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(54) Title: HIGH PRESSURE WIRELINE TOP-ENTRY PACKOFF APPARATUS AND METHOD

(57) Abstract: A high-pressure packoff apparatus and method are disclosed. The packoff allows wireline entering a top drive drilling head through a top entry access system to be isolated in such a fashion to minimize the leakage and escape of drillstring fluids to the atmosphere. Optionally, an extension housing containing a flow tube assembly can be employed to accomplish the task. The flow tube assembly effectuates a pressure drop along the wireline conduit run therethrough, thus minimizing the likelihood of fluid escaping.
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.
HIGH PRESSURE WIRELINE TOP-ENTRY PACKOFF
APPARATUS AND METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

The present invention claims the benefit of U.S. Provisional Application Serial No. 60/481,659 filed November 18, 2003 by Vernon Kauffman and Dwight LeBlanc, entitled “High Pressure Wireline Top-Entry Packoff Apparatus and Method,” hereby incorporated by reference herein.

BACKGROUND OF THE INVENTION

The present invention relates to an apparatus for use on a drilling rig; specifically to a high-pressure wireline packoff seal apparatus for use on top-drive drilling rigs and the methods of using the same.

The majority of large oil well drilling rigs operating throughout the world now use top-drive units to speed the assembly of drill string and to permit rapid, almost continuous, drilling. Wireline operations required on deep wells using these expensive rigs can be a severe bottleneck if they cannot be carried out with the expediency and efficiency sought by all drilling contractors. To remedy the problem of inserting a wireline through a top-drive unit, a top-entry apparatus providing a safe and effective means of inserting and manipulating a wireline in a top-drive unit has been developed. Top entry systems offer oilfield companies the opportunity to perform certain types of wireline operations under elevated drillstring bore and annulus pressures. Such wireline operations include, but are not limited to, pipe recovery, backoff, formation evaluation, and directional drilling operations. Because of the various requirements and measurements recorded during some of these
wireline operations, it is often necessary to maintain this elevated pressure before, during, and after their commencement.

There presently exists an important and long-felt need for a hydraulic packoff system and method with a top drive, top entry, wireline operations scheme that will allow operations to continue without reducing drillstring pressures. In order to accomplish this, a high quality seal mechanism is desired. Such a seal would enable the wireline to communicate with the drillstring bore while allowing the escape or leakage of only minimal amounts of bore fluids. The various embodiments of the present invention all address this particular need.

BRIEF SUMMARY OF THE INVENTION

The deficiencies of the prior art are addressed by a top entry access system including a hydraulic packoff to allow a conduit into a bore of a drillstring. The hydraulic packoff preferably includes a main body wherein the main body preferably has a lower connection, a seal bore, an upper connection, and a mounting surface. The lower connection is preferably configured to attach to an inlet of the drillstring and the seal bore is preferably configured to receive a gland assembly. Preferably, the seal gland assembly is configured to allow the conduit to communicate with the bore of the drillstring without releasing drilling fluids therefrom. Preferably, the mounting surface of the main body is configured to receive and secure the top entry access system thereupon.

The deficiencies are also addressed by a hydraulic packoff for a top drilling assembly wherein the packoff includes a main body having a lower connection, a seal bore, and a roller assembly. Preferably the seal bore is configured to receive a
seal gland assembly with the seal gland configured to allow a conduit to communicate with a bore of a drillstring without releasing drilling fluids therefrom. Preferably, the roller assembly is positioned above and configured to guide the conduit into the gland assembly.

The deficiencies can also be addressed by a hydraulic packoff for a top drilling assembly wherein the packoff includes a main body having a lower connection, a seal bore, and a retaining nut. Preferably the seal bore is configured to receive a seal gland assembly with the seal gland configured to allow a conduit to communicate with a bore of a drillstring without releasing drilling fluids therefrom. Preferably, the retaining nut is configured to compress the gland assembly.

