REVERSIBLE KELLY SYSTEM FOR ROTARY DRILLING

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ABSTRACT

A reversible Kelly drive system suitable for use in a typical oil and gas rotary drilling operation utilizing a reversible Kelly and a locking Kelly saver sub placed between the Kelly cock and the reversible Kelly. The Kelly saver sub has two box joints, the upper being left-hand threaded for connection to the Kelly cock and the lower being right-hand threaded for connection to the Kelly joint. The Kelly saver sub includes means for locking the right-hand threaded connection together, by means of for example set screws, to prevent this connection from backing out and becoming disconnected during use, all other joints in the overall Kelly arrangement being left-hand threaded. The Kelly is bidirectional or reversible end-for-end, having right-hand threaded pin joints at both ends, in order to eliminate the bulging of the hexagonal surfaces and edges of the Kelly which had heretofore occurred during one ended use in prior art Kelly systems.

The Kelly saver sub has two or more grease fitting holes and two or more set screw holes on its bottom most side, and further includes an annular "O" ring seal positioned directly below the set screws on the Kelly saver sub for retaining the grease at the set screws.

7 Claims, 4 Drawing Figures
REVERSIBLE KELLY SYSTEM FOR ROTARY DRILLING

BACKGROUND OF THE INVENTION

This invention relates, generally, to rotary type well drilling equipment for oil wells and the like, and, more particularly, to a Kelly drive sub-system utilizing a reversible or bi-directional Kelly having a locking Kelly saver sub which is to be used in conjunction with the conventional Kelly cock and Kelly arrangement above the rotary table.

Henceforth, a conventional prior art arrangement of the usual rotary table equipment in a typical rotary drilling operation included, from top to bottom and screwed together in line, as shown in FIG. 1: a swivel block 10, an adaptor 12, a Kelly cock 13, a second adaptor 15 and the Kelly or Kelly joint itself 20, all the intermediate, interconnecting joints of which were left-hand threaded. The lowermost section of the Kelly joint had a right-hand threaded pin joint which was connected to the drill string for the driving thereof. The difference in thread direction (right-hand vs. left-hand) is of course due to the fact that the rotary power is applied at the middle section of the Kelly, above the right-hand threaded joints but below the left hand threaded joints, and the thread direction is viewed with reference to that point.

However, using the above-discussed prior art arrangement presented certain serious operational problems, all of which are overcome by the instant invention. More specifically, a particularly costly problem arises when the Kelly joint is continually rotated in the same direction (usually clockwise) during the entire drilling operation.

As is standard in the industry, a new Kelly, whether hexagonal, square or otherwise, will have a series of flat surfaces terminating in straight vertical edges to which the rotary drive is connected thereby enabling the rotary drive to effectively rotate the Kelly joint along with the drill string attached thereto. After continued use of a given Kelly and the resultant accumulation of stresses, and because a constant and high degree of torque is applied to the hexagonal section of the Kelly, the Kelly becomes unsuitable for further use because of the bulges or rounded edges which develop in its hexagonal section.

Thus, because of the large amount of torque involved during rotation of the drill string over a prolonged period of time, a typical Kelly will develop bulges in its theretofore flat surfaced, hexagonal section between its upper and lower box and pin joints. When the Kelly joint becomes bulged or worn to any substantial extent, it will become hung-up in the drive bushings, jamming the drive mechanism. The result is that the Kelly must be completely replaced and/or subsequently repaired.

One prior art method of repairing the old Kelly is to cut its pin and box joint collars and swap them end-for-end on the drive, flat-surfaced portion of the Kelly and then weld them in their new, respective positions. An obvious disadvantage of this method of repair is that the Kelly must be returned to a machine shop where the expensive and time-consuming repairs are made.

A second technique used to minimize the effects of "bulge" of the drive, flat-surfaced portion of, for example, the hexagonal Kelly is to rotate the Kelly one hex position at a time so as to distribute the effects of the rotary torque over the entire faces of each hexagonal section of the Kelly. This technique merely prolongs the period of time which a given Kelly may be used but does not prevent the cumulative effect of "bulge" on the middle section of a given Kelly joint.

Thus, using either of the above repair methods does not effectively or practically overcome the effects of "bulge" caused by continuously rotating the Kelly in the same direction under a high amount of torque. Thus, at some point in time, a given Kelly will be rendered unfit for use because its straight edges and flat surfaces have become rounded by the bulging and can no longer supply the rotary drilling drive unit with the necessary gripping surface which is necessary to rotate the Kelly and drill string.

