Feb. 6, 1951 V. O. POUNDS 2,540,347

FLUID OPERATED PUMPING MECHANISM

Filed Aug. 13, 1948 3 Sheets-Sheet 1

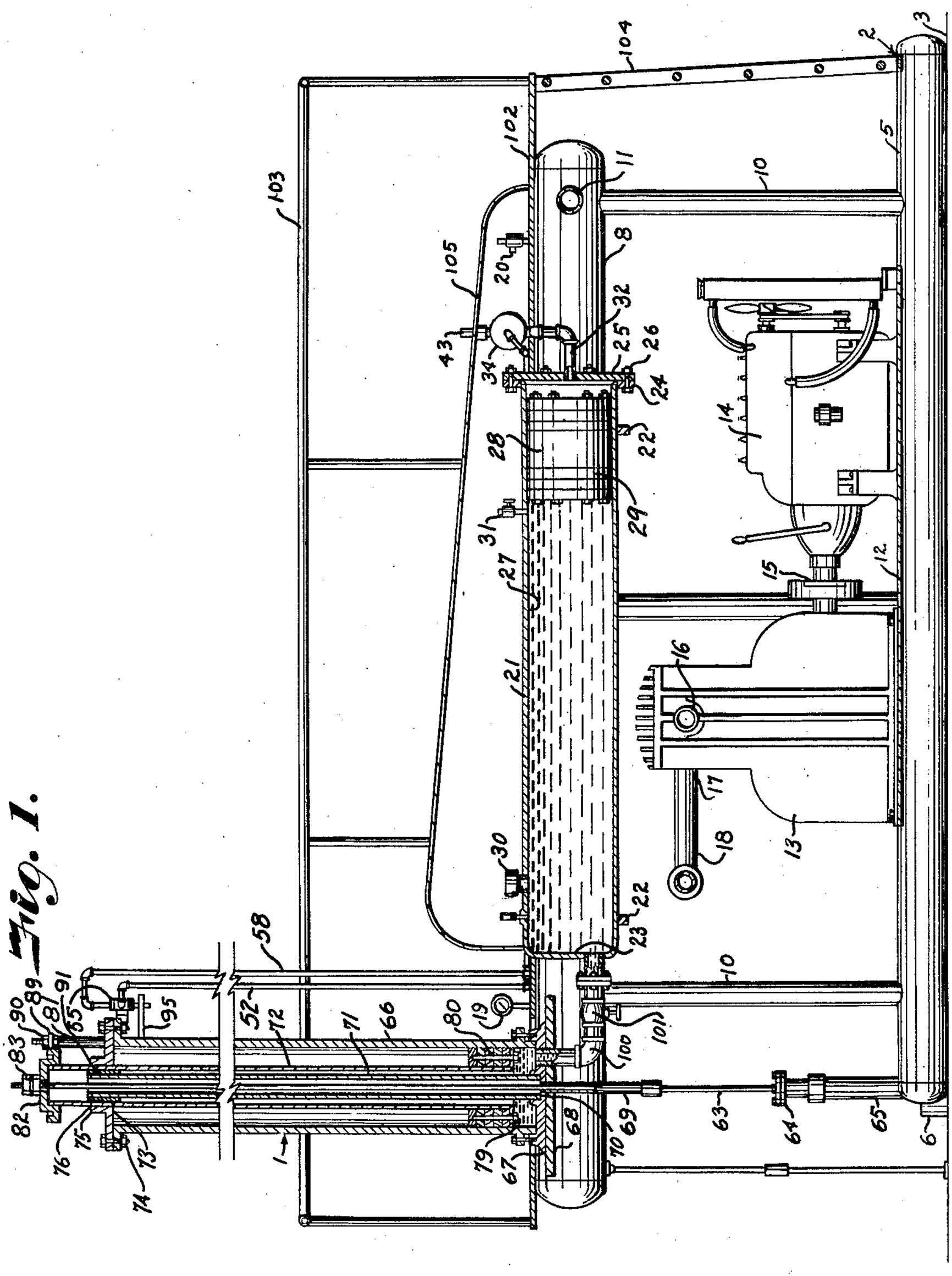

Fig. 1.

