

Aug. 1, 1939.

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2,167,623

FLUID OPERATED PUMP JACK

Filed Aug. 15, 1936

4 Sheets-Sheet 1

FIG. 1

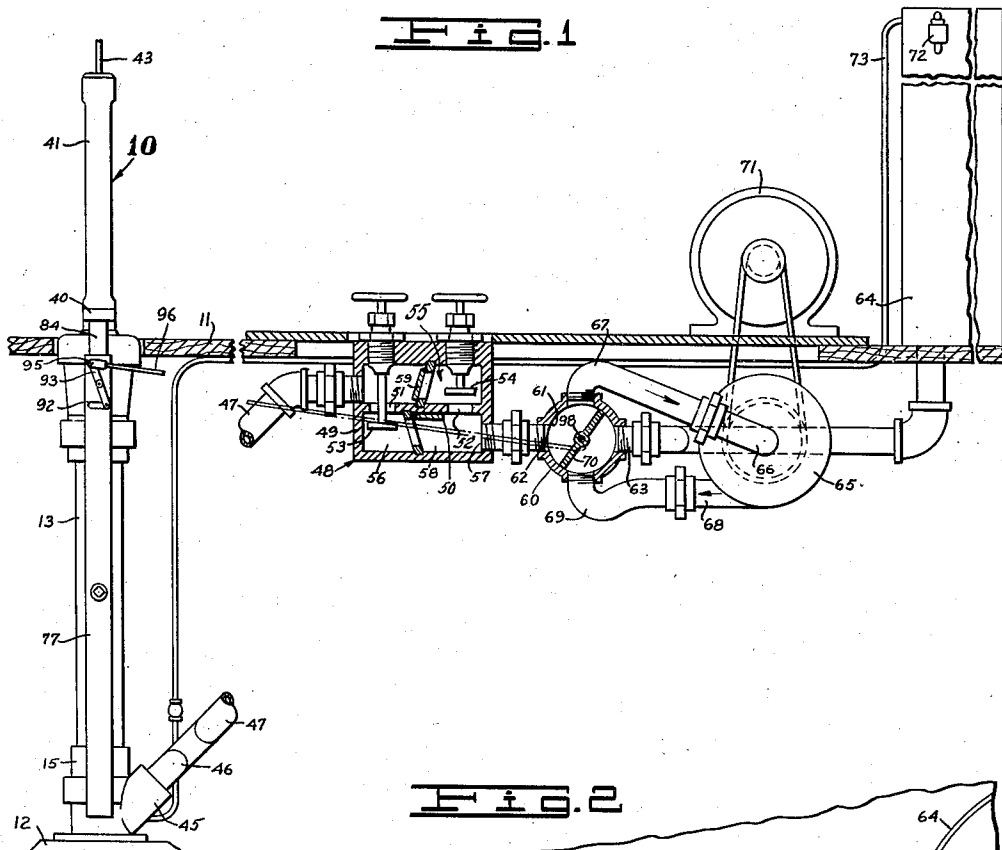


FIG. 2

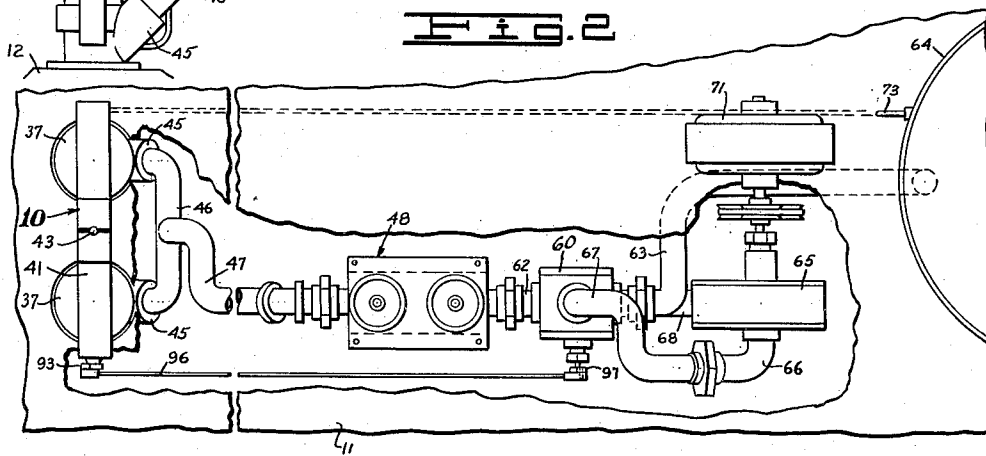
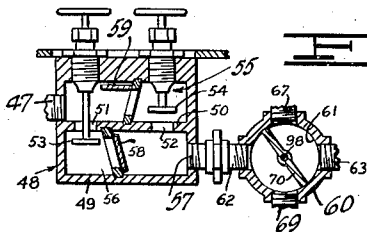


