

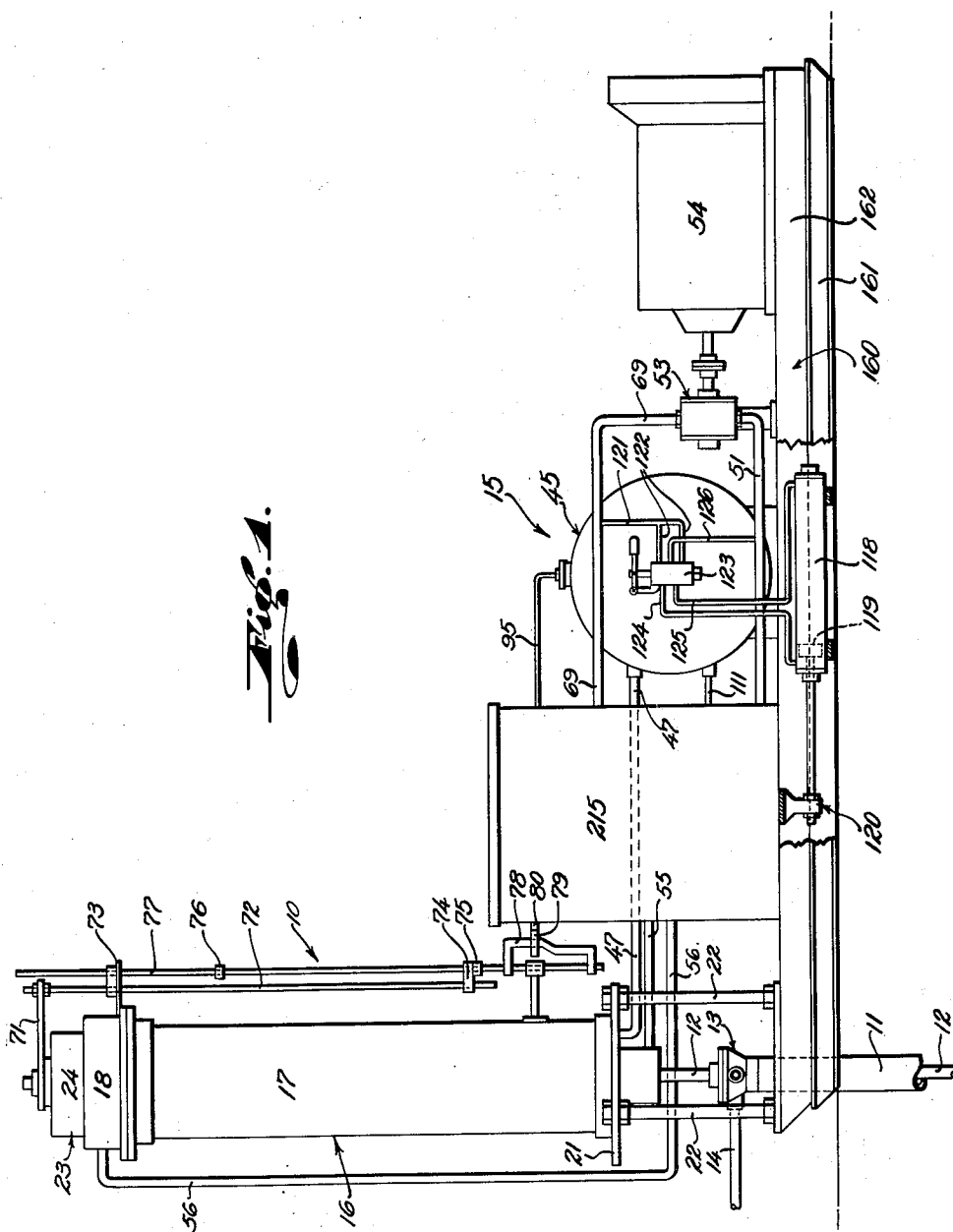
Aug. 14, 1951

S. V. SMITH
PNEUMATIC-HYDRAULIC SYSTEM FOR OPERATING
WELL PUMPING EQUIPMENT

2,564,285

Filed March 11, 1948

4 Sheets-Sheet 1



