

Description

Field of the Invention

This invention relates to pipe swivel joints, and more particularly, to pipe swivel joints having improved bearing and seal life.

Description of the Prior Art

The production of oil and gas from offshore wells is a common endeavor in the petroleum industry. A well or cluster of several wells is drilled in the ocean floor and fluid from these wells transported by conduit to marine tankers which transport the fluid to shore facilities. A system of pipelines convey the fluid from the wells to a platform or floating buoy to which a marine tanker may be attached. The pipeline system includes one or more pipes or conduit extending generally horizontally across the ocean floor from the wells to a point below the floating buoy and a generally vertical pipe or hose extending from the buoy to the horizontal pipe. At a plurality of locations in the pipeline system connections are needed between the various pipes. A flexible hose or an articulated loading are secured between the buoy and a marine tanker may include one or more connections. Some of these connections are used to permit one pipe or hose to rotate relative to an adjacent pipe or hose by the use of swivel joints. Due to the action of the winds, ocean and the floating buoy these joints may experience an oscillatory motion which produces wear and failure of the joints at a rate more rapid than with a non-oscillatory motion. A fatigue failure occurs in the joints because the same area of the bearing is repetitively loaded rather than distributing the load cycle around the bearing. Elastomeric seals in the joints also tend to fail quickly in oscillatory cyclic applications when all of the oscillatory motion is applied to the seals.

US-A-3195931 discloses a conduit coupling which includes the features set out in the pre-characterising part of claim 1.

Summary of the Invention

The present invention comprises a pipe swivel joint for connecting two lengths of pipe in fluid-tight connection having improved life for the joint's bearings and seals. This invention overcomes some of the disadvantages of the prior art by providing the features set out in the characterising part of claim 1.

The overrunning clutches prevent oscillatory motion of the seals and bearings, and decrease the wear and failure of the seals because each of the seals experience a wearing action only when the sleeve is rotated in one of the two rotational directions. This decreases the wearing motions of the seals by 50%. The fact that the sleeve moves in only one direction across the face of a seal may decrease wearing of the seals and further increase the life of the seals. Bearing life in the pipe swivel joint of the present invention is increased because unidirectional rotation of the sleeve dis-

tributes bearing wear over a larger portion of the bearings.

Fig. 1 is a side elevation, partly in section, of one embodiment of the pipe swivel joint of the present invention.

Fig. 2-4 are side elevations, partly in section, of other embodiments of the swivel joint of the present invention.

A swivel joint 11 (Fig. 1) of the present invention includes a pair of annular inner or male members 12, 13 each connected to a corresponding pipe 17, 18 with each of the inner members 12, 13 having a bore 19, 20 extending through the length of the inner member to provide a path for fluid to flow between the pipes 17, 18. The inner members 12, 13 each include radial outward flanges 24, 25 at the adjoining ends.

The inner members 12, 13 are partly surrounded by an annular sleeve or female member 26 having an annular passage 30 extending axially through the sleeve 26 to receive inner members 12, 13. The sleeve 26 includes a radial inward flange 31 which divides the passage 30 into an upper passage 32 and a lower passage 33. A roller thrust bearing 37 is mounted in the upper passage 32 between an outer wall 39 of the inner member 12 and an inner wall 43 of the sleeve 26. Another roller thrust bearing 44 is mounted in the lower passage 33 between an outer wall 45 of the inner member 13 and an inner wall 49 of the sleeve 26.

Each of the thrust bearings 37, 44 includes an inner annular ring 50, an outer annular ring 51 and a plurality of rollers or other bearing means 56. The upper bearing 37 is fixed between an overrunning clutch 57 and the radial flange 24 of the inner member 12. The clutch 57 is secured in the upper passage 32 by an annular plate 58 which is secured to the sleeve 26 by a plurality of bolts 62 each extending through a bore 63 in the plate 58 into a threaded bore 64 in the sleeve 26. The lower bearing 44 is fixed between an overrunning clutch 68 and the radial flange 25 of the inner member 13. The clutch 68 is secured in the lower passage 33 by an annular plate 69 which is secured to the sleeve 26 by a plurality of bolts 70 each extending through a bore 74 in the plate 69 into a threaded bore 75 in the sleeve 26.

