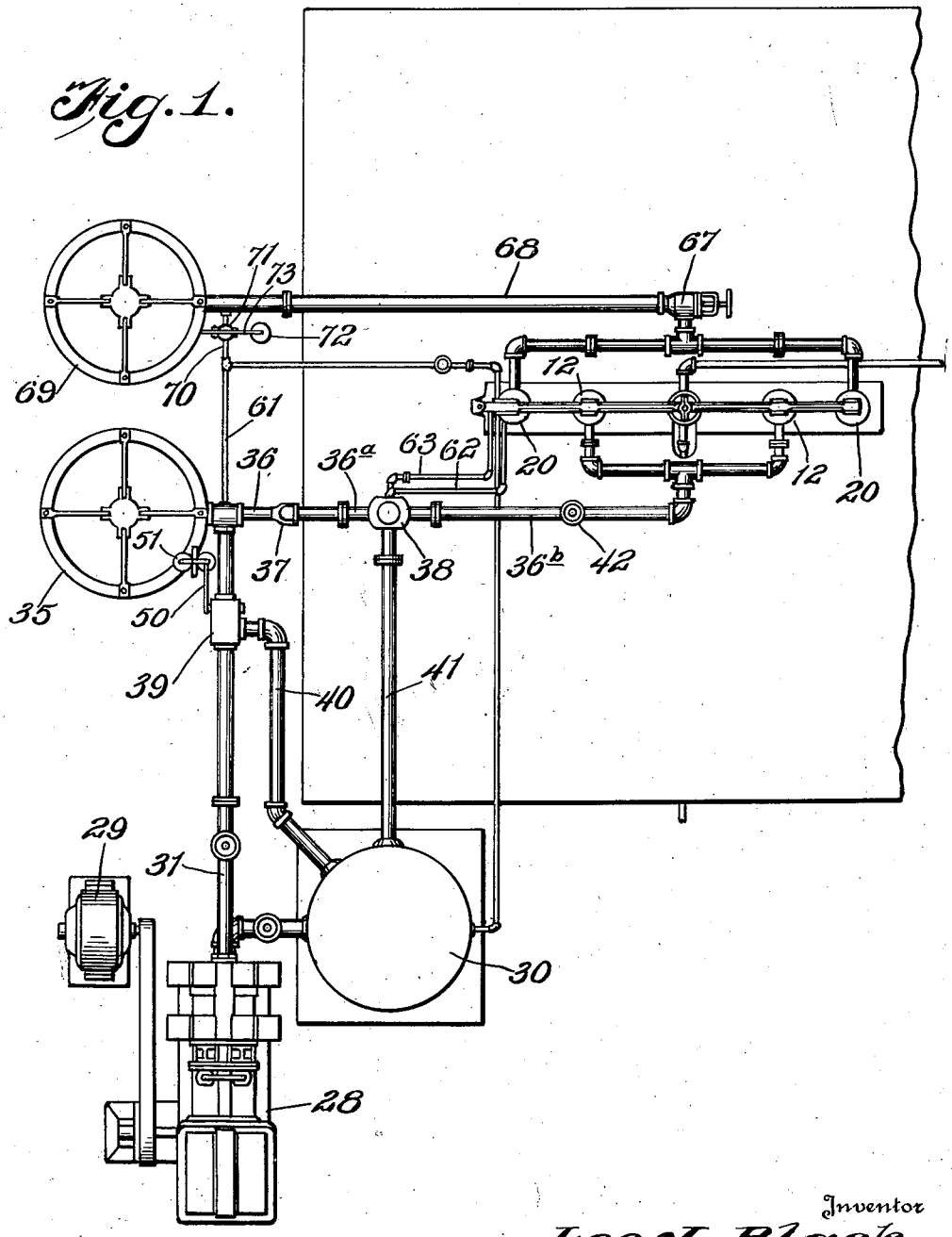
Aug. 17, 1926. 1,596,145

L. J. BLACK

HYDRAULIC PUMPING SYSTEM

Filed Nov. 14, 1925 3 Sheets-Sheet 1

Fig. 1.



