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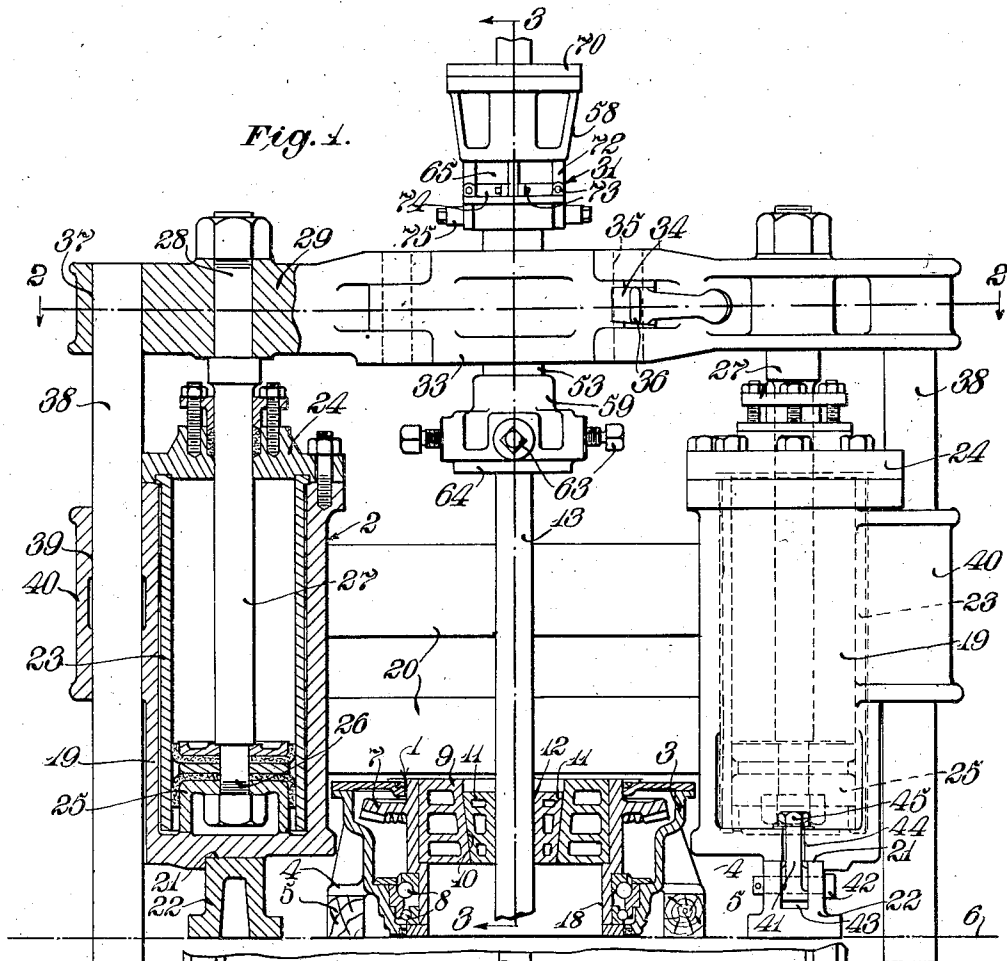
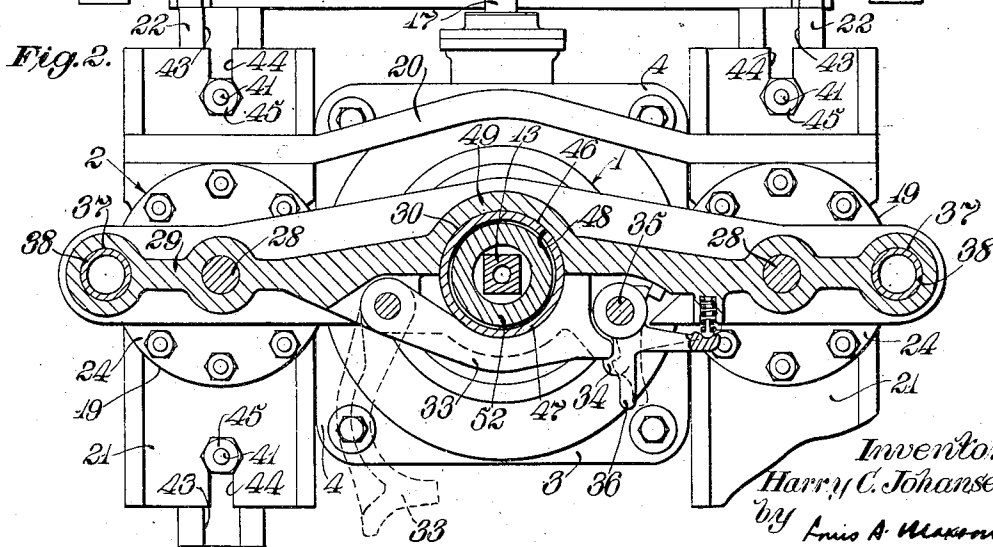
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1,834,597

