(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 001 132 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
17.05.2000 Bulletin 2000/20

(51) Int Cl.[7]: **E21B 17/07**, E21B 17/06

(21) Application number: **99308661.0**

(22) Date of filing: **01.11.1999**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **03.11.1998 US 185383**

(71) Applicant: **Halliburton Energy Services, Inc.**
Dallas, Texas 75381-9052 (US)

(72) Inventor: **Huggins, Jeffry W.**
Carrollton, Texas 75006 (US)

(74) Representative: **Wain, Christopher Paul et al**
A.A. Thornton & Co.
235 High Holborn
London WC1V 7LE (GB)

(54) Telescoping/release joint

(57) A downhole tool comprises a mandrel (120) having a radially reduced region (134) and a housing (108) slidably disposed exteriorly around the mandrel (120). A support ring (138) is initially disposed between the housing (108) and the mandrel (120). The support ring (138) supports an axial load between the housing (108) and the mandrel (120) until the relative axial movement between the housing (108) and the mandrel (120) shifts the support ring (138) into the radially reduced region (134). Thereafter, the downhole tool is telescopically extendable.

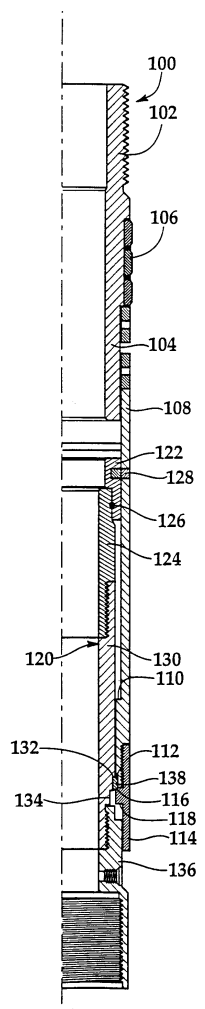

Fig.3A

EP 1 001 132 A2

Description

[0001] This invention relates, in general, to tools used during the completion and operation of a subterranean wellbore. More particularly, the invention relates to a slip joint assembly for use in a wellbore, and especially relates to a slip joint assembly for bidirectional immobilization of a pipe section relative to a subterranean wellbore.

[0002] The background of the invention will be described, by way of example, with reference to perforating and fracturing a subterranean formation.

[0003] Heretofore in this field, a potentially productive geological formation beneath the earth's surface which contains a sufficient volume of valuable fluids, such as hydrocarbons, may have a very low permeability. As the valuable fluids are contained within pores in the potentially productive subterranean formation, if the pores are not interconnected, the fluids cannot move about and, thus, cannot be brought to the earth's surface without a structural modification of the production zone.

[0004] In such a formation having a very low permeability, but a sufficient quantity of valuable fluids in its pores, it becomes necessary to artificially increase the formation's permeability. This is typically accomplished by fracturing the formation, a practice that is well known in the art. Basically, fracturing is achieved by applying sufficient pressure to the formation to cause it to crack or fracture. The desired result of this process is that the cracks interconnect the formation's pores and allow the valuable fluids to be brought out of the formation and to the surface.

[0005] In conventional fracturing, the general sequence of steps needed to stimulate a production zone through which a wellbore extends is as follows. First, a plug is set in the well casing at a predetermined depth in the well, proximate the subterranean production zone requiring stimulation. Next, a perforating trip is made by lowering a perforation assembly into the wellbore on a lower end of a work string. The gun assembly is then detonated to create a spaced series of perforations extending outwardly through the casing, the cement and into the production zone. The discharged gun assembly is then pulled up with the work string to complete the perforating trip.

[0006] Next, the spent gun assembly may be replaced on the work string with a proppant discharge member having a spaced series of discharge openings formed therein. The proppant discharge member is then lowered into the wellbore such that the discharge openings are, at least theoretically, aligned with the gun-created perforations. Proppant slurry is then pumped down the work string so that proppant slurry is discharged through the discharge member openings and then flowed outwardly through the casing and cement perforations into the corresponding perforations in the surrounding production zone. The work string is then pulled out again to complete the stimulation trip and ready the casing for the installation therein of production tubing and its associated production packer structures.

[0007] It has been found, however, that when the proppant slurry discharge member is lowered into the perforated nipple it is, as a practical matter, substantially impossible to obtain a precise alignment, both axial and circumferential, with the gun-created perforations. The usual result of this misalignment is that the proppant must follow a tortuous path on its way to entering the perforations. Because of the highly abrasive character of proppant slurry, this tortuous flow path can cause severe abrasion wear problems in the casing. In addition, it has been found that the perforation and proppant fracturing technique described above lacks the ability to provide well pressure balance control during pre-production trips, thereby tending to create undesirable unbalanced pressure situations during the completion of the well.

[0008] To overcome the above limitations, attempts have been made to design a single trip apparatus and method to perforate and stimulate a hydrocarbon formation. In this case, the work string carries a drop-off type perforating gun and a locator installed thereon above the perforating gun. The gun is operatively positioned within the casing by lowering the locator through an internal profile within the nipple to a location below the nipple. The work string is then pulled upwardly to engage the key of the locator in the nipple profile. Once in place, the guns may be fired to create a spaced series of perforations extending outwardly through the work string, the casing, the cement and into the production zone. The gun is now dropped off to a location below the perforations. The proppant slurry is then pumped down the work string. The proppant slurry is discharged through the openings in the work string, the casing and the cement into the corresponding perforations in the surrounding production zone.

