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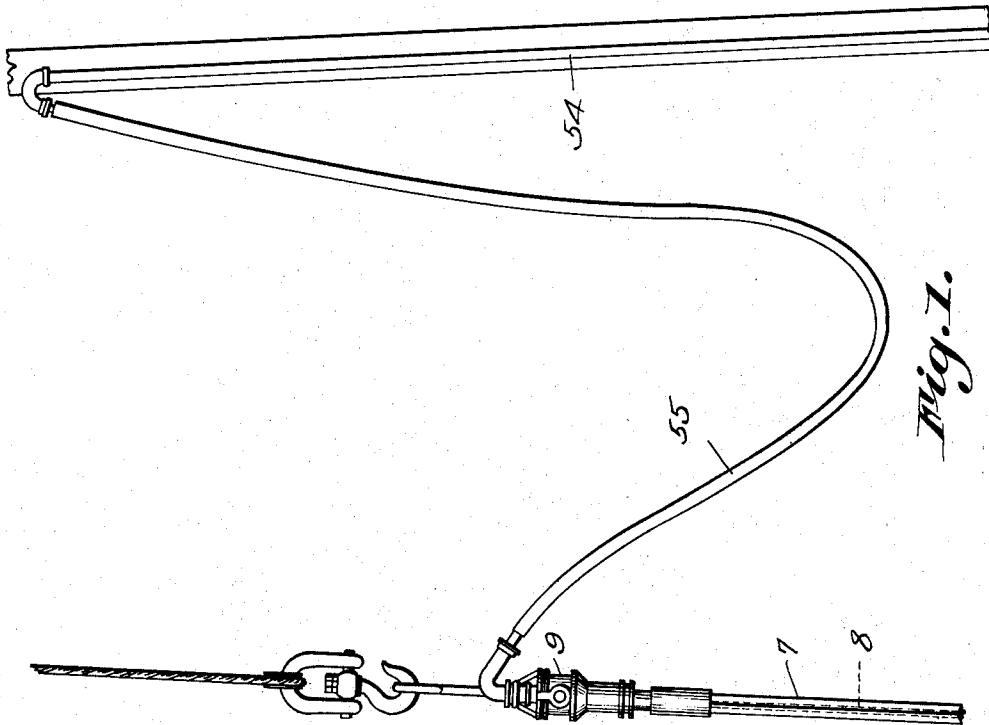
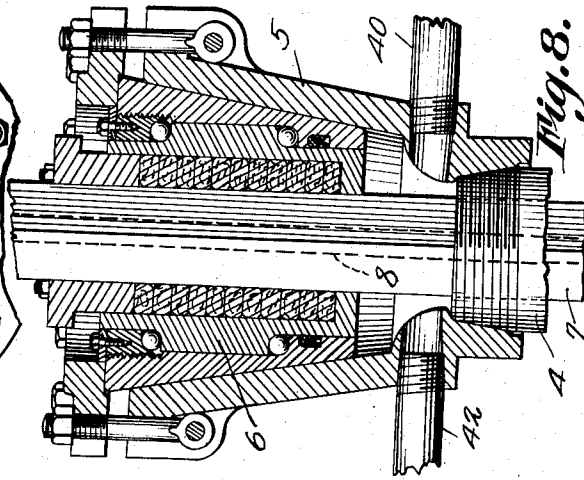
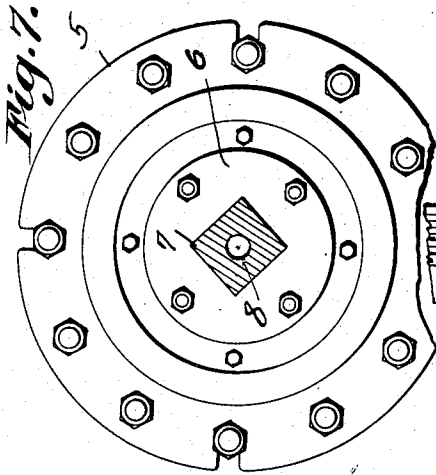
R. A. MITCHELL

