

SPECIFICATION

Connectors with rotatable locking rings

The present invention relates to connectors with rotatable locking rings.

- 5 Connectors embodying the invention are particularly useful as connectors for risers used in offshore oil exploration or production and the invention will be described, by way of example, with special reference to the above application,
10 since connectors embodying the invention are particularly suited to solve connection problems in such risers. However, connectors embodying the invention can be used in other applications.

- The connectors most frequently used in
15 offshore oil exploration or production are of the radially gripping type. They have a major disadvantage in that they develop high radial stresses and result in a poor distribution of the vertical load around the periphery of the
20 connector.

- Known connectors with a rotatable ring comprise interlocking tubular elements having an axial abutment, a locking ring inserted in a first tubular element to form therewith a bayonet
25 coupling wherein locking lugs of said ring co-operate with corresponding lugs of said first tubular element, and means bearing on a second tubular element to apply through said lugs of said locking ring, an axial prestress urging said tubular
30 elements against each other.

- Connectors of this type, disclosed for example in French Patent Specifications 2 249 280 and 2 322 323, suffer from a number of drawbacks, due in particular to the fact that the connection of the
35 two tubular elements is achieved with an angular contact interval between the lugs about the connector axis which is, by construction, smaller than 180° . Consequently, the distribution of the axial stresses about this axis is not sufficiently
40 uniform.

- Moreover, in these known connectors any increase in the prestress urging the two tubular elements against each other results in relative rotation of the lugs and thus in a corresponding
45 reduction of the above-defined angular contact interval.

- The first of these drawbacks can be obviated by constructing a connector with a rotatable ring wherein said first tubular element and said locking
50 ring are each provided with at least two crowns of lugs which are angularly staggered from one crown to the other. This provides a connector wherein the lugs of the first tubular element and those of the locking ring contact each other over a
55 much greater angular interval than that obtainable with conventional bayonet connectors. This angular interval may be close to 350° when said first tubular element of the connector and said locking ring are each provided with only two rows
60 of lugs (this number being in by no way limitative), which provides for excellent distribution of the axial stresses applied to the connector.

French Patent Specification 1 301 318 (Guyot) discloses a pipe coupling provided with locking

- 65 lugs distributed in alternate rows.

A first embodiment of this coupling suffers from the drawback of requiring a succession of axial displacements combined with a succession of rotations to achieve connection, which is hardly
70 acceptable in the above-indicated application.

- This drawback is obviated, in a second embodiment, by using rows of locking lugs of different thicknesses, the first row (from the coupling end) being crossed over by exerting an
75 axial force between the two tubular elements of the coupling, thus causing a radial deformation of the wall of a coupling sleeve. This second embodiment requires the use of a sleeve of flexible or semi-flexible material which seems
80 incompatible with the present application.

- According to the present invention there is provided a connector comprising two interlocking tubular elements provided with axial abutment means, a rotatable locking ring which can be fitted
85 to a first of said tubular elements to form therewith a bayonet assembly wherein lugs of said ring co-operate with corresponding lugs of said first tubular element, and means to bear on the second of the tubular elements to exert in the axial
90 direction, through the lugs of said locking ring, a prestress urging the tubular elements against each other, the first tubular element and the locking ring each comprising two rows of lugs which are angularly staggered with respect to each other,
95 and the lugs being provided in cylindrical surfaces of different radii so that when the locking ring is fitted to the first tubular element the lugs can slide effortlessly on one another up to a position where the lugs of each row of lugs of the locking ring
100 pass between those of the corresponding row of the first tubular element to form a plurality of bayonet couplings which can be simultaneously locked.

- According to a preferred embodiment of the
105 invention, the above-mentioned second drawback can be alleviated or even obviated by using stress applying (clamping) means separate from the locking ring. This permits adjustment of the prestress without changing the overall value of the
110 angular contact interval of the lugs.

The invention will now be further described, by way of illustrative and non-limiting example, with reference to the accompanying drawings, wherein:

- Figure 1 is an overall perspective view of a
115 connector embodying the invention for an offshore drilling riser;

Figure 2 is a partial view of the connector of Figure 1 in axial section, in an unlocked position of the connector;

- Figure 2A shows a first modification of the
120 embodiment of Figures 1 and 2;

Figure 2B illustrates a second modification;

- Figures 3A and 3B are each partly a developed view and partly a longitudinal cross-sectional view
125 showing the engagement and the interlocking of connector elements;

Figures 4A and 4B are two cross-sections along line AA of Figure 2 and illustrate locking of the connector;

Figures 5A and 5D show in longitudinal cross-section four successive phases of the connection of elements of the connector;

Figures 6 and 7A illustrate how the connector is tightened; and

Figure 7B shows how the connector is released.

