

DYNAMIC RISER STRING HANG-OFF ASSEMBLY

BACKGROUND

[0001] Offshore oil and gas operations often utilize a wellhead housing supported on the ocean floor and a blowout preventer stack secured to the wellhead housing's upper end. A blowout preventer stack is an assemblage of blowout preventers and valves used to control well bore pressure. The upper end of the blowout preventer stack has an end connection or riser adapter (often referred to as a lower marine riser package, or LMRP) that allows the blowout preventer stack to be connected to a series of pipes, known as riser, riser string, or riser pipe. Each segment of the riser string is connected in end-to-end relationship, allowing the riser string to extend upwardly to the drilling rig or drilling platform positioned over the wellhead housing.

[0002] The riser string is supported at the ocean surface by the drilling rig and extends to the subsea equipment through a moon pool in the drilling rig. A rotary table and associated equipment typically support the riser string during installation. Below the rotary table may also be a diverter, a riser gimbal, and other sensitive equipment.

[0003] During installation of the riser string, it may be necessary to temporarily move the entire drilling rig, such as for example when a strong storm is approaching. Before moving the rig, it is necessary to pull up the entire riser. If the riser were left in place, movement of the rig would cause the riser string to damage the rotary table, diverter, gimbal, and other sensitive equipment. Pulling up each section of riser string takes a long time, adding cost to the overall drilling operations. Additionally, there may not be enough time to pull the entire riser string before the rig needs to be moved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] For a detailed description of the preferred embodiments of the invention, reference will now be made to the accompanying drawings in which:

[0005] FIGS. 1A–1B show a drilling system;

[0006] FIG. 2 shows a perspective view of a dynamic hang-off assembly in accordance with various embodiments;

[0007] FIG. 3 shows a side elevation view of the dynamic hang-off assembly of FIG. 2;

[0008] FIG. 4 shows a top view of the dynamic hang-off assembly of FIG. 2;

[0009] FIG. 5A shows a side elevation view of the dynamic hang-off assembly of FIG. 2 shown cutaway in a plane A–A of FIG. 4;

[0010] FIG. 5B shows a side elevation view of the detail area B of FIG. 5A; and

[0011] FIG. 6 shows a perspective view of the dynamic hang-off assembly of FIG. 2 shown cutaway in a plane A–A of FIG. 4.

DETAILED DESCRIPTION

[0012] The following discussion is directed to various embodiments of the invention. The drawing figures are not necessarily to scale. Certain features of the embodiments may be shown exaggerated in scale or in somewhat schematic form and some details of conventional elements may not be shown in the interest of clarity and conciseness. Although one or more of these embodiments may be preferred, the embodiments disclosed should not be interpreted, or otherwise used, as limiting the scope of the disclosure, including the claims. It is to be fully recognized that the different teachings of the embodiments discussed below may be employed separately or in any suitable combination to produce desired results. In addition, one skilled in the art will understand that the following description has broad application, and the discussion of any embodiment is meant only to be exemplary of that embodiment, and not intended to intimate that the scope of the disclosure, including the claims, is limited to that embodiment.

[0013] Certain terms are used throughout the following description and claims to refer to particular features or components. As one skilled in the art will appreciate, different persons may refer to the same feature or component by different names. This document does not intend to distinguish between

components or features that differ in name but not function. The drawing figures are not necessarily to scale. Certain features and components herein may be shown exaggerated in scale or in somewhat schematic form and some details of conventional elements may not be shown in interest of clarity and conciseness.

[0014] In the following discussion and in the claims, the terms “including” and “comprising” are used in an open-ended fashion, and thus should be interpreted to mean “including, but not limited to... .” Also, the term “couple” or “couples” is intended to mean either an indirect or direct connection. Thus, if a first device couples to a second device, that connection may be through a direct connection, or through an indirect connection via other devices, components, and connections. In addition, as used herein, the terms “axial” and “axially” generally mean along or parallel to a central axis (e.g., central axis of a body or a port), while the terms “radial” and “radially” generally mean perpendicular to the central axis. For instance, an axial distance refers to a distance measured along or parallel to the central axis, and a radial distance means a distance measured perpendicular to the central axis.

