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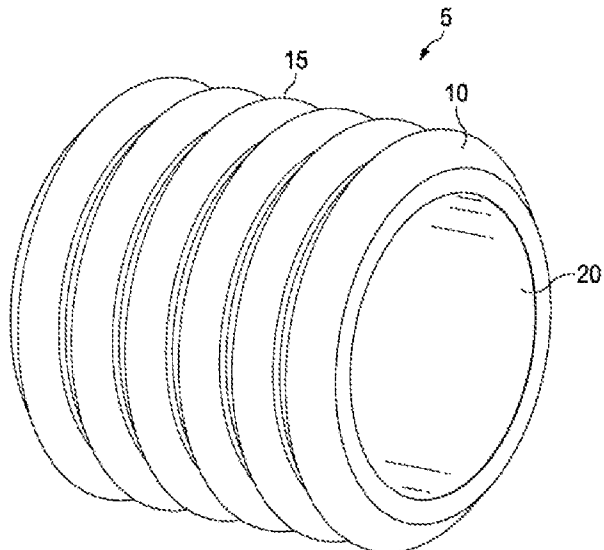
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(54)	Title	COLLAPSIBLE SHELL PACKER FOR METAL-TO-METAL SEALING
(57)	Abstract	

Collapsible shell packers and methods of use.
An example method introduces a collapsible shell packer into a wellbore; wherein the collapsible shell packer comprises a collapsible hollow, metal shell. The method further includes collapsing the collapsible hollow, metal shell by compressing the collapsible hollow, metal shell axially to expand the collapsible hollow, metal shell radially, wherein the collapsible hollow, metal shell is collapsed until a portion of the collapsible hollow, metal shell contacts an adjacent surface thereby isolating a zone.



COLLAPSIBLE SHELL PACKER FOR METAL-TO-METAL SEALING

TECHNICAL FIELD

The present disclosure relates to the use of packers, and more particularly, to the use of collapsible shell packers for providing zonal isolation with metal-to-metal sealing and anchoring.

BACKGROUND

Packers may be used, among other reasons, for anchoring and for forming annular seals in and around conduits in wellbore environments. Packers may be used to anchor a conduit concentrically within another conduit or wellbore. Packers may also seal off a zone within a conduit or wellbore. The seal may restrict all or a portion of fluid and/or pressure communication at the seal interface. Forming seals may be an important part of wellbore operations at all stages of drilling, completion, and production. In some operations, isolation and anchoring functionality may require separate mechanisms with many moving parts in some packer designs. These complications may increase costs as well as incidences of mechanical failures.

Additionally, some packers may expand radially by stretching of the packer material in the axial direction. The greater the expansion, the weaker the sealing capability may be as the material is subjected to increasing tensile stress as a result of reduced cross-section due to the stretching of material. This may lead to issues in seal assurance in some wellbore environments. Provided are improved apparatus and methods for packers used to provide zonal isolation with metal-to-metal sealing and anchoring.

BRIEF DESCRIPTION OF THE DRAWINGS

Illustrative examples of the present disclosure are described in detail below with reference to the attached drawing figures, which are incorporated by reference herein, and wherein:

FIG. 1 is a perspective illustration of an example of a collapsible shell packer in accordance with the examples disclosed herein;

FIG. 2 is a cross-section illustration of the example collapsible shell packer of FIG. 1 in accordance with the examples disclosed herein;

FIG. 3 is a cross-section illustration of the example collapsible shell packer of FIGs. 1 and 2 as used on a conduit when in the uncollapsed state in accordance with the examples disclosed herein;

FIG. 4 is a cross-section illustration of the example collapsible shell packer of FIG. 3 when in the collapsed state in accordance with the examples disclosed herein;

FIG. 5 is a cross-section illustration of another example of a collapsible shell packer as disposed on a conduit in the uncollapsed state in accordance with the examples disclosed herein;

FIG. 6 is a cross-section illustration of the example collapsible shell packer of FIG. 5 when in the collapsed state in accordance with the examples disclosed herein;

FIG. 7 is a cross-section illustration of another example of a collapsible shell packer as disposed on a conduit in the uncollapsed state in accordance with the examples disclosed herein;

FIG. 8 is an enlarged cross-section of the collapsible shell packer of FIG. 7 in accordance with the examples disclosed herein;

FIG. 9 is a cross-section illustration of the example collapsible shell packer of FIG. 7 when in the collapsed state in accordance with the examples disclosed herein;

FIG. 10 is a cross-section of an optional locking mechanism for the collapsible shell packer of FIG. 7 in accordance with the examples disclosed herein;

FIG. 11 is a cross-section of the optional locking mechanism of FIG. 10 once it is engaged in accordance with the examples disclosed herein;

FIG 12. is a cross-section illustrating the collapsible shell packer of FIGs. 7-11 with a sealing element affixed over the tip in accordance with the examples disclosed herein;

FIG 13. is a cross-section illustrating the collapsible shell packer of FIGs. 7-11 with two sealing elements affixed on either side of the tip in accordance with the examples disclosed herein; and

FIG 14. is a cross-section illustrating the collapsible shell packer of FIG. 13 in the collapsed state in accordance with the examples disclosed herein.

The illustrated figures are only exemplary and are not intended to assert or imply any limitation with regard to the environment, architecture, design, or process in which different examples may be implemented.

DETAILED DESCRIPTION

The present disclosure relates to the use of packers, and more particularly, to the use of collapsible shell packers for providing zonal isolation with metal-to-metal sealing and anchoring.

5 In the following detailed description of several illustrative examples, reference is made to the accompanying drawings that form a part hereof, and in which is shown by way of illustration examples that may be practiced. These examples are described in sufficient detail to enable those skilled in the art to practice them, and it is to be understood that other examples may be utilized, and that logical structural, mechanical, electrical, and chemical
10 changes may be made without departing from the spirit or scope of the disclosed examples. To avoid detail not necessary to enable those skilled in the art to practice the examples described herein, the description may omit certain information known to those skilled in the art. The following detailed description is, therefore, not to be taken in a limiting sense, and the scope of the illustrative examples is defined only by the appended claims.

15 Unless otherwise indicated, all numbers expressing quantities of ingredients, properties such as molecular weight, reaction conditions, and so forth used in the present specification and associated claims are to be understood as being modified in all instances by the term “about.” Accordingly, unless indicated to the contrary, the numerical parameters set forth in the following specification and attached claims are approximations that may vary
20 depending upon the desired properties sought to be obtained by the examples of the present disclosure. At the very least, and not as an attempt to limit the application of the doctrine of equivalents to the scope of the claim, each numerical parameter should at least be construed in light of the number of reported significant digits and by applying ordinary rounding techniques. It should be noted that when “about” is at the beginning of a numerical list,
25 “about” modifies each number of the numerical list. Further, in some numerical listings of ranges some lower limits listed may be greater than some upper limits listed. One skilled in the art will recognize that the selected subset will require the selection of an upper limit in excess of the selected lower limit.

30 Unless otherwise specified, any use of any form of the terms “connect,” “engage,” “couple,” “attach,” or any other term describing an interaction between elements is not meant to limit the interaction to direct interaction between the elements and may also include indirect interaction between the elements described. Further, any use of any form of the terms “connect,” “engage,” “couple,” “attach,” or any other term describing an interaction between elements includes items integrally formed together without the aid of extraneous fasteners or

joining devices. 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.” Unless otherwise indicated, as used throughout this document, “or” does not require mutual exclusivity.

5 The terms uphole and downhole may be used to refer to the location of various components relative to the bottom or end of a well. For example, a first component described as uphole from a second component may be further away from the end of the well than the second component. Similarly, a first component described as being downhole from a second component may be located closer to the end of the well than the second component.

10 Examples of the apparatus and methods described herein relate to the use of collapsible shell packers for providing zonal isolation with metal-to-metal sealing and anchoring. Advantageously, the collapsible shell packers comprise metal shells that allow for metal-to-metal sealing and/or anchoring within conduits. As the collapsible shell packers are metal, they may be more durable in some wellbore environments than other packer types
15 such as elastomeric swell packers. Yet a further mechanical advantage is that the collapsible shell packers expand radially by collapsing the hollow shells in the axial direction, the collapsible shell packers are subjected to compressive stress in nature instead of tensile stress, which make it more durable than the bladder type of packer. An additional advantage is that the collapsible shell packers do not rely on inflating fluid or gas bladders, or the use of fluid
20 or gas control lines to actuate the collapsible shell packers. Packers that rely on bladders become thinner upon expansion and may have reduced temperature and pressure ratings. A still further advantage is that the collapsible shell packers may be manufactured by additive manufacturing which allows for some examples to possess completely sealed off shells without openings and yet also remain hollow. Another advantage is that the collapsible shell
25 packers possess very few moving parts and may not be subject to the same mechanical issues as other more complex packers. Additionally, the reduced component demand may also decrease costs. A further advantage is that the collapsible shell packers, although metal, are elastically deformable and may be released and retrievable upon removal of the axial load. In some, examples the collapsible shell packers may be plastically deformable. In these
30 examples, the collapsible shell packers may not be retrievable in some operations.

 The collapsible shell packers comprise a hollow shell comprising a metal. A specific example of a metal is the metal alloy steel, which may provide corrosion resistance in some examples. Other examples of metals may include, titanium alloys, or combinations of titanium, steel, and other metals or alloys.

The collapsible shell packers may be used to form a seal at the interface of the collapsible shell and an adjacent surface. The adjacent surface may be a metal surface of a wellbore conduit, a casing surface, a wall of a cement sheath, the wall of the formation itself, or any other wellbore surface. In some examples the adjacent surface may have profile
5 variances, a rough finish, etc. These surfaces are not smooth, even, and/or consistent at the area where the sealing is to occur. These surfaces may have any type of indentation or projection, for example, gashes, gaps, pocks, pits, holes, divots, and the like. An example of a surface that may comprise these indentations or projections is a wellbore wall such as a casing wall or the wall of the formation.

10 In some examples, the collapsible shell packers are produced by additive manufacturing, for example 3-D printing of the metal shells. Additive manufactured components may not involve precision machining and may, in some examples, comprise a rough surface finish which may assist in texturing the exteriors of the shell for anchoring. In alternative examples, the shells may be finished to provide a smooth surface. In some
15 examples, the metal shells may comprise different materials (e.g., different grades of steel, different alloys, combinations of alloys such as titanium and steel, etc.) layered throughout the shell to give different portions of the shell different material properties. For example, the vertices of the shells may be made more elastically deformable to assist in flexing for expansion of the shells, whereas the walls of the collapsible shells may be made more rigid to
20 improve strength and support. A further advantage of additive manufacturing is that the collapsible shell packers may be manufactured to be completely sealed without opening and yet still retain a hollow core. Such a configuration may improve the strength of the material overall. In some examples, the deformable portions of the collapsible shell packers may be plastically deformable if desired, and may not return to their original shapes. These specific
25 examples of collapsible shell packers may be used in operations where it is not desirable to retrieve the collapsible shell packer. It is to be understood that although the collapsible shell packers are described as being a potential product of additive manufacturing, the collapsible shell packers may also be manufactured via other techniques as desired.

