Feb. 1, 1966 C. E. WAKEFIELD, JR 3,232,346

PRODUCTION APPARATUS AND METHOD

Filed Sept. 25, 1962 2 Sheets-Sheet 1

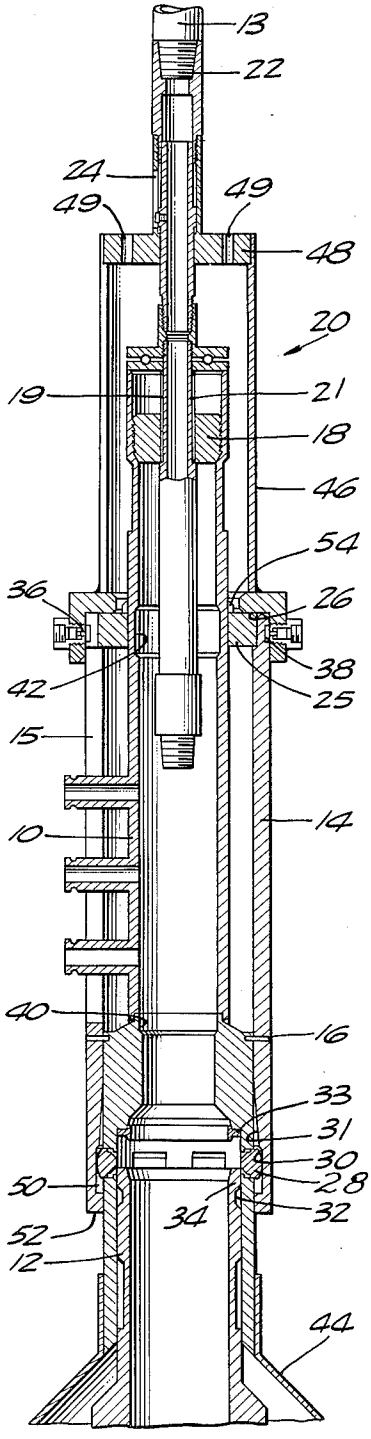
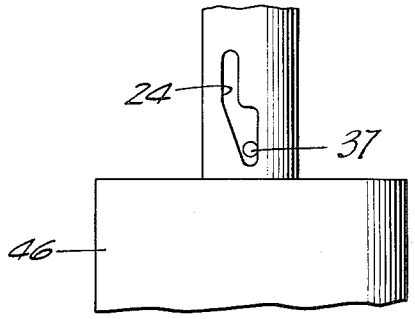


FIG. 1.

FIG. 5.



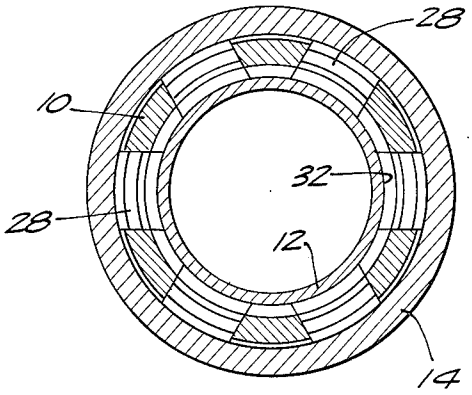


FIG. 3.

CHARLES E. WAKEFIELD, JR
INVENTOR.

