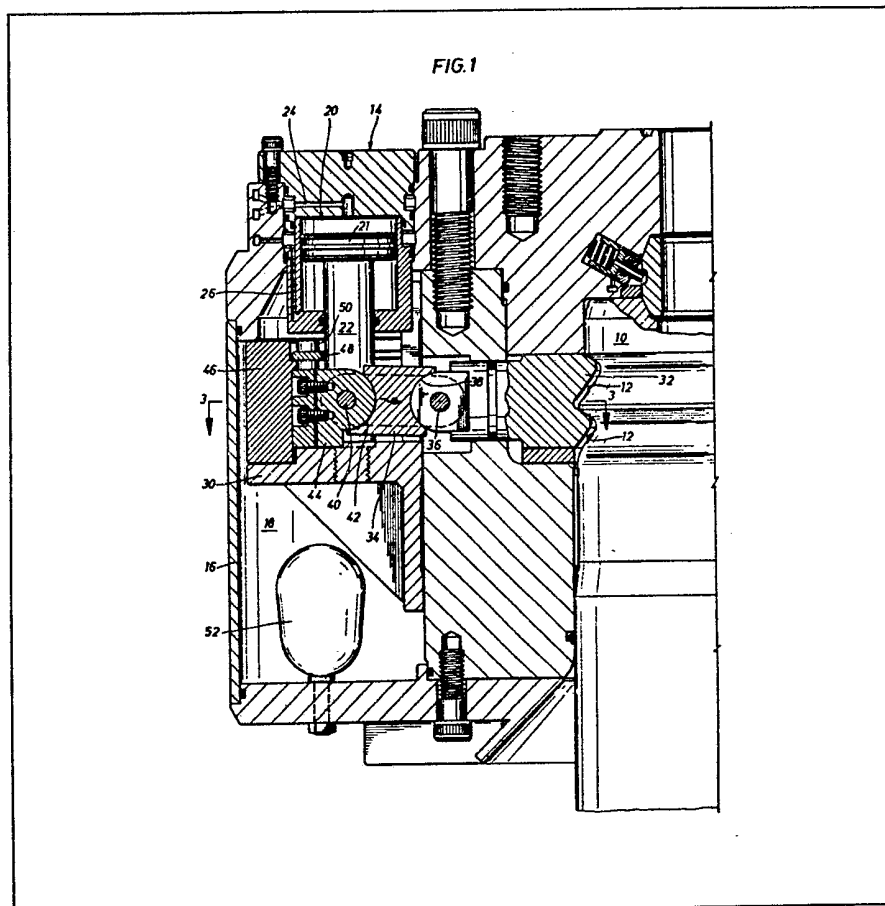


- (21) Application No 7921154
- (22) Date of filing 18 Jun 1979
- (23) Claims filed 18 Jun 1979
- (30) Priority data
- (31) 916981
- (32) 19 Jun 1978
- (33) United States of America (US)
- (43) Application published 16 Jan 1980
- (51) INT CL³
E05C 1/06
- (52) Domestic classification
E2A 108 130 137
E1F 44
F2G 4J6
- (56) Documents cited
GB 1497982
GB 1420587
GB 1256514
GB 1019095
- (58) Field of search
E2A
F2G
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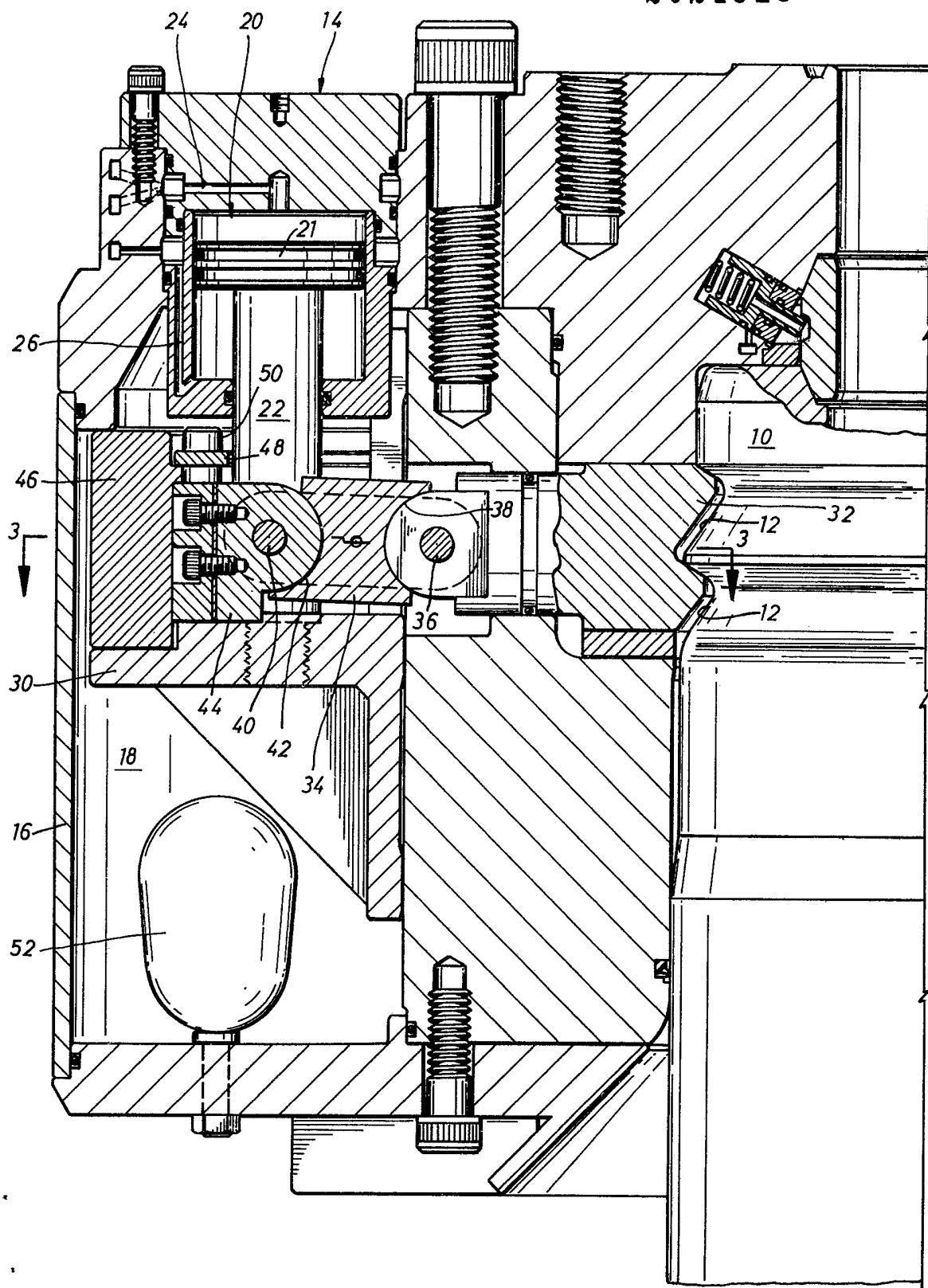
(54) Toggle mechanism connector

(57) An over-the-centre toggle mechanism for moving locking dogs 32 for connecting and disconnecting two underwater members 10, 14 which may be a well head top and a connector therefor. The first member 10 includes locking notches 12 and the second member slidably carries locking dogs 32 for transverse movement for engagement and disengagement with the locking notches. A toggle linkage includes a first pivot connection 36, 38 connected to the dogs and a second pivot connection 40, 42 longitudinally actuated by pistons 21 whereby longitudinal movement of the second pivot connections transversely moves the locking dogs. A resilient load spring 46 acts against the second

pivot connections and towards the first pivot connections for locking the second pivot connections in a past dead-centre position relative to the first pivot connections. The second member includes a tubular body 16 having an annular cavity 18 with a longitudinally reciprocal carriage 30 mounted in the cavity and actuated by the pistons. The second pivot connections and the spring are transversely movable on the carriage and carried by the carriage. The cavity includes seals for sealingly enclosing the cavity and includes a flexible member 52 exposed on one side to the interior of the cavity and on the second side to the exterior of the cavity for compensating for a difference in fluid pressure between the cavity and the outside of the body.



