

Description

This invention relates to adjustable flowline joints. In some subsea applications, production from several subsea christmas trees flows through individual flowlines from each christmas tree to a central main gathering line on the ocean floor. As new wells are drilled and completed the flowlines from these wells are also connected into the main gathering line. Making a connection between the flowlines and the main gathering line is often accomplished by using an articulated piping system having flexible ball and socket joints as shown in U.S. Patent Nos. 3 727 954 and 3 717 920 and remote collet type connectors as shown in U.S. Patent No. 3 096 999. It is desirable that such an articulated piping system be capable of being made non-flexible or rigid after completion of the connection.

Other examples of connectors which have been suggested for making connections between misaligned subsea flowlines are shown in U.S. Patent Nos. 4 153 278; 4 195 865; 4 045 054 and 3 997 197. Each of these patents discloses a ball and socket type of connection which can be used in connecting between two misaligned lines or which can accommodate relative movement of one of the lines angularly with respect to the other. Patent No. 4 195 865 discloses a connection including a slip joint and a ball and socket joint to accommodate for differences in alignment of the two tubular members to be connected and the axial distance separating the two ends. The ball and socket joint includes the use of a bell flange on the end of one of the members which is positioned in a slot defined between two portions of the other member which members are moved together with a pressure actuated toggle joint which prevents the inadvertent separation of the joint.

Patent No. 4 153 278 discloses another similar ball and socket joint with a flange extending outward in arcuate relationship to the tubular member having the ball portion of the joint on its end. The flange extends into an arcuate slot between two portions of the connection member and from which the actuating means for locking the joint members together is suspended. The purpose of the flange in the slot is to provide a stop for the relative angular motion between the members.

It would be advantageous in providing a connection for connecting individual flowings to a main gathering system to have a misalignment feature which allows connection between misaligned tubular members but which may be locked into its final connecting position so that it does not allow relative movement between the members once the connection has been made.

An object of the present invention is to provide an improved connector joint suitable for connection of misaligned subsea flowlines.

The present invention provides an improved flexible connection for subsea pipelines which allows misalignment but once connected is locked into its final connection position. This connecting includes a flanged bell for connection by welding to one member and a two-piece assembly for connecting to the

other member and providing an arcuate slot for receiving the bell flange. The two-piece assembly also includes a means for relaxing the normal clamping engagement of the assembly on the bell flange so that relative movement may take place to accommodate misalignment of the lines being connected and then once the misalignment has been accommodated the clamping engagement is re-established.

According to the present invention there is provided an adjustable flowline joint having an arcuate bell flange, an annular flanged assembly having a flange and a ring secured thereto with facing arcuate surfaces on the flange and the ring, and tension means for securing said flange to said ring, said arcuate surfaces being contoured to receive said bell flange therebetween, the arrangement being such that tensioning of said tension means clamps said bell flange between said surfaces, said joint being characterised by fluid pressure means operative to increase the tension on said tension means to increase the space between said arcuate surfaces whereby said bell flange may be adjusted angularly by pivoting with respect to said flanged assembly.

The invention will be described now by way of example only, with particular reference to the accompanying drawings. In the drawings:

Figure 1A is a schematic drawing of an articulated pipe section having the improved connection joints and being in position for installation.

Figure 1B is a schematic similar to figure 1A but showing the articulated joint installed.

Figure 2 is a sectional view of the improved subsea flowline connection joint showing the completed joint connection with misaligned flowlines.

Figure 3 is an enlarged partial sectional view of the pressure responsive system for relaxing the clamping on the bell flange to allow corrective movement in the joint to compensate for misalignment of the flowlines.

Connector joint 10 as shown in figure 2 is provided to connect between subsea flowlines (not shown). Joint 10 includes bell flange 16 which is secured to the end of flowline section 12 and assembly 18 for receiving bell flange 16 and which is secured to the end of flowline section 14. Assembly 18 includes flange 20 and clamp ring 22 which is secured to flange 20 by studs 24 and nuts 26. Inner surface 28 on ring 22 faces outer surface 30 on flange 20 and is spaced therefrom to form cavity 29 to receive the bell flange 16 therein. Ring 22 includes outer lip 32 which engages exterior surface 34 on flange 20 and inner lip 36 which engages within recess 38 on flanges 20 immediately outward from the openings in flange 20 receiving studs 24. Inner surface 28 of ring 22 includes wiper ring 27 which excludes seaborne debris from cavity 29 between surfaces 28 and 30. Annular recess 40 is formed within the space between lips 32 and 36 of ring 22 and between flange 20 and ring 22. Annular seal element 42 is positioned within recess 40 and port 44 extends through ring 22 into communication with the interior of recess 40. Further, port 46 (shown out of position) extends through ring 22 into communication with cavity 29. Port 46 is a test port to provide an inclination of leakage past bell flange 16 after joint 10 has been set.

