(No Model.) 2 Sheets—Sheet 1.

P. ANDERSON.

PUMP.

No. 428,997. Patented May 27, 1890.

Fig. 2.

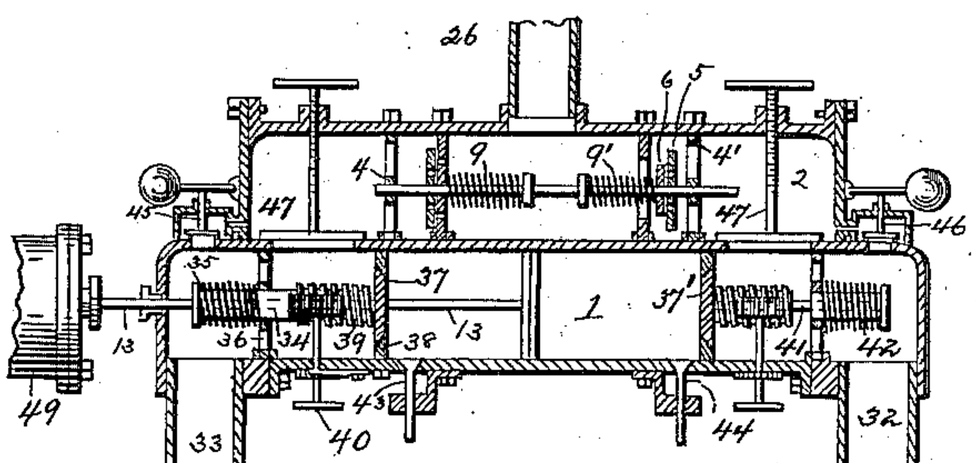


Fig. 1.

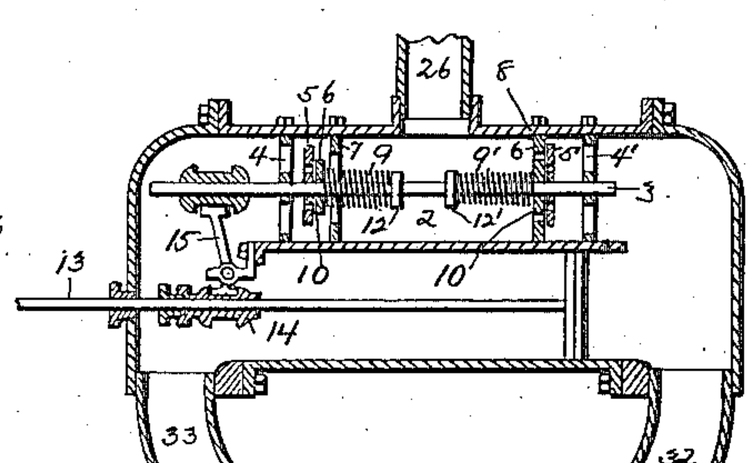
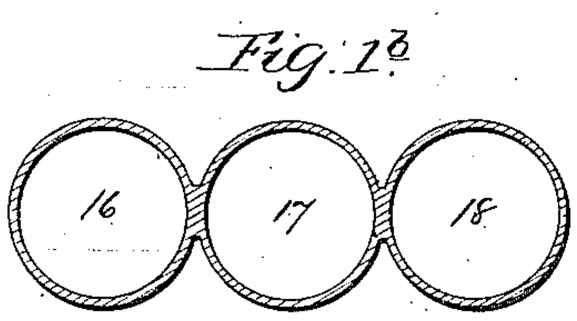


