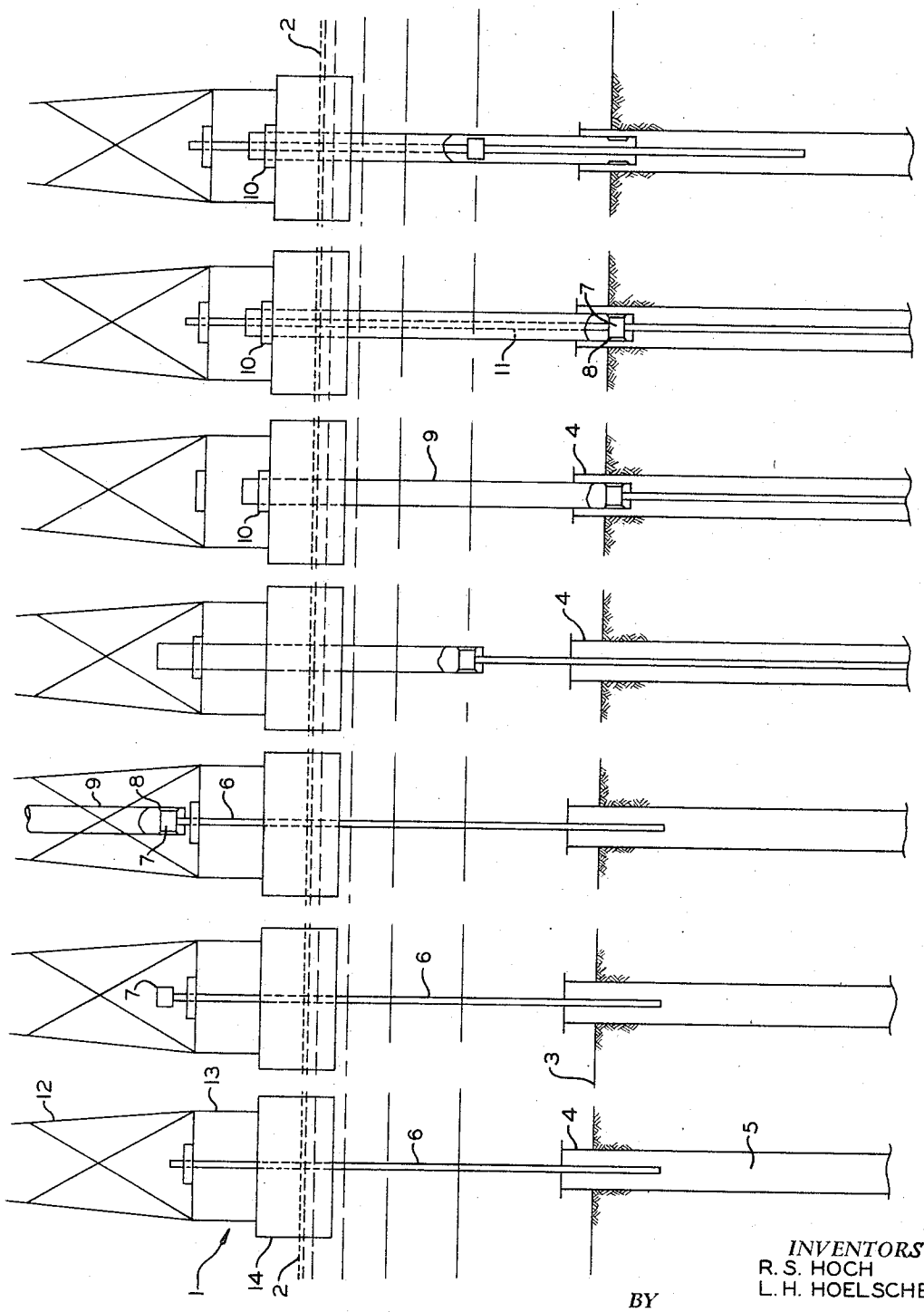
Aug. 29, 1967 R. S. HOCH ETAL 3,338,303

OIL WELL COMPLETION

Filed Jan. 22, 1965 2 Sheets-Sheet 1



INVENTORS
R. S. HOCH
L. H. HOELSCHER

BY

Young & Quigg

ATTORNEYS

Aug. 29, 1967 R. S. HOCH ETAL 3,338,303

OIL WELL COMPLETION

Filed Jan. 22, 1965 2 Sheets-Sheet 2

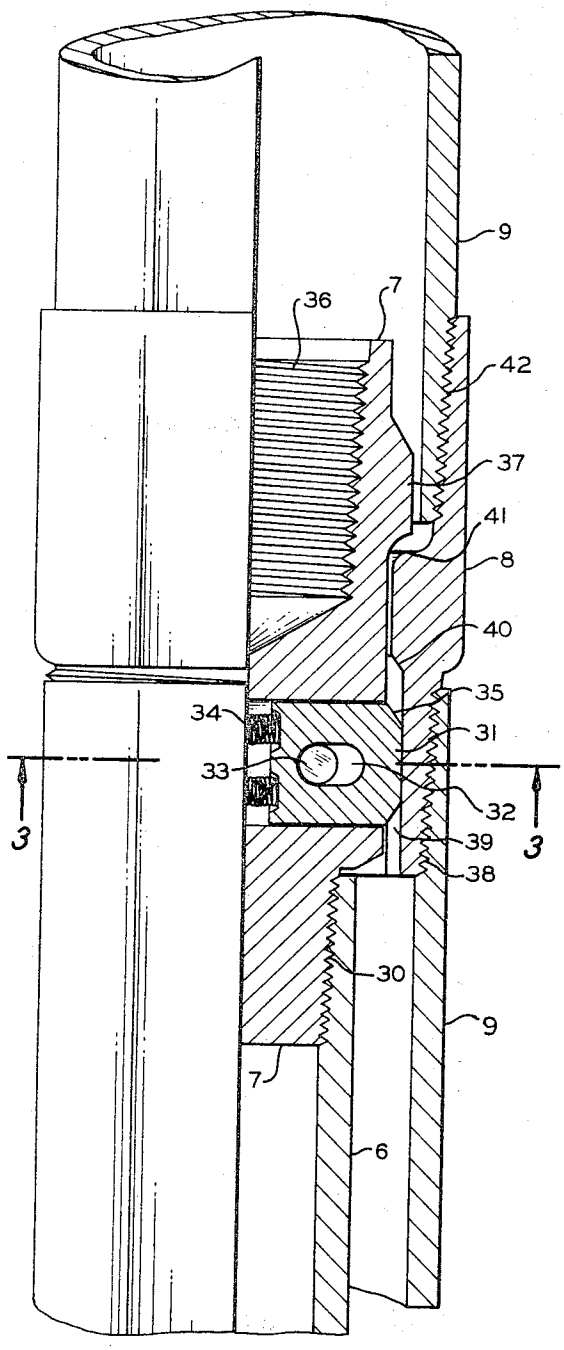


FIG. 2

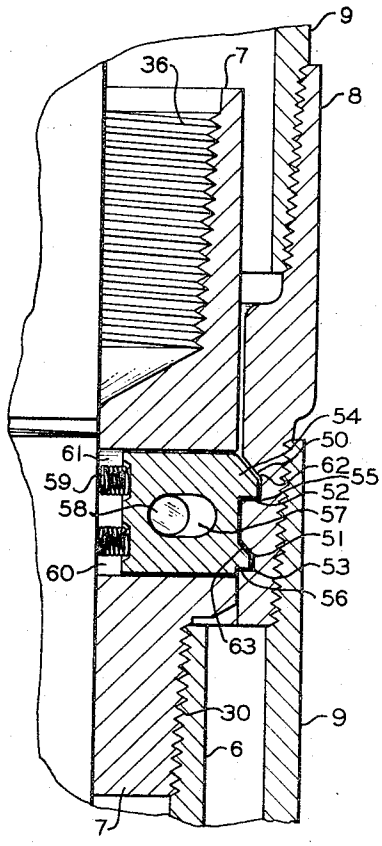


FIG. 4

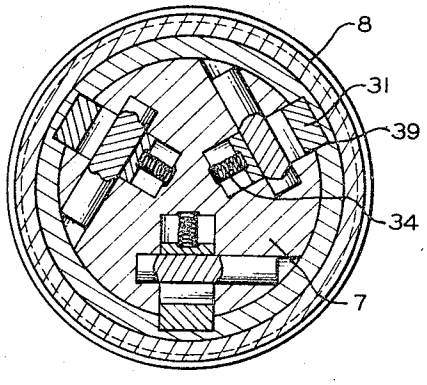


FIG. 3

INVENTORS
R. S. HOCH
L. H. HOELSCHER

BY

ATTORNEYS

United States Patent Office 3,338,303
Patented Aug. 29, 1967

3,338,303

OIL WELL COMPLETION

Robert S. Hoch, Alvin, Tex., and Lawrence H. Hoelscher, Santa Barbara, Calif., assignors to Phillips Petroleum Company, a corporation of Delaware

Filed Jan. 22, 1965, Ser. No. 427,352
10 Claims. (Cl. 166—.5)

ABSTRACT OF THE DISCLOSURE

Method and apparatus for positioning casing in underwater well which has been drilled by a drill string whereby the lower portion of the casing is attached to the upper portion of the drill string and both the drill string and the casing are lowered into the well with the drill string as a guide for the casing.

This invention relates to oil well completion. In one of its aspects it relates to a method for maintaining contact between a drilling rig and an underwater well. In another of its aspects it relates to a method for positioning casings in a drilled underwater well by using a drill string to maintain contact with said well bore, releasably connecting the drill string at the upper end to the casing and lowering the casing and