No. 695,815. Patented Mar. 18, 1902.

C. B. LAKENAN.

HYDRAULIC PUMP.

(Application filed Dec. 4, 1899.)

(No Model.) 2 Sheets—Sheet 1.

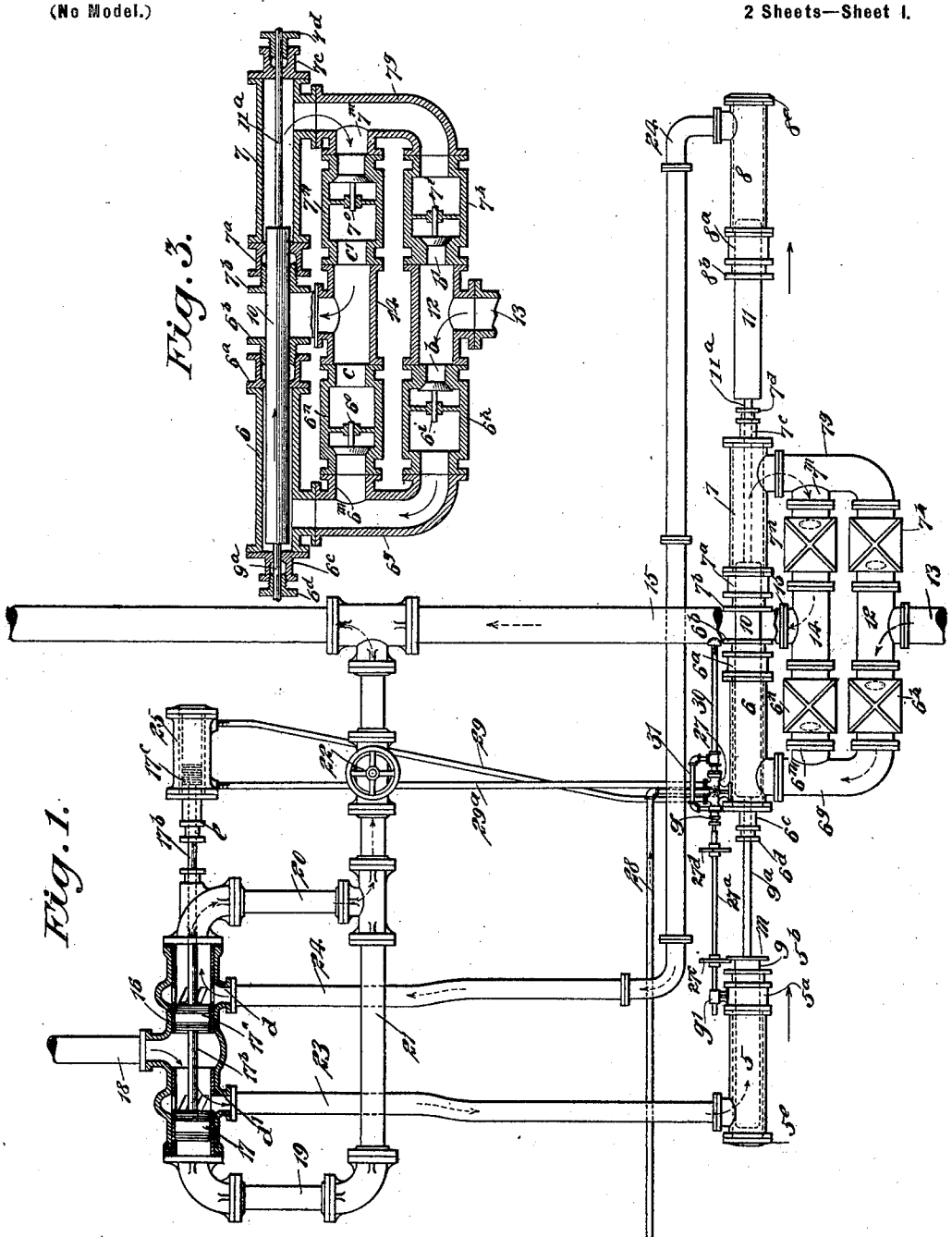

Fig. 3.