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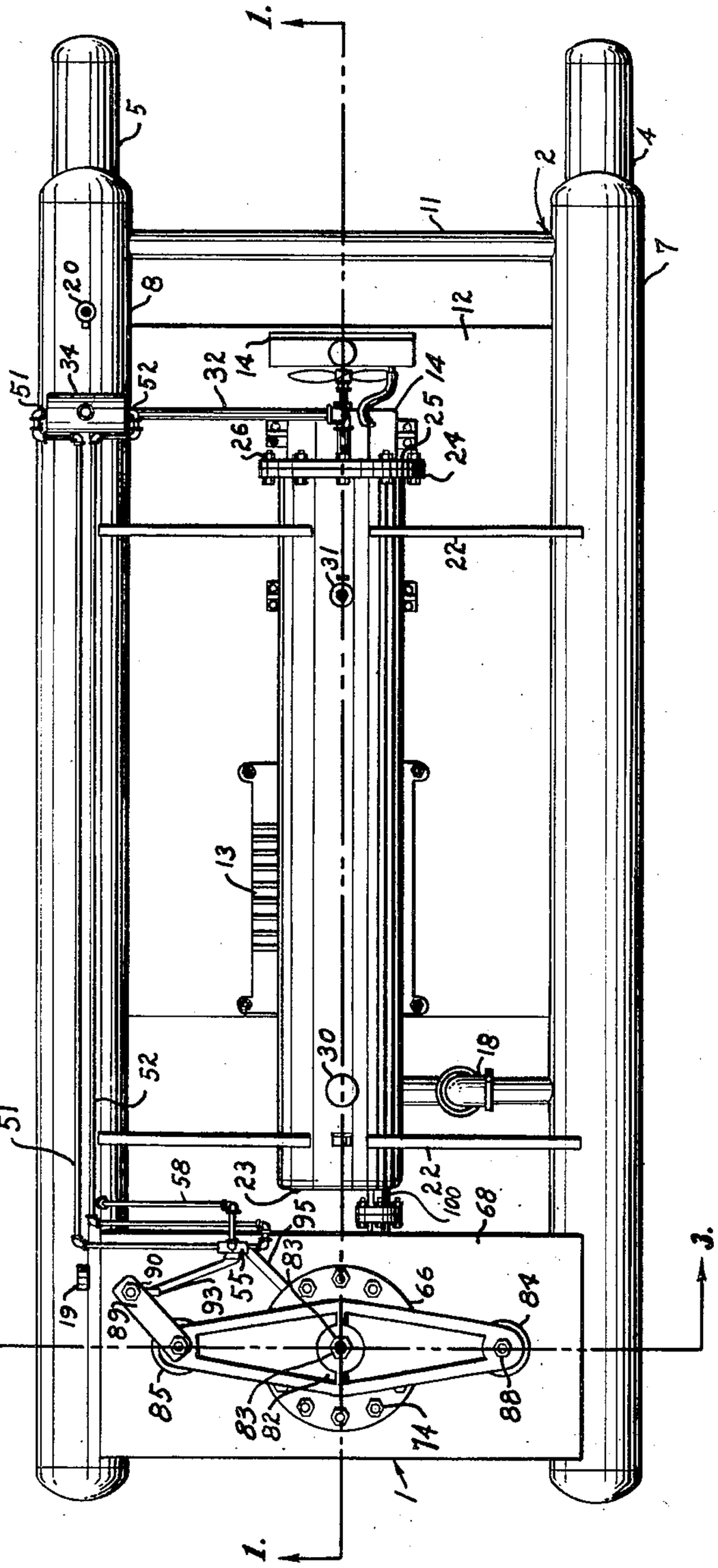

Fig. 2.

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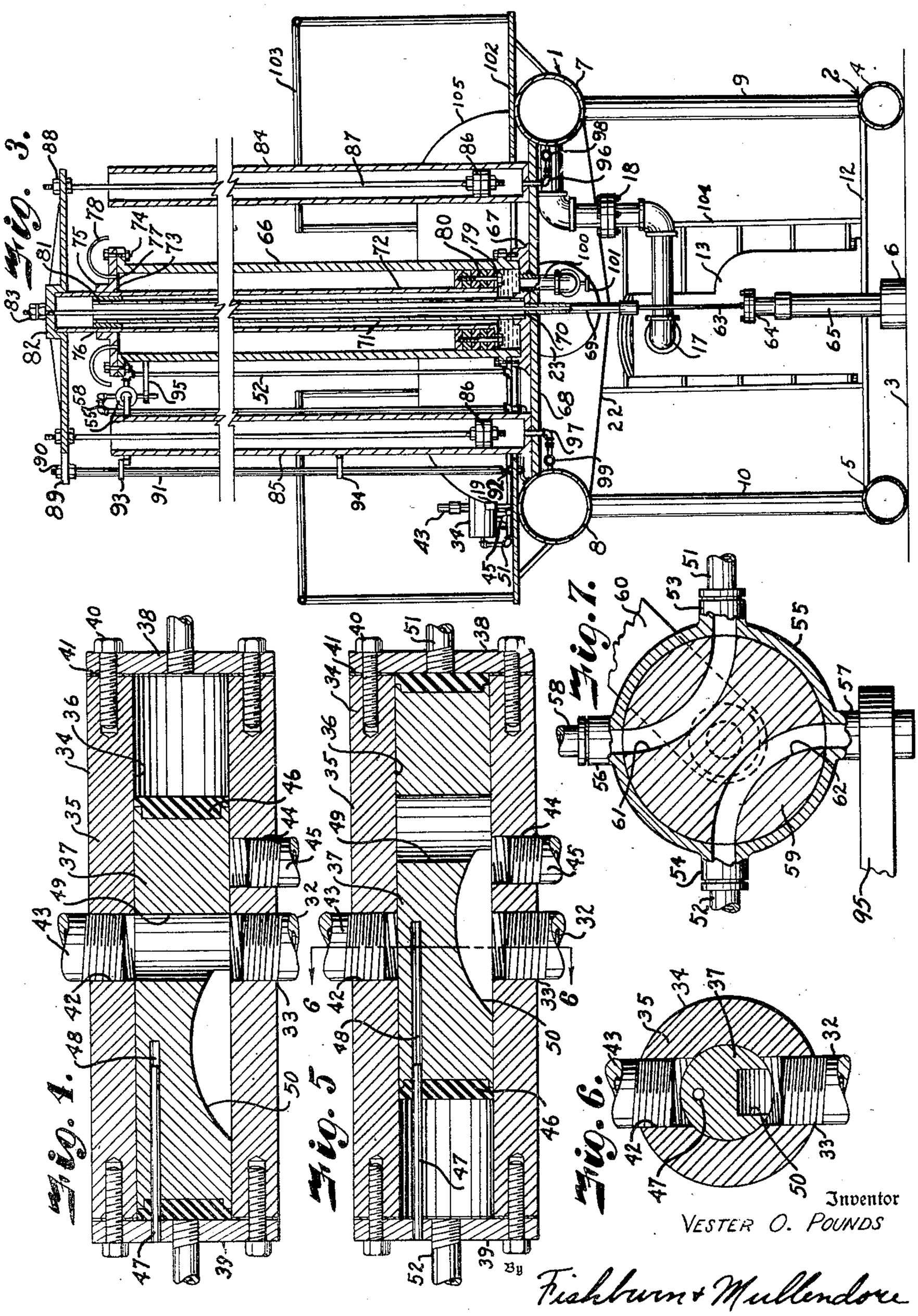

Fig. 3.

