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(54) **ANCHOR LATCH ON OFF FOR SUCKER RODS**

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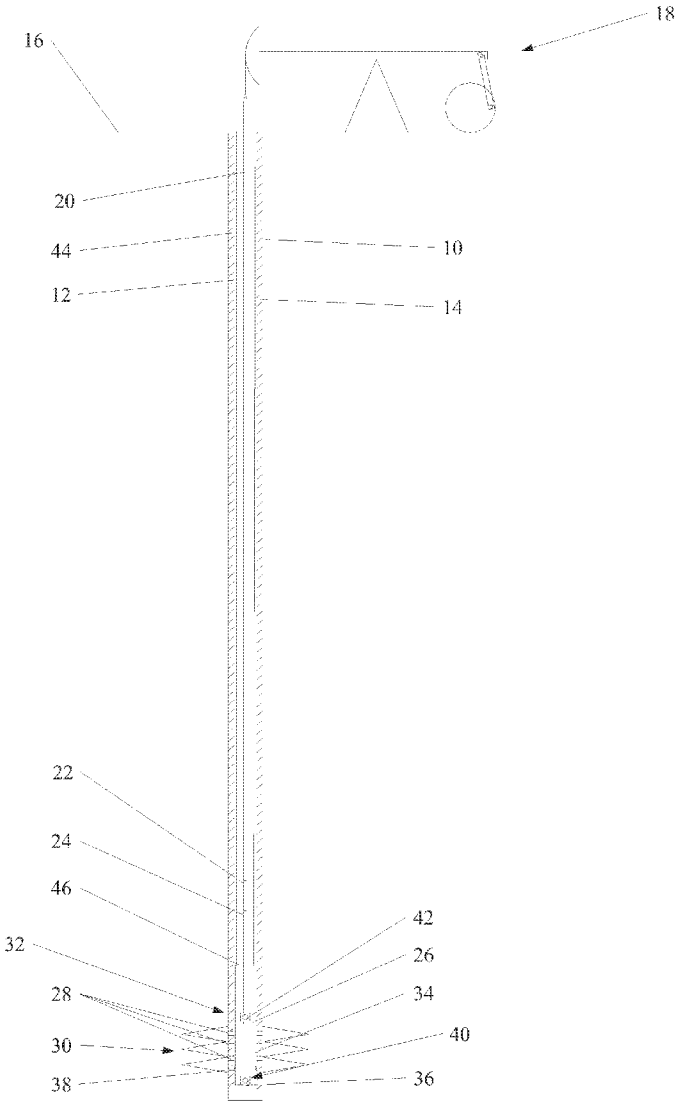
(57) **ABSTRACT**

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.