Fig. 1.

WITNESSES:

C. W. Smith

Wm. P. Patton

INVENTOR

C. B. Lakenan

BY

Munn & Co.

ATTORNEYS.

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Fig. 2.

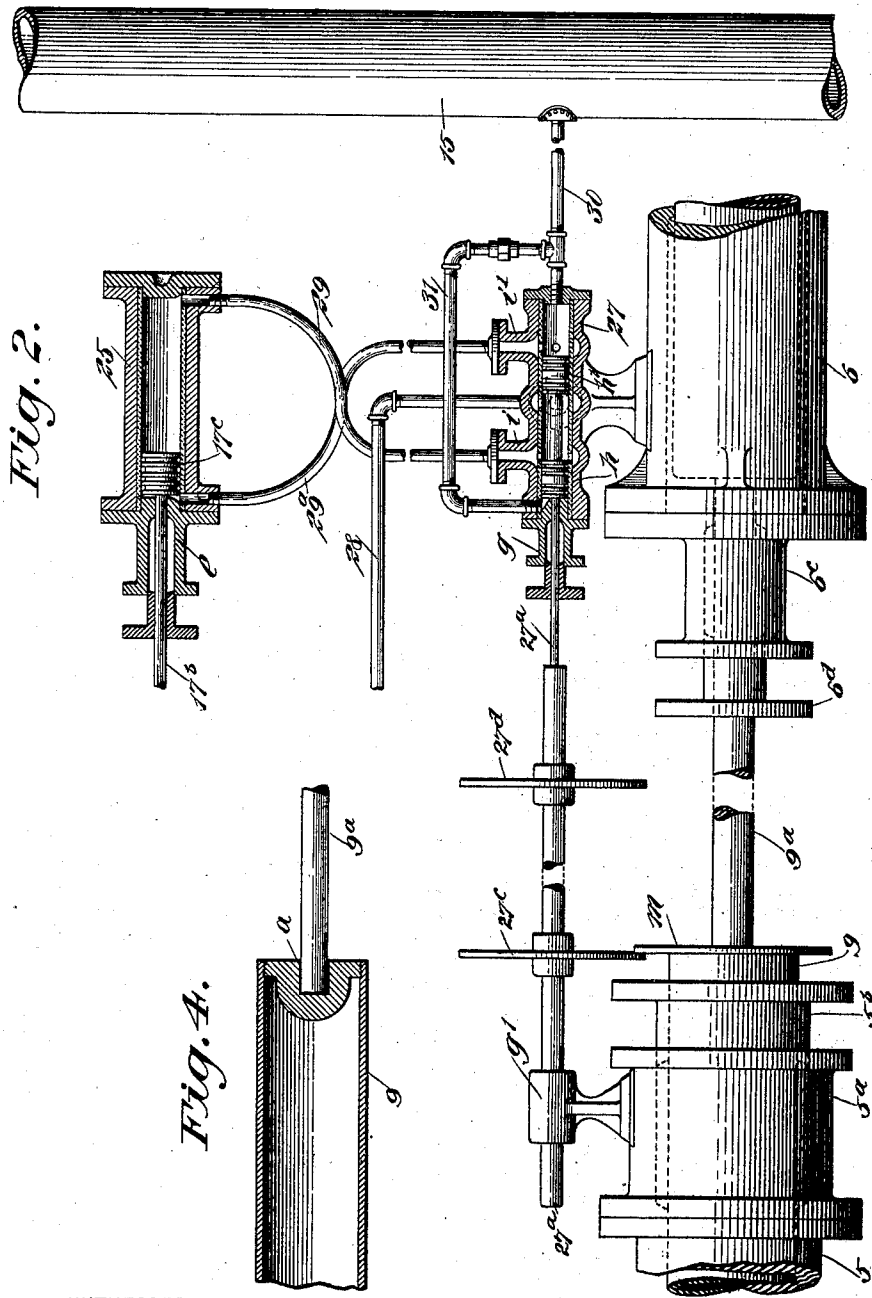

Fig. 4.