FIG. 3



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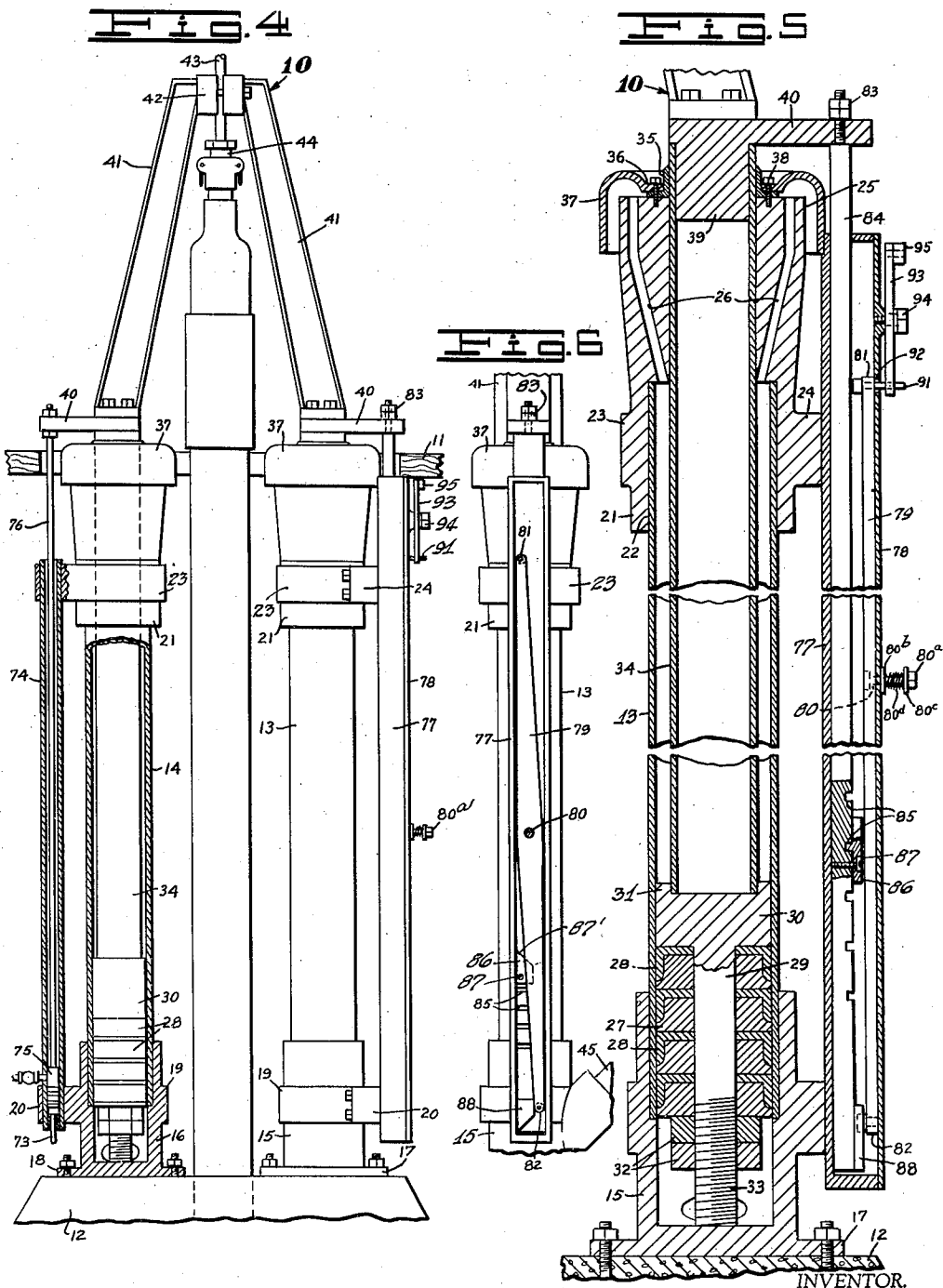
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4 Sheets-Sheet 2