30 The collapsible shell packers may be used to form a seal between adjacent surfaces in the wellbore. Without limitation, the collapsible shell packer may be used to form seals on conduits, formation surfaces, cement sheaths, downhole tools, and the like. For example, a collapsible shell packer may be used to form a seal between the outer diameter of a conduit and a surface of the subterranean formation. Alternatively, a collapsible shell packer may be used to form a seal between the outer diameter of a conduit and a cement sheath (e.g., a

casing). As another example, a collapsible shell packer may be used to form a seal between the outer diameter of one conduit and the inner diameter of another conduit (which may be the same or different). Moreover, a plurality of collapsible shell packers may be used to form seals between multiple strings of conduits (e.g., oilfield tubulars). In one specific example, a collapsible shell packer may form a seal on the inner diameter of a conduit to restrict fluid flow through the inner diameter of a conduit, thus functioning similarly to a bridge plug. It is to be understood that the collapsible shell packer may be used to form a seal between any adjacent surfaces in the wellbore, and the disclosure is not to be limited to the explicit examples disclosed herein.

The collapsible shell packers may be used in high-temperature formations (e.g., in formations with zones having temperatures equal to or exceeding 350° F). In these high-temperature formations, use of elastomeric packers or other species of swell packers may be impacted. Advantageously, the collapsible shell packers of the present disclosure are not impacted by use in high-temperature formations. In some examples, the collapsible shell packers of the present disclosure may be used in both high-temperature formations and exposure to high-salinity brines. In a specific example, a collapsible shell packer may be used to form a seal after contact with a brine having a salinity of 10% or greater and also while being disposed in a wellbore zone having a temperature equal to or exceeding 350° F.

FIG. 1 is a perspective illustration of an example of a collapsible shell packer, generally 5. The collapsible shell packer 5 comprises a collapsible hollow, metal shell 10. The collapsible hollow, metal shell 10 collapses in the axial direction to initiate expansion in the radial direction. The collapsible shell packer 5 is wrapped or slipped on a conduit (not illustrated) with weight, grade, and connection specified by the well design. The conduit may be any type of conduit used in a wellbore, including drill pipe, stick pipe, tubing, coiled tubing, etc. The collapsible shell packer 5 further comprises a corrugated design with tips 15 which contact an adjacent surface to form a seal to prevent passage of fluids as well as to anchor the conduit to the adjacent surface. In some optional examples, an interior 20 of the collapsible shell packer 5 may form a seal with the exterior surface of the conduit including upon expansion of the collapsible shell packer 5.

FIG. 2 is a cross-section illustration of the example collapsible shell packer 5 of FIG. 1. The collapsible hollow, metal shell 10 comprises a cavity 25. Further, the collapsible hollow, metal shell 10 may be manufactured with additive manufacturing to provide a collapsible hollow, metal shell 10 that has no openings and whose cavity 25 is bordered on all sides by the collapsible hollow, metal shell 10 itself.

FIG. 3 is a cross-section illustration of the example collapsible shell packer 5 of FIGs. 1 and 2 as used on a conduit 30 when in the uncollapsed state. The collapsible shell packer 5 is wrapped or slipped on the conduit 30 with weight, grade, and connection specified by the well design. The conduit 30 may be any type of conduit used in a wellbore, including drill pipe, stick pipe, tubing, coiled tubing, etc. The conduit 30 is disposed in a wellbore 35. On one side of the collapsible shell packer 5 is a fixed support 40. Fixed support 40 may be used to prevent slippage or act as an extrusion barrier preventing the applied pressure from sliding or extruding the collapsible shell packer 5 in the direction of said applied pressure. In these optional examples, the fixed support 40 may be attached to the conduit 30 using any suitable connective mechanism such as a threaded connection. Piston 45 applies pressure to the collapsible shell packer 5 to collapse the collapsible hollow, metal shell 10 in the axial direction. Collapse of the collapsible hollow, metal shell 10 in the axial direction forces expansion of the collapsible hollow, metal shell 10 in the radial direction. This expansion is elastic, and the collapsible hollow, metal shell 10 returns to the illustrated uncollapsed state upon removal of the applied pressure from the piston 45.

Piston 45 may be actuated through any sufficient mechanism including motor actuation with gears to create axial movement, hydraulic pressure from the annulus via annular fluid or a downhole fluid with applied pressure from the surface, an internal hydraulic system, or any combination thereof. As the collapsible shell packer 5 is not inflatable, it does not require a control line for the inflation of a bladder with fluid or gas in order to initiate deployment.

FIG. 4 is a cross-section illustration of the example collapsible shell packer 5 of FIG. 3 when in the collapsed state. Piston 45 has moved in the direction illustrated by arrow 50 to apply pressure in the axial direction to the collapsible shell packer 5. The applied pressure collapses the collapsible hollow, metal shell 10 in the axial direction, which initiates expansion in the radial direction. As the collapsible hollow, metal shell 10 expands in the radial direction, the tips 15 contact an adjacent surface 55. The adjacent surface 55 may be the surface of the conduit 30 such as a casing, tubing, etc., or it may be the surface of a wall of the wellbore 35. When tips 15 contact the adjacent surface 55, a seal is formed at the interface, and the collapsible shell packer 5 anchors the conduit 30 to the adjacent surface 55. The optional fixed support 40 prevents slippage of the collapsible shell packer 5 as the piston 45 applies pressure. In some examples, actuation of the piston 45 may be halted, and the applied pressure to the collapsible shell packer 5 may be released. As the collapsible shell packer 5 is elastically deformable, the collapsible shell packer 5 reverts to the uncollapsed

state of FIG. 3 upon removal of the applied pressure. This reversion allows the seal and anchoring of the collapsible shell packer 5 to be removed as desired, as well as for the collapsible shell packer 5 to be retrieved as desired.

FIG. 5 is a cross-section illustration of another example of a collapsible shell packer, generally 100 as disposed on a conduit 110 in the uncollapsed state. The collapsible shell packer 100 comprises a collapsible hollow, metal shell 105. The collapsible hollow, metal shell 105 collapses in the axial direction to initiate expansion in the radial direction. The collapsible shell packer 100 is wrapped or slipped on the conduit 110 with weight, grade, and connection specified by the well design. The conduit 110 may be any type of conduit used in a wellbore, including drill pipe, stick pipe, tubing, coiled tubing, etc. The collapsible shell packer 100 further comprises a flat trapezoidal design with a flat contact surface 115 which contacts an adjacent surface 120 when in the collapsed state to form a seal to prevent passage of fluids as well as to anchor the conduit 110 to the adjacent surface 120. In some optional examples, an interior 125 of the collapsible shell packer 100 may seal to an exterior surface of the conduit 110 including upon expansion of the collapsible shell packer 100. The collapsible hollow, metal shell 105 comprises a cavity 130. Further, the collapsible hollow, metal shell 105 may be manufactured with additive manufacturing to provide a collapsible hollow, metal shell 105 that has no openings and whose cavity 130 is bordered on all sides by the collapsible hollow, metal shell 105 itself.

With continued reference to FIG. 5, the conduit 110 is disposed in a wellbore 135. On one side of the collapsible shell packer 100 is a fixed support 140. Fixed support 140 is an optional component and is illustrated in all examples as strictly optional. Fixed support 140 may be used to prevent slippage or act as an extrusion barrier preventing the applied pressure from sliding or extruding the collapsible shell packer 100 in the direction of said applied pressure. In these optional examples, the fixed support 140 may be attached to the conduit 110 using any suitable connective mechanism such as a threaded connection. Additionally, or alternatively, the collapsible shell packer 100 may be attached to the conduit 110 with a threaded connection. Piston 145 applies pressure to the collapsible shell packer 100 to collapse the collapsible hollow, metal shell 105 in the axial direction. Collapse of the collapsible hollow, metal shell 105 in the axial direction forces expansion of the collapsible hollow, metal shell 105 in the radial direction. This expansion is elastic, and the collapsible hollow, metal shell 105 returns to the illustrated uncollapsed state upon removal of the applied pressure from the piston 145.

Piston 145 may be actuated through any sufficient mechanism including motor actuation with gears to create axial movement, hydraulic pressure from the annulus via annular fluid or a downhole fluid with applied pressure from the surface, an internal hydraulic system, or any combination thereof. As the collapsible shell packer 100 is not inflatable, it does not require a control line for the inflation of a bladder with fluid or gas in order to initiate deployment.

FIG. 6 is a cross-section illustration of the example collapsible shell packer 100 of FIG. 5 when in the collapsed state. Piston 145 has moved in the direction illustrated by arrow 150 to apply pressure in the axial direction to the collapsible shell packer 100. The applied pressure collapses the collapsible hollow, metal shell 105 in the axial direction, which initiates expansion in the radial direction. As the collapsible hollow, metal shell 105 expands in the radial direction, the flat contact surface 115 contacts the adjacent surface 120. The adjacent surface 120 may be the surface of the conduit 110 such as a casing, tubing, etc., or it may be the surface of a wall of the wellbore 135. When the flat contact surface 115 contacts the adjacent surface 120, a seal is formed at the interface, and the collapsible shell packer 100 anchors the conduit 110 to the adjacent surface 120. The fixed support 140 prevents slippage of the collapsible shell packer 100 as the piston 145 applies pressure. In some examples, actuation of the piston 145 may be halted, and the applied pressure to the collapsible shell packer 100 may be released. As the collapsible shell packer 100 is elastically deformable, the collapsible shell packer 100 reverts to the uncollapsed state of FIG. 5 upon removal of the applied pressure. This reversion allows the seal and anchoring of the collapsible shell packer 100 to be removed as desired, as well as for the collapsible shell packer 100 to be retrieved as desired.

