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(54) **EXPANDABLE TUBULAR STRUCTURE FOR MAINTAINING DIFFERENTIAL PRESSURE INTEGRITY IN A WELLBORE**

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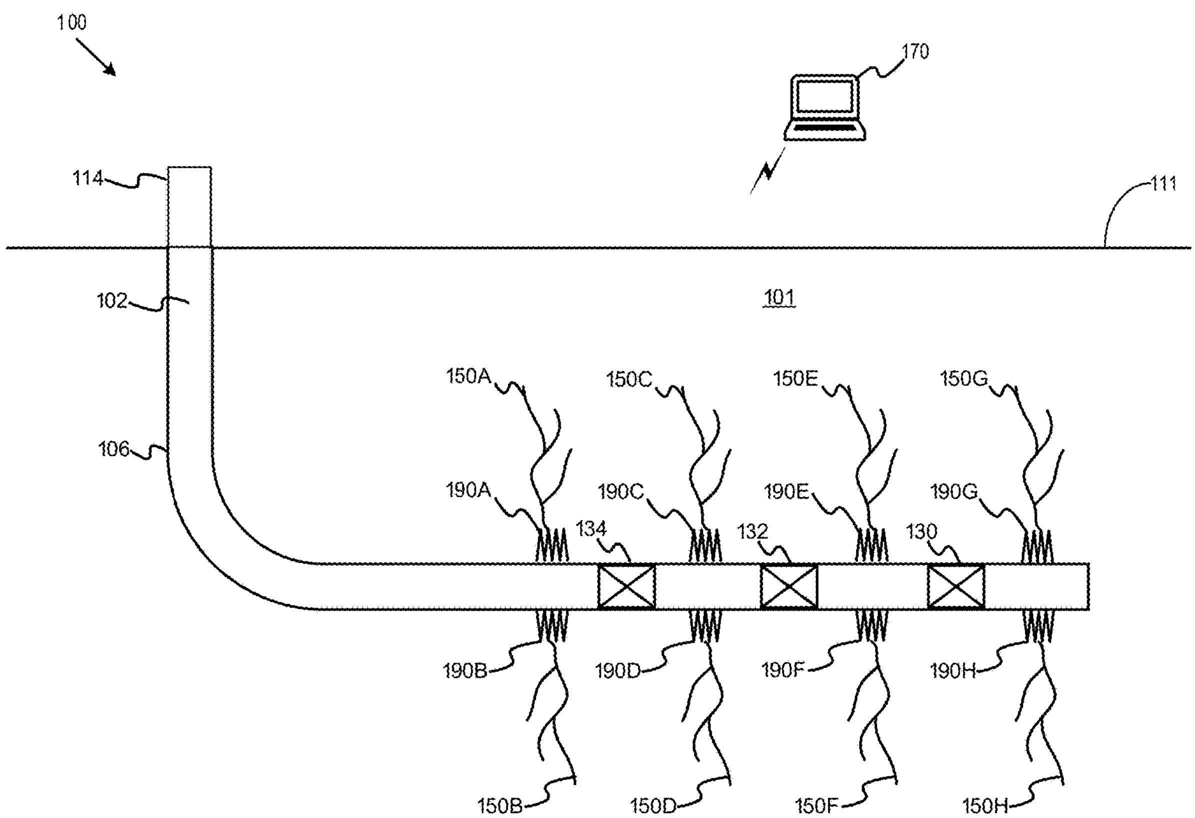
(57) **ABSTRACT**

An apparatus comprising a singular tubular structure to be positioned inside casing of a wellbore formed in a subsurface formation, wherein the singular tubular structure is configured to expand to contact an inner wall of the casing and provide differential pressure integrity in the wellbore while an isolating component is positioned in the singular tubular structure.