Fig. 1b



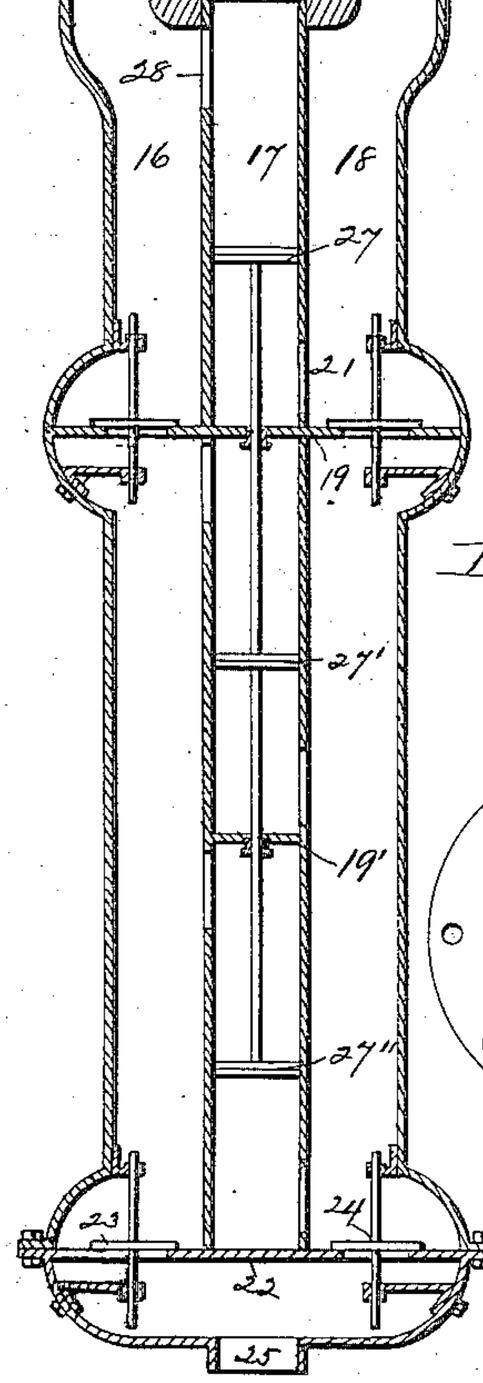
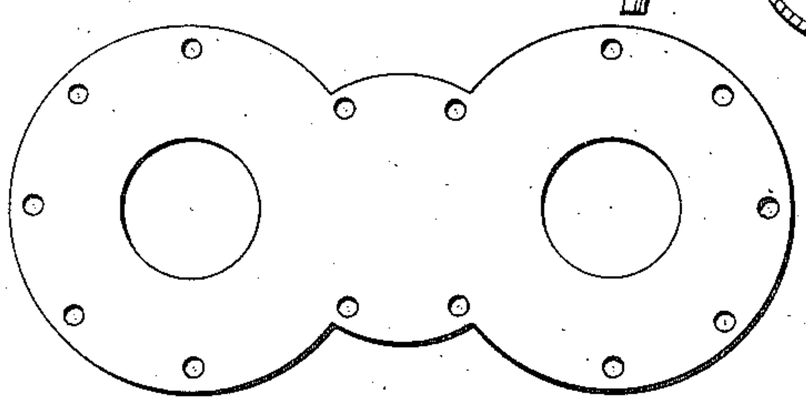
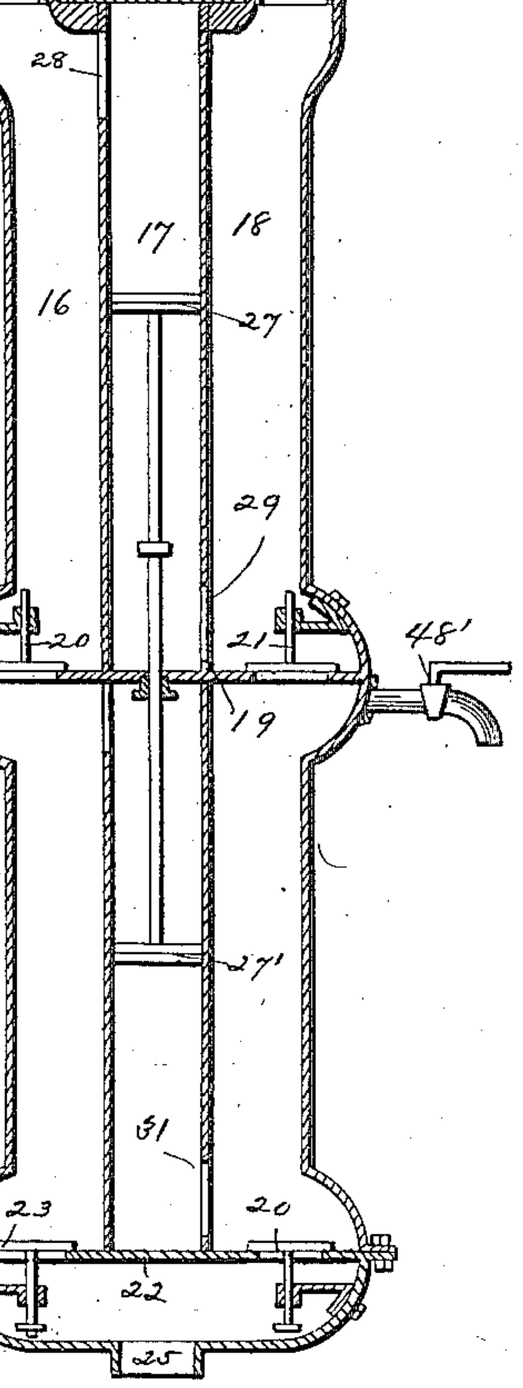


Fig. 3.