Fig. 7.

Fig. 4.

Fig. 5

Fig. 6.

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FLUID OPERATED PUMPING MECHANISM

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Application September 13, 1948, Serial No. 49,100

7 Claims. (Cl. 60—52)

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This invention relates to a fluid operated pumping mechanism and more particularly to improvements in hydro-pneumatic pumping jacks for use in connection with oil or other wells.

The objects of the present invention are to provide a pumping jack having long adjustable stroke in which the forces applied to the pump rod are always in line therewith; to provide an air and liquid cushioned liquid actuated pumping mechanism eliminating shock or jerk in the pump rods; to provide a well pumping mechanism with devices operating on air or gas pressure for assisting the upstroke and cushioning the downstroke of the pump; to provide an air valve for controlling operation of the pumping mechanism; to provide a floating piston actuated by fluid pressure for moving a body of liquid to effect the stroke of a well pumping jack; to provide a hollow frame for a pumping jack wherein said frame serves as a fluid pressure tank; to provide a hydro-pneumatic pumping jack having controls actuated by movement thereof for automatic operation; and to provide a hydro-pneumatic pumping jack which is simple and economic to manufacture, efficient in operation and easily adjusted to vary the lengths of the pumping stroke.

In accomplishing these and other objects of the present invention I have provided improved details of structure, the preferred form of which is illustrated in the accompanying drawings wherein:

Fig. 1 is the detailed longitudinal sectional view through the pumping apparatus on the line 1—1, Fig. 2.

Fig. 2 is a plan view of the pumping apparatus with cover and catwalk removed therefrom.

Fig. 3 is a vertical transverse sectional view through the pumping jack on the line 3—3, Fig. 2.

Fig. 4 is a longitudinal sectional view through the motion control valve, the piston therein being illustrated in position for exhausting fluid from the floating piston chamber.

Fig. 5 is a view similar to Fig. 4 with the piston at the opposite end of the valve cylinder and positioned for applying fluid pressure to the floating piston.

Fig. 6 is a transverse sectional view through the motion control valve on the line 6—6, Fig. 5.

Fig. 7 is a transverse sectional view through the pilot valve.

Referring more in detail to the drawings:

1 designates a hydro-pneumatic pumping jack embodying the features of my invention comprising, a frame 2 adapted to be supported on a base 3 of suitable material. This frame 2 preferably consists of spaced parallel elongated cylindrical tanks 4 and 5 adapted to rest on the base 3 adjacent a well 6 to be pumped, one end of the tanks 4 and 5 preferably being substantially in alignment with said well and equally spaced on opposite sides thereof. Spaced above the tanks 4 and 5 and in alignment therewith are elongated cylindrical tanks 7 and 8, the ends of said upper tanks adjacent the well extending beyond same as illustrated in Fig. 1. A plurality of tubular members 9 and 10 have their ends connected to the tanks 4 and 7 and 5 and 8, respectively for supporting the upper tanks in spaced relation to the lower tanks and providing communication therebetween. Communication between the upper tanks 7 and 8 is provided by a tubular member 11 having its ends secured to respective tanks adjacent the ends thereof remotely of the well whereby the tank and their respective connecting tubular members provides a hollow frame in which each portion cooperates to form a fluid reservoir. The central portion of the tanks 4 and 5 are connected by a plate 12 having its ends rigidly secured to said tanks to cooperate therewith in forming a rigid frame structure. Mounted upon the plate 12 is a power unit such as an air or gas compressor 13 driven by an engine 14. The compressor has an intake 16 for supplying fluid thereto, the discharge 17 of said compressor being connected with the tank 7 by means of suitable pipe fittings 18 whereby the fluid compressed by the compressor is discharged into the hollow frame to maintain a suitable pressure therein. Suitable pressure gauges and pressure relief valves 19 and 20 respectively are provided on the hollow frame for indicating and relieving the pressure therein.

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An elongated hydraulic cylinder 21 is centrally located between the tanks 7 and 8 and is suitably supported by transverse frame members 22 having their ends secured to the tanks 7 and 8 to further add rigidity to the frame. The end of the cylinder next to the well is provided with an end wall 23 and the opposite end is provided with a flange 24, said opposite end of the cylinder being closed by a head 25 secured on said flanges by fastening devices 26. The cylinder is provided with a machined bore 27 to slidably mount a floating piston 28 therein, said piston having suitable rings 29 thereon having sealing engagement with the bore 27. The end of the cylinder adjacent the well is provided with a fill fitting 30 for use in filling the space between the wall 23 and the piston with an hydraulic liquid, a suitable bleeder connection 31 being provided to assure

escape of all gases from said space and complete filling with the liquid when the piston is at the flanged end of the cylinder. Connected to the head 25 and having a communication with the interior of the cylinder 21 is a suitable pipe fitting 32 the opposite end of which is connected as at 33 to a motion control valve 34.