The deficiencies are further addressed by a method for entering a conduit into a drillstring driven by a top drive assembly wherein the method preferably comprises connecting a hydraulic packoff and an extension housing to a drillstring inlet above the top drive assembly. Preferably, the method also includes installing a flow tube assembly inside a bore of the extension housing and connecting a top entry access system above the hydraulic packoff. The method includes routing the conduit from a supply, through the top entry access system, into the hydraulic packoff, through the hydraulic packoff, through the flow tube assembly, through the drillstring inlet and into the drillstring.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more detailed description of the preferred embodiments of the present invention, reference will not be made to the accompanying drawings, wherein:
Figure 1A is a sectioned profile view drawing of a wireline packoff apparatus in accordance with the present invention installed in conjunction with a top entry access system.

Figure 1B is a sectioned side view drawing of the wireline packoff apparatus shown in Figure 1A.

Figure 2 is a sectioned view drawing of a wireline packoff apparatus in accordance with the present invention installed in conjunction with an alternate top entry access system.

Figure 3 is a cross-sectional drawing of a wireline packoff apparatus in accordance with a first preferred embodiment of the present invention.

Figure 4 is a cross-sectional drawing of a wireline packoff apparatus in accordance with a second preferred embodiment of the present invention.

Figure 5 is a cross-sectional drawing of a wireline packoff apparatus in accordance with a third preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring initially to Figures 1A-1B, a high-pressure packoff 10 enables a wireline conduit 20 to enter a bore of a drillstring (not shown) from a top entry access system 12 above an oilfield top-drive assembly (not shown). While conduit 20 is preferably constructed as a high tensile strength jacketed electrical conductor, it should be understood by one of ordinary skill in the art that any flexible oilfield communication conduit can be used with the various embodiments of the present invention. Examples of such conduits can include, but are not limited to, single or
multiple electrical conductor wireline, fiber optic cable, braided steel cable, coiled tubing, and slickline.

Top entry access system 12 typically includes a pair of large diameter sheave wheels 16, 17 between two plates 18, 19 but can be of any other configuration known to one skilled in the art. For example, referring briefly to Figure 2, an alternative top entry access system 12A is shown. Alternative access system 12A includes a single large diameter sheave wheel 16A at its top but instead of a lower sheave wheel, has a plurality of small-diameter rollers 22 to guide conduit 20 into location. Furthermore, alternative access system 12A also includes a structural support bar 24 to rigidly secure system 12A to lifting bales 26 and to prevent flexure. For examples of top entry access and top-drive systems entry, see U.S. Patent No. 5,735,351 entitled “Top Entry Apparatus and Method for a Drilling Assembly” issued to Charles M. Helms on April 7, 1998 and U.S. Patent Application No. 10/249,033 entitled “Universal Top-Drive Wireline Entry System Bracket and Method” filed on March 11, 2003 by Kauffman, et al, both hereby incorporated herein by reference.

Returning again to Figures 1A-1B, packoff 10 is preferably situated between entry access system 12 and a manifold 14 located above the top drive assembly. Manifold 14 preferably includes a first inlet 28 to allow the entry of conduit 20 into the drillstring bore, and a second inlet 30 to allow the entry and pressurization of fluids into the drillstring bore. Manifold 14 is shown with a threaded connector 32 to allow attachment to the top drive assembly. Packoff 10 is preferably constructed to isolate the pressurized bore of drillstring from the atmosphere while still allowing the insertion and removal of conduit 20 in and out thereof. Furthermore, packoff 10 is preferably constructed to allow rotational movement of top entry access system with
respect to manifold 14 and top drive assembly without compromising the sealing mechanism of packoff 10. Finally, packoff 10 is preferably constructed as a robust device, one that will not fail under bending and torsional loading from top entry access system 12 through manipulation of conduit 20.