2,141,111

PACKING BOX AND UNDERREAMER

Filed Oct. 12, 1938

3 Sheets-Sheet 1



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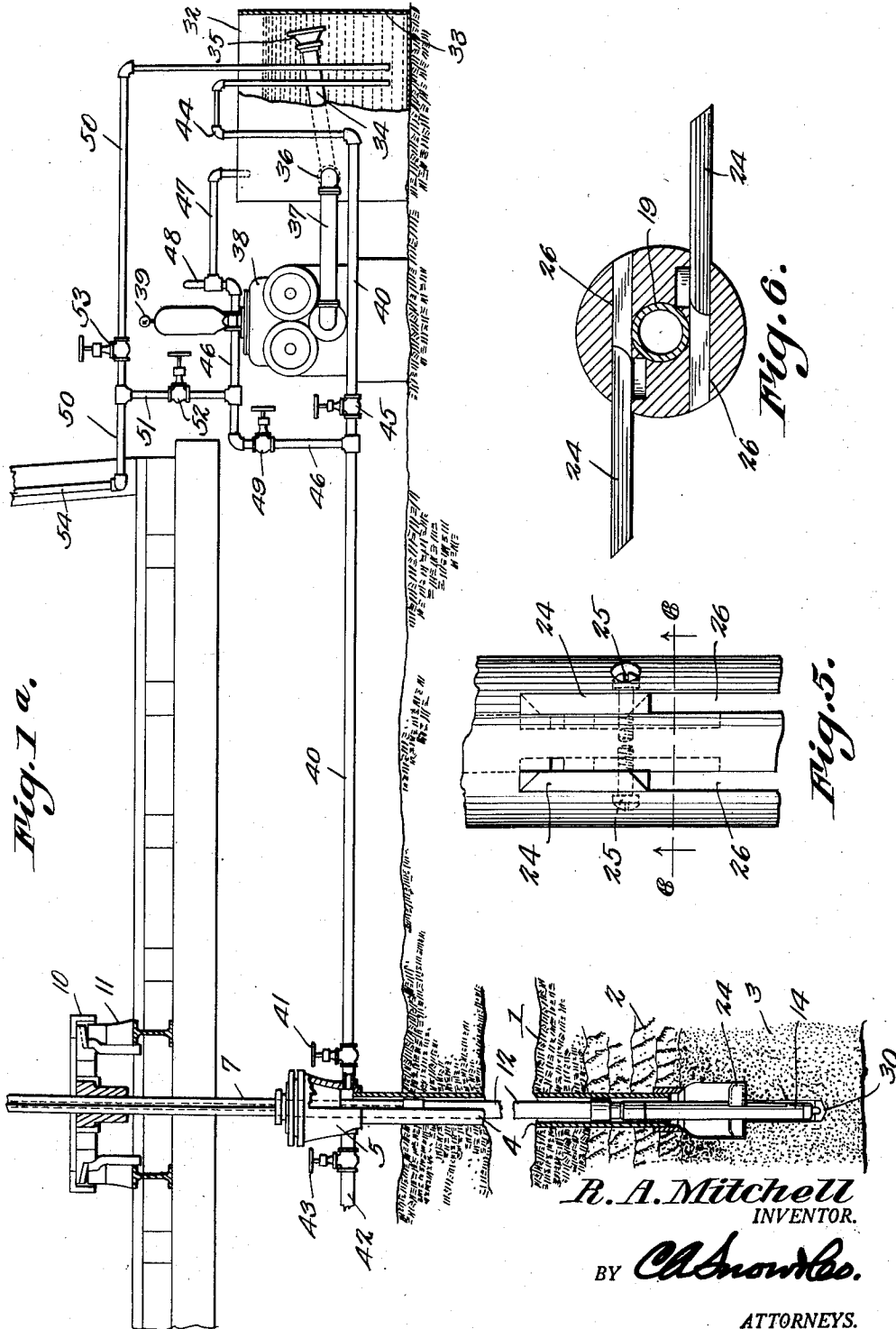