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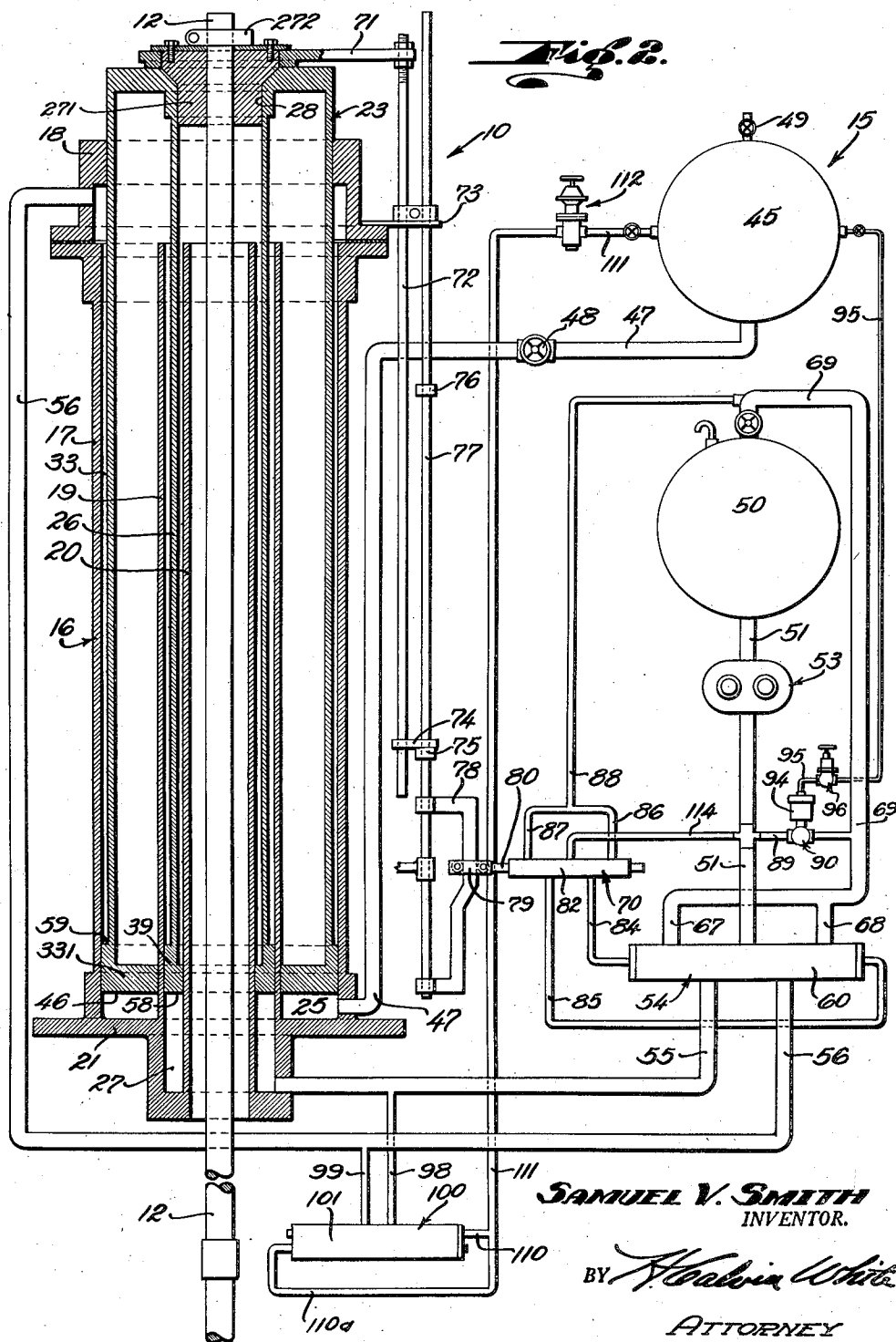
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Fig. 3.

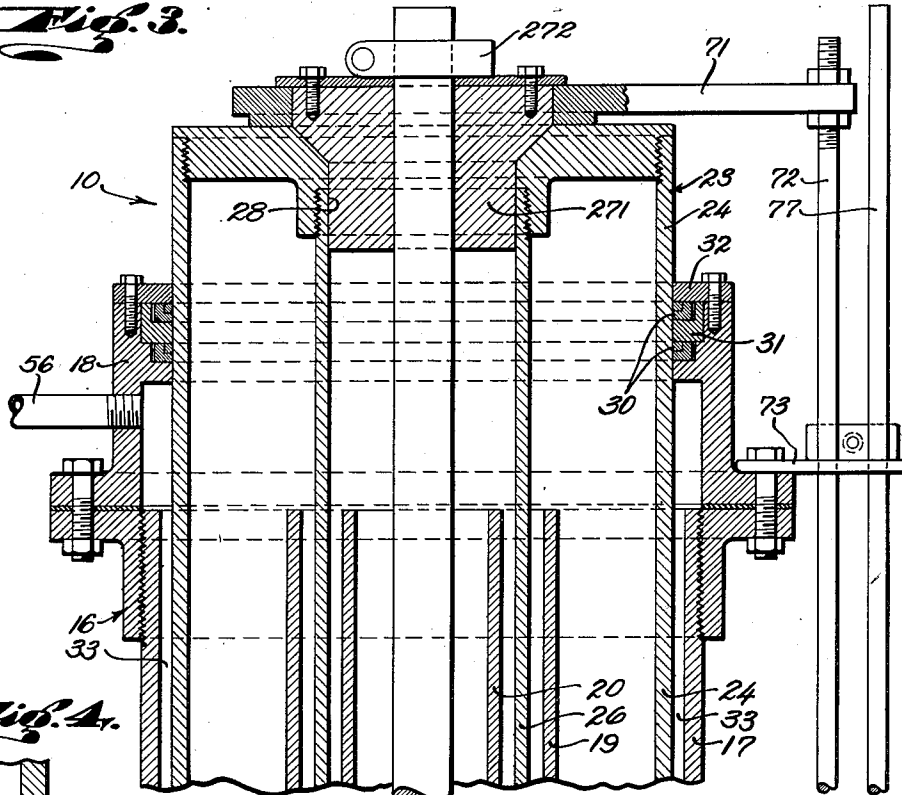


Fig. 4.