WITNESSES:

C. W. Smith

Wm. P. Patton

INVENTOR

C. B. Lakenan

BY

Munn & Co

ATTORNEYS.

UNITED STATES PATENT OFFICE.

CORNELIUS BOWSTEAD LAKENAN, OF GRASS VALLEY, CALIFORNIA.

HYDRAULIC PUMP.

SPECIFICATION forming part of Letters Patent No. 695,815, dated March 18, 1902.

Application filed December 4, 1899. Serial No. 739,159. (No model.)

To all whom it may concern:

Be it known that I, CORNELIUS BOWSTEAD LAKENAN, a citizen of the United States, and a resident of Grass Valley, in the county of Nevada and State of California, have invented new and useful Improvements in Hydraulic Pumps, of which the following is a full, clear, and exact description.

This invention relates to pumps used for removal of water from mines or the elevation of water or other liquid from a low level to a higher one.

The object of my invention is to provide a hydraulic pump with novel simple details of construction which cheapen manufacture and adapt the pump for highly efficient service.

The invention consists in the novel construction and peculiar combination of parts, as is hereinafter described, and defined in the appended claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures.

Figure 1 is a broken partly sectional side elevation of the improved pump. Fig. 2 is an enlarged partly sectional side view of a supplementary hydraulic motor employed. Fig. 3 is a sectional side elevation of a system of pump-valves which are details of the improvement, and Fig. 4 is a sectional side view in part of one of the pump-plungers employed.

As shown, four pump-cylinders 5 6 7 8 are provided, preferably of equal dimensions, and their similar bores may remain unfinished if this as a measure of economy is desired. It is to be understood, however, that the two outer cylinders 5 8, which are of equal diameter, may have increased or decreased diameter as compared with that of the other pair of cylinders, their diameters depending upon the pressure of liquid employed as a motive agent, as will be hereinafter more fully explained. The pump-cylinders 5 6 7 8 are supported by any suitable means, such as a bed-plate, (not shown,) with their longitudinal axes in alinement and in the same plane, which is preferably horizontal. The two outermost cylinders 5 and 8 are spaced an equal distance from the outer ends of the inner cylinders 6 7, said distance being less than the length of either cylinder, including a packing-box secured on an appropriate end of each cylinder.

The packing-boxes 5^a 6^a 7^a 8^a are affixed upon the respective cylinders 5 6 7 8 by any suitable means, and, as shown, said boxes are positioned on the innermost ends of the cylinders. Each packing-box is truly bored and is furnished with a gland occupying a counterbore thereof, said glands 5^b 6^b 7^b 8^b having each a central bore that conforms in diameter to the inner end portion of the box, which is not counterbored. The two innermost cylinders 6 7 are separated a short distance at their adjacent ends, and upon the outer end of each of said cylinders a packing-box 6^c 7^c is secured thereto, the bores of which boxes are in axial alinement with the bores of the outermost glands 5^b 8^b. The outer ends of the pump-cylinders 5 and 8 are sealed by bonnets 5^e 8^e.

Three plungers 9 10 11 are provided for coaction within the four cylinders 5 6 7 8, said plungers having water-tight engagement within appropriate glands and packing-boxes on the ends of the cylinders. The plungers 9 and 11 respectively occupy the outermost cylinders 5 8, and each has a length equal to the combined length of a packing-box and cylinder which the plunger occupies. The plunger 10 is introduced within the two innermost cylinders 6 7 and has such proportionate length as will permit it to fully occupy one of said cylinders and also pass through the packing-boxes and glands on the inner or adjacent ends of the cylinders 6 7, as is clearly shown in Fig. 3.