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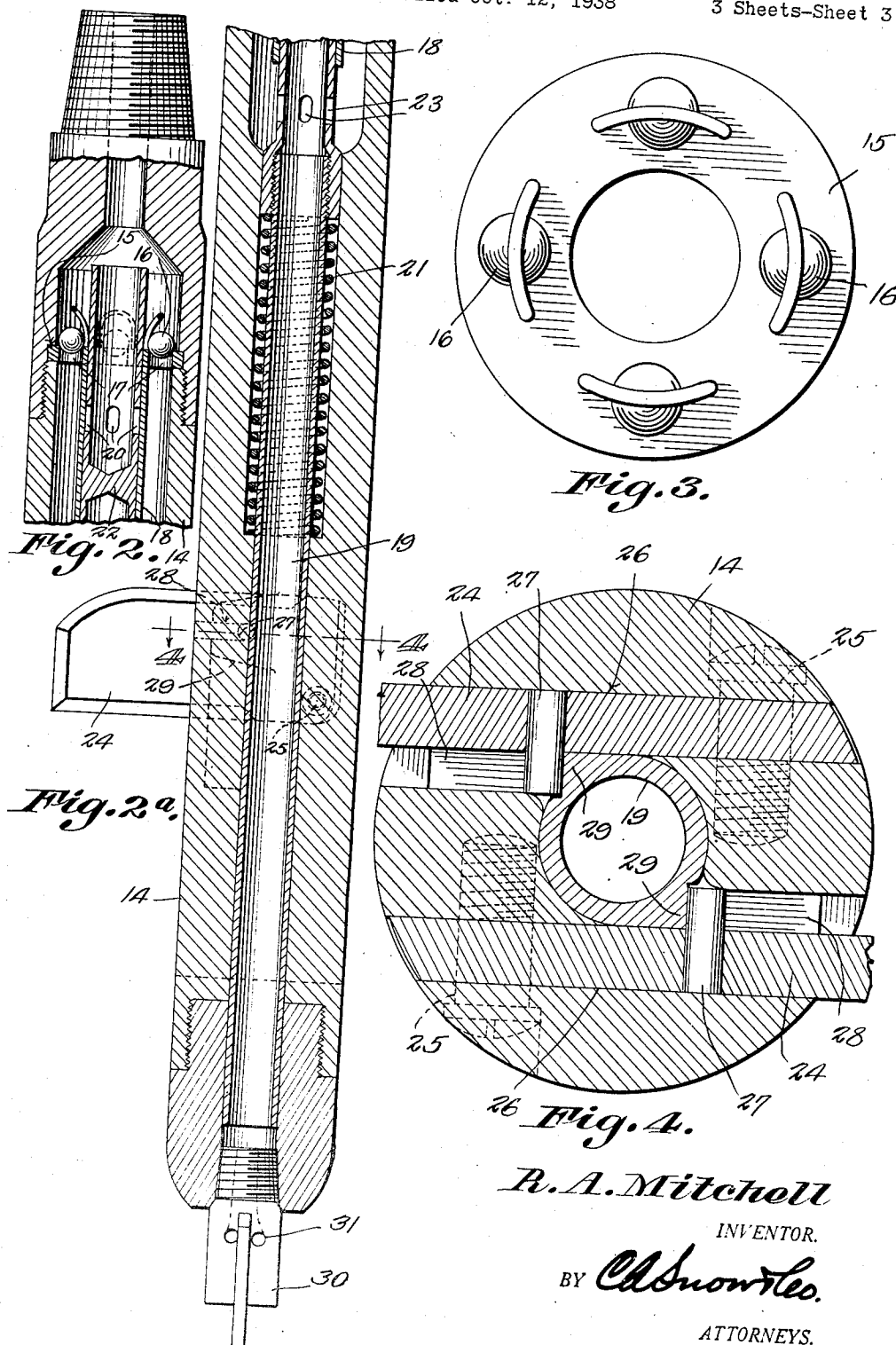
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PACKING BOX AND UNDERREAMER