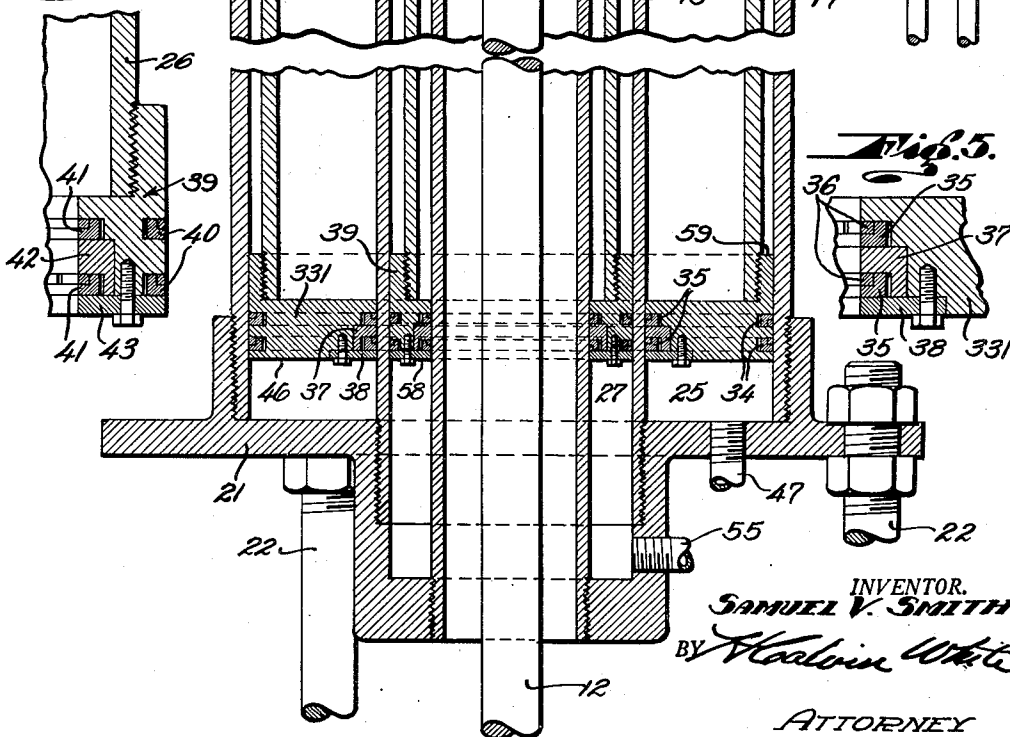
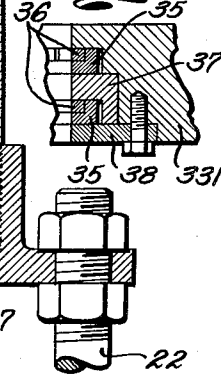


Fig. 5.



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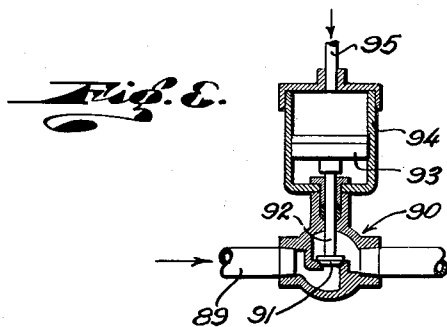
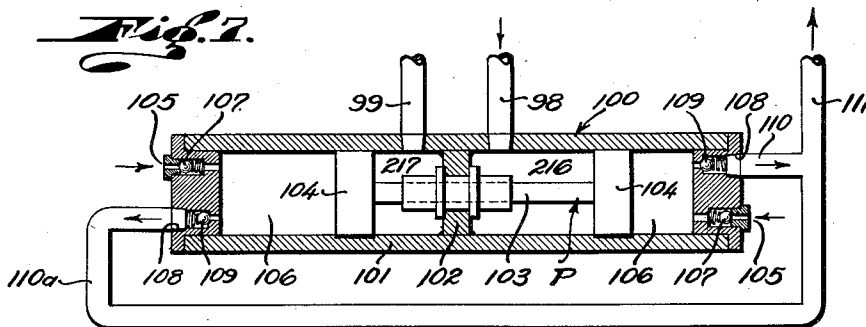
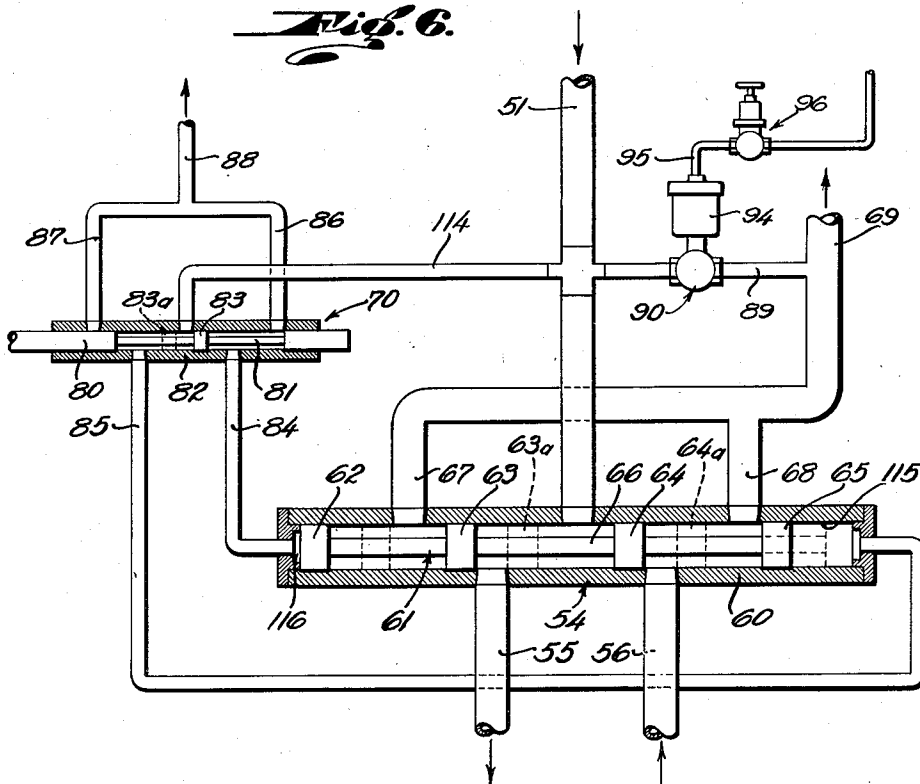
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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