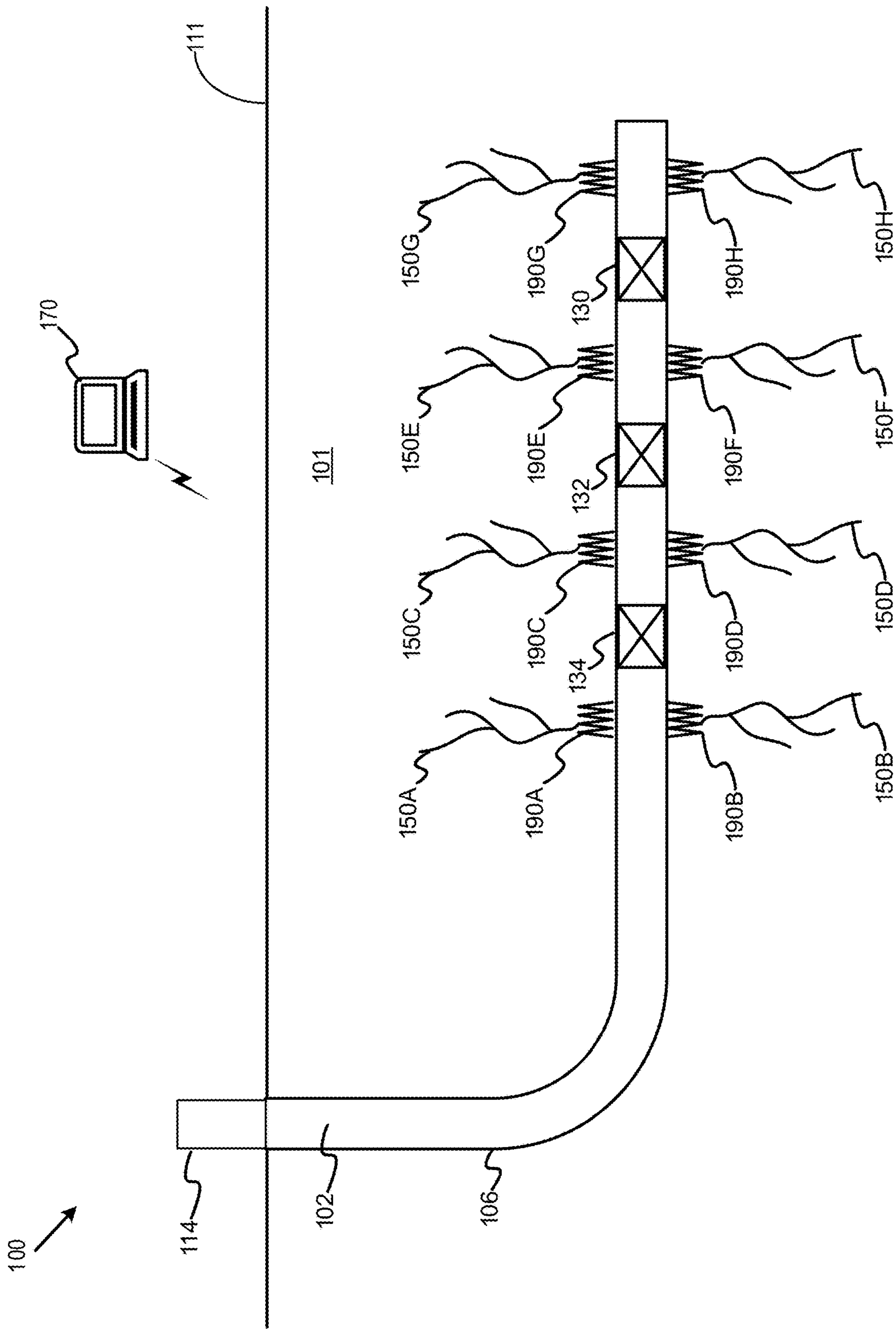

100
111
170
101
114
102
106
130
132
134
150A
150B
150C
150D
150E
150F
150G
150H
190A
190B
190C
190D
190E
190F
190G
190H

FIG. 1