Fig 1a





WITNESSES

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(No Model.) 2 Sheets—Sheet 2.

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PUMP.

No. 428,997. Patented May 27, 1890.

Fig. 4.

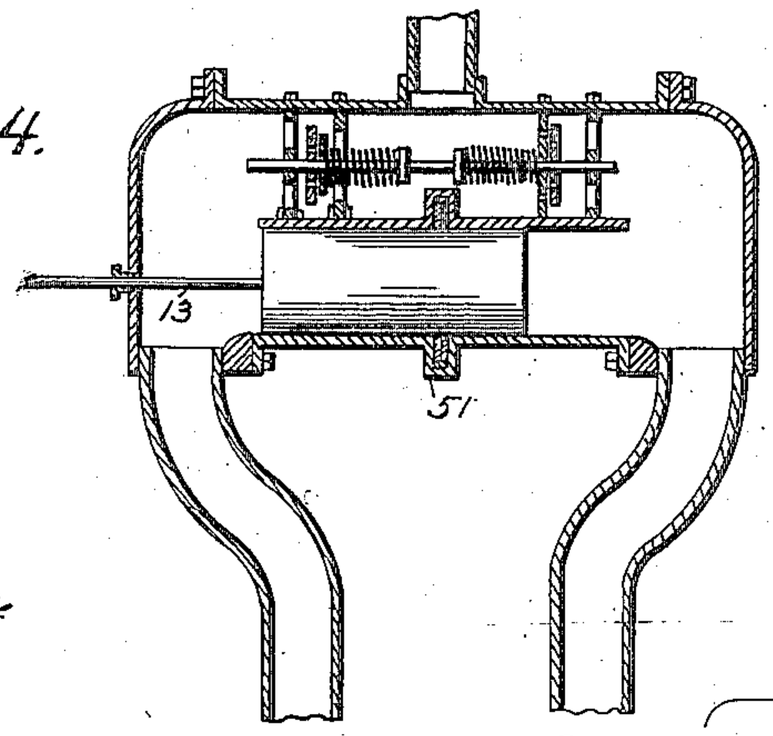
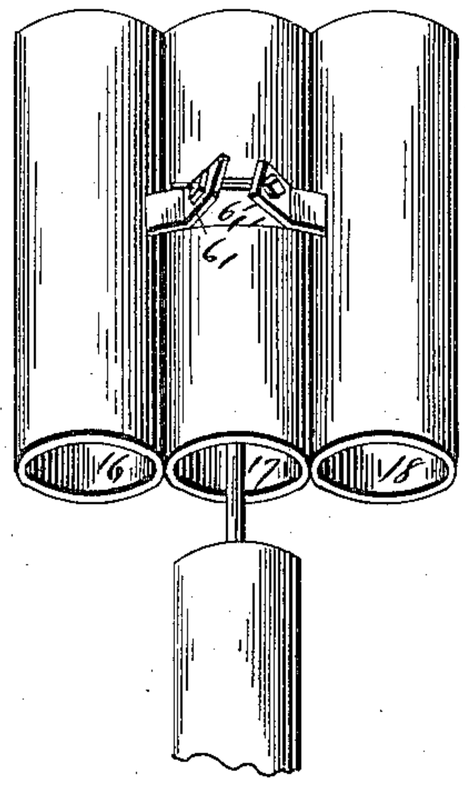


