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(54) Title: ANCHOR LATCH ON-OFF FOR SUCKER RODS

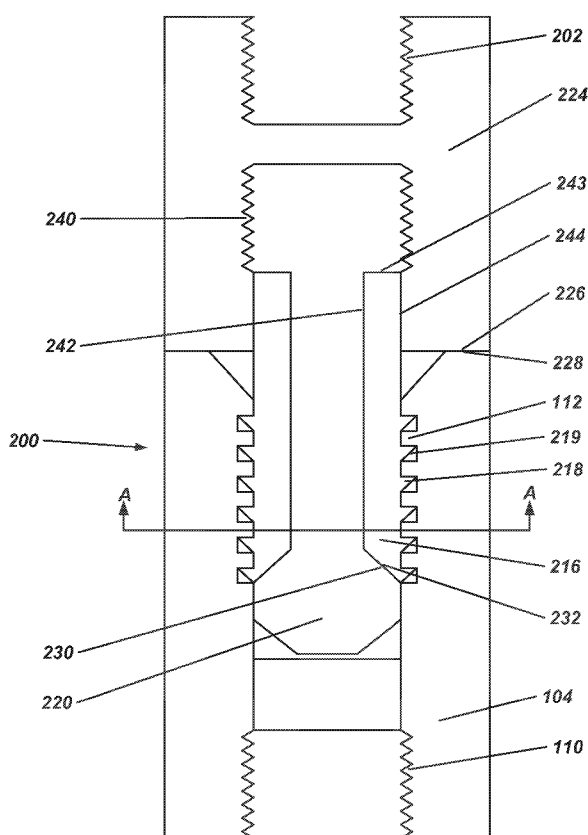


Figure 5

(57) Abstract: A device and method to allow a sucker rod to be disconnected at a particular point in a sucker rod string. Typically the disconnect device is located just above the barrel pump where the disconnect device is able to provide tensile and compressive strength similar to the sucker rod string thereby eliminating at least one failure mode for the sucker rod string.



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ANCHOR LATCH ON-OFF FOR SUCKER RODS

BACKGROUND

[0001] A conventional oil well includes a cased wellbore with at least one string of tubing extending downwardly through the casing into the oil or other petroleum fluid contained in the subsurface mineral formation to be produced. The casing is perforated at the level of the production zone to permit fluid flow from the formation into the casing and the lower end of the tubing string is generally open to provide entry for the fluid in the tubing.

[0002] In many instances, artificial lift may be required in order to raise the produced fluids to the surface. One type of artificial lift device commonly used is a barrel pump driven from the surface by a pumpjack connected to the barrel pump by a sucker rod string.

[0003] A barrel pump is a relatively simple device that has an outer tubular or barrel that is secured to the casing at a location where at least the inlet usually the lower end of the barrel will remain submerged in the produced fluids that flow from the formation, through the casing perforations, and into the casing. At the bottom of the barrel is a one way valve typically a ball in a cage where gravity will act to seat the ball and seal the barrel against fluid moving out of the inlet and the cage will trap the ball to prevent the ball from traveling too far from the seat when fluid moves into the barrel.

[0004] The barrel pump also has a plunger that is located inside of the barrel and has a plunger body sealed to the barrel's interior wall. A polished rod is attached to the plunger body and is of sufficient length so that the polished rod will extend through the upper end of the barrel even at the bottom of the plunger's stroke. The plunger also has a one way valve located at the lower end of plunger body. The one way valve in the plunger body is similar to the one way valve at the bottom of the barrel in

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that the plunger body valve is typically a ball in a cage where gravity will act to seat the ball and seal the plunger against fluid moving downward past the plunger and the cage will trap the ball to prevent the ball from traveling too far from the seat when fluid moves upwards past the plunger body.

[0005] In operation, the plunger moves downward in barrel. The downward motion is typically caused by removing the upward force applied by the pump jack via the sucker rods. The weight of the sucker rods in addition pushes the plunger body through the fluid in the barrel. As the plunger body moves through the fluid in the barrel, the one way valve in the bottom of the barrel seats and seals the barrel to prevent the fluid from moving out of the barrel while the one way valve in the plunger body moves off of its seat to allow fluid in the barrel to move past the plunger body as the plunger body moves toward the bottom of the barrel. Once the plunger body reaches the bottom of the barrel, upward force is again applied to the plunger body by the pump jack through the sucker rods.

[0006] As the plunger is forced upwards in the barrel, gravity as well as the fluid above the plunger body close the one way valve preventing the fluid from moving past the plunger body and back into the barrel. The plunger body, sucker rods, and the pump jack may then act together to move the fluid upwards through the production tubular. In many instances, the force acting on the plunger through the sucker rods may exceed 100,000 pounds. Additionally, as the plunger body moves upwards, the one way valve in the bottom of the barrel will open to allow fluid from the casing to enter into the barrel to replace the fluid that is above the plunger and moving upwards.

[0007] At some point, it may become necessary to remove the plunger or even the entire barrel pump assembly from the well. However, over the life of the barrel pump the barrel or other portions of the barrel pump assembly may become sanded in, corroded, or otherwise difficult to remove from the wellbore. Typically, the sucker rod assembly is not

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robust enough to transmit the necessary force without damaging the sucker rod string for later use. In many instances, it may be desirable remove only the sucker rod assembly simply to adjust and maintain the sucker rod assembly without removing either the plunger or the entire barrel pump assembly. Therefore, it may be desirable to install a disconnect device in the sucker rod string. The disconnect device must be able to disconnect the sucker rod string at the desired location but must also be able to be reconnected as desired by the operator. Usually, the disconnect device is installed in the sucker rod string as close to the polished rod as possible. Unfortunately, it has become apparent that the disconnect devices currently used in the industry may be the weakest part of the sucker rod string thereby becoming the point in the sucker rod string that is the most likely to fail. Testing has indicated that the currently used disconnect becomes weaker over time due to the loading and unloading of the disconnect of loads that may be in excess of 100,000 pounds several time each minute for months or even years.

