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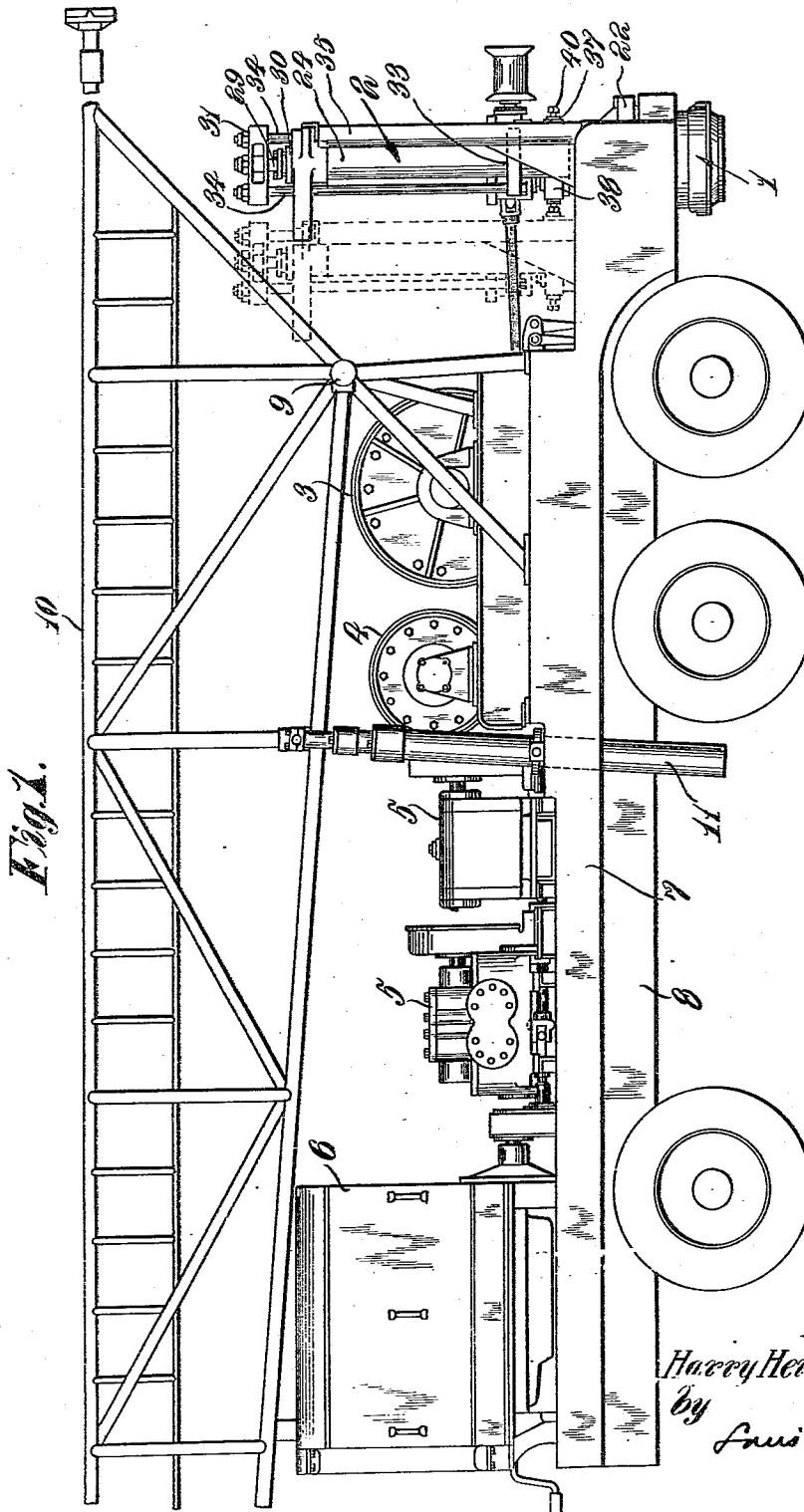
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ROTARY DRILLING APPARATUS