Fig. 4a



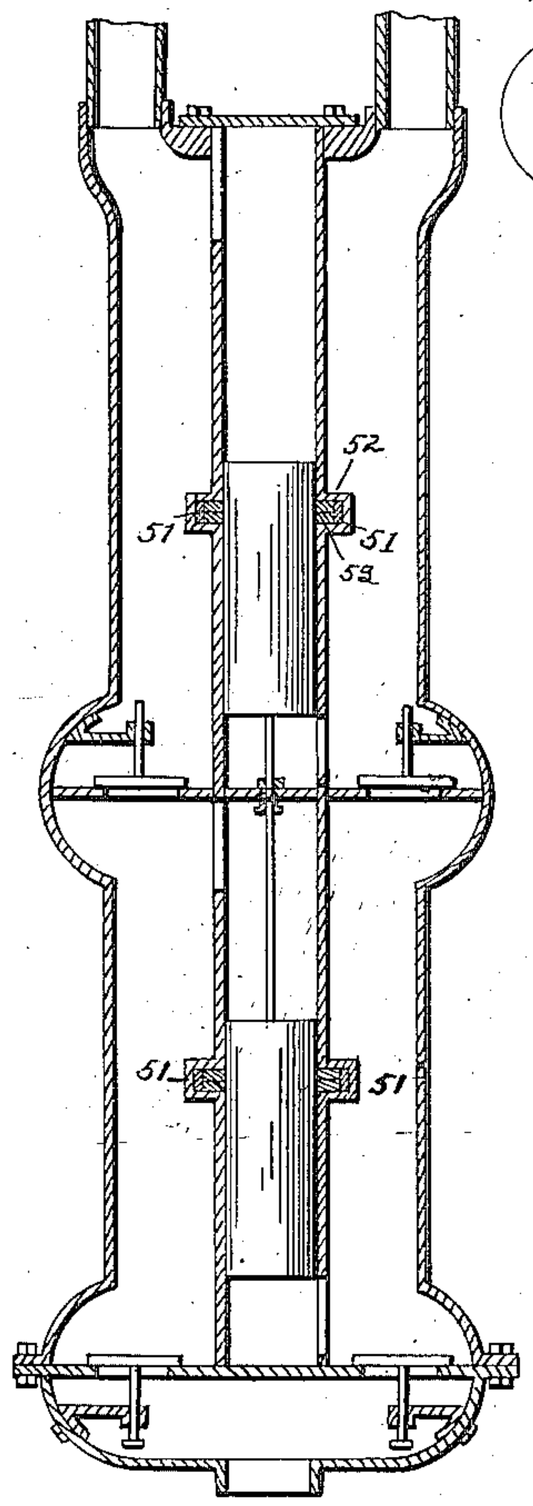


Fig. 1c.

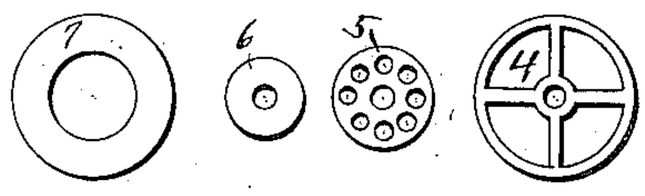


Fig. 4b

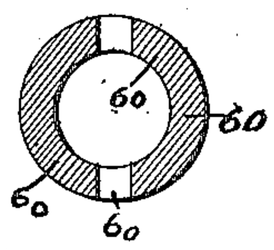


Fig. 4c

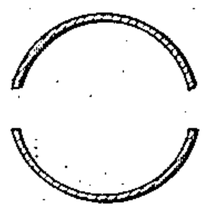


Fig. 4d

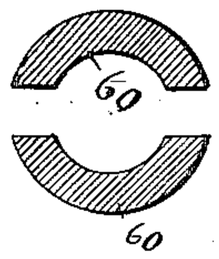
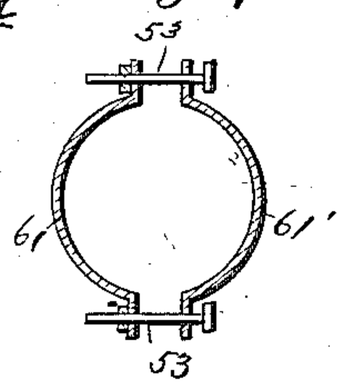


Fig. 4e



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PUMP.

SPECIFICATION forming part of Letters Patent No. 428,997, dated May 27, 1890.

Application filed May 16, 1889. Serial No. 311,036. (No model.)

To all whom it may concern:

Be it known that I, PETER ANDERSON, a citizen of the United States, residing at Salt Lake City, in the county of Salt Lake and Territory of Utah, have invented certain new and useful Improvements in Pumps; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the figures of reference marked thereon, which form a part of this specification.