The overrunning clutches 57, 68 each include an annular cup 76 and a plurality of sprags, rollers or other overrunning clutch means 80. The cup 76 is shaped (not shown) about its circumference so that the sprags 80 of clutch 68 are wedged against the surface of the outer wall 45 of the inner member 13 when the sleeve 26 and the cup 76 of the clutch 68 are rotated clockwise, causing the inner member 13 to also rotate clockwise. When the sleeve 26 and the cup 76 of the clutch 68 are rotated counterclockwise the sprags 80 move over the surface of the outer wall 45 allowing the inner member 13 to remain stationary. Thus, the bearings 56 rotate in only one direction and the sleeve 26 moves in only one direction over the seals 84 and 86.

The clutch 57 is mounted so that the sprags 80

are wedged against the surface of the outer wall 39 of the inner member 12 when the sleeve and the cup 76 of the clutch 57 are rotated counterclockwise causing the inner member 12 to also rotate counterclockwise. When the sleeve 26 and the cup 76 of the clutch 57 are rotated clockwise the sprags 80 move over the surface of the outer wall 39 allowing the inner member 12 to remain stationary. The overrunning clutches 57, 68 are made by several manufacturers and one such clutch which can be used in the present invention is manufactured by Dana Industrial of Warren, Michigan. A plurality of sealing means 81-86 provide fluidtight seals between the sleeve 26 and the inner members 12, 13.

Another embodiment of the swivel joint 11a shown in Fig. 2 includes a plurality of ball bearings 90 (only two shown) in a pair of bearing races 91a, 91b, formed in an outer wall 39a of an inner member 12a and in an inner wall 43a of a sleeve 26a. These ball bearings replace the roller thrust bearing shown in the embodiment of Fig. 1 and couple the sleeve 26a to the inner member 12a. A plurality of ball bearings 92 in a pair of bearing races 96a, 96b formed in an outer wall 45a of an inner member 13a and in the inner wall 43a of the sleeve 26a couple the sleeve 26a to the inner member 13a. A plurality of annular sealing means 81a-86a provide fluid-tight seals between the sleeve 26a and the inner members 12a, 13a. The overrunning clutches 57, 68 provide the unidirectional rotational motion between the sleeve 26a and the inner members 12a, 13a previously described.

Fig. 3 illustrates another embodiment of the swivel joint 11b wherein an annular sleeve 26b includes a radially inward flange 97 which separates the ends 101, 102 of the inner members 12b, 13b. A pair of annular sealing means 106, 107 provide a fluid-tight seal between the sleeve 26b and the inner members 12b, 13b. The inner members 12b, 13b are connected to the sleeve 26b by bearing and clutch means (not shown) in the manner described above.

Another embodiment of the swivel joint 11c (Fig. 4) includes an annular sleeve 26c having a central radial flange 97 and a pair of shoulders 111, 112 which rest against a pair of overrunning clutches 57a, 68a. A pair of annular inner members 12c, 13c are rotatably connected to the sleeve 26c by a plurality of ball bearings 90 mounted in a plurality of bearing races 117-120. A plurality of annular sealing means 124-127 provide fluid-tight seals for the joint 11c. The overrunning clutches 57a, 68a provide the unidirectional rotational motion between the sleeve 26c and the inner members 12c, 13c previously described.

The present invention comprises a pipe swivel joint having a pair of overrunning clutches which prevent oscillatory rotational motion between adjacent joint members having seals and bearings between these adjacent members. The overrunning clutches allow the seals and the bearings

to experience only unidirectional motion and thus reduce wear and failure of the swivel joint.