Filed May 23, 1939

5 Sheets-Sheet 1



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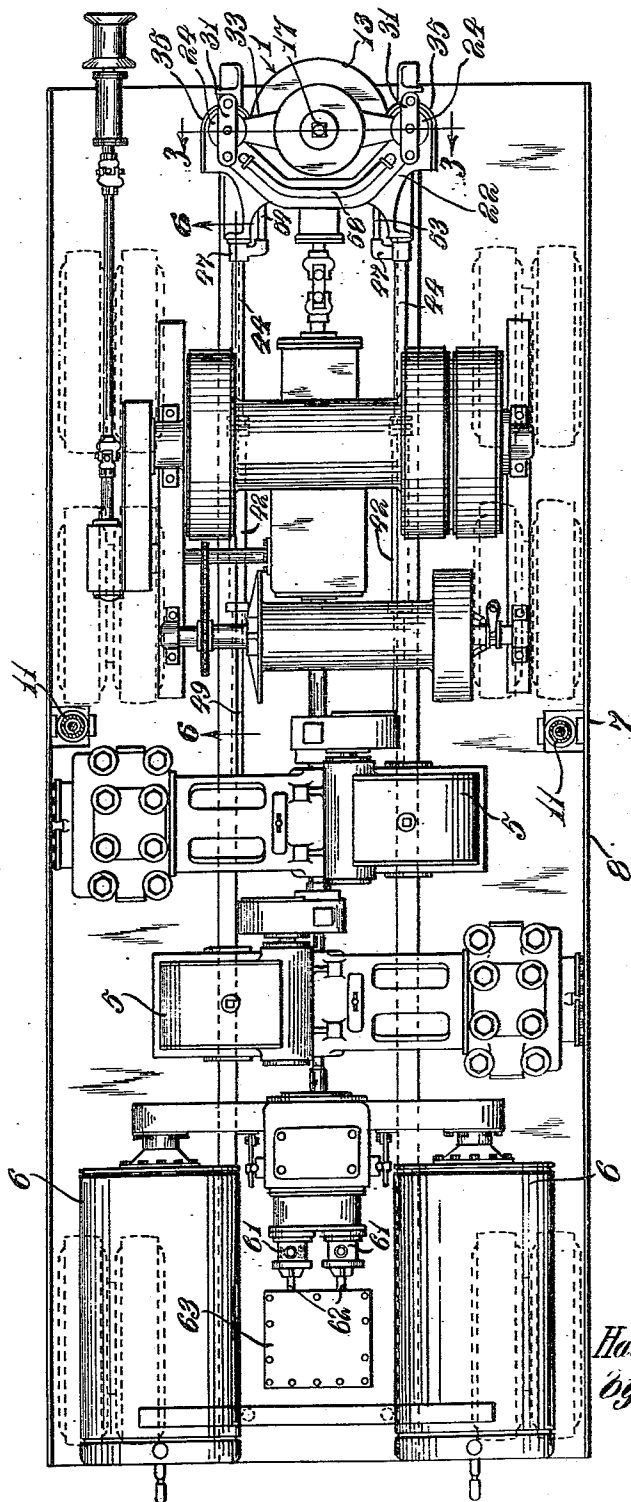
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ROTARY DRILLING APPARATUS

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Fig. 2.