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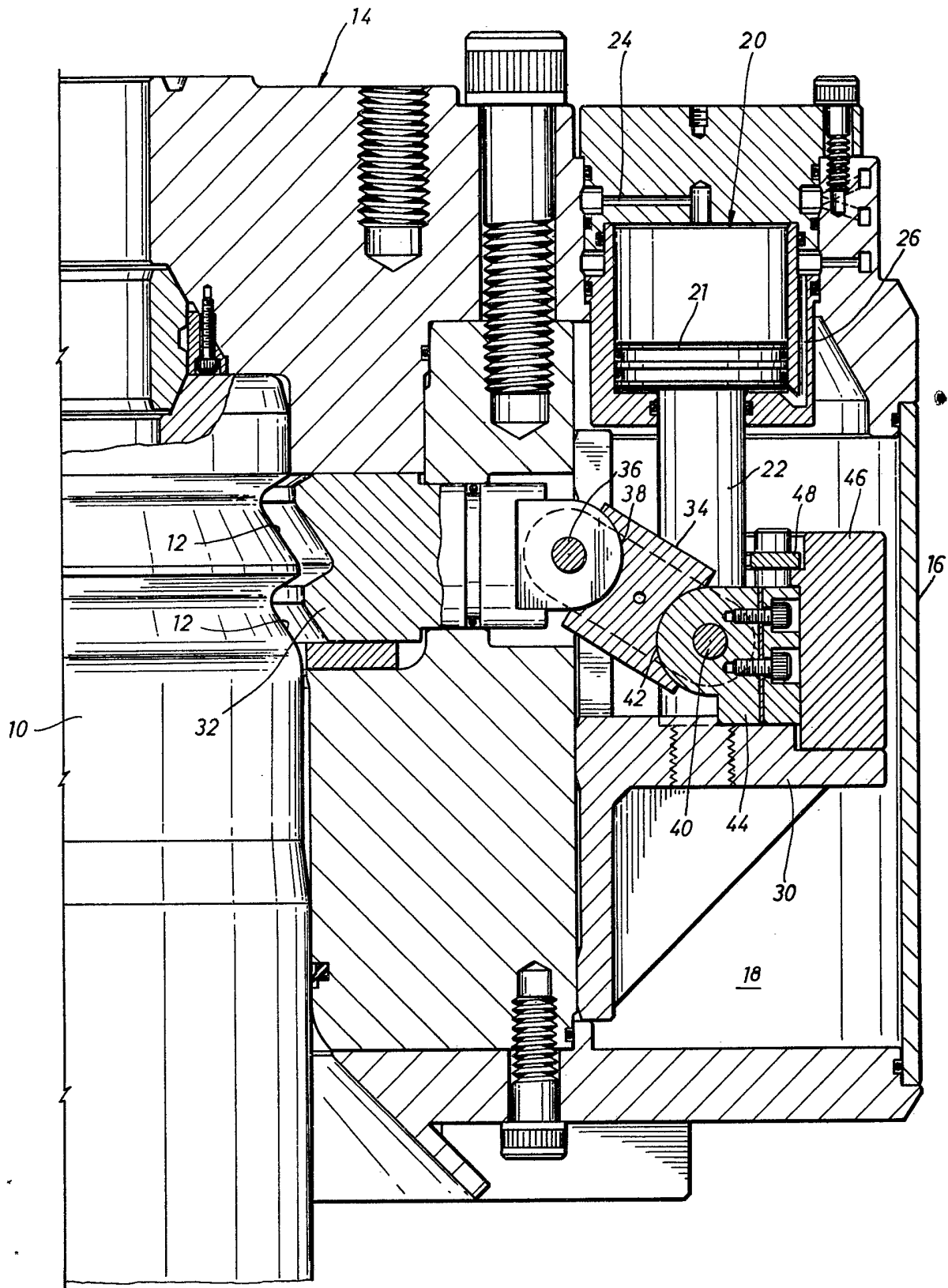
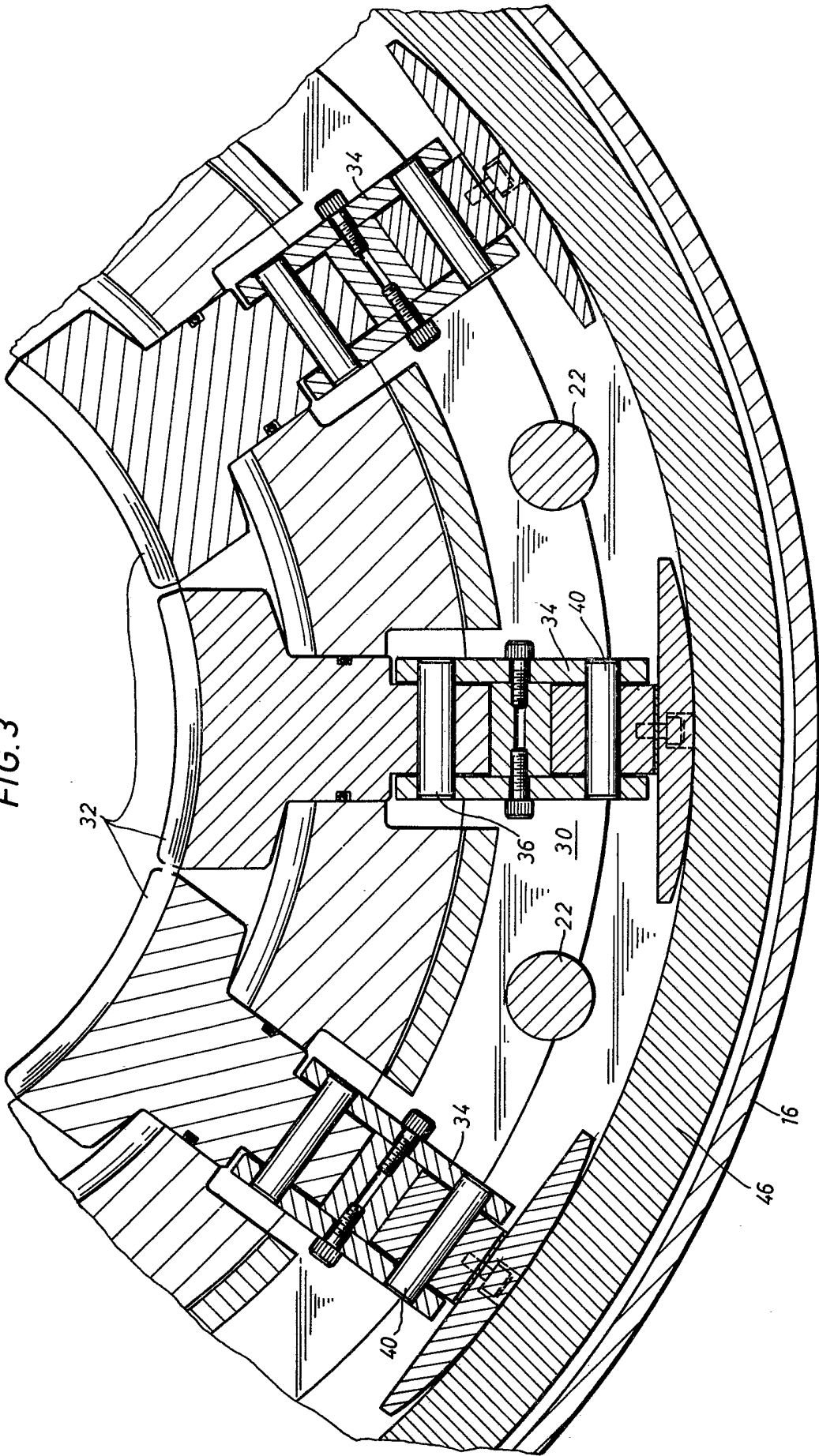