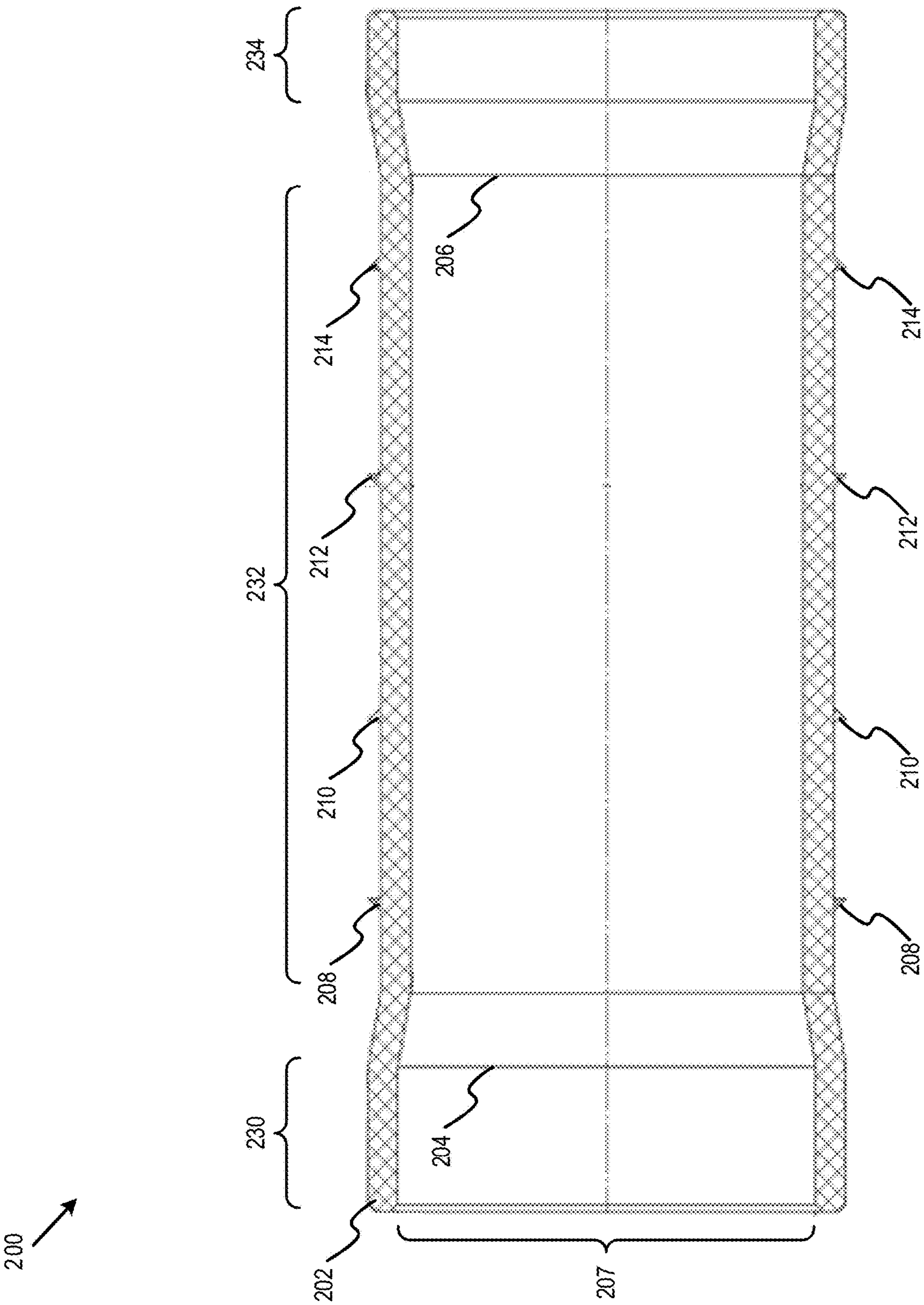



FIG. 2

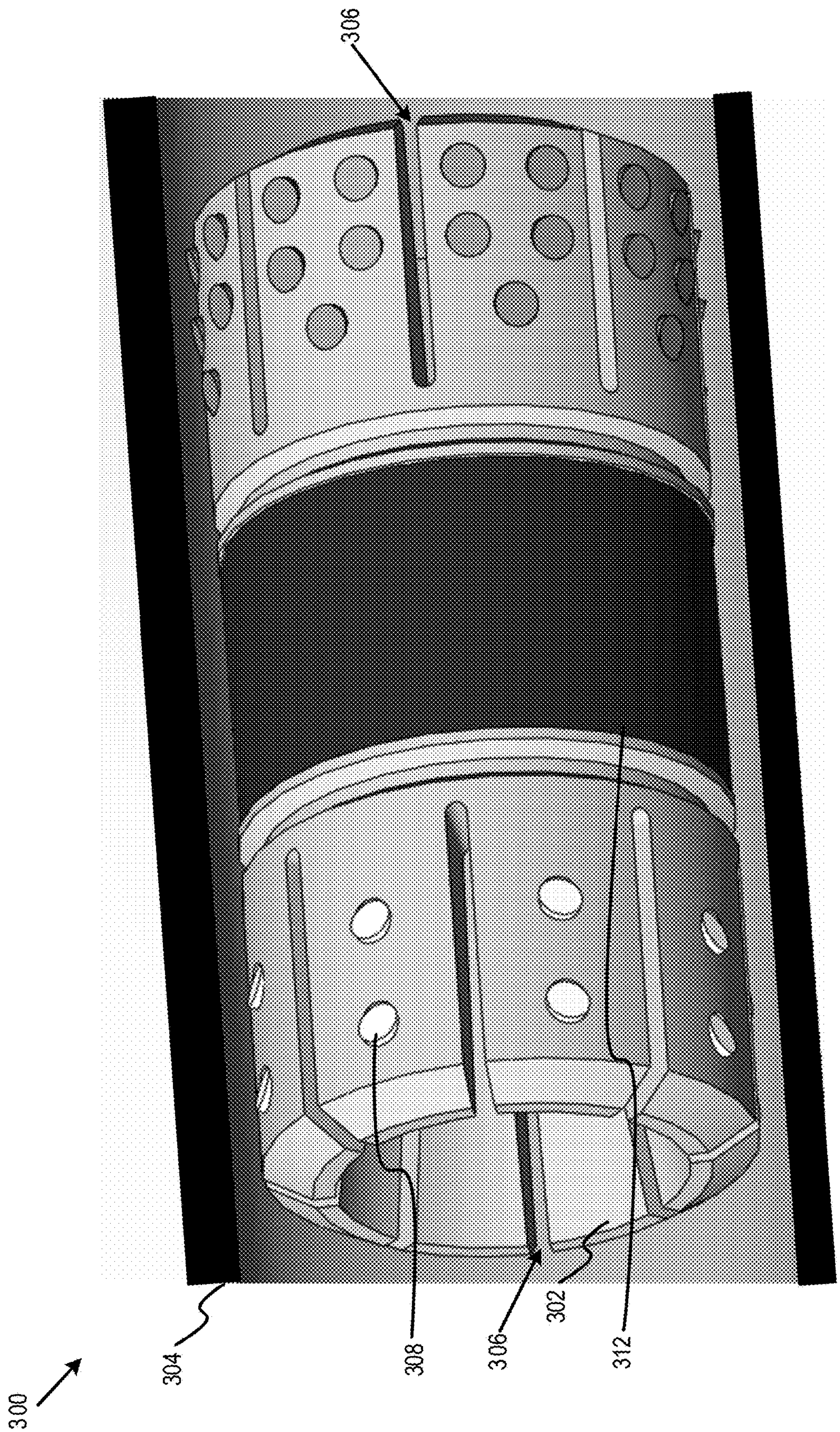



FIG. 3

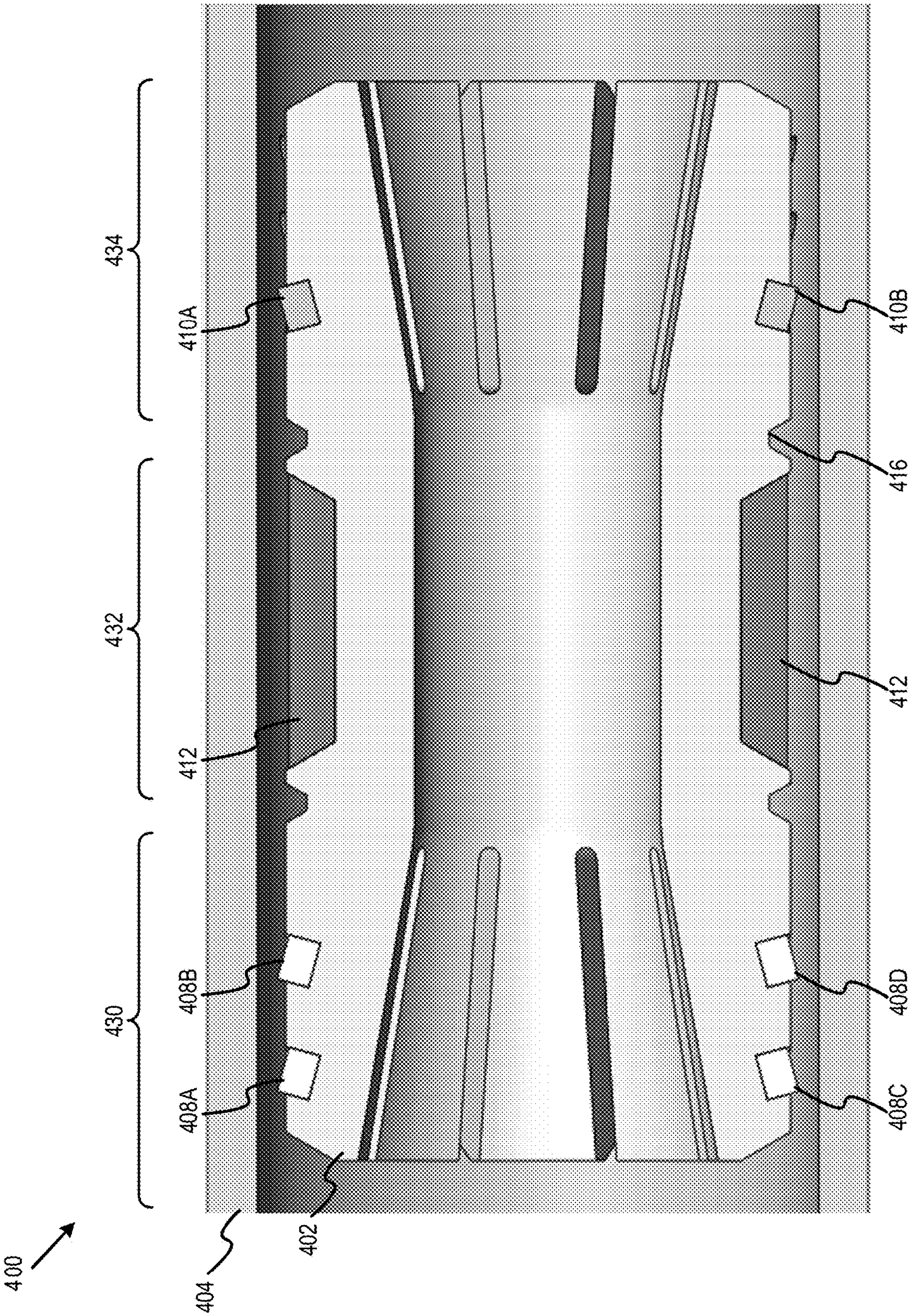
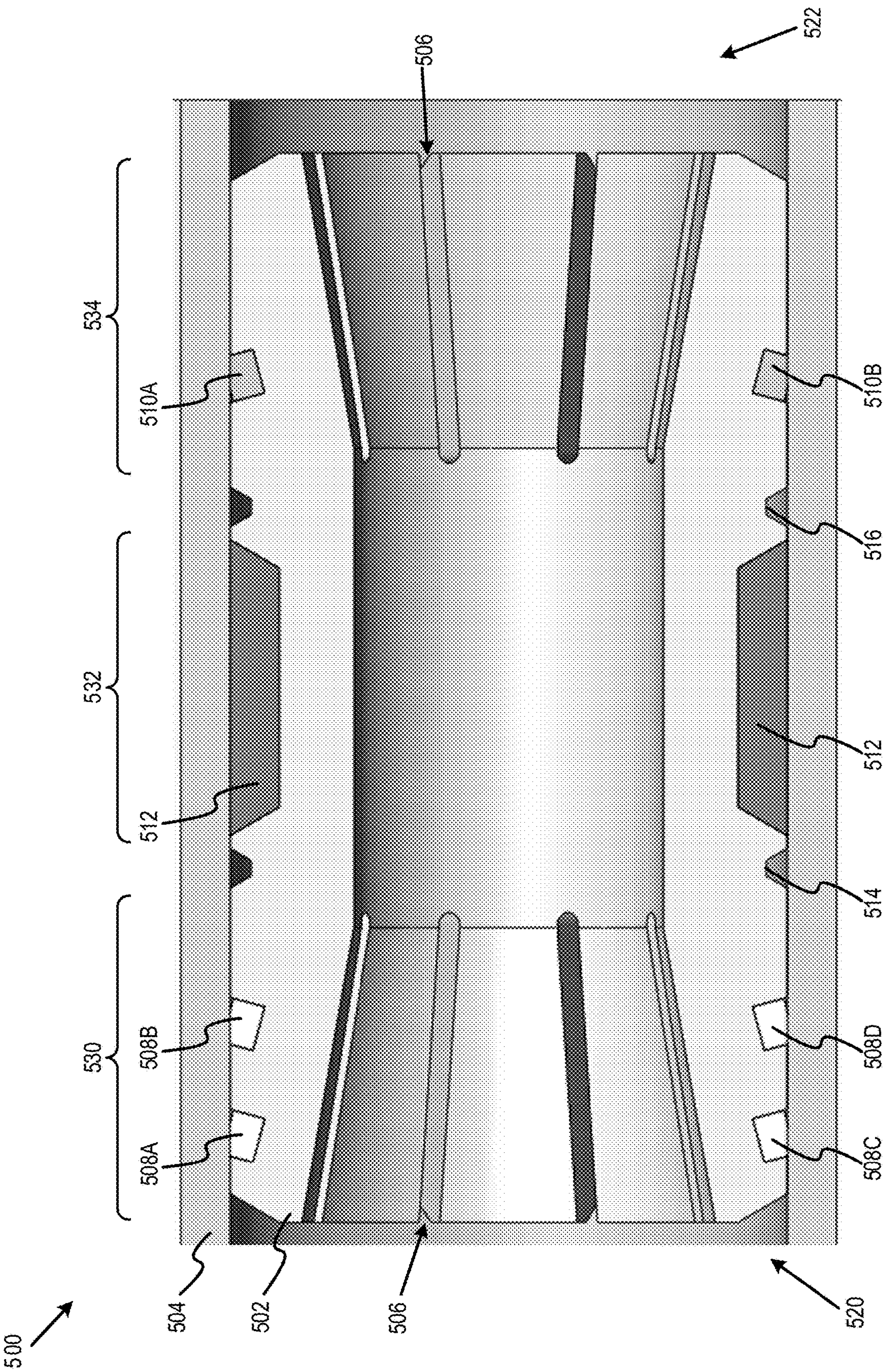

