This invention relates to a lifting device, and more particularly to improvements in a combination air and hydraulic pump jack for use in connection with oil or other wells.

Herefore, with pumping jacks of this and similar nature, there has been a tendency for the devices to cause a jerk or pound on the line, particularly at the end of the downstroke caused by slack in the rods, and then at the start of the upstroke there has been a tendency to jerk the rods, very often snapping them in two, causing great delay in fishing operations.

It is, therefore, the principal objects of the present invention to eliminate jerk in the string of rods attached to the pumping jack; to provide means for combining air and oil for the operation of the jack; to provide means whereby greater lifting force may be created by the jack; to provide for automatic operation of the jack; and to provide a device simple and economical to manufacture and efficient in operation.

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 a detailed longitudinal sectional view through the device.

Fig. 2 is an end view showing parts broken away to better illustrate the invention.

Fig. 3 is a view similar to Fig. 2 taken from the opposite end of the device.

Fig. 4 is a plan view of the device.

Fig. 5 is a vertical section through the valve housing showing the valve in elevation.

Fig. 6 is a transverse section through the control valve.

Referring more in detail to the drawings:

1 signifies a pumping jack embodying the features of my invention comprising a base 2 of concrete or other suitable material for supporting a frame 3 supported on legs 4 positioned at each corner of the frame and having their bottom ends flanged and supported by the concrete base 2. The frame 3 comprises a plate 5 for supporting several units of the device as they are assembled together, as will presently be shown.

Located upon the plate 5 is a power unit preferably consisting of an electric motor 6. Adjacent the motor 6 and driven thereby is an air compressor 7. Also located on the plate 5 adjacent the motor is a tank 8 adapted to contain oil or the like 9. Supported by the tank 8 is a tank 10 of somewhat larger size than the tank 9 and adapted to contain compressed air from the air compressor for a purpose later described.

Located substantially on a level with the bottom of the tank 10 and to one side thereof is an air actuated operating valve 11 and located above the valve 11 is a control valve 12. A line 13 is connected to one side of the tank 10 as indicated at 14, and its opposite end to the lower portion of the operating valve 11 as indicated at 15. A line 16 is connected to one side of the valve 11 near the bottom thereof and its opposite end connected near the top of the oil tank 9.

An air expansion tank 17 is supported on the plate 5 substantially below the operating valve 11 and a line 18 has one end connected near the central portion of the operating valve 11 as indicated at 19 and its opposite end connected to the air expansion tank 17 as indicated at 20. A line 21 is connected to the opposite side of the tank 17 and has its opposite end connected to the air intake of the compressor 7. A line 22 leads from the air discharge of the compressor 7 and is connected to the compressed air tank 10 as indicated at 23.

The air pressure tank 16 is provided with an air pressure gauge 24 to indicate the amount of pressure in the tank. Connected to the coupling 25 of the connection for the gauge 24 is a line 26 which leads to the control valve 12 through which air may pass between the tank and the valve. Connected to the lower side of the control valve 12 is a line 27 which leads to the bottom of the operating valve 11 as indicated at 28. A line 29 is connected to the top of the control valve 12 which leads to the top of the operating valve 11. The control valve 12 is provided with an operating lever 30 actuated by a rod 31 and stops 32 and 33 as will later be described.

Located adjacent the operating valve 11 and air tank 17 is a hydraulic cylinder 34 supported on a base 35 carried by the plate 5 and which provides a closure for the bottom of the hydraulic cylinder 34. The concrete base 2 has an opening which passes a well tubing 36 in which are reciprocated pump rods 37, and which extend upwardly through the frame 3, plate 5 and base 35 of the cylinder 34 as will later be shown.

The plate 5 of the frame 3 is provided with an opening through which the rods 37 extend and the base plate 35 of the cylinder 34 is also provided with an opening adapted to seat a tube 38 concentrically positioned in the cylinder 34 and extending from the top to the bottom thereof to permit passage of the pump rods 37 therethrough.