[0009] It has been found, however, the even when the proppant slurry is pumped down the work string on the same trip as the perforation, the alignment, both axial and circumferential, of the gun-created perforations in the work string and in the casing is not maintained unless the work string is secured in place relative to the casing both above and below the production zone. The achieve this, the work string must carry a upwardly locking locator above the perforating gun to prevent upward movement of the work string during perforation and stimulation and a downwardly locking locator below the perforating gun to prevent downward movement of the work string during perforation and stimulation. It has been found, however, that as a practical matter, it is substantially impossible to install both an upwardly locking locator and a downwardly locking locator within the casing. For example, it is substantially impossible to properly space both the nipple profiles of the casing and the locators in a work string such that both an upwardly locking locator and a downwardly locking locator may be properly engaged in the appropriate nipple profile.

[0010] A need has therefore arisen for an apparatus and method for securing the work string in place relative to the casing both above and below the production zone. A need has also arisen for such an apparatus and method that allows for the simultaneous use of an upwardly locking locator above the perforating gun to prevent upward movement of the work string during perforation and stimulation and a downwardly locking locator below the perforating gun to prevent downward movement of the work string during perforation and stimulation.

[0011] The present invention disclosed herein comprises a downhole tool, such as slip joint assembly, that may be used during a variety of downhole operations. The slip joint assembly of the present invention may be used for bidirectional immobilization of a work string relative to the casing. The slip joint assembly of the present invention may be used in conjunction with an upwardly locking locator and a downwardly locking locator such that both may be properly installed in their respective nipple profiles.

[0012] According to one aspect of the present invention there is provided a downhole tool, such as a slip joint assembly, comprising a mandrel having a radially reduced region and a housing that is slidably disposed exteriorly around the mandrel. A support ring is initially disposed between the housing and the mandrel. The support ring may support an axial load between the housing and the mandrel until the relative axial movement between the housing and the mandrel shifts the support ring into the radially reduced region. More specifically, the support ring may support a tensile axial force between the housing and the mandrel until a compressive axial force between the housing and the mandrel moves the housing in a first direction relative to the mandrel. As the housing moves in the first direction, the support ring is displaced into the radially reduced region of the mandrel which allows a subsequent tensile axial force between the housing and the mandrel to move the housing in a second direction relative to the mandrel. As such, movement of the housing in the second direction is initially prevented by the support ring but once the support ring is displaced into the radially reduced region, movement of the housing in the second direction is allowed which telescopically extends the slip joint assembly.

[0013] The mandrel of the downhole tool may include an annular shoulder. The housing of the downhole tool may include first and second annular shoulders. In this embodiment, the support ring may be initially disposed between the annular shoulder of the mandrel and the first annular shoulder of the housing. Also, in this embodiment, the second annular shoulder of the housing may contact the support ring to shift the support ring into the radially reduced region when the housing moves axially relative to the mandrel.

[0014] The support ring of the downhole tool may be pretensioned such that the diameter of the support ring reduces when the support ring is shifted into the radially reduced region; this may provide clearance between the first shoulder of the housing and the support ring and to allow movement of the housing in the second direction relative to the mandrel, thereby telescopically extending the downhole tool. The support ring may be a c-ring.

[0015] A shearable member may radially extend between the housing and the mandrel to friably prevent axial movement of the housing relative to the mandrel until a predetermined compressive axial force is applied between the housing and the mandrel that displaces the support ring into the radially reduced region.

[0016] In another aspect, the invention provides a method for selectively supporting a tensile axial force between a housing and a mandrel of a downhole tool, such as a slip joint assembly, which method involves disposing a support ring between the housing and the mandrel to prevent axial movement of the housing in a first direction relative to the mandrel, thereby supporting the tensile axial force between the housing and the mandrel. When a compressive axial force is applied between the housing and the mandrel, the housing moves relative to the mandrel in the second direction which shifts the support ring into a radially reduced region of the mandrel. Thereafter, applying a tensile axial force between the housing and the mandrel moves the housing relative to the mandrel in the first direction.

[0017] Another aspect of the invention relates to a method for telescopically extending a downhole tool.

[0018] In the method, the support ring may be initially disposed between an annular shoulder of the mandrel and a first annular shoulder of the housing. When the support ring is shifted into the radially reduced region of the mandrel, this may be achieved by engaging a second annular shoulder of the housing with the support ring. Clearance between the mandrel and the housing may be achieved by using a support ring that is pretensioned such that the diameter of the support ring reduces when the support ring is shifted into the radially reduced region. Relative movement between the housing and the mandrel may be initially prevented by extending a shearable member between the housing and the mandrel that shears when a predetermined compressive axial force is applied between the housing and the mandrel.

[0019] Reference is now made to the accompanying drawings, in which:

Figure 1 is a schematic illustration of an offshore oil and gas platform operating an embodiment of a slip joint assembly according to the present invention;

Figure 2 is a schematic illustration of a downhole formation traversed by a wellbore having an embodiment of a slip joint assembly according to the present invention disposed therein; and

Figures 3A-3C are cross sectional views of an embodiment of a slip joint assembly according to the present invention in its various operating positions.

