March 13, 1951 I. X. CALHOUN 2,544,639

HYDRAULIC TONGS

Filed Jan. 14, 1946 2 Sheets-Sheet 1

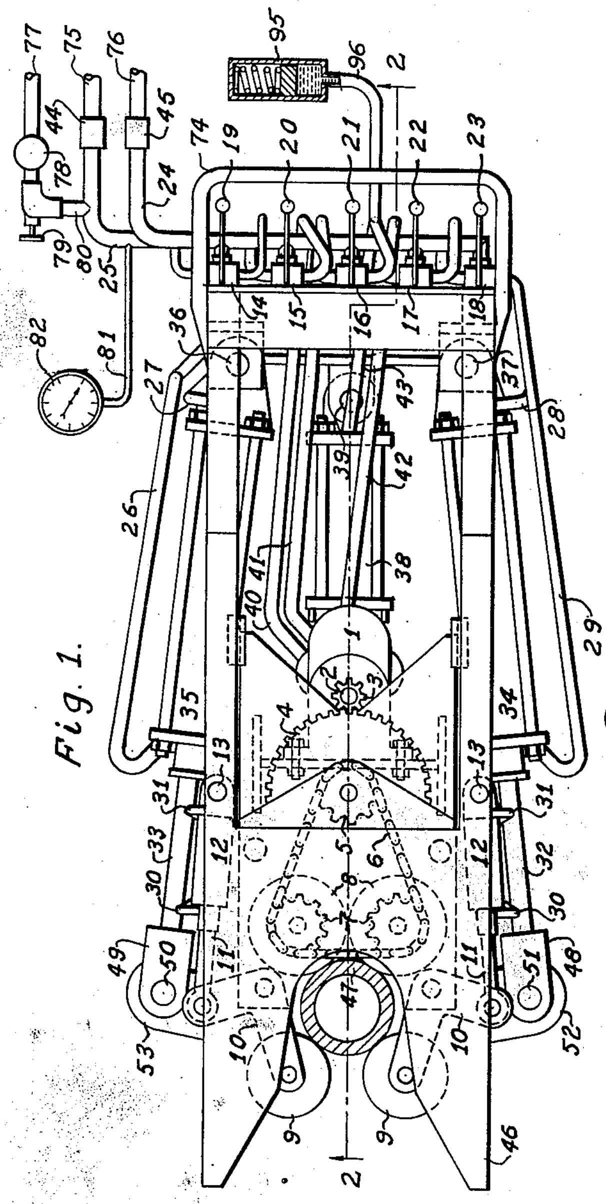

Fig. 1.

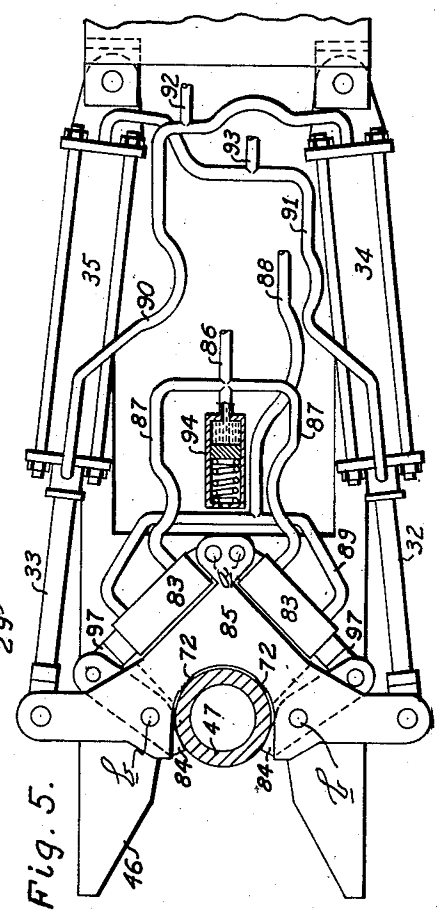

Fig. 5.