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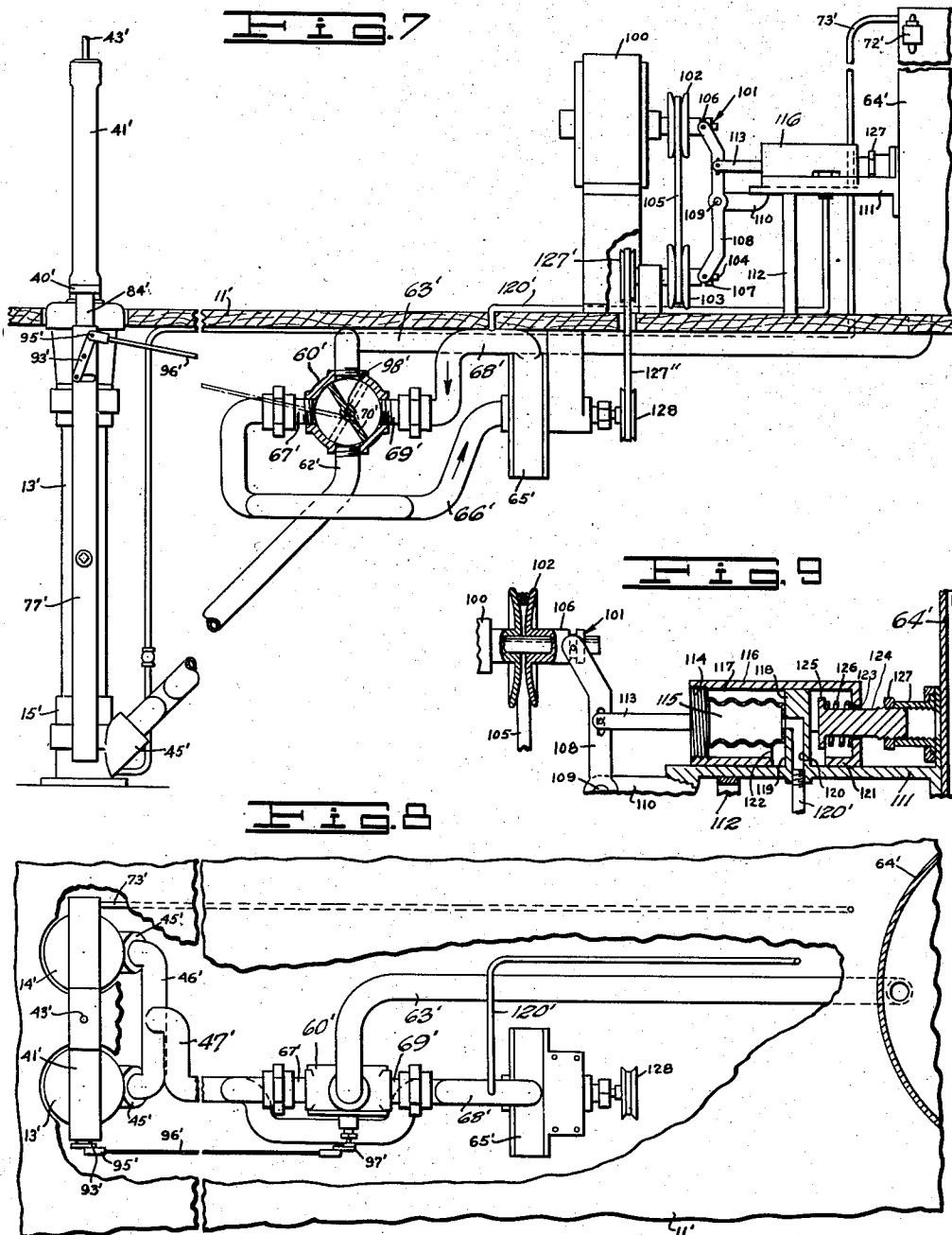
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4 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,167,623

FLUID OPERATED PUMP JACK

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4 Claims. (Cl. 60—52)

This invention relates to hydraulically operated pump jacks.

