

1,197,771.

Fig. 1 is a side view of a mechanical device. It shows a vertical shaft (24) with a series of gears (19, 21, 23, 25, 26) and a crank (18) connected to a lever (15). A piston (16) is shown in a cylinder (17). A vertical rod (22) is connected to a lever (23) and a piston (25). A vertical rod (26) is connected to a lever (27) and a piston (28). A vertical rod (29) is connected to a lever (30) and a piston (31). A vertical rod (32) is connected to a lever (33) and a piston (34). A vertical rod (35) is connected to a lever (36) and a piston (37). A vertical rod (38) is connected to a lever (39) and a piston (40). A vertical rod (41) is connected to a lever (42) and a piston (43). A vertical rod (44) is connected to a lever (45) and a piston (46).

Fig. 2 is a cross-sectional view of the device. It shows a vertical shaft (24) with a series of gears (19, 21, 23, 25, 26) and a crank (18) connected to a lever (15). A piston (16) is shown in a cylinder (17). A vertical rod (22) is connected to a lever (23) and a piston (25). A vertical rod (26) is connected to a lever (27) and a piston (28). A vertical rod (29) is connected to a lever (30) and a piston (31). A vertical rod (32) is connected to a lever (33) and a piston (34). A vertical rod (35) is connected to a lever (36) and a piston (37). A vertical rod (38) is connected to a lever (39) and a piston (40). A vertical rod (41) is connected to a lever (42) and a piston (43). A vertical rod (44) is connected to a lever (45) and a piston (46).

Fig. 3 is a detailed view of a component. It shows a vertical shaft (24) with a series of gears (19, 21, 23, 25, 26) and a crank (18) connected to a lever (15). A piston (16) is shown in a cylinder (17). A vertical rod (22) is connected to a lever (23) and a piston (25). A vertical rod (26) is connected to a lever (27) and a piston (28). A vertical rod (29) is connected to a lever (30) and a piston (31). A vertical rod (32) is connected to a lever (33) and a piston (34). A vertical rod (35) is connected to a lever (36) and a piston (37). A vertical rod (38) is connected to a lever (39) and a piston (40). A vertical rod (41) is connected to a lever (42) and a piston (43). A vertical rod (44) is connected to a lever (45) and a piston (46).

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PUMPING SYSTEM.

1,197,771.

Specification of Letters Patent. Patented Sept. 12, 1916.

Application filed July 7, 1914. Serial No. 849,418.

To all whom it may concern:

Be it known that I, PHILIP H. SHUE, a citizen of the United States, residing at Denver, in the county of Denver and State of Colorado, have invented certain new and useful Improvements in Pumping Systems, of which the following is a specification.

My invention relates to pumps of the type in which a liquid or semi-solid is transported to an elevated point of discharge by the pressure of air or other expansible gas in a closed displacement chamber.

The primary object of my invention resides in providing in a system of this character, an association of units of simple and durable construction which coöperate to raise by the expansive action of compressed air or other similar motive fluid, liquid from one or more sources of supply, to any desired elevation.

Another object of my invention is to construct the units to operate without the aid of moving parts other than the necessary check valves and so that sand, gravel and other solids can be raised with the liquid without injury to the operative parts or interference with their effective action, and still a further object of the invention is to provide means for preventing the escape of motive fluid before its displacing action upon the liquid to be raised.

The above and other objects, all of which will fully appear in the following description, I attain by the system and apparatus illustrated in the accompanying drawings in the various views of which like parts are similarly designated, and in which,

Figure 1 is a sectional elevation of the preferred form of my pumping system in its operative position with relation to a source of water supply, and an operating mechanism of suitable construction, Fig. 2, an elevation drawn to a reduced scale, of a similar mechanism in which the number of units comprised in the system has been increased to lift water from a greater depth or to a point of greater elevation, Fig. 3, a sectional elevation illustrating a modification of the construction and arrangement of the units, designed for the purpose of their coöperation to raise water from two or more separate sources of supply, Fig. 4, a sectional elevation showing my invention in its simplest form in which two coöperative units

are combined in a single part for raising liquid to a limited elevation, and Fig. 5, a transverse section taken along the line 5—5, Fig. 4.

The principal elements of my improved system common to all its forms, are a plurality of liquid receiving units 27 and a valve 21 which controls the flow of a motive fluid to and from the same.

Each unit comprises a displacement chamber provided with one or more valves for the admission of liquid into which it is immersed, a discharge pipe, a check valve normally closing the same, and an opening for connection with the above-mentioned controlling valve which is constructed to alternately place the said opening of each unit in communication with a source of expansive fluid and the atmosphere, and to simultaneously effect the same condition in reverse order in a companion unit.