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3 Sheets-Sheet 3



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2,141,111

PACKING BOX AND UNDERREAMER

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5 Claims. (Cl. 255-76)

This invention relates to oil well drilling equipment, for drilling out a cement plug, after the casing has been set, the device being of use, also, for under-reaming and cleaning out old wells, to re-establish production, and for bringing in new wells, a clean hole being left. The invention aims to provide a means whereby the user can bring in new wells, without relying upon muddy water as a circulating fluid which, in case of the regular flow drilling circulation, tends to seal up the seepage or flow of oil from the oil sand into the well. A further object of the invention is to provide a reverse flow drilling circulation, using crude oil as a drilling fluid, to remove all cuttings from the hole, as the cuttings fall to the bottom of the hole, an exit being provided through the drill stem, and the well being left free of suspended matter which, otherwise, would settle down and cloud the well at the lower end thereof.

A further object of the invention is to supply a rotary Kelly casing head packing box through which the Kelly shaft can be elevated and lowered, it being possible to rotate the Kelly shaft, drilling operations being continued whilst pressure is maintained on the inside of the well casing. Another object of the invention is to provide novel means for changing the circulation from direct to reverse, or from reverse to direct.

A further object of the invention is to provide a novel reamer construction, which, at times, is responsive to pressure beneath it, the construction being such that the reaming may be carried out in reverse flow or when neither reverse nor direct flow is taking place.

It is within the province of the disclosure to improve generally and to enhance the utility of devices of that type to which the present invention appertains.

With the above and other objects in view, which will appear as the description proceeds, the invention resides in the combination and arrangement of parts and in the details of construction hereinafter described and claimed, it being understood that changes in the precise embodiment of the invention herein disclosed, may be made within the scope of what is claimed, without departing from the spirit of the invention.

In the accompanying drawings:

Fig. 1 is an elevation showing the upper portion of a device constructed in accordance with the invention;

Fig. 1a is a view supplementing Fig. 1, and

showing the lower portion of a device constructed in accordance with the invention;

Fig. 2 is a longitudinal section showing the upper portion of the foot;

Fig. 2a is a view supplemental to Fig. 2, and showing the lower portion of the foot;

Fig. 3 is a plan of the valve seat;

Fig. 4 is a section on line 4-4 of Fig. 2a;

Fig. 5 is an elevation showing the mounting of the side cutters in the body;

Fig. 6 is a transverse section on the line 6-6 of Fig. 5.

Fig. 7 is a plan view of the top of the packing box 5 of Figs. 1a and 8.

Fig. 8 is a cross sectional view of the packing box 5 shown in Fig. 1a.

In Fig. 1a, an upper stratum of earth is shown at 1, the cap rock appearing at 2, and the oil sand at 3. A well casing is shown at 4 and carries a head 5 wherein a packing box 6 (Fig. 8) is anti-frictionally supported for rotation. The numeral 7 marks a polygonal shaft, commonly called a "Kelly", held against rotation in the box 6, but longitudinally slidable therein, the shaft having a longitudinal bore 8, in communication with a rotary drilling swivel 9. The shaft 7 is received for longitudinal sliding movement in a turn table 10, supported at 11 for rotation.

The shaft 7 is connected to a drilling tube 12, joined, in its turn, to a hollow foot 14, shown in Figs. 2, 2a and 4, and the foot, for convenience of assembly, may be composed of detachably connected parts. A valve seat 15 is mounted in the foot 14, and carries caged downwardly closing check valves 16, controlling openings 17 in the valve seat.

A short tube 18 is secured to the valve seat 15. A two part hollow plunger or piston 19 is mounted to reciprocate in the tube 18 and in the foot 14. The plunger 19 is supplied with upper side ports 20, and is raised by a compression spring 21, co-operating with the plunger and with the foot 14, as shown in Fig. 2a. A partition 22 extends across the plunger 19, a little way below the upper ports 20. The plunger 19 is supplied with lower side ports 23, disposed below the partition 22.

Lateral upper cutters 24 are pivotally mounted at 25, at their outer ends (Fig. 4) on the foot 14, to swing parallel to the axis of the body, in slots 26 formed in the body. Intermediate their ends, the cutters 24 have transverse projections 27, received slidably in slots 28 formed in lugs 29 projecting outwardly in opposite directions from the plunger 19, and formed thereon. At its lower end, the foot 14 carries a bottom cutter 30, hav-

ing means 31 for the passage of liquid there-through.

The device is intended to be operated with crude oil 32, as a circulating liquid, instead of muddy water as is usual in oil well drilling. The oil 32 is kept in storage above ground, in a tank 33. The oil leaves the tank 33 by means of an outlet tube 34, having a screen 35 at one end, the outlet tube 34 being connected by a swivel joint 36 to a pipe 37. The swivel joint 36 permits the screened end 35 of the outlet tube 34 to be raised or lowered in the tank 33 and the screened end of the outlet tube can be raised or lowered, and kept near the surface of the liquid 32 in the tank 33 at all times. The material freed by the cutters 24 and 30 will settle to the bottom of the tank 33, and the oil withdrawn from the tank will not carry cuttings, in suspension.