The motion control valve consists of a cylinder 35 having a machined bore 36 slidably mounting a piston 37 therein. The ends of the cylinder are closed by plates 38 and 39 secured on the cylinder in sealing engagement therewith by suitable fastening devices such as cap screws 40, gaskets 41 being interposed between the heads and cylinder. Coaxial with the connection of the pipe fitting 32 and on the opposite side of the cylinder is a threaded aperture 42 mounting a pipe 43 which is open to atmosphere, and spaced from the pipe fitting 32 longitudinally of the cylinder is a threaded aperture 44 in which is threaded a pipe 45 having communication with the tank 8 to provide a source of air or gas pressure to the control valve. The piston 37, preferably of suitable metal, is provided with resilient cushions 46 on the ends thereof. A guide rod 47 is mounted on the end plate 39 and extends into the bore 36 of the cylinder, the end of the rod being slidably mounted in a bore 48 in the adjacent end of the piston to prevent rotation thereof.

When the cushion on the end of the piston adjacent the head 39 is in engagement therewith, a transverse bore 49 in said piston aligns with the pipe fitting 32 and the aperture 42 venting the space between the floating piston 28 and the head 25 on the cylinder 21 to the atmosphere. Movement of the piston 37 to the opposite end of the cylinder 35 as illustrated in Fig. 5 closes the aperture 42 and moves a slot 50 into position to provide communication between the aperture 44 and the pipe fitting 32 thereby permitting flow of compressed fluid from tank 8 in the hollow frame through the pipe fitting 45, aperture 44, slot 50, pipe fitting 32 to the cylinder 21 to provide fluid pressure in the space between the piston 28 and the head 25 of the cylinder 21.

In order to move the motion control valve piston 37, the respective heads 38 and 39 are provided with pipe fittings 51 and 52 having communication with the respective ends of the cylinder 35 and with opposite branches 53 and 54 of a four-way pilot valve 55, said four-way valve as illustrated in Fig. 7 also has opposite branches 56 and 57, the branch 56 being connected by a suitable pipe fitting 58 to the tank 8 to provide communication therewith and the branch 57 opens to the atmosphere. The valve 55 is provided with a rotatable valve core 59 having an operating lever 60 for controlling position thereof as later described. The valve core has passages 61 and 62 adapted to connect the adjacent branches as for example, branch 56 with the branch 53 whereby fluid pressure from the tank 8 will flow through the pipe fitting 58, branch 56, passage 61, branch 53, pipe fitting 51 to apply fluid pressure in the bore 36 of the motion control valve at the end of the piston adjacent the head 38. Simultaneously the fluid pressure in the end of the cylinder adjacent the head 39 will flow through the pipe fitting 52, branch 54, passage 62 and branch 57 to the atmosphere. Rotation of the core 59 whereby the passage 62 provides communication between the branches 56 and 54, and passage 61 provides communication between the branches 53 and 57 moves the piston 37 to the opposite end of the motion control valve.

Located above the well 6 and coaxial with the rod 63 extending through a stuffing box 64 on the well tubing 65 is an hydraulic cylinder 66 supported on a base 67 carried by a plate 68 arranged transversely of the frame 2 and having its ends secured to the walls of the tanks 7 and 8, said plate also serving to provide additional stiffness to said frame. The base 67 and plate 68 are provided with apertures coaxial with the rod 63 and secured in said apertures and depending from the base is a tubular member 69 sleeved over the rod 63 to provide a guide therefor. Base 67 is provided with a counterbore 70 coaxial with the rod 63 adapted to seat a tube 71 concentrically positioned in the cylinder 66 and extending from the top to the bottom thereof to permit passage of the pump rods 63 therethrough. Positioned around the tube 71 and within the cylinder 66 is a second tubular element 72 which is movable up and down in the cylinder 66. The cylinder 66 has a flanged upper end on which a head 73 is secured by suitable fastening devices 74, said head having an upstanding cylindrical flange 75 around a central opening 76 of such size that the tubular element 72 slides freely therein. The head 73 also has apertures 77 in which are secured tubes 78 the outer ends of which are turned downwardly as illustrated in Fig. 3 and open to the atmosphere to vent the upper end of the cylinder 66. The lower end of the tubular element 72 is provided with a piston head 79 comprising pump leathers or the like 80 which acts as a piston in the cylinder 66. The upper end of the tube 71 is also provided with a head 81 composed of pump leathers or the like bearing against the inside surface or wall of the tubular element 72 to prevent the passage of liquid into the upper end of the tube 71. Mounted on the top of the tubular element 72 is the cross head or plate 82 having a suitable aperture through which the pump rod 63 extends, said rod having a suitable clamp or nuts 83 adapted to rest on the cross head for supporting the upper end of said rod and raising and lowering said rods with the up and down movement of the tubular element 72 and cross head 82 as later described.

Positioned on opposite sides of the cylinder 66 are fluid cylinders 84 and 85 arranged parallel to the cylinder 66 and supported by the plate 68. The lower ends of the cylinders 84 and 85 are closed and the upper ends are opened. Slidably mounted in the cylinders 84 and 85 are pistons 86 having pump leathers or the like sealingly engaging the inner wall of the cylinders. The pistons are secured to the lower ends of rods 87 which extend upwardly through the open upper ends of the cylinders, said rods extending through openings in the cross head 82 and being secured thereto by suitable fastening devices such as nuts 88 whereby the piston rods 87 and pistons 86 thereon travel up and down in the cylinders 84 and 85 simultaneously with the movement of the piston head 79 in the cylinder 66. If desired, the upper ends of the cylinders 84, 85 and 66 may be suitably connected by brace members to add rigidity to the structure.