DRILLING APPARATUS

Filed March 5, 1929

2 Sheets-Sheet 1



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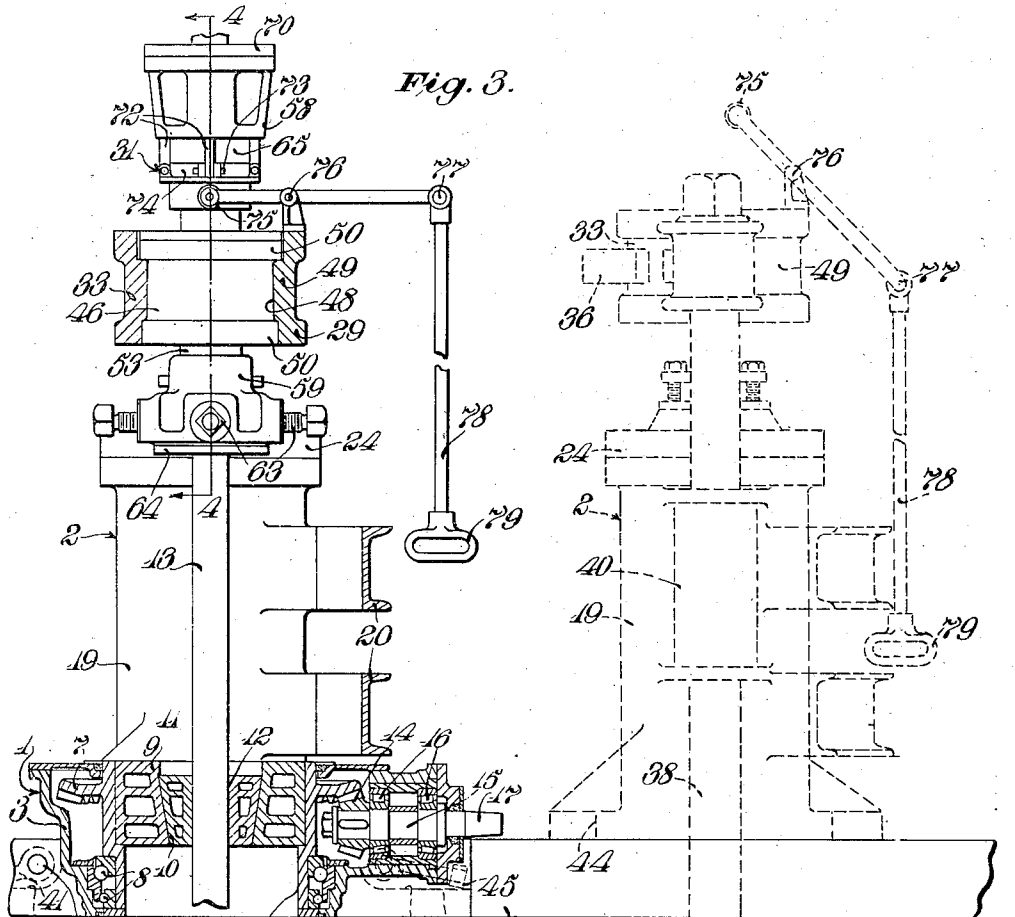
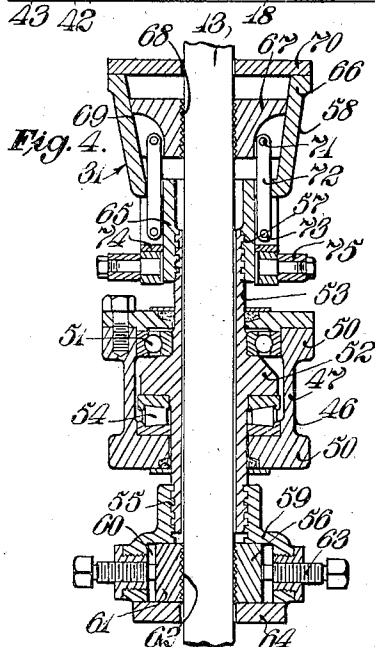
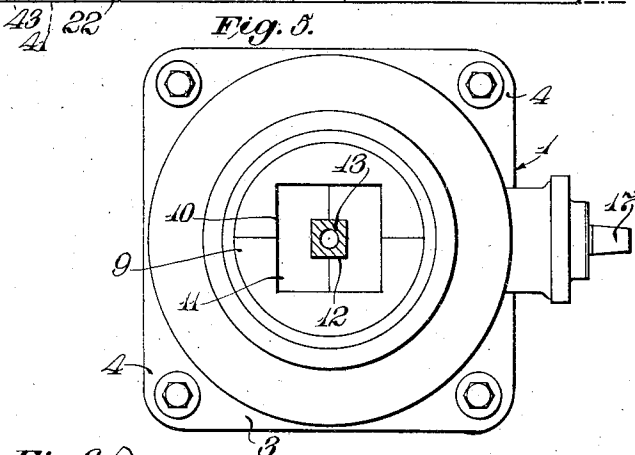
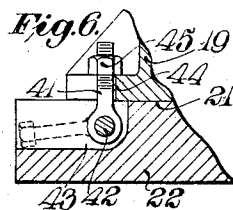
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DRILLING APPARATUS