FIG. 7 is a cross-section illustration of another example of a collapsible shell packer, generally 200, as disposed on a conduit 210 in the uncollapsed state. Multiple collapsible shell packers 200 are illustrated as interconnected in a series. The collapsible shell packers 200 comprise collapsible hollow, metal shells 205. The collapsible hollow, metal shells 205 collapse in the axial direction to initiate expansion in the radial direction. The collapsible shell packers 200 are wrapped or slipped on the conduit 210 with weight, grade, and connection specified by the well design. The conduit 210 may be any type of conduit used in a wellbore, including drill pipe, stick pipe, tubing, coiled tubing, etc. The collapsible shell packers 200 further comprise a pointed design with a single tip 215 which contacts an adjacent surface 220 when in the collapsed state to form a seal to prevent passage of fluids as well as to anchor the conduit 210 to the adjacent surface 220. In some optional examples, an

interior 225 of the collapsible shell packers 200 may comprise threads or other connective mechanisms to secure the collapsible shell packers 200 to the conduit 210. The collapsible hollow, metal shells 205 comprise a cavity 230. This specific example of the collapsible shell packers 200 has an opening adjacent the conduit 210 in the collapsible hollow, metal shells 205, and thus the cavity 230 is exposed on the conduit 210 side to the surface of the conduit 210. However, in some alternative examples, the collapsible hollow, metal shells 205 may be manufactured with additive manufacturing to provide a collapsible hollow, metal shell 205 that has no openings and whose cavity 230 is bordered on all sides by the collapsible hollow, metal shell 205 itself.

With continued reference to FIG. 7, the conduit 210 is disposed in a wellbore 235. One side of the collapsible shell packers 200 comprises a piston housing 240. Piston housing 240 is used to house piston 245. Piston 245 is a component of the opposing side of the collapsible shell packers 200 as the piston housing 240. As piston 245 is on the opposing side of the collapsible shell packers 200 as the piston housing 240, the collapsible shell packers 200 are designed to be interlocking with one another in a series as illustrated. As such, the piston housing 240 of one collapsible shell packer 200 serves as the piston housing 240 of the piston 245 of the adjacent collapsible shell packer 200. This modular design allows the collapsible shell packers 200 to be applied as warranted to apply as much sealing and anchoring as desired.

Piston 245 applies pressure to the collapsible shell packer 200 to collapse the collapsible hollow, metal shell 205 in the axial direction. Collapse of the collapsible hollow, metal shell 205 in the axial direction forces expansion of the collapsible hollow, metal shell 205 in the radial direction. This expansion may be elastic, and the collapsible hollow, metal shell 205 may return to the illustrated uncollapsed state upon removal of the applied pressure from the piston 245. Alternatively, the expansion may be plastic in some examples and the collapsible hollow, metal shell 205 may not return to the illustrated uncollapsed state upon removal of the applied pressure from the piston 245. In some examples, the piston housing 240 may be secured to the conduit 210 to control evenness in the compression rate for all of the collapsible hollow, metal shells 205.

Piston 245 is illustrated as being actuated via a fluid pumped through the dual-layered wall of the conduit 210. The fluid exits via ports 250 into a piston setting chamber 255 to push the piston 245 and collapse the collapsible hollow, metal shells 205 in the axial direction. The piston setting chamber 255 is defined by the boundary of the outermost exterior wall of the piston 245 and the piston housing 240. In some alternative examples, the

piston 245 may be actuated via other mechanisms such as motors or through the application of hydraulic pressure via annular or downhole fluids which may enter the piston setting chamber 255 via an alternative entry port. As the collapsible shell packer 200 is not inflatable, it does not require a control line for the inflation of a bladder with fluid or gas in order to initiate deployment. The use of hydraulic pressure will generate higher contact force than the inflation of a bladder for zonal isolation, thereby providing better performance than the latter. The hydraulic pressure may even be high enough to provide anchor capability in some examples.

FIG. 8 is an enlarged cross-section of the collapsible shell packer 200 of FIG. 7 to better illustrate the piston housing 240, piston 245, port 250, and piston setting chamber 255. As discussed above, actuation of the piston 245 collapses the collapsible hollow, metal shell 205 in the axial direction which initiates expansion in the radial direction.

FIG. 9 is a cross-section illustration of the example collapsible shell packer 200 of FIG. 7 when in the collapsed state. Piston 245 has moved in the direction illustrated by arrow 260 to apply pressure in the axial direction to the collapsible hollow, metal shell 205. Actuation of the piston 245 was performed by a fluid pumped through the dual-wall of the conduit 210. The fluid exited the conduit 210 via ports 250 to enter piston setting chamber 255 to apply pressure to the piston 245. The applied pressure collapses the collapsible hollow, metal shell 205 in the axial direction, which initiates expansion in the radial direction. As the collapsible hollow, metal shell 205 expands in the radial direction, the tip 215 contacts the adjacent surface 220. The adjacent surface 220 may be the surface of a conduit such as a casing, tubing, etc., or it may be the surface of a wall of the wellbore 235. When the tip 215 contacts the adjacent surface 220, a seal is formed at the interface, and the collapsible shell packer 200 anchors the conduit 210 to the adjacent surface 220. In some examples, actuation of the piston 245 may be halted, and the applied pressure to the collapsible hollow, metal shell 205 may be released. As the collapsible hollow, metal shell 205 may be elastically deformable, the collapsible shell packer 200 may revert to the uncollapsed state of FIG. 5 upon removal of the applied pressure. Alternatively, the collapsible hollow, metal shell 205 may be plastically deformable, and the collapsible shell packer 200 may not revert to the uncollapsed state of FIG. 5 upon removal of the applied pressure. Reversion to the uncollapsed state allows the seal and anchoring of the collapsible shell packer 200 to be removed as desired, as well as for the collapsible shell packer 200 to be retrieved as desired.

FIG. 10 is a cross-section of an optional locking mechanism for the collapsible shell packer of FIG. 7. In some examples, it may be desirable to lock the collapsible shell packer

200 in the collapsed orientation. This may be accomplished by maintaining fluid pressure on the piston 245 or by sealing off the port 250 (as illustrated in FIGs. 7-9) once the piston 245 has set. Should these methods not be preferred, a groove 270 may be disposed in the exterior of the conduit 210. A corresponding locking ring 275 may be disposed within the piston 245.

5 Once actuation of the piston 245 begins, the piston 245 and the locking ring 275 will travel in the axial direction towards the groove 270. FIG. 10 illustrates this arrangement when the collapsible shell packer 200 is in the uncollapsed state.

FIG. 11 is a cross-section of the optional locking mechanism of FIG. 10 once it is engaged. As illustrated, actuation of the piston 245 has completed and the piston 245 and the
10 locking ring 275 traveled in the axial direction until the locking ring 275 contacted groove 270. The collapsible hollow, metal shell 205 has now collapsed and remains locked in the collapsed state due to the locking ring 275 preventing movement of the collapsible hollow, metal shell 205 even if the fluid pressure within the setting chamber 255 is removed.

FIG 12 is a cross-section illustrating the collapsible shell packer 200 of FIGs. 7-11
15 with a sealing element 280 affixed over the tip 215. The sealing element 280 may be an elastomeric sealing element and may be used to supplement the sealing capability of the collapsible shell packer 200. In some examples, the sealing element may be a swellable elastomer and may swell upon contact with aqueous and/or oleaginous fluids.

FIG 13 is a cross-section illustrating the collapsible shell packer 200 of FIGs. 7-11
20 with two sealing elements 280 affixed on either side of the tip 215. The sealing elements 280 may be elastomeric sealing elements and may be used to supplement the sealing capability of the collapsible shell packer 200. In some examples, the sealing element may be a swellable elastomer and may swell upon contact with aqueous and/or oleaginous fluids. The sealing elements 280 of FIG. 13 are the same sealing elements 280 of FIG. 12, but are positioned in a
25 different orientation as illustrated.

FIG 14 is a cross-section illustrating the collapsible shell packer 200 of FIG. 13 in the collapsed state. The two sealing elements 280 have been pressed against the adjacent surface 220 to supplement the seal formed at the tip 215.

The sealing elements 280 may be bonded to the collapsible hollow, metal shell 205
30 using any sufficient mechanism including adhesives, melting, etc. Further, although the sealing elements 280 are illustrated as used with the collapsible shell packer 200 of FIGs. 7-14, it is to be understood that the sealing elements 280 may be used with any example of a collapsible shell packer as disclosed herein.

It should be clearly understood that the examples illustrated by FIGs. 1-14 are merely general applications of the principles of this disclosure in practice, and a wide variety of other examples are possible. Therefore, the scope of this disclosure is not limited in any manner to the details of any of the FIGURES described herein.

It is also to be recognized that the disclosed collapsible shell packers may also directly or indirectly affect the various downhole equipment and tools that may come into contact with the collapsible shell packers during operation. Such equipment and tools may include, but are not limited to, wellbore casing, wellbore liner, completion string, insert strings, drill string, coiled tubing, slickline, wireline, drill pipe, drill collars, mud motors, downhole motors and/or pumps, surface-mounted motors and/or pumps, centralizers, turbolizers, scratchers, floats (e.g., shoes, collars, valves, etc.), logging tools and related telemetry equipment, actuators (e.g., electromechanical devices, hydromechanical devices, etc.), sliding sleeves, production sleeves, plugs, screens, filters, flow control devices (e.g., inflow control devices, autonomous inflow control devices, outflow control devices, etc.), couplings (e.g., electro-hydraulic wet connect, dry connect, inductive coupler, etc.), control lines (e.g., electrical, fiber optic, hydraulic, etc.), surveillance lines, drill bits and reamers, sensors or distributed sensors, downhole heat exchangers, valves and corresponding actuation devices, tool seals, packers, cement plugs, bridge plugs, and other wellbore isolation devices, or components, and the like. Any of these components may be included in the systems generally described above and depicted in any of the FIGURES.

Provided are methods for performing zonal isolation in accordance with the disclosure and the illustrated FIGURES. An example method comprises introducing a collapsible shell packer into a wellbore; wherein the collapsible shell packer comprises a collapsible hollow, metal shell. The method further comprises collapsing the collapsible hollow, metal shell by compressing the collapsible hollow, metal shell axially to expand the collapsible hollow, metal shell radially, wherein the collapsible hollow, metal shell is collapsed until a portion of the collapsible hollow, metal shell contacts an adjacent surface thereby isolating a zone.

