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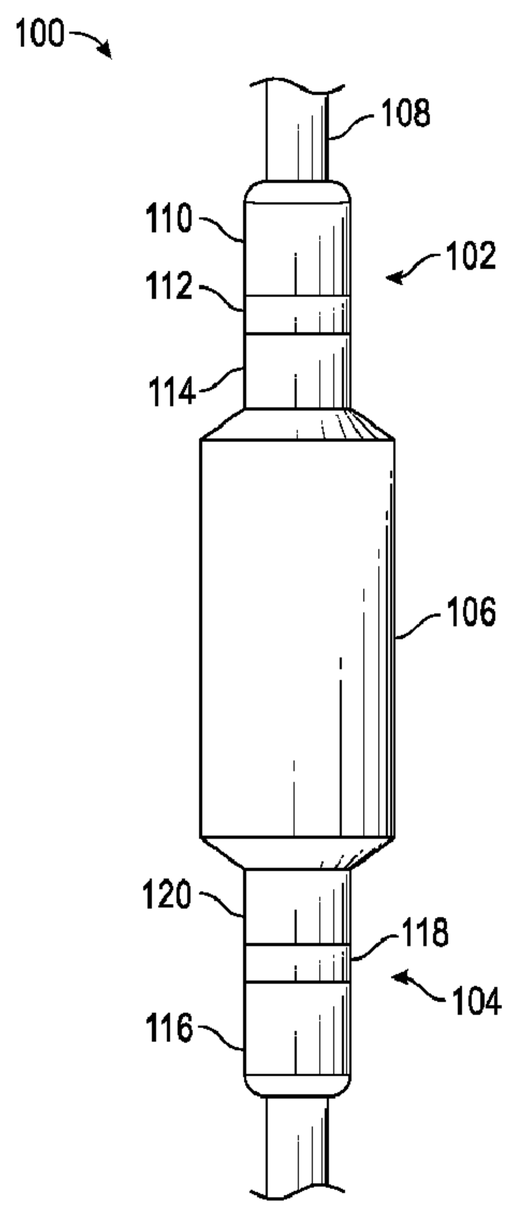

FIG. 1

(57) Abrégé/Abstract:
A packer apparatus and method. The packer includes a mandrel including a gripping structure, a first sleeve received around the mandrel, and a second sleeve received around the mandrel and coupled with the first sleeve. The packer also includes a clamp

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(57) Abrégé(suite)/Abstract(continued):
ring received around the mandrel and axially between at least a portion of the first sleeve and at least a first portion of the second sleeve. The clamp ring includes a first tapered surface and at least one gripping structure configured to engage with the gripping structure of the mandrel. The first sleeve engages the first tapered surface, such that, when the first and second sleeves are moved axially together, the first sleeve applies a radially-inward directed force on the clamp ring.

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[Continued on next page]

(54) Title: PACKER

(57) Abstract: A packer apparatus and method. The packer includes a mandrel including a gripping structure, a first sleeve received around the mandrel, and a second sleeve received around the mandrel and coupled with the first sleeve. The packer also includes a clamp ring received around the mandrel and axially between at least a portion of the first sleeve and at least a first portion of the second sleeve. The clamp ring includes a first tapered surface and at least one gripping structure configured to engage with the gripping structure of the mandrel. The first sleeve engages the first tapered surface, such that, when the first and second sleeves are moved axially together, the first sleeve applies a radially-inward directed force on the clamp ring.

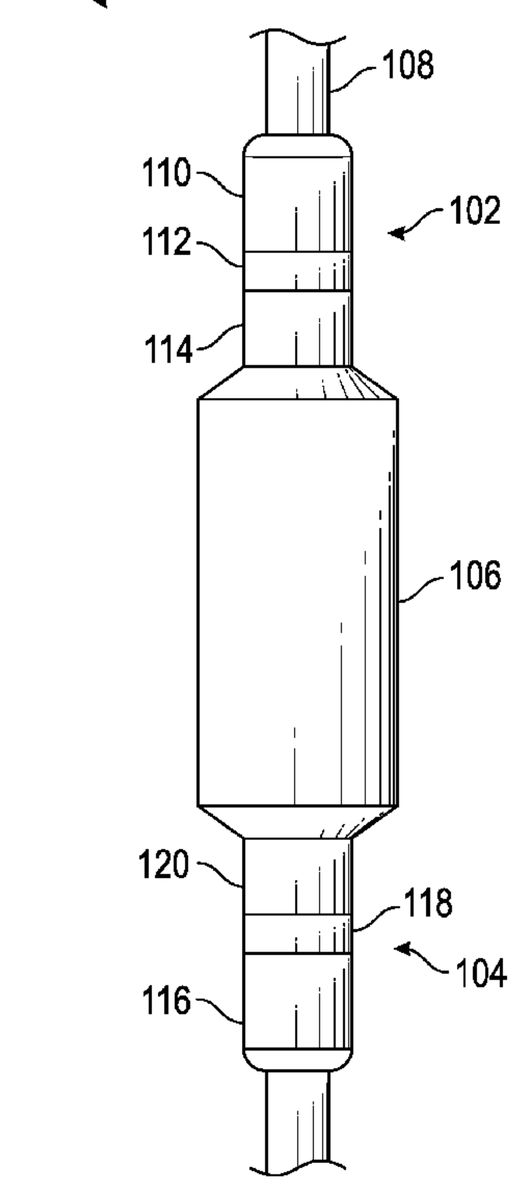

FIG. 1

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PACKER

Cross-Reference to Related Applications

[0001] This application claims priority to U.S. Patent Application serial no. 14/577,527, which was filed on December 19, 2014, and is incorporated by reference herein in its entirety.

Background

[0002] Packers are used to isolate one section of a wellbore annulus from another section. Generally, a packer is run into a wellbore on a casing string, or another other type of oilfield tubular, until positioned at a desired depth, and then expanded. The expanded packer forms a fluid-tight seal between the casing and a surrounding tubular structure, which could be another, larger tubular, or the wellbore wall itself. Packers may be mechanically expanded, inflated, or swelled. A variety of designs are employed for each type of packer.

[0003] Generally, the packer includes a mandrel, which is a tubular body that is connectable to the casing string on either axial end. The other components of the packer are received around the mandrel and held in place by attachment therewith. There are many ways the outer components may be attached to the mandrel, such as by welding or adhering the components to the mandrel. These attachment processes have drawbacks, however. For example, welding the packer to the mandrel can create a heat-affected zone where the welding occurs, which represents an area where the metallurgical properties of the mandrel and/or the other components of the packer are altered. Further, the gripping force provided by adhesives may be negatively affected by the harsh conditions in the wellbore and/or may not provide sufficient holding forces.

Summary

[0004] Embodiments of the disclosure may provide a packer. The packer includes a mandrel including a gripping structure, a first sleeve received around the mandrel, and a second sleeve received around the mandrel and coupled with the first sleeve. The packer also includes a clamp ring received around the mandrel and axially between at least a portion of the first sleeve and at least a first portion of the second sleeve. The clamp ring includes a first tapered surface and at least one gripping structure configured to engage with the gripping structure of the mandrel. The first sleeve engages the first tapered surface, such that, when the first and second sleeves are

moved axially together, the first sleeve applies a radially-inward directed force on the clamp ring.

[0005] Embodiments of the disclosure may also provide a method. The method includes positioning a clamp ring at least partially around a mandrel and at least partially axially between a first sleeve and a second sleeve. The clamp ring includes a first tapered surface that engages the first sleeve, and a gripping structure on an inner diameter of the clamp ring. The method also includes moving the first and second sleeves axially together. Moving the first and second sleeves together causes the first sleeve to apply a radially inward force on the clamp ring, which forces the gripping structure of the clamp ring toward engagement with a gripping structure of the mandrel.

[0006] Embodiments of the disclosure may further provide a packer. The packer includes a mandrel having a threaded region including at least one thread. The packer also includes an expandable sealing element received at least partially around the mandrel, and a retention assembly coupled with the expandable sealing element and configured to retain an axial position of the expandable sealing element relative to the mandrel. The retention assembly includes a first sleeve, a second sleeve movably coupled with the first sleeve, and a third sleeve connected to the expandable sealing element. The retention assembly further includes a clamp ring including at least one thread extending circumferentially on an inner diameter of the clamp ring. The at least one thread of the clamp ring moves into engagement with the at least one thread of the mandrel when the first and second sleeves are moved axially together.