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HYDRAULIC PUMPING SYSTEM

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Fig. 2.

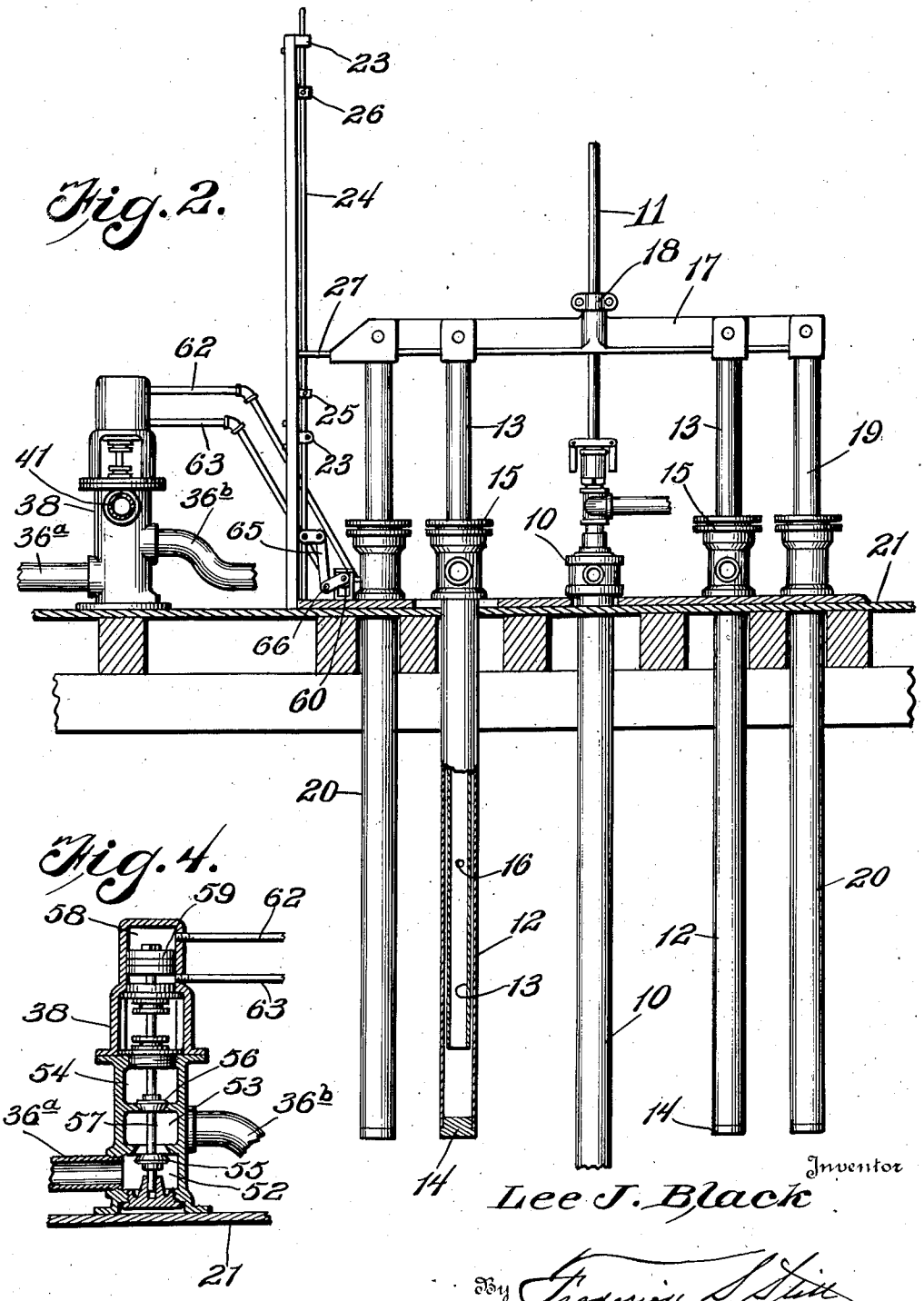


Fig. 4.