BY Donald W Canady

ATTORNEY

Feb. 1, 1966 C. E. WAKEFIELD, JR 3,232,346

PRODUCTION APPARATUS AND METHOD

Filed Sept. 25, 1962 2 Sheets-Sheet 2

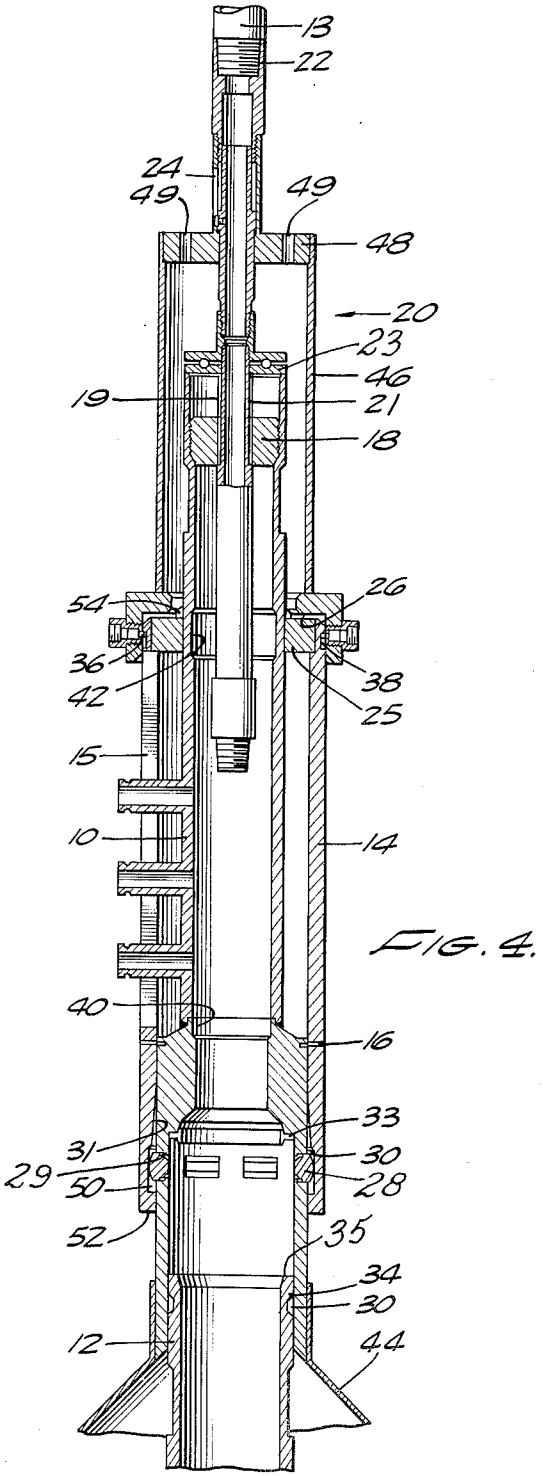
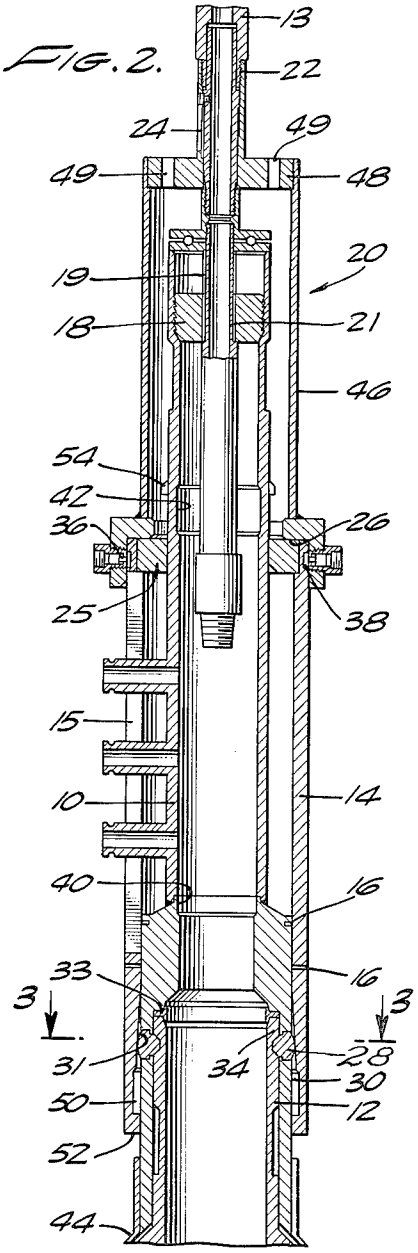


FIG. 4.

FIG. 2.



CHARLES E. WAKEFIELD, JR.
INVENTOR.

BY Donald W Canady
ATTORNEY

United States Patent Office

3,232,346

Patented Feb. 1, 1966

3,232,346

PRODUCTION APPARATUS AND METHOD

Charles E. Wakefield, Jr., Bakersfield, Calif., assignor to Richfield Oil Corporation, Los Angeles, Calif., a corporation of Delaware

Filed Sept. 25, 1962, Ser. No. 225,982

5 Claims. (Cl. 166—.6)

This invention relates to underwater drilling and production, and more particularly relates to a device for remotely latching a production head to a casing which is affixed to a well underlying a body of water.