An extension 89 is provided on the cross head 82 and secured thereto by suitable fastening devices 90 is a tube 91 arranged adjacent the cylinder 85 and parallel therewith. The lower end of the tube 91 is sleeved over a guide rod 92 suitably mounted adjacent the lower end of the cylinder 85 whereby the guide rod maintains the alignment of the tube 91. Adjustably mounted on the tube 91 are spaced stops 93 and 94, said

stops being so arranged relative to the pilot control valve 55, which is preferably supported on a bracket 95 adjacent the upper end of the cylinder 66, that the stops will engage the control lever 60 in response to up and down travel of the tube 91 and cross head 82 and move the rotatable valve core in the four-way valve 55 to position passages 61 and 62 relative to the branches of said control valve to control the flow of fluid to the motion control valve 34.

Connected to the lower ends of the cylinders 84 and 85 and having communication therewith are suitable pipe fittings 96 and 97, respectively, said pipe fittings being connected with the tanks 7 and 8, respectively, to provide communication between said tanks and the cylinders 84 and 85. Suitable valves 98 and 99 are provided in the pipes 96 and 97 to control the application of fluid pressure from the tanks 7 and 8 to the cylinders 84 and 85. Connected to the base 67 and the end 23 of the cylinder 21 is a pipe 100 providing communication between the cylinder 21 and the cylinder 66, said pipe having a valve 101 therein for controlling said communication.

In order to facilitate the maintenance of the equipment a catwalk 102 is suitably mounted on the tanks 7 and 8 provided with a hand rail 103, a ladder 104 being arranged at the end of said catwalk remotely of the well 6 to facilitate access to such catwalk. It is also preferable that a cover 105 be arranged to span the area between the catwalks over the cylinder 21.

Operation of a pumping jack constructed and assembled as described is as follows:

Valve 101 is opened to provide communication between the cylinder 21 and cylinder 66, the fill cap 30 is removed and the bleeder 31 opened and liquid preferably oil is supplied to the cylinder 21 in the space between the end 23 and the piston 28, said piston being at the end of the cylinder adjacent the head 25. Air will escape through the bleeder to assure complete filling of said space in the cylinder with liquid. The weight of the pump rods in the well will hold the cross head 82, tubular element 72, and piston 79 at the lowermost position during said filling operation, however, cylinder 66 may be provided with a suitable bleeder adjacent to the lower end thereof if desired to assure filling of pipe 100 and the space between the piston head 79 and the base 67 with liquid. Then the bleeder is closed and the fill cap applied to the fitting and the engine 14 operated to drive the compressor 13 and create fluid pressure in the hollow frame, the pressure being built up under control of the relief valve 20.

At the lowermost position of the cross head 82, the stop 93 is engaged with the control lever 60 of the four-way valve 55 to position the rotatable core whereby the passage 61 effects communication between the branches 53 and 57, and the passage 62 effects communication between the branches 54 and 56. The valves 98 and 99 are opened whereby the fluid pressure in the tanks 7 and 8 is applied to the lower ends of the cylinders 84 and 85 applying a force on the pistons 86 tending to move the cross head 82 upwardly. The position of the passages and the four-way valve 55 permits flow of fluid to the tank 8 through the pipe 58, branch 56, passage 62, branch 54, pipe 52, to the motion control valve 35 applying fluid pressure in the bore 36 adjacent the head 39. The pipe 51 being connected to the opposite end of the bore 36 vents same through the branch 53 of the four-way valve 55,

passage 61 and branch 57 to the atmosphere. This moves the motion control valve piston 37 to the position shown in Fig. 5 whereby fluid pressure from the tank 8 is delivered through the pipe 45, slot 50 in the valve piston 37 of valve 34, pipe 32 to the cylinder 21 between the head 25 and the piston 28, the fluid pressure effecting movement of the floating piston 28 towards the head 23 of the cylinder 21 forcing oil through the pipe 100 into the lower end of the cylinder 66 under sufficient pressure to force the head 79 on the tubular element 72 upwardly in the cylinder 66. This upward movement which is assisted by the fluid pressure on the pistons 86 moves the cross head 82 upwardly to lift the pump rods 63 upwardly to actuate the pump in the well. This upward movement effects engagement of the stop 94 with the control lever 60 of the four-way valve 55 to move same upwardly at the end of the desired length of stroke of the pump reversing the position of the passageways 61 and 62, moving same into the position shown in Fig. 7 whereby the bore of the motion control valve 34 between the piston 37 and the head 39 is vented to the atmosphere and fluid pressure from the tank 8 is delivered through the pipe 58, branch 56, passage 61, branch 53, pipe 51 to the end of the bore 36 of the motion control valve adjacent the head 38. This fluid pressure forces the piston 37 to the position shown in Fig. 4 closing the aperture 44 to shut off flow of air from the tank 8 and aligning the bore 49 with the pipe 32 to provide communication from the end of the cylinder 21 to the atmosphere through the pipe 43. This reduces the pressure acting on the end of the piston 28 adjacent the head 25 and the weight of the rods 63 and the equipment thereon pulls the cross head 82 downwardly whereby the piston head 79 forces the liquid through the pipe 100 into the cylinder 21. This downward movement is resisted by the fluid pressure acting on the lower ends of the pistons 86 to cushion said downward movement thereby eliminating shock on the pump rods 63.