This invention relates to pumps, and more particularly to that class of pumps by which liquids may be raised from great depths without the intervention of a solid pump-rod between the upper and lower levels.

The invention embraces certain features of novelty, which will be fully described in this specification and definitely indicated in the appended claims.

In the accompanying drawings, which illustrate my invention, Figure 1 shows a double-action pump in vertical section. Fig. 2 shows in vertical section a similar pump provided with self-priming mechanism. Fig. 3 shows in vertical section a modification of the lower pump shown in Fig. 1. Fig. 4 is a sectional view of a pump identical in construction with that shown in Fig. 1, except that plungers are substituted for the ordinary piston, and a novel form of packing is used therewith. Fig. 1^a shows in plan the lower pump in Figs. 1, 3, and 4. Fig. 1^b shows a transverse section of the lower pump shown in Figs. 1, 3, and 4. Fig. 1^c illustrates details of the valves and their supports used in the upper pumps. Figs. 4^a, 4^b, 4^c, 4^d, and 4^e are illustrations of details, showing the manner of packing the plungers when the latter are used.

All of the pumps herein described have certain features in common, the object in all being to raise the water through the instrumentalities of a water or air rod in lieu of the rigid pump-rod commonly adopted.

In carrying out my invention I provide an upper and lower pump, placed, respectively, at the levels from which the fluid must be raised and that at which it must be discharged. The two pumps are connected by two independent conduits or pipes. In the drawings a break in these pipes below the upper pump is shown to indicate that the most of it has been removed to make the illustration on an intelligible scale.

In the form shown in Fig. 1 the upper pump is provided with a double chamber or barrel 1 2, in the lower chamber of which is fitted a piston suitably provided with stuffing-boxes and packing in the ordinary way. In the upper chamber a rod 3 is mounted to have a sliding movement in skeleton bearings 4 4′. (Shown in side elevation in Fig. 1^c.) Valves 5 and 6 and 5′ 6′ co-operate with valve-seats 7 8. The valve-seat is simply a disk provided with a circular opening. Each valve 5 6 consists of two plates, one of which is free to slide on the rod 3 against the tension of a coil-spring 9, and the other of which is fixed to the rod, the latter being provided with a circular series of holes covered by the smaller plate. The smaller plate is capable of being forced back through the valve-seat if at any time the lower piston should reach the end of its stroke before the upper piston does, as will presently be described. Set-screws 12 12′ are provided for varying the tension of the springs 9 9′ when it may be necessary. On the piston-rod is a sleeve 14, which moves easily on the rod, having just enough friction to throw the valves 5 6 by means of the lever 15. As soon as the valve has been thrown over to its seat the piston-rod slides through the sleeve for the rest of its stroke. The piston-rod is connected to any suitable source of power that will give it a reciprocating motion. The lower pump consists of three pipes 16 17 18, suitably held together. Pipes 16 and 17 are connected, respectively, at the top with opposite ends of the upper pump. A diaphragm 19 crosses the pipes at a central point, valved openings being provided in the pipes 16 and 18, the valves opening upwardly and being mounted in suitable supports, as shown. A similar diaphragm 22 crosses the pipes near the bottom, said diaphragm being also provided with upwardly-opening valves 23 24. Below these valves is a chamber, in the wall of which is a neck 25, by which the lower pump may be counected with the fluid reservoir or fount-

ain. In the central pipe 17 is a piston-rod extending through the diaphragm 19, said rod carrying pistons 27 27′. Openings 28 29 30 31 are provided between the outer pipes and the central one, the outer pipes communicating with the central one on opposite sides of the pistons, respectively.

The operation of this pump will now be understood. It must first be primed by filling it with water or other liquid. On the outstroke of the piston 13, to the right in the drawings, water will be forced down pipe 32, and by upward pressure on the piston 27 will raise this piston and will lift water in the pipe 33. Valve-rod 3 will be thrown to the position indicated in the drawings, opening valve 5 and permitting the discharge of water raised in pipe 33. The upward stroke of piston 27 creates a partial vacuum beneath piston 27′, and the pressure of the outside air opens valve 24 and keeps the space beneath the rising piston full of water. Both pistons 27 and 27′ lift water and act as force-pumps, the upper one forcing it through opening 28, the lower one forcing it through opening 30 and valve 20. On the instroke of the piston-rod 13, to the left in the drawings, water is forced down pipe 33 and forces down piston 27. Water is then forced up pipe 32 by the lower sides of both pistons 27 and 27′, the former forcing water through opening 29, the latter through opening 31 and valve 21. Valve 5 of the upper pump is now closed and valve 5′ is open. The partial vacuum thus created below diaphragm 19 by the downstroke of piston 27′ opens valve 23, and the lower portion of the lower pump fills with water by atmospheric pressure. The water forced up pipe 32 is discharged through valve 5′ into exit-pipe 26. Each stroke of the piston thus lifts a volume of water twice as great as the amount displaced by either piston 27 27′.