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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DRILLING APPARATUS

Application filed March 5, 1929. Serial No. 344,487.

This invention relates to drilling apparatus and more particularly, but not exclusively, pertains to improved feeding mechanism for an oil and gas well drilling apparatus of the rotary type.

In oil and gas well drilling it has been found that the standard rotary drill while satisfactory for drilling through relatively soft formations was not practical for use with a diamond core bit in drilling for cores through relatively hard formations, the rotary being unsteady in operation, and due to its relatively slow rotation and unsteadiness and the lack of a sensitive feeding device the diamonds of the bit were frequently damaged, demanding costly replacements. However, in drilling with a standard rotary or fishtail bit in relatively soft formations it has been found that the standard rotary drill has many advantages over drills of other designs. The primary object of this invention is to provide an improved drilling apparatus having combined therein all the advantageous features of a standard rotary drill and of drills of other designs wherein either a diamond core bit or a standard rotary bit may be selectively used when drilling through formations of different character. It is the purpose of this invention to provide a rotary drill, such as that used in drilling oil and gas wells, with feeding mechanism of a character wherein the drill may be fed under sensitive control, and of sufficient flexibility to permit considerable variation in the rate of feed in accordance with the requirements of the drilling encountered. It is a further object of this invention to provide improved means for feeding the grief stem of a rotary drill and which comprises a hydraulically operated device having improved means for engaging the grief stem whereby the latter may be fed positively upwardly and downwardly through the rotary table. A still further object is to provide an improved feeding mechanism for a rotary drill whereby the grief stem may be fed positively, or fed independently of said positive feeding means, thereby permitting selective use of a diamond core bit or a standard rotary bit as different drill-

ing conditions are encountered. Still another purpose of this invention is to provide an improved hydraulic feeding mechanism for a rotary drill having means whereby the feeding mechanism may be shifted bodily laterally to one side of the rotary table during the hoisting of the rod line. Still another object is to provide an improved hydraulic feeding mechanism for a rotary drill so arranged that the rotary table is unobstructed, thereby enabling the drill to operate as a standard rotary and without the necessity of special devices and costly auxiliary equipment, the improved hydraulic feeding mechanism being used with a standard rotary drill without change. These and other objects and advantages of this invention will, however, hereinafter more fully appear.

In the accompanying drawings there is shown for purposes of illustration one embodiment which the invention may assume in practice.

In these drawings,—

Fig. 1 is a front elevational view of the improved drilling apparatus, parts being shown in section to illustrate details of construction.

Fig. 2 is a transverse sectional view, partially shown in plan, taken substantially on line 2—2 of Fig. 1.

Fig. 3 is a vertical sectional view taken substantially on line 3—3 of Fig. 1, the feeding mechanism being shown in a plurality of positions.

Fig. 4 is an enlarged sectional view taken on line 4—4 of Fig. 3.

Fig. 5 is a top plan view of the rotary table.

Fig. 6 is a detail sectional view illustrating one of the locking bolts for the feeding mechanism.

In this illustrative embodiment of the invention there is shown a drilling apparatus generally comprising a rotary 1 of standard construction, and improved hydraulic feeding mechanism generally designated 2. The rotary 1 comprises a base frame 3 having laterally projecting lugs 4 engaging and supported by parallel beams 5 supported on the derrick floor, the floor line being indicated

