Nov. 12, 1940. J. C. FORTUNE ET AL 2,221,376

ROTARY DRILLING EQUIPMENT

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Fig. 1.

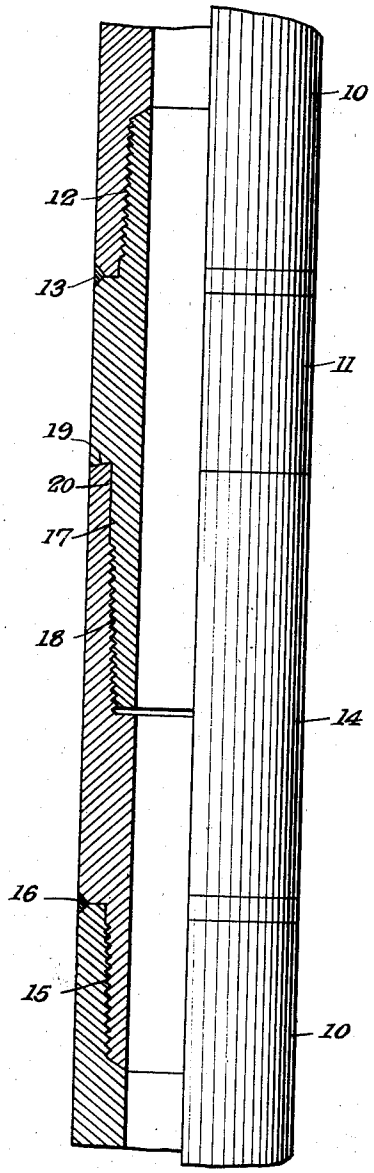

Fig. 2.

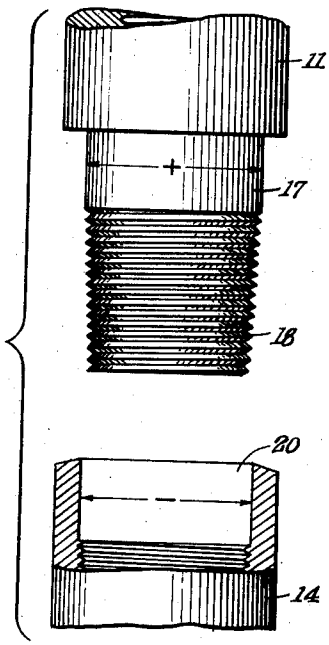

Fig. 3.

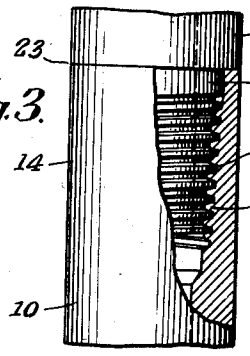

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Fig. 4.

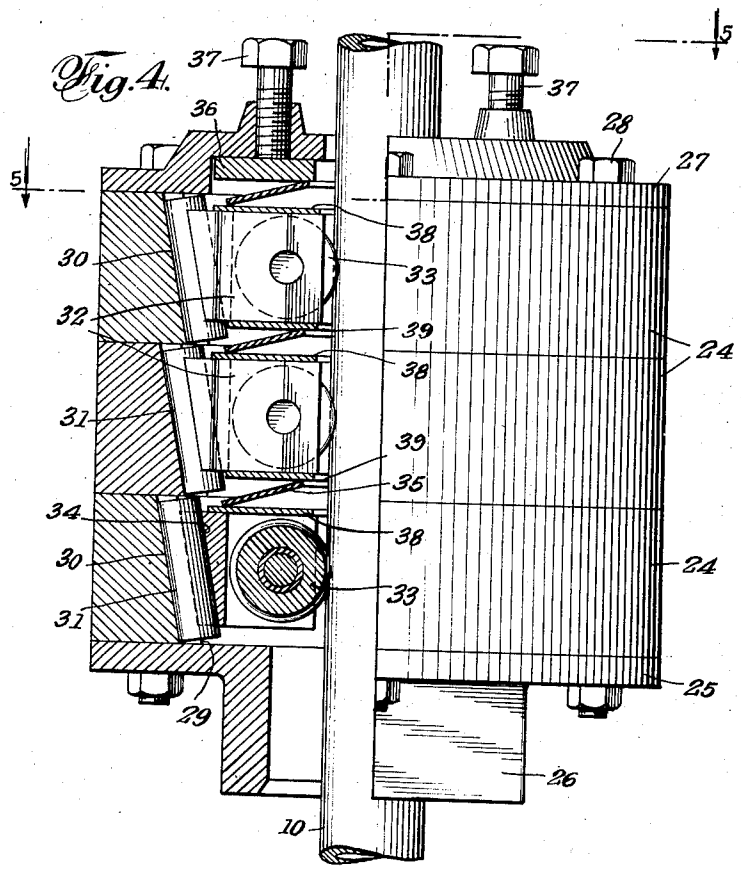

Fig. 5.

