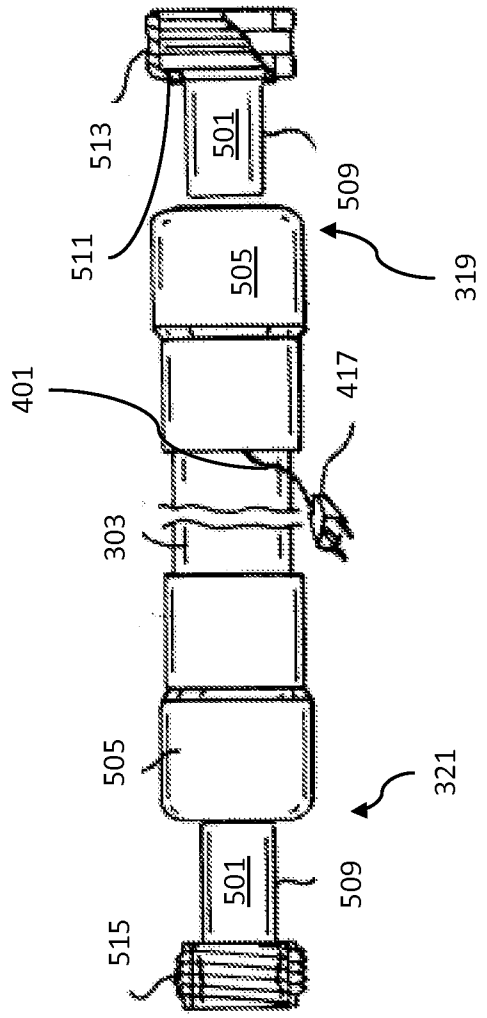
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FIG. 25

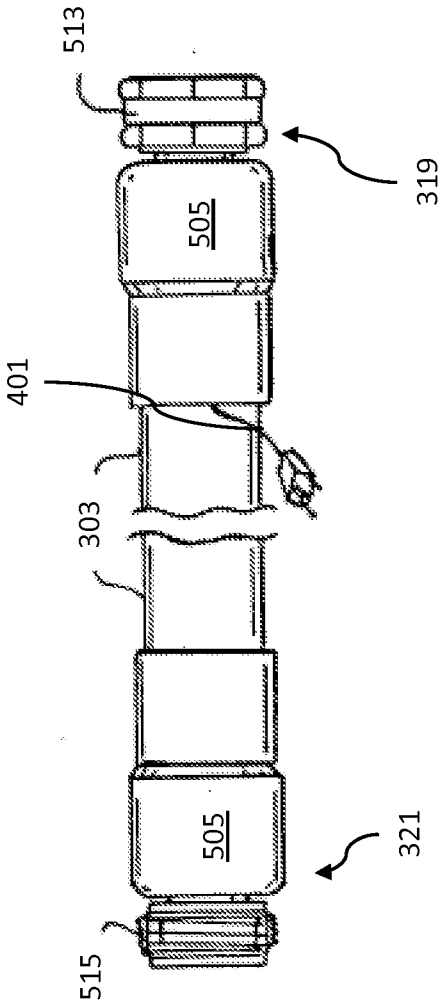
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FIG. 26