When joint 10 has been assembled as shown in figure 2, the tension applied to studs 24 is sufficient to ensure that bell flange 16 is rigidly clamped in metal-to-metal sealing relationship between surface 30 of flange 20 and surface 28 of ring 22.

A typical example of the use of joint 10 would be as shown in figure 1A wherein articulated pipe section 11 has been lowered from vessel S with installation frame 13 for installation between offshore production platform riser R and subsea flowline F. Articulated pipe section 11 includes three of the improved joints 10 interconnected by flowline sections 12 and 14. Articulated joint 11 has a collet type connector 15 on each end, which is similar to the collet connector of U.S. Patent 3 096 999. Platform riser R and subsea flowline F each have a clamp hub 19 to which collet type connectors 15 clamp to rigidly connect articulated joint 11. As articulated joint 11 is lowered from vessel S and positioned between riser R and flowline F, improved joints 10 are held in a non-rigid configuration which will be described below. Since improved joints 10 are held in non-rigid configuration, articulated pipe section 11 may be readily positioned between clamp hubs 19, and collet type connectors 15 may then engage clamp hubs 19 to rigidly connect articulated pipe section 11 without having to overcome any resistance to movement in improved joints 10. As shown in figure 1B, after articulated section 11 has been connected between hubs 19 by collet type connectors 15, improved joints 10 are left non-rigid until section 11 has flexed through improved joints 10 and achieved its «preferred» position. At this point installation frame 13 is no longer needed and is removed.

As shown in figure 3, the improved joint 10 of the present invention is in the non-rigid mode and as such is readily flexible. The joint 10 is made non-rigid or flexible by introducing pressurized hydraulic fluid through port 44 into recess 40 and thereby adding additional tension to studs 24 to move flange 20 and ring 22 axially away from one another and also to move surfaces 28 and 30 away from one another. This movement of surface 28 away from surface 30 releases the metal-to-metal sealing engagement of surfaces 28 and 30 with bell flange 16 and allows joint 10 to be readily flexible as long as pressurized fluid is in recess 40. Pressurized hydraulic fluid is locked into improved joints 10 of articulated section 11 until section 11 has been connected between riser R and flowline F. At this time the pressurized fluid is released from recess 40 through port 44 and therefor joints 10 become rigid with bell flange 16 being engaged by surfaces 28 and 30 in a metal-to-metal sealing relationship. Articulated section 11 thereby becomes a rigid all metal-to-metal sealed piping section connecting riser R to flowline F.

With the improved joint of the present invention, the connection of subsea lines does not require a swivel joint with dynamic seals which may be subject to leakage and may subject the flowlines to unnecessary bending. The improved joint provides the adjustment in angular relationship of the part of the joint to compensate for flowline misalignment and then can be clamped in its desired position with only static type metal-to-metal seals to avoid the

difficulties experienced with prior swivel connections.

Claims

1. An adjustable flowline joint having an arcuate bell flange (16), an annular flanged assembly (18) having a flange (20) and a ring (22) secured thereto with facing arcuate surfaces (28, 30) on the flange (20) and the ring (22), and tension means (24, 26) for securing said flange (20) to said ring (22), said arcuate surfaces (28, 30) being contoured to receive said bell flange (16) therebetween, the arrangement being such that tensioning of said tension means (24, 26) clamps said bell flange (16) between said surfaces (28, 30), said joint being characterized by fluid pressure means (40, 42, 44) operative to increase the tension on said tension means (24, 26) to increase the space between said arcuate surfaces (28, 30) whereby said bell flange (16) may be adjusted angularly by pivoting with respect to said flanged assembly (18).

2. An adjustable flowline joint according to claim 1, characterised in that said tension securing means (24, 26) includes studs (24) extending through said flange (20) and said ring (22) and nuts (26) tightened on each end of each of said studs (24) to tension said studs (24) and thereby secure said ring (22) to said flange (20).

3. An adjustable flowline joint according to claim 1 or claim 2, characterised in that said pressure responsive means (40, 42, 44) includes an annular recess (40) between said ring (22) and said flange (20) of said flange assembly (18), and means (42, 44) for introducing fluid pressure into said annular chamber (40) to force said ring (22) and said flange (20) apart sufficiently to relax the clamping engagement on said bell flange (16).

4. An adjustable flowline joint according to any of the preceding claims characterised in that when fluid pressure is delivered to said annular recess (40), tension is increased on said studs (24) sufficiently to cause their elongation to release clamping engagement of said arcuate bell flange (16) and allow relative angular movement between said arcuate bell flange (16) and said flange assembly (18).

5. An adjustable flowline joint according to any of the preceding claims characterised in that the engagement of said bell flange (16) by said arcuate surfaces (28, 30) provides a metal-to-metal seal therebetween.