A production head or Christmas tree is normally utilized to control the flow of oil and gas from a well during the period when the pressure in an oil and gas well is sufficient for natural flow. The Christmas tree, which is an assemblage of valves, is attached to a casing which is cemented into the well by bolting flanged fittings thereto. When a conventional well head is positioned on the ocean floor, the services of a diver are generally required for installation. In my copending application, Serial No. 100,411, filed April 3, 1961, a production head obviating the need for bolting the flanged fittings of a Christmas tree to the well casing, is described. In order to unlatch the well head described in the aforementioned application, from the well casing when it is desired to retrieve said production head, the latch used to fasten the production head to the lower portion of the production head which is affixed into the well casing, must be manually unlatched. When the well head is installed on a formation underlying a body of water too deep for conventional diving equipment, it is desirable to have a means for remotely latching and unlatching the production head to the casing. By unlatching the production mandrel, it can be retrieved to the surface of the water for repairs or reuse.

Prior art latching tools which are hydraulically set have been found unsatisfactory, in that the hydraulic valves, flow lines, etc. are prone to fouling and such hydraulic equipment necessarily involves the use of external hydraulic lines at the well head, which lines are subject to damage when the well head equipment is remotely stabbed onto the well casings etc. at the ocean floor. Such prior art equipment is set by only the weight of the tool rather than positive setting means.

It is, therefore, an object of the present invention to provide a mechanical method and apparatus for remotely latching and unlatching an underwater production mandrel to a casing mounted in a formation underlying a body of water.

It is also an object of the present invention to provide a mechanical device for retrieving an underwater production head from an operative position on a well bore in a formation underlying a relatively deep body of water.

It is a further object of my present invention to provide a tool suitable for hammering a production head onto a surface pipe mounted in a formation underlying a body of water and retrieving said production head.

Other objects and a more complete understanding of the present invention will become apparent by reference to the following description and the appended claims taken in conjunction with the accompanying drawings wherein:

FIG. 1 shows in partial section a well head running and retrieving tool in position on a modified form of a production mandrel, to drive the production mandrel and latching sleeve into latching position.

FIG. 2 shows in cross-sectional view the production mandrel in latched position on the surface casing landing mandrel.

FIG. 3 is a sectional view taken on section 3—3 of FIG. 2.

FIG. 4 shows the running tool in use as a retrieving tool for unlatching the production head from the casing and withdrawing the production mandrel to the drilling vessel.

FIG. 5 shows the details of a J slot safety device used in the invention.

With reference to the drawings, generally a device and method are illustrated for lowering the production head **10** onto a surface casing **12** and remotely latching it thereto by driving downwardly a tapered sleeve **14** which is slidably mounted on the production mandrel, to force the locking dog **28** through the registering slots or windows in the production head and into the latching neck of the casing. The well head running and retrieving tool shown positioned on the upper end of the drive sleeve **14** may also be used to recover the production head to the drilling barge by latching it to the production head and the sleeve **14** as shown in FIG. 4, and pulling upwardly on the running and retrieving tool with the drill pipe **13** which is threadably attachable to the retrieving tool.

Referring now more particularly to the drawings, FIG. 1 shows a well head running and retrieving tool **20** which is threadably attachable to the drill pipe **13** at **22** and is adapted for positioning over and attaching a production mandrel **10** with a sliding running sub **18** which threads into the upper end of the production mandrel. When the weight of the tool **20** (and the drill pipe when the drill pipe extends below the tool) is supported on the production mandrel, the thrust bearing **23** bears on the upper end of the production mandrel. The running sub **18** slides longitudinally in keyway **19** but is fixed to the spindle **21** of the tool **20** so that when the tool is to be unthreaded from the production head by turning the drill pipe to the right, the running sub **18** slides upwardly along the keyway toward the thrust bearing **23** until the sub is unthreaded from the upper end of the production head **10**. Additional details of the running and retrieving tool **20** will be described in conjunction with the operation of the tool and the running and retrieving of the production head from the well.