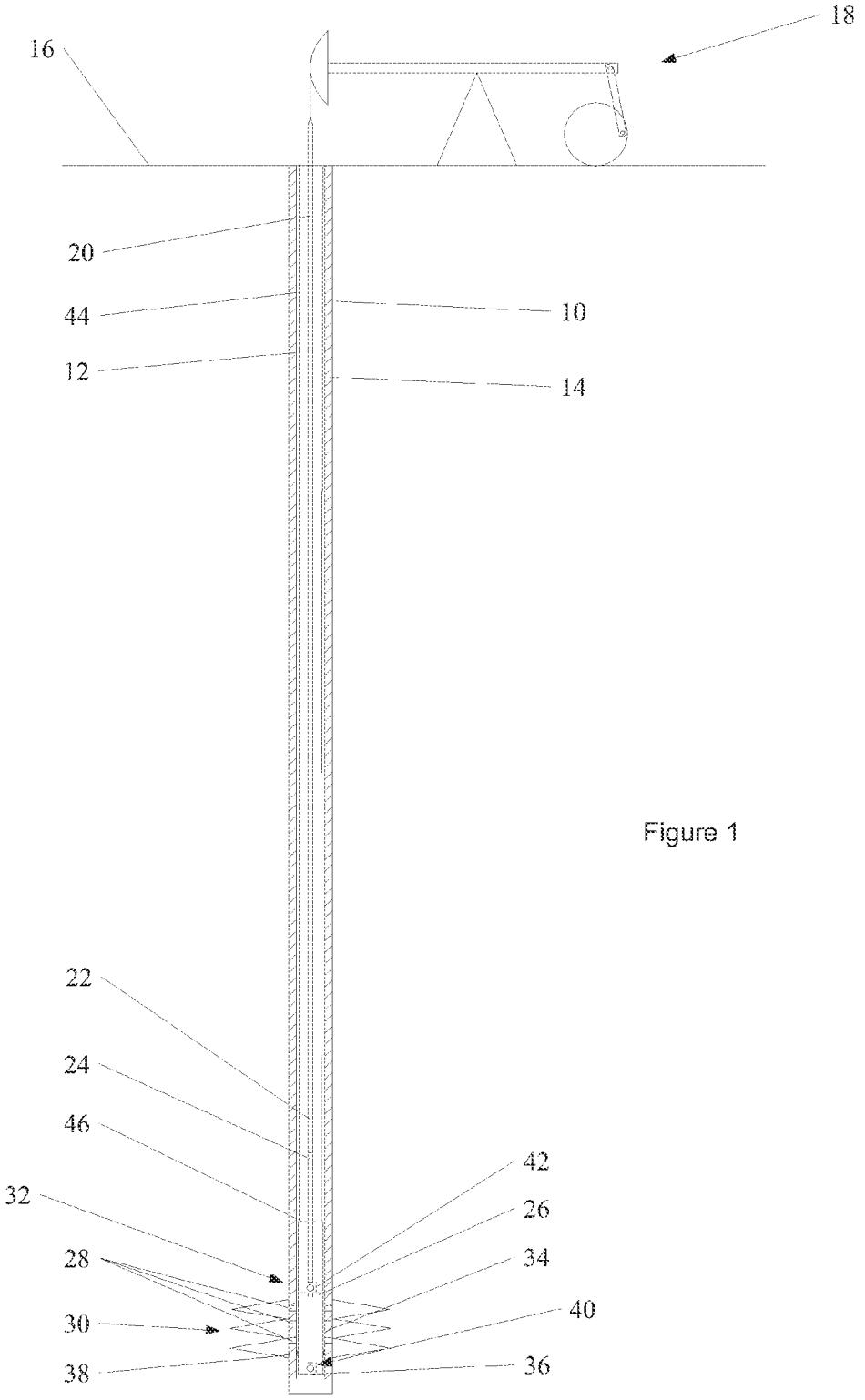


Figure 1

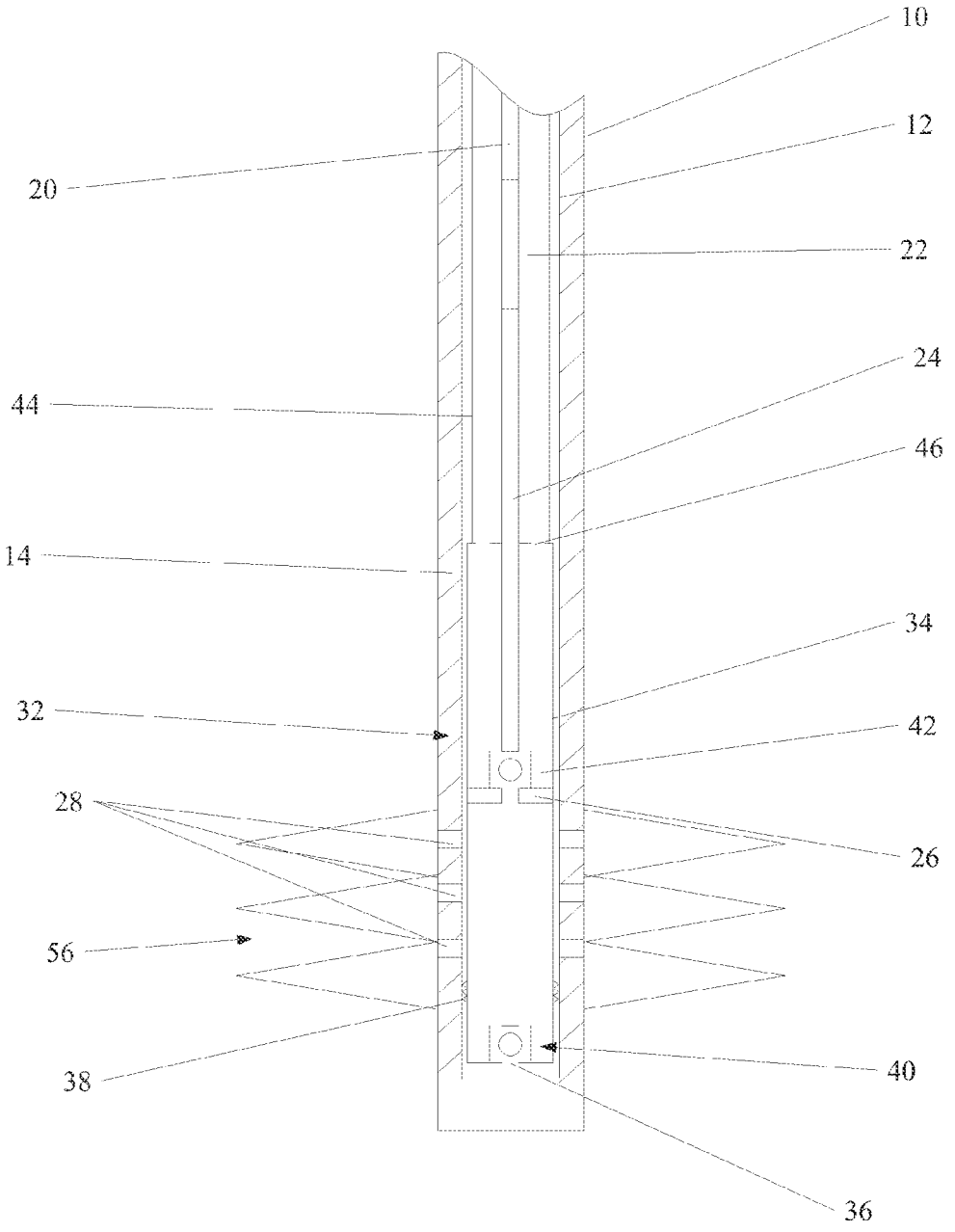


Figure 2

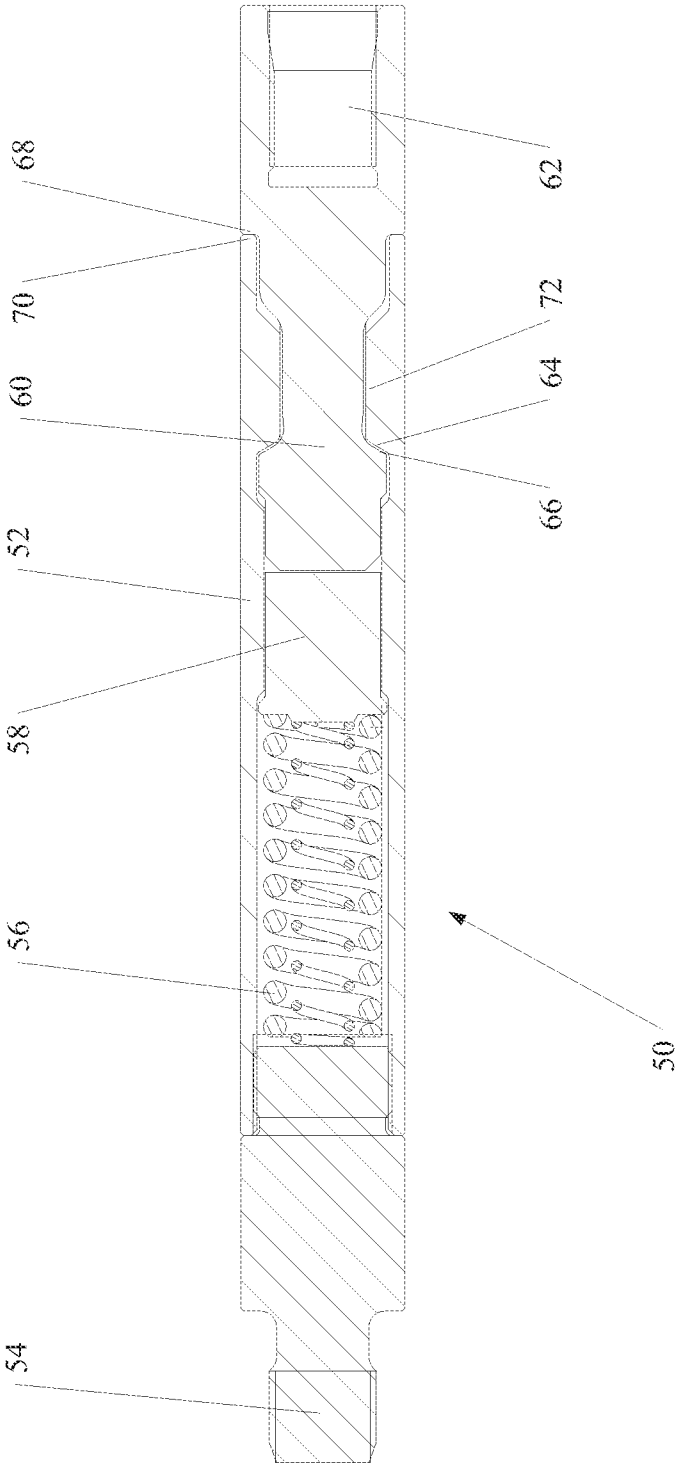


Figure 3

