Nov. 11, 1969 C. C. BROWN 3,477,744

REMOTE UNDERWATER CONNECTOR

Filed May 19, 1965 4 Sheets-Sheet 1

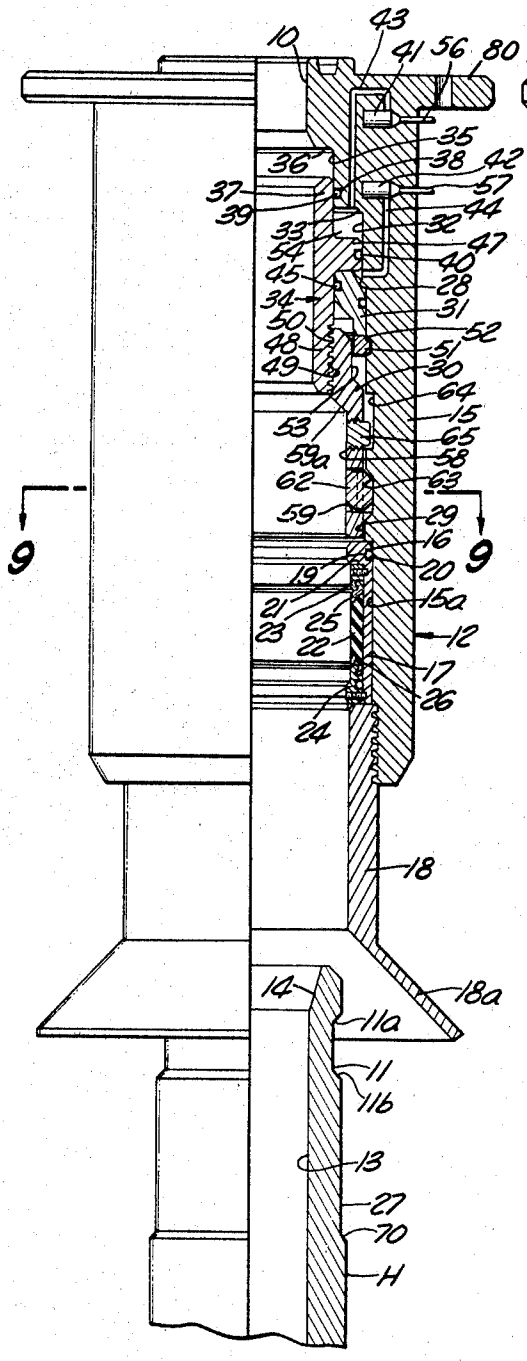


FIG. 1.

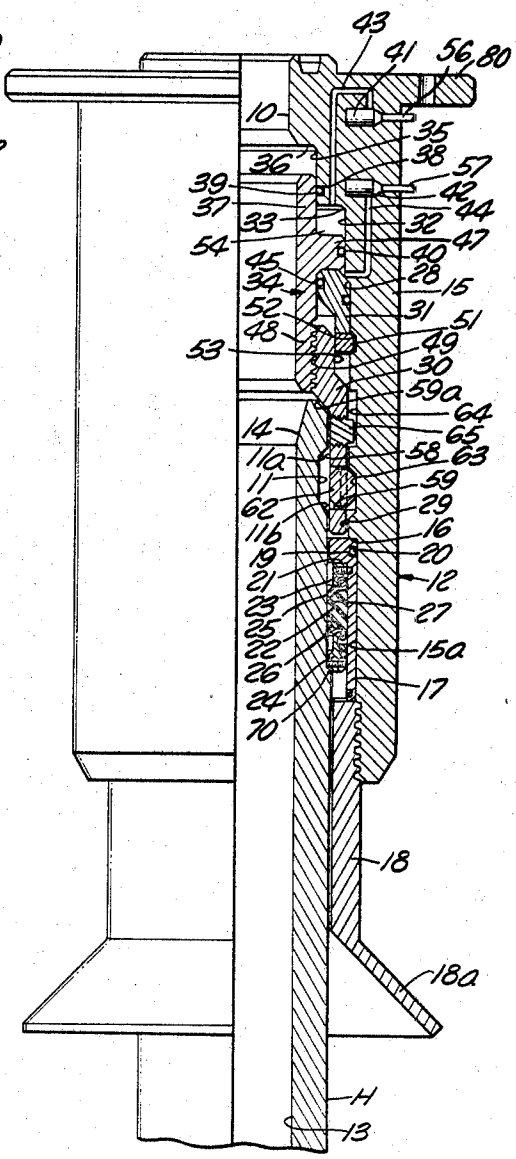


FIG. 2.