In the lower pump, (illustrated in Fig. 3), which may be substituted for the lower pump described above, three times as much water will be lifted at each stroke as is displaced by any one piston, as 27. In this modification an auxiliary diaphragm 19′ is placed in the central pipe, openings being made above and below into the adjoining pipes, and a third piston 27″ is used. On the upstroke of the pistons in this modification water flows in beneath each piston 27 27′ 27″, and a column of water is forced up one of the side pipes by the upper side of each piston. The valve action is precisely similar to that described in the lower pump of Fig. 1, and the description need not therefore be repeated.

If for any reason the piston in the lower pump should reach the end of its stroke before the piston in the upper pump completes its stroke, the water-pressure on the side of the upper pump, toward which piston-rod 13 moves, will be greatly increased, and the plates 6 6′, which are connected to coil-springs 9 9′, will be forced back against the tension of the springs by the water reaching said plates through the openings in fixed plates 5 5′. This will open an avenue of escape for the water to the exit-pipe and allow the piston or rod 13 to complete its stroke. The nuts 12 12′ should be adjusted so as to give the springs 9 9′ the proper tension to prevent their action except under this extra pressure.

The mechanism by which the upper pump may be made self-priming, which is shown in Fig 2, will now be described. On the piston-rod 13 is a close-fitting tube or sleeve 34, capable of sliding on the piston-rod, air-tight packing being provided between the tube and piston-rod. To flange 35, at one end of this sleeve, is secured one end of a coil-spring, the other end of which is fastened to a perforated diaphragm or wheel 36, fixed to the walls of chamber 1. The other end of the sleeve carries a valve 37, co-operating with a fixed seat 38. A worm 39 is secured to the sleeve, into which gears a cog-wheel capable of rotation from the outside by a hand-wheel 40. The valve mechanism in the opposite end of chamber 1 is similar to that just described. A rod 41, connected to the valve, passes through a sleeve 42, fixed on a skeleton support mounted in the chamber, a coil-spring tending to normally hold the valve against its seat. In the chamber 1, on opposite sides of the limits of the piston-stroke, are valves 43 44, which open inwardly and prevent the entrance of air to the chamber as the piston recedes from the valve. Over the ends of the chamber 1 are safety-valves 45 46, over the stems of which are placed casings, as shown, having an opening into the chamber 2. At the ends of chamber 2 are openings communicating with chamber 1, and gates or valves 47 47′, provided with screw-stems and handles on the outside, are arranged in operative relation to the openings, so that they may be opened or closed, as desired. The valves 5 6 of the upper chamber 2 are similar to those described in connection with Fig. 1. No connection with the piston-rod 13 is, however, used. A discharge-pipe 26 and connecting-pipes 32 33, extending to the lower pump, are provided, as in Fig. 1, the connecting-pipes being shown in dotted lines.

When the automatic priming apparatus just described is used, the lower pump is provided with spring-valves and blow-off cocks 48 48′, which are simple faucets with a spring-valve, to prevent the passage of water or air, except under definite high pressure. When the faucets are opened, the air or water can be forced out in a way presently to be described. These faucets are placed under the diaphragm 19 of the lower pump.

In using the priming apparatus just described the gates 47 47′ should first be closed by screwing them against the edges of the openings with which they co-operate. The piston 13 is then thrown into action. A steam-cylinder 49 is shown as the source of power. As the piston moves to the right it compresses the air in front of it and opens valve 37′, forcing air into the pipe 32. The valve 43 opens

under external pressure and keeps the chamber 1 behind the piston full of air at an ordinary density. When the piston makes the return-stroke, this air is compressed, opens valve 37, and the air in the pipe 33 is compressed. During this return-stroke valve 37′ has closed, preventing the expansion of air in pipe 32, and valve 44 admits air from without the chamber 1. At every stroke of the piston the air in pipe 32 or 33 is further compressed. This action is maintained until the pressure of the air in these pipes is sufficient to raise a column of water or other liquid to be pumped to the upper surface from the lower level. The relief-valves 45 and 46 must be set at this pressure, and they will indicate by the escape of air when this air has been sufficiently compressed. At such times the valves 37 37′ are opened by the gear and worm already described, and may be locked against returning by a pawl and ratchet on the outside, as shown, the pawl being thrown off the ratchet during the compressing stage above described.

