MULTI-COMPONENT TUBULAR COUPLING FOR WELLHEAD SYSTEMS

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to U.S. Provisional Patent Application No. 61/165,481, entitled "Multi-Component Tubular Coupling Wellhead Systems", filed on March 31, 2009, which is herein incorporated by reference in its entirety.

BACKGROUND

[0002] This section is intended to introduce the reader to various aspects of art that may be related to various aspects of the present invention, which are described and/or claimed below. This discussion is believed to be helpful in providing the reader with background information to facilitate a better understanding of the various aspects of the present invention. Accordingly, it should be understood that these statements are to be read in this light, and not as admissions of prior art.

[0003] As will be appreciated, oil and natural gas have a profound effect on modern economies and societies. Indeed, devices and systems that depend on oil and natural gas are ubiquitous. For instance, oil and natural gas are used for fuel in a wide variety of vehicles, such as cars, airplanes, boats, and the like. Further, oil and natural gas are frequently used to heat homes during winter, to generate electricity, and to manufacture an astonishing array of everyday products.

[0004] In order to meet the demand for such natural resources, companies often invest significant amounts of time and money in searching for and extracting oil, natural gas, and other subterranean resources from the earth. Particularly, once a desired resource is discovered below the surface of the earth, drilling and production systems are often employed to access and extract the resource. These systems may be located onshore or offshore depending on the

location of a desired resource. Further, such systems generally include a wellhead assembly through which the resource is extracted. These wellhead assemblies may include a wide variety of components, such as various casings, valves, fluid conduits, and the like, that control drilling and/or extraction operations.

[0005] Couplings (also referred to as connectors) are employed to attach certain components together and to wellhead housings. Existing connectors often require machining of the components and/or the connector, such as to machine threads or other fastening mechanism into the component and/or connector. Further, existing connectors may be manufactured for each type and diameter of connection, resulting in increased cost and inventory. Additionally operations to attach or remove existing connectors may be generally expensive and time-consuming.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Various features, aspects, and advantages of the present invention will become better understood when the following detailed description is read with reference to the accompanying figures in which like characters represent like parts throughout the figures, wherein:

[0007] FIGS. 1A and 1B are block diagrams of a mineral extraction system in accordance with an embodiment of the present invention;

[0008] FIG. 2 is a cross-section of a BOP stack and multi-component tubular coupling in accordance with an embodiment of the present invention;

[0009] FIG. 3 depicts a cross-section of the multi-component tubular coupling in accordance with an embodiment of the present invention;

[0010] FIG. 4 depicts an exploded view of the multi-component tubular coupling in accordance with an embodiment of the present invention;

[0011] FIG. 5 is a partial cross-section of FIG. 1B depicting the tubing spool connected to the multi-component tubular coupling in accordance with an embodiment of the present invention;

[0012] FIG. 6 is a cross-section of the multi-component tubular coupling having lock screws in combination with internal threads on a second tubular member in accordance with another embodiment of the present invention;

[0013] FIG. 7 is a cross-section of the multi-component tubular coupling having lock screws and without internal threads on the second tubular member in accordance with another embodiment of the present invention;

[0014] FIG. 8 is a cross-section of the multi-component tubular coupling without a second tubular member in accordance with another embodiment of the present invention; and

[0015] FIG. 9 is a cross-section of a tubing spool and the multi component tubular coupling without the second tubular member in accordance with another embodiment of the present invention

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

[0016] One or more specific embodiments of the present invention will be described below. These described embodiments are only exemplary of the present invention. Additionally, in an effort to provide a concise description of these exemplary embodiments, all features of an actual implementation may not be described in the specification. It should be appreciated that in the development of any such actual implementation, as in any engineering or design project, numerous implementation-specific decisions must be made to achieve the developers' specific goals, such as compliance with system-related and business-related constraints, which may vary from one implementation to another. Moreover, it should be appreciated that such a development effort might be complex and time consuming, but would nevertheless be a routine undertaking of design, fabrication, and manufacture for those of ordinary skill having the benefit of this disclosure.

