REMOTE UNDERWATER WELLHEAD CONNECTOR

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ABSTRACT OF THE DISCLOSURE

This invention relates to a mechanism for connecting a well tool such as a blowout preventer or a riser pipe to a tubular member in which the tool is supported. The mechanism is mechanically latched, unlatched, and packed off with a device which is operable internally of the well tool by rotating a translatory member.

This invention relates to an apparatus for use at offshore wells and pertains more particularly to latch means for securing a well tool, such as a blowout preventer, a riser pipe or a production mandrel, to a wellhead. In the search to find new oil fields, an increasing amount of drilling has been conducted at offshore locations. As the depths have increased, it has become necessary to drill these wells from floating barges and locate the casing head and the wellhead equipment underwater to obviate the need for erecting a platform for placement of the wellhead equipment. In order to install equipment of this type underwater in depths greater than the shallow depth at which a diver can operate, it has become necessary to look to remotely installed equipment. Concurrently on the market are designs of underwater latches that are hydraulically actuated through flexible hoses that may become broken. These broken hoses may be repaired by a diver in relatively shallow water; but at the greater depths this becomes increasingly difficult, if not impossible.

It is therefore one object of this invention to provide a new and improved latch means for securing well tools to a wellhead. Another object of the invention is to provide mechanical latch means for (releasably) securing well tools to a wellhead. Still another object is to provide a mechanical latch means which is controllable from a location remote therefrom for securing a well tool to a wellhead. A still further object of this invention is to provide a mechanical latch means which is remotely controlled, for releasably securing a well tool to a wellhead. Another object of this invention is to provide a mechanically actuated latch means for latching a well tool to an underwater wellhead whereby substantially all axial movement and lateral movement of said well tool may be prevented. Still another object of this invention is to provide a mechanically actuated latch means having a mechanically actuated compression seal. It is also an object of this invention to provide a tool for latching a tubular body into an open ended tubular member which tool can be mechanically internally released. Additional objects and advantages of the invention will become apparent from the following description on an embodiment of the present invention when taken in conjunction with the appended claims and the accompanying drawings, wherein:

FIG. 1 is an elevational view, partially in section, of the latch means in the position just after inserting the well tool to be latched into an underwater wellhead;

FIG. 2 is an elevational view, partially in section, showing the relationship of the latch parts after the latch has been set;

FIG. 3 is an elevational view, partially in section, similar to FIG. 2 showing the relationship of the latch parts after the latch has been released and retrieved a short distance;

FIG. 4 is a transverse sectional view taken on line 4—4 of FIG. 1;

FIG. 5 is a transverse sectional view taken on line 5—5 of FIG. 3.

Referring to the drawings, there is shown a wellhead H which, it will be understood, is connected to the upper end of a large diameter pipe (not shown) extending into a well bore drilled into a formation underlying a body of water. The wellhead H extends a short distance above the top of the land bottom, as shown in co-pending application of C. E. Wakefield, Jr., for "Underwater Drilling Method," Ser. No. 454,019 filed May 7, 1965, now Patent No. 3,398,790, and is provided with an annular groove at 11 for attaching blowout preventers, riser pipe, etc. while drilling below the conductor pipe. The upper end of the wellhead may be provided with a downwardly and inwardly inclined surface 13 which serves as a guide for the tools to be inserted into the bore of the wellhead H. The well body or mandrel 15 is supported in wellhead H when its beveled shoulder 60 is lowered into engagement with the inclined surface 13 of wellhead H.

A latch device is formed by providing an inner annular groove 12 in wellhead H into which well apparatus such as a production head, locks. The inner annular groove 12 defines an upper and lower inclined end walls 12a and 12b, respectively, which serve as the locking or landing recess for the cooperating inner portions of the latch device. The inner portion of the latch is the device to be latched into the wellhead and includes a tubular body 15 having an external diameter to form a close sliding fit in the bore of wellhead H. Body 15 may have an internally threaded box (not shown) at its upper end which serves to connect the tubular body 15 to a pipe string which is used to lower the tubular body 15 from a drilling structure at the surface of the body of water, into the wellhead.