Additionally or alternatively, the method may include one or more of the following features individually or in combination. The collapsing of the collapsible hollow, metal shell by compressing the collapsible hollow, metal shell axially may be performed by applying pressure to the collapsible hollow, metal shell with a piston in the axial direction. The collapsible shell packer may comprise a pointed tip contact surface. The collapsible shell packer may be trapezoidal in shape and comprises a flat contact surface. The collapsible shell packer may be corrugated in shape. The collapsible hollow, metal shell may be hollow

without openings. The collapsible shell packer may further comprise a piston on one end and a piston housing on the opposing end. There may be a plurality of collapsible shell packers interconnected such that the piston of one collapsible shell packer is housing in the piston housing of an adjacent collapsible shell packer. The collapsible shell packer may further
5 comprise a sealing element disposed on a contact surface of the collapsible shell packer.

Provided are collapsible shell packers for forming a seal and providing anchoring in a wellbore in accordance with the disclosure and the illustrated FIGURES. An example collapsible shell packer comprises a collapsible hollow, metal shell configured to collapse in the axial direction and expand in the radial direction.

10 Additionally or alternatively, the collapsible shell packer may include one or more of the following features individually or in combination. The collapsing of the collapsible hollow, metal shell by compressing the collapsible hollow, metal shell axially may be performed by applying pressure to the collapsible hollow, metal shell with a piston in the axial direction. The collapsible shell packer may comprise a pointed tip contact surface. The
15 collapsible shell packer may be trapezoidal in shape and comprises a flat contact surface. The collapsible shell packer may be corrugated in shape. The collapsible hollow, metal shell may be hollow without openings. The collapsible shell packer may further comprise a piston on one end and a piston housing on the opposing end. There may be a plurality of collapsible shell packers interconnected such that the piston of one collapsible shell packer is housing in
20 the piston housing of an adjacent collapsible shell packer. The collapsible shell packer may further comprise a sealing element disposed on a contact surface of the collapsible shell packer.

Provided are systems for performing zonal isolation in a wellbore in accordance with the disclosure and the illustrated FIGURES. An example system comprises a collapsible shell
25 packer comprising a collapsible hollow, metal shell, and a piston to collapse the collapsible metal shell in the axial direction thereby expanding the collapsible metal shell in the radial direction.

30 Additionally or alternatively, the system may include one or more of the following features individually or in combination. The collapsing of the collapsible hollow, metal shell by compressing the collapsible hollow, metal shell axially may be performed by applying pressure to the collapsible hollow, metal shell with a piston in the axial direction. The collapsible shell packer may comprise a pointed tip contact surface. The collapsible shell packer may be trapezoidal in shape and comprises a flat contact surface. The collapsible shell packer may be corrugated in shape. The collapsible hollow, metal shell may be hollow

without openings. The collapsible shell packer may further comprise a piston on one end and a piston housing on the opposing end. There may be a plurality of collapsible shell packers interconnected such that the piston of one collapsible shell packer is housing in the piston housing of an adjacent collapsible shell packer. The collapsible shell packer may further
5 comprise a sealing element disposed on a contact surface of the collapsible shell packer. The system may further comprise a conduit comprising a groove in the exterior of the conduit; wherein the piston comprises a locking ring; and wherein the locking ring is configured to lock into the groove after actuation of the piston. The piston may be a component of the collapsible shell packer and is disposed on one end of the collapsible shell packer; wherein
10 the collapsible shell packer further comprises a piston housing on the opposing end; and further wherein there are a plurality of collapsible shell packers interconnected such that the piston of one collapsible shell packer is housed in the piston housing of an adjacent collapsible shell packer.

One or more illustrative examples incorporating the examples disclosed herein are
15 presented. Not all features of a physical implementation are described or shown in this application for the sake of clarity. Therefore, the disclosed systems and methods are well adapted to attain the ends and advantages mentioned, as well as those that are inherent therein. The particular examples disclosed above are illustrative only, as the teachings of the present disclosure may be modified and practiced in different but equivalent manners
20 apparent to those skilled in the art having the benefit of the teachings herein. Furthermore, no limitations are intended to the details of construction or design herein shown other than as described in the claims below. It is therefore evident that the particular illustrative examples disclosed above may be altered, combined, or modified, and all such variations are considered within the scope of the present disclosure. The systems and methods illustratively
25 disclosed herein may suitably be practiced in the absence of any element that is not specifically disclosed herein and/or any optional element disclosed herein.

Although the present disclosure and its advantages have been described in detail, it should be understood that various changes, substitutions and alterations can be made herein without departing from the spirit and scope of the disclosure as defined by the following
30 claims.

WHAT IS CLAIMED IS:

1. A method for performing zonal isolation comprising:
introducing a collapsible shell packer into a wellbore; wherein the collapsible shell
5 packer comprises a collapsible hollow, metal shell,
collapsing the collapsible hollow, metal shell by compressing the collapsible hollow,
metal shell axially to expand the collapsible hollow, metal shell radially, wherein the
collapsible hollow, metal shell is collapsed until a portion of the collapsible hollow, metal
shell contacts an adjacent surface thereby isolating a zone.
10
2. The method of claim 1, wherein the collapsing the collapsible hollow, metal shell by
compressing the collapsible hollow, metal shell axially is performed by applying pressure to
the collapsible hollow, metal shell with a piston in the axial direction.
- 15 3. The method of claim 1, wherein the collapsible shell packer comprises a pointed tip
contact surface.
4. The method of claim 1, wherein the collapsible shell packer is trapezoidal in shape
and comprises a flat contact surface.
20
5. The method of claim 1, wherein the collapsible shell packer is corrugated in shape.
6. The method of claim 1, wherein the collapsible hollow, metal shell is hollow without
openings.
25
7. The method of claim 1, wherein the collapsible shell packer further comprises a piston
on one end and a piston housing on the opposing end.
8. The method of claim 7, wherein there are a plurality of collapsible shell packers
30 interconnected such that the piston of one collapsible shell packer is housing in the piston
housing of an adjacent collapsible shell packer.
9. The method of claim 1, wherein the collapsible shell packer further comprises a
sealing element disposed on a contact surface of the collapsible shell packer.

10. A collapsible shell packer comprising:
a collapsible hollow, metal shell configured to collapse in the axial direction and expand in the radial direction.

5

11. The collapsible shell packer of claim 10, wherein the collapsible shell packer comprises a pointed tip contact surface.

12. The collapsible shell packer of claim 10, wherein the collapsible shell packer is
10 trapezoidal in shape and comprises a flat contact surface.

13. The collapsible shell packer of claim 10, wherein the collapsible shell packer is corrugated in shape.

14. The collapsible shell packer of claim 10, wherein the collapsible hollow, metal shell is
15 hollow without openings.

15. The collapsible shell packer of claim 10, wherein the collapsible shell packer further
comprises a piston on one end and a piston housing on the opposing end.

20

16. The collapsible shell packer of claim 10, wherein the collapsible shell packer further
comprises a sealing element disposed on a contact surface of the collapsible shell packer.

17. A system for performing zonal isolation in a wellbore, the system comprising:
25 a collapsible shell packer comprising a collapsible hollow, metal shell, and
a piston to collapse the collapsible metal shell in the axial direction thereby expanding
the collapsible metal shell in the radial direction.

18. The system of claim 17, further comprising a conduit comprising a groove in the
30 exterior of the conduit; wherein the piston comprises a locking ring; and wherein the locking
ring is configured to lock into the groove after actuation of the piston.

19. The system of claim 17, wherein the piston is a component of the collapsible shell
packer and is disposed on one end of the collapsible shell packer; wherein the collapsible

shell packer further comprises a piston housing on the opposing end; and further wherein there are a plurality of collapsible shell packers interconnected such that the piston of one collapsible shell packer is housed in the piston housing of an adjacent collapsible shell packer.

5

20. The system of claim 17, wherein the collapsible hollow, metal shell is hollow without openings.

10

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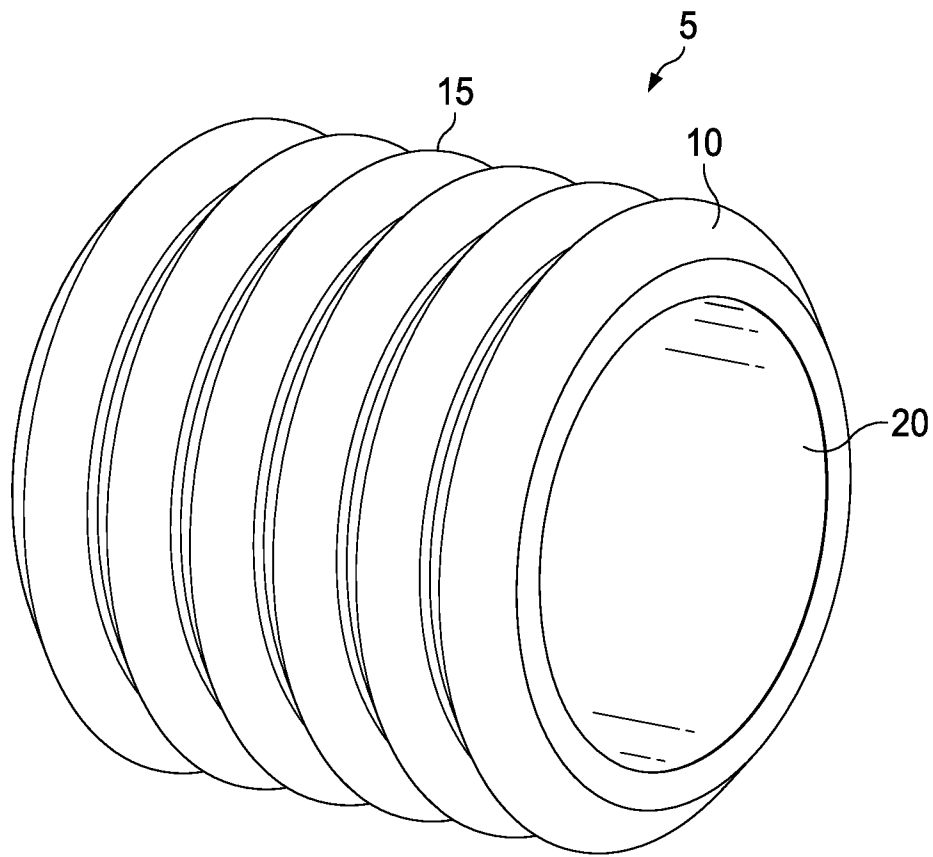