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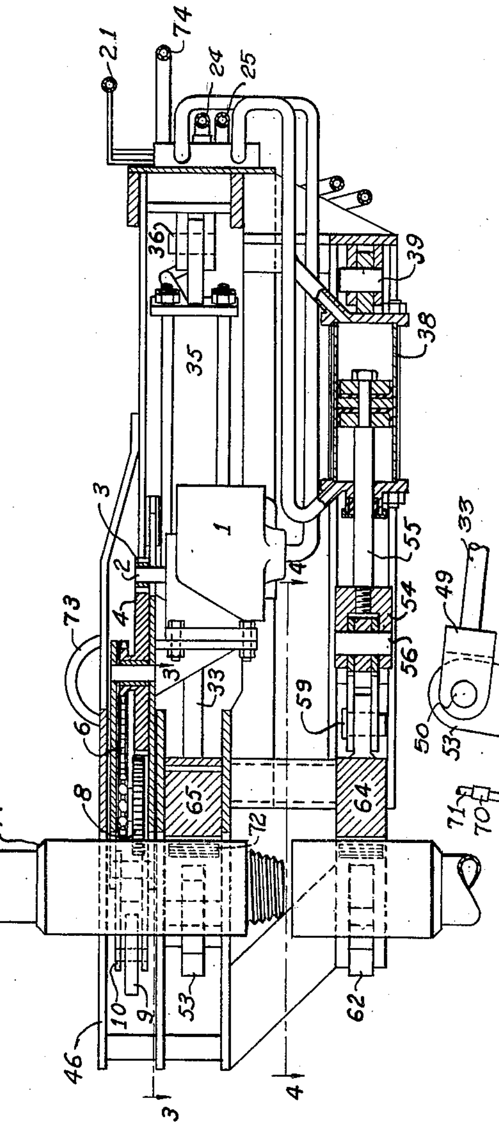

Fig. 2.

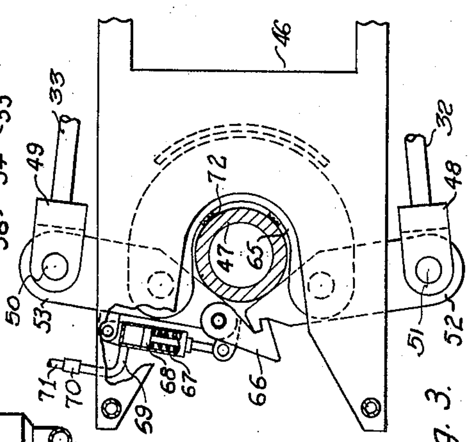

Fig. 3.

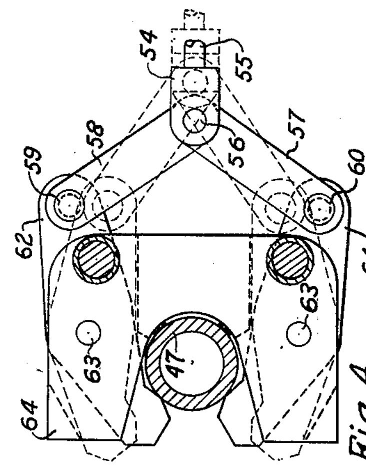

Fig. 4.

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HYDRAULIC TONGS

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2 Claims. (Cl. 255—35)

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This invention relates to pipe handling equipment, especially in drilling wells and it has particular reference to apparatus for and method of breaking drill pipe tool joints.

The principal object of the invention is to reduce to a considerable extent the time ordinarily consumed in pulling and running drill pipe by facilitating the breaking and tightening of tool joints, through the less hazardous and labor saving medium of hydraulic power. Moreover, the invention anticipates the use of hydraulic motors operating cylinders effective to apply controlled torque in such manner as to break the most obstinate joints with less likelihood of mechanical breakage than customary with tools having no provision for predetermining the degree of applied pressures.