4 Claims. (Cl. 60—55)
Positioned around the tube 38 and within the cylinder 34 is a second tubular element 39 which is slideable up and down in the cylinder 34. The cylinder 34 has a cap 46 provided with an upstanding cylindrical flange 41 having a central opening 42 so that the tube 39 may slide freely therein. The lower end of the tubular element 39 is provided with a piston head 43 comprising pump leathers or like the like 44 which act as a piston in the cylinder 34. The upper end of the tube 38 is also provided with a head 45 composed of pump leathers or like like 46 bearing against the inside surface or wall of the tube 35 to prevent the passage of liquid in the upper end of the tube 38.

Supported on the top of the tubular element 39 is a cross bar or plate 47 which carries a pump rod clamp 48 for clamping on the pump rod 37 for raising and lowering the pump rod with the up and down movement of the tubular element 39 and cross bar 47 as will later be described.

Positioned on opposite sides of the cylinder 34 are air compressor cylinders 49 and 50 arranged parallel to the cylinder 34 and supported by the base element 55. The base element 55 is provided with openings 51 and 52 for supporting bosses 53 providing a seal for the cylinders 49 and 50. The upper end of the openings 51 in the base 55 seating the cylinders 49 and 50 is provided with a recess adapted to receive balls 53 substantially on the center axis of the cylinders 49 and 50 to form a checked air intake for the cylinders 49 and 50.

The cylinders 49 and 50 are provided with piston rods 54 provided on their lower ends with pump leathers or like 55 adapted to engage and slide against the inner walls of the cylinder 34, 48 and 50 as the piston rods travel up and down therein. The ends of the cross bar 47 are provided with openings adapted to receive the upper ends of the piston rods 54 and are rigidly held thereto by nuts 56—57 and 58—59 respectively. The upper end of the cylinder 34 is provided with an outwardly extending flange element 60 and secured to the cap 40 by bolts 61, the outer ends of the flange element providing arms 62 having openings through which the upper ends of the cylinders 49 and 50 pass to provide a support for the cylinders. The upper ends of the cylinders 49 and 50 are provided with conventional heads 63.

Secured to the upper side of the cross bar 47 by a nut 58 on the piston rods 47 and rigidly held thereto is a supporting bar 64 having an opening adapted to receive the upper threaded end of the actuating rod 31. The actuating rod 31 is rigidly secured to the bar 64 by nuts 65 and 66 positioned respectively on each side of the bar 64.

The operating lever 30 is secured to the cylinder 39 by a clamp 67 (Fig. 2). The operating lever 30 has a transverse arm 68 having an opening through which the rod 31 passes. Coil springs 69 and 70 are positioned on the rod 31 which engage against the stops 52 and 53 respectively for a purpose later described.

The cylinders 49 and 50 are connected preferably near their lower ends with a line 71 (Fig. 4), said lines communicating with the interior of the cylinders through ports 71'. The line 71 also connects with a line 72 which connects with the air pressure tank as indicated at 73. The line 72 is provided with a check valve 74 (Fig. 4) to permit the flow of air only from the cylinders 49 and 50 to the air pressure tank 10. Running from the oil tank 8 and attached preferably at the bottom thereof is a line 75 which connects to the bottom of the cylinder 34 through an opening in the plate 5 and base 35 of the cylinder as indicated at 76 (Fig. 1). The line 75 is provided with a cut-off valve 77.

The operating valve 11 comprises a housing 78 having a slide plate 19 slideable therein. One side of the housing is provided with openings 80 and 81 connecting with the lines 18 and 16 respectively, the line 18 leading to the air tank 17 and the line 16 leading to the oil tank 8. The opposite side of the housing is provided with an opening 82 connecting with the line 13 leading to the side of the air tank 10 near the top as indicated at 14 (Fig. 1). The piston 79 is provided with spaced lands 83, 84 and 85 providing grooves 86 and 87 therebetween. The top of the operating valve 11 is provided with a screw threaded cap 88 having a central opening 90. The cap 88 is provided with a boss having a screw threaded stem adapted to receive a collar 91 on the end of the pipe 29 for attaching the pipe to the operating valve.

The control valve 12 is of the usual four-way type having connections lines 27 and with the operating valve, a line 26 leading to the air tank 10, and an opening 92 to atmosphere as shown in Fig. 6.

Operation of a device constructed and assembled as described is as follows.