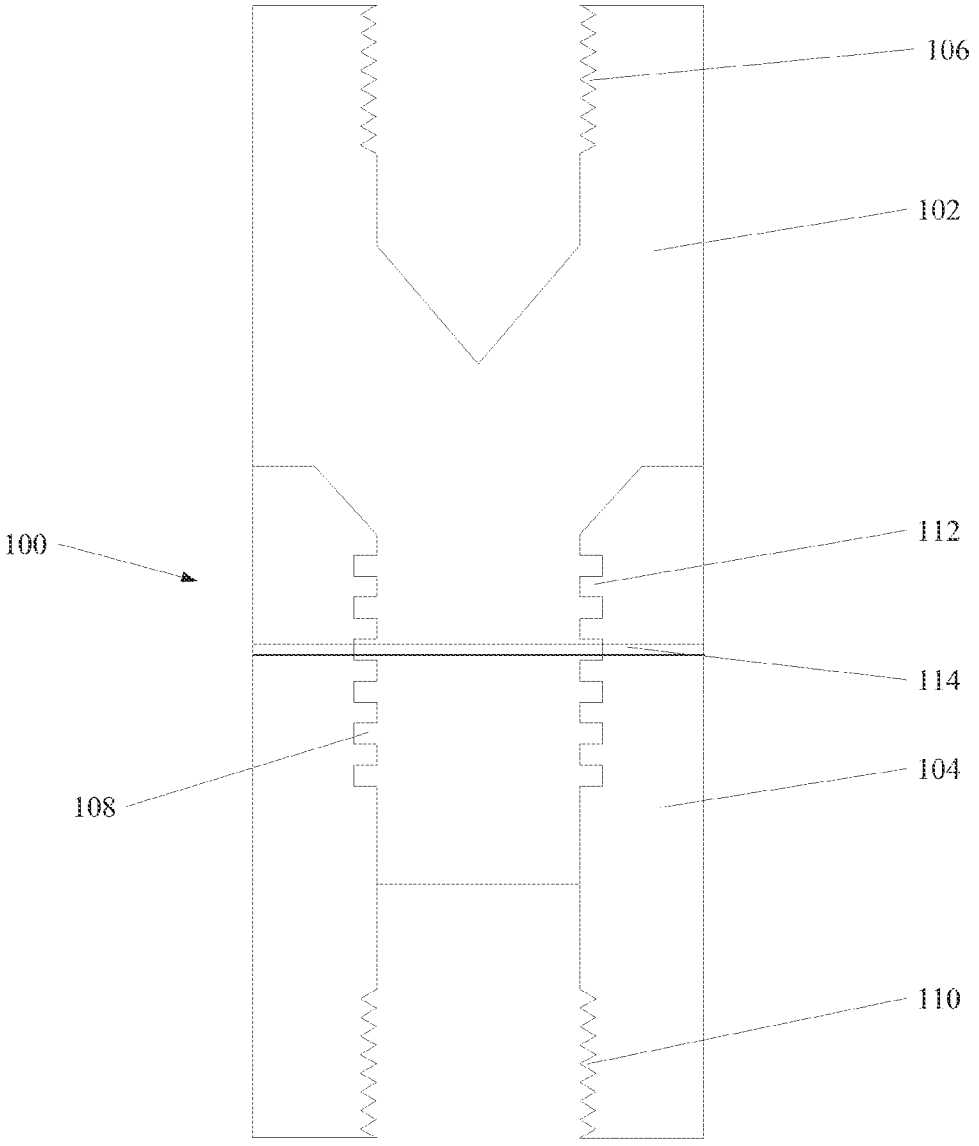


Figure 4

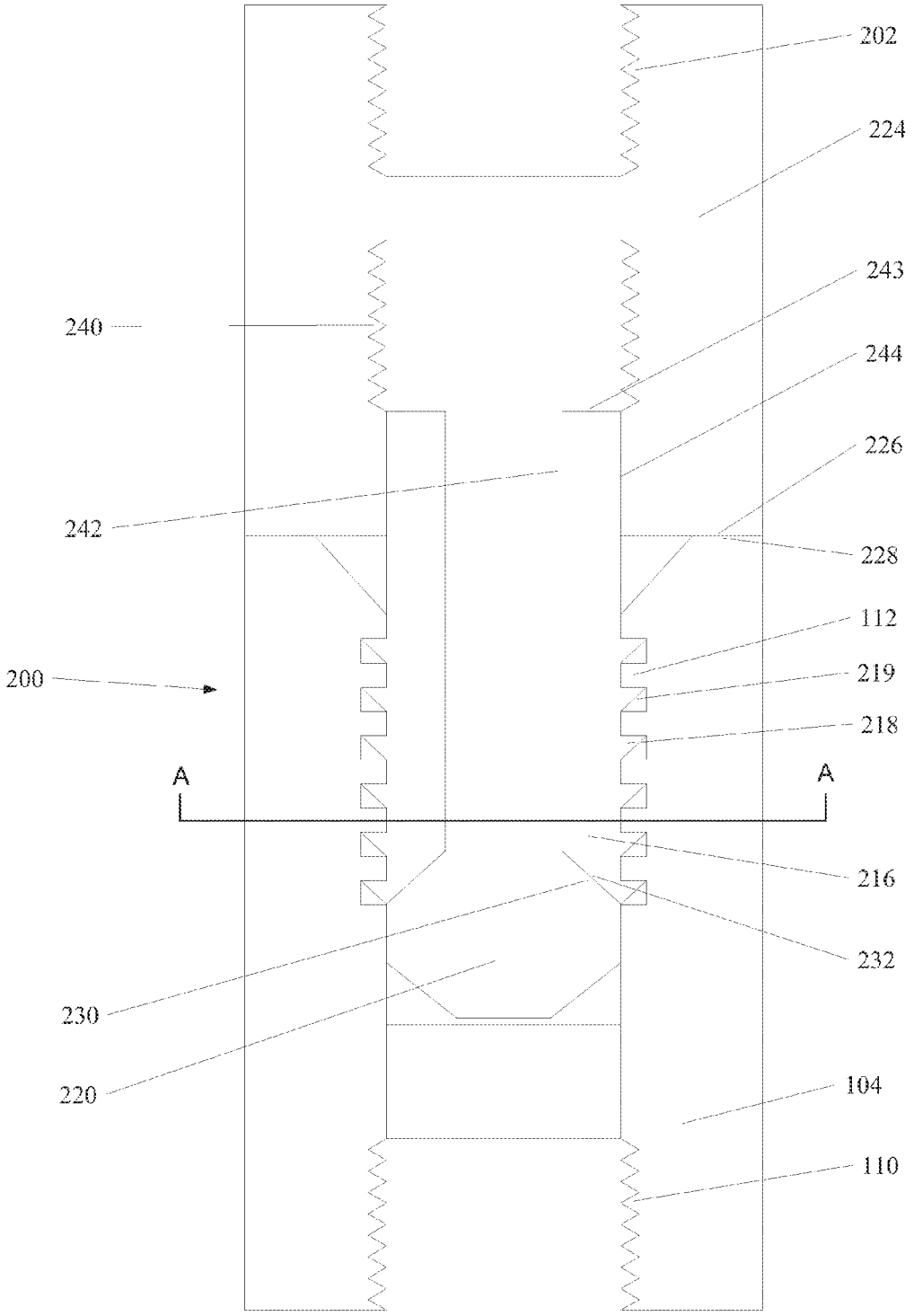
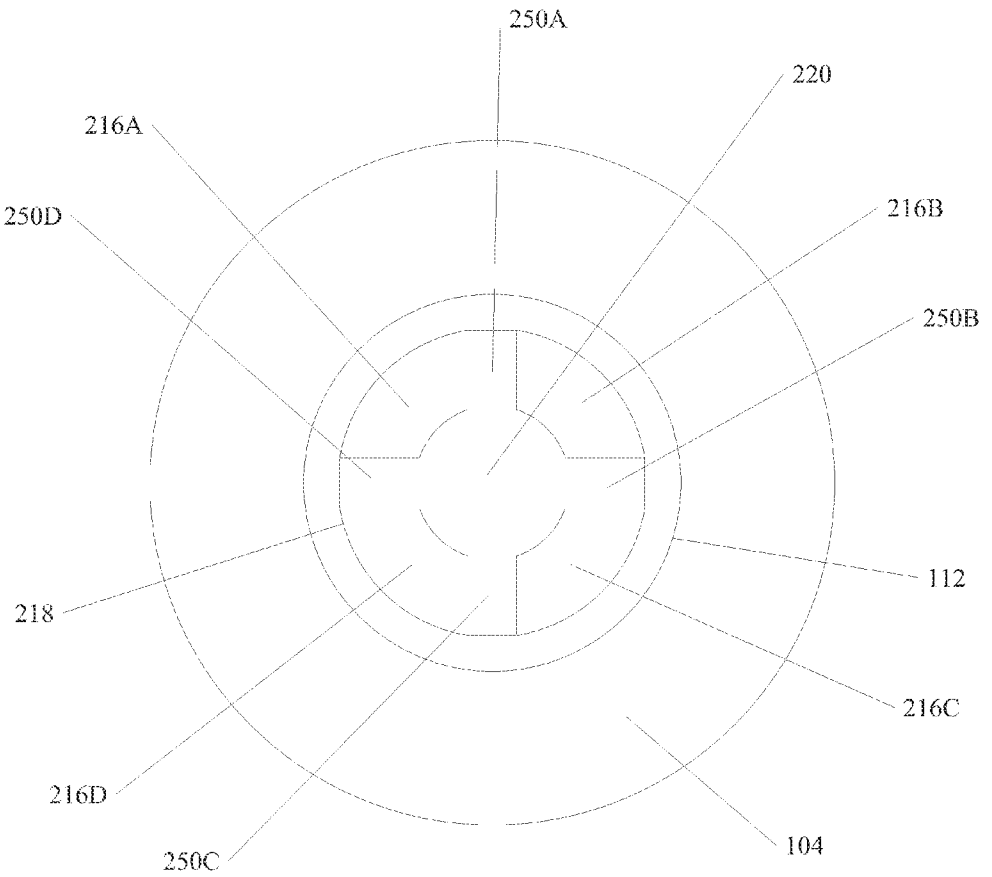

202
224
243
240
244
226
242
228
112
200
219
218
A
A
216
232
230
220
104
110

Figure 5



Section A - A

Figure 6

ANCHOR LATCH ON OFF FOR SUCKER RODS

CROSS-REFERENCE TO RELATED APPLICATIONS

BACKGROUND

[0001] A conventional oil well includes a cased well bore 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 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 upwards 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 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 the 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 therefore the current invention.