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REMOTE UNDERWATER CONNECTOR

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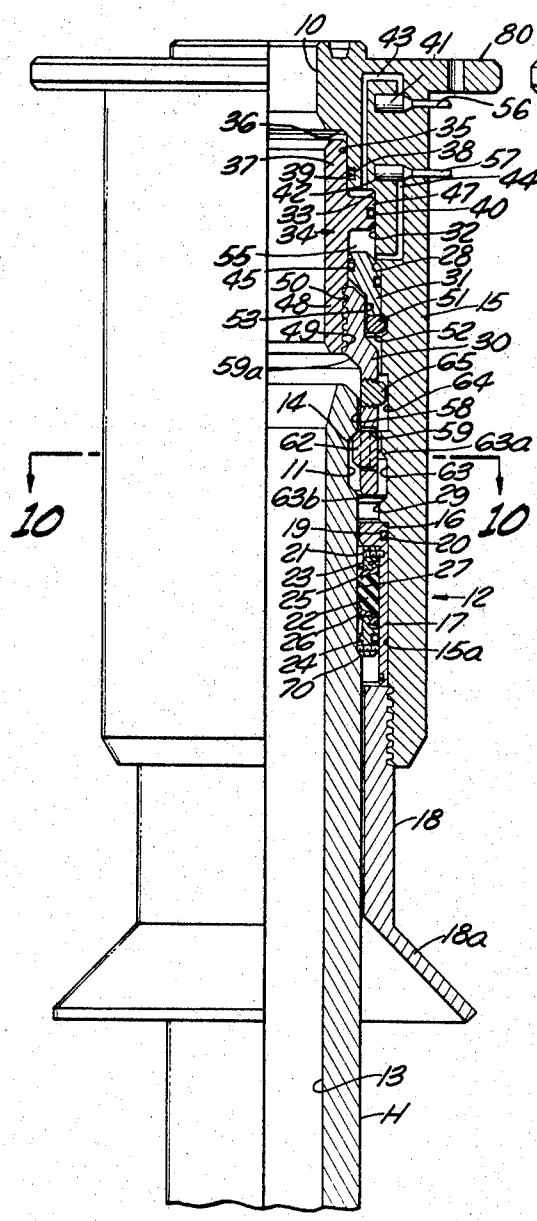


FIG. 3.

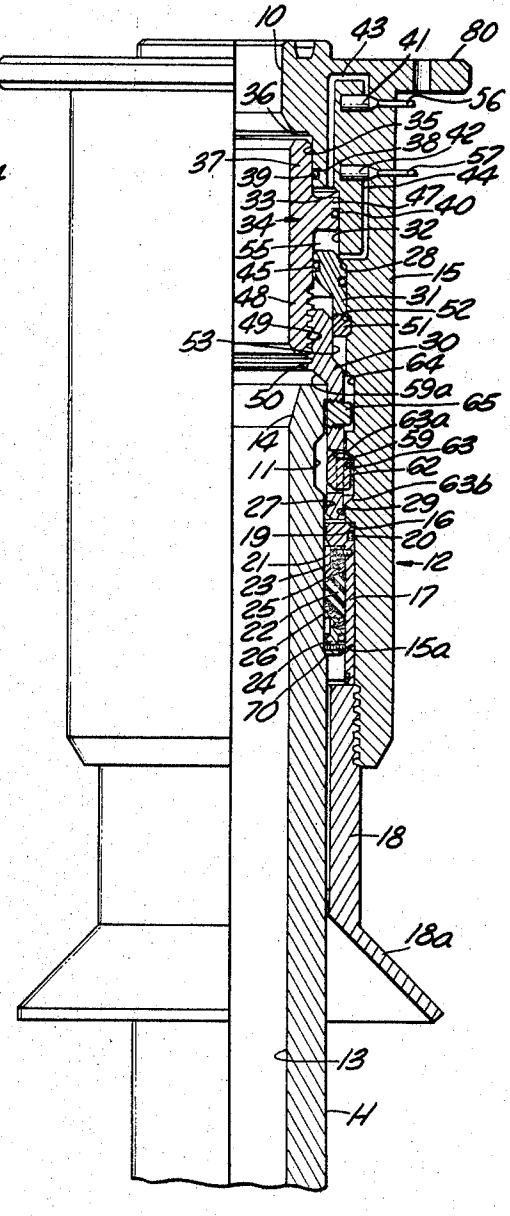


FIG. 4.