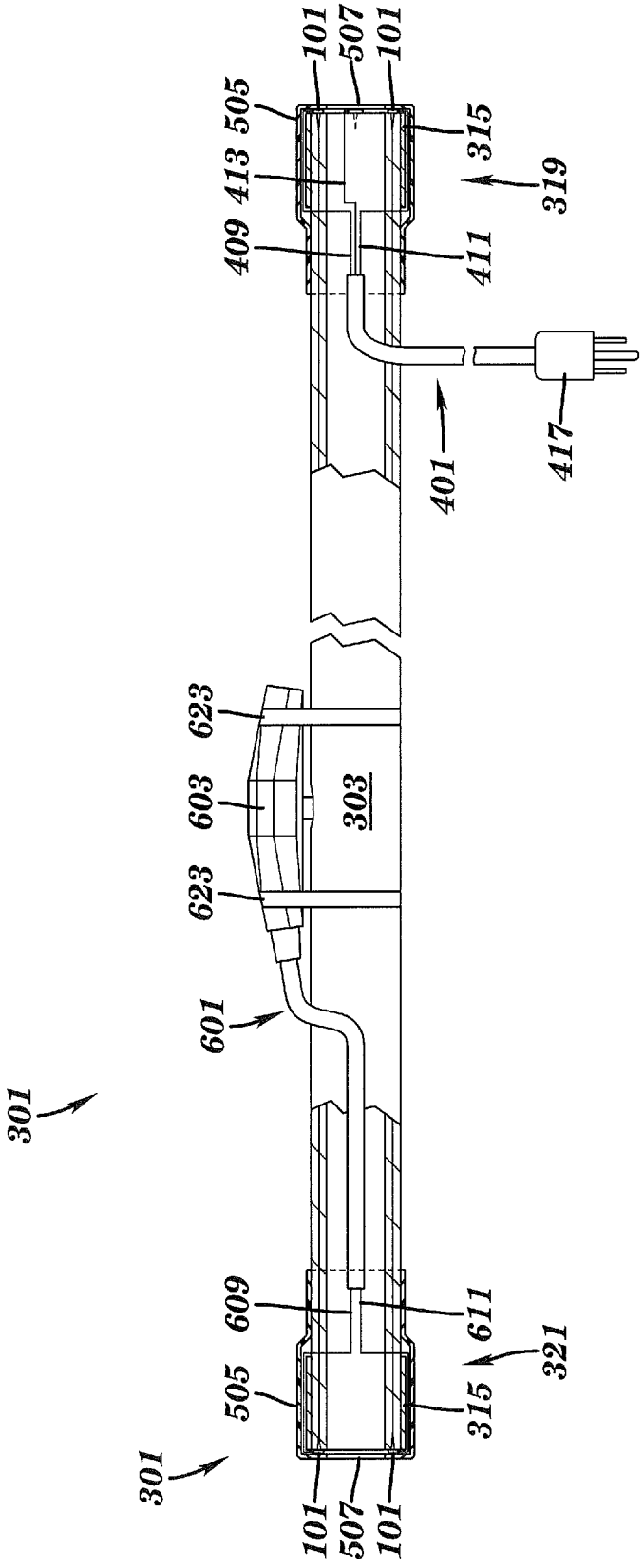
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FIG. 27