Claims

1. A swivel joint for connecting two lengths of pipe, said joint (11) comprising:
an annular sleeve (26) having an axial passage (30) extending through said sleeve;
first and second annular inner members (12, 13) each having an axially extending bore (19, 20) therethrough;

bearing means for rotatably mounting said first and second annular inner members (12, 13) in opposite ends of said axial passage (30) of said annular sleeve (26), the bearing means comprising first and second thrust bearing units (37, 44);

the first thrust bearing means (37) being mounted between said sleeve (26) and said first annular inner member (12) for absorbing axial thrust between said sleeve (26) and said first annular inner member (12);

the second thrust bearing means (44) being mounted between said sleeve (26) and second annular inner member (13) for absorbing axial thrust between said sleeve (26) and said second annular inner member (13);

and characterised in that there is provided:

first and second unidirectional rotation units (57, 68);

said first unidirectional rotation unit (57) being mounted between said sleeve (26) and said first annular inner member (12) to allow said sleeve to rotate in a first direction relative to said first annular inner member and to prevent said sleeve from rotating in a second direction relative to said first annular inner member;

said second unidirectional rotation unit (68) being mounted between said sleeve (26) and said second annular inner member (13) to allow said sleeve to rotate in said second direction relative to said second annular inner member and to prevent said sleeve from rotating in said first direction relative to said second annular inner member; and

seals (83, 84; 106, 107; 125, 126) mounted respectively between said sleeve, and each of first and second annular inner members.

2. A swivel joint as defined in claim 1 characterized by said unidirectional units comprising:

first and second overrunning clutches (57, 68);
said first clutch (57) being mounted between said sleeve (26) and said first annular inner member (12) for allowing said first annular inner member (12) to rotate clockwise relative to said sleeve (26) and for locking sleeve to said first annular inner member when said first annular inner member rotates counterclockwise;

said second clutch (68) being mounted between said sleeve (26) and said second annular inner member (13) for allowing said sleeve to rotate counterclockwise relative to said second annular inner member and for locking said sleeve to said

are wedged against the surface of the outer wall 39 of the inner member 12 when the sleeve and the cup 76 of the clutch 57 are rotated counterclockwise causing the inner member 12 to also rotate counterclockwise. When the sleeve 26 and the cup 76 of the clutch 57 are rotated clockwise the sprags 80 move over the surface of the outer wall 39 allowing the inner member 12 to remain stationary. The overrunning clutches 57, 68 are made by several manufacturers and one such clutch which can be used in the present invention is manufactured by Dana Industrial of Warren, Michigan. A plurality of sealing means 81-86 provide fluidtight seals between the sleeve 26 and the inner members 12, 13.

Another embodiment of the swivel joint 11a shown in Fig. 2 includes a plurality of ball bearings 90 (only two shown) in a pair of bearing races 91a, 91b, formed in an outer wall 39a of an inner member 12a and in an inner wall 43a of a sleeve 26a. These ball bearings replace the roller thrust bearing shown in the embodiment of Fig. 1 and couple the sleeve 26a to the inner member 12a. A plurality of ball bearings 92 in a pair of bearing races 96a, 96b formed in an outer wall 45a of an inner member 13a and in the inner wall 43a of the sleeve 26a couple the sleeve 26a to the inner member 13a. A plurality of annular sealing means 81a-86a provide fluid-tight seals between the sleeve 26a and the inner members 12a, 13a. The overrunning clutches 57, 68 provide the unidirectional rotational motion between the sleeve 26a and the inner members 12a, 13a previously described.

Fig. 3 illustrates another embodiment of the swivel joint 11b wherein an annular sleeve 26b includes a radially inward flange 97 which separates the ends 101, 102 of the inner members 12b, 13b. A pair of annular sealing means 106, 107 provide a fluid-tight seal between the sleeve 26b and the inner members 12b, 13b. The inner members 12b, 13b are connected to the sleeve 26b by bearing and clutch means (not shown) in the manner described above.