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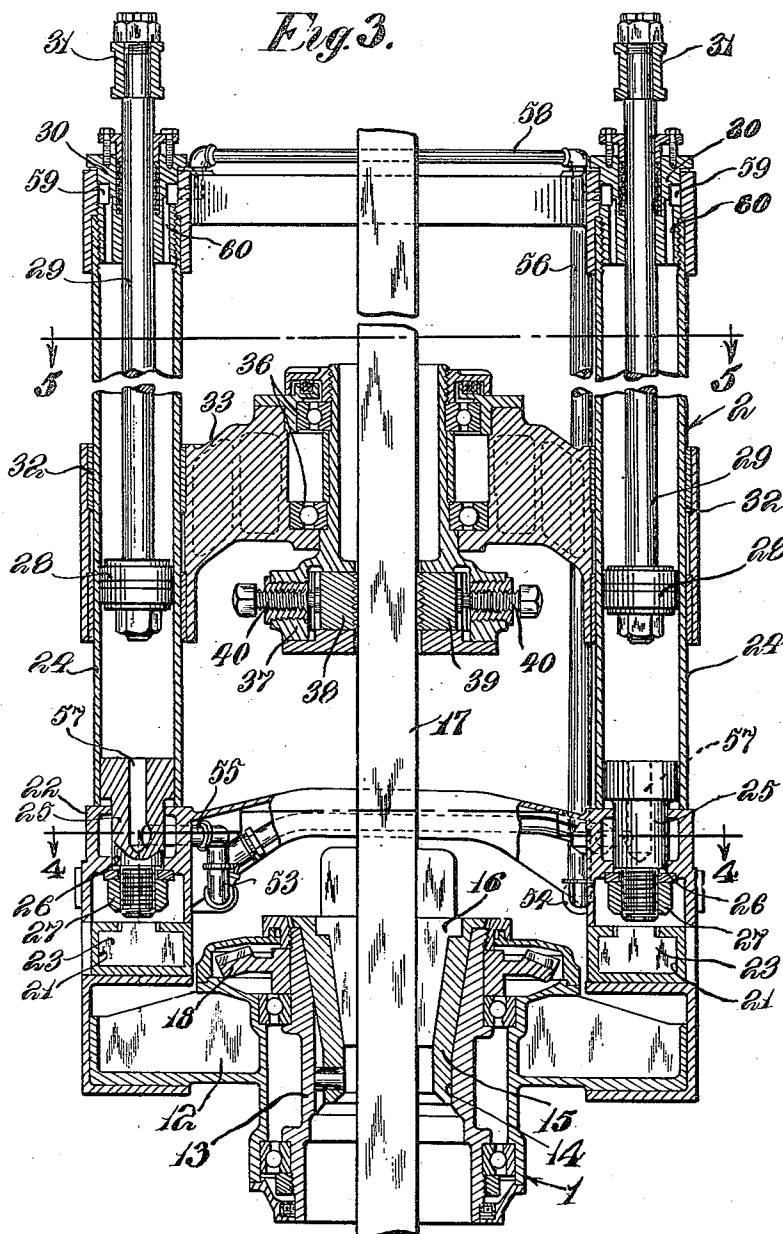
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ROTARY DRILLING APPARATUS

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Fig. 4.

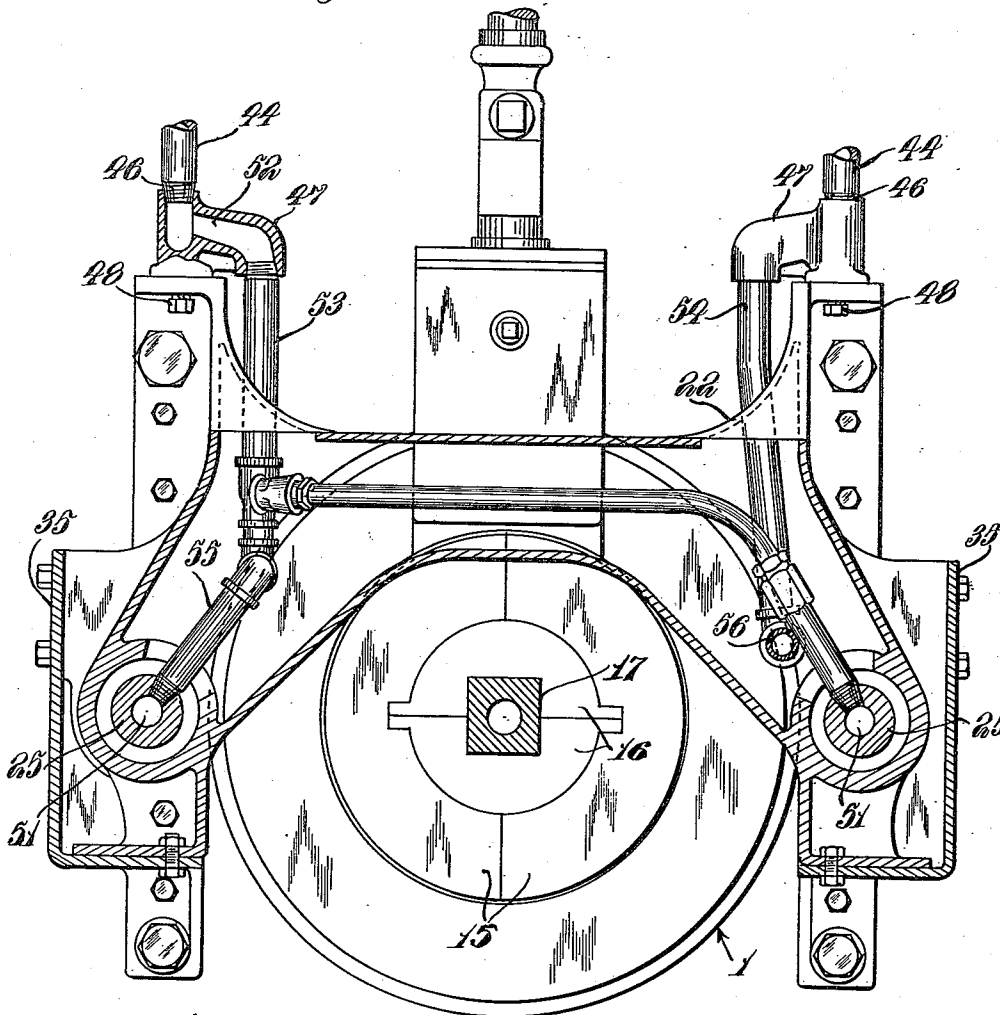
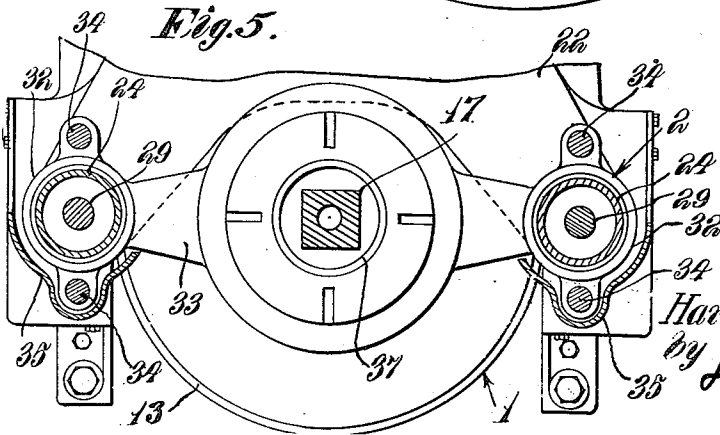