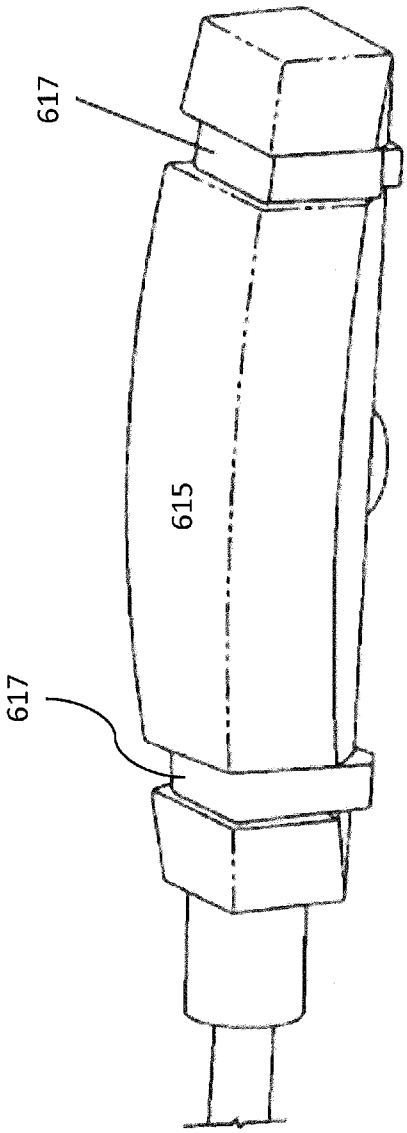

FIG. 28

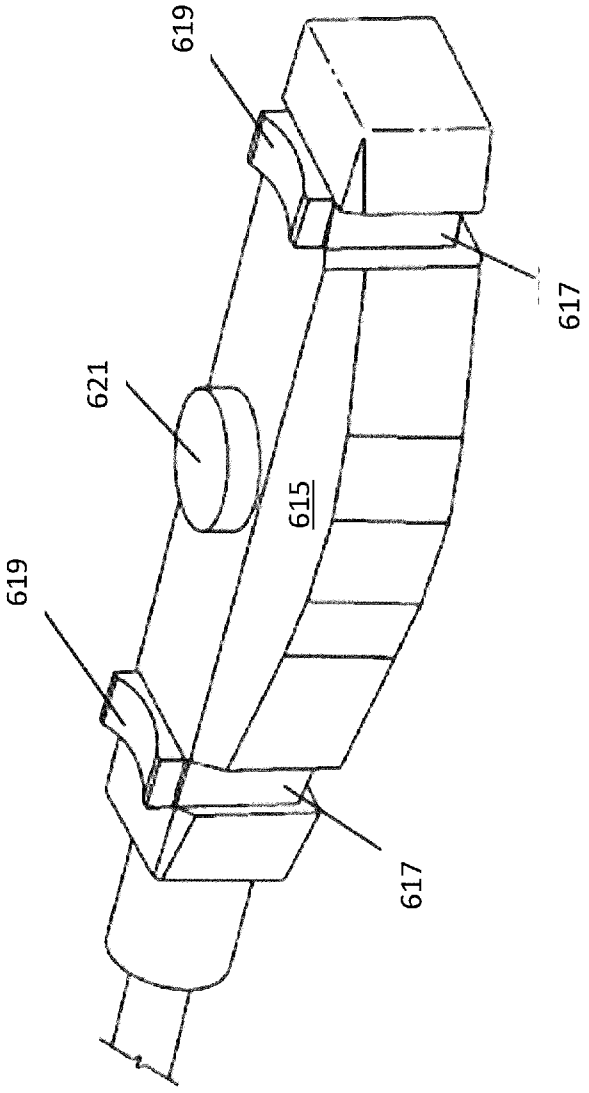

FIG. 29

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/019879

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - H05B 3/58 (2014.01)
USPC - 138/33

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - F16L 53/00; F24H 53/008; H01R 4/24, 4/50, 9/03; H05B 3/58 (2014.01)
USPC - 138/33; 174/84R, 85, 87; 439/425, 427, 387, 393

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
CPC - F16L 53/008; F24H 1/142; H01R 4/2404. 4/5033, 9/03, 9/031 (2014.02)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Orbit, Google Patents, Google Scholar, Google, YouTube

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US 3,786,173 A (VOGT) 15 January 1974 (15.01 .1974) entire document	1-4, 7, 10-11, 14, 17-21, 24 --- 5-6, 8-9, 12-13, 15-16, 22-23, 25-26
Y	US.5,681 ,179 A (LANE) 28 October 1997 (28.10.1 997) entire document	5, 15, 16, 22
Y	US 2010/0029129 A1 (COX et al) 04 February 2010 (04.02.2010) entire document	6, 23
Y	US 3,383,642 A (NAVA et al) 14 May 1968.(14.05.1968) entire document	8, 9
Y	US 5,989,056 A (LANGE et al) 23 November 1999 (23. 11.1999) entire document	12, 13, 25, 26
A	US 2013/0042938 A1 (FERRONE) 21 February 2013 (21 .02.2013) entire document	1-29

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 May 2014	09 JUN 2014

Name and mailing address of the ISA/US	Authorized officer:
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774