Liquefied preferably oil is placed in the tank 8 and the motor energized to operate the compressor 1 to create a pressure of air in the air pressure tank 10. The operating valve 11 is adjusted so that the pipe lines 13 and 16 are connected through the respective openings 80 and 81 by reason of the piston 79 being raised as shown in its position in Fig. 5. The air pressure is passed from the tank 10 through lines 13 and 16 so that air will pass between the lands 84 and 85 through the operating valve, and be discharged into the liquid tank above the level of the tube element 39 in the cylinder 34 which in turn raises the cross bar 47, thereby raising the pump rods 37. The piston rods 54 in the cylinders 49 and 50 being attached at their upper ends to the cross arm 47 will be raised simultaneously with the tubular element 39 whereupon the pump (not shown) in the well is actuated to deliver liquid from the well and discharge it up through the tube 35 where it may be passed out through discharge pipe 93. The tubing 36 is provided beneath the frame 3 with the conventional stuffing box 84.

As the piston heads 55 in the cylinders 49 and 50 are raised upwardly in the cylinders, air is drawn into the cylinders 49 and 50 through the check valves comprising the balls 53 seated in the bottom of the cylinders 49 and 50, the vacuum created by the raising of the piston heads 55 in the cylinders 49 and 50 raising the balls from their seats so the air will be admitted to the cylinders. As the cross bar 47 moves upwardly, the stop 33 through spring 78 will engage and move the control valve lever 30 to its upward position whereby air passes from the air tank 10 through lines 26 and 29 to operate the operating valve 11. The piston 79 in the operating valve 11 will be lowered and the land 84 will
sprang-82's .5 engage over the opening 82 in the line 13. The openings 80 and 81 in the lines 16 and 18 will be opened so that flow of air through the pipe lines 13 and 16 is stopped and the air in the oil tank 8 will flow from the tank through the pipe lines 16 and 18 into the expansion air tank 17 from which tank the air passes through the line 21 to the intake of the air compressor 17 to be returned to the pressure tank 10.

When the pressure is released from the oil tank 8, the load of the pump rods 37 will pull the tubular element 39 downwardly in the cylinder 34 and move the oil therein back through the pipe line 75 into the oil tank 8. As the tubular element 39, cross bar 41 and piston heads 55 move downwardly, the balls 53 seat to close the openings 51. During downward movement of the piston heads 55 the air in the cylinders 49 and 50 will be under pressure and is forced from the cylinders 49 and 50 through line 71, check valve 74 and line 72 into the air pressure tank 10.

Upon completion of the downstroke of the piston rods 54 in the cylinders 49 and 50 respectively, the stop 32 on the rod 31 will engage and rock the control valve lever 30 to its downward position, causing air from the air pressure tank 10 to flow through the pipe lines 46 and 27 and move the piston 79 in the operating valve 11 so that the air pressure will again flow from the air pressure tank 10 through the pipe lines 13 and 16. The lands of the piston 79 will be in the position shown in Fig. 5 so that the openings 51 and 52 will allow the air to flow through pipe 16 to the top of the oil tank 8 to force the oil therefrom through the pipe line 75 into the hydraulic cylinder 34 as previously described. This cycle of operation is repeated from time to time to carry on the process of pumping.

The pressure in the cylinders 49 and 50 will tend to aid in raising of the main piston consisting of the tubular element 39 and the cylinder 34 and will act as a retarder or will have a cushioning effect on the downstroke of the rods in the well to eliminate any jerk on the rods when the device is ready for the next upstroke of the rods.

It will be obvious from the foregoing that I have provided improved lifting structure, and particularly for the pumping of oil or other wells, by the use of a combination of air and hydraulic means whereby a smooth and operating structure is provided.

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

1. A lifting device adapted to be attached to a string of rods in a well hole comprising, air and liquid storage tanks, said liquid storage tank having liquid therein, means for supplying air to said air storage tank, a main cylinder adjacent said tank and located over the well hole, a piston in said cylinder, means for attaching said rods to said piston, an air cylinder located on each side and extending parallel with the main cylinder, pistons in said air cylinders, means connecting the pistons in said air cylinders to the main cylinder, means actuated by the movement of the pistons in the air cylinder for controlling passage of air to and from said air cylinders, a valve activated by the air in the air storage tank for controlling flow of air to said liquid tank, a control valve for controlling the air to said air actuated valve, a lever connected to said control valve, a rod extending parallel with one of said air cylinders, and means on said rod for engaging the lever on said control valve for raising and lowering of said rods in said well for controlling flow of air to said air actuated operating valve.