On completion of the downstroke of the pumping equipment, stop 93 will again engage the control lever 60 to reverse the position of the passages 61 and 62 in the four-way valve 55 to repeat the cycle wherein fluid pressure applied to the floating piston 28 moves a closed column of liquid to effect the lifting action of the piston head 79 and pumping equipment in the well, this lifting action being assisted by fluid pressure acting on the pistons 86. Release of the air pressure acting on the floating piston 28 permits the weight of the pumping equipment in the well to pull the pistons 79 and 86 downwardly in their respective cylinders to complete the downward stroke which is cushioned by the fluid pressure acting on the pistons 86. This cushioning action in an hydro-pneumatic pumping jack particularly adapting same for pumping of oil or other wells with a smooth operation eliminating strain on the rods 63. By adjusting the relative position of the stops 93 and 94, variable lengths of strokes may be obtained in which the forces applied to the pump rods 63 are always in alignment therewith.

What I claim and desire to secure by Letters Patent is:

1. An hydro-pneumatic pumping jack adapted to operate a string of pump rods in a well hole comprising, a frame of spaced horizontal elongated tanks interconnected for communication therebetween, an engine driven fluid compressor unit having a discharge connected to said frame

for delivering compressed fluid to the tanks, means on the frame supporting the air compressor unit, a vertical main cylinder supported on the frame coaxially of the pump rod in a well to be pumped, said cylinder having a port in the lower end thereof, a tube within and concentric with the main cylinder and forming a through passage therein, a second tube encircling the first tube and reciprocable in said main cylinder, a piston head on the lower end of the second tube and having sliding sealing engagement with the interior of the main cylinder wall, a cross head carried on the upper end of the second tube and connected to the pump rods, means on the upper end of the first tube having sealing engagement with the interior of the second tube, means on the upper end of the main cylinder and communicating with the space between said cylinder and the second tube for venting same to the atmosphere, a horizontal cylinder supported by the frame in parallel relation to the tanks thereof and having one end adjacent the lower end of the main cylinder, a valved pipe providing communication between said adjacent end of the horizontal cylinder and the port in the main cylinder, a floating piston in the horizontal cylinder and having sliding sealing engagement therewith, liquid filling the communicated spaces in the main cylinder and the horizontal cylinder when the floating piston is at the end of the horizontal cylinder remote from the main cylinder, a motion control valve body having branches respectively communicating with the fluid tanks of the frame, the remote end of the horizontal cylinder and the atmosphere, a sliding valve member movable in the valve body and having passages registrable with said branches for effecting delivery of fluid pressure from the frame tanks to the remote end of the horizontal cylinder at one position of said valve member for moving the floating piston and delivering the liquid to the main cylinder for effecting upstroke of the pump rods and releasing said fluid pressure from said remote end of the horizontal cylinder to the atmosphere at the other position of said valve member to permit the weight of the pump rod to effect the downstroke of the pump rod and piston head in the main cylinder by gravity, and means responsive to selected limits of movement of the main piston for actuating the motion control valve member.

2. An hydro-pneumatic pumping jack adapted to operate a string of pump rods in a well hole comprising, a frame of spaced horizontal elongated tanks interconnected for communication therebetween, an engine driven fluid compressor unit having a discharge connected to said frame for delivering compressed fluid to the tank, means for adjusting the fluid pressure in said tanks, means on the frame supporting the air compressor unit, a vertical main cylinder supported on the frame coaxially of the pump rod in a well to be pumped, said cylinder having a port in the lower end thereof, a tube within and concentric with the main cylinder and forming a through passage therein, a second tube encircling the first tube and reciprocable in said main cylinder, a piston head on the lower end of the second tube and having sliding sealing engagement with the interior of the main cylinder wall, a cross head carried on the upper end of the second tube and connected to the pump rods, means on the upper end of the first tube sealingly engaging the interior of the second tube, means on the upper end of the main cylinder and communicating with the space between said cylinder and the second tube for venting same to the atmosphere, a horizontal cylinder supported by the frame in parallel relation to the tanks thereof and having one end adjacent the lower end of the main cylinder, a valved pipe providing communication between said adjacent end of the horizontal cylinder and the port in the main cylinder, a floating piston in the horizontal cylinder and having sliding sealing engagement therewith, liquid filling the communicated spaces in the main cylinder and the horizontal cylinder when the floating piston is at the end of the horizontal cylinder remote from the main cylinder, a motion control valve body having branches respectively communicating with the fluid tanks of the frame, the remote end of the horizontal cylinder and the atmosphere, a sliding valve member movable in the valve body and having passages registrable with said branches for effecting delivery of fluid pressure from the frame tanks to the remote end of the horizontal cylinder at one position of said member for moving the floating piston so that it delivers the liquid within said horizontal cylinder to the main cylinder for effecting upstroke of the pump rods and releasing said fluid pressure from said remote end of the horizontal cylinder to the atmosphere at the other position of said valve member to permit the weight of the pump rod to effect the downstroke of the pump rod and piston head in the main cylinder by gravity, a four-way valve supported adjacent the upper end of the main cylinder having branches respectively communicating with the frame tank, atmosphere and opposite ends of the motion control valve body, a control lever for operating the four-way valve so as to position it to direct fluid pressure from the frame tanks to said motion control valve and thus effect movement of the valve member in the motion control valve to the respective positions thereof, adjustable stop members carried by the cross head for engagement with the control lever for actuating same at the selected limits of the upstroke and downstroke of the pump rod.