[0008] There exists, therefore, a significant need for an improved sucker rod disconnect that allows the sucker rod assembly to be disconnected at a particular point but may then be reconnected without the disconnect becoming the weakest point in the sucker rod assembly, and thereby becoming the most likely failure point in the sucker rod string. The present invention fulfills these needs and provides further related advantages.

SUMMARY

[0009] The present invention is a disconnect that may be disconnected from a sucker rod string by rotating the sucker rod string in a direction that is opposite of the direction that the threads connecting the sucker rods are cut. Typically, sucker rods are cut with threads that tighten when rotated to the right and loosen when rotated to the left.

[0010] An embodiment for disconnecting a sucker rod may include an upper section or connection member. The upper section has an upper

end and a lower end. The upper end has a first threaded section, and the lower end has a second threaded section threaded in the opposite direction of the first threaded section. A lower section or connection member has an upper end and a lower end. The lower end has a third threaded section, and the upper end has a fourth threaded section threaded in the opposite direction of the third threaded section. The second threaded section and the fourth threaded section cooperate to join the upper section and the lower section.

[0011] The apparatus for disconnecting the sucker rod may include a second threaded section that has left handed threads and a fourth threaded section with left handed threads. The first threaded section may be a box connector, and the third threaded section may be a box connector. The upper section may be a rod connector, and the lower section may be a rod connector. The upper section may be a tube, and the lower section may be a tube. The upper section and the lower section may each be a rod or a tube.

[0012] Another embodiment for reconnecting a sucker rod may have a lower section or connection member with an interior, an upper end, and a lower end. The interior of the lower end has a first threaded section, and the interior of the upper end has a second threaded section that is threaded in the opposite direction of the first threaded section. An upper section or connection member with an interior, an upper end, and a lower end. The interior of the upper end has a third threaded section. A reinforcing member with an exterior, an upper end, and a lower end, and a recess. The exterior of the upper end of the reinforcing member is attached to the interior of the lower end of the upper section, and the exterior of the lower end of the reinforcing member has a bias device. The recess may be located between the lower end of the upper section and the bias device. At least one retaining collet has an interior, an exterior, an upper end, and a lower end. The exterior lower end has a fourth threaded section that cooperates with the threads of the second threaded section.

The interior of the lower end has a shoulder that cooperates with the bias device. The retaining collet is located in the recess such that the bias device provides force in the radial outward direction against the shoulder.

[0013] The apparatus for reconnecting a sucker rod may include a bias device that may be a ramp. The second threaded section may have left hand threads. The second threaded section may have right hand threads. The second threaded section may have threads that have a lower surface that extends from the radially inward lower end of each thread radially outward to radially outwards upper end of each thread.

[0014] Another embodiment of the invention may include a method of reconnecting a sucker rod string comprising attaching a disconnect assembly to a sucker rod string, rotating the sucker rod string in a first direction, removing the upper portion of the disconnect assembly from the wellbore, attaching a reconnect assembly to the sucker rod string, running the reconnect assembly into a wellbore, stabbing the reconnect assembly into a lower end of the disconnect assembly, and locking the reconnect assembly to the lower end of the disconnect assembly.

[0015] The method of reconnecting a sucker rod may include rotating the sucker rod string in a first direction that is to the left. In some cases, the method of reconnecting a sucker rod may include rotating the sucker rod string in a first direction that is to the right. The reconnect assembly may have an external threaded surface where the threads have a lower surface that extends radially outward from a radially inward lower end of each thread to a radially outward upper end of each thread. The reconnect assembly may be locked to the lower end of the disconnect by a bias device and a retaining collet shoulder.

[0016] As used herein the terms "tightening" means in a right hand (clockwise) direction as the nut progresses onto a bolt or threaded section and "reverse" means in a left hand (counterclockwise) direction, typically as a nut is removed from a bolt or threaded section. Lower or downward

means towards the bottom of the while upper or upwards means towards the surface.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] Figure 1 depicts a wellbore with a barrel pump, a sucker rod string, a disconnect, and a surface drive.

[0018] Figure 2 depicts a detailed view of the lower end of the wellbore, barrel pump, disconnect, and sucker rod string of Figure 1.

[0019] Figure 3 depicts a prior art sucker rod disconnect.

[0020] Figure 4 depicts an embodiment of a sucker rod disconnect.

[0021] Figure 5 depicts an embodiment of a sucker rod reconnect.

[0022] Figure 6 depicts a cross-section of the sucker reconnect of Figure 5.

DETAILED DESCRIPTION OF EMBODIMENT(S)

[0023] The description that follows includes exemplary apparatus, methods, techniques, and instruction sequences that embody techniques of the inventive subject matter. However, it is understood that the described embodiments may be practiced without these specific details.

[0024] Figure 1 depicts a wellbore 10 with cement in the annular area 14 between the casing 12 and the wellbore 10 to secure the casing 12 in place. The casing 12 has perforations 28 to allow fluid from the formation 30 flow into the interior of the casing 12. On the surface 16, a reciprocating pumpjack 18 is connected to the sucker rod string 20. The sucker rod string 20 is attached to disconnect 22 that is, in turn, connected to polished rod 24. Polished rod 24 is attached to the plunger body 26. A barrel pump 32 is placed in the casing 12 and secured by anchors 38 so that the barrel 34 inlet 36 is immersed in the formation fluid.