[0020] Referring to Figure 1, a single trip perforating and fracturing apparatus including a slip joint assembly in use on an offshore oil and gas platform is schematically illustrated and generally designated 10. A semi-submersible platform 12 is centered over a submerged oil and gas formation 14 located below sea floor 16. A subsea conduit 18 extends from deck 20 of platform 12 to wellhead installation 22 including blowout preventers 24. Platform 12 has a hoisting apparatus 26 and a derrick 28 and for raising and lowering pipe strings such as work string 30.

[0021] A wellbore 32 extends through the various earth strata including formation 14. A casing 34 is cemented within wellbore 32 by cement 36. As best seen in figure 2, casing 34 includes a nipple 38 that has, from top to bottom along its interior, an annular nipple profile 40, a reduced diameter top annular seal surface 42, a radially thinned tubular perforatable side wall area 44, a reduced diameter bottom annular seal surface 46 and an annular nipple profile 48.

[0022] Work string 30 extends downwardly through casing 34 and its nipple 38. Work string 30 includes, from top to bottom, an upwardly locking locator 50, upper annular seal structure 52, a longitudinal gun carrying portion 54, a lower annular seal structure 56, a downwardly locking locator 58, an upwardly locking locator 60 and a conventional screened tubular sliding side door assembly 62 having upper and lower external annular end seals 64 and 66. In addition, work string 30 includes a slip joint assembly 68, the operation of which will be more fully described below.

[0023] A drop-off type perforating gun 76 is operatively supported within an upper end section of the gun carrying potion 54 of the work string 30. The lower end of gun carrying portion 54 is connected to the portion of the work string 30 therebelow by a suitable releasable connection 70 such as, for example, that typically used in a lock mandrel running tool. Directly above the releasable connection 70, within the work string 30, is a check valve 72 that functions to permit upward fluid flow therethrough and preclude downward fluid flow therethrough. An internal no-go structure 74 is located above downwardly locking locator 58 which, as later described herein, functions to catch perforating gun 76 after it has been fired and drops off its mounting structure within the work string 30.

[0024] When it is desired to perforate and stimulate formation 14, work string 30 is lowered through casing 34 until upwardly locking locator 50 passes through nipple profile 40 and downwardly locking locator 58 engages nipple profile 48. Once downwardly locking locator 58 has engaged nipple profile 48, further downward movement of work string 30 through casing 34 is prevented. As will be more fully described below, slip joint assembly 68 operates to telescopically extend the length of work string 30 between upwardly locking locator 50 and downwardly locking locator 58. As such, the upper portion of work string 30 may be raised until upwardly locking locator 50 is operatively engaged by nipple profile 40 to prevent further upward movement of work string 30. Work string 30 is now bidirectionally immobilized within casing 34 between upwardly locking locator 50 and downwardly locking locator 58. Perforating gun 76 is now disposed between the upper and lower internal nipple seal areas 42 and 46, with the side of gun 76 facing the perforatable side wall area 44 of the nipple 38. Upper and lower tubing seals 52 and 56 respectively engage the upper and lower nipple areas 42 and 46, thereby sealing off the interior of the perforatable side wall area 44 from the rest of the interior of work string 30.

[0025] Next, the pressure within work string 30 is elevated placing the portion of the work string 30 above locator 50 in tension. The gun 76 is then fired to create a spaced series of first perforations 78 in the side wall of the gun carrying portion 54 and a spaced series of second perforations 80 aligned with the first perforations 78 and extending outwardly through the perforatable side wall area 44, the cement 36 and into formation 14.

[0026] Alternatively, the first perforations 78 may be pre-formed in the gun carrying portion 54, before it is lowered into casing 34, and appropriately aligned with the series of detonation portions on the perforating gun 76. When gun 76 is later fired, it fires directly outwardly through the pre-formed perforations 78, thereby reducing the overall metal wall thickness which gun 76 must perforate.

[0027] After the firing of gun 76 and the resulting circumferentially and axially aligned sets of perforations 78 and 80, the gun 76 is automatically released from its mounting structure within work string 30 and falls downwardly through work string 30 to the dotted line position of the gun 76 in which it is caught within a lower end section of gun carrying portion 54 by the no-go structure 74. In this position, dropped gun 76 is disposed beneath the lowermost aligned perforation set.

[0028] After the perforation gun 76 drops, and while still maintaining the bidirectional immobilization of work string 30 between upwardly locking locator 50 and downwardly locking locator 58 as well as the tension force on work string 30 above upwardly locking locator 50, formation 14 is stimulated by pumping stimulation fluid, such as a suitable proppant slurry, downwardly through work string 30. The proppant slurry flows outwardly through perforations 78 and into formation 14 through perforations 80 which are aligned with perforations 78 both circumferentially and axially.

[0029] At this point it is important to note that the stimulation process for formation 14 has been completed not with the usual plurality of downhole trips, but instead with a single trip of work string 30. Additionally, during the pumping and discharge of the proppant slurry, work string perforations 78 are kept in their initial firing alignment with casing, cement and production perforations 80 as a result of the bidirectional immobilization of work string 30 between upwardly locking locator 50 and downwardly locking locator 58. The high pressure streams of proppant slurry exiting the work string perforations 78 are jetted essentially directly into their corresponding aligned perforations 80, thereby eliminating the conventional tortuous path, and resulting abrasion wear problems, of discharged proppant slurry resulting from misalignments occurring in conventional multi-trip stimulation operations.