FIG. 2

FIG. 3



SPECIFICATION

Toggle mechanism connector

The present invention relates to a connector for connecting and disconnecting two members of which the first member includes a locking notch.

Generally, it is old, as shown by patent no. 3,851,897, to connect and disconnect an underwater wellhead by the use of a hydraulically actuated piston moving locking dogs into a locking relationship between a connector and a wellhead.

The present invention is directed to various improvements in a connector for connecting and disconnecting two members.

According to the invention there is provided a connector for connecting and disconnecting two members of which the first member includes a locking notch, the connector comprising a double acting longitudinally moving means for moving locking dogs into and out of the locking notch wherein the dogs are slidably carried by the second member for transverse movement toward and away from the second member for engagement and disengagement with the locking notch, and a toggle linkage having a first pivot connection connected to the dogs and a second pivot connection longitudinally actuated by the said moving means whereby the longitudinal movement of the second pivot connection transversely moves the locking dogs.

Preferably there is provided a resilient load spring acting against the second pivot connections and toward the first pivot connections for locking the second pivot connections in a past dead-centre position relative to the first pivot connections thereby providing a positive mechanical lock for the dogs as well as resulting in high preloads acting between the pivot and second member with a relatively small piston force due to the high mechanical advantage of the toggle linkage.

Further it is preferable also to provide a hydraulically actuated connector in which the second body includes an annular cavity in which a longitudinally reciprocal carriage is mounted and moved by the piston, and the carriage supports the second pivot connections and the spring which are transversely movable on the carriage.