Brief Description of the Drawings

[0007] The present disclosure may best be understood by referring to the following description and accompanying drawings that are used to illustrate some embodiments. In the drawings:

[0008] Figure 1 illustrates a side perspective view of a packer, according to an embodiment.

[0009] Figure 2 illustrates a side, cross-sectional view of a first retention assembly of the packer, according to an embodiment.

[0010] Figure 3 illustrates a side, cross-sectional view of a second retention assembly of the packer, according to an embodiment.

[0011] Figure 4 illustrates raised perspective view of a clamp ring which may be employed with either of the first or second retention assemblies, according to an embodiment.

[0012] Figure 5 illustrates a raised perspective view of a mandrel of the packer, according to an embodiment.

[0013] Figure 6 illustrates a flowchart of a method for assembling a packer, according to an embodiment.

[0014] Figure 7 illustrates an enlarged cross-sectional view of the first retention assembly, according to an embodiment.

Detailed Description

[0015] The following disclosure describes several embodiments for implementing different features, structures, or functions of the invention. Embodiments of components, arrangements, and configurations are described below to simplify the present disclosure; however, these embodiments are provided merely as examples and are not intended to limit the scope of the invention. Additionally, the present disclosure may repeat reference characters (e.g., numerals) and/or letters in the various embodiments and across the Figures provided herein. This repetition is for the purpose of simplicity and clarity and does not in itself dictate a relationship between the various embodiments and/or configurations discussed in the Figures. Moreover, the formation of a first feature over or on a second feature in the description that follows may include embodiments in which the first and second features are formed in direct contact, and may also include embodiments in which additional features may be formed interposing the first and second features, such that the first and second features may not be in direct contact. Finally, the embodiments presented below may be combined in any combination of ways, e.g., any element from one exemplary embodiment may be used in any other exemplary embodiment, without departing from the scope of the disclosure.

[0016] Additionally, certain terms are used throughout the following description and claims to refer to particular components. As one skilled in the art will appreciate, various entities may refer to the same component by different names, and as such, the naming convention for the elements described herein is not intended to limit the scope of the invention, unless otherwise specifically defined herein. Further, the naming convention used herein is not intended to distinguish between components that differ in name but not function. Additionally, in the following discussion and in the claims, the terms "including" and "comprising" are used in an open-ended fashion, and thus should be interpreted to mean "including, but not limited to." All numerical

values in this disclosure may be exact or approximate values unless otherwise specifically stated. Accordingly, various embodiments of the disclosure may deviate from the numbers, values, and ranges disclosed herein without departing from the intended scope. In addition, unless otherwise provided herein, "or" statements are intended to be non-exclusive; for example, the statement "A or B" should be considered to mean "A, B, or both A and B."

[0017] In general, embodiments of the present disclosure may provide a packer with a retention assembly. The packer retention assembly includes two or more sleeves that may be interlocked, and are movable axially along a mandrel with respect to one another. A clamp ring may be received axially between the two sleeves and radially between the mandrel and the sleeves. The clamp ring and the mandrel each have gripping structures (e.g., threads) that are sized to mesh with one another. When the sleeves of the packer retention assembly are adducted, they apply a radially inward force on the clamp ring, which drives the gripping structure thereof toward engagement with the gripping structure of the mandrel. The engagement between the griping structures resists at least axial displacement of the outer components of the packer with respect to the mandrel, thus serving to retain the outer components in place, e.g., without welding or adhesive.

[0018] Turning now to the specific, illustrated embodiments, Figure 1 depicts a side, perspective view of a packer 100, according to an embodiment. The packer 100 may be an inflatable packer, and may be configured for use in isolating one section of a wellbore annulus from another, e.g., during a cementing operation. However, this is but one example among many implementations of the packer 100 that are contemplated herein. In other embodiments, the packer 100 may be swellable or mechanically set, and/or may be employed in other wellbore operations in which zonal isolation may be used. For example, inflatable packers may be expanded by receiving a fluid radially between the mandrel and the sealing element. Swellable packers may be expanded by the sealing element absorbing fluids in the wellbore.

[0019] In the illustrated embodiment, the packer 100 includes a first retention assembly 102, a second retention assembly 104, an expandable sealing element 106, and a mandrel 108 about which the other components 102, 104, 106 are received. The sealing element 106 is illustrated in an expanded configuration, having been inflated, e.g., by fluid pressure between the mandrel 108 and the inner surface of the sealing element 106. In the expanded configuration, the sealing element 106 may engage a surrounding tubular (e.g., an oilfield tubular such as a casing or drill

pipe, or the wellbore wall itself). The sealing element 106 may also have an un-expanded configuration, e.g., for use during run-in, so as to minimize and/or avoid engagement between a surrounding tubular and the sealing element 106.

[0020] The first and second retention assemblies 102, 104 may each be formed from several interlocking parts. For example, the first retention assembly 102 may include a first sleeve 110, a second sleeve 112, and a third sleeve 114. The first sleeve 110, in some embodiments, may serve as a valve body for an internal valve that allows control over inflation of the sealing element 106. The third sleeve 114 may retain the sealing element 106 in place on the mandrel 108. The second sleeve 112 may be between and coupled with the first and third sleeves 110, 112, as will be described in greater detail below. In some embodiments, the second sleeve 112 may be omitted, with the first sleeve 110 and the third sleeve 114 being directly coupled together. As shown, the first, second, and third sleeves 110, 112, 114 may define a generally constant outer diameter.

[0021] Similarly, the second retention assembly 104 may include a first sleeve 116, a second sleeve 118, and a third sleeve 120. In some embodiments, the first sleeve 116 may serve as a seal body, which may function to prevent fluid, or other materials, from moving radially between the second retention assembly 104 and the mandrel 108. The third sleeve 120 may engage and retain the sealing element 106 in place on the mandrel 108. The second sleeve 118 may connect together the first and third sleeves 116, 120 as will be described below. However, in some embodiments, the second sleeve 118 may be omitted and the first and third sleeves 116, 120 may be directly coupled together. As shown, the first, second, and third sleeves 116, 118, 120 may define a generally constant outer diameter.

[0022] Figure 2 illustrates an enlarged, cross-sectional view of the first retention assembly 102, according to an embodiment. The first retention assembly 102 is defined about a central axis 200 of the mandrel 108, and cross-sections thereof may or may not be symmetric about the central axis 200. As the term is used herein, “axially” refers to a direction that is parallel to the central axis 200.

[0023] The mandrel 108 may be hollow, and may include a bore 201 therein, through which wellbore fluids such as cement, fracturing fluid, etc., may be deployed, and/or through which production fluids, such as hydrocarbons, may be recovered. In some embodiments, the bore 201 may have substantially the same diameter as the bore of one or more adjacent casing joints, or

any other oilfield tubular to which the mandrel 108 may be attached. As mentioned above, the first sleeve 110 may be a valve body; thus, the first sleeve 110 may include a valve 203, which may be any suitable type of valve for an inflatable packer. In other embodiments, the first sleeve 110 may include any other type of device for controlling expansion of the sealing element 106 or for performing any other function, e.g., in other types of packers.

[0024] The first retention assembly 102 may also include a clamp ring 202A. The clamp ring 202A may be positioned axially between a tapered engaging surface 204 of the first sleeve 110 and a tapered engaging surface 206 of the second sleeve 112. The clamp ring 202A may also be positioned radially between the mandrel 108 and at least a portion of both of the first and second sleeves 110, 112.

[0025] Moving the first and second sleeves 110, 112 axially together may cause the first and/or second sleeves 110, 112 to apply a radially-inward directed gripping force on the clamp ring 202A. For example, the first sleeve 110 and the second sleeve 112 may be axially overlapping, such that a connecting portion 208 of the first sleeve 110 may be received radially between the mandrel 108 and a first connecting portion 210 of the second sleeve 112. The connecting portions 208, 210 may each have threads formed thereon, which may mesh and, as the first and second sleeves 110, 112 are rotated relative to one another in a circumferential direction, may draw the first and second sleeves 110, 112 axially towards one another. Additionally, one or more seals 211 may be received between the connecting portions 208, 210 so as to prevent fluid flow therebetween. In other embodiments, the first and second sleeves 110, 112 may include a ratcheting assembly, e.g., in addition to or in lieu of such threads. For example, the first sleeve 110 may include teeth, which may be sloped on one side and generally flat on the other, while the second sleeve 110 may similarly include teeth that are sloped on one side and flat on the other. The teeth of the sleeves 110, 112 may engage with one another, so as to allow axial translation in one direction (e.g., toward one another) while preventing it in the reverse direction. In still other embodiments, the first and second sleeves 110, 112 may be slid axially together, e.g., using a clamp or another tool, and a device, such as a locking wire inserted between the first and second sleeves 110, 112, set screws, bolts, pins, other fasteners, etc. or any combination thereof, may be employed to hold the first and second sleeves 110, 112 in place.