drill string in a conventional manner until the casing is within the well, and retrieving the drill string. In another of its aspects the invention relates to an apparatus for laying casing and the like in underwater wells comprising a mandrel attachable to the top of a drill string and having a means to engage a collar which can be attached to the lower end of the casing, said collar having a diameter larger than said mandrel and being so engaged with said mandrel that the drill string and mandrel cannot move downwardly with respect to the collar, but can move upwardly with respect to the collar.

After drilling and before completing an ocean floor well, it is necessary to maintain contact between the well bore and the drilling rig at all times. Further, it is desirable to have a means to gain re-entry to the well bore when the drill pipe is pulled from the well. Frequently, contact is made between the drilling rig and the well bore by leaving a portion of the drill string at one end in the well and at the other end connected to the drilling rig. When it is desirable to position casing in the well bore, the casing is stripped over the drill string. In this process, the casing is positioned in the well by using the drill string as a guide and lowering the casing while the drill string is maintained intact. This procedure is very complicated and time consuming.

Another method for maintaining contact with the well bore and positioning casing in the well bore is to connect the top of the well bore and the rig with a series of cables. When it is desirable to position casing within the well bore the casings are lowered into the well bore and guided into the well bore by the cables. This system is somewhat faster than the stripping system, but the equipment is expensive and the guide lines sometimes become tangled with the control hoses. We have now found that casing and like can be positioned in an underwater well bore by using a drill string as a guide and attaching the casing to the upper end of the drill string.

It is therefore, an object of this invention to provide a simple efficient means to install casing in an underwater well.

It is a further object of this invention to provide an apparatus for installing casing and the like in underwater oil wells.

Other aspects, objects, and the several advantages of this invention are apparent from a study of the disclosure, drawing and the appended claims.

According to the invention, a drill string is used to maintain contact with an underwater oil well and casing can be positioned in the oil well without stripping. The casing is releasably attached to the upper end of the drill string and the casing and drill string are lowered into the well bore until a portion of the casing is within the well bore. The casing is then held in place and the drill string is retrieved. More specifically, a special mandrel is attached to the top of the drill string and a special collar is attached to the bottom of the casing. The collar and the mandrel fit together so that the mandrel cannot be displaced downward with respect to the collar, but can be displaced upward with respect to the collar.