Referring now to Figure 3, a packoff 50 assembly in accordance with a first preferred embodiment of the present invention is shown in more detail. Packoff assembly 50 is shown having a main body 52, a gland assembly 54, and a roller assembly 56. Main body 52 preferably includes an outer journal surface 58, a thrust surface 60, an internal seal bore 62, a bottom threaded connection 64, and an upper threaded connection 66. Surfaces 58, 60 are preferably provided to receive the connecting top entry access system that is mounted thereupon and provide a journal surface for rotational movement thereof and a thrust surface for axial loads therefrom. Depending on configuration, Journal surface 58 can be constructed either to allow rotation of access system 12 or not to allow such rotation. In circumstances where free movement of access system 12 is desired, journal surface 58 can be constructed as a journal bearing surface, one that would allow such movement. In other circumstances where the movement of access system 12 is preferred to be restricted, an ordinary journal surface 58 can be employed. Alternatively, Top entry access system can connect to other rigsite structures such as lifting bales or the top drive head itself. Internal seal bore 62 houses packoff gland assembly 54 that includes a bladder 68, a split rubber 70, and a line rubber 72. Backup rings 74 are positioned at the top and bottom of bladder 68 and include o-ring seals 76. Backup rings 74 and seals 76 help seal, isolate, and compress bladder 68, and rubbers 70, 72 against wireline (20 of Figures 1-2) run therethrough.
At its bottom, packoff gland assembly 54 is held in place by a bottom plate 78 secured by a bottom lip 80 of main body 52. Optionally, below bottom lip 80 of main body 52, a pin insert 82 and sealing ring 90 can be installed with bolts 84 to help align packoff assembly 50 into position on top of top drive assembly. At its top, packoff gland assembly 54 is compressed and held into place with an upper retainer nut 86. Upper retainer nut 86 has an outer threaded profile 88, and an inner threaded profile 90. Retainer nut 86 is installed by threading outer profile 88 into thread profile 66 of main body 52 until gland assembly 54 is properly compressed. Once retainer nut 86 is in position, a packoff safety cap 94 is installed and secured with bolts 96.

Above main body 52 roller assembly 56 is optionally installed. Roller assembly 56 preferably includes roller body 98, a plurality of rollers 100, a bushing 102, and a bushing cage 104. Rollers 100, mounted at the top of roller body 98 and secured with bearing pins 106 and cotter keys 108, smoothly guide wireline 20 into the main body 52 and through the gland assembly 54. A threaded profile 110 is located at the bottom of roller body 98 and corresponds with internal threaded profile 90 to engage roller assembly 56 into upper retainer nut 86. Bushing 102, preferably constructed of brass or any other standard bushing material, acts in conjunction with bushing cage 104 to compress and hold line rubber 72 in place.

Wireline conduit 20 enters packoff assembly 50 of Figure 3 at rollers 100, travels through bushing 102 to line rubber 72 and out through bottom plate 78 and pin insert 82 and into top drive drilling head assembly. A lubrication channel 112 is preferably pressurized with lubrication oil or other suitable lubricating fluid to help
maintain the sealing of wireline 20. Seals 77, 90, and bladder 68 maintain the isolation of lubrication channel 112 from the atmosphere.

Referring now to Figure 4, a packoff assembly 120 in accordance with a second preferred embodiment of the present invention is shown. Packoff assembly 120 is shown similarly to packoff assembly 50 of Figure 3, but with the inclusion of an extension housing 122 and a flow tube assembly 124. As with assembly 50 of Figure 3, packoff assembly 120 includes a main body 126 and a gland assembly 128. Main body 126 includes upper and lower threaded profiles 130, 132, an outer bearing surface 134, and a bore 136 to receive gland assembly 128. Gland assembly 128 is held in place with a gland retainer nut 138 but a seal retainer 140 holds gland assembly 128 in compression rather then a bushing and roller assembly (102 and 56 of Figure 3). Extension housing 122 includes an upper threaded profile 142, a lower mating pin 144, a receptacle bore 146, and a threaded securing nut 148. Extension housing 122 is installed upon the wireline entry inlet 28 of manifold 14, located just above the top drive assembly (not shown). While one embodiment of extension housing 122 is shown, it should be understood by one of ordinary skill in the art that housing 122 can be constructed in many different manners without departing from the spirit of the invention. Particularly, extension housing can be constructed integral to main body 52 of packoff assembly 50 (or 120), while maintaining the same characteristics of housing 122 shown in Figures 4 and 5.