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REMOTE UNDERWATER CONNECTOR

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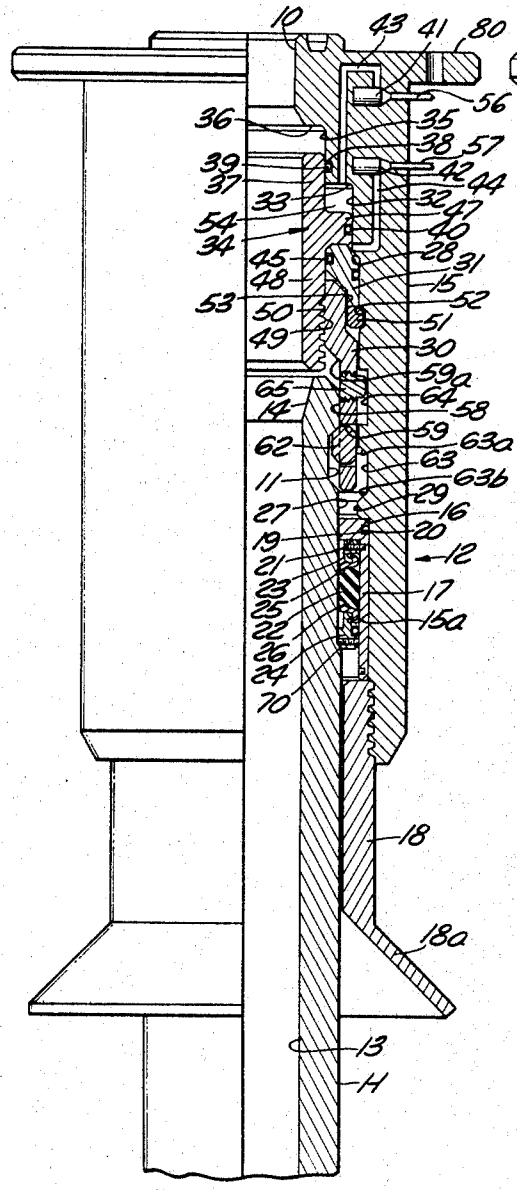


FIG. 5.

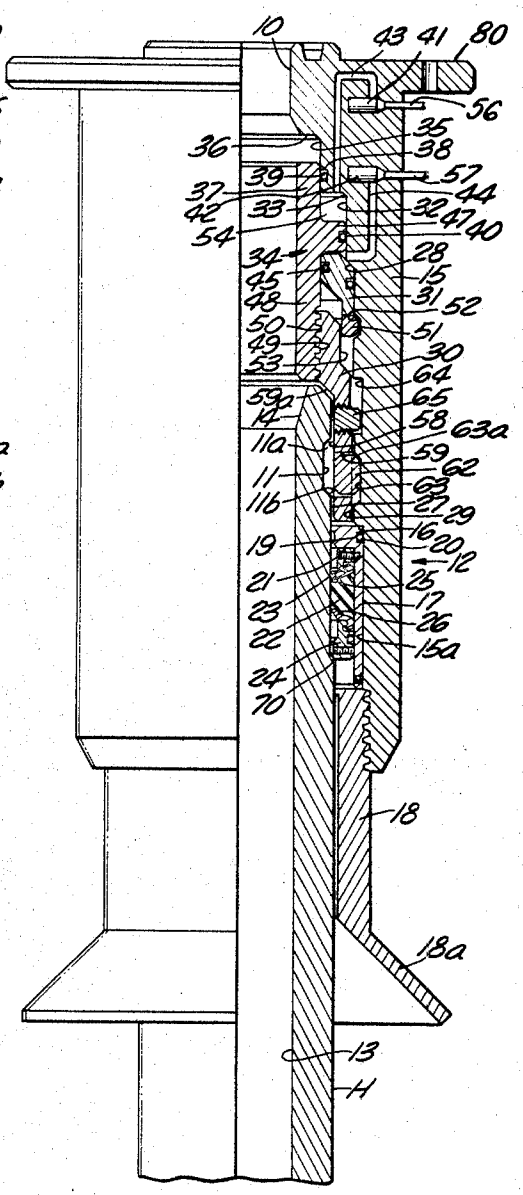


FIG. 6.

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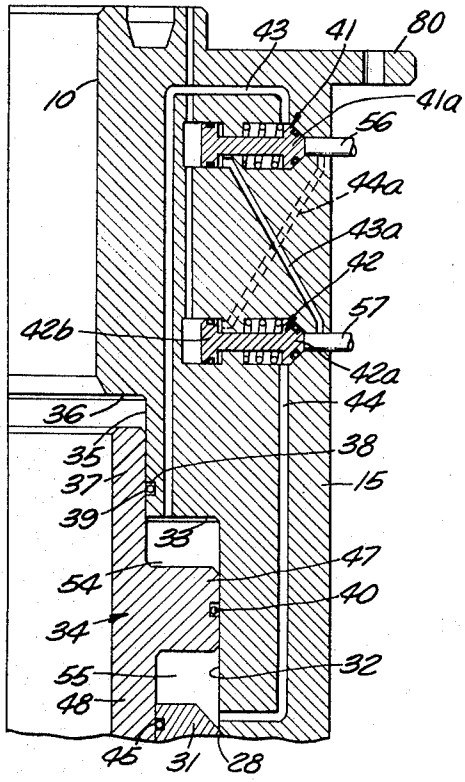


FIG. 7.