FIG. 1 shows the production mandrel **10** being lowered onto the casing landing mandrel **12** on the drill string with the running tool **20**. The production head **10** is threadably attached to the tool **20** and the tool **20** in turn, is attached to the drill pipe at the barge or platform, and lowered as a unit into position as shown in FIG. 1. A latching and releasing sleeve **14** having a longitudinal slot **15** is disposed around the production mandrel **10** and temporarily attached thereto for lowering purposes, with a shear pin **16**. A split ring **25** is attached to the sleeve **14** and spaced between the sleeve and the production mandrel **10**. The sleeve is longitudinally slidable on the production mandrel. The lower inner portion of the sleeve is tapered outwardly at **31** and has a second taper **30** for purposes which will be hereinafter disclosed. The lower end of the sleeve has a recessed portion **50** and a stop **52** to limit the downward motion of the sleeve and the production mandrel. The upper movement of the sleeve relative to the production mandrel is limited by the production mandrel lugs **54**.

Circumferentially spaced segmented dogs **28**, as best viewed in FIG. 3, as positioned within circumferentially spaced slots or openings **29** in the lower portion of the production mandrel **10**. Dog **28** is transversely slidable within slot **29**. The tapered shoulder **30** of the sleeve drives or positions the dogs **28** inwardly into the slots **29** as the sleeve **14** moves downwardly relative to the production mandrel **10**. The taper **31** wedges or holds the dogs into the slots **29**. The sleeve does not move relative to the production mandrel while the production mandrel

is being lowered from the drilling vessel onto the casing due to the presence of shear pins 16. When the downward movement of the production mandrel 10 is stopped as the shoulder portion 33 abuts the upper edge 35 of the surface casing 12, the slots 29 in the production mandrel and the dogs 28 are adjacent or register with the latching neck 32 of the casing landing mandrel 12.

The production mandrel may then be locked to the surface casing by un-J-slotting J slot 24 and jarring or exerting pressure on the latching hammer 26 of the running tool 20 through the drill string 13. This may be either a gradual pressure or an actual hammering. The hammer shoulder 26 engages the upper surface of the split ring 25 and as pressure is exerted on the hammer, the pin 16 is sheared and sleeve 14 is driven downwardly relative to the production mandrel 10 thereby forcing dog 28 inwardly into engagement with the latching neck 32 of the casing landing mandrel 12 due to the tapered shoulder 30 and the taper 31 of the sleeve, thus locking the production mandrel to the casing 12, as shown in FIG. 2. The sleeve 14 as shown in FIG. 2 holds the dog keyed into the latching neck 32 of the casing landing mandrel and the weight of the sleeve 14 holds the sleeve down.

A funnel 44 may be fastened to the lower end of the production mandrel 10 to aid in guiding the production mandrel onto the casing landing mandrel 12.

The running and retrieving tool consists essentially of an inner mandrel or spindle 21 and an outer tubular portion 46 which is mounted to the tubular portion with a ring member 48. The ring member 48 has longitudinal holes 49 to provide for the escape of trapped fluids. The tool 20 is provided with a conventional J slot safety device so that the tool cannot be raised or lowered without first rotating the drill pipe to align the pin 33 with the vertical section 24 of the J slot.

The tool 20 may be released from the production mandrel or the well head by turning the drill pipe to the right to disengage the tool from the production mandrel by unthreading the running sub 18 from the upper threaded portion 11 of the production head.

The production head may be released from the casing landing mandrel by guiding the tool from the drilling vessel back into the production mandrel by first threadably engaging the running sub 18 with the threaded portion 11 of the production mandrel, and actuating the retrieving pin 36 on the shouldered portion of the latching hammer 26; thus, attaching the tool firmly to the sleeve by latching into the release neck 38 thereof. Pin 36 may be spring loaded, in which case it would only be inserted during the retrieving operation. This retrieving pin may also be actuated hydaulically, electrically, or pneumatically in a conventional manner. The retrieving pin may be threadably mounted in the shouldered portion 27 of hammer 26 so that the pin may be removed during the latching operation to prevent damage thereto during the hammering of the latching hammer 26 against the split ring 25.