A plunger-rod 9^a extends between the opposing ends of the plungers 9 and 10, and preferably the ends of said rod loosely engage within a socket *a*, formed in the head wall of each plunger, as shown with regard to the plunger 9 in Fig. 4. A like plunger-rod 11^a extends between the opposing ends of the central plunger 10 and outer plunger 11, loosely seating its ends in sockets formed in the head walls of said plungers, as already described with regard to the plungers 9 and 10. The plunger-rods 9^a 11^a have water-tight engagement with the stuffing-boxes 6^c 7^c on the outer ends of the innermost cylinders 6 7, which coact to hold the rods alined with each other

and axially coincident with the centers of the plungers with which they engage.

On the lower sides of the pump-cylinders 6 7 branch pipes 6^g and 7^g are respectively secured, as shown in Figs. 1 and 3, and the lower end of each of said branch pipes bends toward the other, these bends being axially coincident.

A valve-box 6^h is secured upon the bent lower end of the branch pipe 6^g, and a like valve-box 7^h is secured upon the bent lower end of the branch pipe 7^g, these valve-boxes respectively containing the valves 6^i 7^i, which are held to reciprocate therein and seat upon inlet-orifices *b b'*, as represented in Fig. 3. The inlet-orifices *b b'* are in communication with the top horizontal member of the T-shaped branch pipe 12, which at its lower side is connected with the upper end of the vertical sump-pipe 13, that extends into a supply of water to be raised by the pump.

An outlet-opening 6^m is formed in the inner side of the depending pipe 6^g, and a like outlet-opening 7^m is formed in the inner side of the pipe 7^g, these outlets being directly opposite each other.

A valve-box 6^n is secured upon the pipe 6^g over the outlet 6^m therein, and a like valve-box 7^n is affixed over the outlet 7^m in the depending pipe 7^g, these valve-boxes having discharge-orifices at the inner ends and also inlet-apertures respectively alined with the outlets 6^m 7^m. A valve 6^o controls the entrance of liquid into the valve-box 6^n from the pipe 6^g, and a similar valve 7^o controls the influx of water into the valve-box 7^n from the pipe 7^g.

A discharge-opening *c* is provided at the inner end of the valve-box 6^n, and a similar discharge-opening *c'* is formed in the inner end of the valve-box 7^n, these opposite openings *c c'* being covered by the ends of a T branch pipe 14, which opens upwardly intermediately of its ends and over which opening is secured the lower end of the vertical discharge-pipe 15 for water passed through the plurality of valve-boxes and forced by the pump, as will be further described.

The four-barreled pump which has been described if employed to lift water from a deep well or to remove water from a low level in a mine is placed in said well or mine at a suitable point, and above the pump, either in the well or mine or exterior thereof, a pump-actuating medium is located.

The primary motor for the pump is as follows: Arranged above the pump is a balanced piston-valve (shown in Fig. 1) comprising the following details: Within the valve-chamber 16, preferably in cylindrical form and closed at each end, two piston-valves 17 17^a are held to slide with the piston-rod 17^b, whereon they are mounted and secured, the valve 17 being positioned at the left-hand end of said rod and the other valve 17^a suitably spaced therefrom, as will be further described.

Over an opening on the upper side of the horizontal valve-chamber 16, near the longitudinal center thereof, the lower end of a pipe 18 is secured, which pipe is shown broken, but in complete form extends to a source of water-supply under pressure for actuation of the device, and from each end of the valve-chamber 16 respectively extend the waste-water branch pipes 19 20, which are connected at their lower ends with the common water-discharge pipe 21, that has communication with the vertical lift-pipe 15, a valve 22 affording means to control the efflux of liquid passing through the pipe 21.

At suitable points on the valve-chamber 16 annular swells are formed to afford passages for water, each annular enlargement having an opening at the lower side, over which openings *d d'* upper ends of the depending water-conduits 23 24 are respectively secured.