The general object of the invention is to provide an improved pump jack wherein an improved motor driven hydraulic power unit operates the jack.

Another object of the invention is to provide a power jack including a continuously driven motor and hydraulically operated mechanism driven thereby to reciprocate the working portions of the jack.

Another object of the invention is to provide a hydraulic pump jack wherein a novel pneumatic air chamber is used in conjunction with the jack.

Another object of the invention is to provide an improved hydraulic jack including novel control means.

An additional object of my invention is to provide a novel hydraulic power device which is used with one or more oil wells for pumping purposes.

Other objects and the advantages of this invention will be apparent from the following description taken in connection with the accompanying drawings, wherein:

Fig. 1 is a central, sectional view with parts in elevation showing my improved pump jack;

Fig. 2 is a top plan view with parts broken away showing the jack;

Fig. 3 is a fragmentary, sectional detail showing the control valve and the adjusting valve;

Fig. 4 is an enlarged end elevation partly in section showing the cylinders and associated parts;

Fig. 5 is a central, sectional view showing one of the cylinders and the associated reversing device;

Fig. 6 is a side elevation showing one of the cylinders and the reversing device with the closure removed from the latter;

Fig. 7 is a view similar to Fig. 1 showing a modification of my invention;

Fig. 8 is a top plan view with parts broken away showing the modification;

Fig. 9 is a section in detail showing the pulley control mechanism;

Fig. 10 is a fragmentary, sectional view with parts in elevation showing a modification of my invention;

Fig. 11 is a section taken on line 11—11 of Fig. 10;

Fig. 12 is a top plan view of the operating member; and

Fig. 13 is a fragmentary side elevation showing a further modification.

Referring to the drawings by reference characters I have indicated a hydraulically operated pump jack embodying the features of my invention generally at 10. As shown the jack is mounted on a floor 11 beneath which I arrange a suitable foundation 12 which is disposed above the well which is to be pumped.

In the following specification I will describe my invention as embodied in a pump for use in an oil well but it will be understood that my apparatus can be used in connection with a water well or for other purposes and may even be used in connection with lifts or elevators without departing from the spirit of my invention.

Referring again to the drawings I show a pair of cylinders 13 and 14 which are mounted in bases 15 and 16, respectively. The bases 15 and 16 are provided with flanges 17 and 18 through which bolts pass to hold the bases on the foundation 12. Each base includes an outwardly directed collar 19 which includes a projecting boss 20.

Each of the cylinders 13 and 14 adjacent its upper end is provided with a cap member 21. As shown these cap members are identical in construction and the description of the one shown in Fig. 5 will suffice for the purpose of both. Each cap member includes a lower cylindrical portion 22 which engages the upper end of the cylinder. The cylindrical portion 22 is provided with an outwardly directed collar 23 from which a boss 24 projects. The upper end of the cap member flares outwardly and merges into a cylindrical end portion 25. The cap member is provided with vents 26.

Mounted within each cylinder 13 and 14 I show a piston indicated at 27 and which includes a plurality of piston elements 28 which have central apertures and which are disposed on the lower end of a head 29. The head 29 includes an end portion 30 having an integral collar 31 thereon. The piston elements 28 are secured in place by lock nuts 32 on the threaded end 33 of the head.

Fitted within the collar 31 and secured as by welding I show a tube 34 which serves as a piston or plunger rod. At its upper end the tube 34 engages a packing member 35 which is mounted on the end portion 25 and is engaged by a flange 36 on a dust cap 37 which is removably held in place by screws 38.

Fitted within the upper end of the tube 34 and secured thereto as by welding I show a plug 39 from which a bar 40 projects.

Each of the plugs 39 is connected to an A-frame 41 which includes blocks 42 which are

secured to the polish rod 43 of the well. This polish rod passes through a suitable packing member 44 and into the well. The particular type of sucker rod and working barrel form no part of my present invention and therefore will not be described in detail.