Seal packing 16 of any suitable type is seated in annular grooves 17 formed on the exterior of the tubular body, and is adapted to form a fluid-tight seal between the latter and the wellhead when the tubular body is inserted into the wellhead. A short distance below the lower annular groove 17, a reduced diameter tubular section 19 is formed and at its lower end is a male acme type thread 18 cut on the exterior of the reduced diameter tubular section 19. A shoulder 20 is defined where the tubular body 15 outside diameter reduces to the tubular section 19. An annular ring 21 is supported against shoulder 20 by springs 24. Threaded into the lower face 22 of this ring are a plurality of socket head cap screws 10 provided to retain an annular T-head dog retainer 23 in limited axial movement relative to the tubular section 19. A plurality of holes 25 are drilled through the retainer 23 to accommodate the cap screws. Counterbore 26 are provided in the lower face of the retainer large enough to provide clearance for the heads 27 of the cap screws and deep enough to provide for limited longitudinal travel of the cap screw heads within the counterbore. Mounted about each of the cap screw shanks 10 and pressing against the lower face of annular ring 21 and the upper face of the T-head dog retainer 23 are a plurality of springs 24. These springs resiliently urge the dog retainer 23 away from the lower annular ring to its full extended position where they are retained from further extension by the heads of the cap screws in the counterbores of the T-head dog retainer. The reduced diameter tubular section 19 has an annular groove
is set screwed from the upper face of this ring to the seal setting body by set screw 59. In operation, tubular body 50 or mandrel 51 may be secured to the lower end of the drill string or a riser and lowered from the drilling structure for coupling to the wellhead H. The tubular body 15 is thus introduced into the bore of housing or wellhead H. The drill string and tubular body 15 may be secured together inter alia with conventional guide lugs. The body 15 may be "streamed over" a drill pipe which may be left in the hole for this purpose. In either event, as the pipe string is lowered, the tubular body 15 having coupling device therein, is inserted in the bore of the wellhead H and lowered therein. As this occurs, the beveled upper inside diameter of the wellhead will guide the coupling device within its bore. The dogs 30 which are forced outwardly due to the springs forcing the dogs against the sleeve 32 will be forced to retracted position as the dogs land against the beveled portion 13 of the wellhead H. When the beveled slider 60 on the upper end of the coupling device seats on the mating bevel 13 of the wellhead, the dogs will be indexed longitudinally adjacent the annular groove 12 in the wellhead. As this occurs, the dogs will expand radially into this groove to latched relationship therewith as the springs expand the dogs against the tapered top of the sleeve 32. The drill string may then be picked up to check the locked position and prove that it is anchored. At this point the seal 52 has not yet been set nor has the axial play that is left between the coupling members been removed. To accomplish the foregoing a torsional gripping tool 57 is run adjacent the inner surface 62 of the seal setting member 54 and right-hand rotation is begun. The torsional gripping means 57 will grip the inner surface 62 and cause the setting member or sleeve 54 to rotate. This rotation causes the translatory member 41 to rotate also, as is sheared pinned to the seal setting member 62 by shear pin 63. As the translatory member 41 rotates to the right it will move upon threads 18 relative to the body 15, pushing the dogs 30 against the shoulder 120 in the housing. This position is shown in FIG. 2. As this occurs the rotation of the translatory member stops and shear pin 63 will be sheared from the seal ring 53 and the seal setting member may be removed. As this occurs the left-hand thread 56 will begin to make up and the upper face of flange 55 will move the seal ring 53 upward setting seal 52 and thereby sealing off the tubular body 19 with the liner 50, or wellhead H when the liner is absent and the seal 52 is set directly against the inner surface of the wellhead. The tool is now fully set and the torsional gripping tool 57 is released and pulled from the hole.

To release the tool, the torsional gripping means 57 is rerun adjacent the surface 62 of the seal setting means and rotated to the left. This will cause the seal setting member 54 to move downward releasing the seal 52. As this occurs the lower face of the retainer nut 58 hits the left-hand acme thread and stops relative rotation between the seal setting member and the translatory member. These members then rotate together causing the thread 18 to unscrew causing the translatory member to move downward. This causes the sleeve 32 to be pulled from under the dogs 30 until they reach the fully retracted position as shown in FIG. 3. The torsional tool 57 is now removed from the hole and the casing member may then be picked up, uncoupling the device so that it can be removed to the barge.

I claim:

1. An apparatus for latching a tubular body into the open end of a tubular member having an internal shoulder therein and internally mechanically releasing said body from said tubular member, comprising in combination:

-meaning for supporting said tubular body within said tubular member,

-a reduced diameter section of said tubular body forming an annular space between said tubular member and said body,
5 a movable dog in said annular space adjacent to said shoulder to prevent relative axial movement between said tubular body and said tubular member, means on said tubular body for retaining said dog thereon adjacent said shoulder when said tubular body is supported within said tubular member, and a translatory member threadably engaging said body below said dog, means associated with said translatory member for holding said dog radially outward against said shoulder, and means internal with respect to said tubular body and said translatory member for rotating said translatory member relative to said tubular body to drive said holding means upwardly against said dog to move said dog until said dog engages the top of said shoulder, said holding means retaining said dog radially outwardly in said shoulder and against the top of said shoulder.