[0017] Embodiments of the present invention include a multi-component tubular coupling for wellhead components. In one embodiment, the coupling includes a first tubular member, a landing ring, and a second tubular member. In another embodiment, the coupling includes only the first tubular member and the landing ring. The landing ring may engage the first tubular member via a threaded connection. The second tubular member may be disposed over the landing ring and include protrusions extending underneath a flanged portion of the landing ring. The second tubular member may include internal threads configured to couple to a wellhead component, securing the wellhead component to the coupling. In some embodiment, the first tubular member may be a coupling having standardized threads and/or diameters. Other embodiments of the multi-component tubular coupling may include lock screws with or without the internal threads.

[0018] FIGS. 1A and 1B are a block diagrams that illustrates an embodiment of a mineral extraction system 10. As discussed below, one or more tubular couplings are employed throughout the system 10. The illustrated mineral extraction system 10 can be configured to extract various minerals and natural resources, including hydrocarbons (e.g., oil and/or natural gas), or configured to inject substances into the earth. In some embodiments, the mineral extraction system 10 is land-based (e.g., a surface system) or subsea (e.g., a subsea system). As illustrated, the system 10 includes a wellhead assembly 12 coupled to a mineral deposit 14 via a well 16, wherein the well 16 includes a wellhead hub 18 and a well-bore 20. The wellhead hub 18 generally includes a large diameter hub that is disposed at the termination of the well-bore 20. The wellhead hub 18 provides for the sealable connection of the wellhead assembly 12 to the well 16.

[0019] The wellhead assembly 12 typically includes multiple components that control and regulate activities and conditions associated with the well 16. For example, the wellhead assembly 12 generally includes bodies, valves and seals that route produced minerals from the mineral deposit 14, provide for regulating pressure in the well 16, and provide for the injection of chemicals into the well-bore 20 (down-hole). For example, FIG. 1A illustrates a blowout preventer (BOP)

stack 22 coupled to a casing spool 24 via a tubular coupling 26, such as during changing of components of the system 10. FIG. 1B depicts another operation of the wellhead assembly illustrating a tubing spool 28 coupled to the casing spool 24 via the tubular coupling 26, such as during installation of a tubing hanger and extraction of the mineral from the well 16.

[0020] In the illustrated embodiment, the wellhead assembly 12 may include what is colloquially referred to as a Christmas tree 29 (hereinafter, a tree). The system 10 may include other devices that are coupled to the wellhead assembly 12, and devices that are used to assemble and control various components of the wellhead assembly 12. For example, in FIG. 1A, the system 10 includes a tool 30 suspended from a drill string 32. In certain embodiments, the tool 28 includes a running tool that is lowered (e.g., run) from an offshore vessel to the well 16 and/or the wellhead 12. In other embodiments, such as surface systems, the tool 30 may include a device suspended over and/or lowered into the wellhead 12 via a crane or other supporting device.

[0021] The blowout preventer (BOP) stack 22 may also be included during drilling or workover operations. The BOP may consist of a variety of valves, fittings and controls to prevent oil, gas, or other fluid from exiting the well in the event of an unintentional release of pressure or an unanticipated overpressure condition. The BOP 22 may be hydraulically operated and may close the wellhead assembly 12 or seal off various components of the wellhead assembly 12. During operation of the system 10, a BOP 22 may be installed during removal or installation of additional components, changes in operation of the system 10, or for other safety reasons. For example, in one embodiment, installation of the BOP 22 may be performed before installation of the tubing spool 28, such as for moving to production. As described further below, the BOP 22 may be coupled to the casing spool 24 by the multi-component tubular coupling 26. The BOP 22 may be removed from the wellhead assembly 12 and the tubing spool 28 may then be coupled to the casing spool 24 using the tubular coupling 26.