[0026] Similarly, the third sleeve 114 may have a connecting portion 212, and the second sleeve 112 may have a second connecting portion 214. The second connecting portion 214 may

be received radially between the connecting portion 212 and the mandrel 108. The connecting portions 212, 214 may have threads formed thereon, which may mesh, such that relative rotation of the second and third sleeves 112, 114 may cause the second and third sleeves 112, 114 to move axially toward one another. Further, one or more seals 216 may be received between the connecting portions 212 and 214, so as to prevent fluid flow therebetween.

[0027] When the first and second sleeves 110, 112 are moved axially toward one another, e.g., by rotating either or both of the first sleeve and/or second sleeve 110, 112, the engaging surfaces 204, 206 may also move toward one another, thereby applying an axially-directed compressive force on the clamp ring 202A. The clamp ring 202A may have one or more tapered surfaces, which may serve as a wedge, converting a portion of the axially-directed compressive force to a radially-inward directed gripping force on the mandrel 108. This engagement will be described in greater detail below. However, in general, the gripping force applied by the clamp ring 202 on the mandrel 108 may serve to fix the axial position of the clamp ring 202A relative to the mandrel 108, such that the clamp ring 202A resists axial displacement relative thereto. Thus, the engagement between the engaging surfaces 204, 206 of the first and second sleeves 110, 112, and the connection between the first and second sleeves 110, 112, may prevent the first retention assembly 102 from being displaced at least axially along the mandrel 108.

[0028] Figure 3 illustrates an enlarged, cross-sectional view of the second retention assembly 104, according to an embodiment. As mentioned above, the first sleeve 116 of the second retention assembly 104 may be a seal body, and thus may include one or more seals (two are shown: 300, 302). The seals 300, 302 may be received between the first sleeve 116 and the mandrel 108, e.g., in a groove formed in either or both of the first sleeve 116 and the mandrel 108, so as to prevent fluid therebetween.

[0029] The second retention assembly 104 may be generally similar to the first retention assembly 102. For example, the first, second, and third sleeves 116, 118, 120 may be interlocking, and may be held in position by engagement with another clamp ring 202B. In particular, the clamp ring 202B may be positioned axially between an engagement surface 304 of the first sleeve 116 and an engagement surface 306 of the second sleeve 118. The clamp ring 202B may also be positioned radially between the mandrel 108 and connecting portions 308, 310 of the first and second sleeves 116, 118, respectively.

[0030] In turn, the connecting portions 308, 310 may be coupled together, e.g., via meshing threads. When the first and second sleeves 116, 118 are moved toward one another, e.g., by rotating the first and second sleeves 116, 118 relative to one another, the engaging surfaces 304, 306 thereof apply an axially-directed compressive force on the clamp ring 202B. The clamp ring 202B may convert at least some of this axially-directed force into a radially-inward directed gripping force. Thus, the clamp ring 202B may grip the mandrel 108, and, by engagement with the engaging surfaces 304, 306, may fix the position of the second retention assembly 104 on the mandrel 108, at least in an axial direction.

[0031] Figure 4 illustrates a perspective view of a clamp ring 202, according to an embodiment. The clamp ring 202 may be representative of an embodiment of either or both of the clamp rings 202A, 202B of the first and second retention assemblies 102, 104 (Figures 2 and 3). As shown, the clamp ring 202 includes circumferential ends 400, 402, which are separated apart by a gap 404. This geometry, which may be characterized as a c-ring, may allow the clamp ring 202 to flex, so as to facilitate receiving the clamp ring 202 over an end of the mandrel 108 (e.g., Figure 2). For example, the c-ring shape may facilitate elastically flexing the clamp ring 202 so as to increase its effective inner diameter. However, in other embodiments, the clamp ring 202 may be a continuous, generally toroidal structure, and may be configured to deform radially inwards upon application of a radially (and/or axially) compressive force.

[0032] The clamp ring 202 may also define one or more tapered surfaces (two are shown: 406, 408). The tapered surfaces 406, 408 may be defined on opposite axial sides of the radial outside of the clamp ring 202, and, in an embodiment, may be reverse tapered with respect to one another. The tapered surfaces 406, 408 may be sized, shaped, and/or otherwise configured to engage the tapered engaging surfaces 204, 206 (Figure 2) and/or the tapered engaging surfaces 304, 306 (Figure 3). For example, the tapered surfaces 406, 408 may be complementary to the tapered engaging surfaces 204, 206, 304, 306.

[0033] More particularly, the tapered surfaces 406, 408 may define an inclination angle. In an embodiment, the inclination angle may be the same, but oppositely oriented, for both of the tapered surfaces 406, 408, such that the tapered surfaces 406, 408 are reversed tapered. In other embodiments, the tapered surfaces 406, 408 may be tapered to different degrees. The inclination angle may be characterized as being defined between the tapered surface 406, 408 and the central axis 200 (see, e.g., Figure 2), and is described herein as such; however, it may also be

characterized as between a radial line perpendicular to the central axis 200, or any other suitable line. The inclination angle may be from about 15 degrees, about 20 degrees, or about 25 degrees to about 35 degrees, about 40 degrees, or about 45 degrees, with respect to the central axis 200.

[0034] A shoulder 409 may be formed between the tapered surfaces 406, 408. The shoulder 409 may extend radially outward, and may provide a generally flat, non-tapered surface upon which the adjacent first and second sleeves 110, 112 or 116, 118 may engage. The shoulder 409 may thus serve to provide an end range for the sleeves 110, 112 or 116, 118 sliding along the tapered surfaces 406, 408, as the sleeves 110, 112 or 116, 118 are drawn axially closer together, which may reduce radially-outward deformation of the sleeves 110, 112, or 116, 118.

[0035] Although the clamp ring 202 is described herein as having two tapered surfaces 406, 408, it will be appreciated that the clamp ring 202 may, in some embodiments, have a single tapered surface. In such an embodiment, the clamp ring 202 may have a flat side, axially opposite to the remaining tapered surface, which may bear against a flat engaging surface of either of the first and second sleeves 110, 112 or 116, 118. Further, the outside of the clamp ring 202 may also define multiple tapered surfaces on either side of the shoulder 409, without departing from the scope of the present disclosure.

[0036] The clamp ring 202 may also include a gripping structure, such as a plurality of threads 410 extending circumferentially between the ends 400, 402. In an embodiment, the threads 410 may extend along an inner diameter 412 of the clamp ring 202, e.g., entirely between the ends 400, 402. In other embodiments, the threads 410 may extend partially or may be separated into two or more circumferentially-extending segments. Further, in embodiments in which the clamp ring 202 is a continuous ring, the threads 410 may extend entirely around the inner diameter of the clamp ring 202, or may extend partially therearound.

[0037] The clamp ring 202 may be formed from a metal, such as a stainless steel or another steel alloy. In another embodiment, the clamp ring 202 may be formed from a fiber-reinforced plastic or another type of composite material.

[0038] The threads 410 may be provided by a plurality of generally parallel rows of teeth. In another embodiment, the threads 410 may be provided by a helical ridge, which would extend continuously around the inner diameter 412, e.g., multiple times, but for the gap 404 (in embodiments that include the gap 404). In other embodiments, e.g., omitting the gap 404, the threads 410 may be provided from a single, continuous, helical ridge extending along the inner

diameter 412 multiple times. In some embodiments, a single thread 410 may be employed. The threads 410 may be sized and configured to mesh with, and thereby form an axial engagement with, threads formed into the mandrel 108.

[0039] In other embodiments, the gripping structure may include other types of geometries or structures. For example, the gripping structure may include knurls, a high-roughness (e.g., gritty) surface, a high-friction surface, axially-extending threads (e.g., in lieu of or in addition to the circumferentially-extending threads).

[0040] Figure 5 illustrates a perspective view of the mandrel 108, according to an embodiment. The mandrel 108 may include a gripping structure configured to engage the gripping structure of the clamp ring 202. For example, the mandrel 108 may define at least one threaded region (two are shown: 500, 502). In other embodiments, other types of gripping structures may be employed, such as knurls, a high-roughness (e.g., gritty) surface, a high-friction surface, axially-extending threads (e.g., in lieu of or in addition to the circumferentially-extending threads). Although shown as having a generally constant outer diameter surface away from the threaded regions 500, 502, it will be appreciated that, in other embodiments, the mandrel 108 may have various grooves, recesses, shoulders, etc.