The invention can be better understood by reference to the accompanying drawings, of which FIGURES 1*a–g* are a series of schematic drawings showing the sequential method of laying pipe in the well bore of an underwater oil well; FIGURE 2 is a cross section of a novel mandrel and collar which can be used to position the casing according to the invention; FIGURE 3 is a sectional view through line III—III of FIGURE 2; and FIGURE 4 is a cross section through another novel mandrel and collar which can also be used according to the invention.

Referring now to FIGURE 1*a*, a floating drilling rig **1**, comprising a derrick **12**, a derrick substrate **13** and a floating drilling base **14**, is positioned over an ocean well **4** having well bore **5** on the ocean bottom **3**. The water level is indicated by **2**. The drilling string **6** extends from the drilling rig into the ocean well **4**. The drill string has been used to drill the well bore **5** and is still in contact with the well bore. Referring now to FIGURE 1*b*, a special mandrel **7**, as will be later described, is positioned on the top of the drill pipe **6**. Referring now to FIGURE 1*c*, a special collar **8** is positioned over mandrel **7** and attached to the lower end of casing **9**. A section of casing **9** and collar **8** can be stripped on to the drill pipe before mandrel **7** is positioned on the top of the drill pipe **6**. Whether or not collar **8** is positioned on drill pipe **6** before mandrel **7** is attached to drill pipe **6** will depend on the type of mandrel and collar combination. The casing and drill pipe are lowered into the well as shown in FIGURE 1*d*. It is obvious that the casing is lengthened by adding more sections of casing. When a portion of the casing is within well **4**, as shown in FIGURE 1*e*, casing **9** is fixed on moon pool spider **10**. A retrieving string **11** such as drill pipe or the like is lowered into casing **9** and engages mandrel **7**. Mandrel **7**, which is releasably attached to collar **8**, is pulled out of the well as shown in FIGURE 1*f* and FIGURE 1*g*. Since mandrel **7** is firmly attached to drill pipe **6**, the drill pipe is pulled out of the casing along with mandrel **7**.

Referring now to FIGURE 2, mandrel **7** has on the lower portion a threaded male portion **30** which is adapted to engage a threaded female portion of a drill pipe **6**. A retractable key or lock **31** is positioned in the central portion of mandrel **7** and, as can be seen from FIGURE 3, is adapted to slide in a radial direction, being biased outward by strings **34**. The motion of key **31** is constrained by bar **33** which is positioned in slot **32**. The upper portion of mandrel **7** has on the outer part an annular collar **37**. Collar **37** has a diameter less than that of casing **9**. The upper portion of mandrel **7** is annular shaped and contains female threads **36**. Collar **8** has on the lower portion a threaded portion **38** which is adapted to engage the upper end of a casing **9**. In using this combination of collar and mandrel, it is desirable to strip one section of casing **9** onto the drill string **6** and attach collar **8** to casing **9** before attaching mandrel **7** to drill string **6**. The lower end of collar **8** contains vertical slots **39**, which are adapted to engage the outer portion of key **31**. As can be seen from FIGURE 3, the combination of key **31** and slots **39** pre-

vent rotational motion between mandrel 7 and collar 8. It is obvious that slots 39 need not extend from the middle portion to the lowermost portion of collar 8. They may be square slots just large enough to engage the outermost portion of key 31. The uppermost part of slot 39 contains a shoulder 40 which is slanted upwardly and inwardly. This shoulder 40 cooperates with beveled edge 35 of key 31 so that when the mandrel is pulled upwardly with respect to the collar 8, bevel 35 will so cooperate with shoulder 40 that key 31 will be pushed back into mandrel 7 and mandrel 7 will be allowed to freely move upwardly. An upper shoulder 41 on collar 8 is provided to coact with mandrel collar 37 to limit the downward movement of mandrel 37 with respect to collar 8. Thus, the diameter of shoulder 41 will be less than that of the mandrel collar 37. Collar 8 is threaded on the upper inner portion so that it can be attached to casing 9. As can be seen from FIGURE 2, collar 8 must be stripped onto drill string 6 before mandrel 7 is attached thereto or, due to the interaction between shoulder 41 and mandrel collar 37, collar 8 would not be able to be positioned as shown in FIGURE 2.