400
404
402
430
432
434
408A
408B
410A
412
408C
408D
412
416
410B

FIG. 4



500
502
504
506
506
508A
508B
508C
508D
510A
510B
512
512
514
516
520
522
530
532
534


FIG. 5

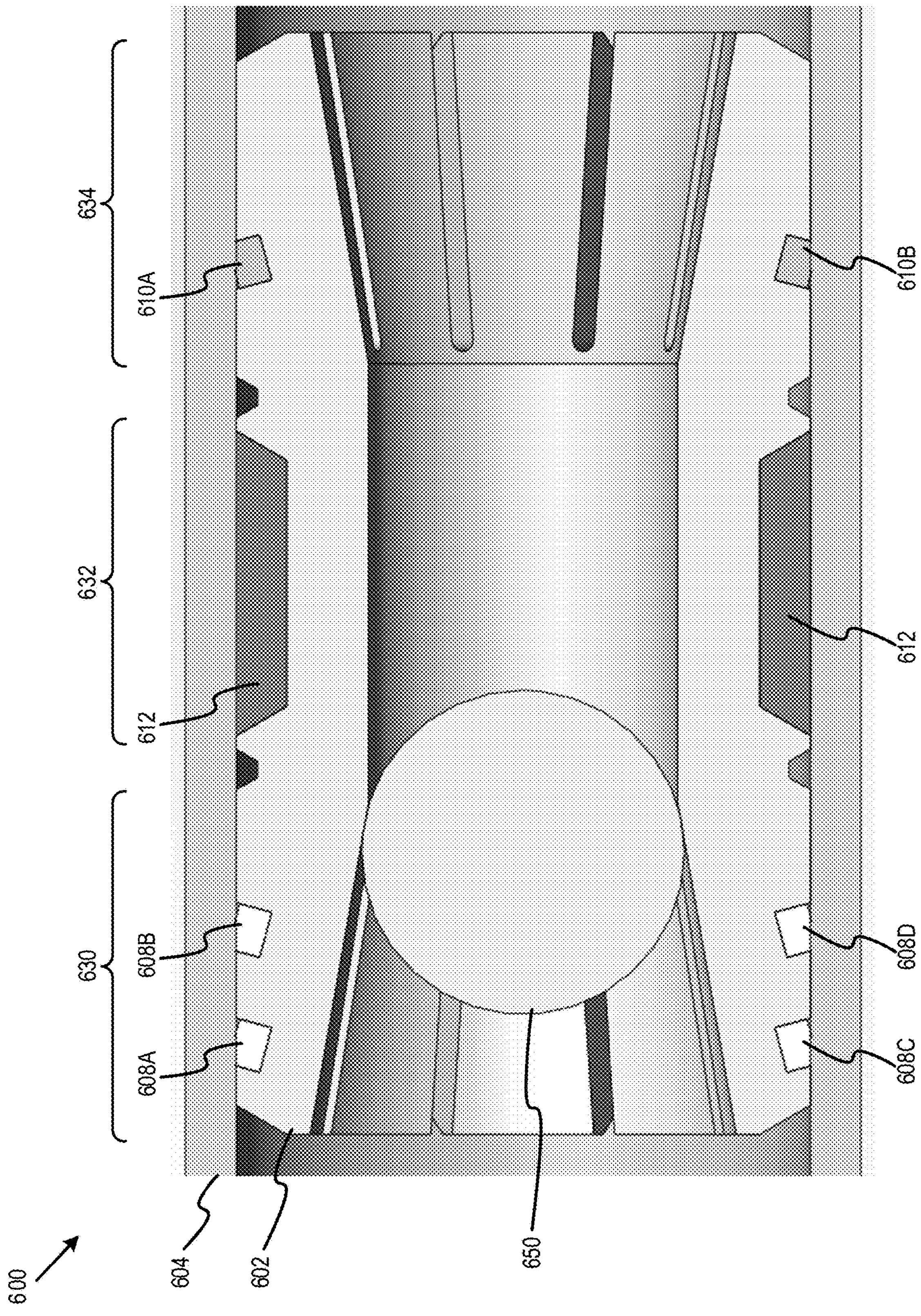

600
604
602
650
608A
608B
608C
608D
610A
610B
612
612
630
632
634

FIG. 6

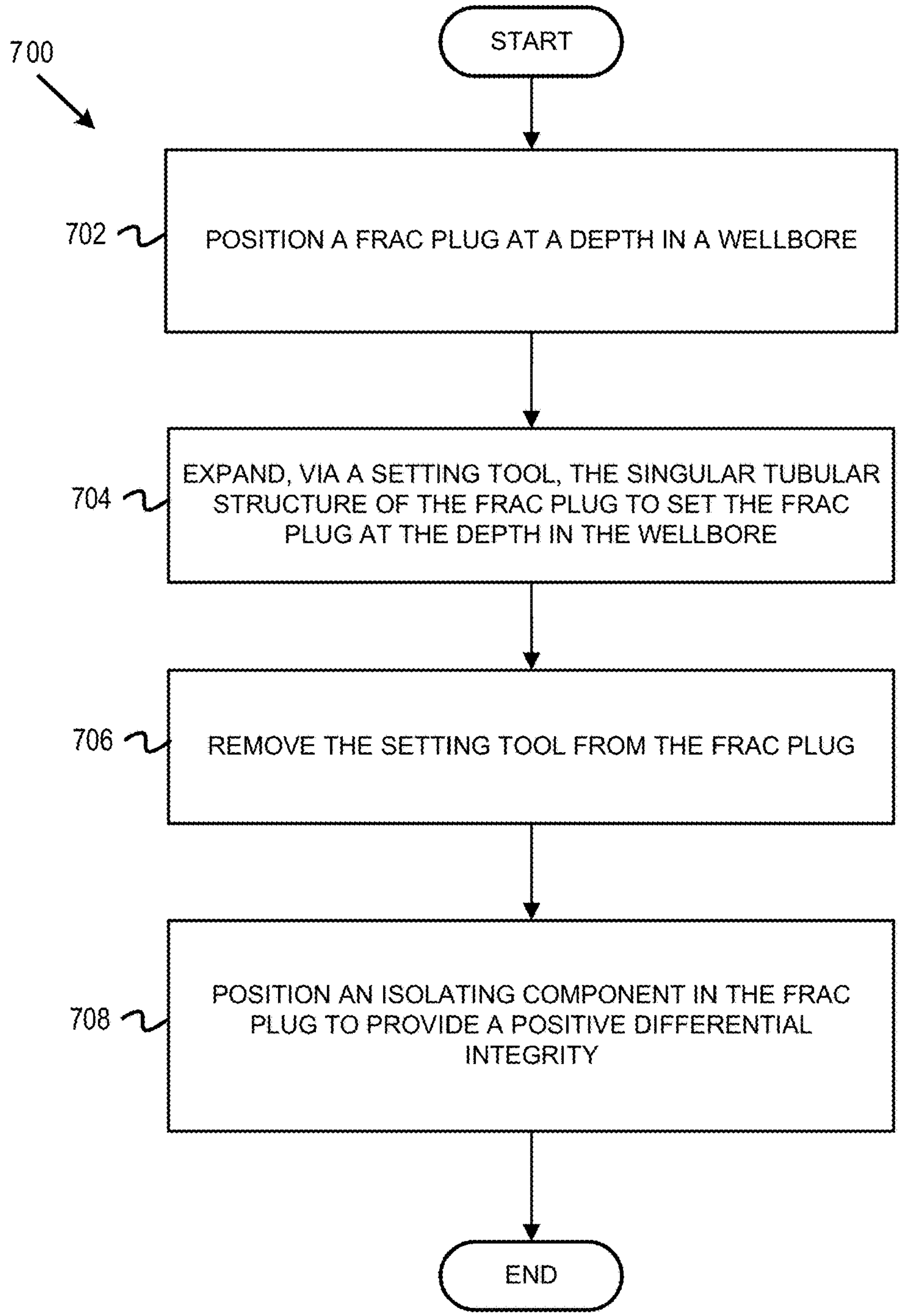

700
START
702
POSITION A FRAC PLUG AT A DEPTH IN A WELLBORE
704
EXPAND, VIA A SETTING TOOL, THE SINGULAR TUBULAR STRUCTURE OF THE FRAC PLUG TO SET THE FRAC PLUG AT THE DEPTH IN THE WELLBORE
706
REMOVE THE SETTING TOOL FROM THE FRAC PLUG
708
POSITION AN ISOLATING COMPONENT IN THE FRAC PLUG TO PROVIDE A POSITIVE DIFFERENTIAL INTEGRITY
END

FIG. 7

# EXPANDABLE TUBULAR STRUCTURE FOR MAINTAINING DIFFERENTIAL PRESSURE INTEGRITY IN A WELLBORE

## TECHNICAL FIELD

**[0001]** This disclosure relation generally to the field of hydraulically fracturing a wellbore in a subsurface formation and more particular to the field frac plugs.

## BACKGROUND

**[0002]** In hydrocarbon recovery operations, fluid and sand may be pumped into a wellbore to hydraulically fracture a subsurface formation. The pump rate and pressure from the fluid may fracture the subsurface formation, creating a conduit for the fluid in the subsurface formation to flow to the wellbore and ultimately to the surface. Sand may be pumped with the fluid and placed into the fractures to support said fractures. A wellbore may be hydraulically fractured in one or more stages, where each stage includes clusters of perforations in which the fluid and sand may enter the subsurface formation to fracture said subsurface formation. A frac plug may be positioned between stages to prevent hydraulic communication between stages.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0003]** Implementations of the disclosure may be better understood by referencing the accompanying drawings.

**[0004]** FIG. **1** is an illustration depicting an example well system, according to some implementations.

**[0005]** FIG. **2** is a schematic depicting an example expandable frac plug, according to some implementations.

**[0006]** FIG. **3** is a schematic depicting an example expandable frac plug, according to some implementations.

**[0007]** FIG. **4** is a schematic depicting an example expandable frac plug, according to some implementations.

**[0008]** FIG. **5** is a schematic depicting an example expandable frac plug, according to some implementations.

**[0009]** FIG. **6** is a schematic depicting an example expandable frac plug, according to some implementations.

**[0010]** FIG. **7** is a flowchart depicting example operations for positioning an expandable frac plug in a wellbore, according to some implementations.

## DESCRIPTION

**[0011]** The description that follows includes example systems, methods, techniques, and program flows that embody aspects of the disclosure. However, it is understood that this disclosure may be practiced without these specific details. For instance, this disclosure refers to an expandable frac plug utilized during hydraulic fracturing operations. Aspects of this disclosure can also be applied to any other scenarios where an expandable plug may be utilized in a wellbore. For clarity, some well-known instruction instances, protocols, structures, and operations have been omitted.