[0030] The maintenance of the desirable, abrasion reducing alignment between perforations sets 78 and 80 during the proppant slurry phase of the overall stimulation process is facilitated by the previously mentioned bidirectional immobilization. Such upward engagement of upwardly locking locator 50 with nipple profile 40 and the downward engagement of downwardly locking locator 58 with nipple profile 48, automatically builds into work string 30 compensation for thermal and pressure forces imposed on work string 30 during proppant slurry delivery that otherwise might shift perforations 78 relative to their directly facing perforations 80.

[0031] If desired, after the proppant slurry pumping step is completed, a cleanout step may be carried out to remove residual proppant slurry from the interior of nipple 38. After this optional clean out step is performed, work string 30 may be manipulated to apply sufficient force to shear out and disable upwardly locking locator 50, thereby permitting upwardly locking locator 50 to pass upwardly through nipple profile 40. Continued upward movement of work string 30 releases downwardly locking locator 58 from nipple profile 48 until locator 60 engages profile 40 to halt further upward movement of work string 30. At this point, the annular upper and lower sliding side door end seals 64 and 66 sealingly engage the annular internal nipple sealing surface areas 42 and 46, respectively, with the screened tubular sliding side door structure 62 longitudinally extending between the sealing surfaces 42 and 46.

[0032] Finally, an upward pull is exerted on the portion of the work string 30 above locator 60 with sufficient force to separate work string 30 at the releasable connection 70, thereby leaving the lower portion of the work string 30 in place within nipple 38.

[0033] It should be noted that with the use of slip joint assembly 68 to achieve the one trip method described above, the spent perforating gun 76 is automatically retrieved with the upper work string portion upon completion of the method instead of being simply dropped into the well's rat hole as is typically the case when a drop-off type perforating gun is used in conventional multi-trip perforation and stimulation methods.

[0034] Also, it should be noted that the screened sliding side door structure 62 was initially installed in its closed position in work string 30. Accordingly, the sliding side door structure 62, when left in place within the nipple 38 at the end of the one-trip perforation and stimulation process, serves to isolate formation 14 from the balance of the well system by blocking inflow of production fluid from formation 14 through perforations 80 and then upwardly through either work string 30 or casing 34.

[0035] The overall method just described is thus utilized, in a single downhole trip, to sequentially carry out in a unique fashion a perforation function, a stimulation function and a subsequent production zone isolation function. As will be readily appreciated, similar one-trip methods may be subsequently performed on upwardly successive formations (not shown) to perforate, stimulate, and isolate them in readiness for later well fluid delivery therefrom.

[0036] After each formation has been readied for well fluid delivery in this manner, any zone, such as formation 14, may be selectively recommunicated with the interior of its associated work string section simply by running a conventional shifting tool down casing 34 and using it to downwardly shift the door portion of sliding side door structure 62, to thereby permit production fluid to flow from formation 14 inwardly through perforations 80, into the now opened screened sliding side door structure 62, and then upwardly through work string 30 to the surface. Alternatively, of course, the sliding side door structure could be rotationally shiftable between its open and closed positions instead of axially shiftable therebetween.

[0037] Even though figures 1 and 2 depict a vertical well, it should be note by one skilled in the art that the slip joint assembly of the present invention is equally well-suited for use in deviated wells, inclined wells or horizontal wells. As such, it should be apparent to those skilled in the art that the use of directional terms such as above, below, upper, lower, upward, downward and the like are used in relation to the illustrative embodiments as they are depicted in the figures, the upward direction being towards the top of the corresponding figure and the downward direction being toward the bottom of the corresponding figure. It is to be understood that the slip joint assembly of the present invention may be operated in vertical, horizontal, inverted or inclined orientations without deviating from the principles of the present invention.

[0038] Turning now to figures 3A-3C, therein is depicted a slip joint assembly of the present invention in its various operating positions that is generally designated 100. Specifically referring to figure 3A, slip joint assembly 100 includes an upper connector 102 that has a threaded pin end for securing slip joint assembly 100 to other downhole equipment thereabove such as a section of work string pipe or another downhole tool. In the illustrated embodiment, slip joint assembly 100 includes a seal assembly 104 having seal elements 106. Seal assembly 104 is securably coupled to outer housing 108 of slip joint assembly 100. It should be apparent to those skilled in the art that slip joint assembly 100 may be constructed without seal assembly 104 and seal elements 106 without departing from the principals of the present invention. For example, outer housing 108 may be coupled directly to upper connector 102.

[0039] Outer housing 108 has an upwardly facing annular shoulder 110 and a downwardly facing annular shoulder 112. Outer housing 108 is threadably coupled to a housing extension 114. Housing extension 114 has an upwardly facing annular shoulder 116 and a downwardly facing annular shoulder 118. Disposed within outer housing 108 is an inner mandrel subassembly 120. Inner mandrel subassembly 120 includes a separation ring 122 that is selectively coupled to an upper mandrel assembly 124 by a circumferential shearable member 126. Separation ring 122 is also selectively coupled to outer housing 108 by one or more shearable members such as shear pin 128. Upper mandrel assembly 124 is threadably coupled to inner mandrel 130. Inner mandrel 130 has a downwardly facing annular shoulder 132 and a radially reduced region 134. Inner mandrel 130 is threadably coupled to a lower connector 136 that has a threaded box end for securing slip joint assembly 100 to other downhole equipment therebelow such as a section of work string pipe or another downhole tool.