3. An hydro-pneumatic pumping jack adapted to operate a string of pump rods in a well hole comprising, a frame of spaced horizontal elongated tanks interconnected for communication therebetween, an engine driven fluid compressor unit having a discharge connected to said frame for delivering compressed fluid to the tanks, a vertical main cylinder supported on the frame coaxially of the pump rod in a well to be pumped, said cylinder having a port in the lower end thereof, means including a cross head for connecting the main piston to the pump rods, means on the upper end of the main cylinder and communicating with the space therein for venting same to the atmosphere, a horizontal cylinder supported by the frame in parallel relation to the tanks thereof and having one end adjacent the lower end of the main cylinder, a valved pipe providing communication between said adjacent end of the horizontal cylinder and the port in the main cylinder, a floating piston in the horizontal cylinder and having sliding sealing engagement therewith, liquid filling the communicated spaces in the main cylinder and the horizontal cylinder when the floating piston is at the end of the horizontal cylinder remote from the main cylinder, a motion control valve body having branches respectively communicating with the fluid tanks of

the frame, the remote end of the horizontal cylinder and the atmosphere, a sliding valve member movable in the valve body and having passages registrable with said branches for effecting delivery of fluid pressure from the frame tanks to the remote end of the horizontal cylinder at one position of said valve member for moving the floating piston so that it delivers the liquid within said horizontal cylinder to the main cylinder for effecting upstroke of the pump rods and releasing of said fluid pressure from said remote end of the horizontal cylinder to the atmosphere at the other position of said valve member to permit the weight of the pump rods to effect the downstroke of the pump rod and piston head in the main cylinder by gravity, means responsive to selected limits of movement of the main piston for actuating the motion control valve member, a pair of fluid cylinders parallel to and on opposite sides of the main cylinder, pistons operable in said fluid cylinders and having connection with the cross head for movement in unison with the piston head in the main cylinder, and valved pipes providing communication between the frame tanks and the lower ends of said fluid cylinders to maintain fluid pressure on the pistons therein for aiding the upstroke and resisting the downstroke of the pump rod.

4. An hydro-pneumatic pumping jack adapted to operate a string of pump rods in a well hole comprising, a frame of spaced horizontal elongated tanks interconnected for communication therebetween, an engine driven fluid compressor unit having a discharge connected to said frame for delivering compressed fluid to the tanks, means on the frame supporting the air compressor unit, a vertical main cylinder supported on the frame coaxially of the pump rod in a well to be pumped, said cylinder having a port in the lower end thereof, a tube within and concentric with the main cylinder and forming a through passage therein, a second tube encircling the first tube and reciprocable in said main cylinder, a piston head on the lower end of the second tube and having sliding sealing engagement with the interior of the main cylinder wall, a cross head carried on the upper end of the second tube and connected to the pump rods, means on the upper end of the first tube having sealing engagement with the interior of the second tube, means on the upper end of the main cylinder and communicating with the space between said cylinder and the second tube for venting same to the atmosphere, a horizontal cylinder supported by the frame in parallel relation to the tanks thereof and having one end adjacent the lower end of the main cylinder, a valved pipe providing communication between said adjacent end of the horizontal cylinder and the port in the main cylinder, a floating piston in the horizontal cylinder and having sliding sealing engagement therewith, liquid filling the communicated spaces in the main cylinder and the horizontal cylinder when the floating piston is at the end of the horizontal cylinder remote from the main cylinder, a motion control valve body having branches respectively communicating with the fluid tanks of the frame, the remote end of the horizontal cylinder and the atmosphere, a sliding valve member movable in the valve body and having passages registrable with said branches for effecting delivery of fluid pressure from the frame tanks to the remote end of the horizontal cylinder at one position of said valve member for moving the floating piston and delivering the liquid to the

main cylinder for effecting upstroke of the pump rods and releasing said fluid pressure from said remote end of the horizontal cylinder to the atmosphere at the other position of said valve member to permit the weight of the pump rod to effect the downstroke of the pump rod and piston head in the main cylinder by gravity, means responsive to selected limits of movement of the main piston for actuating the motion control valve member, a pair of fluid cylinders parallel to and on opposite sides of the main cylinder, pistons operable in said fluid cylinders and having connection with the cross head for movement in unison with the piston head in the main cylinder, and valved pipes providing communication between the frame tanks and the lower ends of said fluid cylinders to maintain fluid pressure on the piston therein for aiding the upstroke and resisting the downstroke of the pump rod.