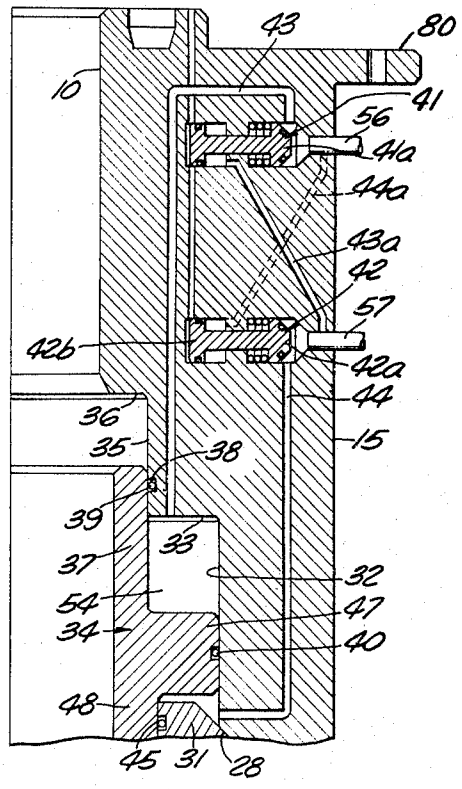


FIG. 8.

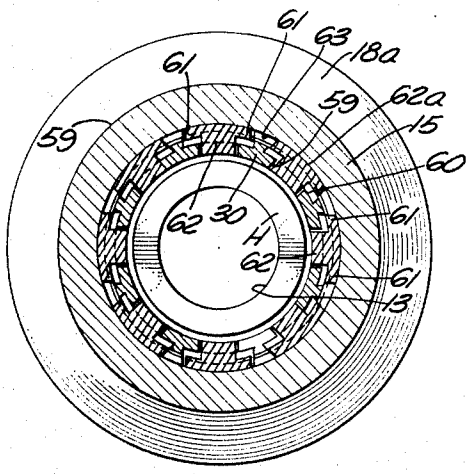


FIG. 9.

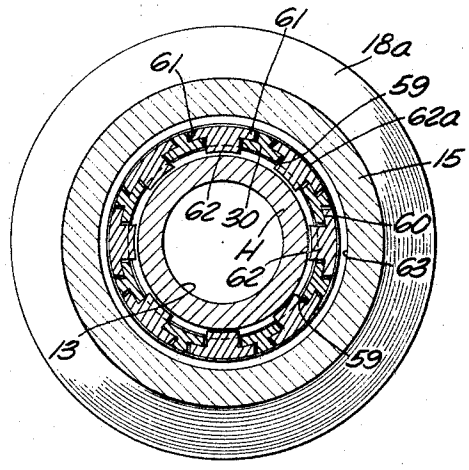


FIG. 10.

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United States Patent Office 3,477,744
Patented Nov. 11, 1969

3,477,744

REMOTE UNDERWATER CONNECTOR

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Filed May 19, 1965, Ser. No. 456,969
Int. Cl. F16l 37/08
U.S .Cl. 285—18 11 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to a latch for connecting a well tool, such as a blowout preventer or a riser pipe, to a member having an external latch groove. The latch is operable either hydraulically or mechanically and may be internally released mechanically by rotating a sleeve inside the tool which moves locking dogs out of locking engagement with the latch groove with a latch housing which is threadably movable when said sleeve is rotated.

This invention relates to an apparatus for use at offshore wells and pertains more particularly to latch means for securing well tools, such as blowout preventers, riser pipe and production mandrels, to a wellhead.

With the advent of drilling wells offshore from floating barges, the problem of installing wellhead equipment underwater has required the design of entirely new equipment. One such design is disclosed in applicant's co-pending application, Ser. No. 456,968 filed May 19, 1965, for Remote Underwater Wellhead Connector. Other designs have utilized hydraulically actuated latches requiring flexible hoses from the barge to the depth where the latch is attached to the wellhead. The above application disclosed a mechanical actuated latch to eliminate the flexible hoses as the use of such hoses required the services of divers to repair them when they became broken. As the depths of operation increases, the position of the wellhead reaches a depth below the depth at which a diver can operate. Rather than to entirely eliminate the hydraulic actuating means from equipment used for deep water service, it may be desirable to employ equipment which can be actuated either hydraulically or mechanically thus utilizing the advantages inherent in both systems.

It is therefore one object of this invention to provide an underwater latch means that can be actuated either mechanically or hydraulically.

Another important object is to provide an underwater latch means with the hydraulic hoses attached to the section being lowered from the barge that may be retrieved and repaired from the surface in the case of a hose break.

Still another object is to provide an alternate means of actuating the latch so that the quicker method of hydraulic actuation may be utilized while retaining a mechanical means of actuation in case of hydraulic failure.