Another object of the invention is to provide a hydraulic tong having means for clamping a portion of a tool joint under hydraulic pressure, combined with complementary means for applying torque to the companion portion of the tool joint under hydraulic pressure to make or break the joint within safe torque limits, as indicated by pressure exhibiting means calibrated in hydraulic pressure or foot pounds of torque.

Still another object of the invention is to provide a hydraulically actuated tong whose controls are so arranged that they may be manipulated by an operator at a safe distance from the point of operation at the center of the derrick floor, thus lessening danger from moving blocks and the like.

With the foregoing and other objects in view, the invention has particular reference to certain features of accomplishment, to become manifest as the description proceeds, taken in connection with the accompanying drawing wherein:

Figure 1 is a plan view of a hydraulic tong embodying the invention, shown clamped to a tool joint.

Figure 2 is a longitudinal sectional view, taken on line 2—2 on Figure 1.

Figure 3 is a plan view of the upper jaws per se of the tong, taken on line 3—3 of Figure 2.

Figure 4 is a plan view of the lower jaws per se of the tong, taken on line 4—4 of Figure 2, and

Figure 5 is a plan view of an alternate or modified form of tong showing the same in clamped position on a tool joint.

Continuing with a more detailed description of the drawing, reference is primarily made to Figures 1 and 2 wherein numeral 1 denotes a reversible hydraulic motor whose shaft 2 carries

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a pinion 3, adapted to drive a gear 4 which latter, in turn, rotates a sprocket 5, mounted on the shaft of the gear. A sprocket chain 6 is driven by the sprocket 5 and surrounds sprockets 7 to rotate fluted rollers 8 which latter engage a tool joint 47 for threading in or out. Opposing the fluted rollers 8 are plain faced rollers 9 which are mounted pivotally between arms 10 and are adapted to urge the tool joint 47 against the fluted faces of rollers 8 through the medium of piston rods 11, actuated by hydraulic cylinders 12, the latter being pivotally attached to the main frame 46 of the tong by pins 13. Hydraulic operating fluid is conveyed to cylinders 12 from a valve 14 through lines 30 and 31. An operating handle 19 is provided for controlling the valve 14.

A cylinder 38 is attached to the frame 46 of the tong by means of a pin 39 at right angles to the major axis of the cylinder and through the medium of its piston, a force is exerted on rod 55 and clevis 54 to actuate arms 61 and 62 (Fig. 4) through pin 56, toggle links 57 and 58, which latter are connected to said arms 61 and 62 by pins 59 and 60. In this manner, arms 61 and 62 are fulcrumed on pins 63 and the open position of the jaws and linkage is shown in dotted lines in Figure 4.

A spring loaded accumulator 95, as shown in Figure 1 is connected through line 96 to a line 43, which latter in turn is connected to and serves to maintain pressure in cylinder 38 upon actuating a handle 21 of a valve 16 to neutral, non-by-pass position subsequent to the closing of the lower jaws of the tong.

On each side of the frame 46, hydraulic cylinders 34 and 35 are mounted thereto by means of pins 36 and 37. Pistons in these cylinders exert a force on rods 32 and 33 respectively, to actuate upper jaws 52 and 53 of the tong, as shown more clearly in Figure 3. Clevises 48 and 49 connect rods 32 and 33 to their respective jaws 52 and 53 by means of pins 50 and 51. The jaws 52 and 53 are designed to clamp the upper section of a tool joint 47 through the medium of a floating yoke 65 whose pipe engaging portion is provided with case hardened teeth 72, as may be observed in Figure 3.

In Figure 3, the jaws 52 and 53 are shown as being latched together by an automatically actuated latch 66 which is operated by a piston 68, supplied by hydraulic fluid through a flexible line 69, coupling 70 and line 71 to source. A spring 67 in the piston cylinder resists fluid pressure to disengage latch 66 when piston 68 is relieved of pressure.