[0040] As best seen in figure 3A, when slip joint assembly 100 is in its run-in configuration, a support ring such as c-ring 138 is disposed between outer housing 108 and inner mandrel 130. Specifically, c-ring 138 is disposed between downwardly facing annular shoulder 132 of inner mandrel 130 and upwardly facing annular shoulder 116 of housing extension 114. In this configuration, upward movement of c-ring 138 relative to inner mandrel 130 is prevented by downwardly facing annular shoulder 132 of inner mandrel 130. In turn, upward movement of outer housing 108 relative to inner mandrel 130 is prevented by the interaction between upwardly facing annular shoulder 116 of housing extension 114 and c-ring 138. As such, slip joint assembly 100 will carry an axial tensile load between outer housing 108 and inner mandrel 130. In fact, c-ring 138 will carry an axial tensile load between outer housing 108 and inner mandrel 130 much greater than would otherwise be supportable by shearable members 128. Thus, slip joint assembly 100 will support the substantial axial tensile load typically present in the middle of a work string, such as work string 30 between upwardly locking locator 50 and downwardly locking locator 58 of figures 1 and 2.

[0041] As best seen in figure 3B, outer housing 108 may be shifted downwardly relative to inner mandrel 130 after a sufficient axial force is applied to shearable member 128. As explained above, slip joint assembly 100 may carry a substantial tensile load that is transferred from outer housing 108 to inner mandrel 130 through c-ring 138. A compressive load between outer housing 108 and inner mandrel 130, however, is carried by shearable members 128. Thus, when a predetermined compressive load is placed on slip joint assembly 100, shearable members 128 will shear allowing outer housing 108 to slide downwardly relative to inner mandrel 130. As outer housing 108 slides downwardly relative to inner mandrel 130, downwardly facing annular shoulder 112 of outer housing 108 engages c-ring 138 to move c-ring 138 downwardly until c-ring 138 is displaced into radially reduced region 134. When c-ring 138 is displaced into radially reduced region 134, c-ring 138 snaps around radially reduced region due to the pretensioning of c-ring 138. Once in the radial reduced area, c-ring 138 no longer interferes with upwardly facing annular shoulder 116 of housing extension 114.

[0042] As best seen in figure 3C, outer housing 108 is now free to slide upwardly relative to inner mandrel 130. Placing slip joint assembly 100 in tension pulls outer housing 108 upwardly which telescopically extends the length of slip joint assembly 100. The extension of slip joint assembly 100 is limited by the contact between upwardly facing annular shoulder 110 and the lower end of separation ring 122. It is to be understood by those of skill in the art that the relative lengths of outer housing 108 and inner mandrel 130 are selected such that the desired extension of slip joint assembly 100 is achievable.

[0043] If, for example, the work string becomes stuck within the casing below slip joint assembly 100, it may be desirable to remove the portion of the work string above slip joint assembly 100. In this situation, outer housing 108 is pulled upwardly until upwardly facing annular shoulder 110 impacts the lower end of separation ring 122. Continued exertion of upward force at a predetermined level will shear circumferential shearable member 126 such that outer housing 108 and separation ring 122 release from inner mandrel 130 and upper mandrel assembly 124. The portion of the work string above slip joint assembly 100 is now separated from the portion of the work string below slip joint assembly 100 such that the portion of the work string above slip joint assembly 100 including seal assembly 102, separation ring 122 and outer housing 108 may be removed from the well.

[0044] Slip joint assembly 100 may therefore be used any time that it is desirable to carry a tensile load with a downhole tool then telescopically extend the downhole tool. For example, slip joint assembly 100 that may be used in conjunction with a downwardly locking locator disposed below slip joint assembly 100 that may be locked in place to prevent downward movement, then slip joint assembly 100 may be telescopically extended to allow an upwardly locking locator disposed above slip joint assembly 100 to be locked in place to prevent upward movement.

[0045] It will be appreciated that the invention described above may be modified. For example, it should be noted by one skilled in the art that the principles of the present invention are not only applicable to a slip joint assembly that carries a tensile load that can be telescopically extended by sequentially applying a compressive force than a tensile force but are also applicable to a slip joint assembly that carries a compressive load that can be telescopically extended by sequentially applying a tensile force followed by a compressive force.

Claims

1. A downhole tool comprising: a mandrel (120) having a radially reduced region (134); a housing (108) slidably disposed exteriorly around the mandrel (120); and a support ring (138) initially disposed between the housing (108) and the mandrel (120), the support ring (138) supporting an axial load between the housing (108) and the mandrel (120) until the relative axial movement between the housing (108) and the mandrel (120) shifts the support ring (138) into the radially reduced region (134).

2. A downhole tool comprising: a mandrel (120) having a radially reduced region (134); a housing (108) slidably disposed exteriorly around the mandrel (120); and a support ring (138) initially disposed between the housing (108) and the mandrel (120), the support ring (138) preventing movement of the housing (108) in a first direction relative to the mandrel (120) until the housing (108) is moved in a second direction relative to the mandrel (120) displacing the support ring (138) into the radially reduced region (134).