[0041] The threaded regions 500, 502 may each include one or more threads 504, 506, respectively. The threads 504, 506 may be configured to engage the threads 410 of the clamp rings 202A, 202B, respectively. In some embodiments, the threads 504, 506 may each be formed from a helical groove cut into the outer diameter of the mandrel 108. In other embodiments, the threads 504, 506 may be formed from a plurality of parallel grooves formed around the outer diameter of the mandrel 108. The threads 504, 506 may extend inwards from the nominal outer diameter of the mandrel 108, may be small relative to the diameter of the mandrel 108. This may avoid the packer 100 having a reduced burst strength as a result of the threaded regions 500, 502.

[0042] The mandrel 108 may be formed from a metal, such as stainless steel or another steel alloy. Further, the mandrel 108 may be formed from a fiber-reinforced plastic or another type of composite material. In some embodiments, the mandrel 108 and the clamp ring 202 may both be composite, both steel (or another type of metal), or one may be metal while the other is composite. Furthermore, in examples in which at least one of the clamp ring 202 or the mandrel 108 is formed at least partially from a composite, an adhesive, such as an epoxy, may be

deposited on the threaded region 500 of the mandrel 108, or on the threads 410 of the clamp ring 202, or both, to increase the holding force of the clamp ring 202 on the mandrel 108.

[0043] Figure 6 illustrates a flowchart of a method 600 for assembling a packer, according to an embodiment. The method 600 may be employed to assemble one or more embodiments of the packer 100 discussed above, and thus is described herein with reference thereto. However, in other embodiments, the method 600 may be employed to assemble other packers, and thus may not be limited to any particular structure. Furthermore, the method 600 is described with reference to the first retention assembly 102; however, it will be appreciated that the method 600 may be generally similar for assembling the second retention assembly 104, and thus may be repeated for the second retention assembly 104 and/or the method 600 may include assembling the second retention assembly 104 prior to assembling the first retention assembly 102.

[0044] The method 600 may begin by positioning the clamp ring 202A at least partially around the mandrel 108, as at 602. For example, the clamp ring 202A may be positioned such that the gripping structure thereof is disposed around and able to engage the gripping structure of the mandrel 108. For example, the clamp ring 202A may be positioned such that the thread(s) 410 thereof are at least partially around the thread(s) 504 of the threaded region 500 of the mandrel 108. Furthermore, the clamp ring 202A may be positioned at least partially axially between the first sleeve 110 and the second sleeve 112.

[0045] In an embodiment, the clamp ring 202A includes at least the first tapered surface 406 that engages the tapered engaging surface 204 of the first sleeve 110. The clamp ring 202A may also include the shoulder 409 extending radially outwards from the first tapered surface 406. In some embodiments, however, the shoulder 409 may be omitted. For example, the clamp ring 202A may have a pointed outer profile.

[0046] In an embodiment, the clamp ring 202A may be expandable/contractible between a first, larger diameter and a second, smaller diameter. For example, the clamp ring 202A may be provided with the gap 404, which may allow the clamp ring 202A to be flexibly expanded, e.g., to receive the clamp ring 202A around the mandrel 108 and slide the clamp ring 202A with respect thereto. The clamp ring 202A may then be contracted, e.g., by application of the radially-inward force by the first and/or second sleeves 110, 112.

[0047] In another embodiment, the clamp ring 202A may have a natural (no expansion/contraction force applied) diameter that is slightly larger than the mandrel 108. The

clamp ring 202A may then be contracted by the radially-inward force applied by the first and/or second sleeves 110, 112. In such an embodiment, the clamp ring 202A may be rotated relative to the mandrel 108 during assembly, such that it is screwed onto the threaded region 500, and then compressed by interaction with the first and second sleeves 110, 112, as will be described below.

[0048] At this point, according to an embodiment, the clamp ring 202A may be positioned radially between the mandrel 108 and at least a portion of the first sleeve 110 and radially between the mandrel 108 and at least a portion of the second sleeve 112, as shown in Figure 2, and indicated at 603 in Figure 6. Further, the clamp ring 202A may be positioned axially between at least a portion of the first sleeve 110 and at least a portion of the second sleeve 112. In an embodiment, the tapered surfaces 406, 408 may engage the engaging surfaces 204, 206 of the first and second sleeves 110, 112, which may be complimentarily tapered.

[0049] In some embodiments, the second sleeve 112, which may be a connector sleeve, may be received around the mandrel 108 first, followed by the clamp ring 202A, and then the first sleeve 110, which may be a valve body. In other embodiments, this order may be changed, or the second sleeve 112 may be omitted, with the engaging surface 206 thereof provided by the third sleeve 114, e.g., the sealing element retention body. Furthermore, the sealing element 106 may be received around the mandrel 108 before, during, or after receiving any of the sleeves 110-114 therearound.

[0050] The method 600 may then proceed to moving, at 604, the first and second sleeves axially together. With the tapered surfaces 406, 408 engaging the tapered engaging surfaces 204, 206, such axial movement may result in a radially-inward force being applied to the clamp ring 202A. Such force may cause the gripping structure (e.g., at least one thread 410) of the clamp ring 202A to move toward engagement with the gripping structure (e.g., at least one thread 504 of the threaded region 500) of the mandrel 108, as at 605. In various embodiments, the gripping structure of the clamp ring 202A may be in engagement with the gripping structure of the mandrel 108 prior to such application of force, and thus the application of the radial-inward force, may drive the gripping structures into tighter engagement. In this situation, the radial inward force is, for purposes of this disclosure, still considered to be driving the gripping structure of the clamp ring 202 toward engagement with the gripping structure of the mandrel 108.

[0051] Referring now additionally to Figure 7, there is shown an example of the interactions that occur when the first and second sleeves 110, 112 are moved axially together, according to an embodiment. As shown, moving the first sleeve 110 toward the second sleeve 112 (and/or vice versa) may cause the tapered engaging surfaces 204, 206 thereof to bear, in an axial direction, against the tapered surfaces 406, 408 of the clamp ring 202A. The shoulder 409 may provide an end-range for such motion, preventing the tapered engaging surfaces 204, 206 from sliding too far over the clamp ring 202A, which might otherwise damage the clamp ring 202A, the first sleeve 110, and/or the second sleeve 112. Further, the shoulder 409 may provide an additional axially-facing surface area on which to transmit axial loading, e.g., to further assist in retaining the axial position of the first retention assembly 102 (and thus the sealing element 106, Figure 1) with respect to the mandrel 108. In other embodiments, the shoulder 409 may be omitted, and another structure or device may be employed to avoid drawing the first and second sleeves 110, 112 together.

[0052] The axially-directed force applied on the clamp ring 202A may be transferred at least partially to a radially-inward directed force. This may cause the clamp ring 202A to reduce in diameter, which, in turn, may drive the gripping structure (e.g., the threads 410) on the inner diameter thereof toward engagement with the gripping structure (e.g., the threads 504 in the threaded region 500) of the mandrel 108. If the gripping structures were already in engagement, driving the gripping structure of the clamp ring 202A toward engagement with the gripping structure of the mandrel 108 means moving the gripping structures into tighter and/or deeper engagement.

[0053] In some embodiments, moving at 604 may include rotating one or both of the first and second sleeves 110, 112 relative to the mandrel 108, and to each other. For example, as illustrated in Figure 2, the first and second sleeves 110, 112 may be connected together via meshed threads, such that rotation in a circumferential direction adducts the first and second sleeves 110, 112.

[0054] The foregoing has outlined features of several embodiments so that those skilled in the art may better understand the present disclosure. Those skilled in the art should appreciate that they may readily use the present disclosure as a basis for designing or modifying other processes and structures for carrying out the same purposes and/or achieving the same advantages of the embodiments introduced herein. Those skilled in the art should also realize that such equivalent

constructions do not depart from the spirit and scope of the present disclosure, and that they may make various changes, substitutions, and alterations herein without departing from the spirit and scope of the present disclosure.

CLAIMS

What is claimed is:

1. A packer, comprising:

a mandrel comprising a gripping structure;

a first sleeve received around the mandrel;

a second sleeve received around the mandrel and coupled with the first sleeve; and

a clamp ring received around the mandrel and axially between at least a portion of the first sleeve and at least a first portion of the second sleeve, wherein the clamp ring comprises a first tapered surface and at least one gripping structure configured to engage with the gripping structure of the mandrel, and wherein the first sleeve engages the first tapered surface, such that, when the first and second sleeves are moved axially together, the first sleeve applies a radially-inward directed force on the clamp ring.