at 6. Rotatably mounted within the base frame 3 of the rotary 1 is a large bevel gear or rotary table 7 horizontally disposed and journaled on ball thrust bearings 8 suitably supported within the base frame. Suitably supported within and secured to the rotary table 7 is a member 9 herein in the form of a two-part or split bushing having a central square tapered opening 10 which receives wedge-shaped drive members or slips 11. As clearly shown in Fig. 5 the slips 11 cooperate to form a central square opening 12 through which the usual square grief or drill stem 13 extends, the slips 11 engaging and upon rotation of the table driving the grief stem 13 as will later be described. Meshing with the large bevel gear 7 is a bevel pinion 14 fixed to a horizontal shaft 15 suitably journaled within bearings 16 supported by the base frame 3. The shaft 15 has a projecting end 17 and is adapted to be driven in any suitable manner in accordance with the standard rotary practice from any suitable source of power such as a gas, electric, or steam engine or a sprocket and chain connection. The base frame 3 of the rotary table has a central vertical opening 18 through which the grief stem 13 extends as shown in Fig. 1. It is obvious that the wedge-shaped slips 11 carried within the rotary table may be of any desired form and that wedge-shaped jaws with teeth or any other suitable devices may be substituted for those disclosed, for instance, jaws of the type adapted to grip the stem to prevent sliding movement thereof through the table. It is also evident that grief stems of differently shaped cross section and slips cooperating to form differently shaped openings may be readily substituted for those disclosed.

The improved feeding mechanism 2 as shown in the drawings comprises parallel vertically disposed cylinders 19 disposed at opposite sides of the rotary table 2 and connected rigidly together by transverse rearwardly bent channel irons 20, disposed above and extending across the table. The feed cylinders 19 have bottom plane guiding surfaces or sliding shoes 21 slidably engaging parallel horizontal guideways or guide rails 22 disposed at opposite sides of the rotary and suitably secured to the derrick floor. Disposed within each of the cylinders 19 is a cylinder liner 23 having a radial flange at its upper end clamped between the top surface of the cylinder and the top cylinder head 24. As illustrated, reciprocally mounted within the cylinder liners 23 are pistons 25 rigidly secured at 26 to upwardly extending parallel piston rods 27. These piston rods extend upwardly through suitable stuffing boxes carried by the top cylinder heads 24 and are secured at 28 to a cross arm 29 extending transversely across the tops of the feed cylinders and rotary table and this cross arm rotatably sup-

ports at 30 a suitable chuck and thrust head mechanism generally designated 31 disposed centrally above the rotary table 1. This chuck and thrust head mechanism is releasably connected to the cross arm by means of a pivoted clamp member or gate 33 held in its closed position by means of a spring pressed latch 34 pivoted at 35 on the cross arm. This latch has a suitable handle 36 whereby the same may be readily released to permit the clamp 33 to be swung laterally away from the chuck mechanism for a purpose to be later described. Secured at 37 in any suitable manner to the ends of the cross arm 29 are vertical guide rods 38 arranged parallel with the feed cylinders 19 and guided at 39 at the outer sides of the cylinders within projecting bosses 40 formed integral with the feed cylinders. The feeding mechanism 2 may be shifted bodily laterally relative to the rotary table 1 along the guideways 22 so that the feeding mechanism may be positioned entirely clear of the rotary table thereby facilitating hoisting of the rod line and enabling the drill to operate as a standard rotary. The means employed for shifting the feeding mechanism 2 laterally to one side of the rotary table 1 may assume any suitable form. For instance, this may be accomplished by means of suitable cable and pulleys operated by the drill hoisting mechanism or by any other suitable power devices.

Improved means is employed for rigidly securing the hydraulic feeding mechanism 2 to the guideways 22 during the feeding operation and this means comprises locking or clamping bolts 41 pivotally connected at 42 to the guide members 22 and disposed in vertical slots 43 formed in these guide members. The sliding shoes 21 formed on the lower ends of the feed cylinders 19 are slotted at 44 at their ends to receive the bolts when the same are swung upwardly into their locking position as shown in full lines in Fig. 6. Threadedly connected to these bolts are nuts 45 and these nuts when tightened rigidly clamp the feed cylinders 19 to the guide members 22. When it is desired to shift the feeding mechanism laterally to one side of the rotary table these bolts 41 are released and swung downwardly within the slots 43 in the guide members 22 as shown in dotted lines in Fig. 6, thereby leaving the upper surfaces of the guide members clear. Moreover, attention is directed to the fact that pressure fluid, herein water under pressure, may be selectively supplied to the ends of the feed cylinders at opposite sides of the feed pistons through any suitable connections and under the control of suitable operator-controlled valve mechanism.