[0025] As the pumpjack 18 pulls the plunger body 26 upward in the barrel 34, the one way valve 42 seals the plunger body 26 so that fluid may not move through the plunger body 26 as the plunger body 26 is moved

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upwards. This causes the fluid to move out of the barrel 34 via the barrel exit ports 46, thereby lifting the entire column of fluid towards the surface via production tubing 44. Additionally, as the plunger body 26 moves upwards in the barrel 34, the one way valve 40 at the inlet 36 to the barrel 34 opens to allow fluid to move into the barrel 34 and replace the fluid that is moving towards the surface 16 above the plunger body 26.

[0026] Once the pumpjack 18 reaches the top of its stroke, the pumpjack 18 reverses the force exerted on the sucker rod string 20, allowing the sucker rod string 20 to move downwards and ultimately allowing the plunger body 26 to move downwards. As the plunger body 26 moves downwards, the one way valve 40 at the bottom of barrel 34 closes to prevent the fluid in the barrel 34 from flowing back into the casing 12. At the same time, the one way valve 42 opens to allow the fluid in the barrel 34 to flow past the plunger body 26.

[0027] Figure 2 depicts a close up view of the lower well 10, lower casing 12, production tubing 44, formation 30, barrel pump 32, disconnect 22, and lower sucker rod 20.

[0028] Figure 3 depicts a prior art sucker rod disconnect 50. The sucker rod disconnect 50 has a body 52. At the upper end of the body 52 is a pin connector 54 that may thread into the sucker rod string. Within the housing body 52 is a spring 56 and a spring guide 58. The sucker rod disconnect 50 also has a key 60. At the lower end of the key 60 is a box connector 62 that may be threaded onto either the sucker rod string or the polished rod. The key 60 is depicted in the locked position such that the housing shoulder 64 cooperates with the key shoulder 66 to transmit the tensile forces exerted by the pump jack on the up stroke that would otherwise pull the key 60 from the housing 52. Key shoulder 68 cooperates with housing shoulder 70 to transmit to the polished rod and ultimately the plunger body, any compressive forces that be exerted through the disconnect 50.

[0029] The key 60 is typically inserted into the key slot 72 where the key 60 acts upon the spring guide 58 to compress the spring 56. The key 60 is then rotated, typically about 90 degrees, to place the key 60 in the locked position. The spring guide 58 and the spring 56 then act upon the key 60 to prevent the key from returning to the unlocked position until the operator desires to disconnect the sucker rod string at the location of the disconnect. The key 60 allows the operator to disconnect the sucker rod string or to reconnect the sucker rod string, as desired.

[0030] Figure 4 depicts an embodiment of the present invention. Figure 4 depicts a sucker rod connector 100 with an upper portion or connection member 102 and a lower portion or connection member 104. The upper portion 102 has threads 106 on its top end to accept a sucker rod pin connector. The upper portion 102 has on its lower end a threaded section 108 where the threads are cut to tighten in the direction opposite that of the threaded section 106. For example, typically the threaded section 106 may have threads cut to tighten when rotated in the right hand direction usually referred to as right hand threads. In the case where the threaded section 106 is cut with right hand threads then the threaded section 108 would be cut with threads that tighten when rotated in the left hand direction usually referred to as left hand threads.

[0031] The lower portion 104 has threads 110 on its lower end to accept a sucker rod pin connector. The lower portion 104 has on its upper end a threaded section 112 where the threads are cut to tighten in the direction opposite that of the threaded section 110. The threaded sections 108 and 112 cooperate so that the upper portion 102 and the lower portion 104 may be coupled together. The upper portion 102 and the lower portion 104 are coupled together and then sufficient torque is applied such that the upper portion 102 and the lower portion 104 will not become uncoupled until the operator desires to disconnect the sucker rod string. In some instances, it may be desirable to add a shear device 114 such as a

shear pin or a shear screw to prevent rotation of the disconnect 100 until the operator desires to disconnect the sucker rod string.

[0032] Figure 5 depicts an embodiment of the present invention that allows the operator to reconnect the sucker rod string to the lower portion 104 after the upper portion 102 and the lower portion 104 have been disconnected in the casing.

[0033] Figure 5 depicts the lower portion 104 of the disconnect 100 after the upper portion 102 of the disconnect 110 has been removed. The lower portion 104 has threads 110 on its lower end to accept a sucker rod pin connector. The lower portion 104 has on its upper end a threaded section 112 where the threads are cut to tighten in the direction opposite that of the threaded section 110.

[0034] The reconnect tool 200 has threads 202 on its top end to accept a sucker rod pin connector. A collet 216 is at least partially circumferential about the reconnect tool 200. The exterior face of the collet 216 has a threaded section 218 that is cut to tighten in the direction opposite that of the threaded section 110, but will cooperate with the threads 112 to tighten when rotated in the appropriate direction. Typically, the threaded section 118 may be modified so that an angled surface 219 on the lower portion of each thread is presented to the threaded section 112 as the reconnect tool 200 is lowered into place. The angled surface 219 is a lower surface of the threads 218 that extend from the radially inward lower end of each thread radially outward to radially outwards upper end of each thread. Typically, the modified threaded section 219 is referred to as a modified, left hand, square thread for an anchor latch. The angled section 219 of each thread of the threaded section 218 allows the reconnect tool 200 to be stabbed in to place with regard to the lower portion 104 but with a square thread on the upper side of each thread the reconnect tool may not be simply pulled straight out.

[0035] Typically, the collet 216 of the reconnect tool 200 is located in a recess created by upper surface 243 and sidewall 244 of the top

subassembly 224 and sidewall 242 of the reinforcing member 220. Typically, the collet 216 is held in place or locked by bearing surface 230 of reinforcing member 220 that is biased to exert pressure against the bearing surface 232 of the collet 216. The collet 216 is not held rigidly in the recess until it is locked in place by the bearing surface 232 to allow the collet 216 to move slightly as it stabs into the lower portion 104.