2. The packer of claim 1, wherein the first sleeve comprises a first tapered engaging surface engaging the first tapered surface of the clamp ring, such that the first sleeve applies the radially-inward force on the clamp ring when the first and second sleeves are moved axially together.

3. The packer of claim 1, wherein the clamp ring comprises a shoulder extending radially outward from the first tapered surface.

4. The packer of claim 3, wherein the clamp ring further comprises a second tapered surface, the shoulder being between and extending outwards from the first and second tapered surfaces.

5. The packer of claim 4, wherein the second sleeve comprises a second tapered engaging surface that engages the second tapered surface, such that the second sleeve applies a radially-inward force on the clamp ring when the first and second sleeves are moved axially together.

6. The packer of claim 1, wherein the gripping structure of the mandrel comprises at least one thread formed into the mandrel, and the gripping structure of the clamp comprises at least

one thread formed into the clamp ring, wherein the threads mesh together at least when the first sleeve applies the radially-inward directed force on the clamp ring.

7. The packer of claim 1, wherein the clamp ring is positioned radially between the mandrel and at least a second portion of the second sleeve.

8. The packer of claim 1, wherein the clamp ring has a first inner diameter that is larger than an outer diameter of the mandrel prior to applying the radially-inward directed force, and a second inner diameter that is smaller than the outer diameter of the mandrel after when the radially-inward directed force is applied.

9. The packer of claim 8, wherein the clamp ring comprises a first circumferential end and a second circumferential end, and defines a gap therebetween, such that the clamp ring is flexible between the first and second diameters.

10. The packer of claim 1, wherein the first tapered surface of the clamp ring defines an inclination angle with respect to a central axis of the mandrel, wherein the inclination angle is from about 15 degrees to about 45 degrees.

11. The packer of claim 1, wherein the first sleeve and the second sleeve are configured to move axially together and bear on the clamp ring.

12. The packer of claim 1, further comprising an inflatable sealing element disposed around the mandrel and held axially in place with respect thereto by the first sleeve, the second sleeve, and the clamp ring, wherein the first sleeve comprises a valve body having a valve to control inflation of the inflatable sealing element.

13. The packer of claim 12, further comprising a third sleeve coupled with the second sleeve, such that the second sleeve is positioned at least partially axially between the first and third sleeves, wherein the third sleeve is coupled with the inflatable sealing element.

14. The packer of claim 1, further comprising a sealing element disposed at least partially around the mandrel and held axially in place relative thereto by the first sleeve, the second sleeve, and the clamp ring, wherein the sealing element is configured to swell in the wellbore.

15. A method, comprising:

positioning a clamp ring at least partially around a mandrel and at least partially axially between a first sleeve and a second sleeve, wherein the clamp ring comprises:

a first tapered surface that engages the first sleeve; and

a gripping structure on an inner diameter of the clamp ring; and

moving the first and second sleeves axially together, wherein moving the first and second sleeves together causes the first sleeve to apply a radially inward force on the clamp ring, which forces the gripping structure of the clamp ring toward engagement with a gripping structure of the mandrel.

16. The method of claim 15, wherein moving the first and second sleeves axially together comprises rotating at least one of the first or second sleeves relative to the other.

17. The method of claim 15, wherein the first sleeve comprises a tapered engaging surface that bears on the first tapered surface of the clamp ring when the first and second sleeves are moved together, and wherein the clamp ring comprises a shoulder extending outward from the first tapered surface, the shoulder providing an end-range for axial movement of the first sleeve relative to the clamp ring.

18. The method of claim 17, wherein the clamp ring comprises a second tapered surface extending inward from the shoulder and away from the first tapered surface, wherein the second sleeve comprises a second tapered engaging surface that bears on the second tapered surface when the first and second sleeves are moved together.

19. The method of claim 15, wherein positioning the clamp ring comprises:

expanding a diameter of the clamp ring;

sliding the clamp ring over the mandrel after expanding the diameter of the clamp ring; and

contracting the diameter of the clamp ring once the clamp ring is at least partially on the mandrel.

20. The method of claim 15, further comprising positioning an inflatable sealing element around the mandrel, wherein the first sleeve comprises a valve for controlling inflation of the inflatable sealing element.

21. A packer, comprising:

a mandrel having a threaded region comprising at least one thread;

an expandable sealing element received at least partially around the mandrel; and

a retention assembly coupled with the expandable sealing element and configured to retain an axial position of the expandable sealing element relative to the mandrel, wherein the retention assembly comprises:

a first sleeve;

a second sleeve movably coupled with the first sleeve;

a third sleeve connected to the expandable sealing element; and

a clamp ring comprising at least one thread extending circumferentially on an inner diameter of the clamp ring, wherein the at least one thread of the clamp ring moves into engagement with the at least one thread of the mandrel when the first and second sleeves are moved axially together.