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HYDRAULIC PUMPING SYSTEM

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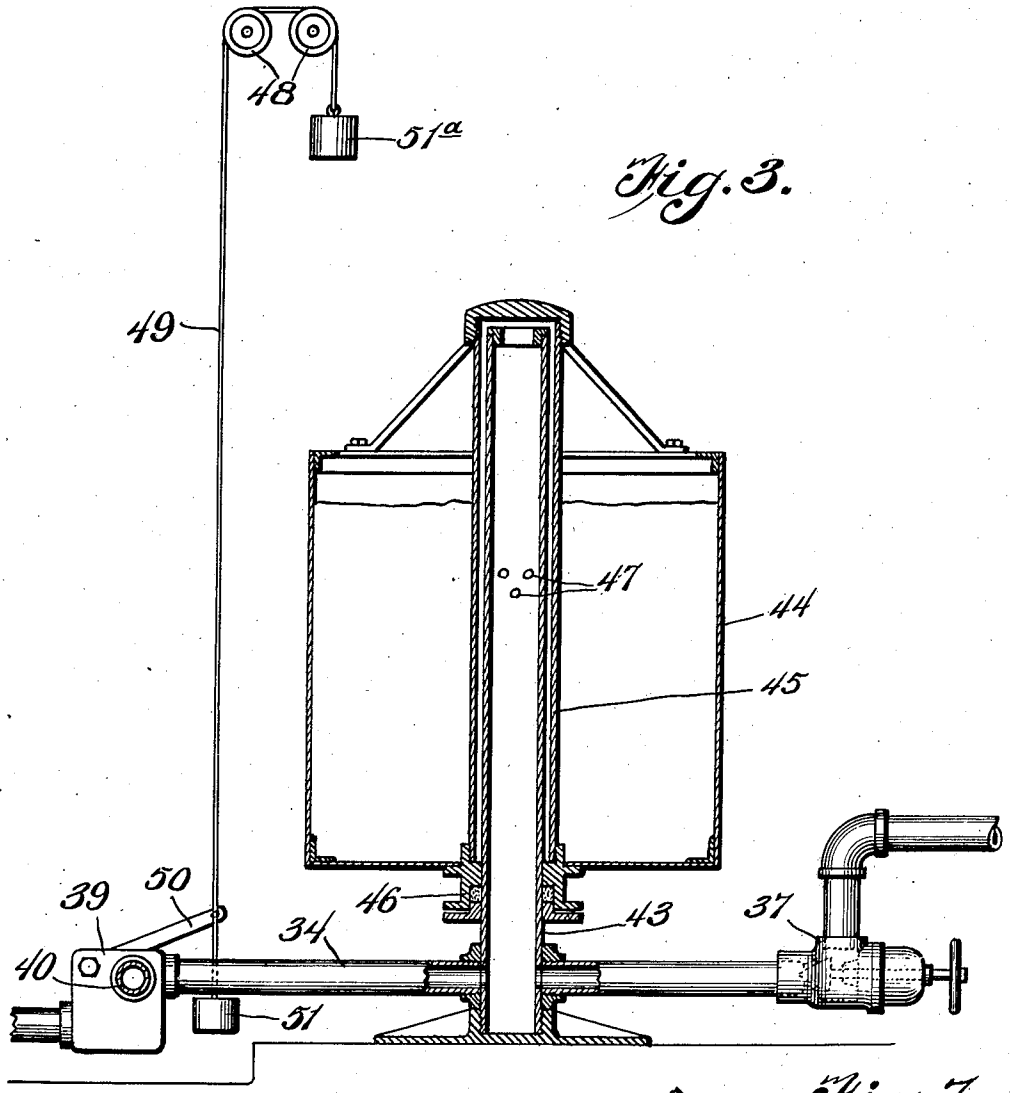


Fig. 3.

Fig. 5.

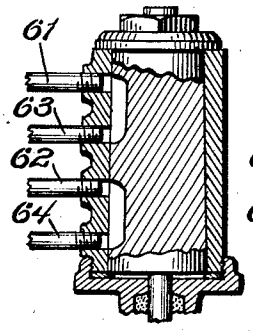


Fig. 6.