2. A lifting device adapted to be attached to a string of rods in a well hole comprising, air and liquid storage tanks, said liquid storage tank having liquid therein, means for supplying air to said air storage tank, a main cylinder adjacent said tank and located over the well hole, a piston in said cylinder, means for attaching said rods to said piston, an air cylinder located on each side and extending parallel with the main cylinder, pistons in said air cylinders, means connecting the pistons in said main cylinder to the pistons in said air cylinder, means connecting the piston in said main cylinder to the pistons in said air cylinder, means connecting the piston in said main cylinder to the pistons in said air cylinder, means controlling the air cylinders to support the same, means for delivering air to the air storage tank, means for delivering air from the air storage tank to the liquid storage tank for maintaining liquid in the liquid tank to the lower end of said main cylinder to raise said piston, said rods, and the pistons in the air cylinders, means including check valves in said air cylinders for passage of air from the atmosphere to said air cylinders upon raising of said pistons, the air in the air cylinders cushioning the forces acting on the rods, a valve actuated by the air from the air storage tank for controlling flow of air to said liquid tank, a control valve for controlling the air to said air actuated valve, a lever connected to said control valve, a rod extending parallel with one of said air cylinders, and means on said rod for engaging the lever on said control valve for controlling flow of air to said air actuated valve.

3. A lifting device adapted to be attached to a string of rods in a well hole comprising, air and liquid storage tanks, said liquid storage tank having liquid therein, means for supplying air to said air storage tank, a main cylinder adjacent said tank and located over the well hole, a piston in said cylinder, means for attaching said rods to said piston, an air cylinder located on each side and extending parallel with the main cylinder, pistons in said air cylinders, valves controlling flow of air to and from the air cylinders, means connecting the piston in said main cylinder to the pistons in said air cylinders, means on said main cylinder engaging the air cylinders to support the same, means for delivering air to the air storage tank, means for delivering air from the air storage tank to the liquid storage tank for maintaining liquid in the liquid tank to the lower end of said main cylinder to raise said piston, said rods, and the pistons in said air cylinders, the raising of the pistons in the air cylinders effecting drawing of air from the atmosphere into said air cylinders, a valve actuated by the air from the air storage tank for controlling flow of air to said liquid tank, a control valve for controlling the air to said air actuated valve, a lever connected to said control valve, a rod extending parallel with one of said air cylinders, means on said rod for engaging the lever on said control valve for controlling flow of air to said air actuated valve.
and means including an air expansion tank for delivering air from the liquid storage tank to the means for supplying air to said air storage tank.

4. A lifting device adapted to be attached to a string of rods in a well hole comprising, air and liquid storage tanks, said liquid storage tank having liquid therein, means for supplying air to said air storage tank, a main cylinder adjacent said tank and located over the well hole, a piston in said cylinder, means for attaching said rods to said piston, an air cylinder located on each side of said cylinder, pistons in said air cylinders, ball valves in the lower end of said air cylinders, a line connecting the lower end of the air cylinders with the air storage tank and providing communication therebetwen, means connecting the piston in said main cylinder to the pistons in said air cylinders, means on said main cylinder engaging the air cylinders to support the same, means for delivering air to the air storage tank, means for delivering air from the air storage tank to the liquid storage tank, means for delivering liquid from the liquid tank to the lower end of said main cylinder to raise said piston, said rods, and the pistons in the air cylinders, the raising of the pistons in the air cylinders effecting unseating of the ball valves and drawing of air from the atmosphere into the air cylinders, a valve actuated by the air from the air storage tank for controlling flow of air to said liquid tank, a control valve for controlling the air to said air actuated valve, a lever connected to said control valve, a rod extending parallel with one of said air cylinders, means on said rod for engaging the lever on said control valve for controlling flow of air to said air actuated valve, and means including an air expansion tank for delivering air from the upper portion of the liquid storage tank to the means for supplying air to said air storage tank, passage of air from the liquid storage tank to said means for supplying air to said air storage tank being controlled by the air actuated valve.

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