Extension housing 122 allows for the installation of flow tube assembly 124 to help reduce the bore fluid pressure acting on wireline conduit 20 as it exits gland assembly. Flow tube assembly 124 includes a plurality of expansion cavities 150 that extend around wireline 120 from the bottom to the top of flow tube 124. A fluid
port 152 is connected to a main cavity 154 of flow tube 124 and is used to remove pressurized bore fluids from around wireline 20. Because of elevated borehole pressures, flow tube assembly 124 needs to be held in place inside housing 122 with a nut or a c-ring (not shown). Otherwise, sudden elevations in bore pressure could cause flow tube assembly 124 to “blow out” of its seat in housing 122.

As pressurized fluids flow from bottom of flow tube 124 to main cavity 154 the pressure is incrementally dropped after experiencing each cavity 150. Finally, fluids are siphoned off at port 152 to further effectuate the pressure drop, resulting in a fluid pressure at gland assembly 128 that is significantly lower than the fluid pressure at the top drive drilling assembly. This reduced pressure at gland assembly 128, allows for the insertion and removal of wireline conduit 20 from the drilling assembly with little or no escaping bore fluids. While a particular construction for flow tube assembly 124 is shown, it should be understood that various designs can be created and used by one skilled in the art. For instance, a flow tube with varying profiles and numbers of expansion cavities 150 can be used. The specific design and construction of flow tube assembly 124 will depend on variables such as bore pressure, the size of conduit 20, and the amount and rate of pressure drop desired. The example shown is not meant to limit the design, configuration, and construction of flow tube assembly 124, but is merely illustrative.

Referring still to Figure 4, one method of installing packoff assembly 120 with flow tube assembly 124 can be described. Extension housing 122 can first be installed atop entry inlet 28 of manifold 14 placing mating pin 144 into inlet 28 and tightening securing nut 148. Securing nut 148 has internal threads 156 that correspond to mating outside threads 158 of inlet 28. Furthermore, an o-ring 160 is
positioned on the outside of mating pin 144 to prevent the leakage of fluids therefrom. With Extension housing 122 secured to manifold 14, flow tube assembly 124 can then be inserted into the receptacle bore 146 of extension housing 144. O-rings 162 on the outer surface of flow tube assembly 124 are lubricated and installed to prevent the fluids from bypassing the internal cavities 150, 154 of flow tube assembly 124.

Next, a length of wireline conduit 20 is released and fed through the gland assembly 128 and main body 126 and then fed through flow tube assembly 124. With wireline conduit 20 pre-fed, main body 126 is threaded onto the upper threads 142 of extension housing 122 with corresponding lower thread profile 132. When packoff assembly 120 is so assembled, Top entry access system 12 can then be secured to the outer bearing surface 134 of main body 126. Preferably, upper threads 142 of extension housing 122 and mating outside threads 158 of inlet 28 are of the same design and construction. This way, if the flow tube assembly 124 is not needed for a particular operation, main body 126 can be threaded directly onto pin 28 without installing extension housing 122, similar to assembly shown in Figures 1-3.

Referring briefly to Figure 5, a packoff assembly 220 in accordance with a third preferred embodiment of the present invention is shown. Packoff assembly 220 is similar to packoff assembly 120 of Figure 4, but with the addition of a roller body 298 to the top of main body 226. Roller body 298 acts in a manner similar to roller body 98 of Figure 3 and helps guide wireline conduit 20 from top entry access system 12 into main body 226, through flow tube assembly 224 and extension housing 222 and into entry inlet 28 of manifold 14. As with extension housing 122 of
Figure 4, extension housing 222 is secured atop inlet 28 with a securing nut 248 that engages outer threads 258 of pin. Roller body 298 of Figure 5 would be installed atop gland assembly (not shown in Figure 5) in place of the retainer nut 138 shown in Figure 4. Alternatively, roller body 298 could be secured to the top of retainer nut 138 by any means known by one of ordinary skill in the art.