Fig.5.



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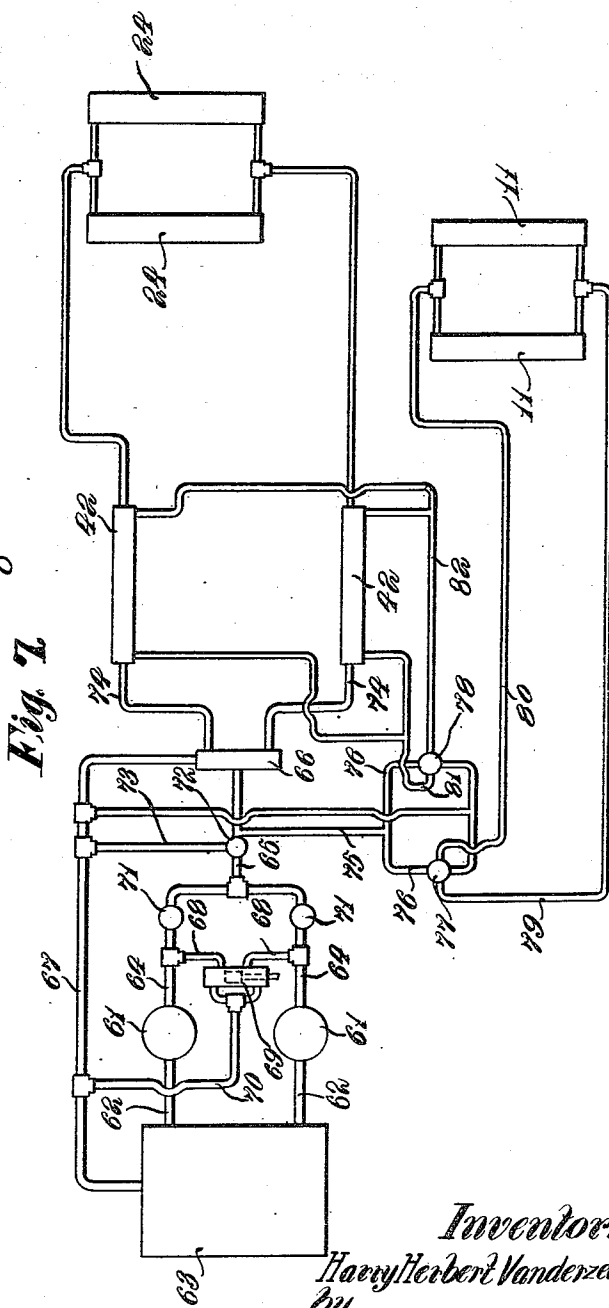
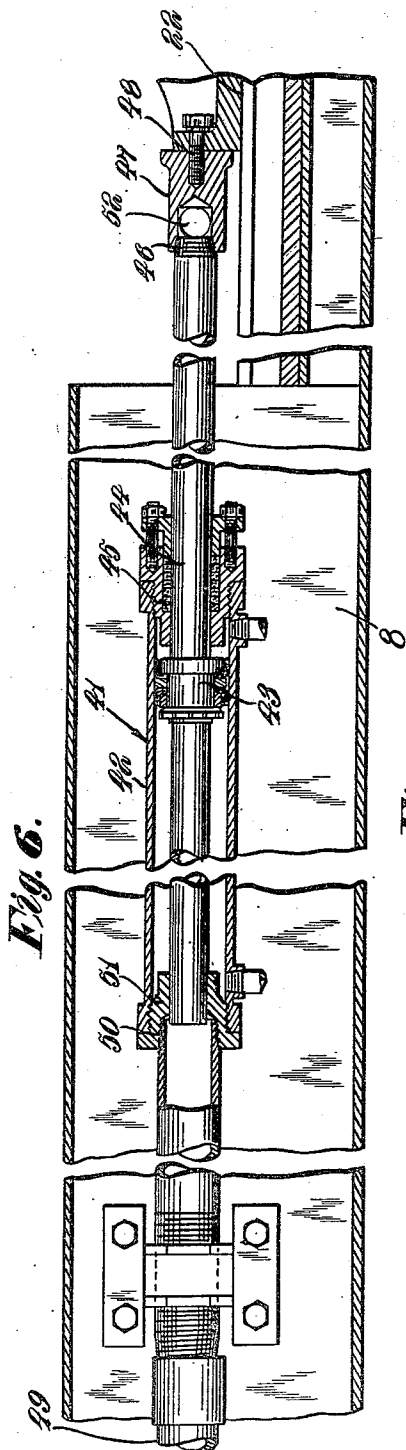
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ROTARY DRILLING APPARATUS