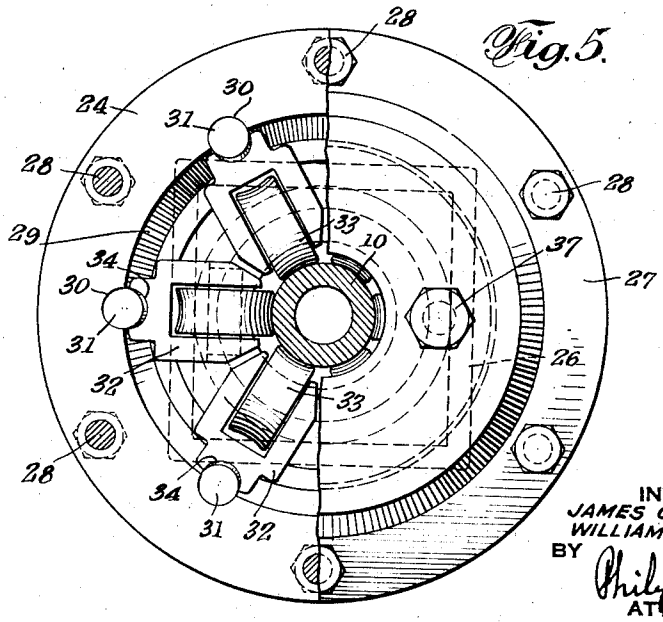

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Fig. 6.

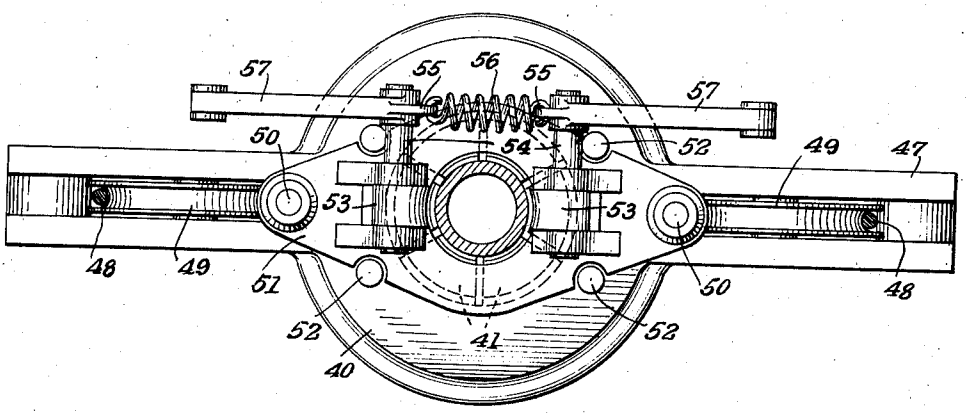
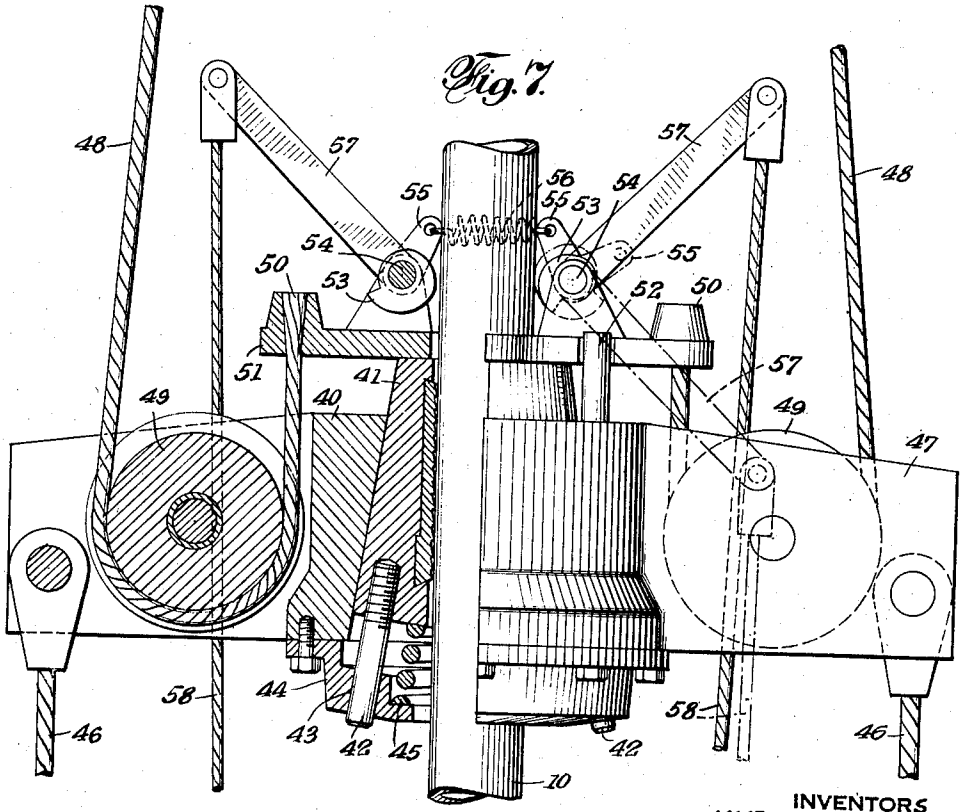