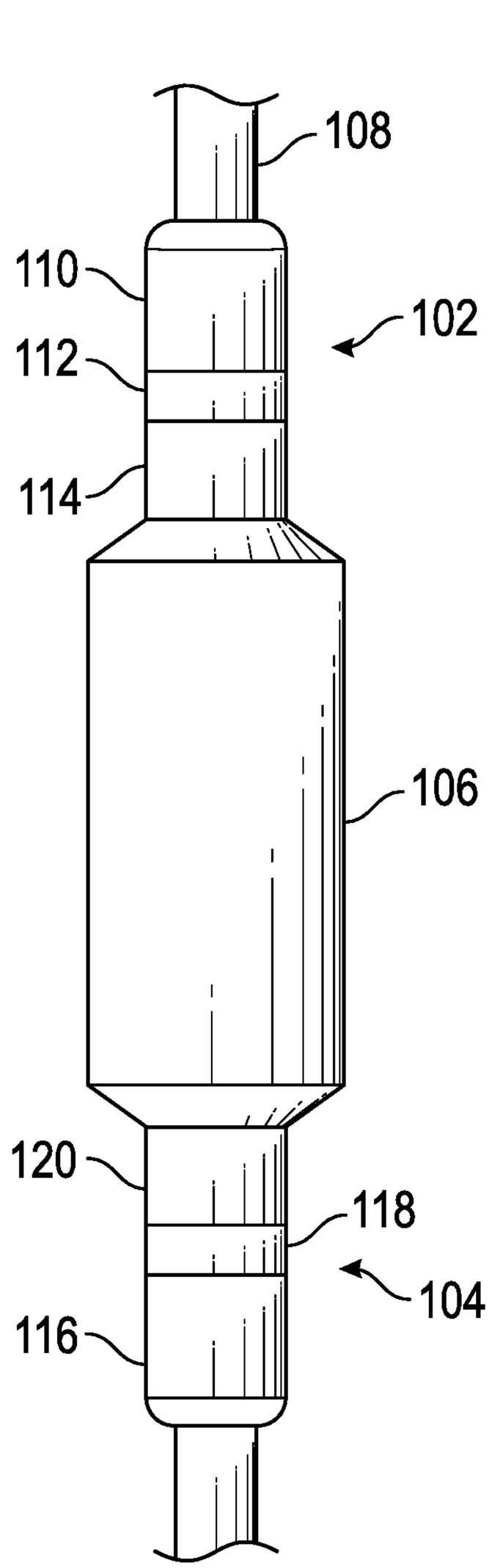

FIG. 1

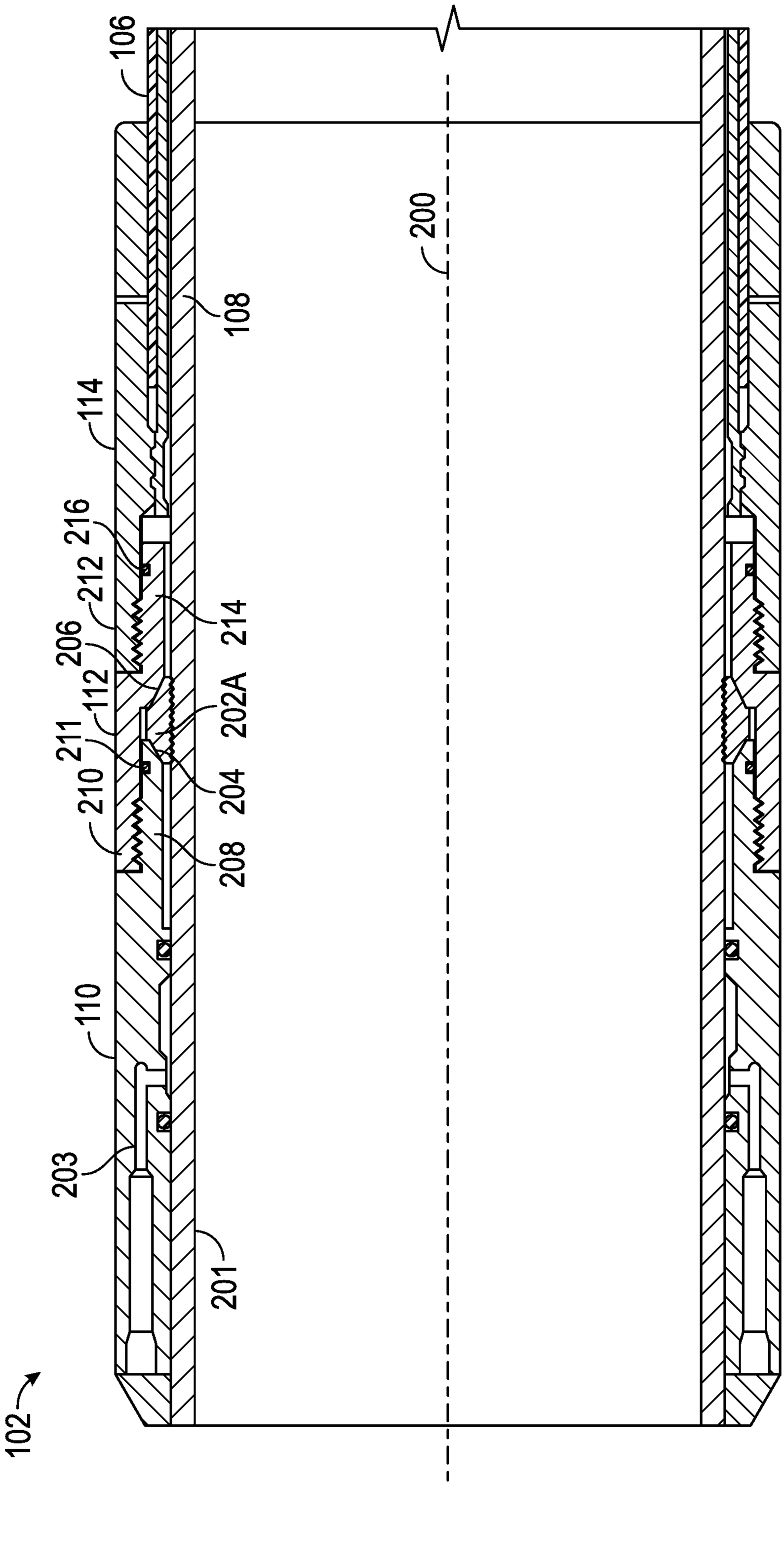
106
200
108
114
216
212
214
206
112
211
210
202A
204
208
110
203
201
102