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PNEUMATIC-HYDRAULIC SYSTEM FOR OPERATING WELL PUMPING EQUIPMENT

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Application March 11, 1948, Serial No. 14,355

14 Claims. (Cl. 60—51)

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This invention has to do generally with load hoisting equipment, and relates particularly to improvements in fluid pressure powered hoist or jack units, especially as adapted to the operation of deep well pumps.

Generally speaking, the present unit may be characterized as comprising a jack piston and cylinder assembly connected to and operating the load, e. g. an oil well pump and rod string, and pressurized fluid sources from which the fluid pressure is communicated to power the jack piston. Particularly contemplated is a system whereby the jack piston is powered by pressurized gas and hydraulic fluid in a manner involving utilization of the energy of the piston down-stroke by compression of the gas for application to the piston on its up-stroke.

One of my major objects is to provide a system of high operating efficiency made possible by powering the jack piston with gaseous and liquid fluids under conditions such that operation of the piston, whatever may be its load, can be accomplished under low applied hydraulic pressures with correspondingly low energy input required to pressurize the hydraulic fluid. For application of both gas and liquid pressures to actuate the load, the invention contemplates a novel and efficient jack piston and cylinder assembly so constructed to permit separate application and maintenance of the two fluids against the piston, and specifically in a manner whereby the pressurized gas acts constantly against the piston in an elevating direction, while the hydraulic fluid pressure is alternately applied to the piston in opposite directions to effect its reciprocation. As will appear, by maintaining proper relationship of the piston areas and applied gas pressure, reciprocation of the piston and its load may be accomplished by low hydraulic fluid pressure.

A further object of the invention is to modify the speed of the piston to the advantage of the pump, preferably by a unit having the dual functions of accommodating surges of the hydraulic fluid between its pressurizing source and the jack piston, and of delivering to the pressurized air supply, whatever compressed air that may be required for make-up as by reason of slight air leakages from the system. For this purpose I employ a fluid pressure displaceable device, such

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as an auxiliary piston and cylinder, connected to the jack cylinder hydraulic system in a manner such that the auxiliary piston is displaceable by pressure transmitted by the hydraulic fluid from the jack piston. So that its travel is modified in accordance with the surge of liquid into and out of the auxiliary cylinder, the consequent displacement of the auxiliary piston may be used to compress air to the pressurized air supply when the pressure drops below a set limit.

Also contemplated by the invention is a novel pressure control for the hydraulic system operating to prevent the hydraulic fluid pressure from exceeding the maximum which the control is set to maintain. Briefly, such regulation is effected preferably by maintaining in a by-pass section of the hydraulic system, a settable and variable release regulator controlled by pressure taken from the pressurized gas supply. As will appear, under circumstances which might otherwise result in overloading or injury of the equipment as consequence of excessive hydraulic pressure increases, the by-pass control will function smoothly and reliably to limit the pressure increase to whatever limit desired.

The invention has various additional features and objects, all of which, together with the objects referred to in the foregoing will be understood most readily and to best advantage from the following detailed description of a typical embodiment of the invention shown by the accompanying drawings, in which:

Fig. 1 is a general view showing in elevation the pump jack assembly including its power source, and the relationship of the unit to the well head.

Fig. 2 is a view showing diagrammatically various parts of the hydraulic and air systems, and their association with the piston and cylinder assembly appearing in section;

Fig. 3 is an enlarged view illustrating more in detail the structure of the piston and cylinder assembly;

Figs. 4 and 5 are fragmentary enlarged sections illustrating the packing ring confinement within inner and outer portions of the piston structure;

Fig. 6 is a view illustrating diagrammatically the hydraulic control pilot and master valves, together with the fluid by-pass control;

Fig. 7 is a view showing the air check and make-up cylinder in longitudinal section; and

Fig. 8 is an enlarged section of the fluid by-pass control means.

Referring first to the general showing of Fig. 1, the equipment comprises the jack piston and cylinder assembly 10 positioned above the well casing 11 and operating to vertically reciprocate the pump liquid being discharged from the casing head 13 through connected line 14. The jack piston in the assembly 10 is operated, as will later appear, by gas and hydraulic fluid pressures supplied from the sources contained in the general assembly indicated at 15, all of which together with the jack cylinder at 10 may be mounted as a unit, on a base or skid structure 160 for movement toward or away from the well head.