The pipe 37 is connected to a pump 38. The pump 38 is provided with a pressure gauge 39. The numeral 40 marks a pipe communicating with the head 5. A valve 41, under the control of an operator, is interposed in the pipe 40, adjacent to the head 5. An extra lead for the head 5 is marked by the numeral 42, and in it is interposed a valve 43, under the control of an operator. The pipe 40 leads to a place adjacent to the tank 33, and terminates in an inverted U-shaped member 44, in communication with the tank 33. A valve 45, under the control of an operator, is interposed in the pipe 40, between the valve 41 and the tank 33.

A pipe 46 is branched off from the pipe 40, between the valves 41 and 45, and communicates with the pump 38. A pipe 47 leads from the pump 38 and discharges into the tank 33. The pipe 47 carries a release valve 48. A valve 49 is interposed in the pipe 46, between the pipe 40 and the pump 38.

The numeral 50 designates a pipe communicating with the tank 33. The numeral 51 designates a pipe which communicates with the pipe 46, between the valve 49 and the pump 38. The pipe 51 is in communication with the pipe 50. A valve 52, under the control of an operator, is interposed in the pipe 51. A valve 53, under the control of an operator, is interposed in the pipe 50, between the tank end of the said pipe and the place where the pipe 51 joins the pipe 50. The pipe 50 is connected to an upwardly extended pipe 54, joined by a flexible hose 55 to the swivel 9, and the hose 55 is in communication with the bore 8 of the Kelly shaft 7.

During what may be denominated the "regular flow", the valves 43, 49 and 53 of Fig. 1a are closed, and the valves 41, 45 and 52 are open.

The circulation begins at the tank 33 and is carried on through the tube 34, the pipe 37, the pump 38, the part of the pipe 46 that is between the valve 49 and the pump 38, the pipe 51, the part of the pipe 50 that is between the pipe 54 and the valve 53, the pipe 54, the hose 55 of Fig. 1, the swivel 9, the bore 8 (Fig. 7) of the Kelly shaft 7, and the drilling tube 12, to the upper part of the foot 14 in Fig. 2. Here the pressure is checked by the ball valves 15, and is communicated to the partition 22 of the slidable piston tube 19. The piston tube 19 moves downwardly, the cutters 24 being folded to inoperative position. As the piston tube 19 moves downwardly, the upper ports 20 of the piston tube 19 are disposed below the lower end of the fixed guide tube 18. The liquid enters the upper end of the piston tube 19, and passes outwardly, through the exposed ports 20, into the space between the fixed tube 18 and the wall of

the foot 14. Thence, the liquid passes inwardly through the lower ports 23 of the piston tube 19, into the piston tube and downwardly in the said tube, and out through the opening 30 of the lower bit 29 into the space between the foot 14 and the well casing 4. The liquid moves upwardly in the well casing 4, into the head 5, and from the head 5, the liquid flows through the pipe 40, throughout its length, to the pipe 44, and is discharged into the tank 33.

During the "reverse flow", the valves 52, 45 and 43 of Fig. 1a are closed, the valves 53, 49 and 41 being opened. The upper ports 20 of the piston plunger 19 are closed by the fixed tube 18, and the tube may be considered part of the valve seat 15. Then the circulation begins at the tank 33 and is carried on through the tube 34, the pipe 37, the pump 38, the pipe 46, so much of the pipe 40 as is between the valve 45 and the head 5, through the head 5, downwardly between the casing 4 and the foot 14, upwardly through the openings 30 of the lower cutter 29, upwardly through the tube 19, outwardly through the lower ports 23 of the said tube, into the space between that tube and the wall of the foot 14, upwardly through the upper portion of the foot 14 in Fig. 2, past the valves 16, upwardly through the drilling tube 12, upwardly through the bore 8 of the Kelly shaft 7, to the swivel 9, through the hose 55 of Fig. 1, downwardly through the pipe 54, and through the pipe 55 of Fig. 1a, into the tank 33.

In either direction of flow, the cuttings are carried away and deposited in the bottom of the tank 33, the oil rising clean, above the settled cuttings.