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5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

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ROTARY DRILLING APPARATUS

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Application May 23, 1939, Serial No. 275,235

7 Claims. (Cl. 255—22)

This invention relates to drilling apparatus, and more particularly, but not exclusively, to improvements in a well drilling rig of the portable rotary type especially designed for use in oil field work.

An object of this invention is to provide an improved rotary drilling apparatus. The invention has for another object the provision of a portable well drilling rig which is comparatively light in weight and powerful and rugged in design, while at the same time embodying features whereby economy and ease in operation and control are obtained, and for otherwise surmounting the obstacles incident to oil well drilling in isolated territories. Still another object is to provide an improved hydraulically operated rod line feeding mechanism and improved transfer means for the feeding mechanism. Another object is to provide an improved hydraulic transfer means for the feeding means and having associated therewith improved fluid conducting means for the feeding means. A still further object is to provide an improved well drilling rig having novel arrangements and combinations of parts. Other objects and advantages of the invention will, however, hereinafter more fully appear in the course of the following description.

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

In these drawings—

Fig. 1 is a side elevational view of the improved well drilling rig, showing the parts in transport position.

Fig. 2 is a plan view of the well drilling rig shown in Fig. 1, with the derrick mast and certain other parts omitted.

Fig. 3 is an enlarged vertical sectional view taken substantially on line 3—3 of Fig. 2, illustrating the improved hydraulic feeding means.

Fig. 4 is a horizontal sectional view taken substantially on line 4—4 of Fig. 3.

Fig. 5 is a horizontal sectional view taken substantially on line 5—5 of Fig. 3.

Fig. 6 is a detail view in longitudinal vertical section taken substantially on line 6—6 of Fig. 2, showing a portion of the hydraulic transfer means.

Fig. 7 is a diagrammatic view illustrating the improved hydraulic fluid system.

In this illustrative embodiment of the invention there is shown a rotary drilling apparatus of the portable oil well type especially designed for use in deep structure core testing or shallow or so-called "slim-hole" production drilling, and

preferably mounted on an automotive base. The improved drill, in this instance, is mounted on an automotive trailer, although it will be evident that the same may be mounted on various forms of transport means such as an automotive truck, a tractor tread wagon, or skids, without departing from the spirit of the invention.