Fig. 7.



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UNITED STATES PATENT OFFICE

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ROTARY DRILLING EQUIPMENT

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Application June 16, 1938, Serial No. 213,994

7 Claims. (Cl. 254—29)

The invention herein disclosed relates to rotary drills and more particularly to the grief stem, the grief stem drive and snubbing equipment.

Objects of the invention are to provide a round, as distinguished from an ordinary square grief stem, of flush joint construction and which will not accidently or unintentionally unscrew from the torque of the swivel lag or other causes; to provide a compact and efficient slip drive for the round Kelly or drill pipe, which will firmly grip and drive the pipe without crushing or cutting while permitting the pipe to feed therethrough; and to provide practical and efficient snubbing mechanism readily controllable to effect the desired snubbing operations.

Other objects and the novel features of construction, combinations and relations of parts by which all such objects are attained are set forth and will appear in the course of the following specification.

The drawings accompanying and forming part of the specification illustrate certain preferred embodiments of the invention. The structure, however, may vary or be modified to suit requirements, all within the true spirit and scope of the invention as hereinafter defined and claimed.

Figure 1 is a broken part sectional longitudinal view of the round or cylindrical flush joint grief stem.

Figure 2 is a broken part sectional view showing the round grief stem separated at one of the flush joints.

Figure 3 is a broken sectional detail of another form of the round flush joint grief stem.

Figure 4 is a broken and part vertical sectional side elevation of the slip drive for the round grief stem.

Figure 5 is a broken part sectional plan view of the slip drive bushing, the sectioned portion as on line 5—5 of Figure 4.

Figure 6 is a broken part sectional plan view of the snubbing bar.

Figure 7 is a broken part sectional side elevation of the snubbing bar.

The round flush joint grief stem or Kelly is indicated at 10 in the several views and the novel construction of the same is shown in detail in Figures 1, 2 and 3.

Considering the first form, illustrated in Figures 1 and 2, the round sections of grief stem 10 are made in any desirable or convenient lengths connected by flush joints, consisting of a pin member 11 screwed at 12 in the end of one section and welded at 13 and a box member 14 screwed in the companion section at 15 and welded at 16, said pin member having a smooth ground portion 17 above the screwthreads 18 and below the undercut shoulder 19 and the box member having a smooth receiving portion 20 slightly smaller but adapted when heated to receive portion 17.

The joint is made up by heating the reduced portion sufficiently to receive the smooth pin portion, the parts being designed and proportioned so that the shrink fit thus accomplished will resist a torque greater than any torque developed by the swivel lag. This joint, however, may be readily unscrewed when required by heating sufficiently to expand and release the shrink fit.

