

PATENT SPECIFICATION (11)

1 368 122



- (21) Application No. 50805/71 (22) Filed 2 Nov. 1971
 (31) Convention Application No. 106 855 (32) Filed 15 Jan. 1971 in
 (33) United States of America (US)
 (44) Complete Specification published 25 Sept. 1974
 (51) International Classification F16L 17/00 F16B 2/14 F16J 15/00
 (52) Index at acceptance

F2G 18G 18H 23F 23J
 E2A C4C
 E2B 6C1A

(54) APPARATUS AND METHOD FOR CONNECTING A CYLINDRICAL MEMBER TO ANOTHER MEMBER

(71) We, HYDROTECH INTERNATIONAL INC., a Corporation incorporated under the laws of the State of Delaware, United States of America, of 4800 West 34th Street, Houston, Texas, 77018, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention concerns the connection of cylindrical, e.g. tubular, members to other members that may also be cylindrical.

In the construction and repair of pipelines and of drilling platforms or other structures formed of tubular members, conventional construction techniques are frequently unsuitable. For example, for underwater construction in murky waters and in onshore construction around explosive materials, conventional welding practices may be extremely hazardous and time consuming. Various mechanical connectors have been suggested for use in these environments but, however, these connectors usually involve elaborate and time-consuming mechanical installation techniques.

An hydraulically-actuated pipe coupling which overcomes some of the prior art problems has been proposed in U.S. Patent 3,393,926. This Patent discloses the use of a set of tapered slips arranged to grip the outside surface of a pipe or like tubular member in a manner such that an axial force tending to move the member in one direction relatively to the coupling will be resisted by wedging action increasing the grip of the slips upon the member.

An object of this invention is to provide an improved apparatus and method for connecting a cylindrical, e.g. tubular, member to another member in a manner to resist axial forces displacing the cylindrical member in either direction.

In one aspect, therefore, the invention provides apparatus for connecting a cylindrical first member to a second member,

comprising a housing having one end adapted to receive the end of a cylindrical first member to which connection is to be made; first and second gripping means spaced apart in said housing and adapted for engaging the external surface of the cylindrical first member when received in said housing, by movement in opposite actuating directions within said housing, each gripping means including a plurality of tapered slips cooperating with a camming surface; fluid pressure-operable actuating means for displacing each said gripping means in its respective actuating direction; and means for connecting the other end of the housing to said second member.

The cylindrical member and the second member may both be conduits intended to convey a fluid, and in such case the housing may be arranged to provide fluid-tight communication between the members when connected by the apparatus. For this purpose the housing may include seal means for engaging the external surface of the cylindrical member upon actuation of the gripping means.

The connecting means may include a flange secured to the second end of the housing and arranged for connection to a second member.

The actuating means preferably includes piston means mounted for axially slidable movement in said housing and responsive to fluid pressure thereagainst for actuating said gripping means, and means for injecting a pressurized fluid into a fluid chamber to actuate said piston means.

In another aspect, the invention provides a method of connecting a cylindrical first member to a second member, comprising the steps of mounting over the end of said cylindrical first member one end of a coupling housing having spaced apart gripping means therein adapted for engaging the external surface of said cylindrical member at axially spaced apart positions by movement in opposite actuating directions, each said gripping means including a plurality of tapered slips and a cooperating camming surface; actuating said gripping means, to en-

50

55

60

65

70

75

80

85

90

95

gage said first member, by transmitting a fluid pressure-generated force to said gripping means to displace each in its respective actuating direction; and connecting the other end of said coupling housing to said second member.

The invention will be further described with reference to the accompanying drawings, in which:

Figures 1A and 1B are enlarged side elevation views, partly in section, of the left and right end portions, respectively, of a coupling shown in Figure 2;

Figure 2 is an axial sectional view of a coupling constituting an embodiment of the invention, showing this coupling actuated to engage a cylindrical member; and

Figure 3 is a plan view showing two of the couplings illustrated in Figure 2 connecting two cylindrical members together.

Figures 1A, 1B and 2 of the drawings illustrate, by way of example, one embodiment of the apparatus of this invention. As shown, this apparatus comprises a coupling having a housing, generally designated 10, formed from three generally cylindrical coaxially aligned segments 11, 17 and 27.

The segment 11 of housing 10 is shown in detail in Figure 1A and includes a first gripping means arranged to engage the outside surface of a tubular member disposed within housing 10, for example a pipe 38 as shown in Figure 2. This gripping means includes a multiple camming surface tapered bowl 12 formed on the inside surface of segment 11 and a plurality of elongated, partially cylindrical, tapered slips 13 which are matingly and slidably positioned in bowl 12. The radially inward surface of slips 13 is provided with wickers or other gripping surface 14 arranged to engage the external surface of pipe 38.