3. A downhole tool according to claim 1 or 2, wherein the downhole tool is a slip joint assembly.

4. A downhole tool according to any preceding claim, wherein the support ring (138) supports a tensile axial force between the housing (108) and the mandrel (120) until a compressive axial force between the housing (108) and the mandrel (120) moves the housing (108) in a first direction relative to the mandrel (120) and shifts the support ring (138) into the radially reduced region (134), thereby allowing a tensile axial force between the housing (108) and the mandrel (120) to move the housing (108) in a second direction relative to the mandrel (134).

5. A downhole tool according to any preceding claim, wherein the mandrel (120) has an annular shoulder (132), wherein the housing (120) has first and second annular shoulders (116, 112) and wherein the support ring (138) is initially disposed between the annular shoulder (132) of the mandrel (120) and the first annular shoulder (116) of the housing (108).

6. A downhole tool according to claim 5, wherein the second annular shoulder (112) of the housing (108) shifts the support ring (138) into the radially reduced region (134) when the housing (108) moves axially relative to the mandrel (120).

7. A method for selectively supporting a tensile axial force between a housing (108) and a mandrel (120) of a downhole tool, the method comprising the steps of: disposing a support ring (138) between the housing (108) and the mandrel (120) to prevent axial movement of the housing (108) in a first direction relative to the mandrel (120) and to support a tensile axial force between the housing (108) and the mandrel (120); applying a compressive axial force between the housing (108) and the mandrel (120); moving the housing (108) relative to the mandrel (120) in the second direction; shifting the support ring (138) into a radially reduced region (134) of the mandrel (120); and applying a tensile axial force between the housing (108) and the mandrel (120), thereby moving the housing (108) relative to the mandrel (120) in the first direction.

8. A method for telescopically extending a downhole tool comprising the steps of: disposing a support ring (138) between a housing (108) and a mandrel (120) to support a tensile axial force between the housing (108) and the mandrel (120); applying a compressive axial force between the housing (108) and the mandrel (120); moving the housing (108) in a first direction relative to the mandrel (120); shifting the support ring (138) into a radially reduced region (134) of the mandrel (120); applying a tensile axial force between the housing (108) and the mandrel (120); and moving the housing (108) in a second direction relative to the mandrel (120), thereby telescopically extending the downhole tool.

9. A method according to claim 7 or 8, further comprising the step of radially extending a shearable member (128) between the housing (108) and the mandrel (120).

10. A method according to claim 9, further comprising applying a predetermined compressive axial force between the housing (108) and the mandrel (120) to shear the shearable member (128).

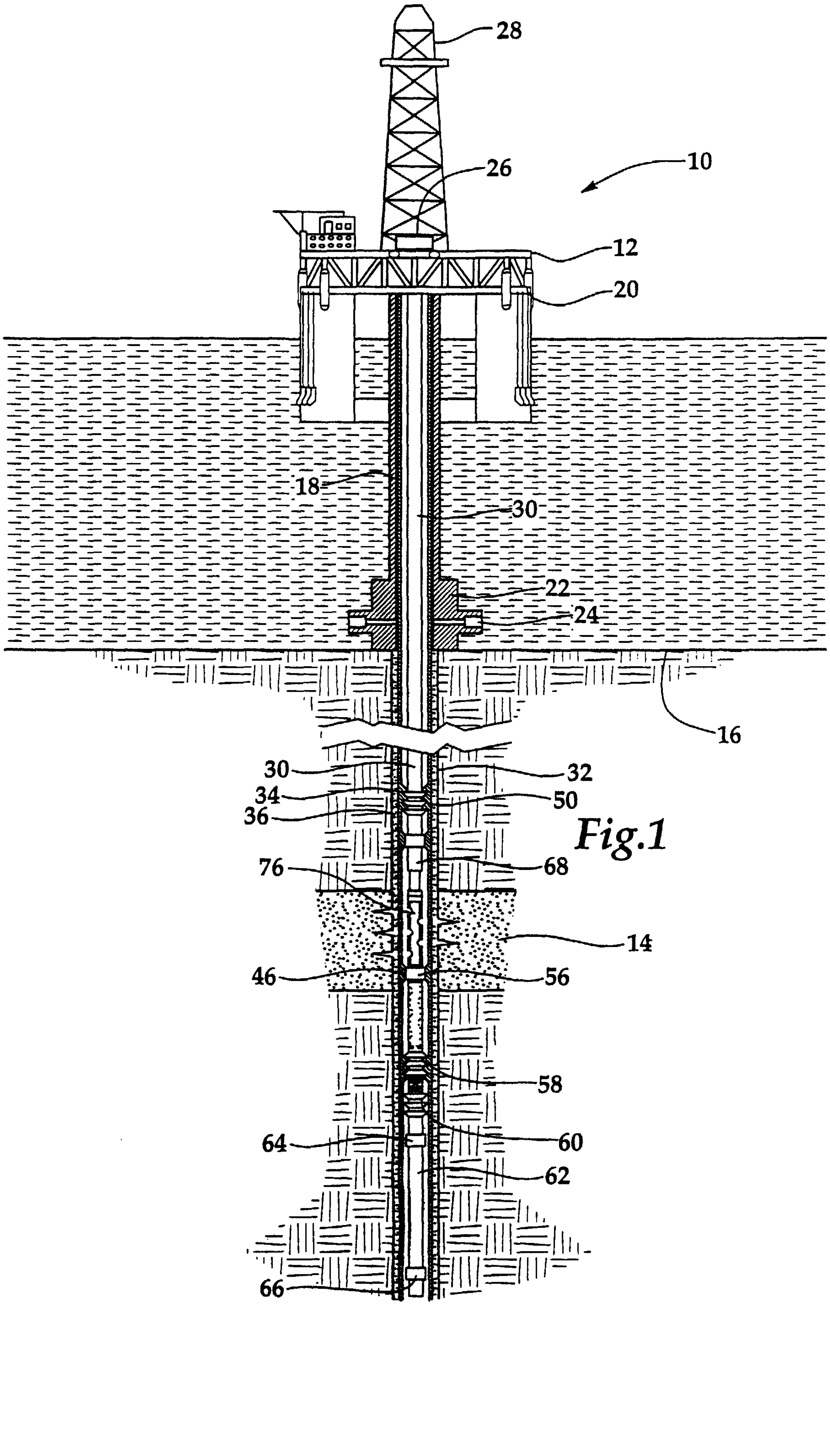
28
26
10
12
20
18
30
22
24
16
30
32
34
50
36
76
68
14
46
56
58
64
60
62
66