FIG. 1

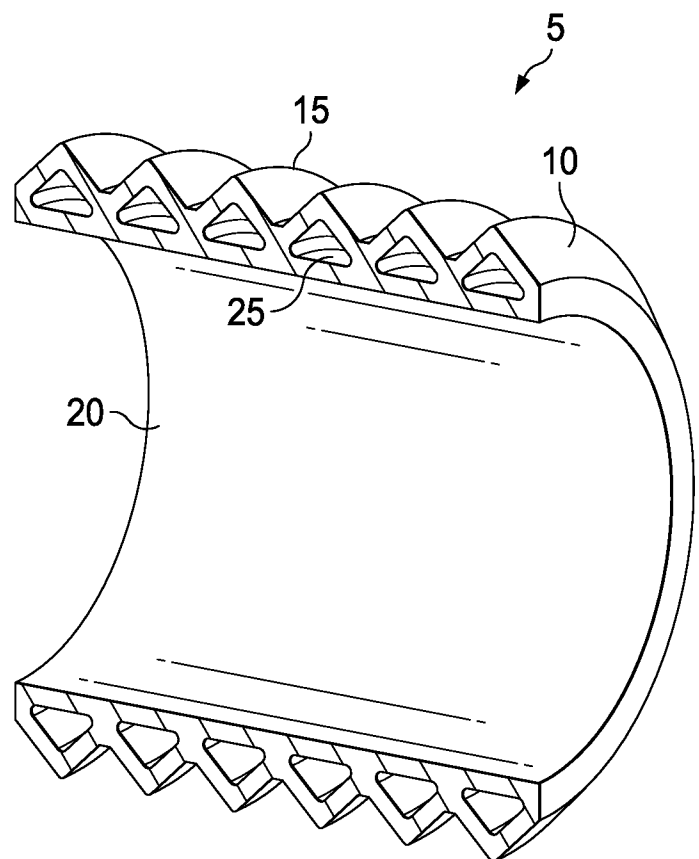


FIG. 2

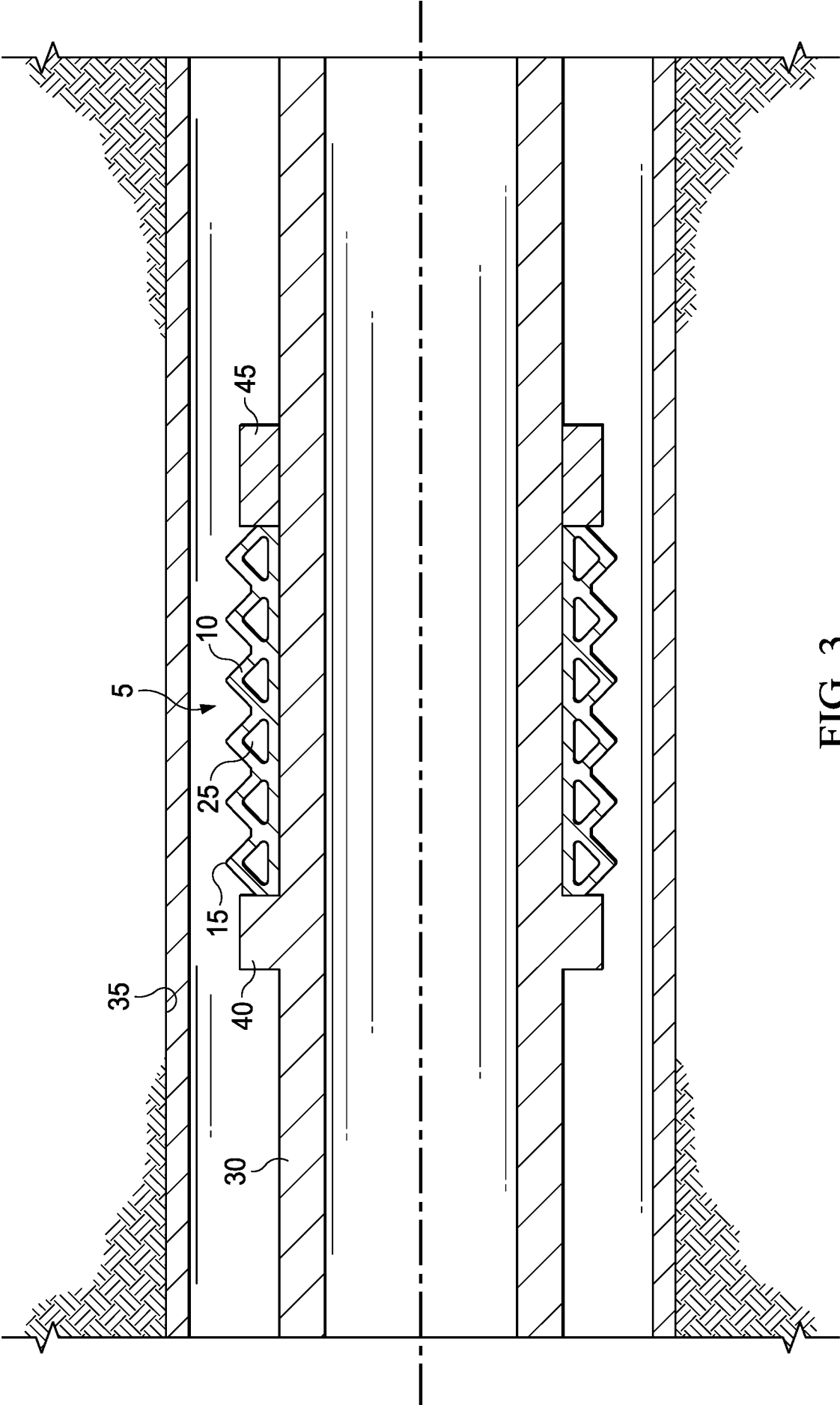


FIG. 3

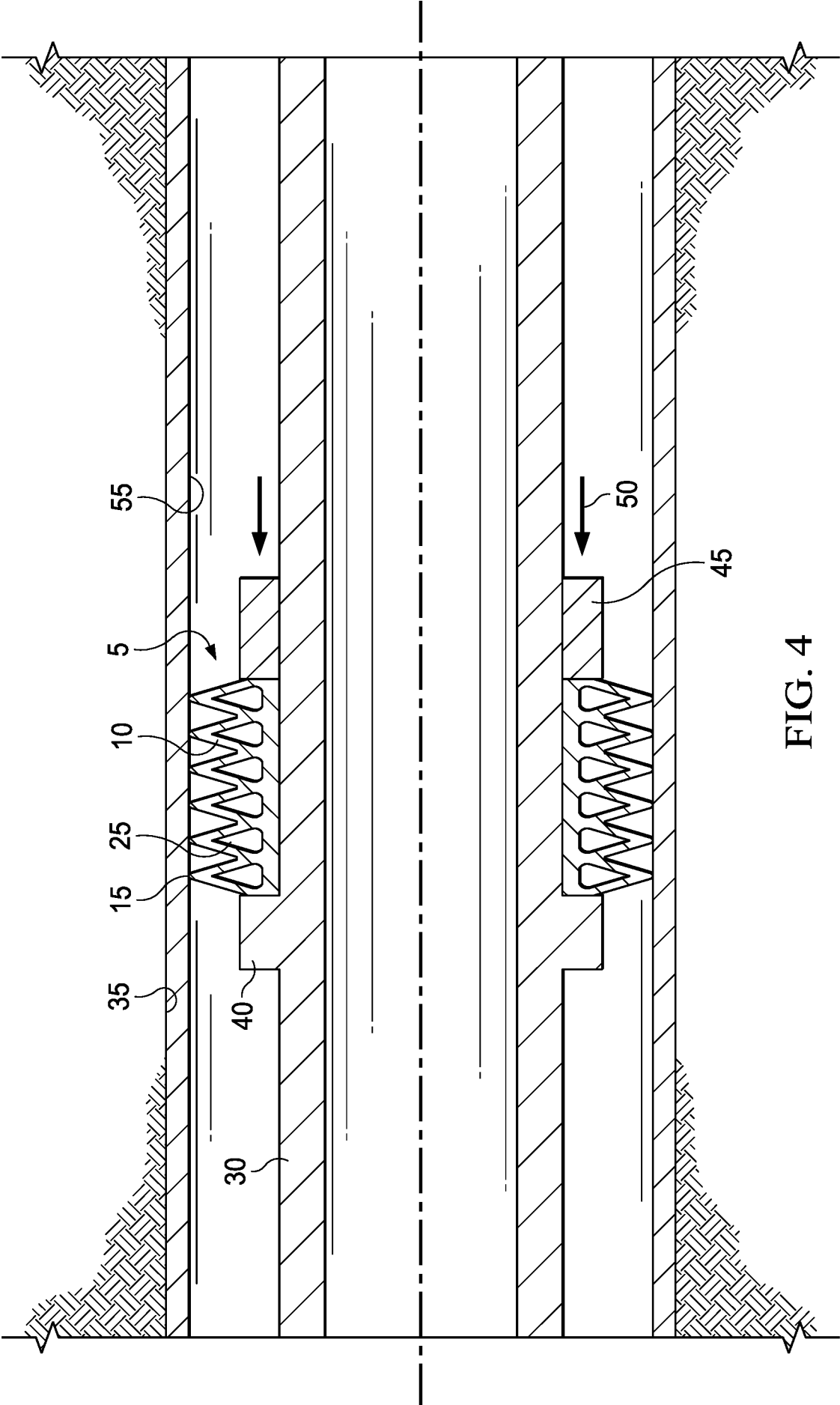


FIG. 4

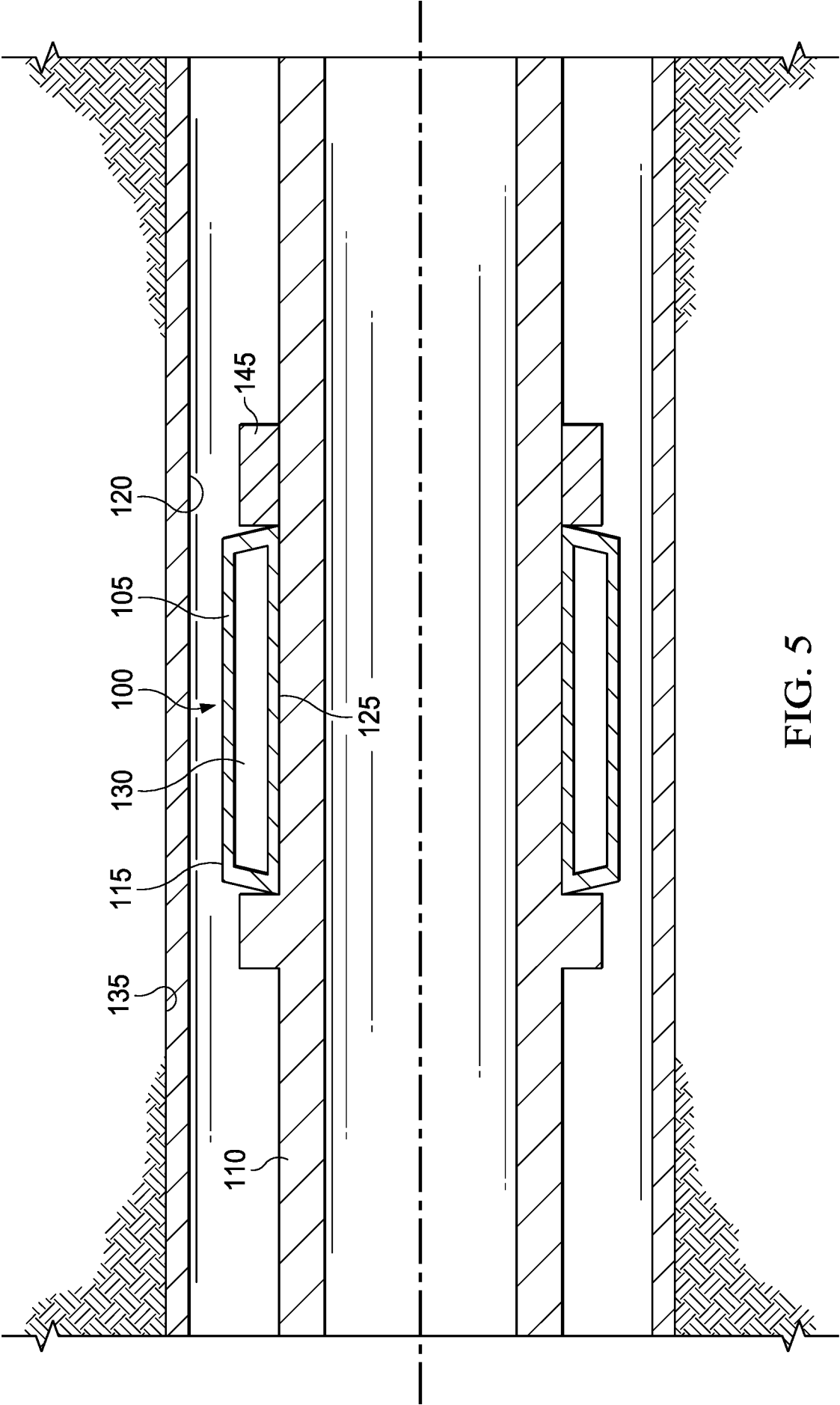