2. The apparatus of claim 1 including in said combination, a sleeve engageable with said translatory member and wherein said rotating means includes means for engaging said sleeve.

3. An apparatus for latching a tubular body into the open end of a tubular member having an internal shoulder therein and internally mechanically releasing said body from said tubular member, comprising in combination:
- means for supporting said tubular body within said tubular member,
- a reduced diameter section of said tubular body forming an annular space between said tubular member and said body,
- a movable dog in said annular space adjacent said shoulder to prevent relative axial movement between said tubular body and said tubular member when said dog is engaged in said shoulder,
- spring means on said tubular body for retaining said dog thereon adjacent said shoulder when said tubular body is supported within said tubular member,
- a translatory member threadably engaging said body below said dog,
- tapered means associated with said translatory member for holding said dog radially outward against said shoulder, and,
- means internal with respect to said tubular body and said translatory member relative to said tubular body to drive said taper means upwardly against said dog to move said dog until said dog engages the top of said shoulder, said tapered shoulder means retaining said dog radially outwardly in said shoulder and against the top of said shoulders.

4. An apparatus for latching a tubular body into the open end of a tubular member having an internal shoulder therein and internally mechanically releasing said body from said tubular member, comprising in combination:
- means for supporting said tubular body within said tubular member,
- a reduced diameter section of said tubular body forming an annular space between said tubular member and said body,
- a movable dog in said annular space adjacent said shoulder to prevent relative axial movement between said tubular body and said tubular member when said dog is engaged in said shoulder,
- spring means on said tubular body for retaining said dog thereon adjacent said shoulder when said tubular body is supported within said tubular member,
- a translatory member threadably engaging said body below said dog,
- tapered means associated with said translatory member for holding said dog radially outward against said shoulder, and,
- means internal with respect to said tubular body and said translatory member relative to said tubular body to drive said holding means upwardly against said dog engaging the top of said shoulder, said tapered shoulder means retaining said dog radially outwardly in said shoulder and against the top of said shoulders.

5. The apparatus of claim 4 wherein said extrudable packer is positioned between said setting sleeve and an open ended well casing hung in said tubular body and said packer is set between said sleeve and said casing.

6. An apparatus for latching a tubular body into the open end of a tubular member and internally mechanically releasing said body from said tubular member, comprising in combination:
- means for supporting said tubular body within said tubular member,
- a reduced diameter section of said tubular body forming an annular space between said tubular member and said body,
- means in said annular space movable relative to said tubular body for securing said tubular body to said tubular member to prevent relative axial movement between said tubular body and said tubular member, a translatory member threadably engaging said body, means movable by said translatory member for holding said securing means radially outward against the internal surface of said tubular member, means internal with respect to said tubular body, and said translatory member for rotating said translatory member relative to said tubular body to drive said holding means upwardly against said securing means to move said securing means radially outwardly against the internal surface of said tubular member, said holding means retaining said securing means radially outwardly against the internal surface of said tubular member.

7. The apparatus of claim 6 including in said combination, a sleeve engageable with said translatory member and wherein said moving means includes means for engaging said sleeve.

8. The apparatus of claim 7 wherein said sleeve engaging means is a torsional gripping means.

9. An apparatus for latching a tubular body into the open end of a tubular member and internally mechanically releasing said body from said tubular member, comprising in combination:
- means for supporting said tubular body within said tubular member,
- a reduced diameter section of said tubular body forming an annular space between said tubular member and said body,
- means in said annular space movable relative to said tubular body for securing said tubular body axially with respect to said tubular member, a translatory member threadably engaging said body below said securing means, tapered means movable by said translatory member for holding said securing means radially outward against the inner surface of said tubular member, a packer setting sleeve threadably engaging said translatory member, an extrudable packer between said setting sleeve and said tubular member, and internal means for rotating said translatory member.
with said sleeve to drive said taper means upwardly against said securing means until said securing means engage the inner surface of said tubular member, said tapered means retaining said securing means radially outward against said tubular member, and means for preventing relative movement between said translatory member and said sleeve while said translatory member and sleeve are moving upwardly with respect to said tubular body, until said securing means engage the inner surface of said tubular member in securing relationship, said movement preventing means being shearable upon further rotation of said setting sleeve after said securing means engage the inner surface of said tubular member in securing engagement whereupon said sleeve moves upwardly relative to said translatory member to set said packer.

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