The improved well drilling rig as shown in the drawings generally comprises a drill rod rotation mechanism 1, hydraulic drill rod feeding mechanism 2, a draw works 3, a sand reel 4, mud pumps 5 and a pair of power units 6, 6, the various elements aforesaid being mounted on a platform 7 of an automotive trailer 8. Pivotally mounted at 9 at the sides of the trailer platform on suitable uprights, and overlying the various elements of the drilling apparatus in the manner shown in Fig. 1, is a derrick mast 10 of a conventional design. This derrick mast may be swung from its lowered transport position shown, into its upright operative position by means of hydraulic cylinder and piston devices 11 arranged at the opposite sides of the trailer platform and pivotally connected to the sides of the derrick mast. As this derrick mast structure is of a well known design and does not per se enter into this invention, further detailed description thereof is herein unnecessary.

The drill rod rotating means as shown in Fig. 3 comprises a frame or rotary base 12 mounted on the truck platform at the end of the drilling rig remote from the power units 6, 6. Journaled in bearings supported within the frame 12 is a rotary table 13 having a central recess 14 for receiving a usual adaptor or bowl 15, the latter in turn having recesses for receiving the "Kelly" drive bushing 16. The "Kelly" drive bushing is of the two-piece type having recesses cooperating to form a rectangular socket for receiving a drill stem or so-called "kelly" 17 herein of rectangular cross section. The drill stem drive bushing is self-locking in the table adaptor and may be readily lifted out of the way so that standard drill pipe slips may be inserted in its place, in a well known manner. As is usual in rotary drills, the adaptor or bowl 15 is interlocked with the table, and the drive bushings or slips are interlocked with the adaptor, so that the parts all rotate together. Secured to the rotary table is a bevel gear 18 driven in a suitable manner by the power units 6, 6.

Associated with the rod line rotating means and mounted on parallel longitudinally extending guideways 21, 21 at the opposite sides of the rotary table 13 is the hydraulic feeding means 2. This hydraulic feeding means comprises a base

frame 22 having secured thereto, as by bolts, shoes 23 slidably mounted in the guideways 21. The frame 22 is generally U-shaped in plan so that free access to the rotary table from its outer side may be obtained. This hydraulic feeding means is preferably of the twin cylinder type and comprises a pair of parallel vertical cylinders 24, 24 mounted at their lower ends on the frame 22 at the opposite sides of the rotary table. The lower cylinder heads have bolt-like portions 25 received in vertical openings 26 in the frame 22 and held in position by nuts 27 threaded on the lower ends of the bolt-like portions. Contained within the cylinders are reciprocable pistons 28 having their piston rods 29 extending upwardly through the packed top heads 30 of the cylinders. The piston rods are connected at their upper ends to cross yokes 31. Slidably guided at 32 on and extending between the cylinders is a sliding crosshead 33 which is connected to the yokes 31 by parallel connecting rods 34. Coextensive with the feed cylinders between and suitably secured to the top heads and the bottom frame, are vertical guards 35, and these guards afford protection for the cylinders and connecting rods at the outer side of the rotary table. Journaled within spaced bearings 36 supported within the crosshead 33 is a chuck sleeve 37 carrying at its lower end a usual chuck 38. The chuck 38 includes chuck jaws 39 adapted to grip the flats of the square drill stem 17 and provided with adjusting screws 40. When the chuck jaws are adjusted into gripping relation with the drill stem and hydraulic pressure is supplied to one end or the other of the feed cylinders, the crosshead may be fed upwardly or downwardly along the feed cylinders, and as a result the drill stem may be fed either upwardly or downwardly, as desired, through the drive bushing of the rotary table.

A hydraulic transfer device generally designated 41 (see Fig. 6) is provided for shifting the hydraulic feeding means along its guideways 21, 21 relative to the rotary table 13 to clear the latter for the usual rotary drilling operations, i. e. when the drill stem is controlled by the cable of the draw works. This transfer device is mounted beneath the top of the trailer platform and comprises parallel hydraulic servo-motor cylinders 42 secured to the trailer platform and containing reciprocable pistons 43, the latter having their piston rods 44 extending forwardly through the packed front heads 45 of the cylinders. The forward ends of the piston rods 44 are threadedly secured at 46 to members 47, the latter in turn being secured by screws 48 to the sliding frame 22 of the hydraulic feeding means 2. Associated with the transfer device is means for supplying liquid under pressure to the hydraulic feeding means, comprising supply conduits 49 threadedly secured at 50 within the rear heads 51 of the cylinders 42. It will be noted that fluid to raise the feed pistons 28 is supplied through one of the transfer piston rods and fluid to effect hydraulic downward feed is supplied through the other transfer piston rod. The transfer piston rods 44 are made hollow so that liquid may be conducted from the conduits 49 therethrough to passages 52 formed in the members 47. Conduits 53 and 54 respectively connect the passages 52 to pipe connections 55 and 56. The pipe connections 55 lead to passages 57 formed in the lower heads of the cylinders and communicating with the lower ends of the feed cylinder bores at the lower sides of the feed pistons. The pipe con-