Fig.1

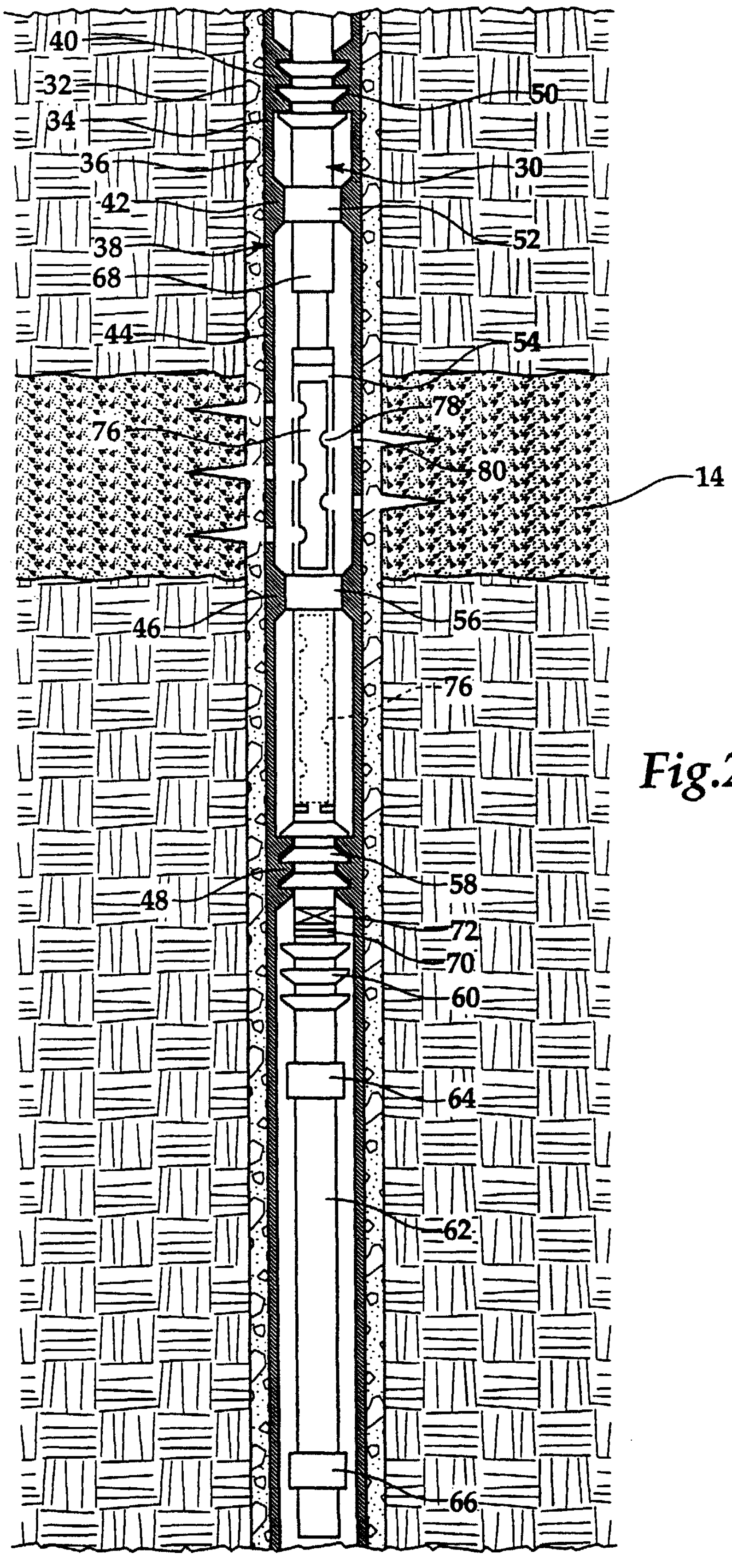
40
32
34
36
42
38
68
44
76
46
48
50
30
52
54
78
80
14
56
76
58
72
70
60
64
62
66