FIG. 5

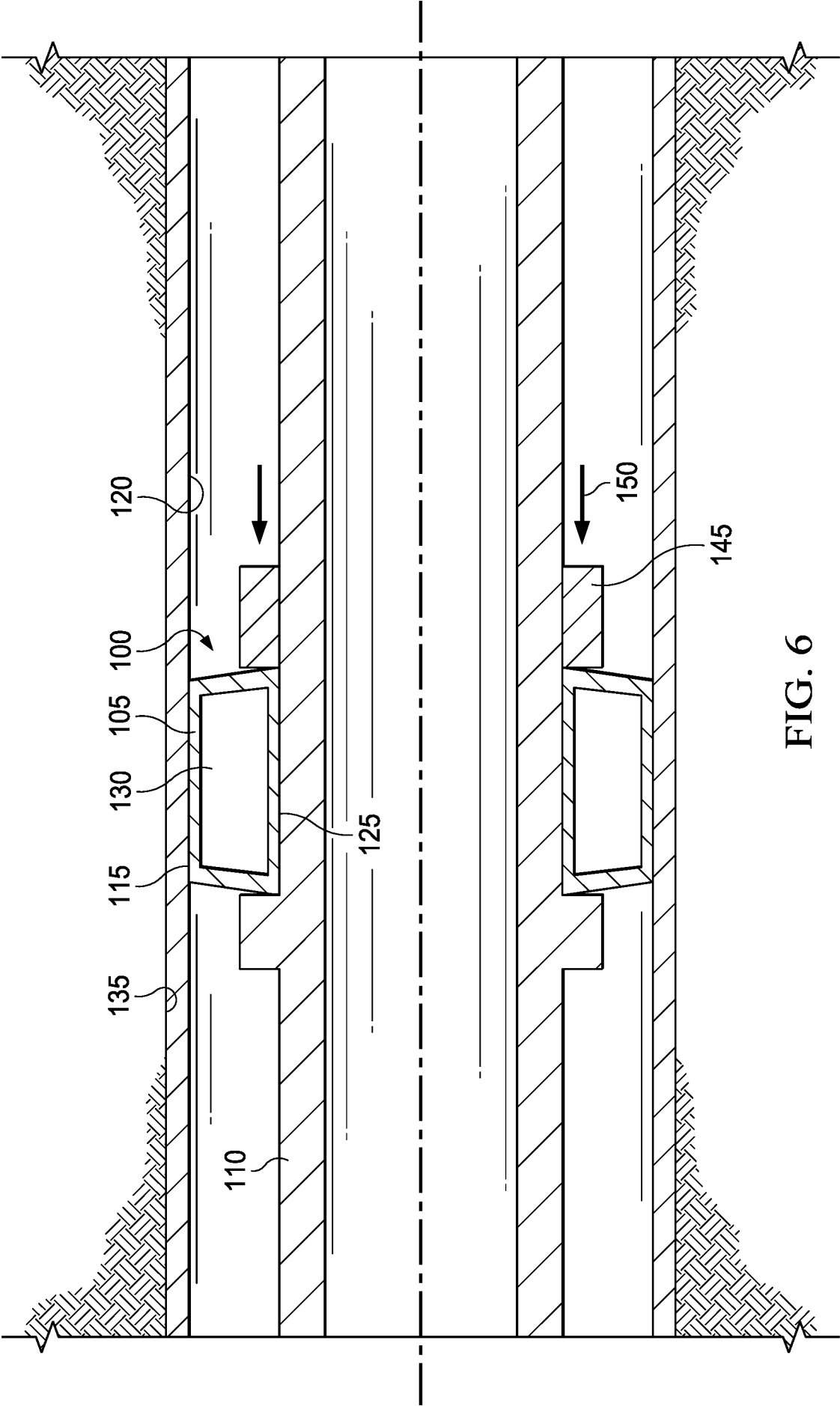


FIG. 6

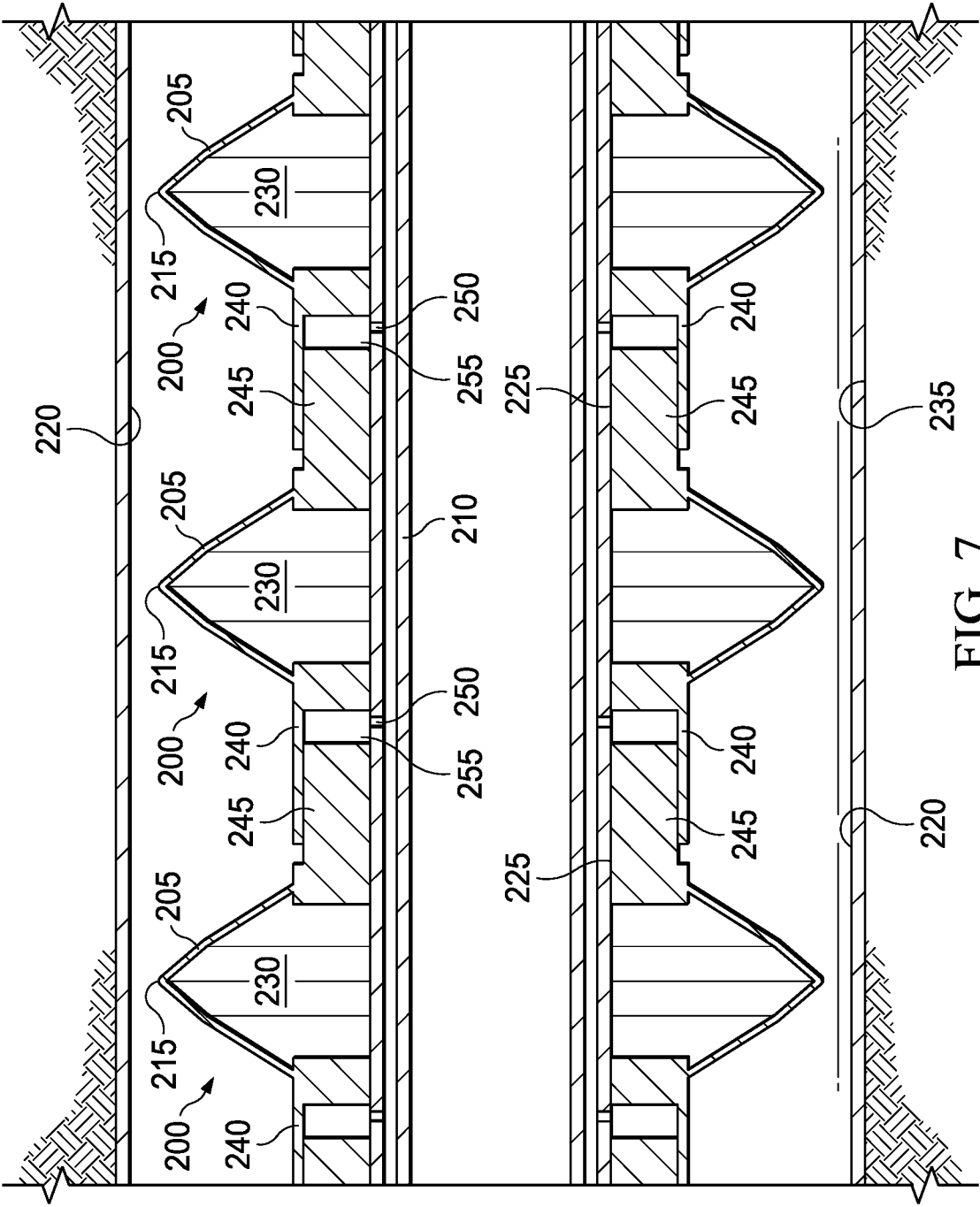


FIG. 7

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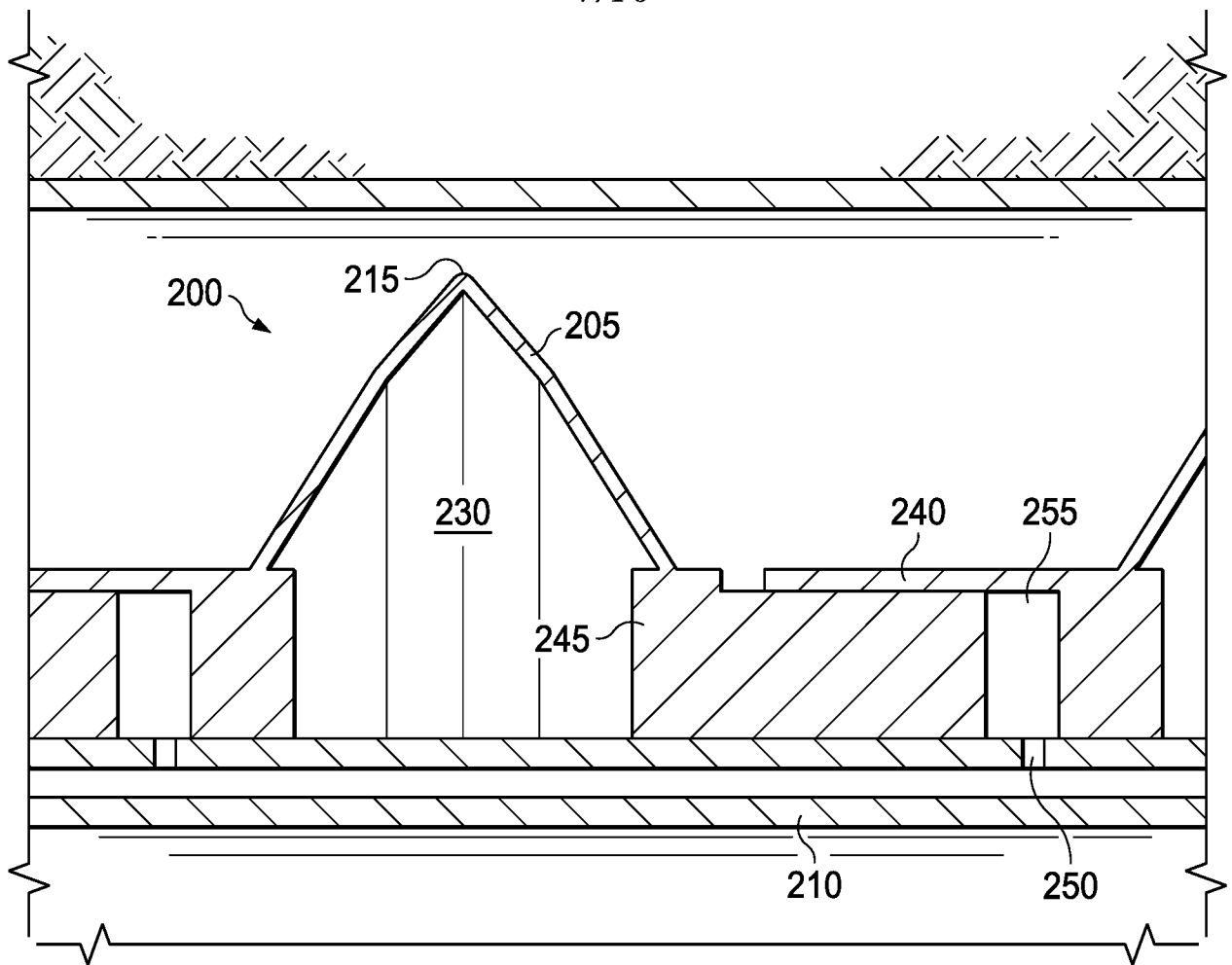