nection 56 is connected through branched pipe connections 58 to chambers 59 formed in the upper cylinder heads, these chambers connected by passages 60 to the upper ends of the feed cylinder bores at the upper sides of the feed pistons. When fluid under pressure is supplied to one end or the other of the transfer cylinders 42 the hydraulic feeding means may be shifted either forwardly or rearwardly along its guideways relative to the rotary table in an obvious manner, as indicated in full and dotted lines in Fig. 1.

Now referring to the hydraulic fluid system shown in Fig. 7, it will be noted that driven by the power units 6 are pumps 61, 61 of the same capacity and characteristics, and having their intakes connected through conduits 62 to a liquid supply tank 63, the latter and the pumps 61 herein being arranged on the trailer platform between the power units 6, 6, as shown in Fig. 2. The discharge sides of these pumps are connected through branched conduits 64, 64 to a conduit 65 leading to the feed valve box 66, and also connected to the feed valve box is a return conduit 67 leading back to the liquid tank 63. The branched conduits 64, 64 are connected through branched conduits 68, 68 to a by-pass valve box 69, the latter in turn connected through a conduit 70 to the return conduit 67. The by-pass valve within the valve box 69 may be operated to by-pass the pressure supplies of either one of the pumps, but not both concurrently, back to the liquid tank. Connected in the branched conduits 64, 64 are check valves 71, 71, and when the liquid flows through the conduits 64 past the check valves to the conduit 65, return flow from the conduit 65 is prevented. Connected in the conduit 65 is a relief valve 72 set at a predetermined pressure and adapted to open automatically when an excessive pressure is reached, thereby to connect the pressure conduit 65 through a conduit 73 to the return conduit 67. Conduits 74, 74 connect the valve box with the supply conduits 49 previously referred to. The conduits 74, 74 may be alternatively connected through the valve box under the control of the feed control valve to the pressure conduit 65, thereby to supply liquid under pressure to one end or the other of the feed cylinders 24 of the hydraulic feeding means 2. Connected to the pressure conduit is a conduit 75 in turn connected through branched conduits 76, 76 to four-way valves 77 and 78 respectively. The valve 77 controls the flow of liquid under pressure through conduits 79, 80 to the opposite ends of the derrick tilting cylinders 11, while the valve 78 controls the flow of liquid under pressure through conduits 81 and 82 to the opposite ends of the transfer cylinders 42. By the provision of the two oil pumps 61, 61 for supplying liquid under pressure to the hydraulic feeding means, the mast raising and lowering cylinders and the hydraulic feed retracting cylinders, it is possible, when a single pump capacity is sufficient, to by-pass the discharge side of the other pump past the by-pass valve back to the tank so that the other pump may idle without load. When a greater volume is desired, the discharge sides of both pumps may be connected to the pressure supply line. By the provision of the feed control valve within the valve box 66, it is possible to obtain an extremely sensitive regulation of the liquid pressure supply of the feed cylinders, thereby to give flexible control over the direction, rate and pressure of the feed.

The general mode of operation of the improved well drilling rig is as follows: When it is desired

to operate the well drilling rig in accordance with the usual rotary drilling operations, liquid under pressure may be supplied to the transfer cylinders 42 to shift the hydraulic feeding means 2 into its retracted position with respect to the rotary table 13, thereby clearing the latter for the usual rotary drilling operations. When the hydraulic feeding means is retracted, the hoisting cable of the hoisting drum of the draw works 3 may be connected in a well known manner to the upper end of the rod line so that the rod line may be raised or lowered with respect to the rotary table, and at certain times during the rotary drilling operation, the hoisting cable may be employed for relieving the drill bit of a substantial portion of the weight of the rod line. When it is desired to effect feed of the rod line by means of the hydraulic feeding means, for instance when it is desired to take cores, or during other drilling operations when it is desired to apply hydraulic control to the rod line, liquid under pressure may be supplied to the transfer cylinders 42 to shift the hydraulic feeding means 2 forwardly into its operative position with respect to the rotary table 13. The rod line may then be lowered through the chuck 38 and through the drive bushing of the rotary table 13, and the screws 40 adjusted to move the chuck jaws into gripping engagement with the drill stem 17. When hydraulic pressure is supplied to one end or the other of the hydraulic cylinders 24, the rod line may be fed upwardly or downwardly, as desired, under hydraulic control. Also when hydraulic pressure is supplied to the cylinders of the mast tilting means 11 the derrick mast 10 may be raised or lowered under hydraulic control. The mud pumps 5, 5 may be separately or simultaneously operated to supply drilling fluid through the rod line to the bottom of the drill hole.