In the drawings, which show connectors embodying the invention for a riser used in offshore oil exploration or production, references 1 and 2 respectively designate a first and a second tubular interlocking element of the connector, such interlocking being limited by an axial abutment or shoulder 3 and sealing being achieved by gasket 4 (fig. 2). Reference 5 designates an element of a lower part of the riser and reference 6 an element of an upper part of the riser. The elements 5 and 6 are secured to the elements 1 and 2 of the connector, respectively by any suitable means, such as by welding.

References 7 and 8 designate flanges for securing peripheral lines, such as the so-called kill line, choke line and booster line which conventionally equip risers used in the oil industry, to the lower and upper parts of the riser, respectively.

The peripheral lines are formed of sections or portions such as 9a, 9b, 10a, 10b, which fit into sleeves 12, 13 at the level of the connector. The connector comprises a locking ring 15 surrounding the ends of the elements 1 and 2 in their fitting position. Locking and unlocking of the connector are effected by rotating the ring 15 through a fraction of a complete turn or revolution (bayonet type locking). This rotation may be effected, for example, by using a handling rod 14 (Figs. 4A and 4B).

The locking ring 15 comprises a shell 16 which may be connected at will, through a pin 19, either to a bracket 17 secured with respect to the line portion 9a, (unlocking or released position shown in Fig. 1), or to a bracket 18 secured with respect to the line portion 10a (locking position).

The connector also comprises a tightening ring 20, which, in the embodiment of Figure 2, can be screwed on to the locking ring 15 by means of co-operating threading 21 and 22 and bear via an annular abutment 23 on an annular collar 24 of the element 2 to apply to an axial prestressing of the tubular elements 1 and 2 against each other, when the ring 15 is in the locking position.

In the embodiment shown in Figure 2A, the tightening ring 20 is screwed onto the tubular element 2 (threading 25 and 26). Moreover, two annular shoulders 27 and 28 interlock the ring 15 and ring 20.

Figure 2B illustrated another embodiment wherein the tightening ring 20 is screwed on to both the locking ring 15 and the tubular element 2, the connection to the ring 15 being achieved via threading 36, 37 whose pitch is different or opposite of that of the threading 25, 26.

In the embodiment of Figure 2, when the tubular elements 1 and 2 have been separated (after unlocking of the tightening ring 20 and rotation of the locking ring 15 to its unlocking

position), the ring 20 cannot be uncoupled or removed since the abutment 23 and collar 24 impede its release downwardly. In the embodiment of Figure 2A the assembly comprising the rings 15 and 20 can, when in the unlocking position and after withdrawal of the tubular element 1, be uncoupled or released simply in a downward direction by screwing the threads 25 and 26. However, due to the shoulders 27 and 28, the rings 15 and 20 cannot then be separated from one another. The embodiment of Figure 2B also has the advantage of permitting the disassembly or uncoupling of the assembly comprising the rings 15 and 20 by virtue of the threads 25 and 26. Furthermore, the locking ring 15 and the ring 20 may then be separated from one another by virtue of the threads 36 and 37. The connector illustrated in Figure 2B is thus completely dismountable.

In the present connectors embodying the invention, the tubular element 1 and the locking ring 15 each comprise the same number of rows of lugs, this number being at least equal to two.

In the illustrated embodiments, the element 1 and ring 15 each comprise a first and a second row of interlocking lugs, when starting from their ends, namely: a first row formed of locking lugs 1A₁, 1A₂,... and a second row formed of lugs 1B₁, 1B₂,... for the tubular element 1; and a first row formed of lugs 15A₁, 15A₂,... and a second row formed of lugs 15B₁, 15B₂,... for the locking ring 15 (Figure 3A).

These locking lugs are angularly staggered from one row to the other and cut, inscribed, machined or otherwise provided in cylindrical surfaces of different radii (r and R for the first and second rows of lugs of the tubular element 1, R' and r' for the first and second rows of lugs of the locking ring 15, Figure 2). The radius R' is slightly greater than the radius r, so that the lugs 15A₁, 15A₂,... of the first row of lugs of the locking ring 15 can freely slide and optionally freely rotate on the lugs 1A₁, 1A₂,... of the first row of lugs of the tubular element 1 (Figures 3A and 5A).