Referring now to Figs. 2 and 3, the jack unit 10 comprises a cylinder assembly 16 comprising an outer section 17 having a head 18, an intermediate section 19 and an inner section 20, the last named sections being open at their upper ends and spaced annularly and concentrically within the outer section 17, as illustrated. The base 21 of the cylinder assembly may be suitably supported on the skids 162, as by legs 22.

The cylinder assembly contains a piston assembly 23 comprising an outer section 24 contained within the outer space 25 between the cylinder sections 17 and 19, and an integral inner section 26 contained within inner space 27 between cylinder sections 19 and 20. The top closed end of the piston assembly is adapted for connection with the pump rod 12, as by bushing 271 and clamp 272 secured to the rod and seating within the head opening 28 of the piston. Thus the rod extends concentrically through and in balanced relationship to the piston and cylinder assemblies. As best illustrated in Fig. 3 the cylinder head 18 contains seal rings 30 retained by rings 31 and 32 and engaging the outer surface of the piston section 24 to prevent fluid leakage from the head and what may be referred to as a third space 33 between the piston and the outer cylinder wall 17.

The outer piston section 24 has a head 331 carrying seal rings 34 and 35 engaging the cylinder walls 17 and 19. As shown in Fig. 5 the seal rings 35, which may be of continuous annular cast iron or other metal composition and containing non-metallic seal inserts 36, are held in place by the retaining rings 37 and 38 in the relationship illustrated. The inner piston section 26 similarly has a head 39 carrying seal ring assemblies 40 and 41 similar to the rings 34, 35, rings 41 being held in place by the retaining rings 42 and 43.

The pressure fluid supply system 15 includes a compressed air reservoir 45 through which air pressure is constantly communicated to space 25 to apply against the piston face 46, by way of line 47 containing a hand valve 48. The reservoir 45 initially may be charged with air under pressure approaching or corresponding to the air pressure to be maintained against the piston face 46, from any suitable source, as by way of the valve inlet 49. Thereafter, the air pressure required for operation of this system may be maintained in the reservoir 45 by utilizing the energy developed by the piston assembly 23, as will later appear.

A hydraulic fluid, such as mineral oil, is supplied from reservoir 50 through line 51 to pump 53 driven by motor 54, see Fig. 1, and is discharged by the pump under control of the master

valve 54 alternately through lines 55 and 56 respectively into spaces 27 and 33 to reciprocate the piston assembly by exertion of the hydraulic fluid pressure against the piston faces 58 and 59. At this point it may be mentioned that preferably these piston faces will correspond closely in area. Referring to Fig. 6, the master valve 54 comprises a cylinder 60 containing a floating piston 61 including heads 62, 63, 64 and 65 on the rod 66. Connecting with the cylinder are the return branches 67 and 68 leading through line 69 to the reservoir 50.

Operation of the master valve 54, and specifically displacement of the floating piston 61, is governed by a pilot valve mechanism 70 which in turn is controlled by the travel of the piston assembly 23. The latter carries a rotatable arm 71 to which is attached a depending rod 72 extending through the guide 73, and carrying arm 74. The latter is engageable with projections 75 and 76 on rod 77 also extending through the guide 73, to shift the rod between its pilot valve actuating positions. Rod 77 carries a cam bracket 78 engaged by a follower 79 attached to the pilot valve rod 80 having a reduced section 81 within cylinder 82 at opposite sides of a valve or piston portion 83. Cylinder 82 is connected with opposite ends of the master valve cylinder 60 by way of lines 84 and 85, as shown in Fig. 6. Branches 86 and 87 lead from cylinder 82 through the return line 88 to the reservoir 50.

Line 51 is communicable at the discharge side of the pump 53 with line 69 by way of by-pass line 89 containing a valve 90 which may be of any suitable type responsive to the fluid pressure, and specifically to air pressure communicated from the reservoir 45. As illustrated, the valve 90 is shown to comprise the valve 91 proper having a stem 92 attached to piston 93 within cylinder 94 to which air pressure is communicated from the reservoir by way of line 95 containing a manually settable valve 96, see Fig. 2. Adjustment of valve 96 imposes controllable air pressure in cylinder 94 and therefore air pressure against piston 93 to maintain such resistance to opening of the valve 91 under the influence of the hydraulic pressure communicated from the pump through line 89, as will limit the maximum hydraulic pressure transmittable through lines 55 and 56 to the piston and cylinder assembly 10. Accordingly, by selective setting of the by-pass control it is possible to confine the maximum hydraulic pressure as desired and within safe limits.

Lines 55 and 56 connect respectively through branches 98 and 99 with the auxiliary hydraulic fluid accommodating assembly, generally indicated at 100, the details of which appear in Fig. 7. The assembly 100 comprises in effect a pair of individual surge receiving units which may be incorporated in a single cylinder 101 containing a central partition 102 through which extends the rod 103 interconnecting the heads 104 of a floating piston P. The cylinder heads contain compression chambers 106 to which air is admitted past check valves 107. The cylinder heads also contain the outlets 108 closed against return air flow by check valves 109, communicating through branches 110 and 110a with line 111 leading to the air reservoir 45. Line 111 contains a pressure regulating valve, conventionally indicated at 112 which may be set to maintain a controllable air pressure in the reservoir, as required for the selected pressure to be exerted against the jack piston.