6. An apparatus according to claim 5, characterised by including a tubular member secured to said bell flange (16) and having a bell flange (16) on its other end and a flange assembly (18) secured thereto.

Patentansprüche

1. Verstellbare Rohrleitungsverbindung, mit einem gekrümmten Glockenflansch (16), einer Ringflanschordnung (18) mit einem Flansch (20) und einem daran befestigten Ring (22), wobei sich gekrümmte Flächen (28, 30) an dem Flansch (20) und

When joint 10 has been assembled as shown in figure 2, the tension applied to studs 24 is sufficient to ensure that bell flange 16 is rigidly clamped in metal-to-metal sealing relationship between surface 30 of flange 20 and surface 28 of ring 22.

A typical example of the use of joint 10 would be as shown in figure 1A wherein articulated pipe section 11 has been lowered from vessel S with installation frame 13 for installation between offshore production platform riser R and subsea flowline F. Articulated pipe section 11 includes three of the improved joints 10 interconnected by flowline sections 12 and 14. Articulated joint 11 has a collet type connector 15 on each end, which is similar to the collet connector of U.S. Patent 3 096 999. Platform riser R and subsea flowline F each have a clamp hub 19 to which collet type connectors 15 clamp to rigidly connect articulated joint 11. As articulated joint 11 is lowered from vessel S and positioned between riser R and flowline F, improved joints 10 are held in a non-rigid configuration which will be described below. Since improved joints 10 are held in non-rigid configuration, articulated pipe section 11 may be readily positioned between clamp hubs 19, and collet type connectors 15 may then engage clamp hubs 19 to rigidly connect articulated pipe section 11 without having to overcome any resistance to movement in improved joints 10. As shown in figure 1B, after articulated section 11 has been connected between hubs 19 by collet type connectors 15, improved joints 10 are left non-rigid until section 11 has flexed through improved joints 10 and achieved its «preferred» position. At this point installation frame 13 is no longer needed and is removed.

As shown in figure 3, the improved joint 10 of the present invention is in the non-rigid mode and as such is readily flexible. The joint 10 is made non-rigid or flexible by introducing pressurized hydraulic fluid through port 44 into recess 40 and thereby adding additional tension to studs 24 to move flange 20 and ring 22 axially away from one another and also to move surfaces 28 and 30 away from one another. This movement of surface 28 away from surface 30 releases the metal-to-metal sealing engagement of surfaces 28 and 30 with bell flange 16 and allows joint 10 to be readily flexible as long as pressurized fluid is in recess 40. Pressurized hydraulic fluid is locked into improved joints 10 of articulated section 11 until section 11 has been connected between riser R and flowline F. At this time the pressurized fluid is released from recess 40 through port 44 and therefor joints 10 become rigid with bell flange 16 being engaged by surfaces 28 and 30 in a metal-to-metal sealing relationship. Articulated section 11 thereby becomes a rigid all metal-to-metal sealed piping section connecting riser R to flowline F.

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4. An adjustable flowline joint according to any of the preceding claims characterised in that when fluid pressure is delivered to said annular recess (40), tension is increased on said studs (24) sufficiently to cause their elongation to release clamping engagement of said arcuate bell flange (16) and allow relative angular movement between said arcuate bell flange (16) and said flange assembly (18).

5. An adjustable flowline joint according to any of the preceding claims characterised in that the engagement of said bell flange (16) by said arcuate surfaces (28, 30) provides a metal-to-metal seal therebetween.

6. An apparatus according to claim 5, characterised by including a tubular member secured to said bell flange (16) and having a bell flange (16) on its other end and a flange assembly (18) secured thereto.

Patentsprüche

1. Verstellbare Rohrleitungsverbindung, mit einem gekrümmten Glockenflansch (16), einer Ringflanschordnung (18) mit einem Flansch (20) und einem daran befestigten Ring (22), wobei sich gekrümmte Flächen (28, 30) an dem Flansch (20) und



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dem Ring (22) gegenüberliegen, und einer Spanneinrichtung (24, 26) zum Befestigen des Flansches (20) an dem Ring (22), wobei die gekrümmten Flächen (28, 30) zur Aufnahme des Glockenflansches (16) zwischen sich konturiert sind und die Anordnung derart ausgestaltet ist, daß das Spannen der Spanneinrichtung (24, 26) den Glockenflansch (16) zwischen die Flächen (28, 30) klemmt, gekennzeichnet durch Fluiddruckmittel (40, 42, 44) die betätigbar sind, um zur Vergrößerung des Abstands zwischen den gekrümmten Flächen (28, 30) die Spannung an der Spanneinrichtung (24, 26) zu erhöhen, wodurch der Glockenflansch (16) durch Verschwenken bezüglich der Flanschanordnung (18) im Winkel eingestellt werden kann.