In this condition of the apparatus the action will be as follows: As the piston is operated, the air will be forced down one pipe and up the other, the piston 27 27′ in the lower pump following the movement of the piston in the upper pump. In other words, the air in the pipes 32 33 has been compressed to such a degree that it performs the functions of a pump-rod. When the upper pump-piston moves to the right, the column of compressed air in pipe 32 acts on under side of piston 27 and lifts the piston, the rising column in pipe 33 permitting the ascent. On the other hand, when the upper pump-piston moves to the left the reverse action takes place, and lower pump-piston 27 is forced down. At every descent of the piston water is taken into left pipe through valve 23, and at every ascent of the piston, water is taken into the right pipe through valve 24. This will continue until the entering water displaces enough air to make the pressure on the upper side of valves 23 24 equal to the pressure of the entering water. The spring-valves in the faucets 48 48′ should be set so that when this occurs air will be forced out. As the action of the pump continues, water will finally be forced through the faucets, when they must be closed by the cocks. After the cocks are turned off the pressure on the upstroke of the piston 27′ will be thrown on valve 20, and through it on the column of compressed air of pipe 33, and the pressure on the downstroke of piston 27′ will be exerted on valve 21, and through it on the column of compressed air in pipe 32. This additional pressure opens the relief-valves 45 46 alternately and permits the column of water to rise in the pipes 32 33 through the valves 20 21, the water displacing the air, which escapes through the relief-valves. This operation continues until the column of air in the pipes is completely displaced by water—a condition which is indicated by the escape of water through the relief-valves 45 46. The gates 47 47′ are then opened, as the pump is fully primed. Each stroke of the piston 13 lifts a column of water alternately on opposite sides of the pump equal to double the space traversed in chamber 17 by the piston 27. Since there is a corresponding stroke of piston 27 for each stroke of piston 13, and since each of the lower pump-pistons 27 27′ lifts a column of water, the action of the valves 5 5′ in the upper chamber 2 of the upper pump will be similar to the action already described in Fig. 1—viz., as the piston-rod 13 moves to the right the right valve 5 will be closed and the left one opened, permitting the discharge of the water lifted in the left pipe of the pump. This action proceeds continuously and the water is discharged through exit-pipe 26.

The pump shown in Fig 4 has the same mode of operation as that shown in Fig. 1, except that a plunger is substituted for the piston shown in said Fig. 1, and a novel form of packing is used in connection with the plunger to prevent the escape of water from one side of the chamber to the other. The walls of the chamber in the upper and lower pumps in which the plungers move have an annular recess, as shown at 51 51, in which are placed four segmental packing-strips 60 60, (see Fig. 4ᵈ,) arranged to overlap, as shown in Fig. 4ᵇ. These segments, when placed in the annular recess, are encircled by metallic bands 61 61′, (see Fig. 4ᵉ,) the ends of which are bent outwardly and project through openings in the sides of the chamber. The nuts on the bolts 53 are tightened sufficiently to make the packing water-tight.

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

1. An apparatus for raising liquids from great depths, comprising an upper pump provided with a reciprocating piston and valves leading to a discharge-pipe, said valves opening on opposite sides of the piston, and independent pipes leading from opposite sides of the piston to a lower pump provided with three pipes having transverse diaphragms 19 22, upwardly-opening valves 20 21 23 24, openings 28 29 24 30, and pistons 27 27′, as and for the purpose set forth.

2. A pump-valve comprising a perforated plate and a seat therefor relatively movable and a spring-pressed disk adapted to move through the valve-seat, said disk normally covering the openings in the plate, whereby on extraordinary pressure on the valve the disk will relieve the pressure by uncovering the openings.

3. A pump-valve comprising a perforated plate and a seat therefor relatively movable, a spring-pressed disk adapted to move through the valve-seat, said disk normally covering the openings in the plate whereby on extraordinary pressure on the valve the disk will relieve the pressure by uncovering

the openings, and an adjusting device for varying the tension of the spring.