While the operation of the controlling valve may be effected by any suitable mechanism within the spirit of my invention, I preferably employ a mechanism which is shown and described in my co-pending application, Serial Number 849,419, filed July 7, 1914, and which briefly is constructed as follows: A cylinder 2 mounted in a horizontal position on a supporting structure 3 connects at its opposite ends with the housing of a valve 4 which by means of a cam 5 and a rocker lever 6 is moved to and fro to alternately place the said ends of the cylinder which normally connect with the atmosphere, in communication with a source of fluid under pressure. The cam receives its continuous rotary motion from a suitable driving element through the intermediary of a pair of cone-pulleys 7 and 8 connected by a belt 9, and a worm 10 which operatively engages a corresponding wheel 12 on the shaft of one of said pulleys, and which by means of a pulley and a belt is connected with the driving element. A reciprocating piston 15 in the cylinder 2 imparts by means of a pitman 16, a rocking movement to a crank shaft 17 which through the medium of a pair of sprocket-wheels 18 and 19, and a corresponding chain 20, effects the operation of the controlling valve 21. The motive fluid required for the displacement of liquid contained in the units above mentioned, is preferably provided by an air compressor installed in suitable proximity to

the apparatus, and when the above described mechanism is employed for the operation of the controlling valve, the compressor provides at the same time the means for the supply of motive fluid to the cylinder and for the actuation of the worm 10. In the drawings, the pipes leading from the compressor to the valves 4 and 21 have been designated by the numerals 22, and the belt which operatively connects a rotary part of the same with a pulley 13 on the worm shaft, by means of the numeral 14.

The controlling valve 21 of the pumping system comprises a housing provided at quadrant points with ports, two opposite ones of which are by means of pipes 23 and 24 connected respectively with the hereinbefore mentioned air intake and exhaust openings of the two units, while an intermediate port 25 connects with the atmosphere for the exhaust of spent fluid from the units and a thereto opposite port which connects with the before mentioned pipe 22 of the air compressor. The rotary body of the valve has two ducts 26 which at the ends of its oscillating movement simultaneously connect adjoining ports in the housing for the passage of fluid from one to the other, so that in the operation of the valve, the two units are alternately and reversely placed in communication with the exhaust port 25 and the thereto opposite intake port.

In the preferred form of my invention which is illustrated in Fig. 1 of the drawings, two units are placed one above the other, the lower one being immersed in the body of liquid to be elevated, such as is contained in the bottom of a well 28.

Each unit, which, as mentioned hereinbefore, provides a displacement chamber to alternately receive a body of water and a corresponding quantity of liquid-displacing air, is composed of a cylindrical shell 29, the edges of which are let into circular grooves of two heads 30 and 31 which are rigidly connected by means of bolts 32.

The upper head of each unit has a central valve chamber 33 formed by a centrally apertured screw-cap 34 which by means of an interposed coupling ring 35 is connected with a flange which exteriorly surrounds a central opening 38 in the head.

The lower head of each unit has a central depression to provide a sump 36 beneath the inlet opening of a discharge pipe 37 which at its upper end is connected with the opening 38 of the opposite head. A flap-valve 39 is disposed in the valve chamber of each unit to control the flow of liquid through the opening in which the pipe 37 is connected, and similar valves are applied to ports 40 in the lower head of the lower unit, through which the liquid in which the latter is immersed, is admitted into the displacement chamber.

The valve chamber of the lower unit connects by means of a pipe 41 screwed into the aperture of its cap 34, with an intake opening 42 in the sump of the upper unit, the flow through which is controlled by a flap valve 43, and the valve chamber of the upper unit is connected with a conduit 44 through which the liquid displaced in the operation of the system is conducted to the desired point of discharge.

The air openings of the two units are by means of the before mentioned pipes 23 and 24, respectively connected with the opposite air-discharge ports of the valve 21, the pipe 23 which leads to the lower unit passing through the displacement chamber of the upper one to avoid the presence of exterior parts which might interfere with the installation of the units in a well of limited diameter.

In the operation of the system, the oscillating controlling valve places, as mentioned hereinbefore, the two air openings of the units alternately and reversely in communication with the supply of motive fluid (in this instance the air compressor), and the exhaust opening 25 so that while air is admitted into the displacement chamber of the lower unit, air is simultaneously exhausted from the chamber of the other unit, and vice versa.

During the exhaust of air from the lower unit, the liquid in which the unit is immersed is compelled to enter its displacement chamber through the normally valve-closed ports in its lower head, until the position of the controlling valve is reversed when the consequent admission of the compressed air into the lower unit through the pipe 23, compels the liquid contained in the unit to flow through the discharge pipe 37 into the valve chamber 33 and to thence rise in the pipe 41 to enter the displacement chamber of the upper unit, it being understood that by the pressure of the body of air which displaces the liquid, the valves of the ports 40 are closed and the check valves which control the flow through the pipes 37 and 41 are simultaneously opened.

At the next succeeding reversal of the position of the valve, when the greater portion of the liquid contents of the lower unit has been transported to the upper unit, the exhaust of air from the lower unit will cause an inflow of water as before, while the simultaneous admission of air to the upper unit will displace the liquid contained therein and compel it to flow through the pipe 37 into the valve chamber 33 and thence through the conduit 44 to the point of discharge, it being obvious that by the pressure of the air on the liquid, the valves 43 and 39 are respectively closed and opened. It will thus be seen that when the valve 21 is continuously oscillated by the operation of the

mechanism with which it is connected, equal quantities of water will be intermittently discharged from the upper unit in rapid succession.