[0036] In order to prevent movement between the lower portion 104 and the top subassembly 224, the operator may rotate the sucker rod string some amount to tighten the cooperating threads 112 and 218. To allow the threads 112 and 218 to transmit any tension through the top subassembly 224 to the lower portion 104 the reinforcing member 220 has bearing surface 230 that acts against the bearing surface 232, thereby transmitting the tensile force to the collet 216 and through the threads 218 and 112 to the lower portion 104.

[0037] Collet 216 is retained by reinforcing member 220 in order to prevent the collet 216 from moving inward toward the center of the reconnect tool 200 when tensile force is exerted through the sucker rod string by the pumpjack. The reinforcing member 220 is attached to the top subassembly 224 by threads, although any means of attaching the reinforcing member 220 to the top subassembly 224 could be used, such as welding, pins, or constructing the reinforcing member 220 as a part of the top subassembly 224. Additionally, the top subassembly 224 has a shoulder 226 through which it may exert a downward or compressive force against the bearing surface 228 of the lower portion 104.

[0038] Figure 6 shows a top down view of the reconnect tool 200 and the lower portion 104 at cross-section A-A in Figure 5. The reinforcing member 220 and collet 216 are surrounded by the lower portion 104 and interface through the threads 112, of the lower portion 104, and the threads 218 of the collet 216. The collet 216 may be divided into sections such as 216A, 216B, 216C, and 216D but it may have pockets or recesses. To transmit any rotational forces to the collet 216 the reinforcing

section 220 may have protrusions 250 such as 250A, 250B, 250C, and 250D that extend into the pockets or recesses of the collet 216 or between the collet sections 216A, 216B, 216C, and 216D. The protrusions such as 250A, 250B, 250C, and 250D may then act on the collet sections 216A, 216B, 216C, and 216D when any rotational force is applied to the sucker rod string. While four sets of protrusions and collet sections are shown, it should be understood that any number may be used to transmit the torque.

[0039] While the embodiments are described with reference to various implementations and exploitations, it will be understood that these embodiments are illustrative and that the scope of the inventive subject matter is not limited to them. 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. In general, structures and functionality presented as separate components in the exemplary 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 inventive subject matter.

WHAT IS CLAIMED IS:

1. An apparatus for disconnecting a sucker rod string in a wellbore, comprising:
 - a first connection member having a first upper end and a first lower end, the first upper end having a first threaded section coupled to an upper portion of the sucker rod string, the first lower end having a second threaded section threaded in an opposite direction of the first threaded section; and
 - a second connection member having a second upper end and a second lower end, the second lower end having a third threaded section coupled downhole, the second upper end having a fourth threaded section threaded in an opposite direction of the third threaded section,wherein the second threaded section and the fourth threaded section cooperate to join the upper section and the lower section.
2. The apparatus of claim 1, wherein the second threaded section has left handed threads, and wherein the fourth threaded section has left handed threads.
3. The apparatus of claim 1, wherein the first threaded section is a box connector, and wherein the third threaded section is a box connector.
4. The apparatus of claim 1, wherein the first connection member is a rod connector, and wherein the second connection member is a rod connector.
5. The apparatus of claim 1, wherein the first connection member is a tube, and wherein the second connection member is a tube.

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6. An apparatus for reconnecting a sucker rod string in a wellbore, comprising:
- a first connection member having a first interior, a first upper end, and a first lower end, the first interior at the first lower end having a first threaded section coupled downhole, the first interior at the first upper end having a second threaded section that is threaded in an opposite direction of the first threaded section;
 - a second connection member having a second interior, a second upper end, and a second lower end, the second interior at the second upper end having a third threaded section coupled to portion of the sucker rod string;
 - a reinforcing member having a first exterior, a third upper end, a third lower end, and a recess, the first exterior of the third upper end being attached to the second interior at the second lower end of the first connection member, the first exterior of the third lower end having a bias device, the recess being located between the second lower end of the first connection member and the bias device;
 - at least one retaining collet having a third interior, a second exterior, a fourth upper end, and a fourth lower end, the second exterior at the fourth lower end having a fourth threaded section that cooperates with the second threaded section, the third interior at the fourth lower end having a shoulder that cooperates with the bias device, the at least one retaining collet being located in the recess such that the bias device provides a force in a radially outward direction against the shoulder.
7. The apparatus of claim 6, wherein the bias device is a ramp.

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8. The apparatus of claim 6, wherein the second threaded section has left handed threads.

9. The apparatus of claim 6, wherein the second threaded section has right handed threads.

10. The apparatus of claim 6, wherein the second threaded section has threads that have a lower surface that extends radially outward from a radially inward lower end of each thread to a radially outward upper end of the each thread.

11. A method of reconnecting a sucker rod string in a wellbore, comprising:

- rotating the sucker rod string in a first direction in the wellbore;
- removing a first connection member of a disconnect assembly attached to portion of the sucker rod string from the wellbore;
- attaching a reconnect assembly to portion of the sucker rod string;
- running the reconnect assembly into the wellbore;
- stabbing the reconnect assembly into a second connection member of the disconnect assembly remaining in the wellbore; and
- locking the reconnect assembly to the second connection member of the disconnect assembly.

12. The method of claim 11, wherein rotating the sucker rod string in the first direction comprises rotating the sucker rod string counterclockwise.

13. The method of claim 11, wherein rotating the sucker rod string in the first direction comprises rotating the sucker rod string clockwise.

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14. The method of claim 11, wherein the reconnect assembly has an external threaded surface.

15. The method of claim 14, wherein the external threaded surface has threads that have a lower surface that extends radially outward from a radially inward lower end of each thread to a radially outward upper end of the each thread.