The improved chuck and thrust head mechanism 31 is utilized to connect the grief stem 13 to the hydraulic feeding mechanism and to rotatably support the grief stem, and

herein comprises a thrust head 46 having a cylindrical casing 47 rotatably mounted within a cylinder recess 48 formed within the cross arm 29. The latter has an inwardly projecting annular flange 49 which extends between external top and bottom flanges 50 formed on the thrust head casing 47. As clearly shown in Fig. 4 suitably supported within the thrust head casing 47 is a ball bearing 51 engaging the upper surface of a radial flange 52 herein formed integral with a rotatable tubular member or sleeve 53 through which the grief stem 13 passes. The bottom surface of the flange 52 engages a roller thrust bearing 54. Threadedly connected at 55 to the lower end of the tubular member 53 is a jaw clutch 56 of the sliding jaw type, while threadedly connected at 57 to the upper end of the member 53 is a wedge type chuck 58. The chuck 56 comprises a casing 59 having radially located chambers 60 in which are slidably mounted chuck jaws 61, the latter having teeth 62 on their inner surfaces, adapted to grip the flat sides of the square grief stem. Threadedly connected to the chuck casing are radially located set screws 63 engaging the jaws and adjustable to move the jaws inwardly into gripping engagement with the grief stem. A cover plate 64 having an axial opening therein for the grief stem is secured to the bottom of the chuck casing 59 for retaining the jaws within the casing. The upper chuck mechanism 58 comprises a casing member 65 having an enlarged generally cup-shaped upper casing portion 66 carrying a plurality of wedge-like stem gripping members or slips 67 adapted to grip the four surfaces of the stem and for this purpose provided with gripping surfaces 68 on their inner surfaces and opposite wedge surfaces 69 cooperating with the corresponding surfaces on the casing portion 66. Attention is also directed to the fact that a cover plate 70 having an axial opening therein for the grief stem is disposed over the member 66 in such manner as securely to retain the members 67 in operative relation. It will also be noted that each of these members 67 is pivotally connected as at 71 with a depending link 72, these links extending downwardly through suitable apertures in the bottom of the casing portion 66 and being in turn pivotally connected at 73 to a member 74 rotatable with the chuck casing 65. Engaging an annular projection on the member 74 are rollers carried by a shipper yoke 75 pivotally mounted as shown in Fig. 3 at 76 on the cross arm 29. Pivotally connected at 77 to the outer end of the shipper lever is a depending operating rod 78 having fixed thereto at its lower end an operating handle 79.

In operation the gripping members 67 operate by the wedge principle to hold the grief stem 13 and its connected rod line against

downward movement from any given position and are releasable and connectible at will in such manner as to facilitate feeding. Thus, for example, when the feeding mechanism has been operated until the feed pistons of the hydraulic feed 2 are at the bottoms of the feed cylinders, the grief stem 13 is connected to the usual hoisting mechanism or draw works of the drilling apparatus and is operated in such manner that the weight of the grief stem and rod line connected thereto is carried by the hoisting mechanism. Then the lower chuck 56 is released and the control handle is grasped by the operator and the operating rod 78 pulled down to swing up the shipper yoke 75 which in turn causes the members 67 to be raised and thereby releasing the stem 13 so that the feed pistons of the hydraulic feeding mechanism may be run up for a fresh feed. When the hydraulic has thus been run up the operating rod 78 is pushed up in such manner as to cause the jaws 67 to grip the grief stem and the lower chuck 56 is then reset, whereupon the weight of the grief stem and rod line is released from the hoisting mechanism by slackening the usual connections and the feeding apparatus is prepared to feed down a further section of rod line. Another mode of operation is to hold the rods against downward axial movement, for instance by suitable gripping devices carried by the rotary table 1, when the hydraulic pistons are an inch or two from their lowest positions and then run the pistons down to release the jaws of the top clutch, this mode of operation minimizing clutch handling and the need for operating the hoisting mechanism of the drill.

When relatively soft formation is encountered and it is desired to use the drill as a standard rotary without the hydraulic feed, the operator releases the latch 34 and swings the pivoted clamp 33 from the full line position shown in Fig. 2 to the dotted line position thereby releasing the chuck mechanism 31 and thrust head from the hydraulic. The clamping bolts 41 are then released and the feeding mechanism 2 is shifted bodily laterally along the guide members 22 from the full line position shown in Fig. 3 to the dotted line position in that figure. The rotary table is then suitably rotated, thereby rotating the grief stem 13 as it passes axially there-through, the grief stem being fed at that time solely by gravity or by the usual hoisting mechanism of the drilling apparatus. During this operation the drill operates as a standard rotary and a usual rotary or fish-tail bit is used. If it is desired to operate the drill with a diamond core bit, for instance when relatively hard formation is encountered and it is desired to obtain a core, the hydraulic feeding mechanism 2 is again shifted back along the guideways 22 to the full line position shown in Fig. 3 and rigidly