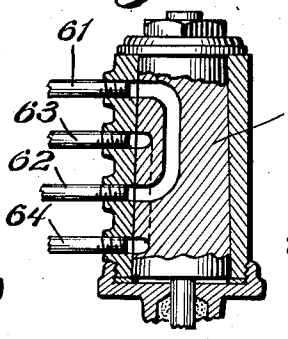
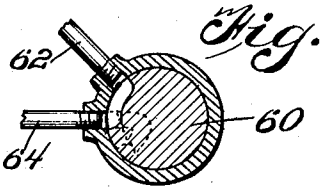


Fig. 7.



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Patented Aug. 17, 1926. 1,596,145

UNITED STATES PATENT OFFICE.

LEE J. BLACK, OF BEAUMONT, TEXAS.

HYDRAULIC PUMPING SYSTEM.

Application filed November 14, 1925. Serial No. 69,119.

This invention relates to hydraulic pumping systems and more particularly to a device of this character intended for use with oil wells.

An important object of the invention is to provide a device of this character having means for compensating for leakage in the pumping system of the fluid employed as a transmission element.

A further object of the invention is to provide means for counterbalancing the weight of the moving parts of the pumping apparatus which is adjustable so as to compensate for leakage or to permit regulation of the speed at which these parts descend in their return stroke.

A further object of the invention is to provide in a device of this character a substantially uniform pressure for operating the pumping apparatus.

A still further object of the invention is to provide a device of this character which is simple and at the same time durable so that it may be adequate for use under the conditions to which such pumping apparatus is put.

A further object of the invention is to provide means preventing damage of the parts of the pumping mechanism and the like upon failure of the control elements to function properly.

These and other objects I attain by the construction shown in the accompanying drawings, wherein for the purpose of illustration is shown a preferred embodiment of my invention and wherein:—

Figure 1 is a plan view of hydraulic pumping apparatus constructed in accordance with my invention;

Figure 2 is a view partially in section through the pumping apparatus proper;

Figure 3 is a sectional view through the controlling accumulator of the operating cylinders;

Figure 4 is a detail sectional view through the reversing valve of the operating cylinders;

Figures 5, 6 and 7 are views of the control valve for the reversing valve.

Referring now more particularly to the drawings, the numeral 10 generally designates deep well pumping apparatus which may be of the character usually employed in pumping oil wells, the numeral 11 indicating the reciprocating pump rod by means of which the pumping operation is actually carried out. In accordance with my invention, arranged at opposite sides of the pumping apparatus 10 is a pair of vertically disposed cylinders 12 having displacement pistons 13 arranged therein, these pistons being preferably hollow, as indicated. The lower end of each cylinder 12 is closed, as at 14, and the upper end thereof has a packing gland connection, as at 15, with the piston 13. Each piston 13 has formed therein at a point adjacent the lower end thereof a plurality of openings 16 extending through its walls, the purpose of which will hereinafter appear.

The upper ends of these pistons are connected to a rigid bar 17 which is provided centrally with an opening through which passes the pump rod 11. This pump rod has secured thereto a fixed collar 18 bearing against the upper surface of the bar 17. The ends of this bar 17 project beyond the point of engagement with the pistons 13 and have engaged therewith the pistons 19 of cylinders 29. The pistons 19 and cylinders 20 are similar in construction to the cylinders 12 and piston 13, hereinbefore described. All of these cylinders, including the pumping apparatus 10, may be directed through the floor structure 21 of a derrick. Arising from the floor structure adjacent one end of the bar 17 is a vertical support 22 having bearings 23 in which a rod 24 is mounted for vertical reciprocation. This rod has stops 25 and 26 with which an extension 27 of the bar is adapted to alternately engage.