The pressure is recorded at all times on the pressure gauge 39. The release valve 48 may be adjusted to any desired pressure and when that pressure is exceeded, the liquid will be returned to the tank 33 by way of the pipe 47, an undesirable increase in pressure existing, for instance, when there is a stoppage in any of the flow conduits. The spring 21 of Fig. 2a exerts an upward pressure on the plunger 19 and raises the plunger, so that the cutters 24 may be advanced for use, even though a circulation, direct or reverse, is not taking place.

The head 5 which is attached to the well casing 4, below and independently of the rotary table 10, can be used on any type or design of table. It can be used, also, on any shape, design or size of Kelly shaft or drill bar 7, by changing the shape of the structure delineated in Fig. 8, such a change being understood readily, without specific description. Should there be a stoppage anywhere in any of the conduits, the obstructing material may be loosened by simply shifting from a direct flow to a reverse flow, or from a reverse flow to a direct flow, as occasion may require. Ample provision is made for raising, lowering and rotating the working parts, without decreasing the liquid pressure or impairing the circulation.

What is claimed is:

1. In a device of the class described, a well casing, a head on the casing and communicating with the casing, a tubular shaft mounted to rotate and to reciprocate longitudinally in the head, a hollow foot within and spaced from the casing, a cutter carried by the lower end of the foot and having a passage for liquid, in communication with the well casing, means for connecting the foot to the tubular shaft, the tubular shaft being in communication with the upper portion of the foot, a valve seat in the foot, a downwardly-closing check valve carried by the foot, a piston

plunger slidable in the foot and having a pressure partition, the piston plunger being provided with an upper port and with a lower port, the lower port being normally open, and the upper port being closed by the valve seat when the piston plunger is raised, both ports being open and in communication with the well casing when the piston plunger is depressed by liquid pressure on the partition, spring means for raising the piston plunger, to close the upper port, a conduit connected to the upper end of the tubular shaft, a conduit connected to the head, and means under the control of an operator for securing direct and reverse pressure and wash-out flow through the conduits.

2. In a device of the class described, a well casing, a head on the casing and communicating with the casing, a tubular shaft mounted to rotate and to reciprocate longitudinally in the head, a hollow foot within and spaced from the casing, a cutter carried by the lower end of the foot and having a passage for liquid, in communication with the well casing, means for connecting the foot to the tubular shaft, the tubular shaft being in communication with the upper portion of the foot, a valve seat in the foot, a downwardly-closing check valve carried by the foot, a piston plunger slidable in the foot and having a pressure partition, the piston plunger being provided with an upper port and with a lower port, the lower port being normally open, and the upper port being closed by the valve seat when the piston plunger is raised, both ports being open and in communication with the well casing when the piston plunger is depressed by liquid pressure on the partition, spring means for raising the piston plunger, to close the upper port, a conduit connected to the upper end of the tubular shaft, a conduit connected to the head, means under the control of an operator for securing direct and reverse pressure and wash-out flow through the conduits, a side cutter movably connected to the foot, and interengaging elements on the cutter and on the piston plunger, cooperating to extend

the side cutter when the piston plunger is raised.

3. A device of the class described, constructed as set forth in claim 1, and wherein the means under the control of an operator is an oil tank, each conduit having an outlet discharging into the tank, valves under the control of an operator and governing the outlets, a pump in communication with the tank, and means for selectively directing the flow from the pump into either conduit.

4. A device of the class described, constructed as set forth in claim 1, and wherein the means under the control of an operator is an oil tank, each conduit having an outlet discharging into the tank, valves under the control of an operator and governing the outlets, a pump in communication with the tank, means for selectively directing the flow from the pump into either conduit, a gland wherein the hollow shaft reciprocates, the gland being journaled in the head, an outlet for the pump, leading to the tank, and a pressure-actuated relief valve controlling the outlet.

5. In a device of the class described, a well casing, a tubular shaft located in the well casing, a hollow foot carried by the shaft and in communication with the shaft and the casing, the foot being within and spaced from the casing, a cutter movably mounted on the foot, means for establishing direct and reverse circulation flow through the casing, the hollow shaft and the foot, a piston mounted to slide in the foot, the piston and the foot embodying relatively movable valve means checking direct flow and permitting reverse flow, and interengaging elements on the cutter and the piston, coacting to advance the cutter when the piston responds to pressure due to reverse flow, spring means for actuating the plunger in a direction opposite to that in which it moves responsive to direct flow pressure, to retract the piston and close the valve means, and a check valve restraining direct flow through the space between the casing and the foot.

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