[0022] Turning in more detail to FIG. 1B, the tree 29 generally includes a variety of flow paths (e.g., bores), valves, fittings, and controls for operating the well 16. For instance, the tree 29 may include a frame that is disposed about a tree body, a flow-loop, actuators, and valves. Further, the tree 29 may provide fluid communication with the well 16. For example, the tree 29 includes a tree bore 34. The tree bore 34 provides for completion and workover procedures, such as the insertion of tools (e.g., the hanger) into the well 16, the injection of various chemicals into the well 16 (down-hole), and the like. Further, minerals extracted from the well 16 (e.g., oil and natural gas) may be regulated and routed via the tree 29. For instance, the tree 12 may be coupled to a jumper or a flowline that is tied back to other components, such as a manifold. Accordingly, produced minerals flow from the well 16 to the manifold via the wellhead assembly 12 and/or the tree 29 before being routed to shipping or storage facilities.

[0023] The tubing spool 28 provides a base for the tree 29. Typically, the tubing spool 28 is one of many components in a modular subsea or surface mineral extraction system 10 that is run from an offshore vessel or surface system. The tubing spool 28 includes a tubing spool bore 36. The tubing spool bore 36 sealably connects (e.g., enables fluid communication between) the tree bore 34 and the well 16. Thus, the tubing spool bore 36 may provide access to the well bore 20 for various completion and worker procedures. For example, components can be run down to the wellhead assembly 12 and disposed in the tubing spool bore 36 to seal-off the well bore 20, to inject chemicals down-hole, to suspend tools down-hole, to retrieve tools down-hole, and the like. As mentioned above, the tubing spool 28 may be coupled to the casing spool 24. The casing spool 24 may include a bore 33 that sealably connects to the tubing spool bore 36 and may provide for casing or other components to be suspended or inserted into the casing spool 24.

[0024] FIG. 2 is a cross-section of the BOP stack 22 and the multi-component tubular coupling 26 in accordance with an embodiment of the present invention. The multi-component tubular coupling 26 may include a first tubular member 38,

a landing ring 40, and a second tubular member 42, e.g., a union nut. A casing string 44 may be installed in the casing spool 24 and extend though the coupling 26.

[0025] As shown in FIG. 2, the first tubular member 38, the landing ring 40, and the second tubular member 42 may be disposed concentrically around the bore 33 of the casing spool 24. As described in further detail below, the first tubular member 38, the landing ring 40, and the second tubular member 42 may be stacked axially to provide the assembled multi-component tubular coupling 26. The first tubular member 38 includes one or more inlets 39 and outlets 41. The landing ring 40 may include external threads 46 to couple to internal threads 48 of the first tubular member 38. The landing ring 40 may include annular seals 50 to seal against the second tubular member 42.

[0026] During installation, the BOP 22 may land on an upper portion 52 of the landing ring 40 of the coupling 26. The BOP 22 may be further secured to the second tubular member 42 via external threads 54. The external threads 54 may engage internal threads 56 of the second tubular member 42. The BOP 22 may be installed by rotating the second tubular member 42 into engagement with the lower portion of the BOP 22.

[0027] FIG. 2 also includes a seal ring assembly 58 to provide sealing of the lower portion of the wellbore below the BOP 22. The seal ring assembly 58 may land on an internal beveled protrusion 60 of the landing ring 40. The seal ring assembly 58 may include external annular seals 62 to seal the seal ring against the landing ring 40. The seal ring assembly 58 may also include one or more internal annular seals 64 to seal an internal coupling 66, e.g., threaded sleeve, of the seal assembly 58.

[0028] Turning now in greater detail to the multi-component tubular coupling 26, FIG. 3 depicts a cross-section of the multi-component tubular coupling 26 and FIG. 4 depicts an exploded view of the multi-component tubular coupling 26 in accordance with an embodiment of the present invention. As mentioned above, the multi-component tubular coupling 26 includes the first tubular member

38, the landing ring 40, and the second tubular member 42 arranged concentrically around a center axis 68, such as the center axis of the bore 33. In some embodiments, as described below, the second tubular member 42 may be omitted from the assembled multi-component tubular coupling 26.