Another embodiment of the swivel joint 11c (Fig. 4) includes an annular sleeve 26c having a central radial flange 97 and a pair of shoulders 111, 112 which rest against a pair of overrunning clutches 57a, 68a. A pair of annular inner members 12c, 13c are rotatably connected to the sleeve 26c by a plurality of ball bearings 90 mounted in a plurality of bearing races 117-120. A plurality of annular sealing means 124-127 provide fluid-tight seals for the joint 11c. The overrunning clutches 57a, 68a provide the unidirectional rotational motion between the sleeve 26c and the inner members 12c, 13c previously described.

The present invention comprises a pipe swivel joint having a pair of overrunning clutches which prevent oscillatory rotational motion between adjacent joint members having seals and bearings between these adjacent members. The overrunning clutches allow the seals and the bearings

to experience only unidirectional motion and thus reduce wear and failure of the swivel joint.

5 Claims

1. A swivel joint for connecting two lengths of pipe, said joint (11) comprising:

an annular sleeve (26) having an axial passage (30) extending through said sleeve;

first and second annular inner members (12, 13) each having an axially extending bore (19, 20) therethrough;

bearing means for rotatably mounting said first and second annular inner members (12, 13) in opposite ends of said axial passage (30) of said annular sleeve (26), the bearing means comprising first and second thrust bearing units (37, 44);

the first thrust bearing means (37) being mounted between said sleeve (26) and said first annular inner member (12) for absorbing axial thrust between said sleeve (26) and said first annular inner member (12);

the second thrust bearing means (44) being mounted between said sleeve (26) and second annular inner member (13) for absorbing axial thrust between said sleeve (26) and said second annular inner member (13);

and characterised in that there is provided:

first and second unidirectional rotation units (57, 68);

said first unidirectional rotation unit (57) being mounted between said sleeve (26) and said first annular inner member (12) to allow said sleeve to rotate in a first direction relative to said first annular inner member and to prevent said sleeve from rotating in a second direction relative to said first annular inner member;

said second unidirectional rotation unit (68) being mounted between said sleeve (26) and said second annular inner member (13) to allow said sleeve to rotate in said second direction relative to said second annular inner member and to prevent said sleeve from rotating in said first direction relative to said second annular inner member; and

seals (83, 84; 106, 107; 125, 126) mounted respectively between said sleeve, and each of first and second annular inner members.

2. A swivel joint as defined in claim 1 characterized by said unidirectional units comprising:

first and second overrunning clutches (57, 68); said first clutch (57) being mounted between said sleeve (26) and said first annular inner member (12) for allowing said first annular inner member (12) to rotate clockwise relative to said sleeve (26) and for locking sleeve to said first annular inner member when said first annular inner member rotates counterclockwise;

said second clutch (68) being mounted between said sleeve (26) and said second annular inner member (13) for allowing said sleeve to rotate counterclockwise relative to said second annular inner member and for locking said sleeve to said



second annular inner member when said sleeve rotates clockwise.

3. A swivel joint as defined in claim 1 or claim 2, characterized by said seals comprising:

first and second seals (83, 84; 106, 107; 125, 126), the first seal (83, 106, 125) being mounted between said sleeve (26) and said first annular inner member (12); and the second seal (84, 107, 126) being mounted between said sleeve and said second annular inner member (13).

4. A swivel joint as defined in claim 3 characterized by each of said annular inner members (12, 13) having external ends respectively connected to corresponding ends (17, 18) of said two lengths of pipe with the bores of said annular inner members aligned with axial passages in each of said lengths of pipe.