Fig.2

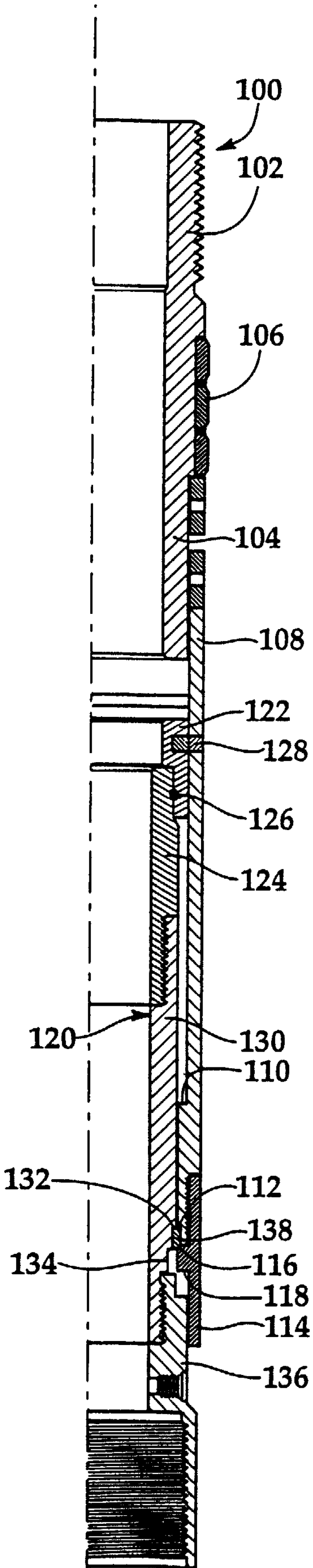

Fig.3A

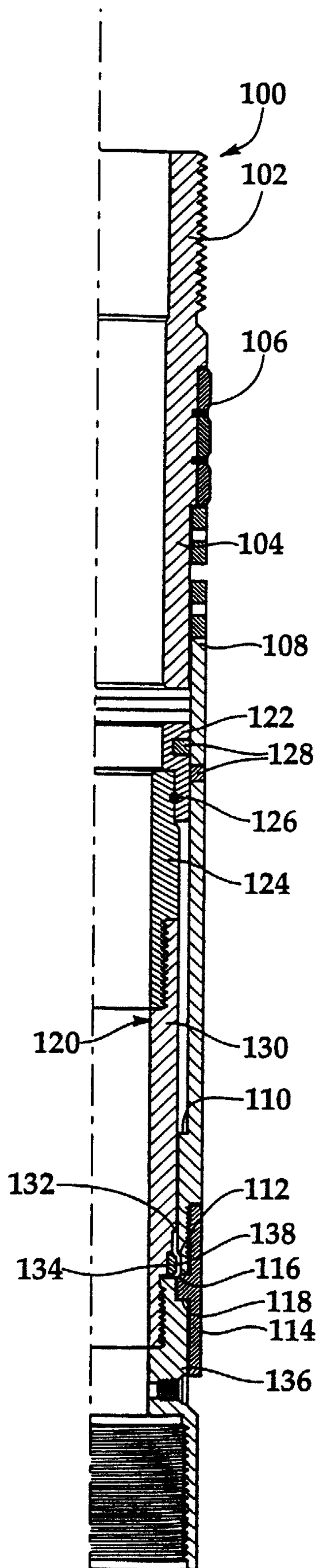

Fig.3B

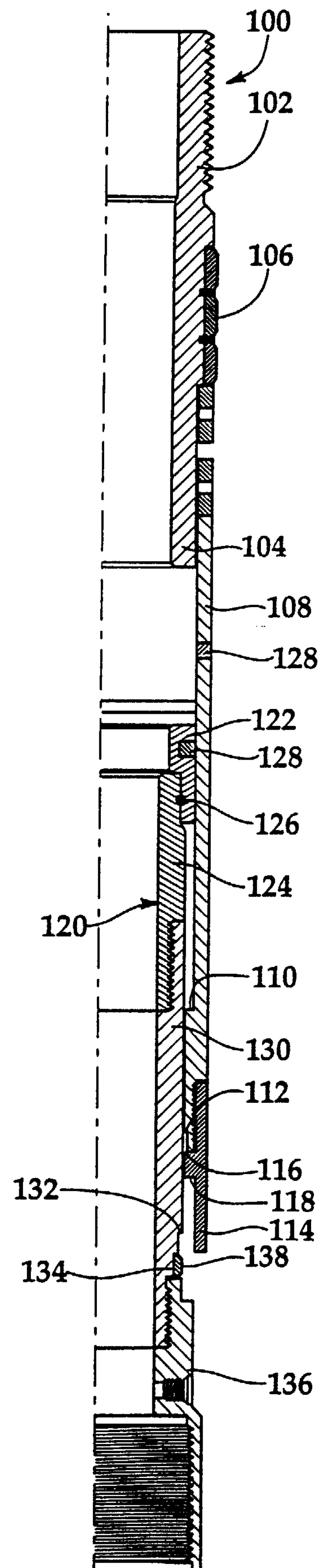

Fig.3C