[0015] Figures 1A–1B show a drilling system 100 in accordance with various embodiments. The drilling system 100 includes a platform of a drilling rig 126 with a riser string 122 and a blowout preventer stack 112 used in oil and gas drilling operations connected to a wellhead housing 110. The wellhead housing 110 is disposed on the ocean floor and connected with the blowout preventer stack 112 with a hydraulic connector 114. The blowout preventer stack 112 includes multiple blowout preventers 116 and kill and choke valve 118 in a vertical arrangement to control well bore pressure in a manner known to those of skill in the art. Disposed on the upper end of the blowout preventer stack 112 is a riser adapter 120 to allow connection of the riser string 122 to the blowout preventer stack 112. The riser string 122 is composed of multiple sections of pipe or riser joints 124 connected end to end and extending upwardly to the drilling rig 126.

[0016] The drilling rig 126 further includes a moon pool 128 having a telescoping joint 130 disposed therein. The telescoping joint 130 includes an inner barrel 132 that telescopes inside an outer barrel 134 to allow relative motion between the drilling rig 126 and the wellhead housing 110. A dual packer 135 is disposed at the upper end of the outer barrel 134 and seals against the exterior of inner barrel 132. A landing tool adapter joint 136 is connected between the upper end of the riser string 122 and the outer barrel 134 of the telescoping joint 130. A tension ring 138 is secured on the exterior of the outer barrel 134 and connected by tension lines 140 to a hydraulic tensioning system as known to those skilled in the art. This arrangement allows tension to be applied by the hydraulic tensioning system to the tension ring 138 and the telescoping joint 130. The tension is transmitted through the landing tool adapter joint 136 to the riser string 122 to support the riser string 122. The upper end of the inner barrel 132 is terminated by a flex joint 142 and a diverter 144 connecting to a gimbal 146 and a rotary table spider 148.

[0017] Before, and even after installation of the riser string 122 to the subsea equipment, it may become necessary to detach the riser string 122 from the diverter 144, the gimbal 146, rotary table 148, and any other sensitive equipment. For example, the drilling rig 126 may need to be moved from one location to another and movement of the drilling rig 126 relative to the riser would damage the equipment. In such cases, instead of pulling up and dismantling the entire riser string 122, the drilling rig 126 may include a dynamic hang-off assembly 200 as shown in FIGS. 2–6 to support the riser string 122 after it is detached from the diverter 144 and other equipment.

[0018] As shown in FIGS. 2–6, the dynamic hang-off assembly 200 includes the tension ring 138 that includes a housing 210 with a passage through the housing 210. Alternatively, the housing 210 may be designed specifically for the hang-off assembly and replace the tension ring 138. The housing 210 is connected by the tension lines 140 to a dynamic tensioning system such as described above and as known to those skilled in the art. The housing 210 is shown as a ring but it should be appreciated that the housing 210 may be any

suitable shape to support the riser string 122. Although not shown connected in FIGS. 2–6, the tension lines 140 attach to the housing 210 at connection points 212 to support the housing 210 in the moon pool 128.

[0019] The hang-off assembly 200 also includes an adapter 250 attachable to the riser string 122. The adapter 250 includes a profile 252 on the outside of a radially extended portion of the adapter 250 as shown. It should be appreciated that the configuration of the adapter 250 and the profile 252 shown are examples only and that different dimensions and locations may be used. The profile 252 is shown as annular but need not be formed continuously on the outside surface of the adapter 250. The adapter profile 252 is shaped to enable the adapter 250 to be supported by the housing 210 to support the riser string 122 as described below.