**[0012]** Example implementations relate to a frac plug comprising a singular tubular structure. Frac plugs may be utilized in hydraulic fracturing operations to hydraulically isolate frac stages. A frac plug may be positioned in the casing of a wellbore during hydraulic fracturing operations. A setting assembly may set the frac plug at the desired depth such that the frac plug is held in place in the casing. An isolating component, such as a sealing device (e.g., a cone shaped device, egg shaped device, ball, dart, etc.), may then be positioned in the frac plug to hydraulically isolated the portion of the wellbore below the frac plug (i.e., at depths greater than the frac plug) from the portion of the wellbore above the frac plug (i.e., depths less than the frac plug towards the wellhead). In conventional operations, a frac plug may be configured with multiple components. For example, traditional frac plugs may be configured with a mandrel, one or more slip tools coupled with the mandrel, ratchet features, collet features, etc. When the frac plug is set, a setting mechanism may shift one or more components on the frac plug such that one or more slip components, buttons, etc. may translate along the mandrel and engage with the casing to prevent the frac plug from moving. With multiple components that operate mechanically to set a frac plug in place, the associated cost and risk may increase. For instance, one or more of the components may fail during the setting process, resulting in additional operations and/or cost to retrieve the damaged frac plug.

**[0013]** In some implementations, a frac plug may include a singular tubular structure that may be configured to expand to a desired diameter to set in the casing. The singular tubular structure may be configured with a uniform material that may be configured to expand to contact the inner wall of a tubular (such as casing). Prior to expansion, the outer diameter of the singular tubular structure may be small enough to drift through tubulars or other wellbore components (casing, tubing, liner hangers, etc.) in the wellbore when positioning the frac plug at the desired depth in the wellbore. When the frac plug is positioned at the desired depth, the singular tubular structure may expand to the desired diameter (such as the inner wall of the casing) to hold the frac plug in place. The materials of the singular tubular structure may include any suitable ductile material that may be capable of dissolving in a downhole environment (such as when exposed to formation fluid at reservoir temperatures for a period of time), where the elastic properties of the materials may allow the singular tubular to expand to contact the inner diameter of the casing (inner wall of the casing). The singular tubular structure may expand via a setting tool comprising one or more swedges, or any other components configured to increase the inner diameter and/or the outer diameter of the singular tubular. The one or more swedges may traverse through the inner bore of the singular tubular structure to press the singular tubular structure, expanding the singular tubular structure to contact the inner wall of the casing. In some implementations, the friction between the outer face of the singular tubular structure and the inner wall of the casing may hold the frac plug in place while the outer face of the singular tubular structure is expanded and in contact with the inner wall of the casing. In some implementations, one or more components may be integrated into the singular tubular structure (such as rings machined into the singular tubular structure) and configured to engage with the inner wall of the casing to hold the single tubular structure in place. In some implementations, the frac plug may combine all of the traditional frac plug components into one structure. For instance, the singular tubular structure may include buttons, sealing elements, etc. positioned on the outer wall of the singular tubular structure and configured to engage with the inner wall of the casing while the singular tubular structure is expanded. Once expanded, the setting tool may be completely removed from the frac plug, leaving the frac plug in place at the desired depth in the wellbore. While the frac plug is anchored in place, one or more isolating components such as a sealing device may be positioned in the inner bore of the frac plug to provide differential pressure integrity in the wellbore above and below the frac plug.

## Example System

**[0014]** FIG. **1** is an illustration depicting an example well system, according to some implementations. In particular, FIG. **1** is a schematic of a well system **100** that includes a wellbore **102** in a subsurface formation **101**. The wellbore **102** includes casing **106** and a number of perforations **190**A-**190**H being made in the casing **106** at different depths to allow reservoir fluids (i.e., oil, water, and gas) from the subsurface formation **101** to flow into the wellbore **102**. During hydraulic fracturing operations of the wellbores **102**, fracturing fluid, with or without sand, may be pumped into the subsurface formation **101**, via the perforations **190**A-**190**H, to generate fractures **150**A-**150**H in the subsurface formation such that reservoir fluid may flow into the wellbore **102**.

**[0015]** In some implementations, the wellbore **102** may be hydraulically fractured in stages. For example, a first stage may include hydraulically fracturing the perforations **190**G, **190**H to generate fractures **150**G, **150**H, respectively. After the hydraulic fracturing operations for the first stage are complete, a frac plug **130** may be positioned in the casing **106** above the first stage (i.e., at a lesser depth in the wellbore than perforations **190**G, **190**H). The frac plug **130** may be positioned in the wellbore **102** via any suitable setting method such as wireline. In some implementations, the frac plug **130** may be set by expanding such that the outer face of the frac plug **130** may come into contact with the inner wall of the casing **106**, thus holding the frac plug **130** in place. A setting tool on the wireline may press the inner diameter of the frac plug **130** to expand and set the frac plug **130**. Once set, an isolating component. may be positioned (e.g., dropped/released from a setting kit in the wellhead **114** or other location on surface **111**) in the frac plug **130** to prevent hydraulic communication between the portion of the wellbore **102** below the frac plug **130** (i.e., the first stage that was hydraulically fractured) and the portion of the wellbore **102** above the frac plug **130**. Once the sealing component is positioned in the frac plug **130**, the perforations **190**E, **190**F may be formed in the casing **106** and hydraulic fracturing operations may commence for the next stage. Similar operations may be repeated for each subsequent stage (i.e., setting frac plug **132** and frac plug **134** and hydraulically fracturing the next subsequent stage) until hydraulic fracturing operations for the wellbore **102** are complete.

## Example Expandable Frac Plugs

**[0016]** Examples configurations of an expandable frac plug are now described. The expandable frac plugs are described in reference to the frac plugs **130-134** of FIG. **1**.

**[0017]** FIG. **2** is a schematic depicting an example expandable frac plug, according to some implementations. In particular, FIG. **2** includes a cross sectional view of a frac plug **200**. The frac plug **200** includes a singular tubular structure **202**. When the frac plug **200** is positioned, via a setting tool, in the casing of a wellbore, the outer diameter(s) of the frac plug **200** may initially be less than the inner diameter of the casing such that the frac plug **200** may be able to drift through the casing (or any other components in the wellbore such as tubing, liner hanger, etc.) to run in hole to the desired position. For example, the outer diameter of sections **230**, **232**, and **234** of the frac plug **200** may be less than the inner diameter of the casing. The outer diameter of the of sections, **230**, **232**, and **234** may be similar and/or different than one another.

**[0018]** Once the frac plug has reached the desired depth in the wellbore, one or more swedges (on the setting tool) may traverse through the inner bore **207** of the frac plug **200** to expand the singular tubular structure **202**. The outer diameter of the one or more swedges may be greater than the inner diameter of the frac plug **200**, resulting in the one or more swedges pressing against the inner wall(s) of the frac plug **200** to expand the singular tubular structure **202** (i.e., increasing the inner diameter and/or the outer diameter of the singular tubular structure **202**). Any suitable tool, method, etc. may be utilized to expand the singular tubular structure **202**.

**[0019]** The singular tubular structure **202** may include any suitable ductile material (such as ductile ceramics), where the elasticity of the material may allow for the singular tubular structure to expand to the inner wall of the casing (i.e., inner and outer diameter of the of the frac plug **200** may increase). In some implementations, the singular tubular structure **202** may be made of a single uniform material or a combination of materials. Any suitable configuration of materials may be utilized such that the singular tubular structure **202** may be able to expand and anchor to the inner wall of the casing. In some implementations, the material of the singular tubular structure **202** may be dissolvable. For example, the material may dissolve when exposed to wellbore conditions (e.g., fluids, temperature, etc.) for a period of time. In some implementations, the frac plug **200** may be configured such that one or more sections, such as **230**, **232**, and **234**, may expand via the one or more swedges. For example, all of the sections **230**, **232**, **234** (i.e., the entire singular tubular structure **202**) may expand, two of the sections **230**, **232**, **234** may expand, or only one section (such as section **232**) may expand. Sections **230**, **232**, **234**, may expand in any suitable sequence. The expansion of sections may be governed by the inner diameter of the singular tubular structure **202** and/or the outer diameter of the one or more swedges. For example, a swedge and/or one or more sections **230**, **232**, **234** may be designed such that the one or more swedges may contact and expand the section(s) configured to expand.

**[0020]** In some implementations, the expansion of one or more sections **230**, **232**, **234** may occur in any suitable sequence. For example, a first swedge may traverse through a first end (such as the distal end corresponding to section **230**) and then continue to traverse through the singular tubular structure **202** and out through the second end (such as the distal end corresponding to the section **234**) to expand any section of the singular tubular structure **202** where the inner diameter is less than the outer diameter of the swedge. Alternatively, a first swedge may traverse through the first end to expand section **230** and section **232**, before being removed from the singular tubular structure **202** (either through the first end or second end). A second swedge may then traverse through the second end to expand the section **234**, before being removed from the singular tubular structure **202** (either through the first end or second end). Any suitable method for expanding the one or more sections **230**, **232**, **234** may be utilized to expand the singular tubular structure **202** and set the frac plug **200** at approximately the desired depth. In some implementation, one or more sections **230**, **232**, **234** may expand but not contact the inner wall of the casing. For example, when the singular tubular structure **202** is expanded, section **232** may contact the inner wall of the casing and sections **230**, **234** may be expanded such that the outer diameter has increased from the original position but does not contact the inner wall of the casing.