locked in position on the guides by the bolts 41. The chuck mechanism 31 and thrust head are then suitably positioned relative to the cross arm 29 and the clamp 33 swung inwardly and locked in position by the latch 34 thereby connecting the chuck mechanism 31 and thrust head to the cross arm. The operator then adjusts the set screws 41 and moves the clamping jaws 61 in position to rigidly connect the grief stem 13 to the hydraulic. At the same time the slips 67 engage and grip the grief stem 13 thereby preventing sliding movement thereof downwardly through the rotary table. Water under pressure is then admitted in any suitable manner to the feed cylinders 19 and the grief stem fed suitably downwardly through the rotary table. During this feeding operation the grief stem 13 and the rod line carried thereby are rotatably supported by the thrust head 46. After the feed pistons have reached their limit of downward feed, the hoisting tackle of the drilling apparatus is suitably connected to the upper end of the grief stem and thereby supports the latter. The chuck 56 is then released and the feed pistons are thereafter moved by water pressure upwardly relative to the feed cylinders to their initial feeding position and the grief stem is then again connected to the hydraulic. It will be evident that the chuck 58 may be operated at will to prevent the grief stem from sliding through the chuck mechanism and the rotary table and that this chuck is releasable at will during rotation of the grief stem.

As a result of this invention it will be noted that an improved rotary drilling apparatus is provided having improved positive feeding means whereby an extremely sensitive feed may be obtained thereby enabling the drill to be used with a standard diamond core bit. It will further be noted that an improved hydraulic feeding mechanism is provided especially adapted to use with a standard rotary drill and which is of extremely rugged design especially adapted to use in drilling relatively deep holes. It will further be evident that by providing a plurality of feed cylinders and by the arrangement thereof the rotary table is unobstructed, thereby permitting the drill to operate as a standard rotary without the necessity of special devices and auxiliary equipment. It will still further be evident that the feeding mechanism is of an exceedingly well-balanced and powerful design especially adapted to use in heavy duty drilling and for drilling against the relatively high oil and gas well pressures encountered. These and other uses and advantages of the improved drilling apparatus will be clearly apparent to those skilled in the art.

While I have in this application specifically described one embodiment which the invention may assume in practice, it will be understood that this embodiment of the same

is shown for purposes of illustration and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. In a drilling apparatus, the combination with a rotary table and a grief stem rotated thereby, of positive feeding mechanism for the grief stem including power feeding devices disposed above the derrick floor at opposite sides of the rotary table and between which the grief stem extends, said feeding devices extending downwardly along the sides of the table and closely adjacent thereto, and horizontal guideways at the sides of the rotary table on which said power feeding devices are slidably mounted for movement bodily laterally relative to the rotary table to clear the latter for the usual rotary drilling operations.

2. In a drilling apparatus, the combination with a rotary table and a grief stem rotated thereby, of hydraulic feeding mechanism for the grief stem including hydraulic feeding devices disposed above the derrick floor at opposite sides of the rotary table and between which the grief stem extends, said hydraulic feeding devices extending downwardly along the sides of the table and closely adjacent thereto, and horizontal guideways at the sides of the rotary table on which said hydraulic feeding devices are slidably mounted for movement bodily laterally relative to the rotary table to clear the latter for the usual rotary drilling operations.

3. In a drilling apparatus, the combination with a rotary table and a grief stem rotated thereby, of hydraulic feeding mechanism for the grief stem comprising parallel feed cylinders and piston reciprocable therein, said cylinders being arranged above the derrick floor at the opposite sides of the table, a thrust head movable with said pistons, said stem extending between said cylinders and through said thrust head, and a plurality of independently operable grief stem gripping chuck mechanisms carried by said thrust head for positively connecting the grief stem to the hydraulic, one of said chuck mechanisms being operative to grip automatically said grief stem upon movement of said stem through the rotary table in one direction.

4. In a drilling apparatus, the combination with a rotary table and a grief stem rotated thereby, of hydraulic feeding mechanism for the grief stem comprising parallel feed cylinders and pistons reciprocable therein, said cylinders being arranged above the derrick floor at the opposite sides of the table, a thrust head movable with said pistons, said stem extending between said cylinders and through said thrust head, and an automatic top grief stem gripping chuck and

a bottom grief stem gripping chuck carried by said thrust head for positively connecting the grief stem to the hydraulic, said top chuck being operative to grip automatically the grief stem upon movement of the grief stem through the rotary table in one direction.

5. In a drilling apparatus, the combination with a rotary table and a grief stem rotated thereby, of a hydraulic feeding mechanism for said stem including parallel feed cylinders arranged above the derrick floor at opposite sides of the rotary table and immediately adjacent the latter, pistons reciprocable in said cylinders, a cross arm carried by said pistons and disposed above the rotary table and extending diametrically across the latter, a grief stem gripping chuck device carried by said cross arm for positively connecting the grief stem to the hydraulic, and means on said arm for quickly releasing said arm from said chuck device while the latter remains connected to the grief stem.