A pump 28 is provided, at present shown as operated by a motor 29, associated with which is a storage tank 30 from which the pump draws its supply of fluid. The discharge 31 of this pump is connected with the intake 34 of an accumulator 35. The outlet of this accumulator is connected by a conduit 36 having arranged therein valves 37 and 38 with the cylinder 12. Arranged in the discharge pipe 31 of the pump is a by-pass valve 39 having means for diverting the discharge of the pump from the accumulator to the storage tank 30 through a conduit 40. The valve 38 hereinbefore mentioned is piston operated and has means for placing the sections 36^a and 36^b of the conduit 36 in communication with one another or for placing the section 36^b of the conduit in communication with one end of a conduit 41, the opposite end of which communicates with the storage tank 30. The valve 37 is of the na-

ture of a throttle valve, as more particularly illustrated in Figure 3, merely providing a means for regulating the speed of flow from the accumulator to the cylinders 12. In the section 36b, a hand operated valve 42 is arranged to provide a means for sealing the fluid within the cylinders 12 and thus provide a means for holding the bar and accordingly the pump rod at a desired elevation.

The accumulator 35 comprises a tubular storage chamber 43 open at its upper end about which is mounted an accumulator counterweight 44 which may be of any desired construction. Extending through the counterweight and secured thereto is a tube 45 of slightly greater internal diameter than the tube 43 and having its upper end closed and at its lower end a packing gland connection with the tube 43, as at 46. The tube 43 is provided at a point adjacent its upper end with a series of openings 47, the purpose of which will hereinafter appear.

Mounted upon a suitable support is a pulley or pulleys 48 having trained thereabout a cable or other flexible element 49 which, adjacent one end, is attached to the operating arm 50 of the valve 39. At the lower end of the cable below the point of its attachment, the arm 50 has secured thereto a counterweight 51. The opposite end of the cable has secured thereto a counterweight 51a which is of sufficient weight to overcome the resistance of the inoperation of the handle 50 and the weight of the counterweight 51 so that the handle of the valve normally occupies a position such that a discharge of the pump is into the accumulator 35 and not to the tank 30 by way of the bypass line 40. The weight 51a is arranged in the path of movement of the counterweight 44 of the accumulator to be engaged thereby when the accumulator reaches a predetermined height so that the weight 51 may act upon the valve to close communication between the pump and accumulator and establish passage through the line 40 to the storage tank 30. In event the valve 39 fails to function and the accumulator continues to rise, the openings 47 will become exposed below the packing gland 46, permitting escape of water from the tube 43 so that the accumulator discontinues its rise and at the same time provides an indication of improper action. The valve 38 includes three superimposed chambers 52, 53, 54 communicating with the sections 36a and 36b of the conduit 36 and the conduit 41 respectively. The walls or webs between the compartments are provided with oppositely directed valve seats for coaction with valve elements 55 and 56 carried by a stem 57 which projects outwardly through the casing and into a cylinder 58 within which it is provided with a piston 59. The valves 55 and 56 are so arranged that they seat alternately so that communication is either established between the chambers 52 and 53 or 53 and 54, depending upon the position of the stem. The position of this stem is controlled by a control valve 60 which receives fluid under pressure from the pump through a conduit 61 and delivers this pressure to either side of the piston 59 through conduits 62 and 63. At the time of connecting one end of the cylinder with the pressure line 61, the valve 60 connects the opposite end of the cylinder with the storage tank 30 through a pipe 64. This valve is controlled in its positions by a link 65 connecting the operating arm 66 of the valve with the rod 24.

The operation of those portions of the mechanism hereinbefore described with the exception of the counterbalancing cylinders 20 is as follows: In the operation of the pump 28, pressure is stored in the accumulator and from there transmitted to the cylinders 12, causing the pistons 13 thereof to rise. As the pistons 13 arise and the pump rod is drawn upwardly, the bar 17 likewise moves upwardly, finally bringing its extension 27 into engagement with the upper stop 26 of the rod 24 to shift the position of the valve. This causes fluid from the pipe 63 to be admitted beneath the piston 59 with the result that the conduit section 36b is placed in communication with the conduit 41 so that the fluid beneath the pistons 13 may return to the storage tank 30. During this period, communication between the accumulator and the cylinders is cut off and pressure may build up within the accumulator for the next operation of the pump. As the lowering continues, the extension 27 will engage the stop 25, reversing the position of the valve 60 and reversing the operation just described. In event by reason of breakage or dislocation of a part, the valve 66 fails to function and the pistons 13 continue to arise, they will, after reaching a predetermined height, expose the openings 16 of the packing glands 15 with the result that pump fluid may escape, preventing further rise on the part of the pistons and providing an indication of an improper condition.