FIG. 8

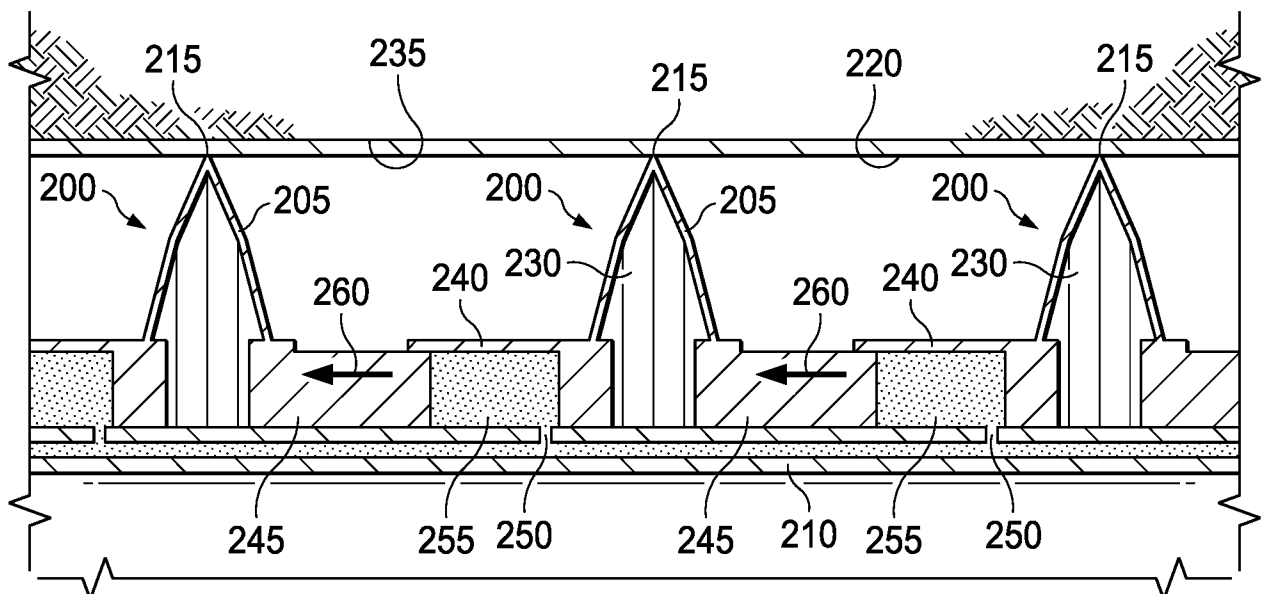


FIG. 9

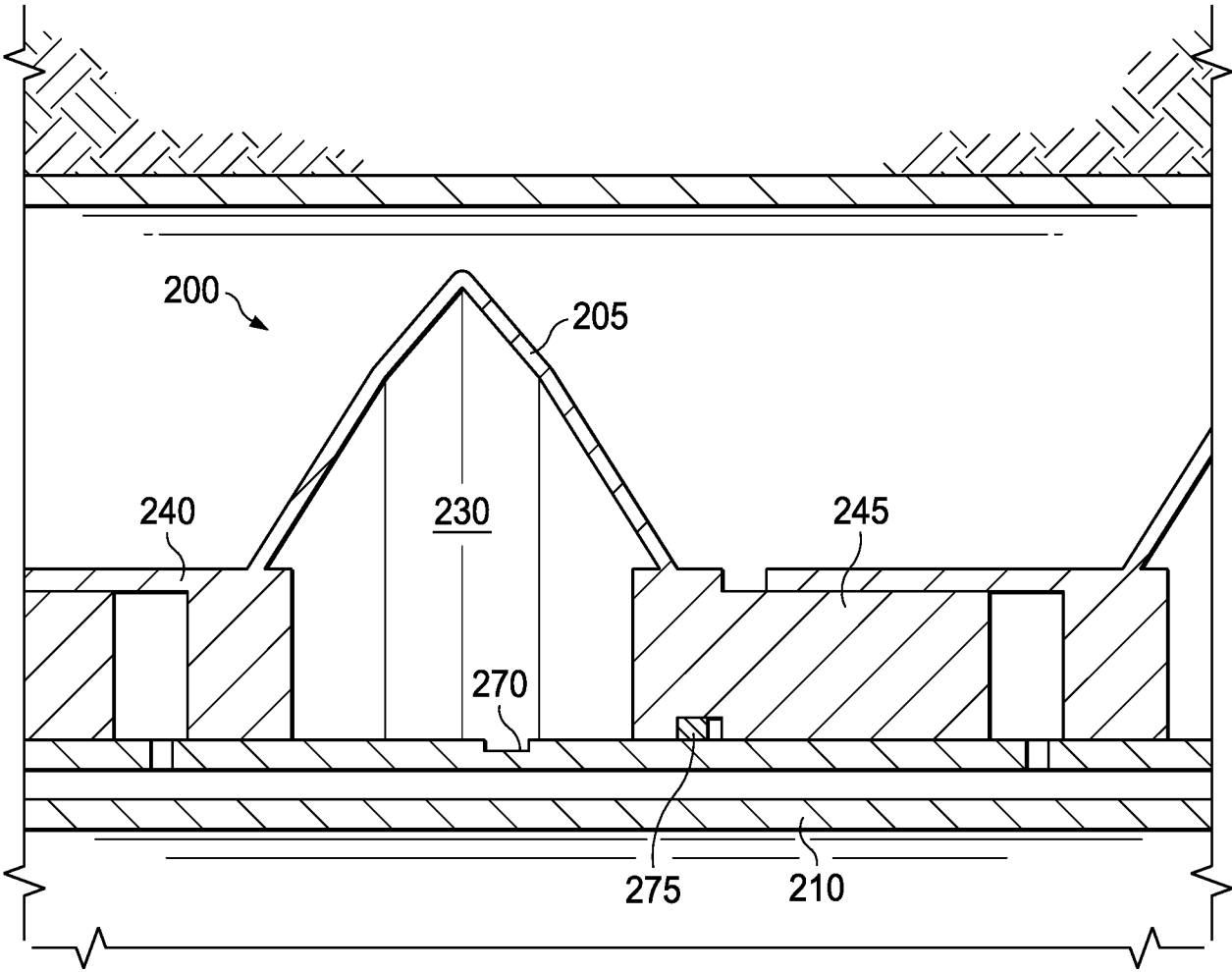


FIG. 10

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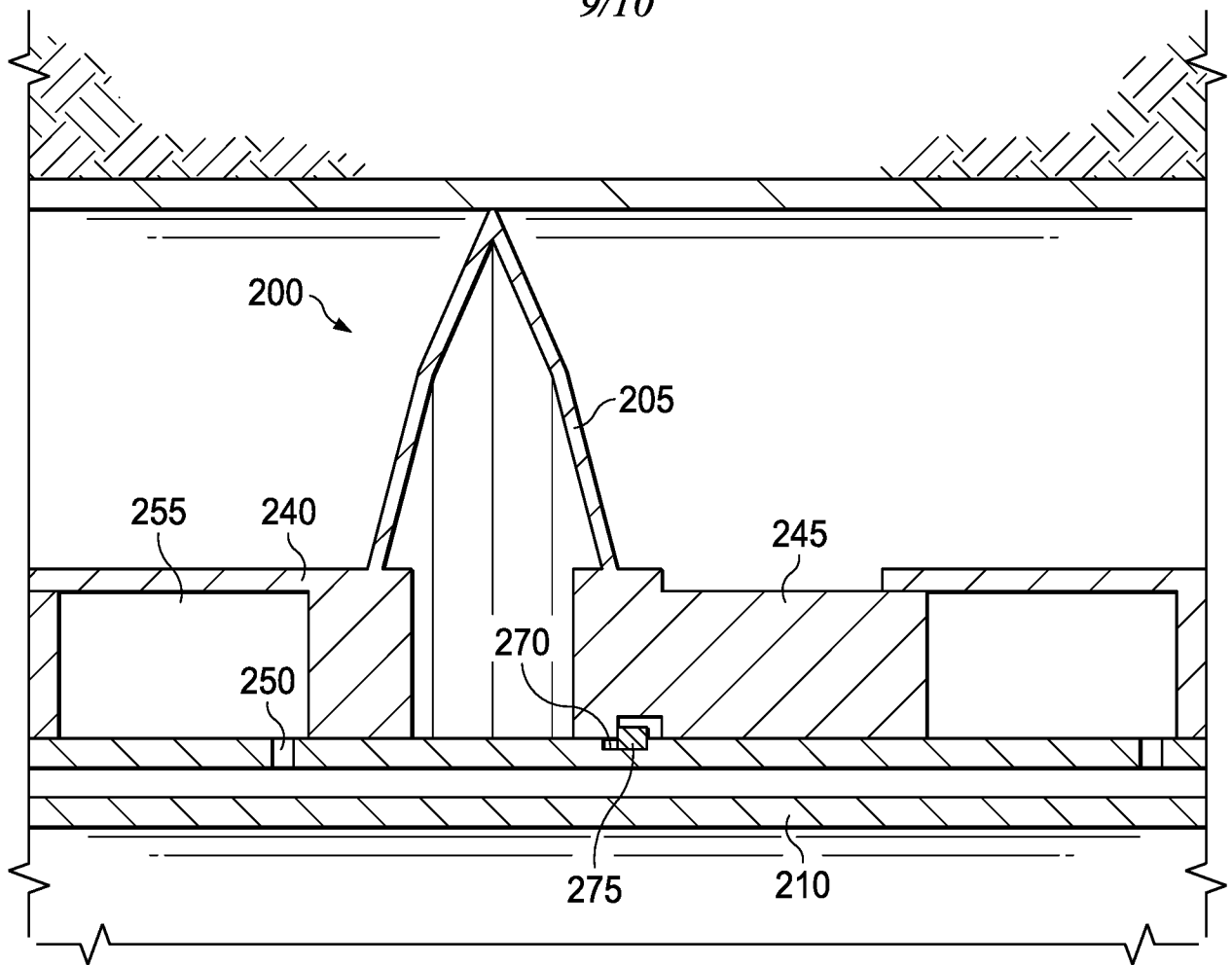