As a result of this invention, it will be noted that an improved well drilling rig of the portable type is provided which is not only extremely rugged and compact in design, but which is also economical and easy to operate and control. It will further be evident that by the provision of the improved hydraulic feeding means, it is possible to apply hydraulic pressure to the rod line in an improved manner, and by the provision of the improved hydraulic transfer means for the feeding means, it is possible to retract the feeding means with respect to the rotary table, thereby to clear the latter for the usual rotary drilling operations, and at that time the hoisting cable of the draw works may be employed to effect raising and lowering of the rod line independently of the hydraulic feeding means. Further, by associating the fluid supply means for the hydraulic feeding means with elements of the hydraulic transfer means, the fluid supply connections are simplified. Other uses and advantages of the improved well drilling rig will be clearly apparent to those skilled in the art.

While there is in this application specifically described one form which the invention may assume in practice, it will be understood that this form 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, a base, hydraulic drill rod feeding means comprising a pair of hy-

draulic feed cylinders, means for mounting said feeding means on said base including means for guiding said feeding means for movement laterally, hydraulic transfer means on said base comprising a pair of hydraulic transfer cylinders for shifting said feeding means back and forth along said guiding means, and means for conducting liquid under pressure to said feeding means including fluid conducting elements extending through said transfer cylinders.

2. In a drilling apparatus, a base, hydraulic drill rod feeding means comprising a pair of hydraulic feed cylinders having upper and lower ends, means for mounting said feeding means on said base including means for guiding said feeding means for movement laterally, hydraulic transfer means on said base comprising a pair of hydraulic transfer cylinders for shifting said feeding means back and forth along said guiding means, and means for conducting liquid under pressure to said feeding means including fluid conducting elements extending through said transfer cylinders, the liquid pressure being conducted to the upper ends of said feed cylinders through one transfer cylinder and to the lower ends of said feed cylinders through said other transfer cylinder.

3. In a drilling apparatus, hydraulic drill rod feeding means comprising a hydraulic feed cylinder, means for mounting said feeding means for horizontal movement back and forth, hydraulic transfer means for shifting said feeding means on its mounting means, said hydraulic transfer means comprising a transfer cylinder containing a reciprocable piston, said piston having a tubular piston rod, and means for conducting liquid under pressure to said feed cylinder including fluid conducting means associated with said piston rod whereby liquid is conducted to said feed cylinder through said piston rod.

4. In an apparatus of the class described, the combination comprising fluid operated feeding means, means for mounting said feeding means for bodily movement into and out of its operative feeding position, fluid operated means for shifting said feeding means back and forth on its mounting means, and means for conducting fluid under pressure to said feeding means including a fluid conducting element extending through an element of said shifting means.

5. In an apparatus of the class described, the combination comprising fluid operated feeding means, means for mounting said feeding means for bodily movement into and out of its operative feeding position, fluid operated means for shifting said feeding means back and forth on its mounting means including relatively reciprocable cylinder and piston elements, and means for conducting fluid under pressure to said feeding means including a fluid conducting element extending axially through said cylinder and piston elements.

6. In an apparatus of the class described, the combination comprising fluid operated feeding means, means for mounting said feeding means for bodily movement into and out of its operative feeding position, fluid operated means for shifting said feeding means back and forth on its mounting means including a fluid operated servomotor, and means for conducting fluid under pressure to said feeding means including a fluid conducting element extending axially through said servo-motor.

7. In an apparatus of the class described, the combination comprising reversible fluid operated

feeding means, means for mounting said feeding means for bodily movement into and out of its operative feeding position, fluid operated means for shifting said feeding means back and forth on its mounting means comprising a pair of fluid operated servo-motors, and means for conducting fluid under pressure to said feeding means in-

cluding a fluid conducting element extending through one of said servo-motors to one end of said feeding means and a fluid conducting element extending through the other of said servo-motors to the opposite end of said feeding means.

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