Numerous embodiments and alternatives thereof have been disclosed. While the above disclosure includes the best mode belief in carrying out the invention as contemplated by the named inventors, not all possible alternatives have been disclosed. For that reason, the scope and limitation of the present invention is not to be restricted to the above disclosure, but is instead to be defined and construed by the appended claims.
CLAIMS

What is claimed:

1. A top entry access system including a hydraulic packoff to allow a conduit into a bore of a drillstring, the hydraulic packoff comprising:
   a main body, said main body having a lower connection, a seal bore, an upper connection, and a mounting surface;
   said lower connection configured to attach to an inlet of the drillstring;
   said seal bore configured to receive a gland assembly;
   said gland assembly configured to allow the conduit to communicate with the bore of the drillstring without releasing drilling fluids therefrom; and
   said mounting surface configured to receive and secure the top entry access system thereupon.

2. The top entry access system of claim 1 wherein said gland assembly includes a bladder and line rubber.

3. The top entry access system of claim 2 wherein said gland assembly further includes back up rings, said backup rings configured to compress said bladder and said line rubber against the conduit.

4. The top entry access system of claim 1 wherein said upper connection is configured to receive a roller assembly to guide the conduit from the top entry access system into said gland assembly.

5. The top entry access system of claim 4 wherein said roller assembly includes a bushing to compress said gland assembly.

6. The top entry access system of claim 1 wherein said upper connection is configured to receive a retaining nut to retain and compress said gland assembly.

7. The top entry access system of claim 1 wherein said mounting surface includes a journal bearing surface configured to allow the rotational movement of the top entry access system with respect to said main body.
8. The top entry access system of claim 1 wherein said mounting surface includes a journal surface configured to resist rotational and bending forces exerted by the top entry access system on said main body.

9. The top entry access system of claim 1 wherein said mounting surface includes a thrust bearing surface configured to resist thrust and bending forces exerted by the top entry access system on said main body.

10. The top entry access system of claim 1 wherein said inlet is positioned on a manifold above a top drive drilling head.

11. The top entry access system of claim 1 wherein an extension housing and a flow tube assembly are positioned between said inlet and said main body.

12. The top entry access system of claim 11 wherein said extension housing is integral to said main body.

13. The top entry access system of claim 11 wherein pressures of said drilling fluids are reduced as said fluids extend up said flow tube assembly along the conduit.

14. The top entry access system of claim 1 further comprising a flow tube, wherein:

   said flow tube assembly includes a through bore and a plurality of expansion cavities arrayed along a length of said through bore;
   said through bore configured to receive the conduit therethrough;
   said through bore in fluid communication with said expansion cavities; and
   said expansion cavities configured to create a pressure reduction profile about the conduit as it extends along said length of said through bore.

15. The top entry access system of claim 14 wherein said flow tube assembly includes a fluid port configured to remove fluids and pressure from said through bore.
16. A hydraulic packoff for a top entry drilling assembly, the hydraulic packoff comprising:
   a main body, said main body having a lower connection, a seal bore, and a roller assembly;
   said seal bore configured to receive a seal gland assembly configured to allow a conduit to communicate with a bore of a drillstring without releasing drilling fluids therefrom; and
   said roller assembly positioned above and configured to guide said conduit into said gland assembly.

17. The hydraulic packoff of claim 16 wherein said seal gland assembly includes a bladder and a line rubber.

18. The hydraulic packoff of claim 16 wherein said seal gland assembly includes at least one backup ring.

19. The hydraulic packoff of claim 18 wherein said backup ring is configured to compress said seal gland assembly against the conduit.

20. The hydraulic packoff of claim 16 wherein said roller assembly includes a bushing to compress said gland assembly.

21. The hydraulic packoff of claim 16 further comprising a mounting surface to attach a top entry access system.

22. The hydraulic packoff of claim 21 wherein said mounting surface includes a journal bearing configured to allow the rotational movement of said top entry access system with respect to said main body.

23. The hydraulic packoff of claim 21 wherein said mounting surface includes a thrust bearing configured to resist thrust and bending forces exerted by said top entry access system on said main body.

24. The hydraulic packoff of claim 16 wherein said lower connection connects to an entry inlet of a top drive drilling assembly.
25. The hydraulic packoff of claim 16 further comprising an extension housing extending from said lower connection, said extension housing providing a seal bore to receive a flow tube assembly.