16. The method of claim 11, wherein the reconnect assembly is locked to the lower second of the disconnect assembly by a bias device and a retaining collet shoulder.

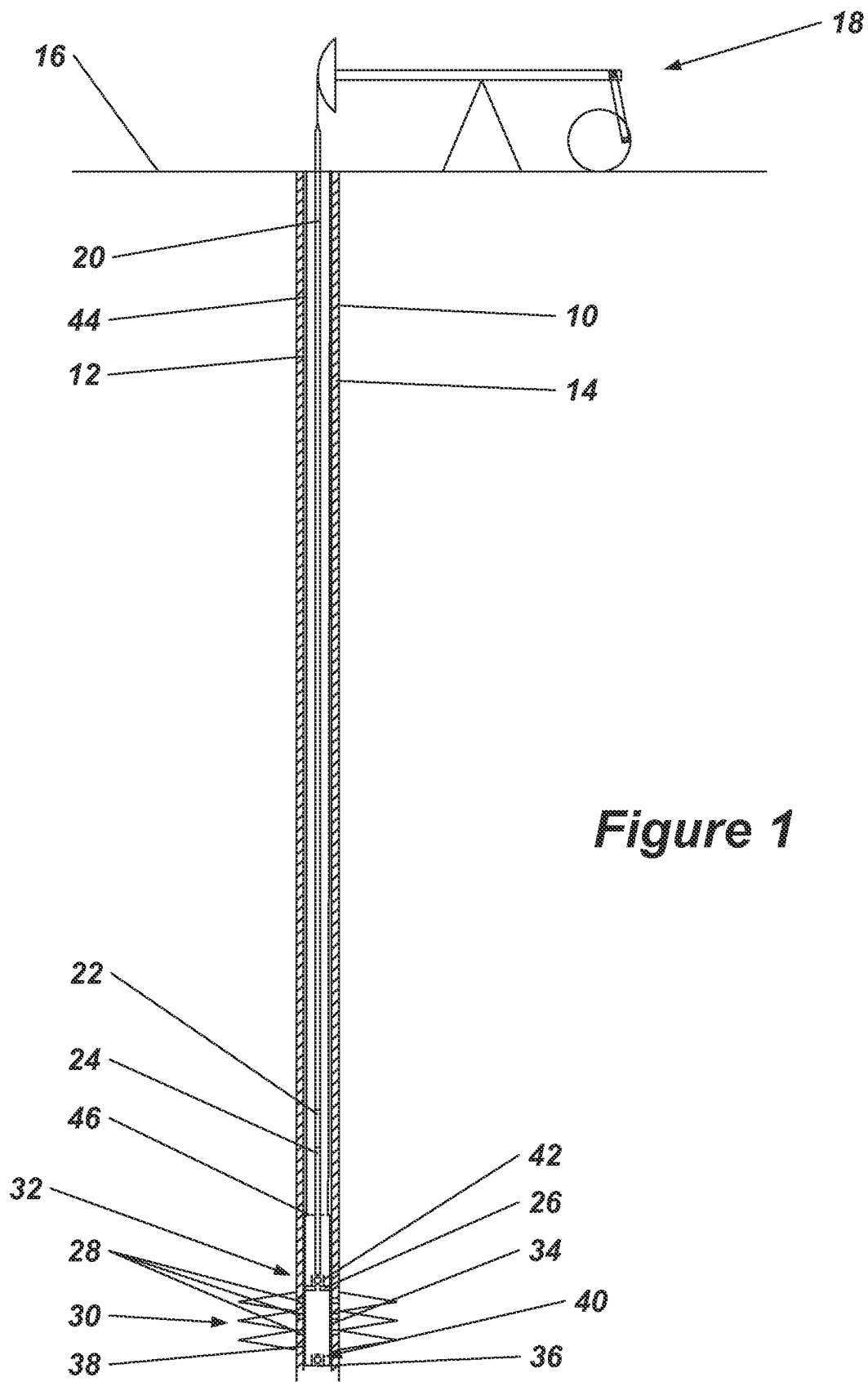


Figure 1

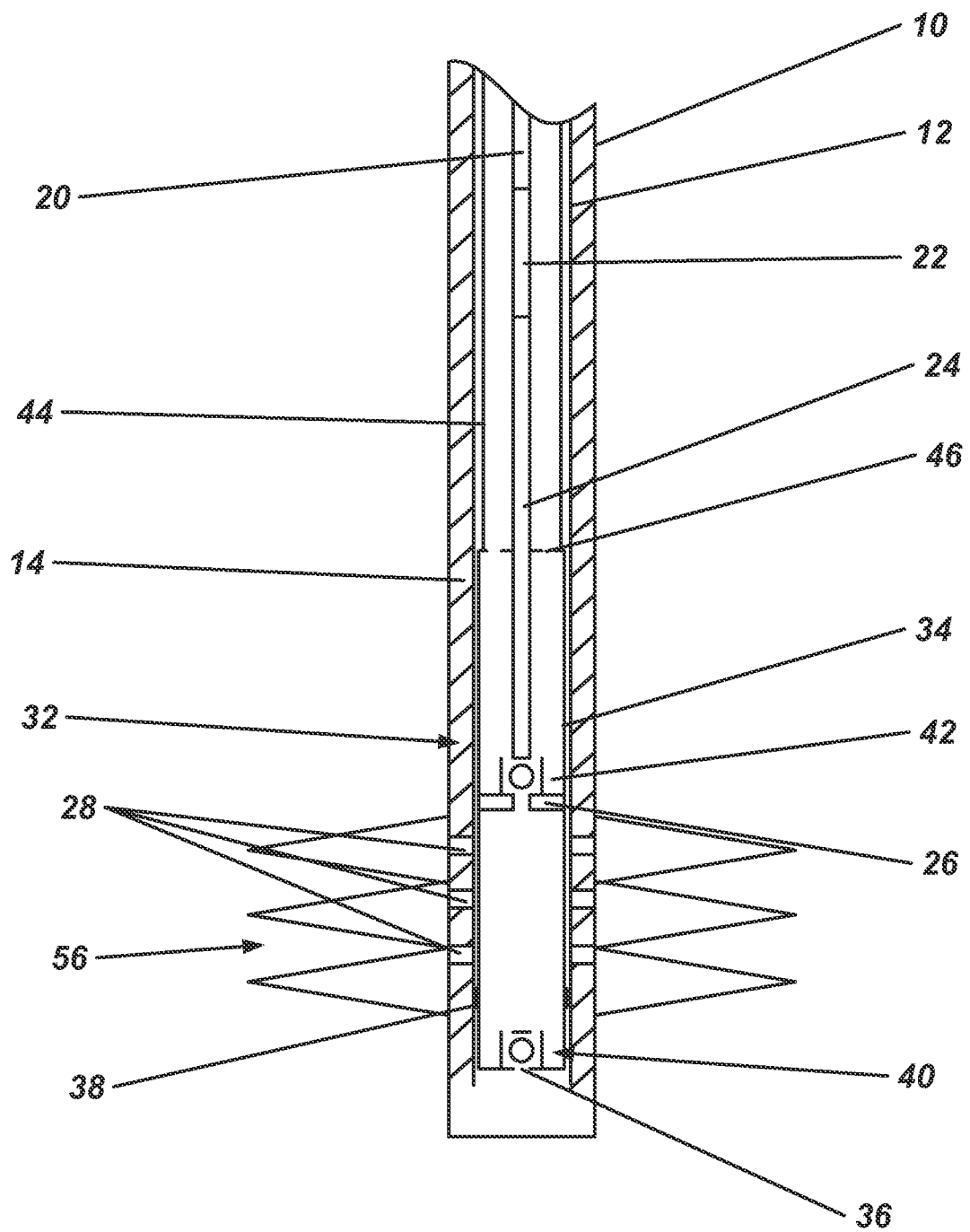


Figure 2

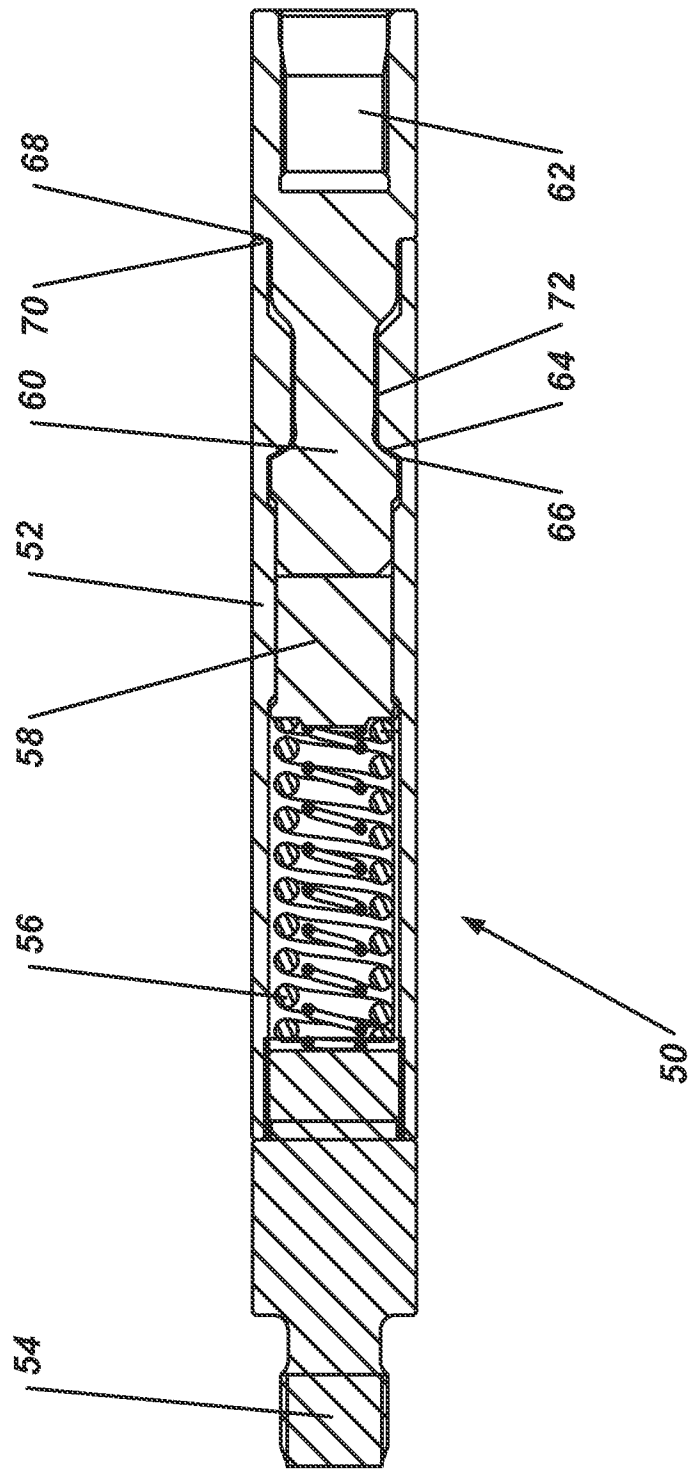


Figure 3
(Prior Art)