**[0021]** Once in position, the one or more swedges (and any other components on the setting tool) may be removed from frac plug **200**, leaving only the expanded frac plug in position in the casing.

**[0022]** The singular tubular structure **202** may expand such that the outer face of the singular tubular structure **202** may at least partially be in contact with the inner wall of the casing (or any other suitable tubular the frac plug **200** may be positioned in). In some implementations, a friction force between the outer face of the tubular structure and the inner wall of the casing may hold the frac plug **200** in place. For example, the friction force may be greater than the force applied to the frac plug **200** via flowing fluid, sand, etc. in the casing such that the frac plug remains in place. In some implementations, the roughness of the outer face of the singular tubular structure **202** may be increased (e.g., texture added to the outer face) to increase the friction factor between the outer face of the singular tubular structure **202** and the inner wall of the casing. In some implementations, the elastic properties (such as Young's modulus, Poisson's ratio, shear modulus, etc.) of the singular tubular structure **202** may hold the frac plug **200** in place.

**[0023]** In some implementations, one or more components may engage with the casing to hold the frac plug **200** in place. The one or more components may be integrated (e.g., machined) into the singular tubular structure **202**. For instance, FIG. **2** depicts rings **208-214** around the outer face of the singular tubular structure **202** and machined into the singular tubular structure **202**. The rings **208-214** may be configured to engage with the casing (e.g., bite into the inner wall of the casing) to prevent the frac plug **200** from moving through the casing during the setting process and/or during hydraulic fracturing operations. A portion of the rings **208-214** may prevent movement in a first direction and the other portion of the ring **208-214** may prevent movement in the opposite direction (such as when one or more swedges are pushed/pulled through the singular tubular structure **202**). For example, rings **208** and **212** may be configured in a wedge shape with one face of the edge having a 45 degree angle (or any other suitable angle) relative to the central axis of the frac plug **200** and the other face of the wedge having a 90 degree angle (or any other suitable angle) relative to the central axis of the frac plug **200**. The rings **210** and **214** may be configured similar to the rings **208** and **212**, but with the faces of the wedge shape facing in opposite directions. In some implementations, the one or more components may include one or more grooves machined into the singular tubular structure **202**. In some implementations, the one or more components may be separate components from the singular tubular structure **202**. For example, one or more components may include buttons, wedges, heavy grit, etc. (or any combination thereof) positioned on the outer face of the singular tubular structure **202**. Any suitable combination of one or more components (integrated and separate) at any suitable position on the singular tubular structure **202** may be utilized to position and/or hold the frac plug **200** in place.

**[0024]** Once the frac plug **200** is in place, one or more isolating components such as a sealing device (e.g., a cone shaped device, egg shaped device, ball, dart, etc.) may be positioned in the inner bore **207** of the frac plug **200** to provide differential pressure integrity above and below the frac plug **200** in the casing. The inner bore **207** of the frac plug **200** may include different inner diameters between the sections **230**, **232**, **234**. In some implementations, the transition **204**, **206** between changes in inner diameters may provide a seat where the isolating component may be positioned. In some implementations, the transition **204**, **206** may include a profile specific for the isolating component such that the isolating component may provide a hydraulic seal between the inner wall of the singular tubular structure **202** and the outer surface of the isolating component. For example, the transition **204** be configured with a profile shaped for a ball such that a ball may be positioned in the transition **204** to provide differential pressure integrity above and below the ball and thus above and below the frac plug **200**.

**[0025]** FIG. **3** is a schematic depicting an example expandable frac plug, according to some implementations. In particular, FIG. **3** includes an illustration of a frac plug **300**. The frac plug **300** may be similar to the frac plug **200** of FIG. **2**. For example, the frac plug **300** includes a singular tubular structure **302** that may expand such that at least a portion of the outer face (or any components coupled to the outer face of the singular tubular structure such as buttons, sealing elements, etc.) of the singular tubular structure **302** may contact the inner wall of the casing **304** (or any other suitable tubular the frac plug **300** may be positioned in). Differential pressure integrity may be provided by the frac plug **300** while one or more isolating components are positioned in the inner bore of the frac plug **300**.

**[0026]** In some implementations, sections of the singular tubular structure **302** may be configured with channels **306**. The channels **306** may be proximate the distal ends of the frac plug allow corresponding sections of the singular tubular structure **302** to expand into the casing **304** while also maintaining structural integrity. Sections of the singular tubular structure **302** may include one or more components that, while the singular tubular structure **302** is expanded into the casing, engage with the casing **304** to prevent the frac plug **300** from moving the casing **304**. The one or more components may include buttons **308**, slips, wedges, heavy grit, or any combination thereof. Any suitable number of components may be coupled with the singular tubular structure **302**. Additionally, the one or more components may be positioned in any suitable location on the singular tubular structure **302**. The components may include materials with a hardness high enough to penetrate the casing **304**, such as ceramic. In some implementations, the frac plug **300** may include a sealing element **312** made of any suitable polymer, elastomer, etc. When the singular tubular structure **302** is expanded, the sealing element **312** may come into contact with the inner wall of the casing **304**, providing a seal between the singular tubular structure **302** and the casing **304**.

**[0027]** FIG. **4** is a schematic depicting an example expandable frac plug, according to some implementations. In particular, FIG. **4** includes a cross section of a frac plug **400**. The frac plug **400** may be similar to the frac plug **300** of FIG. **3**. For example, the frac plug **400** includes a singular tubular structure **402** that may be configured to expand such that at least a portion of the outer face (and any components coupled to the outer face of the singular tubular structure **402** such as buttons **408**A-D, **410**A-B, sealing element **412**, etc.) of the singular tubular structure **302** may contact the inner wall of the casing **404** (or any other suitable tubular the frac plug **400** may be positioned in). The frac plug **400** depicted in FIG. **4** includes a singular tubular structure **402** that has not been expanded into the inner wall of the casing **404**. The outer diameter of the frac plug **400** is less than the inner diameter of the casing **404** (i.e., Sections **430**-**434** have not been expanded into the inner wall of the casing **404** so buttons **408**A-D, **410**A-B, sealing element **412**, do not engage with the inner wall of the casing **404**), allowing the frac plug to traverse through the casing **404**.

**[0028]** FIG. **5** is a schematic depicting an example expandable frac plug, according to some implementations. In particular, FIG. **5** includes a cross section of a frac plug **500** that has been expanded to contact the inner wall of the casing **504**. The frac plug **500** may be similar to the frac plug **400** of FIG. **4**. For example, the frac plug **500** includes a singular tubular structure **502** that may be configured to expand such that at least a portion of the outer face (and any components coupled to the outer face of the singular tubular structure **502** such as buttons **508**A-D, **510**A-B, sealing element **512**, etc.) of the singular tubular structure **502** may contact the inner wall of the casing **504** (or any other suitable tubular the frac plug **500** may be positioned in). While expanded, at least one of the buttons **508**A-D, **510**A-B, sealing element **512**, and any combination thereof may engage with the inner wall of the casing **504**, holding the frac plug **500** in position and a seal between the frac plug **500** and the casing **504** may be formed. The seal may include a seal between the outer body of the singular tubular structure **502** and the casing **504**, between one or more sealing elements **512** positioned on the outer face of the singular tubular structure **502** and the inner wall of the casing **504**, and any combination thereof.

**[0029]** The frac plug **500** may be positioned in the casing of a wellbore via a setting tool. In some implementations, the setting tool may include one or more swedges that may be configured to press through the inner bore of the frac plug **500** to expand the singular tubular structure **502** into the inner wall of the casing **504** (i.e., the outer diameter of the frac plug **500** becomes approximately similar to the inner diameter of the casing **504**) once positioned at the desired depth in the wellbore. For example, a first swedge with a diameter greater than the inner diameter of the inner bore of section **530** may be pressed into to top section **520** of the frac plug **500** to expand the section **530** such that the outer face of the section **530** expands to contact the inner wall of the casing **504**. In some implementations, the singular tubular structure **502** may include relief channels such as channels **506** that may allow the section **530** of the singular tubular structure **502** to expand to the inner diameter of the casing **504** to minimize compressing the material within the section **530** and rather allow the material between the relief channels **506** to flex toward the casing **504**. Once expanded, the buttons **508**A-D may engage with the inner wall of the casing **504**, preventing the frac plug **500** from traversing in the direction towards the top section **520**. The first swedge may be pressed into the singular tubular structure until a desired stopping point (e.g., section **530** has been expanded, the first swedge has pressed through a desired length in the singular tubular structure **502**, etc.). Thereafter, a second swedge may be pulled into the singular tubular structure **502** from the other end of the frac plug **500** (bottom section **522**).