Moreover, the lugs 15A₁, 15A₂,... 15A... of the first row of lugs of the locking ring 15 co-operate with the lugs 1B₁, 1B₂,... 1B... of the second row of lugs of the element 1 to form a first bayonet assembly and the lugs 15B₁, 15B₂,... 15B... of the second row of lugs of the locking ring 15 co-operate with the lugs 1A₁, 1A₂,... 1A... of the first row of lugs of the element 1 to form a second bayonet assembly.

Each of these two bayonet assemblies provides contact between the lugs of the tubular element 1 and the lugs of the locking ring 15 over an overall angular interval of about 175°. Since these two locking assemblies are angularly staggered about the connector axis, the illustrated embodiments provide for distribution of the axial stresses about the connector axis over an angular interval of about 350°.

The insertion of the connector elements, and the steps of locking the ring 15 and achieving prestressing by means of the ring 20, are

described below.

Figure 3A shows, partly in developed view and partly in longitudinal cross-section, the locking ring 15 and the tubular element 1 of the connector 5 before the ring 15 is positioned on the element 1.

Insertion of the ring 15 is illustrated in Figure 5A, which shows the locking lugs 15A₁, 15A₂... of the first row of lugs of the ring passing over those of the second row of lugs of the element 1 (radius 10 R' slightly greater than radius r, Figure 2).

Figure 5B shows how the lugs 15A₁, 15A₂... of the first row of lugs of the locking ring 15 can pass between the lugs 1B₁, 1B₂... of the second row of lugs of the tubular element 1 and how, 15 simultaneously, the lugs 15B₁, 15B₂... of the second row of lugs of the ring 15 can pass between the lugs 1A₁, 1A₂... of the first row of lugs of the tubular element 1, in the angular position of the shell 16 illustrated in Figures 1, 2 20 and 4A.

This operation is completed in the position illustrated in Figure 5C and it is then sufficient to rotate the ring 15 through a fraction of a turn (revolution) to reach the locking position 25 illustrated in Figures 4B and 5D. This rotation of the ring 15 to its position of Figure 4B may be effected by means of the rod 14 (Figure 4B), the ring 15 being then secured in this locking position by means of the pin 19, traversing the shell 16 of 30 the ring 15 and the bracket 18 which is secured with respect to the peripheral line portion 10a.

Tightening of the ring 20 to place the locking lugs in the position illustrated in Figures 3B and 6 and locking of the ring 20 in this position may 35 be effected by any suitable means, an embodiment of such tightening and locking means being illustrated in Figure 7A.

In this embodiment the ring 20 comprises on the periphery of its upper wall a plurality of bores 40 29 into which removable pins 30 can be inserted (alternatively, the ring 20 may be provided with fixed pins). A jack 31, having one end 31a arranged to bear on the peripheral line position 10a through an annular shoulder 35 of the line 45 portion and having its other end 31b arranged to bear on a pin 30, makes it possible to tighten (rotate) the tightening ring 20 by rotating it in the direction indicated by the arrows in Figure 7A. The jack 31, which in the embodiment shown in Figure 50 7A is provided with a handle 32, is fed with pressurised fluid through a pipe 33.

When the ring 20 has been thoroughly tightened it is in the position illustrated in Figure 6, where the annular abutment 23 bears on the 55 collar 24 of the tubular element 2 to apply, in the axial direction, through the lugs of the locking ring 15 and those of the tubular element 1, a prestress urging the element 1 against the element 2, the elements 1 and 2 contacting each other at the 60 level of the shoulder 3.

The ring 20 is provided with means for locking it in the position tightening the ring 15, or in a released position, as defined below.

In the embodiment illustrated in Figures 6, 7A 65 and 7B such means comprises a cam 41 integral

with the ring 20 and locking means carried by ring 15 and bearing on the cam, the locking means comprising a self-locking screw 43 passing through a support member 42.

70 In the tightening position of the ring 20, the screw 43 bears on a ramp 41b of the cam 41, thus preventing releasing of the ring 20 relative to the ring 15, the ring 15 being held in position, in the manner illustrated in Figure 4A, by means of 75 the pin 19 traversing the shell 16 and the bracket 17 which is secured with respect to the peripheral line portion 9a.

In order to release the ring 20, screw 43 is first unscrewed, then the jack 31 is placed in the 80 position shown in Figure 7B where it bears against the peripheral line portion 9a, its end 31a then being located on the annular shoulder 34 of this line portion.