In order to enable fluid to flow into and out of the lower portion of the cylinders 13 and 14 I provide each cylinder with a combined inlet and outlet member 45. The members 45 are connected by a header 46 (see Fig. 2) to a pipe 47 which is connected by suitable fittings to a stroke control mechanism (Fig. 1) indicated generally at 48. The stroke control mechanism includes a housing 49 having a partition 50 therein which is provided with valve seats 51 and 52 which are adapted to be engaged by valves 53 and 54. The valve 53 is shown as on the lower side of the partition while the valve 54 is on the upper side. The partition provides two compartments 55 and 56. In the compartment 56 an inlet and outlet pipe 57 is provided. Also in the compartment 56 a flap valve 58 is arranged and this flap valve opens towards the pipe 57. In the compartment 55 a flap valve 59 is arranged and this valve opens towards the pipe 47 previously mentioned.

The inlet and outlet pipe 57 is connected to a valve 60. This valve 60 includes a body having a cylindrical bore 61 therein and having four circumferentially spaced openings therein which openings are arranged at 90° relative to each other. One of the openings is connected by a pipe 62 with the pipe 57 previously described and the opening opposite the pipe 62 is connected by a pipe 63 with a tank 64 which is adapted to contain the working fluid which may be a certain grade of oil.

The pump is indicated at 65 and the inlet 66 of this pump is connected by a pipe 67 with another of the openings in the bore 61 while the outlet 68 of the pump is connected by a pipe 69 with the remaining opening in the bore. The pipes 67 and 69 enter the bore on diametrically opposite sides thereof. Arranged in the bore 61 is a shiftable valve vane member 70 which is adapted to be moved from the position shown in Fig. 1 to the position shown in Fig. 3. The pump 65 is adapted to be driven by a motor 71 by current supplied in any suitable manner. The tank 64 is adapted to have compressed air supplied in the upper portion thereof above the liquid in the tank and a blow-off valve 72 serves to prevent excessive pressure in the tank 64. As one means of providing compressed air in the tank 64 I show a pipe 73 which is connected to a pump barrel 74, as shown in Fig. 4. This pump barrel is mounted on the bosses 20 and 24 and includes a piston 75 and a piston rod 76 which is connected to the bar 40 disposed on the barrel 14 previously mentioned and as a result when the piston in the barrel reciprocates the pump 74 will force air under pressure into the tank 64.

Mounted on the bosses 20 and 24 on the cylinder 13 I show a cam housing 77 which is provided with a closure 78 which is suitably held in place. Mounted within the housing 77 I show a cam engaging member 79 which is provided with a recess through which a headed shaft member 80 extends. This shaft 80 is provided with a nut 80^a on the outer end and mounted on the shaft member I show a pair of spaced washers 80^b and 80^c with a spring 80^d between the washers and urging the washers apart so that the shaft is held in the correct position.

The cam engaging member 79 tapers towards

each end and is provided with a cam engaging portion 81 on the upper end, and a cam engaging portion 82 on the lower end. Mounted within the housing 77 and connected by a threaded extension and retaining nuts 83 to the bar 40 of the cylinder 13 I show a cam member 84. This cam member 84 moves within the housing 77 when the piston in the cylinder 13 reciprocates as will be understood from the preceding description.

The cam member 84 is provided with a plurality of notches 85 in any one of which I may fit a cam device 86 which is held in place by a suitable screw 87. This cam 86 has a bevelled upper surface 87' (see Fig. 6) while opposite the cam 86 I show a fixed cam 88 which is arranged adjacent the lower end of the rod 84. The cam engaging portions 81 and 82 are disposed in the path of movement of the cams 86 and 88 and as a result when the cam rod moves to its lower position the cam 88 rocks the member 79 to the position shown in Fig. 6 and when the cam rod is lifted so that the cam 86 engages the portion 81 the member 79 is rocked about the pivot 80 to another position. By shifting the cam engaging portion 85 the length of the stroke may be varied. A pin 91 on the cam engaging member 79 projects through a slot 92 in the housing closure 78 and fits within an aperture in the end of an arm 93 which is pivoted as at 94 to the closure 78 and is pivotally connected by a coupling member 95 with a rod 96. The rod 96 engages a lever 97 (see Fig. 2) on the shaft 98 of the valve member 70.