Referring now to FIGURE 4, a collar 8 and mandrel 7 are provided with a configuration such that collar 8 need not be stripped onto drill pipe 6 prior to attaching mandrel 7 to drill pipe 6. Mandrel 7 is provided with threads 30 to engage drill pipe 6 in the lower portion and with threads 36 on the upper portion for engaging a retrieving string. Key 54, biased outwardly by springs 59, is positioned in slots 60 and 61. The key is held in place by rod 58 which is slidable in slot 57. The outer portion of key 54 has two projections, each having a beveled upper portion 62 and 63. The lower portions of the projections contain horizontal or slightly inclined surfaces 55 and 56. Collar 8 has indentations to accommodate the projections of key 54. Horizontal surfaces 52 and 53 engage key surfaces 55 and 56 and prevent downward movement of mandrel 7 with respect to collar 8. The beveled surfaces 62 and 63 of key 54 cooperate with the slanting surfaces of slots 50 and 51 in collar 8 so that an upward force on mandrel 7 will cause key 54 to be retracted and will cause upward movement of mandrel 7 with respect to collar 8. The upper portion of collar 8 has threads for engaging casing 9 and threads for engaging casing 12. With this combination of mandrel and collar, it is not necessary to strip on a section of drill pipe and collar 8 prior to attaching mandrel 7 to the drill pipe 6. Thus by using this apparatus as shown in FIGURE 4, the mandrel 7 can be attached to drill pipe 6 and then collar 8 can be positioned around mandrel 7 after that.

By releasably connecting the lower end of well casing with the upper end of the drill string, it is contemplated that the lower end of the casing and the upper end of the drill string move substantially as a unit. In other words, the only requirement is that the two, i.e., the drill string and the casing, not come apart as the casing is lowered into the well.

The invention further contemplates lowering a pipe of a given diameter into a well bore by connecting the same to a pipe of a smaller diameter. In the broadest concept, any means for connecting the pipe of smaller diameter with the larger diameter pipe would be suitable. For example, a shear pin could be used to connect the casing to the drill string. When the casing is lowered into the well bore, a pull on the drill string by a cable extending inside the casing attached to the drill string would pull the drill string free from the casing so that it could be retrieved from the well.

A collar or cup could also be used to attach the drill string to the casing. The collar can have a means for attaching to the casing and a series of spokes which engage the upper end of the drill string when the casing is positioned in the well bore. The drill string can be retireved by breaking the spokes.

It is not necessary that the drill string be retrieved. It can be left in the well bore, engaged to or disengaged from the casing.

Reasonable variation and modification are possible within the scope of the foregoing disclosure, drawings and the appended claims to the invention, the essence of which is that a method and apparatus are provided for positioning casing and the like in underwater oil wells, said method comprising maintaining a connecting rod or drill string or other element which can be lowered between an underwater well bore and a drilling rig, said rod extending down and into said well, attaching a lower part of a casing of larger diameter than the connecting rod to an upper part of the connecting rod and then lowering the casing into the well by lowering said rod; the apparatus comprising a drill string, rod or other lowerable element, a casing, and a means for connecting said drill pipe and said casing.

We claim:

1. A method for positioning a well casing in a drilled underwater well, said method comprising drilling an underwater well using a drill pipe, maintaining contact with said well with one end of a drill pipe having the other end supported by a drilling rig, releasably attaching to the upper portion of said drill pipe the lower end of well casing to be positioned in said well, lowering said casing and said drill pipe so that at least a portion of said casing extends to a point below the upper end of said well, and retrieving said drill pipe while maintaining said portion of said casing below said upper end of said well.