2. Rohrleitungsverbindung nach Anspruch 1, dadurch gekennzeichnet, daß die Spann-Befestigungs-Einrichtung (24, 26) sich durch den Flansch (20) und den Ring (22) erstreckende Bolzen (24) sowie Muttern (26) aufweist, die an jedem Ende jedes der Bolzen (24) festgezogen sind, um die Bolzen (24) zu spannen und dadurch den Ring (22) an dem Flansch (20) zu befestigen.

3. Rohrleitungsverbindung nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Fluiddruckmittel (40, 42, 44) eine zwischen dem Ring (22) und dem Flansch (20) der Flanschanordnung (18) befindliche Ringausnehmung (40) sowie eine Einrichtung (42, 44) zum Einleiten von Fluiddruck in die Ringkammer (40) aufweist, um den Ring 22 und dem Flansch (20) in zum Lockern des Klemmeingriffs an dem Glockenflansch (16) ausreichendem Maße auseinanderzudrängen.

4. Rohrleitungsverbindung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß wenn in die Ringausnehmung (40) Fluiddruck eingeleitet wird, die Spannung an den Bolzen (24) ausreichend erhöht wird, um ihre Längung zu veranlassen und damit den Klemmeingriff des gekrümmten Glockenflansches (16) zu lockern und eine relative Winkelbewegung zwischen dem gekrümmten Glockenflansch (16) und der Flanschanordnung (18) zu gestatten.

5. Rohrleitungsverbindung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß der Eingriff des Glockenflansches (16) durch die gekrümmten Oberflächen (28, 30) dazwischen eine Metall-Metall-Abdichtung bildet.

6. Vorrichtung nach Anspruch 5, gekennzeichnet durch ein an dem Glockenflansch (12) festgelegtes Rohrelement mit einem Glockenflansch (16) an seinem anderen Ende und einer daran befestigten Flanschanordnung (18).

Revendications

1. Joint réglable pour conduite, comportant une bride (16) arquée en forme de cloche, un assemblage

(18) annulaire à bride qui comprend une bride (20) et une bague (22) fixée à celle-ci, la bride (20) et la bague (22) présentant des surfaces arquées respectives (28, 30) qui se font face, et des moyens travaillant en tension (24, 26) destinés à fixer la bride (20) à la bague (22), les surfaces arquées (28, 30) ayant un contour conformé de manière à pouvoir recevoir entre elles la bride (16) en forme de cloche, l'ensemble étant tel que la mise en tension des moyens travaillant en tension (24, 26) serre la bride (16) en forme de cloche entre les surfaces (28, 30), ce joint étant caractérisée par des moyens (40, 42, 44) à pression de fluide utilisables pour augmenter la tension des moyens travaillant en tension (24, 26) afin d'agrandir l'espace compris entre les surfaces arquées (28, 30) de façon que la bride (16) en forme de cloche puisse être réglée angulairement par pivotement par rapport à l'assemblage (18) à bride.

2. Joint réglable pour conduite conforme à la revendication 1, caractérisé en ce que les moyens (24, 26) de fixation travaillant en tension comprennent des goujons filetés (24) qui traversent la bride (20) et la bague (22), et des écrous (26) serrés sur chaque extrémité de chacun des goujons filetés (24) pour mettre ces derniers en tension et fixer ainsi la bague (22) à la bride (20).

3. Joint réglable pour conduite conforme à l'une des revendications 1 ou 2, caractérisé en ce que les moyens sensibles à la pression (40, 42, 44) comprennent un évidement annulaire (40) ménagé entre la bague (22) et la bride (20) de l'assemblage (18) à bride, et des moyens (42, 44) pour introduire une pression de fluide dans cette chambre annulaire (40) afin d'écarter de force la bague (22) de la bride (20) suffisamment pour relâcher la prise de serrage sur la bride (16) en forme de cloche.

4. Joint réglable pour conduite conforme à l'une des revendications précédentes, caractérisé en ce que, lorsqu'on amène une pression de fluide dans l'évidement annulaire (40), la tension des goujons (24) est augmentée suffisamment pour que l'allongement de ces goujons relâche la prise de serrage sur la bride arquée (16) en forme de cloche et permette un déplacement angulaire relatif entre la bride arquée (16) en forme de cloche et l'assemblage (18) à bride.

5. Joint réglable pour conduite conforme à l'une des revendications précédentes, caractérisé en ce que la prise exercée par les surfaces arquées (28, 30) sur la bride (16) en forme de cloche constitue entre chacune de ces surfaces et la bride une étanchéité métal sur métal.

6. Appareil conforme à la revendication 5, caractérisé en ce qu'il comprend un élément tubulaire fixé à la bride (12) en forme de cloche et qui présente à son autre extrémité une bride (16) en forme de cloche à laquelle est fixé un assemblage (18) à bride.