**[0030]** The second swedge may be pressed through the remaining portions of the inner bore to expand the other sections **532**, **534** such that the outer face of the sections **532**, **534** expands into the inner wall of the casing **504**. Due to the buttons **508**A-D engaging with the inner wall of the casing **504**, the sections **532**, **534** may expand via the second swedge without the frac plug **500** moving positions in the casing **504** (i.e., traversing towards the top section **520**). Section **534** may include relief channels **506** such that the material of section **534** may also expand similar to section **530**. While expanded, the buttons **510**A-B of the section **534** may be engaged with the inner wall of the casing **504** to prevent the frac plug **500** from traversing in the direction of the bottom section **522**. Additionally, the sealing element **512** of the section **532** may expand to contact the inner wall of the casing **504** when section **532** is expanded, creating a hydraulic seal. Channels **514** may limit the extrusion of the sealing element **512** while pressed against the inner wall of the casing **504**. Once the singular tubular structure **502** has been fully expanded, the setting tool (one or more swedges) may be removed from the inner bore of the frac plug **500**, resulting in the expanded frac plug **500** positioned in the casing **504** with an open inner bore.

**[0031]** FIG. **6** is a schematic depicting an example expandable frac plug, according to some implementations. In particular, FIG. **6** includes a cross section of a frac plug **600** that has been expanded to contact the inner wall of the casing **504** and an isolating component **650** is positioned in the inner bore of the frac plug **600** to provide positive differential integrity across the frac plug **600**. The frac plug **600** may be similar to the frac plug **500** of FIG. **5**. For example, the frac plug **600** includes a singular tubular structure **602** that may be configured to expand such that at least a portion of the outer face (and any components coupled to the outer face of the singular tubular structure **602** such as buttons **608**A-D, **610**A-B, sealing element **612**, etc.) of the singular tubular structure **602** may contact the inner wall of the casing **604** (or any other suitable tubular the frac plug **600** may be positioned in). While expanded, at least one of the buttons **608**A-D, **610**A-B, sealing element **612**, and any combination thereof may engage with the inner wall of the casing **604**, holding the frac plug **600** in position and a seal between the frac plug **600** and the casing **604** is formed.

**[0032]** Once the frac plug **600** is expanded and the seal is formed, an isolating component **650** may be positioned in the inner bore of the frac plug **600**. In some implementations, the isolating component **650** may be dropped/released from a setting kit (on or proximate the wellhead on the surface). The inner bore of the frac plug **600** may include different inner diameters. For example, the inner diameter corresponding to section **630** may be greater than the inner diameter corresponding to section **632** (following the expansion of the singular tubular structure **602**). The isolating component **650** may be configured to be positioned in the portion of the inner bore where inner diameter transitions from the section **630** to the section **632**. For instance, the outer diameter of a ball may be less than the inner diameter corresponding to the section **630**, and greater than the inner diameter corresponding to the section **632**, resulting in the ball being positioned in the inner bore between the section **630** and the section **632**. In some implementations, the inner bore may include a profile configured for the isolating component **650** where the isolating component **650** may be positioned. Once the isolating component **650** is positioned in the frac plug **600**, a seal may be formed such that there may be approximately no hydraulic communication through the inner bore of the frac plug **600**, providing a positive differential pressure across the frac plug **600**.

EXAMPLE OPERATIONS

**[0033]** Examples operations are now described.

**[0034]** FIG. **7** is a flowchart depicting example operations for positioning an expandable frac plug in a wellbore, according to some implementations. FIG. **7** depicts a flow-chart **700** of operations to position an expandable frac plug comprising a singular tubular structure at a desired depth in casing of a wellbore. The operations of flowchart **700** are described in reference to the expandable frac plugs **200-600** described in FIGS. **2-6**, respectively.

**[0035]** At block **702**, an expandable frac plug may be positioned at a depth in a wellbore. The expandable frac plug may be run in and positioned in the casing of a wellbore via a setting tool. While running in the wellbore, the outer diameter of the frac plug may be less than the inner diameter of the casing.

**[0036]** At block **704**, the singular tubular structure of the frac plug may be expanded, via the setting tool, to set the frac plug at the desired depth in the wellbore. The setting tool may include one or more swedges that may be pressed through the singular tubular structure, expanding the singular tubular structure to contact the inner wall of the casing. In some implementations, the singular tubular structure may include one or more components that may engage with the casing to assist in holding the frac plug in place.

**[0037]** At block **706**, the setting tool may be removed from the frac plug. Once removed, the frac plug may remain at the desired depth with an open inner bore.

**[0038]** At block **708**, an isolating component may be positioned in the frac plug to provide a positive differential integrity. In some implementations, hydraulic fracturing operations may begin once the isolating components is positive differential integrity is achieved.

**[0039]** While the aspects of the disclosure are described with reference to various implementations and exploitations, it will be understood that these aspects are illustrative and that the scope of the claims is not limited to them. In general, techniques for expanding an expandable frac plug herein may be implemented with facilities consistent with any hardware system or hardware systems. Many variations, modifications, additions, and improvements are possible.

**[0040]** Plural instances may be provided for components, operations or structures described herein as a single instance. Finally, boundaries between various components, operations and data stores are somewhat arbitrary, and particular operations are illustrated in the context of specific illustrative configurations. Other allocations of functionality are envisioned and may fall within the scope of the disclosure. In general, structures and functionality presented as separate components in the example configurations may be implemented as a combined structure or component. Similarly, structures and functionality presented as a single component may be implemented as separate components. These and other variations, modifications, additions, and improvements may fall within the scope of the disclosure.

**[0041]** Various modifications to the implementations described in this disclosure may be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other implementations without departing from the spirit or scope of this disclosure. Thus, the claims are not intended to be limited to the implementations shown herein but are to be accorded the widest scope consistent with this disclosure, the principles and the novel features disclosed herein.

**[0042]** Certain features that are described in this specification in the context of separate implementations also may be implemented in combination in a single implementation. Conversely, various features that are described in the context of a single implementation also may be implemented in multiple implementations separately or in any suitable subcombination. Moreover, although features may be described as acting in certain combinations and even initially claimed as such, one or more features from a claimed combination may in some cases be excised from the combination, and the claimed combination may be directed to a subcombination or variation of a subcombination.

**[0043]** Similarly, while operations are depicted in the drawings in a particular order, this should not be understood as requiring that such operations be performed in the particular order shown or in sequential order, or that all illustrated operations be performed, to achieve desirable results. Further, the drawings may schematically depict one more example process in the form of a flow diagram. However, some operations may be omitted and/or other operations that are not depicted may be incorporated in the example processes that are schematically illustrated. For example, one or more additional operations may be performed before, after, simultaneously, or between any of the illustrated operations. In certain circumstances, multitasking and parallel processing may be advantageous. Moreover, the separation of various system components in the implementations described should not be understood as requiring such separation in all implementations, and the described program components and systems may generally be integrated together in a single software product or packaged into multiple software products. Additionally, other implementations are within the scope of the following claims. In some cases, the actions recited in the claims may be performed in a different order and still achieve desirable results.

**[0044]** Unless otherwise specified, use of the terms "up," "upper," "upward," "uphole," "upstream," or other like terms shall be construed as generally away from the bottom, terminal end of a well; likewise, use of the terms "down," "lower," "downward," "downhole," or other like terms shall be construed as generally toward the bottom, terminal end of the well, regardless of the wellbore orientation. Use of any one or more of the foregoing terms shall not be construed as denoting positions along a perfectly vertical axis. In some instances, a part near the end of the well can be horizontal or even slightly directed upwards. Unless otherwise specified, use of the term "subsurface formation" shall be construed as encompassing both areas below exposed earth and areas below earth covered by water such as ocean or fresh water.

EXAMPLE IMPLEMENTATIONS

**[0045]** Implementation #1: An apparatus comprising: a singular tubular structure to be positioned inside casing of a wellbore formed in a subsurface formation, wherein the singular tubular structure is configured to expand to contact an inner wall of the casing and provide differential pressure integrity in the wellbore while an isolating component is positioned in the singular tubular structure.