The production head is unlatched by lifting the tool 20 latched to the sleeve 14 upwardly with the drill pipe. The sleeve moves relative to the production mandrel until the split ring 25 engages the lugs 54 of the production mandrel. By moving the sleeve 14 relative to the production mandrel, the recessed portion 50 of the sleeve is moved upwardly to the area adjacent the latching dog as shown in FIG. 4. The upward pull on the drill pipe then forces the dog 28 out of the latching neck 32 of the casing landing mandrel and into the recessed portion 50 of the sleeve. Hence, when the sleeve is moved upwardly relative to the production mandrel, the dog 28 is no longer locked in position in the latching neck of the casing landing mandrel and may be removed therefrom, thus releasing the production mandrel from the casing landing mandrel. The sleeved production mandrel can then be raised to the vessel for repairs or replacement without the necessity for a diver at the well head.

The well head tubing hanger of either the packer cup or the hydraulically set packer type can be used with the production head described in the foregoing specification. The tubing hanger mandrel is landed into the production mandrel on shoulder 40 by lowering the tubing hanger mandrel into the production head on conventional drill string equipment such as that described in my copending application, Serial No. 100,411, filed April 3, 1961. When the tubing hanger mandrel is equipped with hydraulically set packers, the tubing hanger is locked down with retractable dogs which lock into grooves 42 of the production mandrel.

While I have described my present invention with a certain degree of particularity in order to set forth the best mode of operation, it is to be understood that my invention is not limited to the details set forth, but is of the full scope of the appended claims.

I claim:

1. An apparatus for remotely landing and latching a production head on well apparatus positioned in a well drilled in a formation underlying a body of water from a structure on said body of water and wherein said well apparatus includes a well casing having a latching neck, comprising in combination:

a production head adapted to fit over said casing latching neck and having an opening therein, said opening being adjacent said latching neck,

a locking dog movable in said opening,

a sleeve disposed about said production head arranged and constructed for moving said dog into engagement with said latching neck through said opening, and

mechanical means for driving said sleeve downward with a force actuated from said structure to move said dog into engagement with said latching neck through said opening.

2. An apparatus for remotely landing and latching a production head on well apparatus positioned in a well drilled in a formation underlying a body of water from a support structure positioned on said body of water and wherein said well apparatus incudes a tubular member extending from said well apparatus to said structure and a well casing having a latching neck, comprising in combination:

a production head having a window therein, said head being adapted to fit over said casing latching neck whereby said window is adjacent said neck,

a locking dog movable in said window, a sleeve disposed around said production head, said sleeve having means for moving said dog through said window into engagement with said casing latching neck, and

mechanical means for jarring said sleeve downwardly with a force actuated from said structure through said tubular member thereby moving said dogs into engagement with said latching neck through said window.

3. An apparatus for remotely landing and latching a production head on well apparatus positioned in a well drilled in a formation underlying a body of water from a support structure positioned on said body of water and wherein said well apparatus includes a well casing having a latching neck, comprising in combination:

a production head having a window therein, said head being adapted to fit over said casing latching neck whereby said window is adjacent said neck,

a retractable dog,

a sleeve disposed around said production head, said sleeve having means for engaging said dog with said casing latching neck through said production head window when said window is brought into registry with said casing latching neck, and

a running tool connectible to said production head for lowering said production head from said structure onto said casing, said tool having a hammer member

for driving said sleeve downward relative to said production head to move said dogs into engagement with said latching neck through said window.

4. The apparatus of claim 3 wherein said tool has a spindle connectible to said production head for lowering said production head from said structure onto said casing and said hammer member is arranged and constructed to move downwardly relative to said spindle after said production head has been lowered onto said casing to drive said sleeve downward relative to said production head.

5. The apparatus of claim 3 including means for latching said hammer member to said sleeve.

References Cited by the Examiner

UNITED STATES PATENTS

2,962,096	11/1960	Knox	166—75
3,021,909	2/1962	Postlewaite	175—7
3,096,999	7/1963	Ahlstone et al.	175—7 X
3,102,591	9/1963	Raulins	166—66.5

CHARLES E. O'CONNELL, *Primary Examiner.*

R. E. FAVREAU, *Assistant Examiner.*