Revendications

1. Raccord tournant destiné à raccorder deux longueurs de tube, ledit raccord (11) comprenant: un manchon annulaire (26) traversé par un passage axial (30);

des premier et second éléments annulaires intérieurs (12, 13) traversés chacun par un alésage axial (19, 20);

des moyens à paliers destinés au montage rotatif desdits premier et second éléments annulaires intérieurs (12, 13) dans des extrémités opposées dudit passage axial (30) dudit manchon annulaire (26), les moyens à paliers comprenant des première et seconde unités de paliers de butée (37, 44); le premier moyen (37) à palier de butée étant monté entre ledit manchon (26) et ledit premier élément annulaire intérieur (12) afin d'absorber la charge axiale entre ledit manchon (26) et ledit premier élément annulaire intérieur (12);

le second moyen à palier de butée (34) étant monté entre ledit manchon (26) et ledit second élément annulaire intérieur (13) afin d'absorber la charge axiale entre ledit manchon (26) et ledit second élément annulaire intérieur (13),

et caractérise en ce qu'il est prévu:

des premier et second dispositifs (57, 68) de rotation unidirectionnelle;

le premier dispositif (57) de rotation unidirectionnelle étant monté entre ledit manchon (26) et ledit premier élément annulaire intérieur (12) pour permettre audit manchon de tourner dans un premier sens par rapport audit premier élément annulaire intérieur et pour empêcher ledit manchon de tourner dans un second sens par rapport audit premier élément annulaire intérieur;

ledit second dispositif (68) de rotation unidirectionnelle étant monté entre manchon (26) et ledit second élément annulaire intérieur (13) pour permettre audit manchon de tourner dans ledit second sens par rapport audit second élément annulaire intérieur et pour empêcher ledit manchon de tourner dans ledit premier sens par rapport audit second élément annulaire intérieur; et

des joints (83, 84; 106, 107; 125, 126) montés, respectivement, entre ledit manchon et chacun desdits premier et second éléments annulaires intérieurs.

2. Raccord tournant selon la revendication 1, caractérisé en ce que lesdits dispositifs unidirectionnels comprennent:

des première et seconde roues libres (57, 68); ladite première roue libre (57) étant montée entre ledit manchon (26) et ledit premier élément annulaire intérieur (12) pour permettre audit premier élément annulaire intérieur (12) de tourner dans le sens des aiguilles d'une montre par rapport audit manchon (26) et pour bloquer ledit manchon sur ledit premier élément annulaire intérieur lorsque ledit premier élément annulaire intérieur tourne dans le sens inverse de celui des aiguilles d'une montre;

ladite seconde roue libre (68) étant montée entre ledit manchon (26) et ledit second élément annulaire intérieur (13) pour permettre audit manchon de tourner dans le sens inverse de celui des aiguilles d'une montre par rapport audit second élément annulaire intérieur et pour bloquer ledit manchon sur ledit second élément annulaire intérieur lorsque ledit manchon tourne dans le sens des aiguilles d'une montre.

3. Raccord tournant selon la revendication 1 ou la revendication 2, caractérisé en ce que lesdits joints comprennent:

des premier et deuxième joints (83, 84; 106, 107; 125, 126), le premier joint (83, 106, 125) étant monté entre ledit manchon (26) et ledit premier élément annulaire intérieur (12), et le second joint (84, 107, 126) étant monté entre ledit manchon et ledit second élément annulaire intérieur (13).

4. Raccord tournant selon la revendication caractérisé en ce que chacun desdits éléments annulaires intérieurs (12, 13) présente des extrémités extérieures reliées, respectivement, à des extrémités correspondantes (17, 18) desdites deux longueurs de tube, les alésages desdits éléments annulaires intérieurs étant alignés sur les passages axiaux de chacune desdites longueurs de tube.