The lower end of the conduit 23, near the left-hand end of the valve-chamber 16, is in connection with the upper side of the left-hand pump-cylinder 5, a sufficient annular space being afforded between the plunger 9 and the inner surface of the cylinder to admit water from the conduit into said cylinder. The water-conduit 24 is extended to the outermost end of the pump-cylinder 8 and is connected therewith.

The piston-valve 17 by its reciprocal movement is adapted to control the passage of water from the supply-pipe 18 into the conduit 23, and the piston-valve 17^a controls the transmission of water under pressure from the supply-pipe 18 into the conduit-pipe 24, and it will be evident, therefore, that the proper longitudinal movement of the piston-rod 17^b will so simultaneously dispose the valves thereon that water under pressure will pass from the pipe 18 through the valve-chamber 16 alternately into the conduits 23 24 and exert pressure upon the ends of the plungers 9 and 11, whereby these plungers are successively pressed inwardly or toward the intermediate cylinder 6 or 7, as the case may be.

Obviously the longitudinal movement of the piston-valves 17 17^a will cause a discharge of water which is at the end of a respective valve nearest to the waste-pipe 19 or 20, with which an appropriate end of the valve-chamber 16 is in connection.

It is essential for the proper operation of the pump mechanism that means be provided to coact with the balanced valve, which has been described, said means consisting of a supplementary hydraulic valve mechanism, (shown in Fig. 2 and constructed as follows:)

The valve-rod 17^b is extended water-tight through the right-hand closed end of the valve-chamber 16 and has a slidable engagement with the stuffing-box *e*, that is on the opposing end of a supported hydraulic chamber 25, a piston-head 17^c, secured on the end of the valve-rod mentioned, having engagement with the true cylindric bore of the hydraulic chamber 25.

Upon the cylinder 6 a hydraulic valve-chamber 27, substantially similar to the chamber

16, is secured in a plane parallel with the bore of said cylinder, and a valve-rod 27^a is supported to reciprocate in the valve-chamber 27 by the loose engagement of one end thereof within a stuffing-box g on the end of said valve-chamber above the inner end of the pump-cylinder 6, the other end of the valve-rod having slidable engagement with a bracket-stand g' or the like on the cylinder 5 or the packing-box 5^a thereon.

Two spaced cylindric piston-valves $h\ h'$ are mounted upon the rod 27^a within the true cylindric bore of the valve-chamber 27, and a pipe 28, extended from a source of water-supply under pressure, taps the valve-chamber 27 at a suitable point between the piston-valves $h\ h'$, as clearly shown in Fig. 2.

Two outlets $i\ i'$ are formed on the valve-chamber 27 and tap the same, one outlet having communication with the valve-chamber between the piston-valves $h\ h'$ and the other outlet intersecting the bore of the valve-chamber at a proper distance from the right-hand end thereof and beyond the inward travel of the piston-valve h', as indicated in Fig. 2. Two similar pipes 29 29^a for the transfer of water passing from the hydraulic valve-chamber 27 to the opposite ends of the hydraulic chamber 25 are secured by their lower ends over the outlets $i\ i'$, the pipe 29 having communication with the outlet i and the pipe 29^a with the outlet i', said pipes being respectively attached to the right-hand and left-hand ends of the hydraulic chamber 25, so as to convey water thereto. From the head which closes the right-hand end of the hydraulic valve-chamber 27, a waste-water pipe 30 extends to the vertical lift-pipe 15 and taps the latter for the transfer of water, and into the opposite or left-hand end of said valve-chamber one end of the inverted-U-shaped water-discharge pipe 31 is inserted, the other extremity of the latter tapping the side of the discharge-pipe 30, as clearly shown in Fig. 2.

The valve-rod 27^a may have increased diameter beyond that portion which travels in the valve-chamber 27, and on this outer portion of the valve-rod two disks $27^c\ 27^d$ are mounted and secured at a suitable distance apart.