[0029] As shown in FIG. 3, the landing ring 40 may be axially stacked onto the first tubular member 38 such that a portion 69 of the landing ring 40 extends axially into the interior of the first tubular member 38. The landing ring 40 may include an upper flanged portion 70 extending radially outward over the edge of the first tubular coupling 38. The landing ring 40 includes the internal beveled protrusion 60 to provide a landing point for various components coupled to the multi-component tubular coupling 26. As more clearly seen in FIG. 4, the landing ring 40 includes external threads 46 around the portion 69 of the landing ring 40 that extends axially into the interior of the first tubular member 38. The first tubular member 38 includes interior threads 48 configured to couple to the exterior threads 46 of the landing ring 40. In one embodiment, the interior threads 48 and exterior threads 46 may be API LCSG threads, such as Bakerlok® threads. Thus, the landing 40 may be coupled to the first tubular member 38 by engaging the exterior threads 46 of the landing ring 40 with the interior threads 48 of the first tubular member 38.

[0030] The second tubular member 42, e.g., a union nut, may include a annular protrusion 72 that extends radially inward underneath the upper flanged portion 70 to couple the second tubular member 42 to the landing ring 40 and, thus, to the first tubular member 38. As also mentioned above, the second tubular member 42 includes internal threads 56 to enable the second tubular member 42 to couple to a wellhead component coupled by the coupling 26.

[0031] The first tubular member 38 includes the inlet 39, the outlet 41, and internal threads 48. Advantageously, in some embodiments, the first tubular member 38 may be a standardized coupling having standardized internal and external diameters and/or standard threads. In such an embodiment, the inlet 39 and outlet 41 may be welded onto the first tubular member 38. Use of a standard

coupling for the first tubular member 38 may reduce cost and increase availability of the multi-component tubular coupling 26. Additionally, elimination of any machining of the first tubular member 38 (by using the included threads on a standard coupling and welding the inlet 39 and outlet 41) also reduces cost and difficulty of manufacture. By using a standardized coupling for the first tubular member 38, the multi-component coupling may be more easily assembled (including easier assembly in the field) for a reduced cost as compared to non-standard specially designed and machined couplings.

[0032] FIG. 5 is a partial cross-section of FIG. 1B depicting the tubing spool 28 connected to the multi-component tubular coupling 26 in accordance with an embodiment of the present invention. As shown in FIG. 5, the tubing spool 28 may be installed by engaging the tubing spool 28 with the upper surface of the landing ring 40, such that the tubing spool 28 fits over the internal coupling 66 of the seal assembly 58. The tubing spool 28 may be further engaged with the wellhead assembly by the engagement of the internal threads 56 of the second tubular member 42 with external threads 76 of the tubing spool 28. As described above, the BOP 22 may be first removed from the multi-component tubular coupling 26 and then the tubing spool 28 may be installed on the multi-component tubular coupling 26 to couple the tubing spool 28 to the casing spool 24. In this manner, the BOP 22, tubing spool 28, and/or any other component may be interchangeably coupled to the casing spool 24 via the multi-component tubular coupling 26 without additional machining of the coupling 26 and/or the BOP 22, tubing spool 28, and/or other component. Additionally, the flanged portion 70 of the landing ring 40 is axially captured from below by the annular protrusion 72 and from above by the tubing spool 28 or other component.