4. The combination, with a suitable lower pump, of an upper pump comprising a reciprocating piston and two or more valves opening alternately on opposite sides of the piston, said valves being perforated and provided with a spring-pressed disk covering the perforations.

5. The combination of a suitable lower pump and an upper pump having chambers 1 and 2, a reciprocating piston in one chamber, valves 5 6 5′ 6′ and their co-operating seats in the other chamber, said valves containing a relief device capable of yielding under abnormal pressure and opening a passage through the valve, and a discharge-pipe opening into the last-named chamber at a point between the valves.

6. The combination of an upper pump containing a reciprocating piston, pipes communicating with opposite sides of the piston, discharge-valves opening alternately on opposite sides of the piston, and a lower pump comprising pipes 16, 17, and 18, diaphragms 19 and 22, with their co-operating valves, as described, one or more auxiliary diaphragms 19′, and a multiplex piston in pipe 17, co-operating with openings, as described, into pipes 16 18, as and for the purpose set forth.

7. In a self-priming double-action pump, the combination of chambers 1 2, reciprocating piston in chamber 1, inwardly-opening air-valves 43 44, elastic valves opening away from the piston on opposite sides of the latter, and relief-valves in chamber 2, connecting pipes 32 33 to a lower pump comprising pipes 16 18, pipe 17, containing a double piston, diaphragms 19 and 22, valves co-operating with said diaphragms, as described, and relief-valves below diaphragm 19, as and for the purpose set forth.

8. In a self-priming pump for raising liquids from great depths, the combination of a lower pump containing suction and force pistons, pipes connecting it with the upper level, the lower pump-pistons being actuated by pressure in said pipes, an upper pump containing air-compressing apparatus connected with the pipes, valves for relieving the air-pressure at a definite point, and a valve-controlled eduction-opening at the upper level, whereby the pump may first be primed by air-pressure and then actuated by hydraulic pressure.

9. The combination of a combined suction and force pump at a lower level, the actuating-piston for the same being controlled by pressure in pipes leading to the upper level, and a pump at the upper level connected to said pipes, said pump comprising a pressure-piston for exerting pressure alternately in opposite pipes, air-valves for admitting air behind the piston, eduction-valves controlling a discharge-opening alternately on opposite sides of the pressure-piston, a gate for disestablishing communication with the discharge-valves, and a relief-valve controlling an independent discharge-opening and operated at a definite degree of pressure, whereby the pump may be first primed by the action of compressed air acting as a pump-rod and then operated by the water acting as a pump-rod.

10. The combination of a combined suction and force pump at a lower level and a pump at an upper level, comprising chambers 1 and 2, reciprocating piston in chamber 1, inwardly-opening air-valves 43 44, elastic valves 37 37, opening away from the piston, means for holding said valves open after the pump becomes primed, gates to disestablish communication with chamber 2, and discharge-valves in chamber 2.

11. In a self-priming double-action pump, the combination of chambers 1 and 2, reciprocating piston in chamber 1, inwardly-opening air-valves 43 44, elastic valves opening away from the piston on opposite sides of the latter, discharge-valves in chamber 2, opening alternately on opposite sides of the piston-gates 47 47′ and connecting pipes 32 33 to a lower pump comprising pipes 16 18, pipe 17, containing a double piston, diaphragms 19 and 22, valves co-operating with said diaphragms, as described, and relief-valves below diaphragm 19, as and for the purpose set forth.

12. The combination, with a plunger-piston, of a cylinder or pipe in which it moves, said pipe being provided with an annular recess, two or more packing-rings composed of overlapping segments in said recess, metallic bands around the rings, the extremities of the bands extending through openings in the pipe, and means for drawing the extremities together to compress the rings in the recess and upon the plunger.

13. A pump comprising a chamber at an upper level containing a reciprocating piston, a chamber at a lower level containing a lifting-piston reciprocated by the upper piston through the instrumentality of a column of water acting as a pump-rod, and a relief-valve for the water column controlling an opening through a discharge-valve and capable of yielding to permit the pistons to complete their strokes when out of unison.

In testimony whereof I affix my signature in presence of two witnesses.

PETER ANDERSON. [L. S.]

Witnesses:

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FREDERICK G. HEATH.