Upon the outer extremity of the plunger 9, adapted to reciprocate in the pump-cylinder 5 and packing-box 5^a, a peripheral flange m is formed or secured, and the relative diameters of the like disks $27^c\ 27^d$ and the flange m are such as will permit the disks to relatively engage the opposite sides of the flange when the valve-rod is reciprocated by the plunger.

Assuming that the piston-valves in the valve-chamber 16 are positioned as shown in Fig. 1 and the plungers 9 10 11 moved their full travel to the left, so as to locate the plunger 9 a full stroke within the cylinder 5, the plunger 10 nearly filling the cylinder 6 and the plunger 11 drawn out of the cylinder 8, it will be seen that space is afforded in the cylinders 7 and 8 for a return stroke of the three plungers to cause the plungers 10 11 to occupy the cylinders 7 and 8. At this stage of valve and plunger adjustment a free passage is afforded for water under pressure from the supply-pipe 18 to pass down through the valve-chamber 16 into the conduit-pipe 23 to press upon the outermost end of the plunger 9 and cause it to move in the direction of the arrow below the cylinder 5. (See Fig. 1.) The relative adjustment of the parts at this juncture disposes the disk 27^c in contact with the outer side of the flange m, as shown in Figs. 1 and 2, the outward travel of the valve-rod 27^a having located the piston-valves $h\ h'$, so that the water fed from the pipe 28 will enter the hydraulic valve-chamber 27 and rise in the pipe 29 through the opening i.

A proper space is provided between the disks $27^c\ 27^d$ on the valve-rod 27^a, so that the flange m will be caused to alternately slide this rod in either direction of its travel in accord with the full reciprocatory movement of the plunger 9, said movement of the valve-rod 27^a being exactly sufficient to change the positions of the piston-valves $h\ h'$ to alternately open and close the passages $i\ i'$ into the pipes 29 29^a in unison with the travel of the plunger 9.

When the piston-valves 17 17^a in the valve-chamber 16 are at the left-hand end of their stroke, as represented in Fig. 1, then the piston-valve 17^c in the hydraulic chamber 25 is at the left-hand termination of its reciprocatory movement.

In operation when the parts are adjusted as hereinbefore explained the force of water under pressure in the supply-pipe 18 will pass down the conduit-pipe 23 and force the plunger 9 to the right, thus correspondingly sliding the plunger 10 into the cylinder 7 and vacating mainly the cylinder 6. The travel of the plunger 10 in the cylinders 6 7 opens the valve 6^i in the lower left-hand valve-box 6^h (see Fig. 3) and draws water from the sump-pipe 13 into the valve-box named and thence into the branch pipe 6^g. The return stroke of the plungers 9 10 11, which closes the valve 6^i and opens the valves $6^c\ 7^i$, and thus expels water from the upper valve-box into the lift-pipe 15, is preferably effected by the coaction of the supplementary hydraulic motor device shown best in Fig. 3, which has previously been described. It will be seen that if the plunger 9 is at the end of its stroke in the pump-cylinder 5 and the valves $h\ h'$ are positioned in the hydraulic chamber 27, as shown, the reversed movement of the plunger 9, due to pressure of water down the conduit-pipe 23, will cause the flange m to impinge upon the disk 27^d when the plungers 9 10 11 have nearly reached their end of travel to the right. This will simultaneously change the positions of the valves $h\ h$ and permit water under pressure fed through the pipe 28 to pass into the pipe 29^a and force the piston-valve 17^c to the right, the water contained in

the chamber 25 being expelled through the pipes 29, 31, and 30 into the lift-pipe 15. The movement of the piston-valve 17^c and valve-rod 17^b toward the right-hand end of the chamber 25 shifts the piston-valves 17 17^a correspondingly, and this movement of the valves named permits water under pressure fed through the pipe 18 to pass down the conduit-pipe 24, and thus produce water-pressure on the right-hand end of the plunger 11, whereby the valve 7^i in the lower valve-chest 7^h is closed and water previously drawn into the right-hand branch pipe 7^g is expelled from the upper chest 7^n through the opening c' into the branch 14 and thence into the lift-pipe 15. It will be apparent that the continued pressure of water fed from the pipes 18 and 28 will insure the continuous operation of the pump, the set of valves at the right and at the left hand ends of the branches 12 and 14 alternately becoming active in accord with the reciprocating movement of the three plungers 9 10 11.