In considering the operation of the system, assume the parts to be in the positions illustrated in Figs. 2 to 7, with the piston assembly 23 at the limit of its down stroke. Pressurized hydraulic fluid is delivered from line 51 through the master valve cylinder between pistons 63 and 64, through line 55 into the cylinder space 27. The hydraulic fluid thus applied to the piston face 58 supplements the air pressure communicated to space 25 and acting against the piston face 46, to elevate the piston assembly. At this point it may be observed that ordinarily the air pressure acting against the piston may rather closely approach that pressure required to elevate the piston and its load taken through the rod 12, so that the magnitude of hydraulic fluid pressure required for operation of the piston is relatively small. Preferably the air pressure will be just under, say within a range of 25 lbs., that pressure required to elevate the piston and its load. The supplementary hydraulic fluid pressure in chamber 27 thus operates to elevate the piston assembly and the rod string throughout its pumping stroke.

During elevation of the piston, hydraulic fluid is displaced from space 33 through line 56 and the master valve cylinder between the piston valve heads 64 and 65, and through lines 68 and 69 to the reservoir 50. At the same time, the pilot valve is positioned to communicate the hydraulic pump discharged pressure through line 114, cylinder 82 at the left of the valve piston 83, and line 85 to the master valve chamber 115, to maintain the master valve in its Fig. 6 position. During the previous displacement of the master valve 61 from right to left, the fluid in chamber 116 will have been displaced through line 84, the pilot valve cylinder, and lines 86 and 88 to the reservoir 50.

As the piston assembly 23 approaches the upper limit of its stroke, the valve control arm 74 engages projection 76 to raise rod 77 and its cam 78, shifting the pilot valve to bring its piston section 83 to the dotted line position 83a, whereupon the pump discharge pressure is communicated through line 84 to the master valve cylinder shifting valve 61 to bring its intermediate piston sections to the positions indicated by the dotted lines 63a and 64a. As a result, the high pressure hydraulic fluid is discharged through line 56 into space 33 to apply against the piston face 59 during the down stroke of the piston assembly 23. Throughout the piston down stroke, fluid in space 27 is returned through line 55, the master valve cylinder and lines 67 and 69 to the reservoir 50. As the master valve shifts to the right, fluid is displaced from chamber 115 through line 85, the pilot valve cylinder 82 and lines 87 and 88 to the reservoir 50. From the foregoing it will be apparent that the relationships between the hydraulic and the air pressures, and the areas of the piston 23 against which such pressures act, may be such that the weight of the pump rod 12 and its load is sufficient to move the piston throughout its down stroke. Should the load encounter such resistance, as by reason of the required force to be transmitted to the well pump, or for any other reason, that the load weight is insufficient to power the piston assembly throughout its down stroke, the supplemental hydraulic pressure acting against the piston face 59 will supply the energy required for the piston down stroke.

It is anticipated that under some circumstances upward or downward movement of the load 12 might encounter such resistance as to

cause damage or breakage of the rod string, or other parts, under the influence of the full hydraulic power of which the pump 53 is capable of developing. By proper setting of the by-pass control valve 90, as previously explained, the effective hydraulic pressure transmittable to the piston and cylinder assembly 10 may be kept within safe but adequate operating limits.

The function of the assembly 100 is two-fold in that it serves to modify the speed of the piston assembly 23, and also to compress and deliver to the reservoir 45 such make-up air as the system may require from time to time as for example because of slight leakages. As the piston assembly 23 starts its upward travel, its speed in relation to the rate of oil displacement by the pump 53 is retarded due to the fact that the pressure in lines 55 and 98 is sufficiently high to displace the piston P toward the right and permit a portion of the oil to enter the enlarging chamber 216. Then as the jack piston gains upward speed, the pressure against piston head 104 at the right of the air previously compressed during movement of the piston to the right, tends to move the latter toward the left and displace the oil from chamber 216 to the jack cylinder chamber 27, supplementing the pump delivery rate. During the reciprocations of piston P, air may be compressed through lines 110 or 110a to the reservoir 45 if its pressure has fallen below that which regulator 112 is set to maintain. Upon reversal of the travel of the piston assembly 23, and starting its down stroke, the pressurized oil is transferred through lines 56 and 99 to the auxiliary unit chamber 217. Initially in the down stroke, the oil pressure may shift the piston P toward the left from an intermediate position due to a greater pressure which at first is required to overcome the piston inertia, following which the piston may return to an intermediate position after the piston is in motion and less oil pressure is required to keep it in motion. Thereafter, the tendency of the oil pressure will be to increase (due to compression of the air applied to the piston) and shift the position to the left, permitting an inflow of oil to chamber and consequent retardation of the jack piston speed during the latter extent of its down stroke.

Referring again to Fig. 1, it is contemplated that all working parts possibly subject to hydraulic fluid leakage, may be contained within a single chamber serving as a common housing and receptacle for such leakage. Accordingly, the reservoir 50, pilot and master valves 70 and 54, the check cylinder 100 and by-pass control valve 90, all may be contained within a tank 215 mounted together with the remaining parts of the described pump jack assembly on the skid or base structure 160.