In addition there is preferably provided sealing means for enclosing the cavity so that it may be oil filled and a flexible member is provided exposed on one side to the interior of the cavity and on the second side to the exterior of the cavity for compensating for a difference in fluid pressure between the inside and outside of the body as well as compensating for movement of the piston and dogs into and out of the cavity.

To help understanding of the invention, the following description of a presently preferred embodiment of the invention is now given in conjunction with the accompanying drawings, in which

Figure 1 is an elevational view, in quarter section, of the connector of the present invention shown in the locked position,

Figure 2 is an elevational view, in quarter

section, of the connector of the present invention shown in the unlocked position, and

Figure 3 is a cross-sectional view taken along the line 3—3 of Figure 1.

Referring now to the drawings, the reference numeral 10 generally indicates a first tubular member such as the top of a wellhead having one or more annular locking notches 12 on its exterior to which a second member or connector, generally indicated by the reference numeral 14, is connected or disconnected.

The connector 14 includes a tubular body 16 having an annular cavity 18 therein. The body 16 is adapted to telescope over and seat and seal on member 10.

One or more double acting piston and cylinder assemblies 20 are provided in the body 16 each with a piston 21 having a piston rod 22 extending into the cavity 18. Hydraulic pressure line 24 supplies hydraulic pressure to one side of the pistons 21, and hydraulic pressure line 26 applies hydraulic pressure to the other side of the piston 21. An annular carriage 30 is longitudinally movable in the cavity 18 and is connected to the piston rods 22 and longitudinally reciprocates with the pistons 21. The carriage 30 bears against the inside of the body 16 for providing a secure support.

A plurality of locking dogs 32 are provided having one end for engaging the locking notches 12 on the first member 10 and having their second ends extending through seals into the body cavity 18. The dogs 32 move transversely in the body 16 for engagement and disengagement with the locking notches 12.

A toggle linkage 34 is provided to translate the longitudinal motion of each of the piston rods 22 into a transverse movement of one of the locking dogs 32. Each toggle linkage 34 has a first pivot connection connected to one of the dogs within the cavity 18. The first pivot connection includes a pin 36 as well as arcuate power-bearing surfaces 38. The second pivot connection of each of the toggle linkages 34 is longitudinally actuated by the pistons 21 whereby the longitudinal movement of the second pivot connections transversely moves the locking dogs 12. The second pivot connections include a pin 40 and coating arcuate power-bearing surfaces 42 between the linkage 34 and a bearing journal 44, which rest on and is carried by the carriage 30.

An annular load spring 46 is supported on the carriage 30 and acts against the second pivot connections and toward the first pivot connections for locking the second pivot connections in a past dead-centre position relative to the first pivot connections. The annular spring ring 46 is retained to the carriage 30 by a retainer plate 48 and hold-down bolts 50 although the spring 46 and bearing journals 44 are transversely movable on the carriage 30 so that the spring 46, which acts as a large garter spring, flexes outwardly and inwardly to allow the toggle linkages 34 to snap over dead-centre into a locked or unlocked position.

The cavity 18 includes seals for sealingly

enclosing the cavity whereby it may be filled with oil to reduce maintenance of the operating parts and protect the operating parts from hostile subsea environment. A flexible member such as a rubber bladder 52 may be provided which has one side exposed to the interior of the cavity 18 and a second side exposed to the exterior of the body 16 for compensating for a difference in fluid pressure between the cavity 18 and the outside of the body 16 as well as compensating for the movements of the piston rods 22 and dogs 32 into and out of the cavity 18.

Referring to Figure 2 with the second member 14 in position encompassing the first member 10 and in the unlocked position, hydraulic fluid is applied to the bottom side of the piston 21 through line 26 which forces the piston rods 22 and carriage 30 upwardly. The second pivot connections comprising the bearing journals 44 and pins 42 are trapped between the carriage 30 and annular load ring 46. As the second pivot connections move upwardly or longitudinally, they force the toggle linkages 34 to rotate about the first pivot connections which includes the arcuate bearing surfaces 38 and pins 36 to transversely move the locking dogs 32 into the locking notches 12 of the first member 10. Furthermore, as the angle between the centreline of the toggle linkages 34 and the centreline of the dogs 32 decreases, the ratio of the radial inward force on the dogs 32 to the vertical actuating force on the carriage 30 increases. This mechanical advantage allows a high clamping force with relatively low actuating forces. Furthermore, the load ring 46 flexes radially outward to allow the linkage 34 to snap over dead-centre and then inwardly as the annular ring 46 bottoms out against the body 16 to create a positive past dead-centre lock to hold the dogs 32 in engagement, as shown in Figure 1.