The present invention overcomes the problems of the prior art and substantially reduces and effectively eliminates "bulge" in a Kelly joint thereby prolonging its useful life without the necessity of expensive and time-consuming repairs or replacements of a given Kelly joint. Basically, this is accomplished by utilizing a dual-ended, easily reversible or bi-directional Kelly, permitting the Kelly to be periodically and quickly rotated end-for-end. By periodically rotating the Kelly end for end, the direction of torque changes upon each end-for-end rotation thereby preventing the effects of counteracting or preventing the "bulge" which would ordinarily result from rotating the Kelly in a single direction.

A further advantage is that when the Kelly is rotated end-for-end, the rotary drive unit connecting or making contact with the hexagonal section of the Kelly is automatically changed to the other end of the Kelly thereby eliminating the need for cutting off the pin and box joints of the Kelly to accomplish this same result. As discussed hereinabove with reference to prior art repair techniques, when the pin and box joints of a conventional Kelly are cut off, they must be taken to a machine shop and the entire operation of cutting and welding must be done at the shop location.

It is an object of the present invention to provide a reversible Kelly having a supplemental locking Kelly saver sub unit which substantially reduces the time consuming and expensive effects of "bulge".

Another object of the invention is provide a reversible Kelly system which permits the Kelly to be rotated end-for-end, thereby reducing the effects of torque which causes a Kelly joint to become bulged during prolonged periods of use, causing it to hang in the rotary bushing because of the improper fit.

Still another object of the invention is to provide a reversible Kelly system which extends the useful life of a given Kelly thereby eliminating the costly and time-consuming repairs or replacement of the Kelly unit.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the nature and objects of the invention, reference should be had to the following detailed description and to the accompanying drawings, in which like parts are given like reference numerals and wherein:

FIG. 1 is side view, partially in cross-section, of the standard rotary table Kelly arrangement in accordance with the prior art;

FIG. 2 is a side view, partially in cross-section, of the rotary table Kelly arrangement using the locking Kelly
saver sub and reversible Kelly of the present invention;

FIG. 3 is a side, partial, close-up view, partially in cross-section, of the Kelly saver sub as it is to be connected to the upper pin joint of the reversible Kelly; and

FIG. 4 is a side, partial, close-up, partially in cross-section, of the Kelly saver sub connected and locked in position to the reversible Kelly joint.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, particularly to FIG. 1, the standard prior art arrangement shown includes a swivel block 10 having a lower pin connection 11, the latter of which is connected to the upper box joint of an adaptor 12. The lower pin joint of adaptor 12 is in turn connected to a box joint of Kelly cock 13 which includes the standard closing means 14 for closing the Kelly cock on its mid section. The lower pin joint of Kelly cock 13 is connected to the upper box joint of a second adaptor 15 whose lower pin joint is connected to the upper box joint of the Kelly collar 23. All of the above pin and box connections are left-hand threaded. Kelly 20 has a lower collar 22 which has a right-hand threaded pin joint that in turn connects to the first joint in the drill string (not shown). The above constitutes the standard prior art arrangement presently used throughout the industry. Although a hexagonal Kelly is illustrated and described herein, the present invention is of course applicable to practically any Kelly configuration.

FIG. 2 illustrates a similar rotary table arrangement but includes therein the locking Kelly saver sub 16 and the reversible Kelly 20′ utilized in the present invention. Comparing the prior art arrangement shown in FIG. 1 to the inventive arrangement shown in FIG. 2, it will be noted that the locking Kelly saver sub 16 is placed between the lower adaptor 15 and the upper collar 23′ of reversible Kelly 20′.

It is most important to note that the Kelly 20′ in FIG. 2 has right-hand threaded pin joints at both of its ends. It is this latter feature that permits the Kelly to be reversible or bidirectional, that is, to be turned about end-for-end at periodic intervals, depending upon the condition of the hexagonal portion of Kelly 20 after it has been used for some time in a drilling operation.

However, because of its reversibility and dual, identical, right-hand threaded ends, the Kelly 20′ under certain conditions of use would have a natural tendency to back out of its upper, right-hand threaded, screw connection were it not for the locking joint characteristic of Kelly sub saver 16. To provide the locking joint capability to the Kelly sub saver 16, a downwardly extending female chamber 21 is included at its lower end, as best illustrated in FIG. 3. The upper collar 23′ of the Kelly 20′ serves as a male member and fits in and mates with the female chamber 21. In order to prevent relative rotation between the Kelly 20′ and the Kelly sub 16, a suitable set screw locking system is provided for locking the Kelly 20′ and Kelly sub 16 together during use.