It is contemplated that the entire jack assembly 10 and 15 may be shifted toward and away from operating position over the well head, by power derived from the pressurized hydraulic fluid. For this purpose, the structure 160 may comprise a stationary base or track section 161 and a support 162 carrying the assemblies 10 and 15 and slidable toward and away from the well head on the base 161. The power unit for so shifting the jack unit is shown typically to comprise a cylinder 118 stationarily secured to the base 161, and containing a piston 119 attached at 120 to the support or skid 162. High pressure fluid from line 51 is delivered through line 126 to a manually reversible 4-way valve

123 from which lines 124 and 125 run to opposite ends of the cylinder 118. Return flow line 121 and its branches 122 connect the valve 123 with the hydraulic pump suction line 69.

After disconnection of the assembly 10 from the pump rod string 12, the 4-way valve 123 may be thrown to a position causing the high pressure hydraulic fluid to be delivered to cylinder 118 through line 124, causing the skid support 162 and the unit carried thereby, to be shifted to the right a distance such that the assembly 10 clears the well head. During such displacement of the unit, the opposite end of cylinder 118 is in communication with pipe 69 through lines 125 and 121. Upon reversal of the valve 123, high pressure fluid is delivered through line 125 to cylinder 118 to return the jack unit to its Fig. 1 position over the well, while fluid return from the left end of cylinder 118 occurs through lines 124 and 121.

I claim:

1. A well pump jack comprising a vertically extending cylinder assembly including three concentric and annularly spaced tubular sections containing inner and outer spaces, a tubular piston assembly comprising an outer tubular section reciprocable within said outer space and an attached inner section reciprocable within said inner space, means for supporting a pump rod or the like by the piston, and means for operating the piston by fluid pressure.

2. A well pump jack comprising a vertically extending cylinder assembly including three concentric and annularly spaced tubular sections containing inner and outer spaces, a tubular piston assembly comprising an outer tubular section reciprocable within said outer space and an attached inner section reciprocable within said inner space, means for supporting a pump rod or the like by the top portion of the piston so that the rod extends downwardly through said inner cylinder section, and means for operating the piston by fluid pressure.

3. A well pump jack comprising a vertically extending cylinder assembly including three concentric and annularly spaced tubular sections containing inner and outer spaces, a tubular piston assembly comprising an outer tubular section reciprocable within said outer space and an attached inner section reciprocable within said inner space, there being a third space between said outer cylinder and piston sections, means for supporting a pump rod or the like by the piston, and means for communicating fluid pressure to said spaces to operate the piston.

4. A well pump jack comprising a vertically extending cylinder assembly including three concentric and annularly spaced tubular sections containing inner and outer spaces, a tubular piston assembly comprising an outer tubular section reciprocable within said outer space and an attached inner section reciprocable within said inner space, there being a third space between said outer cylinder and piston sections, means for supporting a pump rod or the like by the piston, means for constantly communicating gas pressure to said outer space and against the outer piston section tending to raise the piston assembly, means for communicating to said inner space hydraulic pressure acting against inner piston section and tending to raise the piston assembly, and means for communicating to said third space hydraulic fluid pressure acting against said outer piston section and tending to lower the piston assembly.

5. A well pump jack comprising a vertically extending cylinder assembly including three concentric and annularly spaced tubular sections containing inner and outer spaces, a tubular piston assembly comprising an outer tubular section reciprocable within said outer space and an attached inner section reciprocable within said inner space, there being a third space between said outer cylinder and piston sections, means for supporting a pump rod or the like by the piston, means for constantly communicating gas pressure to said outer space and against the outer piston section tending to raise the piston assembly, means for communicating to said inner space hydraulic pressure acting against inner piston section and tending to raise the piston assembly, and means for communicating to said third space hydraulic fluid pressure acting against said outer piston section and tending to lower the piston assembly, the hydraulic fluid pressure acting against substantially equal effective areas of said inner and outer piston sections.

6. A well pump jack comprising a vertically extending cylinder assembly including three concentric and annularly spaced tubular sections containing inner and outer spaces, a tubular piston assembly comprising an outer tubular section reciprocable within said outer space and an attached inner section reciprocable within said inner space, there being a third space between said outer cylinder and piston sections, means for supporting a pump rod or the like by the piston, means for constantly communicating gas pressure to said outer space and against the outer piston section tending to raise the piston assembly, means for communicating to said inner space hydraulic pressure acting against said inner piston section and tending to raise the piston assembly, means for communicating to said third space hydraulic fluid pressure acting against said outer piston section and tending to lower the piston assembly, a pressurized hydraulic fluid source, and valve means controlled by movement of said piston assembly to transmit the hydraulic fluid pressure from said source alternately to said inner and third spaces.

7. A well pump jack comprising a vertically extending cylinder assembly including three concentric and annularly spaced tubular sections, containing inner and outer spaces, a tubular piston assembly comprising an outer tubular section reciprocable within said outer space and an attached inner section reciprocable within said inner space, there being a third space between said outer cylinder and piston sections, means for supporting a pump rod or the like by the piston, means for constantly communicating gas pressure to said outer space and against the outer piston section tending to raise the piston assembly, means for communicating to said inner space hydraulic pressure acting against inner piston section and tending to raise the piston assembly, means for communicating to said third space hydraulic fluid pressure acting against said outer piston section and tending to lower the piston assembly, a pressurized hydraulic fluid source, a pilot valve, means for actuating said pilot valve in accordance with the piston assembly travel, a master valve responsive to movement of said pilot valve, and means whereby movements of the master valve transmit the hydraulic fluid pressure from said source alternately to said inner and third spaces.