A further object of the present invention is to provide a latch mechanism for latching well tools to an underwater wellhead, which can be hydraulically latched and subsequently mechanically released.

Additional objects and advantages of the invention will be readily apparent from the reading of the following description of a device constructed in accordance with the invention, and reference to the accompanying drawings thereof, wherein:

FIG. 1 is a longitudinal elevational view of the latch means partially in section, showing the tool to be latched in the unset running position before latching to the installed underwater wellhead;

FIG. 2 is a longitudinal elevational view of the latch means, partially in section, showing the relative position of the components after landing the tool upon the installed underwater wellhead and slacking-off weight to set the compression seal;

FIG. 3 is a view similar to FIG. 2 showing the relation of the parts after hydraulic actuation of the latch means;

FIG. 4 is a longitudinal-sectional view showing the relation of the parts as shown in FIG. 3 after mechanically unlocking the latch member;

FIG. 5 is a longitudinal-sectional view showing the relation of the parts when the latch is run and set mechanically only;

FIG. 6 is a longitudinal-sectional view showing the relation of the parts of the device that has been mechanically locked and then mechanically unlocked;

FIG. 7 is an enlarged half-sectional view of the valving arrangement used to lock pressure into the device for hydraulically holding the latch mechanism and showing the relation of the valve parts in the locked position;

FIG. 8 is a similar view as FIG. 7 but showing the relative position of the valves when hydraulic pressure is applied to actuate the latch mechanism;

FIG. 9 is a cross-section taken along the line **9—9** on FIG. 1;

FIG. 10 is a cross-section taken along the line **10—10** on FIG. 3.

Referring to the drawings, there is shown a special 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 extending a short distance above the top of the land bottom and provided with an annular groove at **11** for attaching a blowout preventer, riser pipe, etc. used while drilling below the pipe. Wellhead H with its annular groove at **11** forms a coupling device for attaching the latch designated generally as **12**. Wellhead H has a bore **13** substantially the same as the conductor pipe to which it is attached. The upper inside diameter of the wellhead H may be beveled at **14** to allow easy entrance of tools that are to be run in and out of the hole. The upper outside edge of this part is beveled at **16** to allow easy coupling of the coupling device over this member and it also serves as a stop for the seal member as will hereinafter be explained. The annular groove **11** defines upper and lower inclined end walls **11*a*–11*b***, which serves as the locking or landing recess for the co-operating outer portion of the coupling device **12**.

The outer portion of the coupling device includes a tubular body **15** having a flanged connection **80** at its upper end for attaching blowout preventers, riser pipe, etc. The inside diameter **10** is substantially the same as the conductor pipe. The lower end of the tubular body **15** is counter-bored at **15*a*** defining a shoulder **16**. Installed within this counter-bore and abutting shoulder **16** at its upper end is the seal housing member **17**. The lower end of the aforementioned counter-bore **15*a*** is provided with a suitable female thread for attaching thereto a seal retainer and guide member **18**. The lower end of this member is flared to provide a guide member **18*a*** for ease in guiding the latch member **12** over the wellhead H. The upper end of the retainer member **18** abuts the seal housing member **17** and retains it within the tubular body **15**. The outside diameter of the seal housing is provided with an **0** ring groove **19** for mounting an O-ring **20** to seal off between the seal housing and the tubular body. The lower end of the seal housing **17** is counter-bored below shoulder **21** to provide a place to install the seal **22**. The upper end of the seal **22** abuts shoulder **21** and is retained at its lower end by the upper end of the seal retainer and guide member **18**. The seal **22** comprises an upper header ring **23**, a lower header

ring 24, upper segmented extrusion fingers 25 and lower segmented extrusion fingers 26. The lower header ring is provided with a bore slightly smaller than the diameter of the special wellhead H so that the lower header ring 24 will abut the shoulder 70 of the wellhead H when the coupling device is landed on the wellhead. Since the header rings are free to slide axially within the counterbore of the seal housing, it can be seen that as weight is applied this force will cause the seal to compress as seen in FIG. 2. The extrusion fingers will rock out against the surface 27 of the special wellhead to prevent extrusion of the sealing material.

Another counter-bore 29 is provided above counterbore 15*a* from shoulder 16 to shoulder 28 in the tubular body to provide a space to install the latch housing 30 and cylinder bearer ring 31. An additional counter-bore 32 is provided from shoulder 28 to shoulder 33 to provide a cylinder in which is positioned piston member 34. Still another counter-bore 35 is provided from shoulder 33 to shoulder 36 to provide a cylindrical surface to seal off on the reduced diameter upper projection 37 of the piston member 34. There is provided in counter-bore 35 an O-ring groove 38 in which is installed O ring 39 to seal off between this counter-bore and the piston member. Provided on the piston member 34 is a flanged member 47 that fits closely within counter-bore 32 and seals off therewith by a suitable seal 40 provided on the flange.