The ring 20 is then released by actuating the 85 jack 31 in the direction indicated by the arrow in Figure 7B to bring the ring 20 into the position where the screw 43 can engage a recess 41a of the cam 41.

Locking of the ring 20 in this released position 90 is then obtained by screwing the self-locking screw 43.

Uncoupling is then effected by rotation of the ring 15.

The axial prestress exerted by ring 20 may be 95 achieved by other tightening means than those illustrated in Figures 7A and 7B. In particular, in the embodiments illustrated in Figures 2A and 2B, the prestress may be obtained by means separate from the ring 20 which will produce a prestress of 100 the desired value between the element 2 and locking ring 15 and will maintain this prestress temporarily. The ring 20 will then be easily screwed up to contact the axial shoulder 24. It will then be sufficient to discontinue the action of the 105 device which has produced the prestress of the desired value and this prestress will then be maintained by the ring 20.

More generally, the connector will comprise means for fastening the tightening ring 20 and the 110 locking ring 15 to the elements 1 and 2, an alternative embodiment of that shown in Figures 6, 7A and 7B consisting in securing the tightening ring 20 directly to the tubular element 2.

CLAIMS

- 115 1. A connector comprising two interlocking tubular elements provided with axial abutment means, a rotatable locking ring which can be fitted to a first of said tubular elements to form therewith a bayonet assembly wherein lugs of said 120 ring co-operated with corresponding lugs of said first tubular element, and means to bear on the second of the tubular elements to exert in the axial direction, through the lugs of said locking ring, a prestress urging the tubular elements against each other, the first tubular element and the locking 125 ring each comprising two rows of lugs which are angularly staggered with respect to each other, and the lugs being provided in cylindrical surfaces of different radii so that when the locking ring is



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described below.

Figure 3A shows, partly in developed view and partly in longitudinal cross-section, the locking ring 15 and the tubular element 1 of the connector before the ring 15 is positioned on the element 1.

Insertion of the ring 15 is illustrated in Figure 5A, which shows the locking lugs 15A₁, 15A₂... of the first row of lugs of the ring passing over those of the second row of lugs of the element 1 (radius R' slightly greater than radius r, Figure 2).

Figure 5B shows how the lugs 15A₁, 15A₂... of the first row of lugs of the locking ring 15 can pass between the lugs 1B₁, 1B₂... of the second row of lugs of the tubular element 1 and how, simultaneously, the lugs 15B₁, 15B₂... of the second row of lugs of the ring 15 can pass between the lugs 1A₁, 1A₂... of the first row of lugs of the tubular element 1, in the angular position of the shell 16 illustrated in Figures 1, 2 and 4A.

This operation is completed in the position illustrated in Figure 5C and it is then sufficient to rotate the ring 15 through a fraction of a turn (revolution) to reach the locking position illustrated in Figures 4B and 5D. This rotation of the ring 15 to its position of Figure 4B may be effected by means of the rod 14 (Figure 4B), the ring 15 being then secured in this locking position by means of the pin 19, traversing the shell 16 of the ring 15 and the bracket 18 which is secured with respect to the peripheral line portion 10a.

Tightening of the ring 20 to place the locking lugs in the position illustrated in Figures 3B and 6 and locking of the ring 20 in this position may be effected by any suitable means, an embodiment of such tightening and locking means being illustrated in Figure 7A.

In this embodiment the ring 20 comprises on the periphery of its upper wall a plurality of bores 29 into which removable pins 30 can be inserted (alternatively, the ring 20 may be provided with fixed pins). A jack 31, having one end 31a arranged to bear on the peripheral line position 10a through an annular shoulder 35 of the line portion and having its other end 31b arranged to bear on a pin 30, makes it possible to tighten (rotate) the tightening ring 20 by rotating it in the direction indicated by the arrows in Figure 7A. The jack 31, which in the embodiment shown in Figure 7A is provided with a handle 32, is fed with pressurised fluid through a pipe 33.

When the ring 20 has been thoroughly tightened it is in the position illustrated in Figure 6, where the annular abutment 23 bears on the collar 24 of the tubular element 2 to apply, in the axial direction, through the lugs of the locking ring 15 and those of the tubular element 1, a prestress urging the element 1 against the element 2, the elements 1 and 2 contacting each other at the level of the shoulder 3.

The ring 20 is provided with means for locking it in the position tightening the ring 15, or in a released position, as defined below.