[0033] In some embodiments, the multi-component tubular coupling 26 may include lock screws for securing the second tubular member 42 of the coupling 26, either alone or in combination with the internal threads 56 of the second tubular member 42. FIG. 6 depicts an alternate embodiment of the multi-component tubular coupling 26 having lock screws 80 in combination with internal threads 56. As shown in FIG. 6, the lock screws 80 may insert radially in

a receptacle 82 of the second tubular member 42. The lock screws 80 may insert through the second tubular member 42 to engage the flanged portion 70 of the landing ring 40. In such an embodiment, the second tubular member 42 may not include the annular protrusion 72, with the function of such protrusion 72 instead being replaced by the engagement of the lock screws 80 with the flanged portion 70 of the landing ring 40.

[0034] As described above, the tubing spool 28 is coupled to the second tubular member 42 via engagement of internal threads 56 with external threads 76 of the tubing spool 28. The addition of the lock screws 80 further secure the tubing spool 28 and the second tubular member 42 to the landing ring 40, preventing further axial translation and/or rotational movement of the tubing spool 28. Thus, the flanged portion 70 is axially captured between the lock screws 80 engaging the flanged portion 70 from below, and the threaded connection (e.g., threads 56 and 76) between the second tubular member 42 and the tubing spool 28 from above. It should be appreciated that lock screws 80 may be replaced by any suitable fastener, such as pins, tie down screws, etc.

[0035] FIG. 7 depicts an alternate embodiment of the multi-component tubular coupling 26 having lock screws 84 and without internal threads 56 on the second tubular member 42. As shown in FIG. 7, one or more lock screws 84 may insert radially in one or more receptacles 86 of the second tubular member 42. The receptacle 86 is located at and may replace the internal threads 56 of the second tubular member 42. Instead of or in addition to external threads 76, the tubing spool 28 may include recesses 88 configured to receive the lock screws 84. Thus, to engage the multi-component tubular coupling 26 with the tubing spool 28, the lock screws 84 may be inserted radially through the receptacle 86 of the second tubular member 42 and into engagement with the recesses 88 of the tubing spool 28. In such embodiment, the second tubular member 42 may also include the annular protrusion 72 extending under the flanged portion 70 of the landing ring 40. The flanged portion 70 of the landing ring 40 is axially captured between the annular protrusion 72 of the second tubular member 42 and the tubing spool 28 or other component.

[0036] In some embodiments, the multi-component tubular coupling 26 may only include the first tubular member 38 and the landing ring 40, without the second tubular member 42. FIG. 8 depicts an alternate embodiment of the multi-component tubular coupling 26 without the second tubular member 42. As shown in FIG. 8, this embodiment of the multi-component tubular coupling 26 only includes the first tubular member 38 and the landing ring 40. The first tubular member 38 maintains the inlet 39 and outlet 41, which may be welded to a standard coupling as described above. Similarly, the portion 69 the landing ring 40 is partially disposed inside the first tubular member 38 and maintains the upper flanged portion 70 extending radially outward over the wall of the first tubular member 38. The landing ring 40 includes external threads 46 to couple the landing ring to the internal threads 48 of the first tubular member 38.

[0037] FIG. 9 depicts the multi component tubular coupling 26 of FIG. 8 without the second tubular member 42 in the wellhead assembly 12 in accordance with an alternate embodiment of the present invention. In such an embodiment, as shown in FIG. 9, the tubing spool 28 may include an axially extended annular portion 90 that extends over the landing ring 40. The extended annular portion 90 may include lock down screws 92 inserted into receptacles 94. The lock screws 92 may be inserted through the receptacles 94 and into engagement with a tapered surface 96 of the upper flanged portion 70 of the landing ring 40. In this embodiment, the tubular spool 28 may or may not include external threads; however, the lock screws 92 are used to couple the tubing spool 28 to the multi-component tubular coupling 26, preventing axial translation and/or rotational movement of the tubing spool 28. The multi-component tubular coupling 26 depicted in FIG. 9 does not include the second tubular member 42, as the lock down screws 92 provide the engagement between the tubing spool 28 and the coupling 26 and, thus, between the tubing spool 22 and the casing spool 24.