The lower end of piston member 34 has another reduced diameter 48 that projects through the I.D. of the bearer means 31 and seals off therewith by a suitable seal 45 in the I.D. of the bearer means. The lower end of the reduced diameter 48 is provided with a male thread 49 for attaching the piston member to the latch housing 30 by the means of a female thread 50 in the upper end of the latch housing.

The cylinder bearer ring 31 is retained against shoulder 28 by means of a snap ring 51 installed in groove 52 cut in counter-bore 29 of the tubular body. The snap ring 51 is prevented from releasing out of its groove because its I.D. fits closely over the reduced diameter 53 formed on the upper end of the latch housing 30. Suitable seals are provided in the bearer member so that it seals off with the tubular body and the piston member.

The reduced diameters 37 and 37*a* are of the same diameter and with the flange of the piston member sealing off on surface 32 this defines two annular chambers, annular chamber 54 acting above the piston member and annular chamber 55 acting below the piston member. Annular chamber 54 is communicated to the flexible hose 56 by means of passage 43 formed in the tubular body 15 acting through back-check valve 41. Annular chamber 55 is communicated to the flexible hose 57 by means of passage 44 formed in the tubular body 15 acting through back-check valve 42. When fluid is introduced through flexible hose 56, it enters the passage 43 through the back pressure valve 41 and thence enters the annular chamber 54 to act against the area of the face 46 of the flange of the piston member. This will move the piston member downward. Likewise, when fluid is introduced through flexible hose 57, it enters the chamber 55 through check valve 42 and passage 44 to cause the piston member to move upward.

Check valves 41 and 42 are provided to lock fluid into the chambers 54 and 55 to hold the piston member either in an up or down or neutral position. Their construction can best be seen in FIGS. 7 and 8. FIG. 7 shows the piston locked in a neutral position with check valves 41 and 42 holding the piston in its locked-in position. Passage 44*a* is provided from the flexible hose connection 56 to a position below back-check valve 42 and passage 43*a* provides hose connection 57 with a passage to a position below back-check valve 41 to provide a means for discharging fluid from the chamber on the reverse side of the piston to which pressure is applied. FIG. 8 illustrates flexible connection 56 being pressured. As this occurs, check valve 41*a* opens and fluid flows through passage 43 to chamber 54 to push the piston member downward. Check valve 42*a* is opened to allow fluid from chamber 55 to exhaust through port 44 into the flexible hose 57 because as the flexible hose 56 is pressured, fluid enters port 44*a* to open check valve 42*a*. The fluid in port 44*a* acts against piston 42*b* which through common shaft 42*c*, opens check valve 42*a* to the passage of fluid from chamber 55 into hose 57 through port 44.

Installed within the tubular body between the bearer ring 31 and the upper face of the seal housing member 17 is the latch housing 30. Sufficient axial clearance is allowed between these parts to allow limited axial movement of the latch housing with the tubular body. As previously stated, the latch housing 30 is attached to the lower end of the piston member by an acme type thread 50. The pin member is on the piston member and the box connection is on the upper bore of the latch housing. The outside diameter of the latch housing has just enough clearance inside the counter-bore 29 of the tubular body to allow a sliding fit. The lower end of the latch housing is counter-bored at 58 for clearance over the upper outside diameter 27 of the wellhead H. The counterbore defines a shoulder 59*a* which serves as a stop against the upper end 16 of the wellhead. Provided at approximately the middle of counter-bore 58 is a plurality of rectangular shaped windows 59. A plurality of rectangular shaped latch dogs 62 are mounted in windows 59 for relative radial movement therein. A rectangular shaped land 60 is milled around the windows from the outside diameter to provide a retainer surface to limit the dogs radial travel inward within the latch housing. The latch dogs are provided with bat wings 61 that fit with the rectangular shaped land to limit their radial travel inward. When the bat wings are surfaced on the milled retainer surface 60, the outside arcuate diameter of the latch dogs mate with the outside diameter of the latch housing. This allows for installing the assembly of the latch dog and the housing within the counter-bore 29 of the tubular body. With the latch dogs in this position in the latch housing, their inside arcuate surfaces 62*a* project within the counterbore 58 of the latch housing. This can best be seen in FIG. 3. The upper and lower inside edges of the latch dogs are beveled to allow easy insertion of the latch member over the special wellhead assembly and for easy removal therefrom.

In the going-in-the-hole position preparatory to latching the latch member to the wellhead H, the latch housing is in its lower position with the lower face of the latch housing 30 abutting the upper face of the seal housing 17. An annular groove 63 is provided in the tubular body 15 indexed over the latch members to allow a space for the dogs 62 to project as the latch section is inserted over the wellhead. The upper and lower inclined end walls 63*a*–63*b* are defined by the annular groove. The outer upper and lower edges of the latch members are beveled to mate the end walls 63*a*–63*b*.

