March 4, 1947. I. X. CALHOUN 2,416,815

DRILL PIPE MANIPULATOR

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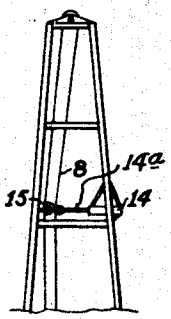


Fig. 2.

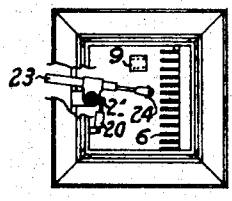


Fig. 3.

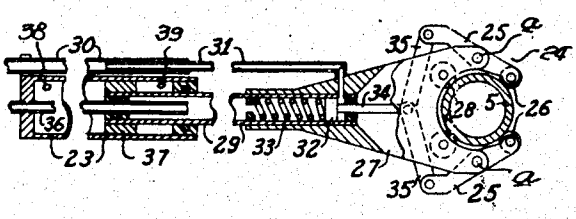


Fig. 4.

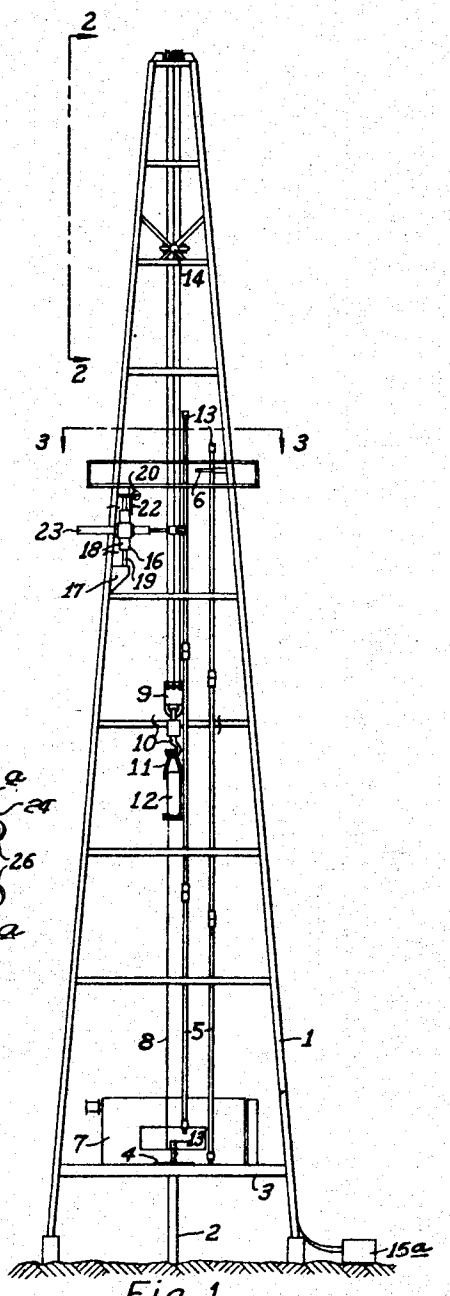


Fig. 1.

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DRILL PIPE MANIPULATOR

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9 Claims. (Cl. 214—1)

1

This invention relates to pipe handling apparatus in well derricks and more especially to hydraulically operated and controlled apparatus for handling and stacking drill stem, casing or tubing during running or pulling operations.

The principal object of the invention is to provide hydraulic means for moving and holding in off-centered position in a derrick the tool hoisting lines, combined with hydraulically operated and controlled means operable synchronously therewith for engaging and orienting pipe with respect to a rack in an elevated position in the derrick, said latter means being also effective to hold stands or sections of pipe for threading and unthreading operations, the said off-centering means, in the mean time restraining the lines against interference with the pipe orienting and holding means.

Another object of the invention is to provide hydraulically operated apparatus for handling pipe in a derrick which will reduce materially the manual effort heretofore required for this purpose as well as the hazards attending the same. Moreover, it has been found in practice that the invention conserves time in racking and manipulating pipe.

With the foregoing objects as paramount, the invention has further reference to certain features of accomplishment which will become apparent as the description proceeds, taken in connection with the accompanying drawing wherein:

Figure 1 is a side elevational view of a well derrick, more or less schematically illustrating the conventional equipment thereof and the relationship of the invention to such equipment.

Figure 2 is a fragmentary view of the derrick in elevation, taken on line 2—2 on Figure 1.

Figure 3 is a view of the derrick in transverse section, taken on line 3—3 on Figure 1, and

Figure 4 is a detail view of the hydraulically operated pipe racking tong in longitudinal section.