The locking Kelly saver sub 16 of course has an upper box joint which is left-hand threaded so as to be compatible with the upper pin joint of adaptor 15 and a lower box joint which is right-hand threaded to be compatible with the upper pin joint of Kelly 20′.

As best seen in the close-up views of FIGS. 3 and 4, grease fitting holes 37 are provided on Kelly saver sub 16 along with set screw holes 19 and “O” ring 18. The “O” ring is designed to retain the grease inserted through holes 37 which keeps the set screws fitted in holes 19 in good working condition at all times. As explained above, the purpose of the set screws placed in holes 19 is to prevent the right-hand threaded pin connection of the upper collar 23′ of Kelly 20′ from backing off in the event, for example, that the swivel 10 should lock or fail to turn.

As an alternate modification of the system shown in FIGS. 2-4, the upper joint of Kelly sub saver 16 could be made into a pin joint rather than the box joint shown, thereby eliminating the need for the lower adaptor 15. The Kelly sub saver 16 could then be directly connected into the lower box joint of the Kelly cock 13.

As pointed out above, the function or purpose of the lower portion of the Kelly sub 16 is to lock it to the reversible Kelly 20′ and in compliance with the disclosure requirements of the patent laws a particular mechanical set screw system has been described. However, many other different locking systems could be utilized instead, it only being required that the locking system be reliable and, preferably, be a relatively simple system which can be easily engaged and disengaged to allow quick and easy reversibility of the Kelly 20′. Moreover, the locking sub 16, although disclosed herein with reference to its use with a reversible Kelly, could be used in conjunction with other elements of a rotary drill system wherein reversibility of the element is desired.

Since numerous additional changes may be made in the above-described construction and different embodiments of the invention may be made without departing from the spirit and scope thereof, it should be realized that as a general rule the details contained in the foregoing description or shown in the accompanying drawings should be interpreted as illustrative only and not in a limiting sense.

I claim as my invention:

1. A reversible Kelly sub-system for use in a drive system for rotary well drilling which includes an upper section of discrete elements (such as a swivel block, a Kelly cock and one or more adaptors) and in a lower section a Kelly unit, all screwed together during use, comprising:

   an elongated, reversible Kelly having identical, screw joint connections at both ends whose direction of threading is opposite that of the discrete elements with which it is to be used;

   a Kelly sub element having at one end a screw joint connection threaded in the same direction as that of the discrete elements for connection with the lower-most one of the discrete elements, and at its opposite end a Kelly screw joint connection threaded in the opposite direction for connection with either end of said reversible Kelly; whereby, the Kelly can be used in either driving direction and quickly and easily reversed in direction.

2. The reversible Kelly sub-system of claim 1 wherein there is further included:

   a locking system connected to said Kelly sub element for positively preventing relative rotation between said reversible Kelly and said Kelly sub element during use when said reversible Kelly and said
Kelly sub element are made up together, whereby, when said reversible Kelly, said Kelly sub-element and the discrete elements are all screwed together and put into use in the rotary drive system, the reversible Kelly will not inadvertently become unscrewed from the rotary drive system.

3. The reversible Kelly sub-system of claim 2 wherein said identical screw joint connections are pin connections extending out from collar sections on the Kelly, and said Kelly screw joint connection is a box connection, and said locking system comprises:
a female chamber fixedly attached to said Kelly sub element adjacent said box connection for receiving and mating with the collar section of the Kelly, and mechanical means mounted on said female chamber for fixedly but temporarily interconnecting said female chamber and said collar section together and hence said Kelly sub element and said reversible Kelly together.

4. The reversible Kelly sub-system of claim 3 wherein said mechanical means comprises a set screw system.

5. The reversible Kelly sub-system of claim 4 wherein there is further included in said female chamber grease fittings and annular "O" ring sealing means positioned below said set screw system for sealing in grease placed in and around said set screw system.

6. The reversible Kelly sub-system of claim 1 wherein said identical, screw joint connections on said Kelly are right-hand threaded.

7. A reversible sub-system analogous to that of claim 1 except that the term "Kelly" should be considered any element generally.

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