In order to anchor the latch housing within the tubular body against rotational movement but to allow limited axial movement, a lateral groove 64 is provided in counterbore 29 of the tubular housing and index pin 65 is provided in the latch housing extending into the aforementioned lateral groove 64.

In operation, the tubular body 15 will be secured at its upper flange member to the equipment, such as blowout preventers, etc., and the necessary riser pipe to lower the device to be secured to the wellhead H connection located adjacent the ocean floor. To guide the device over wellhead H, guide lines of the type which are in general use may be used, or the latch device may be "stripped over" the drill pipe left in the conductor pipe and extending to the barge for this purpose.

The relative position of the parts in the running position is shown in FIG. 1. The flared surface **18***a* will facilitate guiding the latch member over wellhead H. In the running position fluid pressure is locked into chamber **54** which positions the piston member **34** in its lowermost position. Since the latch housing **30** is attached to the piston member, it will also be positioned to its lowermost position. In this position of the latch housing, its windows and the latch dogs therein are registered with the annular groove **63** in the tubular body. This allows the latch dogs to be radially pushed out into the annular groove as the coupling device is lowered over the wellhead H. As the coupling device is lowered over the upward extending wellhead, the lower header ring **24** of the seal assembly will abut the shoulder **70** near the upper end of the wellhead. As the weight of the riser pipe and the equipment installed above the coupling device is applied, the lower header ring will be forced to move up against the seal member **22** causing it to seal between the wellhead and the tubular body **15** by compression. This position is shown in FIG. 2.

To actuate the latch members, pressure is applied through flexible hose **57** into chamber **55**. This will cause the piston member **34** to move axially upward to the position shown in FIG. 3. As this occurs, the latch housing will be pulled upward causing the latch dogs to move inward into recess **11** on the wellhead. The inward movement of the latch dogs is caused by the beveled upper outer edges of the latch dogs being forced inward against the inclined shoulder **63***a* as the latch housing moves upward forcing the dogs out of annular groove **63** into the smaller diameter of the counter-bore or shoulder **29**. As additional fluid is pumped through flexible hose **57** into chamber **55**, the piston member will continue to be forced upward pulling the latch housing with it causing the upper inside shoulder **62***b* of the latch dogs **62***a* to contact shoulder **11***a* of the wellhead. Further pumping of fluid into chamber **55** shortens the distance between shoulders **62***b* of the latch dogs and the shoulder **24***a* on the lower seal header ring causing the seal to be compressed into tight sealing engagement between the latch member tubular body and the wellhead. Since the fluid is locked into chamber **55** by the back-pressure valve **42***a*, the assembly is effectively locked in this sealing engagement.

To hydraulically release the assembly, it is only necessary to pump fluid into the flexible hose **56** and chamber **54** which will force the piston member **34** downward and returning the latch housing to its position, indexing the latch dogs adjacent the annular groove **63** allowing the dogs to expand radially outward to release the latch. This position is shown in FIG. 2.

In a situation where the tool has been run as in FIG. 2 and landed over the special wellhead and the hydraulic setting apparatus will not work because of a broken hose or for any reason, the latch assembly may be set mechanically. In this case a torsional gripping means of a type well known in the art is run adjacent the I.D. of the piston member **34** and rotated to the right. The slips of the gripping device will grip the I.D. of the piston assembly and rotate it to the right. Since the latch housing is attached to the piston member by the means of a right hand acme thread and the latch housing is prevented from rotating because of the index pin **65**, the right hand rotation of the piston member will cause the thread to make up, thus causing the latch housing to move upward. This mechanical actuation causes the latch housing to move upward latching the two members together in seal tight engagement in the same manner as when the latch housing is moved upward hydraulically, as previously explained. FIG. 5 illustrates the mechanically actuated coupling of the two members.

FIG. 4 illustrates the assembly which has been actuated hydraulically and released mechanically. The assembly, hydraulically latched, as shown in FIG. 3, may be mechanically unlatched by a running torsional gripping tool into the I.D. of the piston assembly **34** and rotating to the left. This moves the latch housing down retracting the dogs into the annular groove, and thereby releasing the tubular body **15** from the wellhead H so that it is only necessary to pick up on the riser pipe to uncouple the two members. FIG. 4 shows the mechanically released position.

FIG. 6 illustrates the assembly that has been mechanically locked and then mechanically unlocked by the aforementioned torsional gripping tool means.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction, may be made without departing from the spirit of the invention.