Continuing with a more detailed description of the drawing, reference is primarily made to Figure 1 wherein numeral 1 denotes a conventional well derrick standing over a well 2. A drilling floor 3 of the derrick supports a rotary table 4 and as the pipe 5 is hoisted from the well it is separated into stands of three sections each and stacked in a rack 6, or finger board, mounted at the proper level in the derrick.

Operated in the usual manner by a drawworks 7 is a hoisting line 8 serving to raise and lower a traveling block 9. This block has suspended therefrom by means of a hook 10 and

2

links 11 an elevator 12 which latches around the pipe 5 just below the tool joint 13 to raise and lower the same.

In order to dispose the line 8 in such a position in the derrick that it will not interfere with operations therebelow and near the center of the derrick, a hydraulic cylinder 14 is mounted near the top of the derrick in a horizontal position. This cylinder contains a piston which actuates a rod or plunger 14a towards the side of the derrick opposite the side thereof supporting the cylinder 14. The piston rod or plunger carries two or more annularly grooved rollers or sheaves 15, the number depending upon the number of lines or leads 8. When the cylinder 14 is charged with fluid under pressure, the plunger 14a will be extended, whereupon the sheaves 15 will engage and thrust the lines 8 toward the opposite side of the derrick, thereby disposing the traveling block and other elements suspended thereby to one side of the center of the derrick so that the space directly above the rotary table 4 will be unobstructed. A hydraulic generator 15a (Fig. 1) supplies fluid under pressure to the various cylinders described and to be described.

Complementary to the cylinder 14 and its associated elements is a pipe racking mechanism, broadly identified by reference numeral 16 in Figure 1 and which consists of a double acting, hydraulic elevating cylinder 18, pivoted on a piston rod 19, which latter is mounted on a support 17. The cylinder 18 is capable of rotative displacement on the piston rod 19, such displacement being effected by a second double acting cylinder 20 through a splined and slidable lever 21 and an extensible shaft 22.

A third double acting cylinder 23 is provided, which is shown in longitudinal section in Figure 4 on an enlarged scale. It will be observed in Figures 1 and 3 that cylinder 18 is disposed in a vertical plane in order to raise and lower the main cylinder 23, which latter is disposed on a horizontal plane, as is likewise the smaller cylinder 20 which is effective to rotate cylinder 23 about cylinder 18. Thus, the main cylinder 23 is capable of orientation with respect to pipe raised by elevator 12, as will become apparent presently.

The main cylinder 23 is equipped with a pipe engaging head broadly identified in Figure 3 by reference numeral 24. However, by referring to Figure 4, it will be observed that jaws 25 are disposed on each side of the head 24, carrying rollers 26 adapted to engage the pipe 5. The jaws 25 are pivoted at a to a stationary or fixed jaw

27 which latter is also equipped with pipe engaging rollers 28. The fixed jaw 27 is rigidly attached to a hollow piston rod 29.

Lying parallel with the cylinder 23 and held in fixed relation thereto is a fluid supply pipe 30, into which extends telescopically a similar tube 31 which latter communicates with the hollow piston rod 29 at its forward end. The purpose in making these tubes extensible is, of course, to allow for extension of the piston rod 29 as pressure is supplied to the cylinder 23. In this manner the head 24 may be reached across the derrick in disposing pipe in the rack 6. It is obvious that the telescoping tubes 30 and 31 may be replaced by flexible hydraulic hose, if desired.

Fluid pressure entering the hollow piston rod 29 through tubes 30 and 31 acts upon a piston 32, movement of the latter is resisted by a spring 33 within the hollow rod 29 but continued inward movement of the piston exerts a pull on the rod 34 of the piston, displacing links 35 connecting the rod and jaws 25, causing the latter to expand to release the pipe 5.

When pressure against the piston 32 is exhausted, the spring 33 acts to thrust piston 32 forwardly, collapsing the jaws 25 on the pipe 5 through pivotal action of links 35. Being thus held in a vertical position but free to rotate, the pipe may now be screwed into or unscrewed from a joint, such as the tool joint 13 in the case of drill stem.

Entering the rear end of cylinder 23 is a fluid pressure pipe on flexible hydraulic tubing 36. When pressure is introduced through this pipe or tube into the hollow piston rod 29, piston 32 will be moved forwardly to exert pressure at the pivotal junction of links 35 to collapse the jaws 25 on the pipe 5 with a force sufficient to enable an entire stand of pipe to be lifted without slippage, such slippage being prevented by rollers 26 and 28.