5 The admission of air to the units is regulated so that but part of their contents are discharged and a sufficient quantity is left in the bottom portions of the units to seal the inlet openings of the respective discharge pipes 37 as is indicated in the upper unit of the system shown in Fig. 1, and thereby prevent the escape of air.

The sumps in the bottom of the units directly beneath the discharge pipes, provide catch basins for sand, gravel and other solid matter which entered the displacement chambers together with the water, thereby compelling the same to be drawn into the respective pipes and preventing their accumulation in other parts of the units where they might interfere with the proper operation of the apparatus. By increasing the number of units the water may be transported from one to the other progressively and thus raised to any desired elevation with the same air pressure and strength of material.

For the coöperative action of the units each two companion units are connected with a separate controlling valve as shown in Fig. 2 of the drawings, it being understood that by increasing the number of sprocket wheels 18 on the crank shaft 17 of the operating mechanism, any desired number of these valves may be operated simultaneously for the co-action of a corresponding number of pairs of units.

In the construction shown in Fig. 2, four units A, B, C and D are arranged in two pairs E and F, placed one above the other, the units of the pair E being connected with a controlling valve G and those of the pair F with a controlling valve H, while the two controlling valves are operatively connected with the crank shaft 17 as hereinbefore described. After the lowest unit A has been filled with liquid from the body in which it is immersed, the subsequent admission of air to said unit in the next phase of the oscillatory motion of the valve G, will cause its liquid contents to be displaced into the next unit B from which the air is at the same time exhausted to permit the liquid to enter the same. At the end of the following motion of the controlling valve G, the air being exhausted from the lowest unit, causes a renewed inflow of water, while the simultaneous admission of air to the next unit B which previously had been filled, will compel the water to enter the third unit C from which air is being exhausted through the port 25 of the valve H. After the following movement of the two valves, the water contained in the lowest unit again flows into the next unit, and that contained in the unit

C into which air is now admitted, is at the same time compelled to enter the upper unit D from which the air is being exhausted, and whence it flows through the conduit 44 to the point of discharge. It will thus be seen that during the continuous operation of the two valves, the water is compelled to flow progressively from one unit to the other, thereby effecting a practically continuous flow at the point of discharge.

A modification of the system hereinbefore described is illustrated in Fig. 3 in which two companion units are each provided with admission ports in the bottoms of their respective displacement chambers, like the lower one of the two units of the construction shown in Fig. 1. The valve chambers on the upper ends of the two units are in this form connected with a common discharge conduit 45, but the connections of the air openings with the controlling valve 21 are the same as in the first described form. This construction of my pump is particularly adapted for use in places where there are a number of separated wells or other sources of water supply which singly do not provide a sufficient amount of water for the purpose for which it is desired.

The form illustrated in Figs. 4 and 5 differs from the others in that the two units are combined into one part which consists of a cylinder constructed similarly to one of the units of the other forms and divided by a longitudinal partition 46 into two separated displacement chambers each provided with one or more liquid admission ports 40. The discharge pipes 37 of these displacement chambers open into a common valve chamber with which the conduit 44 is connected, and the air openings of the same connect with the controlling valve as in the other constructions.

The last described form of my invention is designed for use in places where it is desired to lift a limited quantity of water to a limited elevation.

It will be understood that by adjustment of the belt 9 on the correlative cone-pulleys of the operating mechanism, the movements of the controlling valve relative to that of the compressor may be regulated and that in consequence the pump may be readily adjusted to any compressor of suitable construction to raise the water or other liquid in any desired quantity within the capacity of the apparatus.

Having thus described my invention what I claim and desire to secure by Letters-Patent is:

1. In combination, a series of displacement chambers, and valve-controlled discharge conduits extending from a point adjacent the bottom of each chamber of the series into the next adjoining one, the chambers at opposite ends of the series having

respectively a water inlet and a water-outlet and all the chambers of the series being separately connected with a source of fluid-pressure.

5 2. In combination, a series of displacement chambers, valve-controlled discharge conduits extending from a point adjacent the bottom of each chamber of the series into the next adjoining one, the chambers at op-
10 posite ends of the series having respectively a water-inlet and a water-outlet and all the chambers of the series being separately connected with a source of fluid-pressure, and valve-mechanism operating to discontinue
15 the supply of fluid pressure to the chambers periodically, and simultaneously in alternate chambers of the series.

3. In combination, a series of displacement chambers in pairs, valve-controlled
20 discharge-conduits extending from a point

adjacent the bottom of each chamber of the series into the next adjoining one, the chambers at the opposite ends of the series having respectively a water-inlet and a water-outlet, and all the chambers of the series being separately connected with a source of fluid-pressure, and valves operating to periodically discontinue the supply of fluid-pressure to the chambers of each pair alternately, and coöperating to effect said periodic
25 discontinuation of said supply simultaneously in corresponding chambers of the pairs comprised in the series.

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

PHILIP H. SHUE.

Witnesses:

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