[0038] While the invention may be susceptible to various modifications and alternative forms, specific embodiments have been shown by way of example in the drawings and have been described in detail herein. However, it should be

understood that the invention is not intended to be limited to the particular forms disclosed. Rather, the invention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the following appended claims.

CLAIMS

1. A coupling for wellhead components, comprising:

a first tubular member comprising first internal threads, an inlet and an outlet;

a landing ring comprising external threads and an external annular protrusion extending radially outward over the first tubular member, wherein the landing ring is coupled to the first tubular member; and

a second tubular member comprising second internal threads and an internal protrusion extending radially outward under the external annular protrusion of the landing ring, wherein the landing ring is axially stacked on the first tubular member and the second tubular member is stacked on the second tubular member.

2. The coupling of claim 1, wherein the second internal threads are configured to couple to a wellhead component.

3. The coupling of claim 2, wherein the second wellhead component comprises a BOP stack, a running tool, a tubing spool, or a casing spool.

4. The coupling of claim 1, wherein the landing ring comprises an internal annular protrusion configured to provide a landing point for a wellhead component.

5. The coupling of claim 1, wherein the second tubular member comprises lock screws configured to engage the external annular protrusion of the landing ring.

6. The coupling of claim 1, wherein the inlet and outlet are welded onto the first tubular member.

7. A wellhead system, comprising:

a first component coupled to a second component via a coupling; wherein the coupling comprises:

a first tubular member disposed at least partially around the second component;

a landing ring axially engaged with the first tubular member and having portion extending axially into an annulus of the first tubular member; and

a second tubular member disposed at least partially around the first tubular member, the landing ring, and the first component, wherein the second tubular member comprises internal threads configured to couple to external threads of the first component.

8. The wellhead system of claim 7, comprising a seal assembly disposed inside the second component and axially landed on an interior portion of the landing ring.

9. The wellhead system of claim 7, wherein the second component comprises a casing spool, a tubing spool, or a blowout preventer.

10. The wellhead system of claim 7, wherein the first component comprises a tubing spool, a blowout preventer, or a tree.

11. The wellhead system of claim 7, wherein the first tubular member comprises one or more fluid orifices fluidly connected to the bore of the second component.

12. The wellhead system of claim 7, wherein the second tubular member comprises one or more radial receptacles configured to radially receive one or more fasteners.

13. The wellhead system of claim 12, wherein the second tubular member comprises one or more fasteners inserted radially in the one or more radially receptacles and into engagement with the flanged portion of the landing ring.

14. The wellhead system of claim 13, wherein the flanged portion is axially captured by the second component and the one or more fasteners.

15. A system, comprising:

a first component;

a multi-component tubular coupling coupled to the first component, comprising:

a first tubular member comprising an annular wall and first internal threads disposed on the annular wall, wherein the first tubular member is coupled to the first component via the first internal threads; and

a landing ring partially disposed inside the first tubular member, wherein the landing ring comprises a flanged portion extending radially over a portion of the annular wall, wherein the flanged portion comprises a contoured surface configured to engage a lock down screw.

16. The system of claim 15, comprising a second component coupled to the multi-component tubular coupling, wherein the second component comprises an annular extension disposed fully or partially axially over the flanged portion of the landing ring, wherein the annular extension comprises radial receptacles and fasteners inserted radially into the radial receptacles to engage the flanged portion of the landing ring.

17. The system of claim 15, comprising a second tubular member disposed over the flanged portion of the landing ring.

18. The system of claim 17, wherein the second tubular member comprises a radial receptacle and a fastener inserted radially into the radial receptacle such the fastener engages the flanged portion of the landing ring.

19. The system of claim 18, wherein the second tubular member comprises secured internal threads configured to couple to a second component.

20. The system of claim 19, wherein the second tubular member comprises one or more radial receptacles and one or more fasteners inserted radially into the one or more radial receptacles respectively such that the fastener engages a recess on the second component.