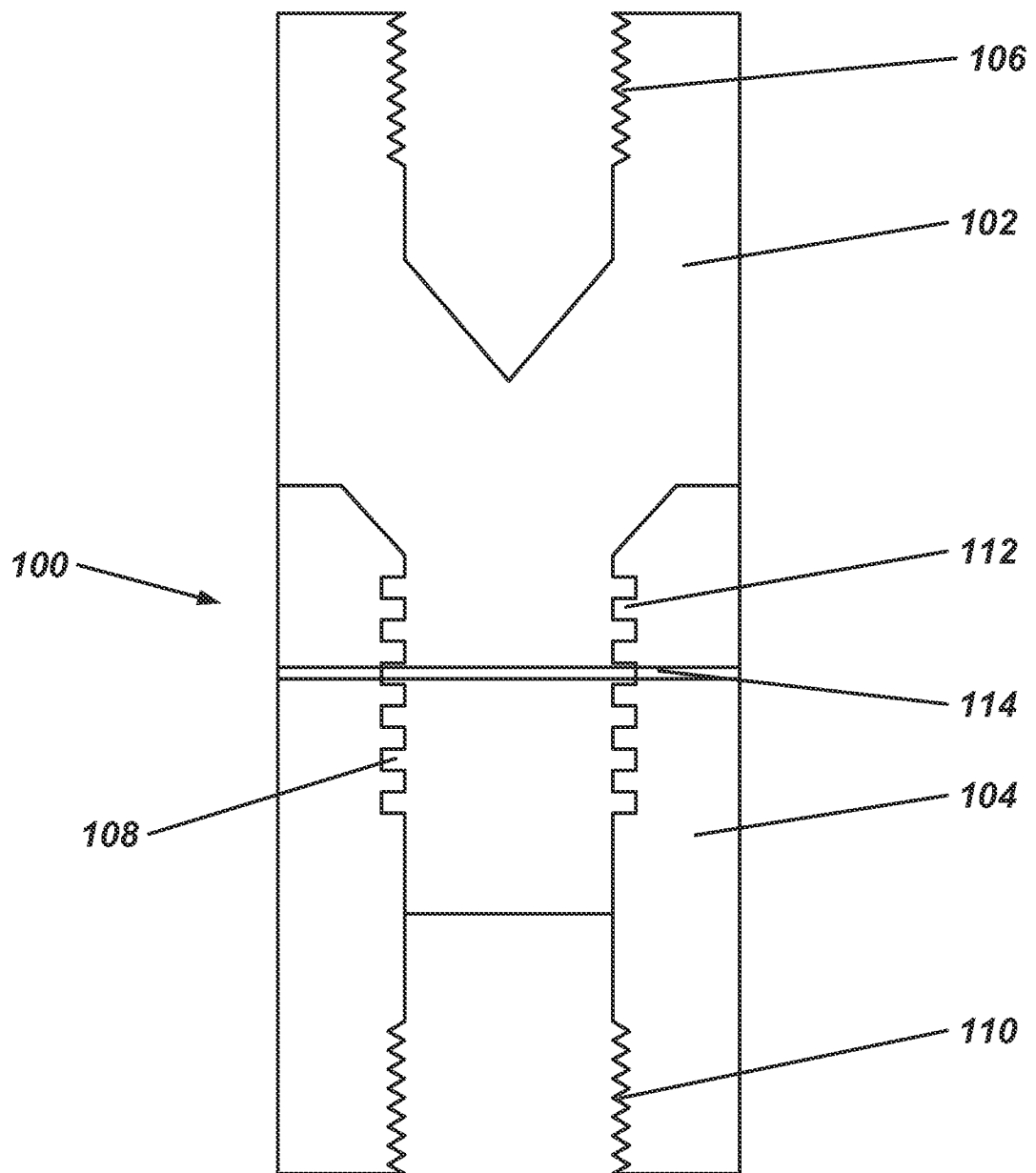


Figure 4

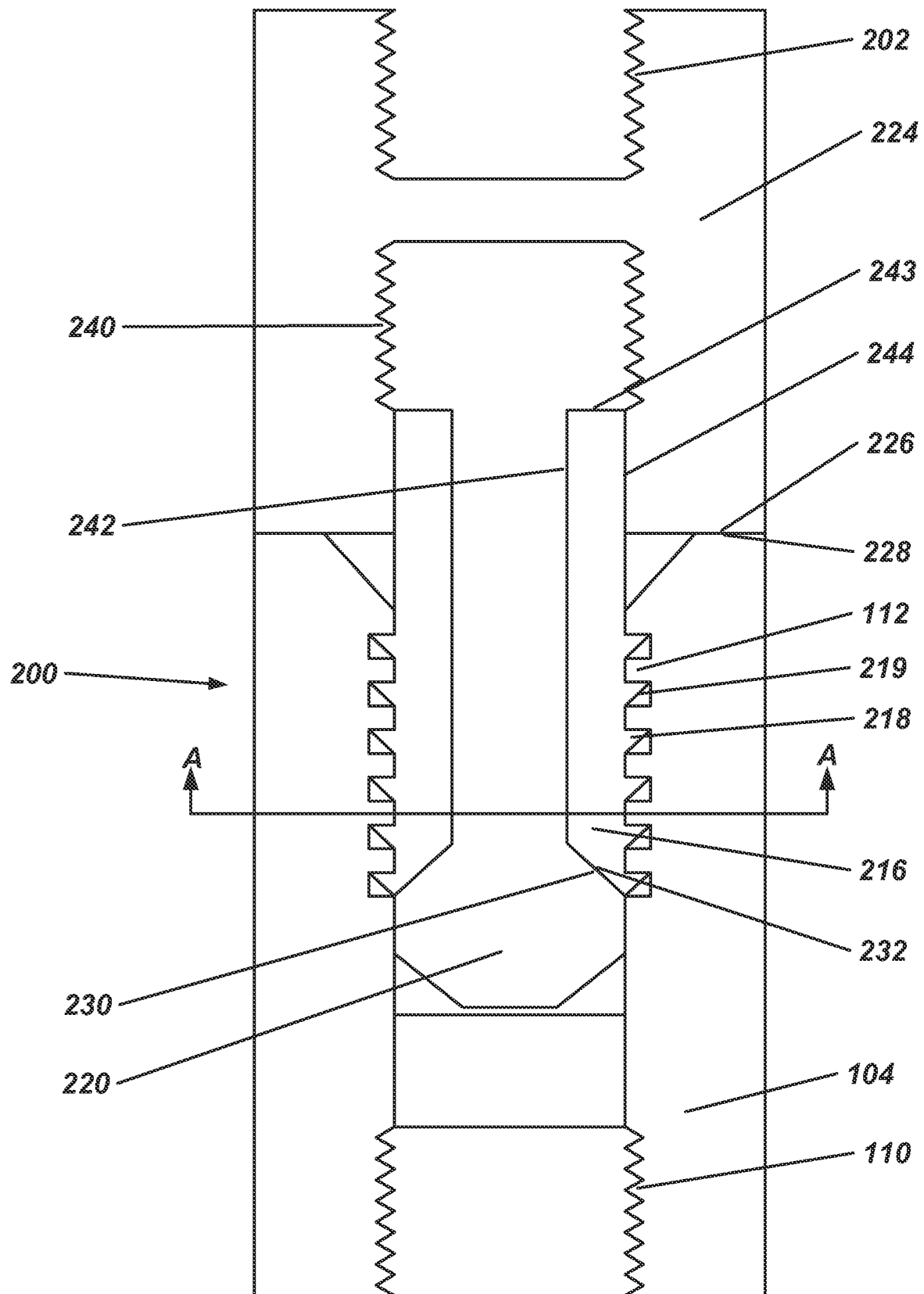