[0010] An embodiment for disconnecting a sucker rod may include an upper section. The upper section has an upper end and a lower end and 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 has an upper end and a lower end and 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 a sucker rod may include a second threaded that has left hand threads and a fourth threaded section with left hand 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 and the lower section may be a rod. 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 with an interior, an upper end, and a lower end. The interior of the lower end has a first threaded section and 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 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 having 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 from the radially inward lower end of each thread radially outward to radially outwards 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 direction as the nut progresses onto a bolt or threaded section and "reverse" means in a left hand 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] FIG. **1** depicts a wellbore with a barrel pump, a sucker rod string, a disconnect, and a surface drive.

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

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

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

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

[0022] FIG. **6** depicts a cross-section of the sucker disconnect of FIG. **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] FIG. **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 upwards causing 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** to 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, 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** form 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] FIG. **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] FIG. **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 hous-

ing 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] FIG. **4** depicts an embodiment of the present invention. FIG. **3** depicts a sucker rod connector **100** with an upper portion **102** and a lower portion **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] FIG. **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] FIG. **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 are 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 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 my 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**. Bearing surface **230** 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,

[0038] 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**.

[0039] FIG. **6** shows a top down view of the reconnect tool **200** and the lower portion **104** at cross-section A-A in FIG. **4**. 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 **216**A, **216**B, **216**C, and **216**D 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 **250**A, **250**B, **250**C, and **250**D that extend into the pockets or recesses of the collet **216** or between the collet sections **216**A, **216**B, **216**C, and **216**D. The protrusions such as **250**A, **250**B, **250**C, and **250**D may then act on the collet sections **216**A, **216**B, **216**C, and **216**D 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.

[0040] 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.

[0041] 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 comprising:
an upper section;
wherein the upper section has an upper end and a lower end;
further wherein 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;
wherein the lower section has an upper end and a lower end;
further wherein 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; and
the second threaded section and the fourth threaded section cooperate to join the upper section and the lower section.

2. The apparatus for disconnecting the sucker rod of claim **1** wherein the second threaded has left hand threads and the fourth threaded section has left hand threads.

3. The apparatus for disconnecting the sucker rod of claim **1** wherein the first threaded section is box connector and the third threaded section is a box connector.

4. The apparatus for disconnecting the sucker rod of claim **1** wherein the upper section is a rod and the lower section is a rod.

5. The apparatus for disconnecting the sucker rod of claim **1** wherein the upper section is a tube and the lower section is a tube.

6. An apparatus for reconnecting a sucker rod comprising:
a lower section having an interior, an upper end, and a lower end;
wherein the interior of the lower end has a first threaded section and 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 having an interior, an upper end, and a lower end;
wherein the interior of the upper end has a third threaded section;
a reinforcing member having an exterior, an upper end, and a lower end, and a recess;
wherein 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;
further wherein the recess is located between the lower end of the upper section and the bias device;
at least one retaining collet having an interior, an exterior, an upper end, and a lower end;
wherein the exterior lower end has a fourth threaded section that cooperates with the threads of the second threaded section;
further wherein the interior of the lower end has a shoulder that cooperates with the bias device; and
the retaining collet is located in the recess such that the bias device provides force in the radial outward direction against the shoulder.

7. The apparatus for reconnecting the sucker rod of claim **6** wherein the bias device is a ramp.

8. The apparatus for reconnecting the sucker rod of claim **6** wherein the second threaded section has left hand threads.

9. The apparatus for reconnecting the sucker rod of claim **6** wherein the second threaded section has right hand threads.

10. The apparatus for reconnecting the sucker rod of claim **6** wherein the second threaded section has 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.

11. 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.

12. The method of claim **11** wherein rotating the sucker rod string in a first direction that is to the left.

13. The method of claim **11** wherein rotating the sucker rod string in a first direction that is to the right.

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 from the radially inward lower end of each thread radially outward to radially outwards upper end of each thread.

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

* * * * *