**[0046]** Implementation #2: The apparatus of Implementation #1 further comprising: a first inner diameter of the singular tubular structure that is less than a second inner diameter of the singular tubular structure, wherein the isolating component is positioned in a transition between the first inner diameter and the second inner diameter after the singular tubular structure is expanded to provide the differential pressure integrity in the wellbore.

**[0047]** Implementation #3: The apparatus of Implementation #2, wherein the transition includes a profile for the isolating component.

**[0048]** Implementation #4: The apparatus of any one or more of Implementation #1-3, wherein the isolating component includes a dart or a ball.

**[0049]** Implementation #5: The apparatus of any one or more of Implementation #1-4, wherein the singular tubular structure includes a dissolvable material.

**[0050]** Implementation #6: The apparatus of Implementation #5, wherein one or more components are integrated into the dissolvable material of the singular tubular structure and configured to engage with the inner wall of the casing and hold the singular tubular structure at a position in the casing when the singular tubular structure is expanded.

**[0051]** Implementation #7: The apparatus of any one or more of Implementation #1-6, wherein the singular tubular structure is held in a position in the casing due to a friction force between the inner wall of the casing and an outer face of the singular tubular structure when the singular tubular structure is expanded.

**[0052]** Implementation #8: The apparatus of any one or more of Implementation #1-7, wherein the singular tubular structure is held in a position in the casing based on elastic properties of material of the singular tubular structure.

**[0053]** Implementation #9: The apparatus of any one or more of Implementation #1-8, wherein one or more swedges are traversed through the singular tubular structure to expand the singular tubular structure to contact the inner wall of the casing, and wherein the one or more swedges are removed from the singular tubular structure after the singular tubular structure is expanded.

**[0054]** Implementation #10: A system comprising: a singular tubular structure to be positioned inside casing of a wellbore formed in a subsurface formation, wherein the singular tubular structure is configured to expand into an inner wall of the casing; and an isolating component to be positioned in the singular tubular structure to provide differential pressure integrity in the wellbore.

**[0055]** Implementation #11: The system of Implementation #10 further comprising: a first inner diameter of the singular tubular structure that is less than a second inner diameter of the singular tubular structure, wherein the isolating component is positioned in a transition between the first inner diameter and the second inner diameter after the singular tubular structure is expanded to provide the differential pressure integrity in the wellbore.

**[0056]** Implementation #12: The system of Implementation #11, wherein the transition includes a profile for the isolating component.

**[0057]** Implementation #13: The system of any one or more of Implementation #10-12, wherein the isolating component includes a dart or a ball.

**[0058]** Implementation #14: The system of any one or more of Implementation #10-13, wherein the singular tubular structure includes a dissolvable material.

**[0059]** Implementation #15: The system of Implementation #14, wherein one or more components are integrated into the dissolvable material of the singular tubular structure and configured to engage with the inner wall of the casing and hold the singular tubular structure at a position in the casing when the singular tubular structure is expanded.

**[0060]** Implementation #16: The system of any one or more of Implementation #10-15, wherein the singular tubular structure is held in a position in the casing due to a friction force between the inner wall of the casing and an outer wall of the singular tubular structure when the singular tubular structure is expanded.

**[0061]** Implementation #17: The system of any one or more of Implementation #10-16, wherein a maximum outer diameter of the singular tubular structure is less than an inner diameter of the casing prior to expansion of the singular tubular structure.

**[0062]** Implementation #18: The system of any one or more of Implementation #10-17, wherein one or more swedges are traversed through the singular tubular structure to expand the singular tubular structure to contact the inner wall of the casing, and wherein the one or more swedges are removed from the singular tubular structure after the singular tubular structure is expanded.

**[0063]** Implementation #19: A method comprising: positioning a singular tubular structure at a depth inside a casing of a wellbore formed in a subsurface formation; expanding, via a setting tool, the singular tubular structure to contact an inner wall of the casing; removing the setting tool from singular tubular structure; and positioning an isolating component in the singular tubular structure to provide differential pressure integrity in the wellbore.

**[0064]** Implementation #20: The method of Implementation #19, wherein the setting tool includes one or more swedges, and wherein the one or more swedges are traversed through the singular tubular structure to expand the singular tubular structure to contact the inner wall of the casing.

**[0065]** Use of the phrase "at least one of" preceding a list with the conjunction "and" should not be treated as an exclusive list and should not be construed as a list of categories with one item from each category, unless specifically stated otherwise. A clause that recites "at least one of A, B, and C" can be infringed with only one of the listed items, multiple of the listed items, and one or more of the items in the list and another item not listed.

**[0066]** As used herein, the term "or" is inclusive unless otherwise explicitly noted. Thus, the phrase "at least one of A, B, or C" is satisfied by any element from the set {A, B, C} or any combination thereof, including multiples of any element.

**1**. An apparatus comprising:

a singular tubular structure to be positioned inside casing of a wellbore formed in a subsurface formation, wherein the singular tubular structure is configured to expand to contact an inner wall of the casing and provide differential pressure integrity in the wellbore while an isolating component is positioned in the singular tubular structure.

**2**. The apparatus of claim **1** further comprising:

a first inner diameter of the singular tubular structure that is less than a second inner diameter of the singular tubular structure, wherein the isolating component is positioned in a transition between the first inner diameter and the second inner diameter after the singular tubular structure is expanded to provide the differential pressure integrity in the wellbore.

**3**. The apparatus of claim **2**, wherein the transition includes a profile for the isolating component.

**4**. The apparatus of claim **1**, wherein the isolating component includes a dart or a ball.

**5**. The apparatus of claim **1**, wherein the singular tubular structure includes a dissolvable material.

**6**. The apparatus of claim **5**, wherein one or more components are integrated into the dissolvable material of the singular tubular structure and configured to engage with the inner wall of the casing and hold the singular tubular structure at a position in the casing when the singular tubular structure is expanded.

**7**. The apparatus of claim **1**, wherein the singular tubular structure is held in a position in the casing due to a friction force between the inner wall of the casing and an outer face of the singular tubular structure when the singular tubular structure is expanded.

**8**. The apparatus of claim **1**, wherein the singular tubular structure is held in a position in the casing based on elastic properties of material of the singular tubular structure.

**9**. The apparatus of claim **1**, wherein one or more swedges are traversed through the singular tubular structure to expand the singular tubular structure to contact the inner wall of the casing, and wherein the one or more swedges are removed from the singular tubular structure after the singular tubular structure is expanded.

**10**. A system comprising:

a singular tubular structure to be positioned inside casing of a wellbore formed in a subsurface formation, wherein the singular tubular structure is configured to expand into an inner wall of the casing; and

an isolating component to be positioned in the singular tubular structure to provide differential pressure integrity in the wellbore.

**11**. The system of claim **10** further comprising:

a first inner diameter of the singular tubular structure that is less than a second inner diameter of the singular tubular structure, wherein the isolating component is positioned in a transition between the first inner diameter and the second inner diameter after the singular tubular structure is expanded to provide the differential pressure integrity in the wellbore.

**12**. The system of claim **11**, wherein the transition includes a profile for the isolating component.

**13**. The system of claim **10**, wherein the isolating component includes a dart or a ball.

**14**. The system of claim **10**, wherein the singular tubular structure includes a dissolvable material.

**15**. The system of claim **14**, wherein one or more components are integrated into the dissolvable material of the singular tubular structure and configured to engage with the inner wall of the casing and hold the singular tubular structure at a position in the casing when the singular tubular structure is expanded.

**16**. The system of claim **10**, wherein the singular tubular structure is held in a position in the casing due to a friction force between the inner wall of the casing and an outer wall of the singular tubular structure when the singular tubular structure is expanded.

**17**. The system of claim **10**, wherein a maximum outer diameter of the singular tubular structure is less than an inner diameter of the casing prior to expansion of the singular tubular structure.

**18**. The system of claim **10**, wherein one or more swedges are traversed through the singular tubular structure to expand the singular tubular structure to contact the inner wall of the casing, and wherein the one or more swedges are removed from the singular tubular structure after the singular tubular structure is expanded.

**19**. A method comprising:

positioning a singular tubular structure at a depth inside a casing of a wellbore formed in a subsurface formation;

expanding, via a setting tool, the singular tubular structure to contact an inner wall of the casing;

removing the setting tool from singular tubular structure; and

positioning an isolating component in the singular tubular structure to provide differential pressure integrity in the wellbore.

**20**. The method of claim **19**, wherein the setting tool includes one or more swedges, and wherein the one or more swedges are traversed through the singular tubular structure to expand the singular tubular structure to contact the inner wall of the casing.

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