In the second form illustrated in Figure 3 the pin and box elements 11 and 14 are integral with the round grief stem which is a solid or integral bored tube with uniform accurate outside diameter and a wall thickness sufficient to prevent distortion by any pressure set up by driving cams or the like. The box end of the threaded connection is indicated as a heavy duty "Reed" tool joint thread 21 and the pin thread 22 is shown as a Reed tool joint pin thread, but a few thousandths inch larger in diameter than would be standard practice, requiring when screwed together, application of considerably more torque to make up, producing a high pressure thread, requiring greater torque to break and hence not affected by swivel lag.

The invention offers many advantages over square grief stems which have reached the limit of length to which they can be made and transported in one piece. Because no practical form of joint has been designed, which will be tight without further make-up and have adjoining square sections coincide, it has been impractical to construct the square grief stems in sections. The round flush joint grief stem disclosed, however, may be made up in short easily transported sections which can be connected together in various combinations to form a grief stem long enough to drill a single, a 60-foot double or even a stand at a time.

When a grief stem joint is above the point of drive, the round grief stem drive bushing (Figure 4) in the rotary table, the friction of the swivel or the so-called "swivel lag" develops the torque above referred to, tending to unscrew the joint. The high surface pressure on the special threads provided by the slightly oversize pin threads may require a torque as high as 6000 ft. lbs. to unscrew, a force greater than any friction that can develop at the swivel.

In making up the joints, special thread com-

pound which retains its lubricating value in the extremely thin film between threads may be employed. In the practical example under consideration this round flush joint grief stem joint may require 6000 ft. lb. torque to make up. Further torque developed in drilling may be carried on the abutting joint shoulders at 23, Figure 3; when clean and put together with the special thread compound as described, this joint may be broken when required, without galling, at practically the same torque required for the make up.

The drive bushing for the flush joint round Kelly consists as shown in Figures 4 and 5 of a number of ring sections 24, a bottom or base section member 25 squared at 26 to fit the master bushing of the rotary and a top or cover section 27, all secured together by through bolts 28.

The ring sections 24 are shown as downwardly tapered with substantially the same taper as a spider, as indicated at 29, and provided in such tapered portions with semicircular seats 30 receiving swivel rods or pins 31. Slips 32 mounting the concave faced drive rollers 33 have sockets 34 at the back rotatably and slidably fitting over the protruding portions of the rod sections 31.

With the construction disclosed, the slips can move downwardly and inwardly to engage the rollers with the pipe and can swing under the rotation of the bushing on the pivotal centers represented by the rod sections to force the rolls as cams against the sides of the pipe.

Downward pressure on the slips is effected in the disclosure by dished conical springs 35 interposed between the adjoining sets of slips and below the top plate. To enable adjustment of such spring pressure an adjustable pressure plate is shown at 36 which can be forced downward by pressure screws 37. The several pressure springs are shown as bearing on thrust flanges 38 resting on the slips and flanges for transferring the pressure from the bottom of one set of slips to the top of the next set of slips are shown at 39.

The drive bushing disclosed is sturdy and compact and forms a practical and efficient slip drive for the round flush joint pipe or grief stem which will not crush, cut or otherwise injure the same.

For snubbing the round flush joint pipe and grief stem, the construction illustrated in Figures 6 and 7 is provided consisting of the spider 40 in which operate the slip segments 41 closing upwardly on the pipe. These slips are slidingly guided by projecting rods 42 operating through guide openings 43 in the bottom cover plate 44 inclined to correspond with the taper of the spider. A coil spring 45 supported by the cover plate 44 thrusts the slips upwardly and inwardly into engagement with the pipe and downward pull by cables 46 on the arms of the spider constituting the snubbing bar 47, tightens the engagement of the slips with the pipe.

In snubbing operations the bar is pulled down, with the slips closed on the pipe as in Figure 7, to the lower limit, over the rotary table.

The upward or recovery stroke is effected by a retrieving line, the two branches of which are indicated at 48 in the form of a bridle passing under sheaves 49 journaled in the bar and connecting at 50 with a plate 51 loosely guided over pins 52 and resting on the upper ends of the snubbing slips 41.

At the end of the downward snubbing stroke, upon release of downward pull on the snubbing lines 46, upward pull is applied to the retrieving lines 48 which through sheaves 49 lift the snubbing bar against the anchor plate 51, releasing the slips from the pipe. The tension of the spring 45 being less than the weight of the snubbing bar, the whole assembly will then move up the drill pipe with the slips in open relation.