The valve 14, previously referred to controls the operation of the clamping jaws 9 through cylinders 12 and flexible lines 30 and 31. A valve 15, operated by a handle 20, controls the fluid supply to the motor 1 through flexible lines 40 and 41. The lower cylinder 38, described in the foregoing as operating the lower clamping jaws 61 and 62, is controlled by a valve 16 having an operating handle 21. Valve 17 controls the operation of torque cylinder 35 through flexible lines 26 and 27 and valve actuating handle 22, and torque cylinder 34 is controlled by means of valve 18 through flexible lines 28 and 29. The valve 18 is provided with an operating handle 23.

Hydraulic fluid under pressure from a pressure generator (not shown) is supplied to the manifold 25 of valves 14, 15, 16, 17 and 18 through a flexible line 75 which is connected to said manifold 25 by means of a coupling 44. Fluid pressure in the manifold 25 is preferably indicated on the dial of gauge 82 in pounds per square inch, torque in foot pounds or both. The gauge may also be equipped with a red danger signal to reveal excessive torque pressures.

And adjustable relief valve 78 controls hydraulic pressure in maniflold line 25, returning excess fluid to the pressure generator through flexible line 77. Cut-off valve 79 is provided so that maximum generator pressure may be applied to the jaws for breaking unusually tight joints. The valves 78 and 79 are connected to the valve manifold line 25 by means of a nipple 80. A fluid return line 24 to the pressure generator is connected to each of the valves 14, 15, 16 17 and 18 and spent fluid entering this line is delivered to line 76, connected to line 24 by a coupling 45.

The frame 46 of the tong is supported in the derrick and counter-balanced by a line attached to a loop 73 affixed to the frame at the approximate gravity center thereof and a handle 74 is secured to the rear of the frame above and rearwardly of the control valve assembly, by which to move the apparatus in relation to the work to permit hoisting and lowering of the drill pipe.

In operation, the tong is advanced upon the work with the rotary jaws 9, torque jaws 52 and 53 and lower clamping jaws 61 and 62 expanded. Valve 14 is opened to supply fluid under pressure to cylinders 12 through lines 30 and 31 thus displacing the pistons therein to actuate rods 11 and arms 10, contracting the rotary jaws on the work and confining the same between the latter jaws and fluted rotary jaws 8. Valve 16 is opened to allow fluid to enter cylinder 38 through line 42 and 43 to actuate piston rod 55, thereby contracting the lower clamping jaws 62 onto the work through the medium of links 57 and 58 (Fig. 4).

It has been stated previously that it is the intent of the invention to provide in a single tool a means for holding a lower section of the work under predetermined hydraulic pressure while torque is applied hydraulically to break a joint by rotating the upper section of the work and further, a means for spinning the upper section after the joint is broken while the lower section remains clamped. These functions are respectively performed by the lower clamping jaws 61 and 62; the intermediate torque jaws 52 and 53 and the rotary jaws 8 and 9.

The foregoing description explains how the lower clamping jaws are applied to the work. Now, the torque jaws 52 and 53 are actuated by alternate reciprocation of rods 32 and 33 to produce a ratchet effect on the work, the direction of applied force being determined by valves 17 and 18 which are alternately opened and closed to supply fluid alternately to torque cylinders 34 and 35 which actuate rods 32 and 33 to produce a ratchet effect on the work. When a joint is encountered which cannot be broken by the rotary jaws 8 and 9, the torque jaws 52 and 53 are set into operation, as described, which are capable of breaking the most obstinate joint.

Following the operation of breaking a joint, valve 15 is opened to admit fluid from the pressure generator, through manifold 25 to the fluid motor 1, setting into operation the chain 6 through gears 3 and 4, which action imparts rotation to rotary fluted jaws 8, whose engagement with the work 47 causes the latter to rotate to disconnect the upper from the lower clamped section of the work.