FIG. 2

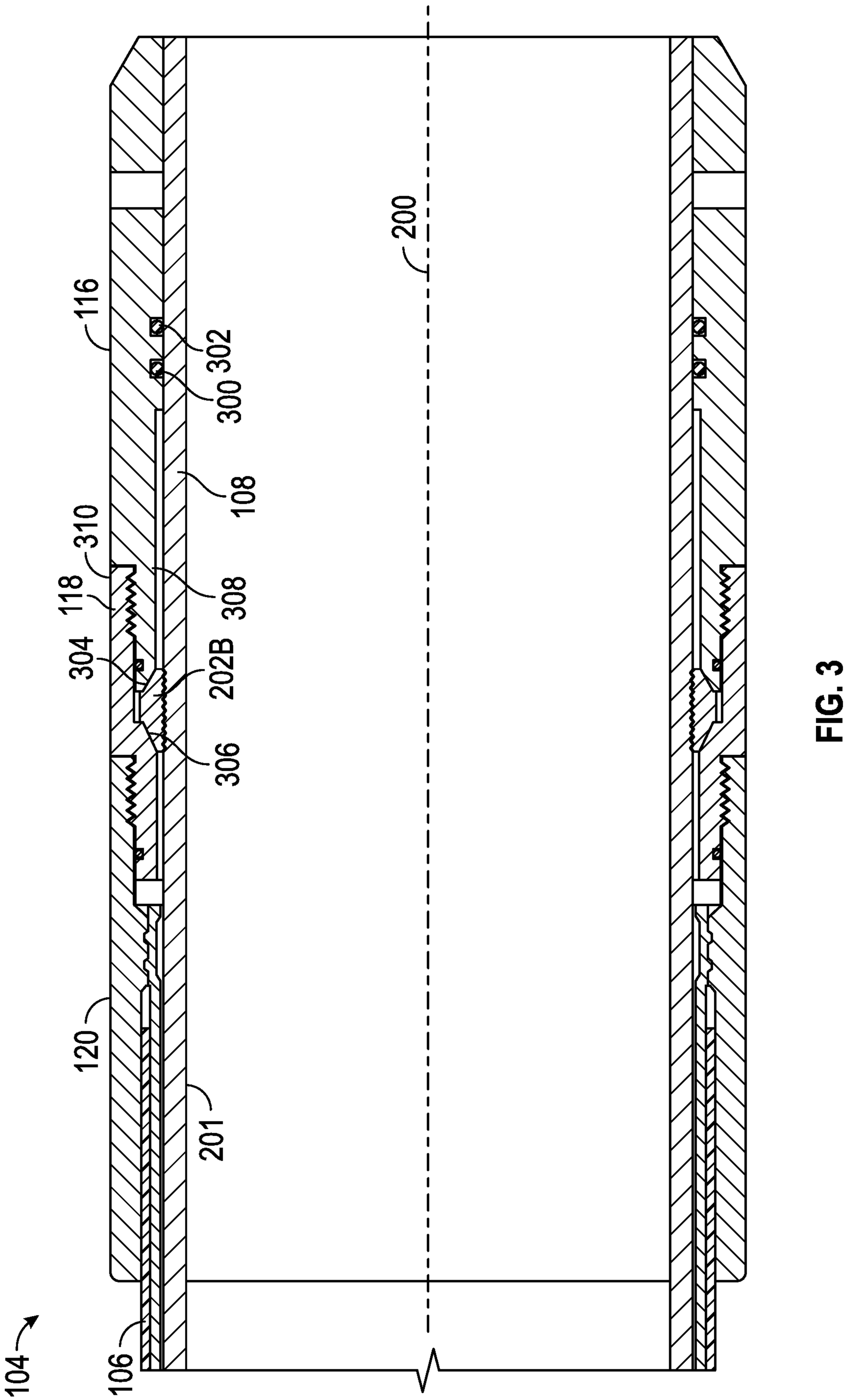

FIG. 3

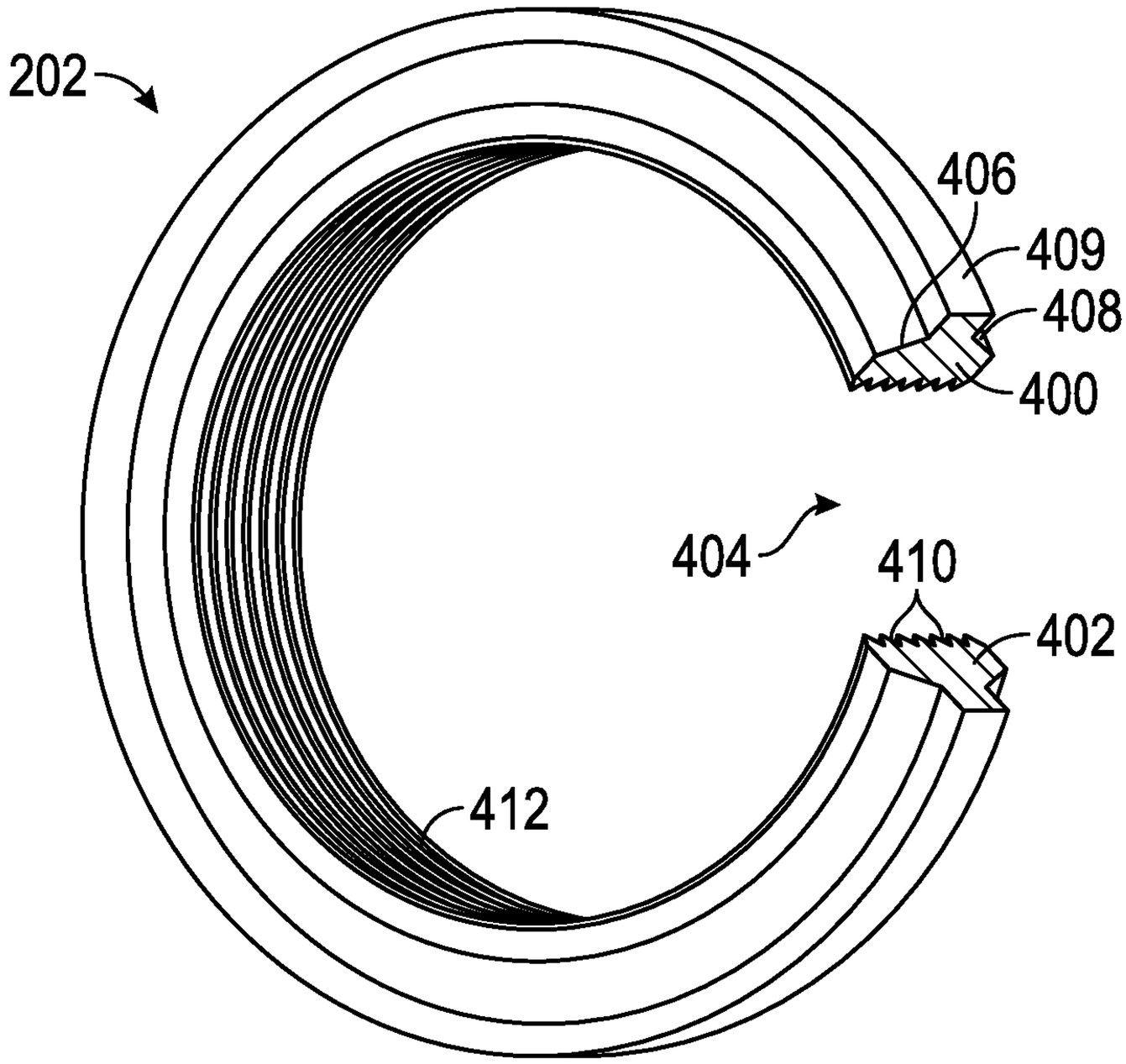

FIG. 4

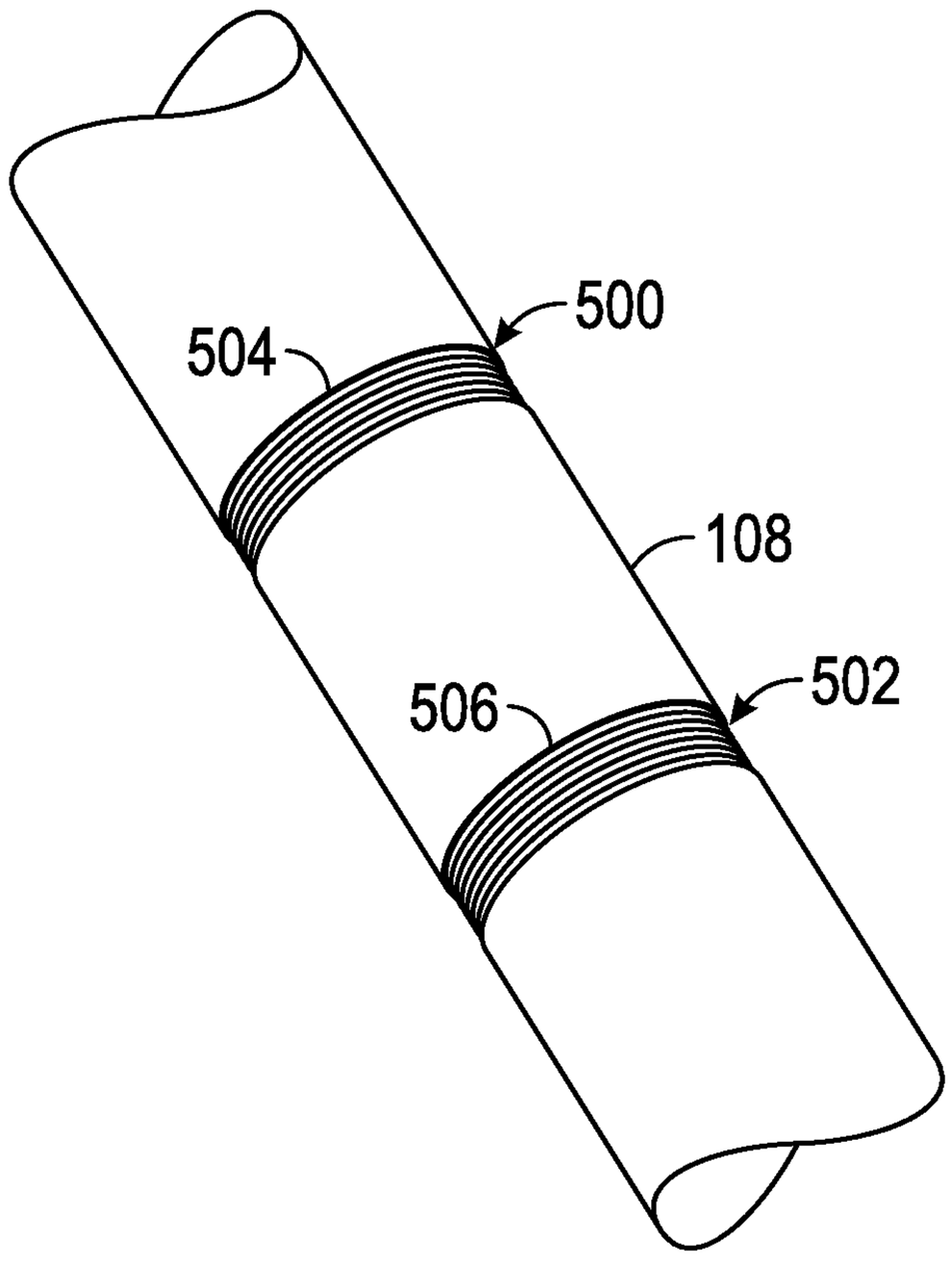

FIG. 5

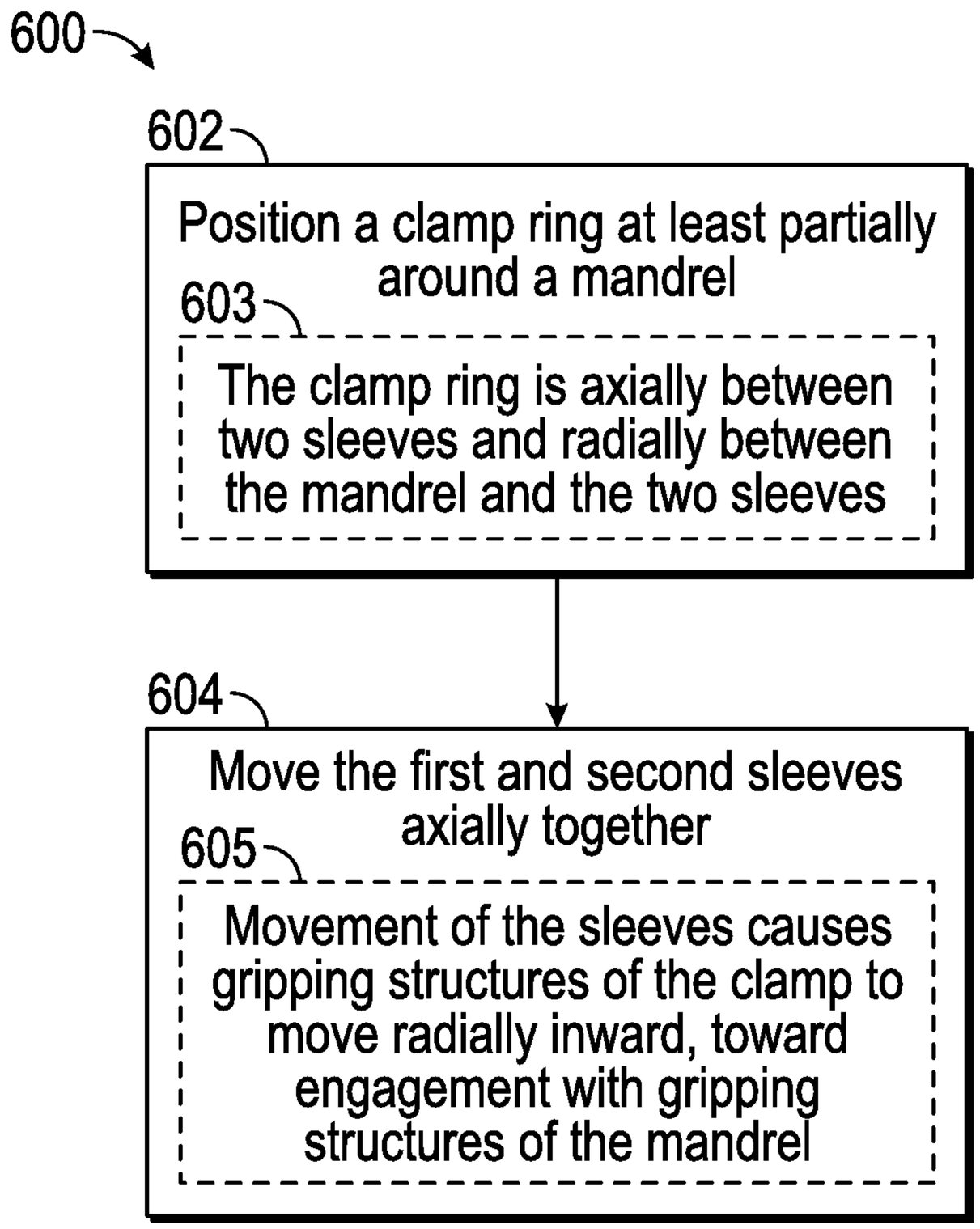
600
602
Position a clamp ring at least partially around a mandrel
603
The clamp ring is axially between two sleeves and radially between the mandrel and the two sleeves
604
Move the first and second sleeves axially together
605
Movement of the sleeves causes gripping structures of the clamp to move radially inward, toward engagement with gripping structures of the mandrel