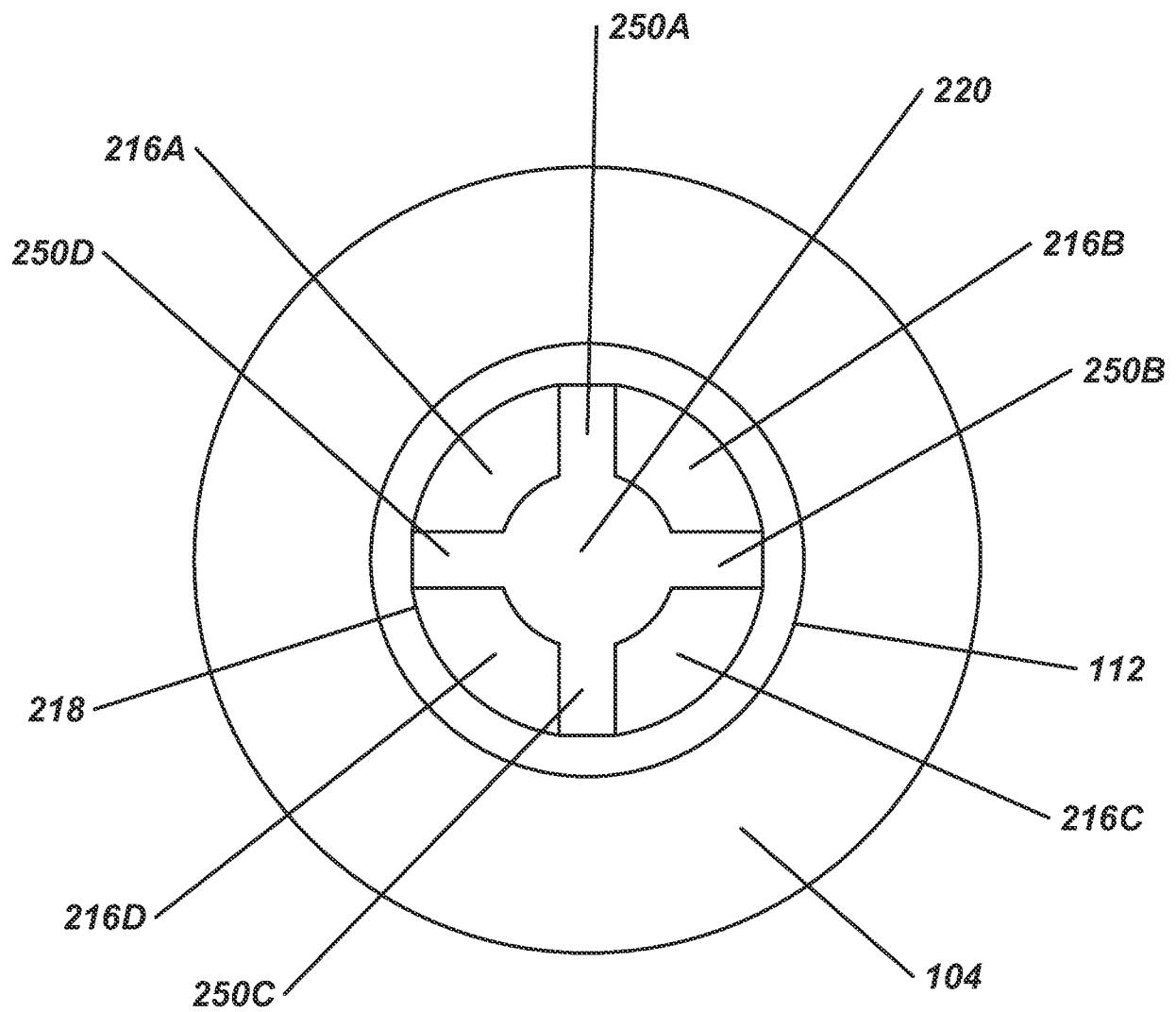


Figure 5



Section A - A

Figure 6