In the operation of my device the tank 64 is partially filled with a suitable liquid and air under pressure is supplied in the tank above the fluid. The pump is then started and assuming that the pistons 28 are at the bottom of their stroke the valve vane member 70 will be turned to the position shown in Fig. 3 to direct liquid from the tank through the valve member 60 to the pump then from the pump to the cylinders so that the piston will be raised. When the piston reaches the top of its stroke the valve vane 70 will be shifted by the rod 96 to the position shown in Fig. 1 so that the pump continues in the same direction of rotation and directs liquid from the cylinders into the valve member 60 and from the valve member 60 through the pump to the tank.

The compressed air in the tank during the raising of the pistons helps the pump in producing power by increasing the pressure while when the pistons are descending pressure is built up in the tank. Due to the action of the pump 74 pressure remains at a desired amount just below the point at which the blow-off valve 72 is set.

In the device shown in Figs. 1 to 6, inclusive, the valves 53 and 54 may be so adjusted that the speed of the stroke up or down may be increased. Other adjustments may be made by the valves 53 and 54 as desired.

In Figs. 7, 8, and 9 I show a modification of my invention. In this modification the cylinders, valve, pump, and tank are similar to those previously described and are indicated by similarly primed reference characters.

In the modified form of my invention I provide a motor 100 which is provided with a variable speed drive device 101. This device 101 includes a pulley 102 comprising a pair of members on the armature shaft of the motor and a pulley 103 comprising a pair of members on a driven shaft 104. The pulleys 102 and 103 are connected by a belt 105 and as is well known in a drive of this

nature when the upper pulley members are shifted towards or from each other to change the diameter of the upper pulley the lower pulley members are simultaneously shifted from or towards each other to change the diameter of the lower pulley and in this way provision is made for changing the relative size of the pulleys and thus varying the drive speed. Drives of this construction are in general use and therefore further details are unnecessary.

In accordance with my invention the two control members 106 and 107 for the pulleys are mounted on a lever 108 which is pivoted on a shaft 109 secured to an arm 110 which is mounted on a support 111 which is shown as secured to the tank 64' and braced by a post 112. This shaft 109 suitably supports the lever 108 and at one side of the shaft 109 I pivot one end of a rod 113 to the lever. The other end of the rod 113 is connected to an end member 114 of a Sylphon member 115. The Sylphon includes a housing 116 which has a cylindrical bore 117 which reciprocates on a cylindrical member 118. The end member 114 is shown as secured to the housing 116 as by screw threaded engagement therewith. The member 118 includes a projecting portion 119 through which a duct member 120 extends. A pipe 120' at one end opens into the duct 120 and at the opposite end opens into the pipe 68'. Thus when the pump 65' is operating a continuous fluid pressure is maintained in the Sylphon member 115. The housing 116 is provided with a base 121 which engages and slides along the support 111 while the member 120 passes through a slot 122 in the housing and passes through the support 111.

The housing 116 at one end is secured to the rod 113 and at the other end has an aperture 123 through which a rod 124 extends. The rod 124 has a head 125 thereon and between the head 125 and the end of the housing adjacent the aperture 123 I arrange a coiled spring 126. The rod 124 is threaded into the bracket 127 shown as fixed on the tank 64' so that the rod may be adjusted towards and from the tank.

The construction is such that when pressure of liquid in the duct member 120 is increased the housing 116 is moved to the left in Fig. 9 thus rocking the lever 108 and increasing the effective diameter of the pulley 102 and decreasing the effective diameter of the pulley 103 so that the speed of the latter pulley is increased. When the pressure in the duct 120 decreases the spring 126 moves the cylindrical housing to the right in Fig. 9 thus rocking the lever and decreasing the diameter of the pulley 102 and increasing the diameter of the pulley 103 and the speed of the latter is decreased.

The pulley 103 is connected to a pulley 127' which through a belt 127'' drives a pulley 128 on the shaft of a pump 65'. This pump 65' has its outlet 68' connected by a pipe 69' with a valve 60' which is similar in all respects to the valve 60 while the inlet of the pump 65' is connected by a pipe 66' with the valve 60'. The tank 64' is connected by a pipe 63' with the valve 60' while the valve is also connected by a pipe 62' with the inlet 45' to the cylinders 13' and 14'. The valve vane member 70' is rocked by a rod 96' as previously described.