The employment of the supplementary hydraulic motor device enables the location of the pump proper at a low level in a well or mine and the assured action of the hydraulic pump.

It is to be noted that the pump-cylinders 5 and 8, with the plungers 9 and 11, that work therein, are pressure-jacks for actuation of the longer plunger 10, that by its reciprocation in the intermediate cylinders 6 7 alternately operates the double set of valves 6^i 6^o 7^i 7^o for continuously raising water through the sump-pipe 13 and discharging it into the lift-pipe 15, and it may be here explained that as there is no pressure other than the gravity of the water-column in the pipe 15 above the waste-pipes 21 and 30 there will be no material obstruction to the discharge of the waste water from the chambers 16 and 27.

Having described my invention, I claim as new and desire to secure by Letters Patent—

1. In a pumping apparatus the combination of four cylinders having their axes in line and in the same horizontal plane, the outer cylinders being spaced substantially an equal distance from the adjacent ends of the inner cylinders and which distance is less than the length of either cylinder and its packing-box, and the inner cylinders separated a short distance at their adjacent ends; packing-boxes affixed upon the ends of the cylinders and exterior to said cylinders whereby interior packing is obviated; three plungers axially in line, two of said plungers occupying the outermost cylinders and having a length about equal to the combined length of the cylinder and the exterior packing-box which it occupies, and the intermediate plunger operating in the two inner cylinders and having such proportionate length as will permit it to fully occupy one of said cylinders, and also pass through the packing-boxes on the adjacent ends of said inner cylinders; branch pipes leading from the sides of the inner cylinders and turned toward each other and axially coincident; valve-boxes secured upon said branch pipes and provided with valves; a water-inlet; a pipe connection between the branch pipes and provided with valve-boxes; and a discharge-pipe leading from the said pipe connection.

2. In a pumping apparatus the combination with the four cylinders axially in line and the pistons reciprocable in line in said cylinders, the inlet and outlet pipes and the valve mechanism, of a primary motor including a valve-chamber and two connected piston-valves therein, a pipe leading from a source of water-supply and entering the valve-chamber between the valves, waste-water branches from the valve-chamber and a discharge-pipe connecting them with the outlet-pipe said discharge-pipe having a controlling-valve and said valve-chamber having annular enlargements with conduits leading thereto from the outer ends of the outermost cylinders.

3. The combination of four cylinders axially in line and pistons reciprocable in line in said cylinders; a hydraulic chamber 25; a hydraulic valve-chamber 27 and a valve-rod to reciprocate in said chamber; two piston-valves on said rod and reciprocable in said valve-chamber; a water-supply pipe 28 tapping the valve-chamber at a point between the said piston-valves; two outlets from the valve-chamber, one of said outlets having communication with the chamber between the piston-valves, and the other outlet intersecting the bore of the chamber at a suitable point beyond the inward travel of the adjacent valve; two pipes extending from the said outlets to opposite ends of the hydraulic chamber 25, to convey water thereto; a waste-water pipe 30 extending from the head end of the valve-chamber; the pipe 15 with which said waste-water pipe connects; two spaced disks secured to the valve-rod, and a flange on one of the pump-plungers of such diameter as will permit the disks to be engaged on their inner sides to reciprocate the valve-rod.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CORNELIUS BOWSTEAD LAKENAN.

Witnesses:
T. W. CARSON,
J. M. LAKENAN.