It is of course obvious that while the foregoing explanation of the performance of the jaws deals with the breaking of a joint of pipe, the process of setting up joints in running in drill stem is performed in substantially the same manner except the direction of rotation of motor 1 and reciprocation of torque jaws 52 and 53 are reversed.

It is to be understood that when the lower clamping jaws 61 and 62 are to be collapsed on the work, pressure in line 71 overcomes the resistance of spring 67, allowing piston 68 to be displaced to actuate latch 66, but upon relieving fluid pressure in line 71, the spring 67 functions to open the latch 66 allowing the jaws 61 and 62 to be expanded to release the work.

In Figure 5 is shown a modified form of clamping jaw corresponding to the lower clamping jaws illustrated per se in Figure 3. In this construction, cylinders 83 are pivotally connected at *a* to a floating yoke 85 and clamping jaws 84 are pivoted at *b* also to this yoke. A spring loaded accumulator 44 is provided to maintain pressure on jaws 84 after the control valve (not shown) is returned to neutral or non-by-pass position subsequent to its opening operation admitting pressure to the accumulator 94 through line 86 and to the lower chambers of cylinders 83 through lines 87. The upper chambers of cylinders 83 are exhausted through flexible lines 89 to line 88, thence to the valve (not shown), the valve being comparable to valve 16, earlier described as the control means for the lower clamping jaws 61 and 62.

Piston rods 97 are reciprocated by pistons in cylinders 83 to urge the clamping jaws 84 against the tool joint 47 to thrust and hold the same against the teeth 72 of the yoke 85. Torque to tighten or loosen the joint is then applied by alternate reciprocation of rods 32 and 33 to the yoke 85 by alternate charging of cylinders 34 and 35 with fluid pressure.

Cylinders 34 and 35 are cross connected by lines 90 and 91, causing torque exerted on yoke 85 to be additive after the tool joint is tightened or loosened as the case may be, pressure is released from line 86, discharging accumulator 94 and removing pressure from the head end of cylinders 83. Pressure is then applied to the gland end of the cylinders, opening jaws 84 to permit the tong to be removed from the tool joint 47. Pressure supplying lines 90 and 91 cross connecting cylinders 34 and 35 enters and leaves these lines through flexible lines 92 and 93 respectively.

Manifestly, the construction as shown and described is capable of some modification and such modification 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. Apparatus for making and breaking the joints of pipe sections including a frame bifurcated at one end to receive the pipe and suspended horizontally for displacement relative to the pipe, a fluid pressure distributing manifold on the opposite end of said frame, a pair of cylinders having connection with said manifold, one being disposed on each side of said frame, pistons in said cylinders, a substantially U-shaped floating yoke in said frame at its pipe receiving end adapted to embrace the pipe above a joint and to which said pistons are each connected, pipe engaging torque jaws carried by said yoke, valves controlling the circulating of fluid in said cylinders in a manner to effect alternate reciprocation of said pistons to oscillate said yoke, means for holding the torque jaws against the pipe in said yoke, a pair of pipe holding jaws in said frame for engaging and holding the pipe below said joint, a common cylinder and piston for actuating said pipe holding jaws simultaneously and valve means for controlling circulation of fluid from said manifold through said latter cylinder.

2. Apparatus for making and breaking threaded pipe sections including a frame suspended for movement towards and away from a string of pipe, a substantially U-shaped floating yoke mounted in one end of said frame and adapted to receive the pipe above a joint, pipe engaging slips in said yoke, a cylinder mounted on each side of said frame, a piston in each of said cylinders, each of said pistons having a rod connected to one side of said yoke, a fluid pressure manifold valve means for circulating fluid alternately through said cylinders from said manifold to oscillate said yoke, a pair of torque jaws pivoted to said yoke and actuated by said piston rods for holding pipe in said yoke, a pair of pipe holding jaws pivoted in said frame below said yoke for engaging and holding the pipe below said joint during operation of said yoke and hydraulic means for effecting simultaneous operation of said pipe holding jaws.

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