[0020] Shown in FIGS. 5A, 5B, and 6, the housing 210 further includes one or more locking mechanisms 218 that engage the adapter profile 252 to secure the adapter 250 to the housing 210. In some embodiments, the locking mechanisms 218 are hydraulically operated. In other embodiments, the locking mechanisms 218 are mechanically operated. The locking mechanisms 218 may be either hydraulically or mechanically operated in some embodiments. Shown in the figures are examples of hydraulically operated locking mechanisms 218 that include a slide actuated between locked and unlocked positions with a hydraulic piston. Additional back-up or secondary locking mechanisms may also be included.

[0021] The hang-off assembly 200 is designed to be attached to the tensioning system on the drilling rig 126 to hang the riser string 122 through the drilling rig moon pool 128. As shown, the riser string 122 and the flex joint 142 are detached from the diverter 144, the gimbal 146, and the rotary table spider 148. The riser adapter 250 is attached to the flex joint 142 using a connection flange on the adapter 250. A riser string running tool 300 is attached to the adapter 250 opposite the riser string 122. The riser string running tool 300 is used on the drilling rig 126 to support and move the riser string 122 into position so that the riser string 122 can be supported by the hang-off

assembly 200. With the housing 210 and the adapter 250 positioned as shown, the locking mechanisms 218 are actuated to lock the adapter 250 to the housing 210. Once in position, the housing 210 thus secures the adapter 250 and supports the riser 122 using the dynamic tensioning system on the rig 126. This allows tension to be applied by the tensioning system to the housing 210. The tension is transmitted through the housing 210 and the adapter 250 to the riser string 122 to support the riser string 122. With the riser string 122 locked in the dynamic hang-off assembly 200 and supported by the tensioning system of the rig 126, the dynamic hang-off assembly 200 is able to dynamically adjust to maintain tension on the riser string 122. The rig 126 may now be moved to a different location while the riser string 122 remains suspended through the moon pool 128.

[0022] Although the present invention has been described with respect to specific details, it is not intended that such details should be regarded as limitations on the scope of the invention, except to the extent that they are included in the accompanying claims.

CLAIMS

What is claimed is:

1. A dynamic hang-off assembly for supporting a riser string from an off-shore drilling rig including a dynamic tensioning system, including:
 - a housing dynamically supportable by the tensioning system, the housing including a passage through the housing;
 - an adapter positionable within the housing passage, the adapter including a profile on an outer surface, the riser string being attachable to the adapter;
 - the housing further including a locking mechanism actuatable to engage the adapter profile and secure the adapter to the housing;
 - wherein the assembly dynamically supports the riser string when the housing is supported by the tensioning system, the riser string is attached to the adapter, and the adapter is secured in the housing.
2. The dynamic hang-off assembly of claim 1, further comprising more than one locking mechanism.
3. The dynamic hang-off assembly of claim 2, wherein the locking mechanisms are hydraulically actuated.
4. The dynamic hang-off assembly of claim 1, wherein the housing is ring-shaped.
5. The dynamic hang-off assembly of claim 1, wherein the adapter profile extends around the outer surface of the adapter.
6. The dynamic hang-off assembly of claim 1, wherein the housing comprises a tension ring of the dynamic tensioning system.

7. A method of dynamically supporting a riser string from an offshore drilling rig, comprising:

detaching the riser from a diverter while maintaining the remaining portion of the riser string intact;
attaching a riser adapter to the riser string;
locking a housing to the riser adapter; and
dynamically supporting the riser by dynamically applying tension to the housing.

8. The method of claim 7, wherein attaching a riser adapter to the riser string comprises attaching a riser adapter to a flex joint that is part of the riser string.

9. The method of claim 7, wherein locking the housing to the riser adapter comprises locking a tension ring of a dynamic tensioning system to the adapter.

10. The method of claim 7, wherein dynamically supporting the riser comprises dynamically applying tension to the housing with a dynamic tensioning system.