FIG. 6

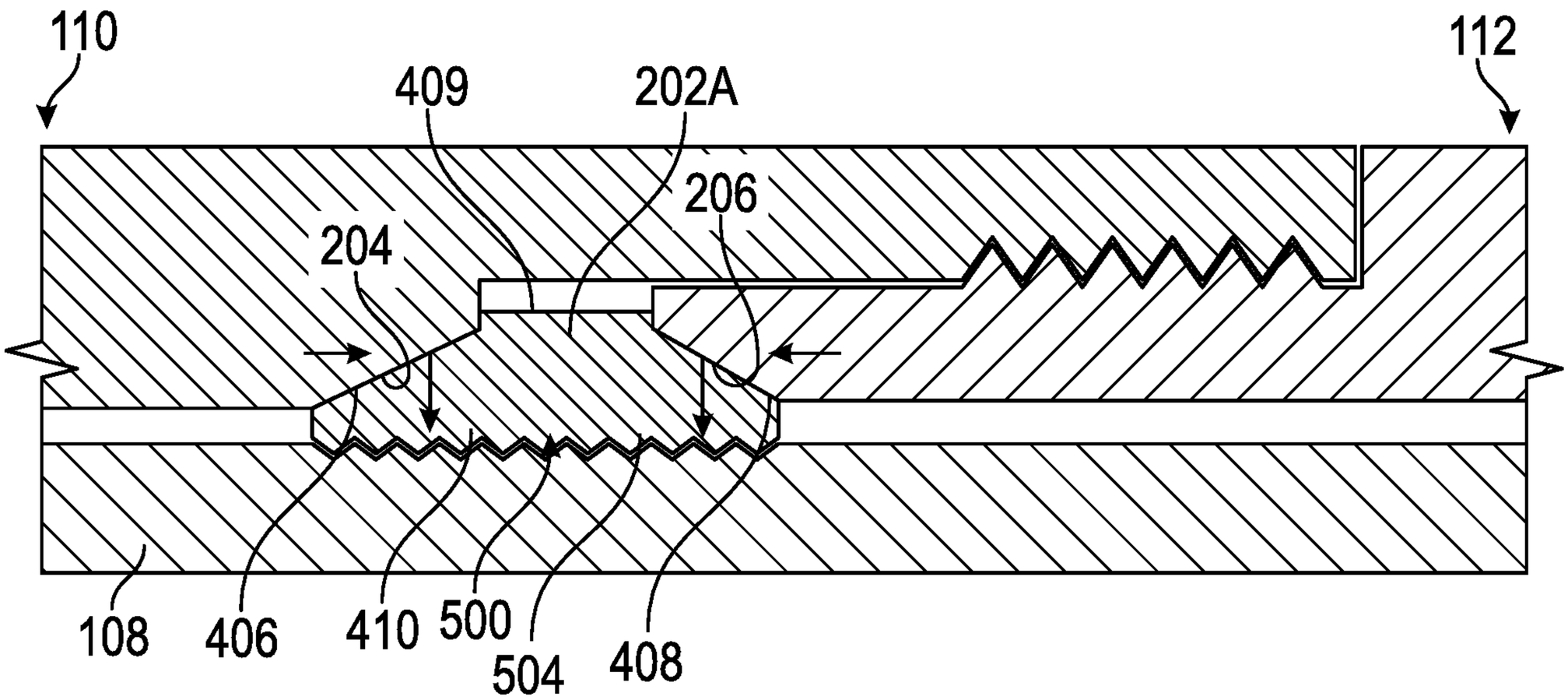
110
112
409
202A
206
204
108
406
410
500
504
408

FIG. 7

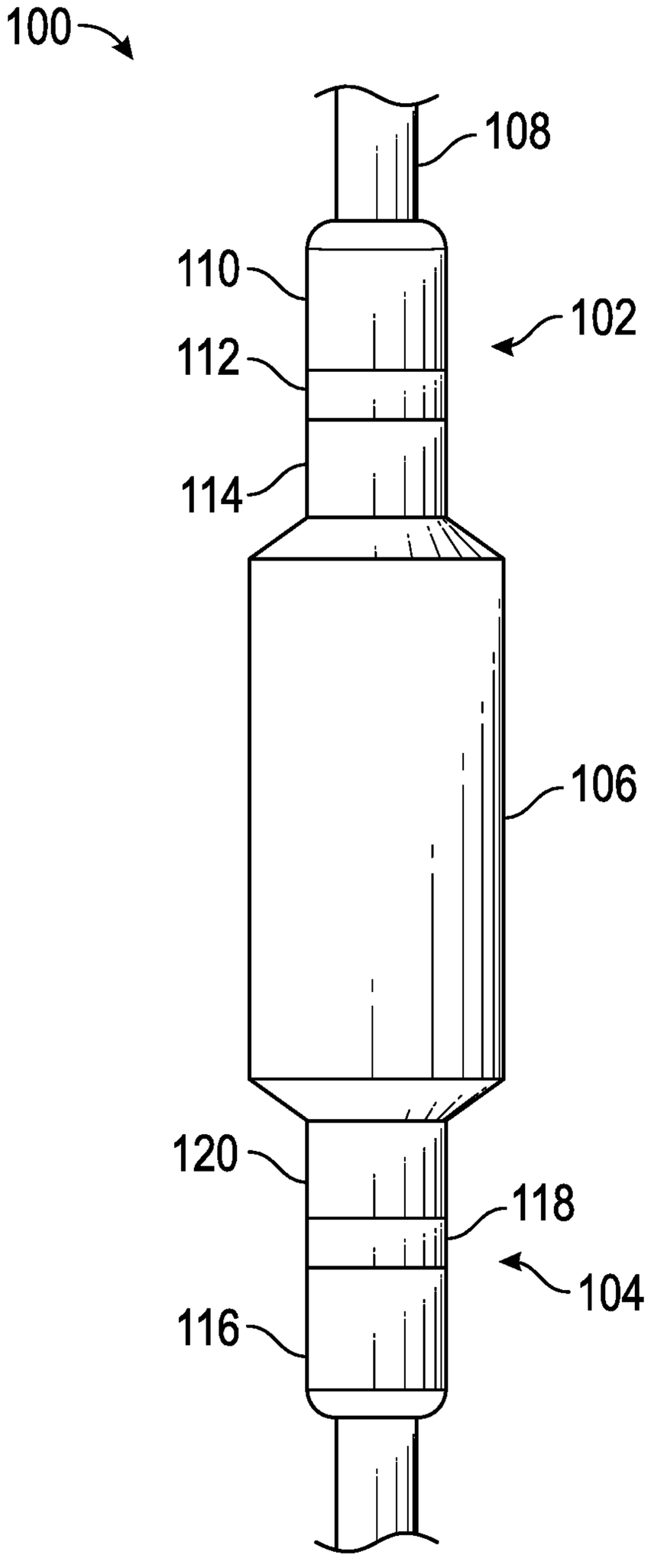

FIG. 1