Patentansprüche

1. Drehbare Verbindung zum Verbinden von zwei Rohrlängen, wobei die Verbindung (11) eine ringförmige Hülse (26) mit einem sich dadurch erstreckenden Axialdurchgang (30), erste und zweite ringförmige Innenglieder (12, 13) mit je einer sich axial erstreckenden Bohrung (19, 20) und eine Lagereinrichtung zum Drehlagern der ringförmigen Innenglieder (12, 13) in gegenüberliegenden Enden des Axialdurchganges (30) der ringförmigen Hülse (26) umfaßt, wobei die Lagereinrichtung erst und zweite Drucklager einrichtungen (37, 44) einschließt, wobei die erste Drucklagereinrichtung (37) zwischen der Hülse (26) und dem ersten ringförmigen Innenglied (12) zum Absorbieren von Axialdruck zwischen der Hülse (26) und dem ersten ringförmigen Innenglied (12) angeordnet ist, wobei die zweite Drucklager-



(12)

einrichtung (44) zwischen der Hülse (26) und dem zweiten ringförmigen Innenglied (13) zum Absorbieren von Axialdruck zwischen der Hülse und dem zweiten ringförmigen Innenglied (13) angeordnet ist, dadurch gekennzeichnet, daß erste und zweite einseitig wirkende Rotationseinheiten (57, 68) vorgesehen sind, daß die erste einseitig wirkende Rotationseinheit (57) zwischen der Hülse (26) und dem ersten ringförmigen Innenglied (12) angeordnet ist, um der Hülse zu gestatten, daß sie sich in einer ersten Richtung in Bezug auf das erste ringförmige Innenglied drehen kann und um die Hülse an einem Drehen in einer zweiten Richtung in Bezug auf das erste ringförmige Innenglied zu behindern, daß die zweite einseitig wirkende Rotationseinheit (68) zwischen der Hülse (26) und dem zweiten ringförmigen Innenglied (13) angeordnet ist, so daß sich die Hülse in der zweiten Richtung in Bezug auf das zweite ringförmige Innenglied drehen kann, sie indessen an einer Rotation in der ersten Richtung in Bezug auf das zweite ringförmige Innenglied gehindert wird, und daß Dichtungen (83, 84; 106, 107; 125, 126) entsprechend zwischen der Hülse und jedem der beiden ringförmigen Innenglieder angeordnet sind.

2. Verbindung nach Anspruch 1, dadurch gekennzeichnet, daß die in eine Richtung wirkenden Einheiten erste und zweite Freilaufkupplungen (57, 68) umfassen, daß die erste Kupplung (57) zwischen der Hülse (26) und dem ersten ring-

förmigen Innenglied (12) angeordnet ist, so daß sich das erste ringförmige Innenglied (12) im Uhrzeigersinn in Bezug auf die Hülse (26) drehen kann und die Hülse an dem ersten ringförmigen Innenglied verriegelt wird, wenn sich das erste ringförmige Innenglied gegen den Uhrzeigersinn dreht, daß die zweite Kupplung (68) zwischen der Hülse (26) und dem zweiten ringförmigen Innenglied (13) angeordnet ist, so daß sich die Hülse in Bezug auf das zweite ringförmige Innenglied gegen den Uhrzeigersinn drehen kann, indessen an dem zweiten ringförmigen Innenglied verriegelt wird, wenn sich die Hülse im Uhrzeigersinn dreht.

3. Verbindung nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Dichtungen erste und zweite Dichtungen (83, 84; 106, 107; 125, 126) umfassen, daß die erste Dichtung (83, 106, 125) zwischen der Hülse (26) und dem ersten ringförmigen Innenglied (12) angeordnet ist und daß die zweite Dichtung (84, 107, 126) zwischen der Hülse und dem zweiten ringförmigen Innenglied (13) angeordnet ist.

4. Verbindung nach Anspruch 3, dadurch gekennzeichnet, daß jedes der ringförmigen Innenglieder (12, 13) Außenenden aufweist, die entsprechend mit entsprechenden Enden (17, 18) der beiden Rohrlängen verbunden sind, wobei die Bohrungen der ringförmigen Innenglieder mit Achsialdurchgängen in jeder der Rohrlängen fluchten.



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