Leftward movement of slips 13 relative to bowl 12, as seen in Figures 1 and 2, will cause slips 13 to move radially inward and because of the multiple camming surfaces on bowl 12 and slips 13 and the small taper angle thereof, a large axial force to radial force transfer is obtained to provide good grip for slips 13 on the pipe 38.

Each of slips 13 is provided with an elongated slot 15 arranged to receive a retainer pin 16 which is secured to the wall of housing 11. Pins 16 provide means for retaining slips 13 in their circumferentially disposed position within housing segment 11 when no cylindrical member is inserted therein.

The central segment 17 of housing 10, shown at the right of Figure 1A and continued into the left portion of Figure 1B, is coaxially aligned with and welded to left housing segment 11. Coaxially positioned within segment 17 is a cylindrical outer piston 18 which slidably contacts the inner surface of segment 17, and a cylindrical inner piston

19 also arranged for sliding movement along the inner surface of segment 17. The axially adjacent ends of cylindrical pistons 18 and 19 overlap forming a fluid chamber 20 therebetween. Means for transmitting a pressurized fluid to chamber 20 is provided by pressure regulating inlet valve 21 which is threadedly secured to segment 17 adjacent to chamber 20 and arranged to communicate therewith. O-rings are provided to form a pressure tight seal between the inner surface of segment 17 and pistons 18 and 19, and between the overlapping portions of these pistons.

Identical packers 22 and 23 are annularly disposed adjacent to the outer ends of pistons 19 and 18, respectively. These packers, which may be composed of a plurality of packing rings 24, as shown, or which may be unitary, or which may assume any other equivalent desired form, are of a resilient type which will deform radially when subjected to an axial compression force. The packers 22 and 23 provide seal means for sealingly engaging the outside surface of a cylindrical member positioned within housing 10, as shown in Figure 2.

Cylindrical thrust rings 25 and 26 are provided adjacent the outer ends of packers 22 and 23, respectively, and are arranged for axially sliding movement within segment 17. The left end of ring 25, as viewed in the drawings, engages the right ends of slips 13 and is arranged to transmit an axial force thereto. Similarly, the right end of thrust ring 26 is arranged to engage and to transmit an axial force to a second and oppositely directed set of tapered slips 29 constituting a part of a second gripping means arranged within the segment 27 of housing 10 to engage the outside surface of a tubular member such as the pipe 38 positioned therein. This second gripping means includes a multiple camming surface tapered bowl 28 which is formed on the inside surface of segment 27, the set of elongated partially cylindrical slips 29 being matingly and slidably positioned in bowl 28. The radially inward surfaces of slips 29 are provided with a gripping surface 30 arranged to engage the outer surface of a cylindrical member positioned therein. Slips 29 are provided with axially aligned elongated slots 31 adapted to receive retainer pins 32 which, in turn, are secured to segment 27 to retain slips 29 in their circumferentially disposed position within housing segment 27 when no cylindrical member is positioned therein.

The tapered surfaces of bowl 28 and slips 29 in right housing segment 27 face in the opposite axial direction from the surfaces of bowl 12 and slips 13 in left housing segment 11 described above. Since the respective bowl and slips assemblies face opposite directions, they will respectively resist oppositely

directed axial forces when set, and thereby together will withstand both tension and compression axial forces.

Means for connecting the right end of housing 10 to another member is provided in the form of a connector housing 33 which is coaxially secured to housing 10 as by weld 34. Connector housing 33 carries a flange 35 at the right end thereof, which flange may have any desired shape and securing means thereon. For example, if it is desired to couple two non-parallel intersecting pipes using the apparatus of this invention, flange 35 could be of the bias cut type as shown in the drawings and could be provided with bolt holes 36 arranged to mate with similar bolt holes in another such connector arranged to receive bolts 37 as shown in Figure 3.

In operation, the coupling in its unactuated state, as shown in Figures 1A and 1B, is positioned over the end of a tubular member, such as pipe 38 in the manner shown in Figure 2. A pressurized fluid is then injected through valve 21 into chamber 20 against pistons 18 and 19. This fluid pressure forces piston 18 to the right against packer 23 and simultaneously forces piston 19 to the left against packer 22. These oppositely directed forces are transmitted by thrust rings 25 and 16 to slips 13 and 29, respectively, causing slips 13 and 29 to engage and seat against pipe 38. Continued pressure from pistons 18 and 19 causes packers 23 and 22, respectively, to become inwardly radially deformed in sealing engagement with the outer surface of pipe 38.

Any convenient source of pressurized fluid may be used to actuate this apparatus. However, if a permanent connection is planned, a hardenable fluid, such as an epoxy resin, should be used so that a permanent, non-yielding pressure will be exerted on the packers and slips.

This invention additionally provides a method of joining a generally cylindrical member to another member, which method is particularly useful in joining together pipe sections and in joining a tubular construction member to another member. This method may be performed using the above described apparatus or equivalents thereof.