FIG. 11

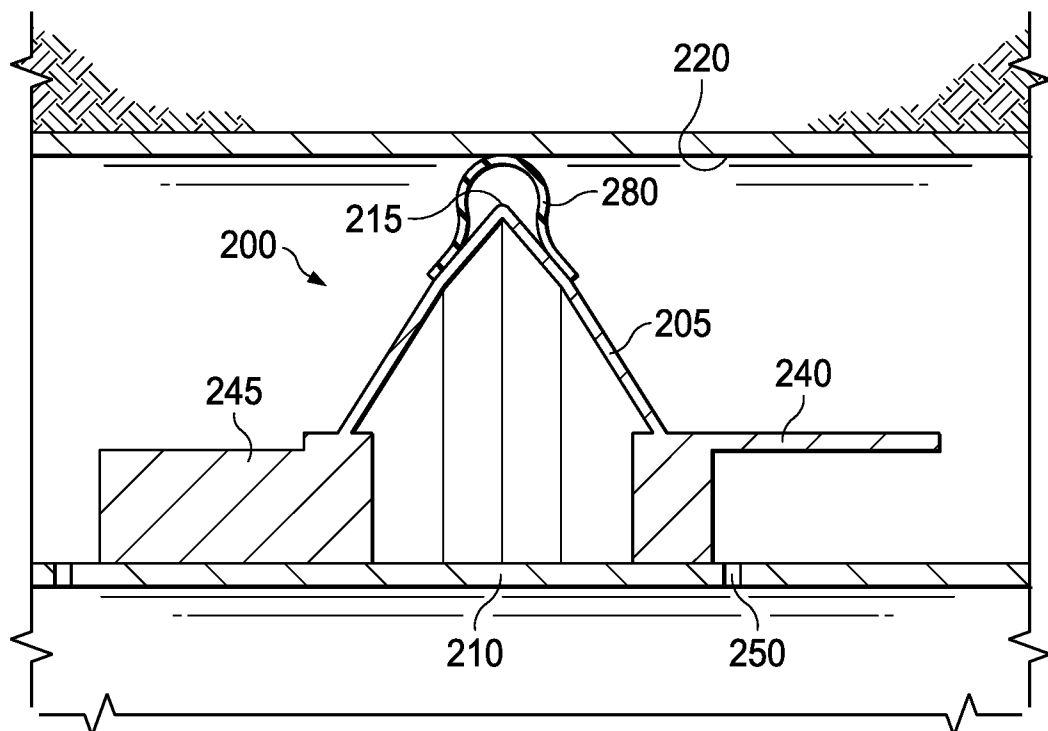


FIG. 12

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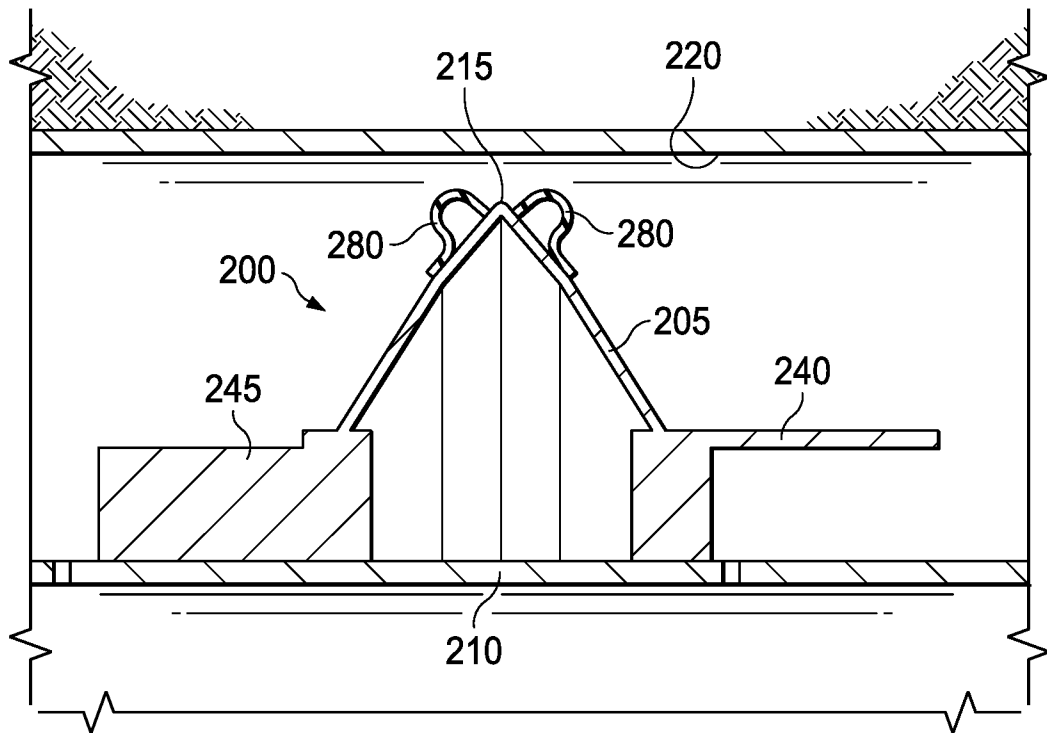


FIG. 13

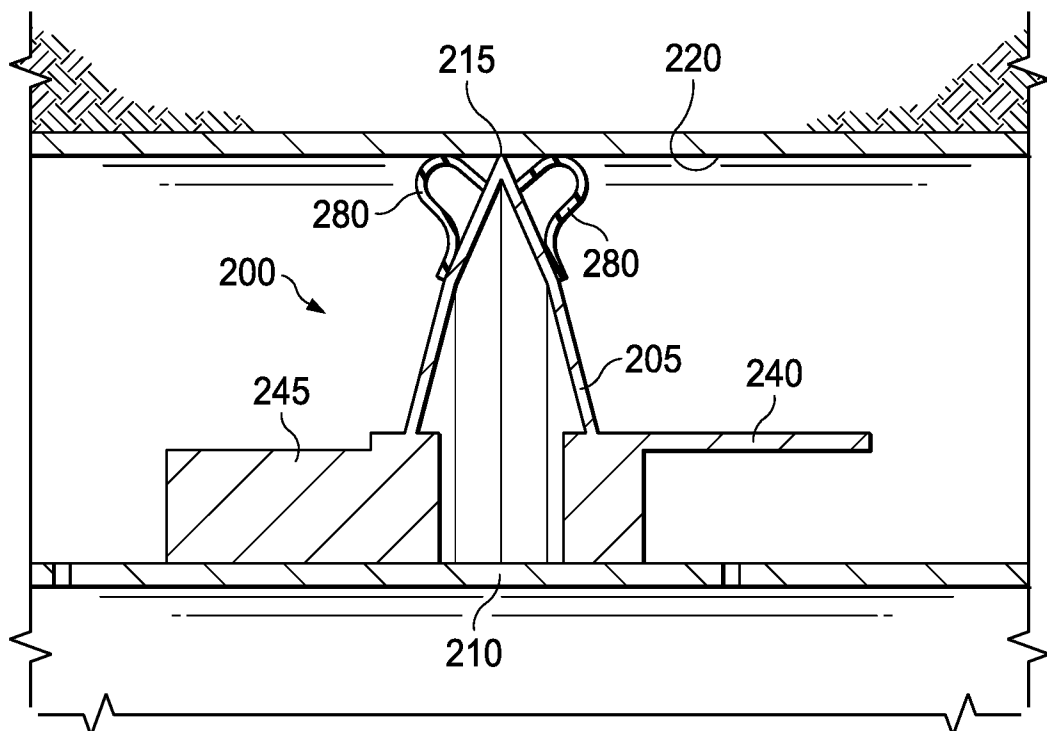


FIG. 14