2. A method for positioning a well casing in a drilled underwater well according to claim 1 wherein said upper portion of said drill pipe is releasably attached to said lower end of said casing by attaching a mandrel to the upper portion of said drill string, said mandrel containing a retractable male member, attaching on said lower portion of said casing a collar containing female portions adapted to receive said male portions of said mandrel and positioning said mandrel within said collar.

3. A method according to claim 2 wherein a second section of casing is stripped over said drill string and attached to said collar before said mandrel is attached to said drill string.

4. An apparatus for laying casing in an underwater well, said apparatus comprising:

a mandrel having substantially a circular shape in cross section

on the lower end, threads on the outer portion to engage a drill pipe,

in the central portion a spring biased retractable key which slides in a horizontal direction,

a hollow top portion having a thread portion on the inner annular portion thereof, and on the outer portion an annular shoulder projecting outwardly from an area located a fixed distance from said retractable key,

an annular collar having

on the upper end threads on the inner portion for attaching said collar to an end of a casing having a diameter greater than said drill pipe and greater than that of any portion of said mandrel,

in the central portion of said collar an inwardly projecting annular ring having a diameter less than that of said annular shoulder projection,

in the lower portion of said collar, indentations to cooperate with said key to prevent rotational motion of said mandrel with respect to said collar.

5. An apparatus according to claim 4 wherein said retractable key has a beveled edge and said indentations slope outwardly and downwardly to cooperate with said retractable key such that when said mandrel is forced upwardly with respect to said collar said key will be

retracted so that said key will pass over said inwardly projecting annular ring on said collar.

6. An apparatus according to claim 4 wherein said indentations on said inner portion of said collar are longitudinal slots extending from said inwardly projecting annular ring to the lowermost portion of said collar.

7. An apparatus according to claim 4 wherein said collar has threads on the lower portion for engaging one end of a casing.

8. An apparatus for positioning a well casing in an underwater well, said apparatus comprising:

a mandrel being circular in cross section and having threads on the lower portion of said mandrel for engaging an end of a drill pipe,

a two-prong key in the central portion being spring biased and being movable in a radial direction, said prongs being substantially horizontal and flat on the lower portion and beveled on the top portion,

an annular top having threads on the inner portion for engaging a means for retrieving said mandrel and drill pipe,

a collar having

on the lower outer portion threads to engage casing of a diameter greater than that of said mandrel and drill pipe,

slots to engage said key, said slots being substantially horizontal on the lower portion and sloping downwardly on the top portion to prevent said mandrel from moving downward with respect to said collar but allowing said mandrel to move upward with respect to said collar.

9. An apparatus for positioning casing in an underwater well bore from a structure on top of the water comprising

(a) connecting means between said structure and said well bore,

(b) means for releasably attaching the top portion of said connecting means to a bottom portion of said casing, said releasable attaching means comprising

(1) an annular collar having means on one end thereof for attaching to the bottom portion of said casing,

(1*a*) said collar having on its inner surface at least one slot,

(2) a mandrel having a means for attaching to said top portion of said connecting means,

(2*a*) said mandrel having a reciprocatable key which is insertable in said slot of (*b*)(1*a*) to prevent relative rotation of said mandrel and said collar.

10. An apparatus according to claim 9 wherein at least one of said key of (*b*)(2*a*) and said slot of (*b*)(1*a*) has a downwardly sloping surface to aid in retracting said key when said mandrel is pulled upwardly.

References Cited

UNITED STATES PATENTS

1,079,689	11/1913	Bowler et al.	285—140
1,391,626	9/1921	Gilthorpe	175—257
1,671,136	5/1928	Stokes	175—257
3,097,000	7/1963	McClintock et al.	285—142
3,163,238	12/1964	Mallot	175—5
3,236,308	2/1966	Leake	166—.5
3,273,915	9/1966	Bishop et al.	285—140

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

R. E. FAVREAU, *Assistant Examiner.*