When hoisted and supported as described on the retrieving line, the slips are open and will remain in this open relation even if the snubbing bar is lowered by the retrieving line; therefore, the snubbing assembly may be adjusted either up or down wholly by the retrieving line.

When it is desired to close the slips on the pipe, as at the start of the snubbing stroke, the load is transferred from the retrieving line to the snubbing cables by means of the two cams shown at 53 pivoted at 54 on the anchor plate 51 at opposite sides of the pipe. Arms or lugs 55 projecting from these cams are shown connected by a spring 56 to hold the cams rocked to a position clear of the pipe. The opposite movement of the cams is effected by levers 57 to which are connected the lines 58 of a bridle having a single pull line extending to the derrick floor.

In Figure 6 the cams 53 are shown in their normal position, clear of the pipe, held so by the spring 56. This is the condition indicated in full lines in Figure 7. The broken lines show how with pull on the bridle 58 the levers 57 will be lowered against the tension of spring 56 to throw the cams 53 into gripping engagement with the pipe. When such engagement is effected, the support of the anchor plate 51 is transferred to the pipe. Then when the retrieving line, represented by bridle 48, is slacked off, the snubbing bar spider 40 will lower and spring 45 at the same time will react to thrust the slips into engagement with the pipe. Downward pull on the snubbing cables 46 will then set the slips and snub the pipe down as far as permitted by the rotary table.

The round flush joint grief stem disclosed is designed for cooperation with both the slip drive bushing of Figures 4, 5 and the special snubbing bar of Figures 6, 7, and conversely, the drive bushing and snubbing bar are designed for handling such flush joint round grief stem.

What is claimed is:

1. In combination with round flush joint grief stem, a snubbing bar therefor including a spider, upwardly closing slips mounted in said spider, means for forcing said snubbing bar downwardly, means for lifting said snubbing bar and slip releasing means operated by said lifting means.

2. In combination with round flush joint grief stem, a snubbing bar therefor including a spider, upwardly closing slips mounted in said spider, means for forcing said snubbing bar downwardly, means for lifting said snubbing bar and slip releasing means operated by said lifting means, including a plate for holding the upper ends of the slips downwardly so that they may be released by the spider lifting upwardly and away from them by the operation of said lifting means.

3. In combination with round flush joint grief stem, a snubbing bar therefor including a spider, upwardly closing slips mounted in said spider, means for forcing said snubbing bar downwardly, means for lifting said snubbing bar, slip releasing means operated by said lifting means, including a plate for forcing the upper ends of the slips downwardly in an opening direction upon operation of said lifting means and said lifting means including sheaves on the snubbing bar and lines extending from said plate and under said sheaves

for forcing said plate downwardly toward the slips.

4. In combination with round flush joint grief stem, a snubbing bar therefor including a spider, upwardly closing slips mounted in said spider, means for forcing said snubbing bar downwardly, means for lifting said snubbing bar, slip releasing means operated by said lifting means, including a plate for forcing the upper ends of the slips downwardly in an opening direction upon operation of said lifting means and said lifting means including sheaves on the snubbing bar, lines extending from said plate and under said sheaves for forcing said plate downwardly toward the slips and means for effecting support of said plate independently of the snubbing bar.

5. In combination with round flush joint grief stem, a snubbing bar therefor including a spider, upwardly closing slips mounted in said spider, means for forcing said snubbing bar downwardly, means for lifting said snubbing bar, slip releasing means operated by said lifting means, including a plate for forcing the upper ends of the slips downwardly in an opening direction upon operation of said lifting means and said lifting means including sheaves on the snubbing bar, lines extending from said plate and under said sheaves for forcing said plate downwardly toward the slips, means for effecting support of said plate independently of the snubbing bar and including cams mounted on said plate and means for forcing said cams into engagement with the grief stem.

6. Snubbing mechanism for round flush joint grief stem comprising a spider, upwardly closing slips operating in said spider, means for forcing said snubbing mechanism downwardly, means for forcing said slips downwardly in said spider to release same from the grief stem and means for temporarily supporting said last-mentioned slip releasing means on the grief stem independently of the spider to permit the latter to ride down over the slips and close them on the grief stem.

7. Snubbing mechanism, comprising a spider, upwardly closing slips operating in said spider, means for raising and lowering said spider, means for forcing said slips downwardly in said spider and means for supporting said last mentioned slip releasing means independently of the spider to permit closing movement of the spider down over said slips.

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