In this method, a housing 10 having therein axially spaced apart gripping means including tapered slips, such as oppositely directed slips 13 and 29, is mounted over the end of a tubular member, as pipe 38 shown in Figure 2. Slips 13 and 29 are initially in the retracted position shown in Figures 1A and 1B. In the subsequent step of this method, slips 13 and 29 are actuated to an engaging position about pipe 38 through application of a fluid pressure generated force to the slips. Using the apparatus illustrated and described above, this force is an axial force which is

applied to the inward ends of slips 13 and 29 and is derived from the longitudinally opposing movement of pistons 18 and 19. This motion is transmitted through packers 22 and 23 and rings 25 and 26. Application of this force causes slips 13 and 29 to move from the positions shown in Figures 1A and 1B to those shown in Figure 2 and causes slips 13 and 29 to grip pipe 38 so as to withstand oppositely directed axial forces.

Using an apparatus such as that above described, the method also includes actuating axially spaced-apart seals, such as packers 22 and 23, into sealing engagement with pipe 38 simultaneously with the engagement of slips 13 and 29. This actuation is accomplished by forming packers 22 and 23 of a resilient material which will deform radially when subjected to an axially compressive force. This compressive force is applied to packers 22 and 23 through the opposition of slips 13 and 29 to the force of pistons 18 and 19 as the slips begin to engage pipe 38.

WHAT WE CLAIM IS:—

1. Apparatus for connecting a cylindrical first member to a second member, comprising a housing having one end adapted to receive the end of a cylindrical first member to which connection is to be made; first and second gripping means spaced apart in said housing and adapted for engaging the external surface of the cylindrical first member when received in said housing, by movement in opposite actuating directions within said housing, each said gripping means including a plurality of tapered slips cooperating with a camming surface; fluid pressure-operable actuating means for displacing each said gripping means in its respective actuating direction; and means for connecting the other end of the housing to said second member.

2. Apparatus according to claim 1, wherein said connecting means includes a flange adapted for connection to said second member.

3. Apparatus according to claim 1 or 2, wherein said cylindrical member and said second member are conduits and said housing provides fluid-tight communication therebetween when connected thereto.

4. Apparatus according to claim 1, 2 or 3, including seal means in said housing for sealingly engaging the external surface of said cylindrical member upon actuation of said gripping means.

5. Apparatus according to any one of claims 1 to 4, wherein said actuating means includes piston means mounted for axially slidable movement in said housing and responsive to fluid pressure thereagainst for actuating said gripping means.

6. Apparatus according to claim 5, including means for injecting a pressurized fluid into a fluid chamber to actuate said piston means.

directed axial forces when set, and thereby together will withstand both tension and compression axial forces.

Means for connecting the right end of housing 10 to another member is provided in the form of a connector housing 33 which is coaxially secured to housing 10 as by weld 34. Connector housing 33 carries a flange 35 at the right end thereof, which flange may have any desired shape and securing means thereon. For example, if it is desired to couple two non-parallel intersecting pipes using the apparatus of this invention, flange 35 could be of the bias cut type as shown in the drawings and could be provided with bolt holes 36 arranged to mate with similar bolt holes in another such connector arranged to receive bolts 37 as shown in Figure 3.

In operation, the coupling in its unactuated state, as shown in Figures 1A and 1B, is positioned over the end of a tubular member, such as pipe 38 in the manner shown in Figure 2. A pressurized fluid is then injected through valve 21 into chamber 20 against pistons 18 and 19. This fluid pressure forces piston 18 to the right against packer 23 and simultaneously forces piston 19 to the left against packer 22. These oppositely directed forces are transmitted by thrust rings 25 and 16 to slips 13 and 29, respectively, causing slips 13 and 29 to engage and seat against pipe 38. Continued pressure from pistons 18 and 19 causes packers 23 and 22, respectively, to become inwardly radially deformed in sealing engagement with the outer surface of pipe 38.

Any convenient source of pressurized fluid may be used to actuate this apparatus. However, if a permanent connection is planned, a hardenable fluid, such as an epoxy resin, should be used so that a permanent, non-yielding pressure will be exerted on the packers and slips.

This invention additionally provides a method of joining a generally cylindrical member to another member, which method is particularly useful in joining together pipe sections and in joining a tubular construction member to another member. This method may be performed using the above described apparatus or equivalents thereof.