In the operation of my device the tank 64' is partially filled with a suitable liquid and air under pressure is supplied in the tank above the fluid. The pump 65' is then started and assuming that the pistons are at the bottom of their strokes

the valve vane member 70' will be turned to the position indicated by the dotted lines in Fig. 7 to direct fluid from the tank through the valve member 60' to the pump thence from the pump to the cylinders so that the piston will be raised. When the piston reaches the top of its stroke the valve vane 70' will be shifted by the rod 96' to the position shown by the full lines in Fig. 7 so that the pump continues in the same direction of rotation and directs fluid from the cylinders into the valve member 60' and through the valve member to the pump 65' and thence to the tank 64'. The compressed air in the tank in the raising of the pistons helps the pump in producing power by increasing the pressure while when the pistons are descending pressure is built up due to the increase of pressure in the tank and also due to the pumping action of the pump 65'. With the device shown in Fig. 7 the Sylphon member may be so adjusted that the speed up or down of the stroke may be adjusted.

In Figs. 10, 11, and 12 I show a modification of my invention wherein the parts comprising the pump, valve, motor, piston, tank, and control for the valve are similar to that described in Figs. 1 to 6, inclusive, and similar parts are indicated by double primed reference numbers. The arrangement of the pump and motor is shown as below the valve and control member but the general relation of the parts is unchanged.

In the modification of Figs. 10, 11, and 12 the A-frame is removed and but a single cylinder 14'' is provided in which a tube 34'' operates. This tube 34'' has an operating member 130 thereon. This operating member as shown is intended for use in a device for pumping one or more wells although it is to be understood that the number may be varied without departing from the spirit of my invention.

As shown the operating member 130 is mounted in the substantial center of a circular base or support 131 on which a plurality of bearing brackets 132 are mounted. These bearing brackets 132 pivotally support pull arm cranks 133 which are in the nature of bell cranks and pivoted at one end to fastening members 134 which are shown as connected to cables 135 the latter of which are arranged to operate the sucker rods.

The arms 133 also include ends 136 which are slotted as at 137 to receive pins 138 on the operating member 130.

The construction is such that when the piston reciprocates within the cylinder 14'' during the operation as previously described the operating member 130 will be raised and lowered thereby rocking the bell crank arms 133 from the dotted line position shown in Fig. 10 to the solid line shown in this figure thereby alternately pulling and slacking the cable 135 and thereby causing the sucker rods to raise and lower.

In Fig. 13 I show a further modification of my invention wherein the operating member 130' which is operated by a cylinder as described in connection with the device shown in Figs. 10, 11, and 12 is connected to one or more cables 139 each of which passes over pulleys 140 whence they go to the well to operate the sucker rod. Each of the pulleys 140 is mounted on a bracket 141 which is arranged on a base 142 through which the tube 34'' extends. The bracket 141 is adjustable towards and from the base by being mounted on threaded members although any other type of adjustment may be employed as desired.

From the foregoing it will be apparent that I

have invented a novel hydraulic pump jack which is very efficient in operation and which can be economically manufactured.

Having thus described my invention I claim:

1. In a hydraulic pump jack, a support, a pair of cylinders on said support, a piston in each of said cylinders, each of said cylinders having an inlet, a valve, said valve including a body having a cylindrical bore and having four openings therein, each of the openings communicating with said bore, a pipe connected to each of said openings, means connecting one of said pipes to said cylinders, a tank adapted to hold liquid, means to connect a second pipe with said tank, a pump, means to connect a third pipe to the inlet to said pump, means to connect a fourth pipe to the outlet from said pump, a shiftable valve member in said bore, said member in one position allowing communication between said first and third pipes and between said second and fourth pipes, said valve member in another position affording communication between said first and fourth pipes and between said second and third pipes, a lever on said valve member, a housing, an arm pivoted on said housing and connected to said lever, a cam engaging member in said housing, means on said cam engaging member engaging said lever to rock the latter, a cam rod connected to one of said pistons, a pair of cams on said cam rod, said cam engaging member being pivoted in said housing and means on said cam engaging member to engage said cams to rock the cam engaging member and thereby shift said arm and said valve.
2. In a hydraulic pump jack, a support, a pair of cylinders on said support, a piston in each of said cylinders, each of said cylinders having an inlet, a valve, said valve including a body having a cylindrical bore and having four openings therein, each of the openings communicating with said bore, a pipe connected to each of said openings, means connecting one of said pipes to said cylinders, a tank adapted to hold liquid, means to connect a second pipe with said tank, said second pipe being disposed diametrically opposite to said first pipe, a pump, means to connect a third pipe to the inlet to said pump, means to connect a fourth pipe to the outlet from said pump, said second and fourth pipes being diametrically arranged, a shiftable valve member in said bore, said member in one position allowing communication between said first and third pipes and between said second and fourth pipes, said valve member in another position affording communication between said first and fourth pipes and between said second and third pipes, a lever on said valve member, a housing on one of said cylinders, a closure for said housing, an arm pivoted to said closure and connected to said lever, a cam engaging member in said housing, means on said cam engaging member engaging said lever to rock the latter, a cam rod connected to one of said pistons, a pair of cams on said cam rod, said cam engaging member being pivoted in said housing and means on said cam engaging member to engage said cams to rock the cam engaging member and thereby shift said arm and said valve.
3. In a hydraulic pump jack, a support, a pair of cylinders on said support, a piston in each of said cylinders, each of said cylinders having an inlet, a valve, said valve including a body having a cylindrical bore and having four openings therein, each of the openings communicating with

said bore, a pipe connected to each of said openings, means connecting one of said pipes with the inlet to each of said cylinders, a tank adapted to hold liquid, means to connect a second pipe with said tank, said second pipe being disposed diametrically opposite to said first pipe, means to connect a third pipe to the inlet to said pump, means to connect a fourth pipe to the outlet from said pump, said second and fourth pipes being diametrically arranged, a valve in said bore, said valve including a blade rotatably mounted, said blade in one position allowing communication between said first and third pipes and between said second and fourth pipes, said valve member in another position affording communication between said first and fourth pipes and between said second and third pipes, a lever on said valve member, a shifter housing on one of said cylinders, said shifter housing having a closure therein, an arm pivoted on said closure, a cam engaging member in said housing, means on said cam engaging member engaging said arm, a shifter rod mounted on said piston, a pair of cams on said shifter rod, a cam engaging member pivoted in said housing and means on said cam engaging member to engage said cams to rock the cam engaging member and thereby shift said arm and said valve.

4. In a hydraulic pump jack, a pair of cylinders, a piston in each of said cylinders, a piston rod on each piston, a pull member connecting said rods, each of said cylinders having an inlet, a valve having a cylindrical bore and having four openings therein communicating with said bore, a stroke control device, means connecting the first opening of said valve with the stroke control device, means connecting said stroke control device with the inlet to said cylinders, a tank adapted to hold liquid, means to connect the second opening of said valve with said tank, a pump having an inlet and an outlet, means to connect the third opening of said valve to the inlet to said pump, means to connect the fourth opening of said valve to the outlet from said pump, a shiftable valve member in said bore, a lever on said valve member, a housing on one of said cylinders, an arm pivoted to said housing and connected to said lever, a cam engaging member in said housing, means on said cam engaging member engaging said arm to rock the latter, a cam rod connected to one of said pistons, cams on said cam rod, said cam engaging member being pivoted in said housing, means on said cam engaging member to engage said cams to rock the cam engaging member and thereby shift said arm and said valve, said valve being shifted when the pistons reach the bottom of their strokes to connect the fourth opening to the first and the second to the third and shifted when the top of their strokes is reached to connect the first to the third opening and the second to the fourth, said stroke control device including a housing having a partition therein forming two chambers, said partition having a pair of valve seats therein, a valve engaging each of said seats, one of said valves being on one side of the partition, the other valve on the other side of the partition, a pair of flap check valves controlling flow through said chambers, one of said flap check valves being directed in one direction and the other being directed in the other direction, means to operate said pump and means to produce air under pressure in said tank.

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