6. In a drilling apparatus, the combination with a rotary table and a grief stem rotated thereby, of a hydraulic feeding mechanism for the grief stem comprising parallel power feeding devices arranged above the derrick floor at opposite sides of the rotary table immediately adjacent the latter and connectible to the grief stem, and horizontal guideways arranged at the sides of the rotary table on which said power feeding devices of the feeding mechanism are slidably mounted, said power feeding devices being shiftable bodily laterally along said guideways to one side of the rotary table to clear the latter for the usual rotary drilling operations.

7. In a drilling apparatus, the combination with a rotary table and a grief stem rotated thereby, of a hydraulic feeding mechanism comprising a feed cylinder disposed above the derrick floor at one side of the rotary table immediately adjacent the latter and a piston reciprocable in said cylinder, an arm supported by said piston and extending over the rotary table, a thrust head carried by said arm, a quickly releasable connection carried by said arm for disconnecting said arm from said thrust head, a grief stem gripping chuck carried by said thrust head for positively connecting the grief stem to the hydraulic, and means permitting bodily movement of said hydraulic laterally relative to said rotary table upon release of said arm from said thrust head.

8. In a drilling apparatus, the combination with a rotary table and a grief stem rotated thereby, of a hydraulic feeding mechanism comprising a feed cylinder disposed above the derrick floor at one side of the rotary table immediately adjacent the latter and a piston reciprocable in said cylinder, an arm

supported by said piston and extending over the rotary table, a thrust head carried by said arm, a quickly releasable device for disconnecting said arm from said thrust head, a plurality of grief stem gripping chucks carried by said thrust head for positively connecting the grief stem to the hydraulic, and means permitting bodily movement of said hydraulic laterally relative to the rotary table upon release of said arm from said thrust head.

9. In a drilling apparatus, the combination with a rotary table and a grief stem rotated thereby, of a hydraulic feeding mechanism comprising a feed cylinder disposed above the derrick floor at one side of the rotary table and a piston reciprocable in said cylinder, an arm supported by said piston and extending over the rotary table, a thrust head carried by said arm, a quickly releasable device for disconnecting said arm from said thrust head, and a plurality of grief stem gripping chucks carried by said thrust head for positively connecting the grief stem to the hydraulic, one of said chucks being releasable at will during rotation of the grief stem.

10. In a drilling apparatus, the combination with a rotary table and a grief stem rotated thereby, of a hydraulic feeding mechanism for the stem comprising hydraulic feeding devices arranged above the derrick floor at the opposite sides of the rotary table and connectible to the grief stem, the lower ends of said hydraulic devices extending below the top surface of the table and immediately adjacent the latter, and horizontal guideways on which said hydraulic feeding devices are slidably mounted.

11. In a drilling apparatus, the combination with a rotary table and a grief stem rotated thereby, of a hydraulic feeding mechanism for the stem comprising a hydraulic feeding device arranged above the derrick floor at one side of the rotary table and connectible to the grief stem, the lower end of said hydraulic device extending below the top surface of the table and immediately adjacent the latter, and a horizontal guideway arranged at the side of the rotary table and on which said hydraulic feeding device is slidably mounted.

12. In a drilling apparatus, the combination with a rotary table and a grief stem rotated thereby, of a hydraulic feeding mechanism for said stem comprising a hydraulic feeding device arranged above the derrick floor at one side of the rotary table immediately adjacent the latter and connectible to the grief stem, and a horizontal guideway at the side of the rotary table along which the hydraulic feeding device is slidable, said feeding device being readily releasable from the grief stem by lateral movement relative thereto.

13. In a drilling apparatus, the combination with a rotary table and a grief stem rotated thereby, of a hydraulic feeding mechanism for said stem comprising a hydraulic feeding device arranged above the derrick floor at one side of the rotary table immediately adjacent the latter, and a chuck mechanism supported by said device for connecting the grief stem thereto, and a horizontal guideway at the side of the rotary table along which the hydraulic feeding device is slidable, said feeding device being readily releasable from the chuck mechanism by lateral movement of said device relative to the stem.

14. In a drilling apparatus, the combination with a rotary table and a grief stem rotated thereby, of a hydraulic feeding mechanism including parallel feed cylinders arranged above the derrick floor at opposite sides of the rotary table, pistons reciprocable in said cylinders and having upwardly extending piston rods projecting through the top heads of the cylinders, a cross arm supported by said piston rods and extending across the rotary table above the latter, a thrust head carried by said cross arm and including a rotatable tubular member through which the grief stem extends, a grief stem gripping chuck carried by said tubular member for positively connecting the grief stem to the hydraulic, and a supplemental automatic grief stem gripping chuck carried by said tubular member and automatically engageable with the grief stem upon movement of the latter through the table in one direction.