In this method, a housing 10 having therein axially spaced apart gripping means including tapered slips, such as oppositely directed slips 13 and 29, is mounted over the end of a tubular member, as pipe 38 shown in Figure 2. Slips 13 and 29 are initially in the retracted position shown in Figures 1A and 1B. In the subsequent step of this method, slips 13 and 29 are actuated to an engaging position about pipe 38 through application of a fluid pressure generated force to the slips. Using the apparatus illustrated and described above, this force is an axial force which is

applied to the inward ends of slips 13 and 29 and is derived from the longitudinally opposing movement of pistons 18 and 19. This motion is transmitted through packers 22 and 23 and rings 25 and 26. Application of this force causes slips 13 and 29 to move from the positions shown in Figures 1A and 1B to those shown in Figure 2 and causes slips 13 and 29 to grip pipe 38 so as to withstand oppositely directed axial forces.

Using an apparatus such as that above described, the method also includes actuating axially spaced-apart seals, such as packers 22 and 23, into sealing engagement with pipe 38 simultaneously with the engagement of slips 13 and 29. This actuation is accomplished by forming packers 22 and 23 of a resilient material which will deform radially when subjected to an axially compressive force. This compressive force is applied to packers 22 and 23 through the opposition of slips 13 and 29 to the force of pistons 18 and 19 as the slips begin to engage pipe 38.

WHAT WE CLAIM IS:—

1. Apparatus for connecting a cylindrical first member to a second member, comprising a housing having one end adapted to receive the end of a cylindrical first member to which connection is to be made; first and second gripping means spaced apart in said housing and adapted for engaging the external surface of the cylindrical first member when received in said housing, by movement in opposite actuating directions within said housing, each said gripping means including a plurality of tapered slips cooperating with a camming surface; fluid pressure-operable actuating means for displacing each said gripping means in its respective actuating direction; and means for connecting the other end of the housing to said second member.

2. Apparatus according to claim 1, wherein said connecting means includes a flange adapted for connection to said second member.

3. Apparatus according to claim 1 or 2, wherein said cylindrical member and said second member are conduits and said housing provides fluid-tight communication therebetween when connected thereto.

4. Apparatus according to claim 1, 2 or 3, including seal means in said housing for sealingly engaging the external surface of said cylindrical member upon actuation of said gripping means.

5. Apparatus according to any one of claims 1 to 4, wherein said actuating means includes piston means mounted for axially slidable movement in said housing and responsive to fluid pressure thereagainst for actuating said gripping means.

6. Apparatus according to claim 5, including means for injecting a pressurized fluid into a fluid chamber to actuate said piston means.



7. Apparatus for connecting a tubular cylindrical first member to a conduit member, comprising a housing having one end adapted to receive one end of the cylindrical first member to which connection is to be made; first and second gripping means spaced apart in said housing and adapted to engage the external surface of the cylindrical first member, at axially spaced apart positions, by movement in opposite actuating directions, each said gripping means including a plurality of tapered slips cooperating with a camming surface; first and second seal means spaced apart in said housing for sealingly engaging the external surface of said cylindrical first member at axially spaced apart positions; piston means mounted for axially slidable movement in said housing and responsive to fluid pressure thereagainst to displace each said gripping means in its respective actuating direction and to actuate the respective seal means; means for introducing a pressurized fluid into said housing and against said piston means; and means for connecting the other end of said housing to said conduit member.

8. Apparatus for connecting the ends of two cylindrical members in end to end relationship, comprising first and second housings each having one end adapted to receive the end of one of said cylindrical members and each having first and second gripping means spaced apart therein for engaging the external surface of one of said cylindrical members, at axially spaced apart positions, by movement in opposite actuating directions, each said gripping means including a plurality of tapered slips cooperating with a camming surface; piston means in each housing responsive to fluid pressure thereagainst for displacing the gripping means of that housing each in its respective actuating direction; means for introducing a pressurized fluid into each housing and against the piston means therein; and means for connecting to-

gether the other ends of said first and second housings.

9. A method of connecting a cylindrical first member to a second member, comprising the steps of mounting over the end of said cylindrical first member one end of a coupling housing having spaced apart gripping means therein adapted for engaging the external surface of said cylindrical member at axially spaced apart positions by movement in opposite actuating directions, each said gripping means including a plurality of tapered slips and a cooperating camming surface; actuating said gripping means, to engage said first member, by transmitting a fluid pressure-generated force to said gripping means to displace each in its respective actuating direction; and connecting the other end of said coupling housing to said second member.

10. A method according to claim 9 and in which said coupling housing has a pair of spaced apart seals adapted for sealingly engaging said cylindrical member at axially spaced apart positions, including the step of actuating said seals to the sealing position substantially simultaneously with the actuation of said gripping means.

11. A method of connecting cylindrical members together, substantially as described with reference to the accompanying drawings.

12. A pipe coupling substantially as described with reference to and as shown in the accompanying drawings.

FORRESTER, KETLEY & CO.,
Chartered Patent Agents,
Forrester House,
52 Bounds Green Road,
London, N11 2EY,
and
Rutland House,
148 Edmund Street,
Birmingham, B3 2LD.
Agents for the Applicants.