When the hollow piston rod 29 is to be actuated longitudinally, fluid pressure is introduced into cylinder 23 ahead of piston 37 therein through inlet 38 to extend the pipe engaging head 24 and at the same time, fluid is exhausted through port 39. To retract the head 24, pressure is applied through port 39 and exhausted through port 38.

It is apparent from the foregoing that the pipe engaging head 24 may be raised and lowered through double action cylinder 18 and at the same time rotated from side to side under power supplied by cylinder 20, all of the parts being pivotally connected for flexibility of control.

While no valves are shown for controlling pressures in the various cylinders, these may be of any conventional design and as conventionally operated.

Manifestly, the construction as shown and described is capable of some modification and such modifications as may be construed to fall within the scope and meaning of the appended claims is also considered to be within the spirit and intent of the invention.

What is claimed is:

1. Hydraulic pipe handling and racking apparatus including a vertically disposed cylinder having a stationary piston and rod on which said cylinder is disposed for rotative and longitudinal displacement, a longitudinally disposed cylinder rotatably supported by said vertically disposed cylinder, having a hollow piston rod, a head on said rod having stationary and movable work engaging jaws, spring means for holding said latter jaws in collapsed position on the work, hydraulic means for expanding said jaws, extensible means within said horizontal cylinder for hydraulically supplementing the compressive force of said spring on said jaws and means for introducing fluid under pressure into and exhausting the same from said horizontal cylinder for effecting longitudinal displacement of said hollow piston rod.

2. Hydraulic pipe holding and racking apparatus adapted to be mounted in a well derrick and comprising a cylinder having a hollow piston rod, a head on said rod having a stationary and movable work engaging jaws, means normally contracting said movable jaws, hydraulic means overcoming the resistance of said contracting means to open said jaws, means for introducing fluid under pressure through said hollow piston rod and supplementing said first means for exerting a closing force on said jaws, hydraulic means for effecting longitudinal displacement of said hollow piston rod, means for hydraulically raising and lowering said cylinder and means for hydraulically rotating said cylinder on a vertical axis.

3. Hydraulic pipe handling and racking apparatus for well derricks comprising in combination with a finger board, a horizontal cylinder, rotatable on a vertical axis opposite said finger board, a piston in said cylinder having a hollow rod, a head on said rod having stationary and movable pipe engaging jaws, means in said hollow rod contracting said movable jaws, means for introducing fluid under pressure into said hollow rod for counteracting the force of said first means to expand said jaws, means for actuating said piston to extend said hollow rod and head, hydraulic means for raising and lowering said cylinder and means for rotating said cylinder on its vertical axis.

4. Hydraulic pipe handling and racking apparatus including a main cylinder supported rotatably on a vertical axis intermediate its ends, and having a piston therein mounted on a hollow rod, a pipe engaging head on said rod having stationary and movable work engaging jaws, means for normally contracting said movable jaws, hydraulic means resisting said latter means for expanding said movable jaws, hydraulic means supplementing the contracting force of said first means for contracting said jaws, hydraulically powered means for raising and lowering said main cylinder and hydraulically powered means for rotating said main cylinder on its vertical axis.

5. A pipe handling and racking apparatus for derricks including in combination with the finger board of a derrick, a horizontally disposed cylinder mounted to rotate on a vertical axis opposite said finger board, containing a piston and a hollow rod carrying pipe engaging and holding jaws, hydraulic means for actuating said jaws, hydraulic means for raising and lowering said cylinder, and hydraulic means for rotating said cylinder on its vertical axis.

6. A pipe handling and racking apparatus for derricks including in combination with the finger board of a derrick, a horizontally disposed cylinder mounted to rotate on a vertical axis opposite said finger board, containing a piston and a hollow rod carrying pipe engaging and holding jaws, hydraulic means for actuating said jaws, hydraulic means for raising and lowering said cylinder, hydraulic means for rotating said cylinder on its vertical axis, and means superimposing said horizontally disposed cylinder in said derrick for dis-

placing pipe hoisting lines with respect to the center of said derrick.

7. The structure set forth in claim 5, further defined in that means auxiliary to the hydraulic means is provided for imposing a normal contracting force on the pipe engaging and holding jaws and means for supplementing the contracting force of said auxiliary means with hydraulic pressure.

8. The structure set forth in claim 5, further defined in that the pipe engaging and holding jaws are advanced upon and retracted from the work by hydraulic means and means to effect elongation of the conduits serving to circulate fluid effective to actuate said jaws.

9. The structure set forth in claim 5, further defined in that the means for displacing the pipe hoisting line consists of a horizontally disposed cylinder having a piston and piston rod, the latter carrying spaced apart sheaves engageable with said hoisting lines to move the same out of their normally suspended position in the derrick.

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