15. In a drilling apparatus, the combination with a rotary table and a grief stem rotated thereby, of a hydraulic feeding mechanism including parallel feed cylinders arranged above the derrick floor at opposite sides of the rotary table, pistons reciprocable in said cylinders and having upwardly extending piston rods projecting through the top heads of the cylinders, a cross arm supported by said piston rods and extending across the rotary table above the latter, a thrust head carried by said cross arm and including a rotatable tubular member through which the grief stem extends, and chuck devices carried by the opposite ends of said tubular member for gripping the grief stem and engageable with the grief stem for positively connecting the latter to the hydraulic, one of said chuck devices being operable at will during rotation of the stem.

16. In a drilling apparatus, the combination with a rotary table and a grief stem rotated thereby, of a hydraulic feeding mechanism including parallel feed cylinders arranged above the derrick floor at opposite sides of the rotary table and immediately adjacent the latter, pistons reciprocable in said cylinders and having upwardly projecting piston rods, a cross arm supported by said

piston rods, a thrust head rotatably mounted on said cross arm, said cross arm having releasable means permitting lateral release of said cross arm from said thrust head, a chuck carried by said thrust head for connecting the grief stem to the hydraulic, and parallel horizontal guideways arranged adjacent the sides of the table and along which the feed cylinders of said feeding mechanism are slidable, said feeding mechanism being slidable to one side of the rotary table upon release of said thrust head from said cross arm.

17. In a drilling apparatus, the combination with a rotary table and a grief stem rotated thereby, of hydraulic feeding mechanism for the grief stem comprising feed cylinders arranged at opposite sides of the rotary table, pistons reciprocable in said cylinders and having upwardly extending piston rods, a cross arm secured to said piston rods above the rotary table and extending over the latter from one side thereof to the other, a rotatable thrust head carried by said cross arm, and quickly releasable means including a pivoted gate on said arm for permitting lateral release of said thrust head from said arm.

18. In a drilling apparatus, the combination with a rotary table and a grief stem rotated thereby, of hydraulic feeding mechanism for the grief stem comprising feed cylinders arranged at opposite sides of the rotary table, pistons reciprocable in said cylinders and having upwardly extending piston rods, a cross arm secured to said piston rods above the rotary table and extending over the latter from one side thereof to the other, a rotatable thrust head carried by said cross arm, a chuck mechanism carried by said thrust head for connecting the grief stem to the hydraulic, and readily releasable means for disconnecting said thrust head and chuck mechanism from said arm including a pivoted gate on said arm permitting lateral release of the said elements from said arm.

19. In a drilling apparatus, the combination with a rotary table and a grief stem rotated thereby, of a hydraulic feeding mechanism arranged above the derrick floor adjacent the rotary table and including a feed cylinder, a piston reciprocable in said cylinder and having a piston rod, a thrust head supported by said piston rod, readily releasable means between said piston rod and said thrust head permitting lateral release of said thrust head therefrom, a chuck carried by said thrust head for connecting the grief stem to the hydraulic, and a horizontal guide along which the hydraulic feeding mechanism is slidable, said feeding mechanism being slidable to one side of the rotary table upon release of said thrust head from said feeding mechanism.

20. In a drilling apparatus, the combination with a rotary table and a grief stem

rotated thereby, of a hydraulic feeding mechanism including parallel feed cylinders arranged at opposite sides of the rotary table, pistons reciprocable in said cylinders and having upwardly projecting piston rods, a cross arm supported by said piston rods, a thrust head rotatably mounted on said cross arm, readily releasable means including a pivoted gate on said cross arm permitting lateral release of said cross arm from said thrust head, a chuck carried by said thrust head for connecting the grief stem to the hydraulic, and parallel horizontal guideways along which the hydraulic feeding mechanism is slidable, said feeding mechanism being slidable to one side of the rotary table upon release of said thrust head from said cross arm.

21. In a drilling apparatus, the combination with a rotary table and a grief stem rotated thereby, of a hydraulic feeding mechanism including a feed cylinder arranged above the derrick floor at one side of the rotary table adjacent the table, a piston reciprocable in said cylinder, devices for connecting said piston to the grief stem, and a guideway adjacent said table for sliding said hydraulic feeding mechanism bodily laterally to one side of the table to clear the latter for the usual rotary drilling operations.

22. In a drilling apparatus, the combination with a rotary table and a grief stem rotated thereby, of hydraulic feeding mechanism for said stem including a hydraulic feeding device arranged adjacent one side of said rotary table and connections extending from said feeding device over the table for connecting the grief stem to the hydraulic, and means whereby said hydraulic feeding device may be shifted bodily laterally relative to the rotary table to clear the latter for the usual rotary drilling operations.

In testimony whereof I affix my signature.

HARRY C. JOHANSEN.