To unlock the connector 14, hydraulic pressure is applied through line 24 moving the pistons 21, piston rods 22, and carriage 30 downwardly. The retainer plates 48 carry the load ring 46 and force the second pivot connections including the bearing journals 44 to move downwardly over dead-centre relative to the first pivot connections to unlock the connector 14. Further downward movement of the carriage 30 causes retraction of the dogs 32 by the pins 36 and 42.

The above described over-centre toggle mechanism connector has the advantages of providing a positive mechanical lock of the locking dogs, providing high preloads by relatively smaller actuator forces due to the high mechanical advantage of the toggle mechanism, holding the toggle mechanism in a past dead-centre position, and securely supporting the actuating mechanism in an oil filled cavity.

While the present invention has been specifically described with reference to a connector for connecting and disconnecting two remote underwater conductors such as subsea blowout preventer stack or a subsea Christmas tree to a wellhead of an oil and/or gas well, the

connector is also suitable for use in a remote subsea pipeline connector, flowline, marine riser connector and other applications.

CLAIMS

1. A connector for connecting or disconnecting two members of which the first member includes a locking notch, the connector comprising a double acting longitudinally moving means for moving locking dogs into and out of the locking notch wherein the dogs are slidably carried by the second member for transverse movement toward and away from the second member for engagement and disengagement with the locking notch, and a toggle linkage having a first pivot connection connected to the dogs and a second pivot connection longitudinally actuated by the said moving means whereby the longitudinal movement of the second pivot connection transversely moves the locking dogs.

2. A connector as claimed in claim 1 including a resilient load spring acting against the second pivot connection and towards the first pivot connection for locking the second pivot connection in a past dead-centre position relative to the first pivot connection.

3. A connector for locking a second member to a first member which includes a locking notch comprising, an annular body having an annular cavity included in the second member, a plurality of locking dogs slidably carried by the body for transverse movement toward and away from the second member for engagement and disengagement with the locking notch, the dogs extending into the said cavity, a plurality of toggle linkages in the cavity, each of which includes first and second pivot connections, the first pivot connection being connected to one of the dogs, a longitudinally reciprocative carriage mounted in the cavity, the carriage carrying the second pivot connections, an annular spring carried by the carriage and acting against the second pivot connections and towards the first pivot connections for locking the second pivot connections in a past dead-centre position relative to the first pivot connections, and a double acting longitudinally movable means connected to and longitudinally moving the carriage.

4. A hydraulically actuated connector for locking a second member to a first member which includes a locking notch comprising, a tubular body for telescoping over the first member and an annular sealed cavity included in the second member, a plurality of locking dogs slidably carried by the body for transverse movement toward and away from the second member for engagement and disengagement with the second locking notch, the dogs extending into the said cavity, a plurality of toggle linkages in the cavity, each of which includes first and second pivot connections, the first pivot connections being connected inside of the cavity to one of the dogs, an annular longitudinally reciprocative carriage mounted in the cavity and bearing on its inside against the inside of the body, the carriage carrying the

second pivot connections, an annular spring carried by the carriage and acting against the second pivot connections and towards the first pivot connection for locking the second pivot connections in a past dead-centre position relative to the first pivot connections, and a double acting longitudinally movable piston carried by the body and extending into the cavity and connected to and longitudinally moving the carriage.

5. A connector as claimed in claim 3 or claim 4 including seals for sealing and enclosing the said cavity, and a flexible member exposed on one side to the interior of the cavity and on the second side to the exterior of the cavity for compensating for a difference in fluid pressure between the cavity and the outside of the body.

6. A connector as claimed in claim 3, claim 4 or claim 5 wherein the second pivot connections and

the spring are transversely movable on the carriage.

7. A connector for connecting and disconnecting two members of which the first member includes a locking notch, the connector comprising in the second member an annular body having an annular cavity, seal means enclosing the cavity, the locking dogs, means for moving the locking dogs into and out of the locking notch, the moving means extending into said cavity, oil filling the cavity, and a flexible member exposed on one side to the interior of the cavity and on the second side to the exterior of the cavity.

8. A connector for connecting and disconnecting two members of which the first member includes a locking notch substantially as hereinbefore described with reference to the accompanying drawings.