5. An hydro-pneumatic pumping jack adapted to operate a string of pump rods in a well hole comprising, a frame of spaced horizontal elongated tanks interconnected for communication therebetween, an engine driven fluid compressor unit having a discharge connected to said frame for delivering compressed fluid to the tank, means for adjusting the fluid pressure in said tanks, means on the frame supporting the air compressor unit, a vertical main cylinder supported on the frame coaxially of the pump rod in a well to be pumped, said cylinder having a port in the lower end thereof, a tube within and concentric with the main cylinder and forming a through passage therein, a second tube encircling the first tube and reciprocable in said main cylinder, a piston head on the lower end of the second tube and having sliding sealing engagement with the interior of the main cylinder wall, a cross head carried on the upper end of the second tube and connected to the pump rods, means on the upper end of the first tube sealingly engaging the interior of the second tube, means on the upper end of the main cylinder and communicating with the space between said cylinder and the second tube for venting same to the atmosphere, a horizontal cylinder supported by the frame in parallel relation to the tanks thereof and having one end adjacent the lower end of the main cylinder, a valved pipe providing communication between said adjacent end of the horizontal cylinder and the port in the main cylinder, a floating piston in the horizontal cylinder and having sliding sealing engagement therewith, liquid filling the communicated spaces in the main cylinder and the horizontal cylinder when the floating piston is at the end of the horizontal cylinder remote from the main cylinder, a motion control valve body having branches respectively communicating with the fluid tanks of the frame, the remote end of the horizontal cylinder and the atmosphere, a sliding valve member movable in the valve body and having passages registrable with said branches for effecting delivery of fluid pressure from the frame tanks to the remote end of the horizontal cylinder at one position of said member for moving the floating piston and delivering the liquid to the main cylinder for effecting upstroke of the pump rods and releasing said fluid pressure from said remote end of the horizontal cylinder to the atmosphere at the other position of said valve member to permit the weight of the pump rod to effect the downstroke of the pump rod and piston head

in the main cylinder by gravity, a four-way valve supported adjacent the upper end of the main cylinder having branches respectively communicating with the frame tank, atmosphere and opposite ends of the motion control valve body, a control lever for operating the four-way valve so as to position it to direct fluid pressure from the frame tanks to said motion control valve and thus effect movement of the valve member in the motion control valve to the respective positions thereof, adjustable stop members carried by the cross head for engagement with the control lever for actuating same at the selected limits of the upstroke and downstroke of the pump rod, a pair of fluid cylinders parallel to and on opposite sides of the main cylinder, pistons operable in said fluid cylinders and having connection with the cross head for movement in unison with the piston head in the main cylinder, and valved pipes providing communication between the frame tanks and the lower ends of said fluid cylinders to maintain fluid pressure on the piston therein for aiding the upstroke and resisting the downstroke of the pump rod.

6. An hydro-pneumatic pumping jack adapted to run a string of pump rods in a well hole comprising, a frame, a vertical main cylinder supported on the frame coaxially of the pump rod in a well to be pumped, said cylinder having a port in the lower end thereof, a tube within and concentric with the main cylinder and forming a through passage therein, a second tube encircling the first tube and reciprocable in said main cylinder, a piston head on the lower end of the second tube and having sliding sealing engagement with the interior of the main cylinder wall, a cross head carried on the upper end of the second tube and connected to the pump rods, means on the upper end of the first tube having sealing engagement with the interior of the second tube, means on the upper end of the main cylinder and communicating with the space between said cylinder and the second tube for venting same to the atmosphere, a second cylinder supported by the frame and having one end adjacent the lower end of the main cylinder, a valved pipe providing communication between said adjacent end of the second cylinder and the port in the main cylinder, a floating piston in the second cylinder and having sliding sealing engagement therewith, liquid filling the communicated spaces in the main cylinder and the second cylinder when the floating piston is at the end of the second cylinder remote from the main cylinder, a motion control valve body having branches respectively communicating with a source of fluid pressure, the remote end of the second cylinder and the atmosphere, a sliding valve member movable in the valve body and having passages registrable with said branches for effecting delivery of fluid pressure from the source of same to the remote end of the second cylinder at one position of said valve member for moving the floating piston and delivering the liquid in the main cylinder for effecting up stroke of the pump rods and releasing said fluid pressure from said remote end of the second cylinder to the atmosphere at the other position of said valve member to permit the weight of the pump rod to effect the down stroke of the pump rod and piston head in the main cylinder by gravity, and means responsive to selected limits of movement of the main piston for actuating the motion control valve member.

7. An hydro-pneumatic pumping jack adapted to be attached to a string of rods in a well hole comprising, a frame, a vertical main cylinder supported on the frame in substantially parallel relationship to the axis of the pump rods in the well to be pumped, said cylinder having a port in the lower end thereof, a main piston in the main cylinder and having sliding sealing engagement therewith, means including a cross head for connecting said main piston to the piston rods, a second cylinder supported by the frame and having one end adjacent the lower end of the main cylinder, a valved pipe providing communication between said adjacent end of the second cylinder and the port in the main cylinder, a floating piston in the second cylinder and having sliding sealing engagement therewith, liquid filling the communicated spaces in the main cylinder and the second cylinder when the floating piston is at the end of the second cylinder remote from the main cylinder, a receiver containing fluid under adjusted pressure, a motion control valve body having branches respectfully communicating with the receiver, the remote end of the second cylinder and the atmosphere, a sliding valve member movable in the valve body and having passages registrable with said branches for effecting delivery of fluid pressure from the receiver to the remote end of the second cylinder at one position of said valve member for moving the floating piston and delivering the liquid to the main cylinder for effecting up stroke of the pump rods and releasing said fluid pressure from said remote end of the second cylinder to the atmosphere at the other position of said valve member to permit the weight of the pump rod to effect the down stroke of the pump rod and piston in the main cylinder by gravity, means responsive to selected limits of movement of the main piston for actuating the motion control valve member, a pair of cylinders, parallel to and adjacent the main cylinder, pistons operating in said pair of cylinders, means connecting said pistons with the cross head whereby said pistons and the main piston operate in unison, and means providing communication between the fluid receiver and the lower ends of said pair of cylinders to maintain fluid pressure on the pistons in said pair of cylinders for aiding the up stroke and resisting the down stroke of the pump rods.

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