The cylinders 20 are connected through a valve 67 similar to the valve 37 to one end of a conduit 68, the opposite end of which is connected with an accumulator 69 similar to the accumulator 35. This conduit has communicating therewith a branch pipe 70 of the pressure pipe 61 having arranged therein a valve 71 normally maintained in closed position by a counterweight 72 at one end of an operating lever 73, the opposite end of which projects beneath the accumulator 69 for engagement thereby during lowering movement of the accumulator if the accumulator drops sufficiently.

It will be obvious that the weight of the rod 11 and its accessories constituting the pumping string of the deep well pump 10 is considerable, often exceeding five tons. This weight, of course, depends upon the depth of the well and is, therefore, variable between two wells. The connections of the cylinders 20 and the accumulator 69 are for the purpose of counterbalancing the weight of these rods so that the return movement of the rod 11 and its associated part will not be too rapid. Assuming the weight of the rods to be ten thousand pounds, the weight of the accumulator will be set at slightly less than this amount, leaving an unbalanced load as small as may be desired to return the rods and pistons 19 and 13 to their lowered position. The water passing from beneath the pistons 19 will, of course, be forced into the accumulator 69 and will be resisted in its movement by the weight of the accumulator. Its speed of passage may be further regulated by the valve 67, if this is found desirable. In event leakage of the packing glands of the cylinders 20 or of the accumulator 69 permits escape of a portion of the water and allows the accumulator 69 to settle to such a point that it would not function properly, it comes into engagement with the lever 73 of the valve 71, opening this valve and permitting the pressure water from the pump to pass into the counterbalancing line 68 to restore the same to its proper condition.

It will be obvious that in a device of this character, under normal operation, there will be but a slight loss of the actuating fluid during the pumping operation and that, therefore, the system admirably adapts itself for use in pumping oil wells where conditions are often such that it is difficult to obtain a supply.

It will furthermore be obvious that this structure is capable of a certain range of change and modification without departing from the spirit of the invention and I accordingly do not limit myself to such specific structure except as hereinafter claimed.

I claim:—

1. In combination with a deep well pump having the usual pumping rods moving downwardly by gravity, operating mechanism therefor including a bar secured to the pumping rods, pairs of cylinders having the pistons thereof connected with the bar at opposite sides of the pump rod, a source of fluid under pressure, a storage tank, an accumulator, means for alternately connecting one cylinder of each pair with the source of pressure and with the storage tank and means for connecting the remaining cylinders of each pair with the intake of said accumulator.

2. In combination with a deep well pump having the usual pumping rods moving downwardly by gravity, operating mechanism therefor including a bar secured to the pumping rods, pairs of cylinders having the pistons thereof connected with the bar at opposite sides of the pump rod, a source of fluid under pressure, a storage tank, an accumulator, means for alternately connecting one cylinder of each pair with the source of pressure and with the storage tank, means for connecting the remaining cylinders of each pair with the intake of said accumulator and means for automatically placing said accumulator in communication with the source of pressure to replace leakage losses therein.

3. In combination with a deep well pump having the usual pumping rods moving downwardly by gravity, operating mechanism therefor including a plurality of cylinders operatively connected with the pumping rod, a source of fluid under pressure, a storage tank and accumulator, means for alternately connecting certain of said cylinders with the source of pressure and with the storage tank, and means for connecting the remainder thereof with the intake of the accumulator.

4. In fluid operated pumping apparatus and in combination with a pump to be operated, having pumping rods moving downwardly by gravity, an operating cylinder for the pump, a pressure pump, a storage tank, means connected between the pressure pump, storage tank and cylinder for alternately placing the pressure pump in communication with the cylinder, and the cylinder in communication with the storage tank, an accumulator counterbalancing the pumping rods of the pump, and means for connecting the pressure pump with the accumulator to compensate for leakage losses.

In testimony whereof I affix my signature.

LEE J. BLACK.