I claim:

1. An apparatus for latching a well tool to a member having an external latch groove near the top thereof, comprising in combination:

a tubular latch body having means for attachment to said tool and an internal shoulder positioned axially in said body adjacent said latch groove when said body is in position for latching said tool to said member,

a tubular latch housing axially movable within said body member and having a window therein,

a latching dog positioned in said window, means for moving said dog radially through said window into said latch groove to lock said tool to said member when said latch housing is moved relative to said body,

an axially movable sleeve having connecting means thereon connecting said sleeve to said latch housing and defining an annular cylinder with a counter-bore in said body, said sleeve having a piston thereon positioned within said cylinder, said sleeve being positioned above said member when said tool is latched to said member to thereby provide internal access to said sleeve,

means for moving said piston in said cylinder to move said latch housing to latch and unlatch said tool from said member, and

means for mechanically contacting said sleeve internally thereof to release said tool from said member.

2. The apparatus of claim **1** wherein said piston moving means are fluid operated.

3. The apparatus of claim **2** including fluid means for holding said piston stationary in said cylinder.

4. The apparatus of claim **2** including separate means for connecting fluid pressure to said cylinder on each side of said piston, check valve means in said separate means and means associated with said check valves for discharging fluid from said cylinder on one side of said piston when pressure is exerted in said cylinder on the other side of said piston to thereby lock said piston relative to said cylinder.

5. An apparatus for latching a well tool to a member having an external circumferentially disposed latch groove near the top thereof, comprising in combination:

a tubular latch body having means for attachment to said tool and an internal shoulder positioned axially in said body adjacent said member latch groove when said body is in position for latching said tool to said member,

a tubular latch housing axially movable within said body member and having a window therein,

a latching dog positioned in said window,

means for moving said dog radially through said window into said latch groove to lock said tool to said member when said latch housing is moved relative to said body,

an axially movable sleeve having connecting means

thereon connecting said sleeve to said latch housing,
a first means for moving said latch housing to latch and unlatch said tool to said member,
said connecting means providing a second means for moving said latch housing relative to said sleeve to unlock said tool from said member.

6. The apparatus of claim 5 including means for automatically sealing between said member and said body.

7. The apparatus of claim 5 wherein said latch housing is threadably connected to said sleeve so that rotation of said sleeve by means internal to said tool unlatches said tool from said member.

8. An apparatus for latching a well tool to an underwater wellhead having an external latch groove near the top thereof, comprising in combination:
a tubular latch body having means for attachment to said tool and an internal shoulder positioned axially in said body adjacent said wellhead latch groove when said body is in position for latching said tool to said wellhead,
a tubular latch housing axially movable within said body member and having a window therein positioned adjacent said internal shoulder before said latching is effected,
a latching dog positioned in said window and extending into said internal shoulder,
means for moving said dog radially through said window into said wellhead latch groove to lock said tool to said wellhead when said latch housing is moved relative to said body,
an axially movable sleeve having connecting means thereon connecting said sleeve to said latch housing and defining an annular cylinder with a counter-bore in said body,
said sleeve having a piston thereon positioned within said cylinder,
means for moving said piston in said cylinder to move said latch housing to latch and unlatch said tool from said wellhead, said sleeve being positioned above said wellhead when said tool is latched to said wellhead to thereby provide internal access to said sleeve,
said connecting means providing means for rotating said latch housing relative to said sleeve to unlock said tool from said wellhead, and
means for mechanically contacting said sleeve internally thereof to rotate said sleeve and thereby release said tool from said wellhead.

9. An apparatus for latching a well tool to a member having an external latch groove near the top thereof, comprising in combination:
a tubular latch body having means for attachment to said tool,
a tubular latch housing axially movable within said latch body,
means for latching said latch body to said member by axially moving said latch housing,

first means for moving said latch housing axially to latch and unlatch said tool to said member, said first means including an axially movable sleeve connected to said latch housing and positioned above said wellhead member when the tool is latched to said member, to thereby provide internal access to said sleeve, said sleeve being so arranged and constructed with respect to said latch housing that said sleeve may be moved with mechanical contact means internally of said sleeve to move said latch housing axially and release said tool from said member.

10. The apparatus of claim 9 means for moving said latch housing by rotation of said sleeve with said internal mechanical means to thereby unlatch said tool from said member.

11. An apparatus for latching a well tool to a member having an external latch groove near the top thereof, comprising in combination:
a tubular latch body having means for attachment to said tool, a tubular latch housing axially movable within said latch body,
locking means for latching said body to said member when said latch housing is moved relative to said body,
a cylinder,
piston means disposed within said cylinder and operatively connected to said latch housing,
means for moving said piston in said cylinder to move said latch housing to latch and unlatch said tool to said member, and an axially movable sleeve connected to said latch housing and said piston, said sleeve being positioned above said member when said tool is latched to said member to thereby provide internal access to said sleeve, said sleeve being arranged and constructed so that it can be moved with mechanical contact means internally of said sleeve to release said tool from said member.

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U.S. Cl. X.R.

166—0.6; 285—85, 141, 3, 348