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8. A well pump jack comprising a vertically extending cylinder assembly including three concentric and annularly spaced tubular sections containing inner and outer spaces, a tubular piston assembly comprising an outer tubular section reciprocable within said outer space and an attached inner section reciprocable within said inner space, there being a third space between said outer cylinder and piston sections, means for supporting a pump rod or the like by the piston, means for constantly communicating gas pressure to said outer space and against the outer piston section tending to raise the piston assembly, means for communicating to said inner space hydraulic pressure acting against inner piston section and tending to raise the piston assembly, means for communicating to said third space hydraulic fluid pressure acting against said outer piston section and tending to lower the piston assembly, a pressurized hydraulic fluid source, valve means controlled by movement of said piston assembly to transmit the hydraulic fluid pressure from said source alternately to said inner and third spaces, a reservoir charged with compressed air and in constant communication with said outer space, and a pump actuated by the energy of said piston assembly and operable to compress air into said reservoir.

9. A well pump jack comprising a vertically extending cylinder assembly including three concentric and annularly spaced tubular sections containing inner and outer spaces, a tubular piston assembly comprising an outer tubular section reciprocable within said outer space and an attached inner section reciprocable within said inner space, there being a third space between said outer cylinder and piston sections, means for supporting a pump rod or the like by the piston, means for constantly communicating gas pressure to said outer space and against the outer piston section tending to raise the piston assembly, means for communicating to said inner space hydraulic pressure acting against inner piston section and tending to raise the piston assembly, means for communicating to said third space hydraulic fluid pressure acting against said outer piston section and tending to lower the piston assembly, a pressurized hydraulic fluid source, valve means controlled by movement of said piston assembly to transmit the hydraulic fluid pressure from said source alternately to said inner and third spaces, a reservoir charged with compressed air and in constant communication with said outer space, a cylinder, having an air inlet and connected to said reservoir, a piston in the last mentioned cylinder, and means for actuating said piston by said hydraulic fluid under pressure created by said piston assembly to compress air into said reservoir.

10. A well pump jack comprising a vertically extending cylinder assembly including three concentric and annularly spaced tubular sections containing inner and outer spaces, a tubular piston assembly comprising an outer tubular section reciprocable within said outer space and an attached inner section reciprocable within said inner space, there being a third space between said outer cylinder and piston sections, means for supporting a pump rod or the like by the piston, means for constantly communicating gas pressure to said outer space and against the outer piston section tending to raise the piston assembly, means for communicating to said

inner space hydraulic pressure acting against inner piston section and tending to raise the piston assembly, means for communicating to said third space hydraulic fluid pressure acting against said outer piston section and tending to lower the piston assembly, a pressurized hydraulic fluid source, valve means controlled by movement of said piston assembly to transmit the hydraulic fluid pressure from said source alternately to said inner and third spaces, a compressed air source communicable with said outer space, and means controllable by the pressure of the compressed air to limit the maximum hydraulic pressure transmitted from said hydraulic fluid source to said inner and third spaces.

11. A well pump jack comprising a piston reciprocable to raise and lower its load in the well, a compressed gas source, a pressurized hydraulic fluid source independent of said compressed gas source, means communicating the compressed gas pressure against the piston in a load elevating direction during both strokes of the piston, means communicating the hydraulic fluid pressure to the piston, means for alternately applying the hydraulic fluid pressure to the piston in advancing directions during both of its strokes, and a valve device controlled by and in accordance with differential pressures of the gas and hydraulic fluid and operating to limit the maximum hydraulic pressure applied to the piston.

12. A well pump jack comprising a vertically extending cylinder and a piston therein reciprocable vertically to raise and lower the jack load in the well, a compressed gas source, a pressurized hydraulic fluid source independent of said compressed gas source, means communicating the compressed gas pressure to a first surface of the piston to aid in elevating the load, means communicating the hydraulic fluid pressure to second and third surfaces of the piston, means for alternately applying the hydraulic fluid pressure to said second and third surfaces to reciprocate the piston, and a valve device controlled by and in accordance with differential pressures of the gas and hydraulic fluid and operating to limit the maximum hydraulic pressure applied to the piston.

13. A well pump jack comprising a vertically extending cylinder assembly including a plurality of annularly spaced concentric tubular sections, a piston assembly including a plurality of annularly spaced concentric tubular sections reciprocable vertically between said cylinder sections, means for constantly applying fluid pressure to a first downwardly facing area of the piston assembly, means for alternately applying fluid pressure to second and third upwardly and downwardly facing areas of the piston assembly, and means for connecting the piston assembly with a pump rod.

14. A well pump jack comprising a vertically extending cylinder assembly including a plurality of annularly spaced concentric tubular sections, a piston assembly including a plurality of annularly spaced concentric tubular sections reciprocable vertically between said cylinder sections, means for constantly applying fluid pressure to a first downwardly facing area of the piston assembly, a pressure fluid source, valve means controlling the delivery of fluid from said source to the piston and cylinder assembly, means for actuating said valve means in accordance with the piston assembly travel to alternately apply fluid pressure to second and third upwardly and downwardly facing areas of the piston as-

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sembly, and means for connecting the piston assembly with a pump rod.

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