26. The hydraulic packoff of claim 16 further comprising:
   a flow tube assembly, said flow tube assembly comprising a through bore and a plurality of expansion cavities arrayed along a length of said through bore;
said through bore configured to receive the conduit therethrough;
said through bore in fluid communication with said expansion cavities; and said expansion cavities configured to create a pressure reduction profile about the conduit as it extends along said length of said through bore.

27. The hydraulic packoff of claim 26 wherein said flow tube assembly includes a fluid port configured to remove fluids and pressure from said through bore.

28. A hydraulic packoff for a top entry drilling assembly, the hydraulic packoff comprising:
   a main body, said main body having a lower connection, a seal bore, and a retaining nut;
said seal bore configured to receive a seal gland assembly, said seal gland configured to allow a conduit to communicate with a bore of a drillstring without releasing drilling fluids therefrom; and
   said retaining nut positioned above and configured to compress said gland assembly.

29. The hydraulic packoff of claim 28 wherein said seal gland assembly includes a bladder and a line rubber.

30. The hydraulic packoff of claim 28 wherein said seal gland assembly includes at least one backup ring.

31. The hydraulic packoff of claim 30 wherein said backup ring is configured to compress said seal gland assembly against the conduit.
32. The hydraulic packoff of claim 28 further comprising:

a flow tube assembly, said flow tube assembly comprising a through bore and
a plurality of expansion cavities arrayed along a length of said through
bore;
said through bore configured to receive the conduit therethrough;
said through bore in fluid communication with said expansion cavities; and
said expansion cavities configured to create a pressure reduction profile
about the conduit as it extends along said length of said through bore.

33. A hydraulic packoff for a top entry drilling assembly, the hydraulic packoff
comprising:

a main body, said main body having a lower connection, a seal bore, and a
retaining device;
a seal gland configured to be received in said seal bore, said seal gland
configured to allow a conduit to communicate with a bore of a drillstring
without releasing drilling fluids therefrom;
a flow tube assembly, said flow tube assembly comprising a through bore and
a plurality of expansion cavities arrayed along a length of said through
bore;
said through bore configured to receive the conduit therethrough;
said through bore in fluid communication with said expansion cavities;
said expansion cavities configured to create a pressure reduction profile
about the conduit as it extends along said length of said through bore; and
said retaining device positioned above and configured to compress said
gland assembly.

34. The hydraulic packoff of claim 33 wherein said retaining device is a roller
head.

35. The hydraulic packoff of claim 34 wherein said retaining device is a retaining
nut.
36. A method for entering a conduit into a pressurized bore of a drillstring driven
by a top drive assembly, the method comprising:
   connecting a hydraulic packoff and an extension housing to an inlet of the
   drillstring, the inlet located above a drive motor of the top drive assembly;
   installing a flow tube assembly inside a bore of the extension housing;
   connecting a top entry access system above the hydraulic packoff; and
   routing the conduit from a supply, through the top entry access system, into
   the hydraulic packoff, through the flow tube assembly, through the drillstring
   inlet and into the drillstring.

37. The method of claim 36 wherein the flow tube assembly includes:
   a through bore and a plurality of expansion cavities arrayed along a length of
   the through bore;
   the through bore configured to receive the conduit therethrough;
   the through bore in fluid communication with the expansion cavities; and
   the expansion cavities configured to create a pressure reduction profile about
   the conduit as it extends along the length of the through bore.

38. The method of claim 37 wherein the flow tube assembly further includes a
   fluid port, the fluid port in fluid communication with the through bore.

39. The method of claim 38 further comprising removing pressurized fluid from
   the fluid port to reduce the pressure in the through bore and in the hydraulic packoff.

40. The method of claim 36 wherein the extension housing is integral to the
    hydraulic packoff.

41. The method of claim 36 wherein the hydraulic packoff includes a roller body,
    the roller body configured to guide the conduit from the top entry access system into
    a seal gland of the hydraulic packoff.

42. The method of claim 36 wherein the hydraulic packoff includes a seal gland,
    the seal gland including a bladder and a line rubber.