In the embodiment illustrated in Figures 6, 7A and 7B such means comprises a cam 41 integral

with the ring 20 and locking means carried by ring 15 and bearing on the cam, the locking means comprising a self-locking screw 43 passing through a support member 42.

In the tightening position of the ring 20, the screw 43 bears on a ramp 41b of the cam 41, thus preventing releasing of the ring 20 relative to the ring 15, the ring 15 being held in position, in the manner illustrated in Figure 4A, by means of the pin 19 traversing the shell 16 and the bracket 17 which is secured with respect to the peripheral line portion 9a.

In order to release the ring 20, screw 43 is first unscrewed, then the jack 31 is placed in the position shown in Figure 7B where it bears against the peripheral line portion 9a, its end 31a then being located on the annular shoulder 34 of this line portion.

The ring 20 is then released by actuating the jack 31 in the direction indicated by the arrow in Figure 7B to bring the ring 20 into the position where the screw 43 can engage a recess 41a of the cam 41.

Locking of the ring 20 in this released position is then obtained by screwing the self-locking screw 43.

Uncoupling is then effected by rotation of the ring 15.

The axial prestress exerted by ring 20 may be achieved by other tightening means than those illustrated in Figures 7A and 7B. In particular, in the embodiments illustrated in Figures 2A and 2B, the prestress may be obtained by means separate from the ring 20 which will produce a prestress of the desired value between the element 2 and locking ring 15 and will maintain this prestress temporarily. The ring 20 will then be easily screwed up to contact the axial shoulder 24. It will then be sufficient to discontinue the action of the device which has produced the prestress of the desired value and this prestress will then be maintained by the ring 20.

More generally, the connector will comprise means for fastening the tightening ring 20 and the locking ring 15 to the elements 1 and 2, an alternative embodiment of that shown in Figures 6, 7A and 7B consisting in securing the tightening ring 20 directly to the tubular element 2.

CLAIMS

1. A connector comprising two interlocking tubular elements provided with axial abutment means, a rotatable locking ring which can be fitted to a first of said tubular elements to form therewith a bayonet assembly wherein lugs of said ring co-operated with corresponding lugs of said first tubular element, and means to bear on the second of the tubular elements to exert in the axial direction, through the lugs of said locking ring, a prestress urging the tubular elements against each other, the first tubular element and the locking ring each comprising two rows of lugs which are angularly staggered with respect to each other, and the lugs being provided in cylindrical surfaces of different radii so that when the locking ring is



4
fitted to the first tubular element, the lugs can slide effortlessly on one another up to a position where the lugs of each row of lugs of the locking ring pass between those of a corresponding row of the first tubular element to form a plurality of bayonet couplings which can be simultaneously locked.

5 2. A connector according to claim 1, wherein said prestress applying means is separate from the locking ring.

10 3. A connector according to claim 2, wherein said prestress applying means comprises a tightening ring.

15 4. A connector according to claim 3, wherein the tightening ring is connected by screw threading with the locking ring and bears against an annular shoulder of the second tubular element.

20 5. A connector according to claim 3, wherein the tightening ring is connected to the second tubular element by screw threading and comprises an annular shoulder engaging a corresponding annular shoulder of the locking ring.

25 6. A connector according to claim 3, wherein the tightening ring is connected to the locking ring by first screw threading and to the second tubular element by second screw threading, said first and second screw threadings being of different or opposite pitches.

30 7. A connector according to claim 3,

comprising means for fastening the tightening ring and the locking ring to the tubular elements.

35 8. A connector according to claim 7, designed for use with a riser for offshore oil exploration or production which is equipped with peripheral lines secured with respect to the tubular elements, the connector comprising means for maintaining the locking ring in its locked position by connection of the locking ring to a first of said peripheral lines

40 and means for maintaining the locking ring in its released position by connection of the locking ring to a second of said peripheral lines.

45 9. A connector according to claim 8, comprising means for securing the tightening ring and the locking against relative movement.

50 10. A connector according to claim 9, wherein said securing means comprises two elements which are respectively secured with respect to the locking ring and secured with respect to the tightening ring, one of said elements comprising a locking screw and the other comprising a cam against which the locking screw can be tightened.

55 11. A connector according to claim 9, comprising means for fastening the tightening ring to the second tubular element.

12. A connector substantially as herein described with reference to Figures 1, 2 and 3A to 7B, Figures 1, 2A and 3A to 7B or Figures 1, 2B and 3A to 7B of the accompanying drawings.