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APPARATUS FOR PUMPING LIQUIDS.

APPLICATION FILED MAR. 13, 1918.

1,323,864. Patented Dec. 2, 1919.

Fig. 1.

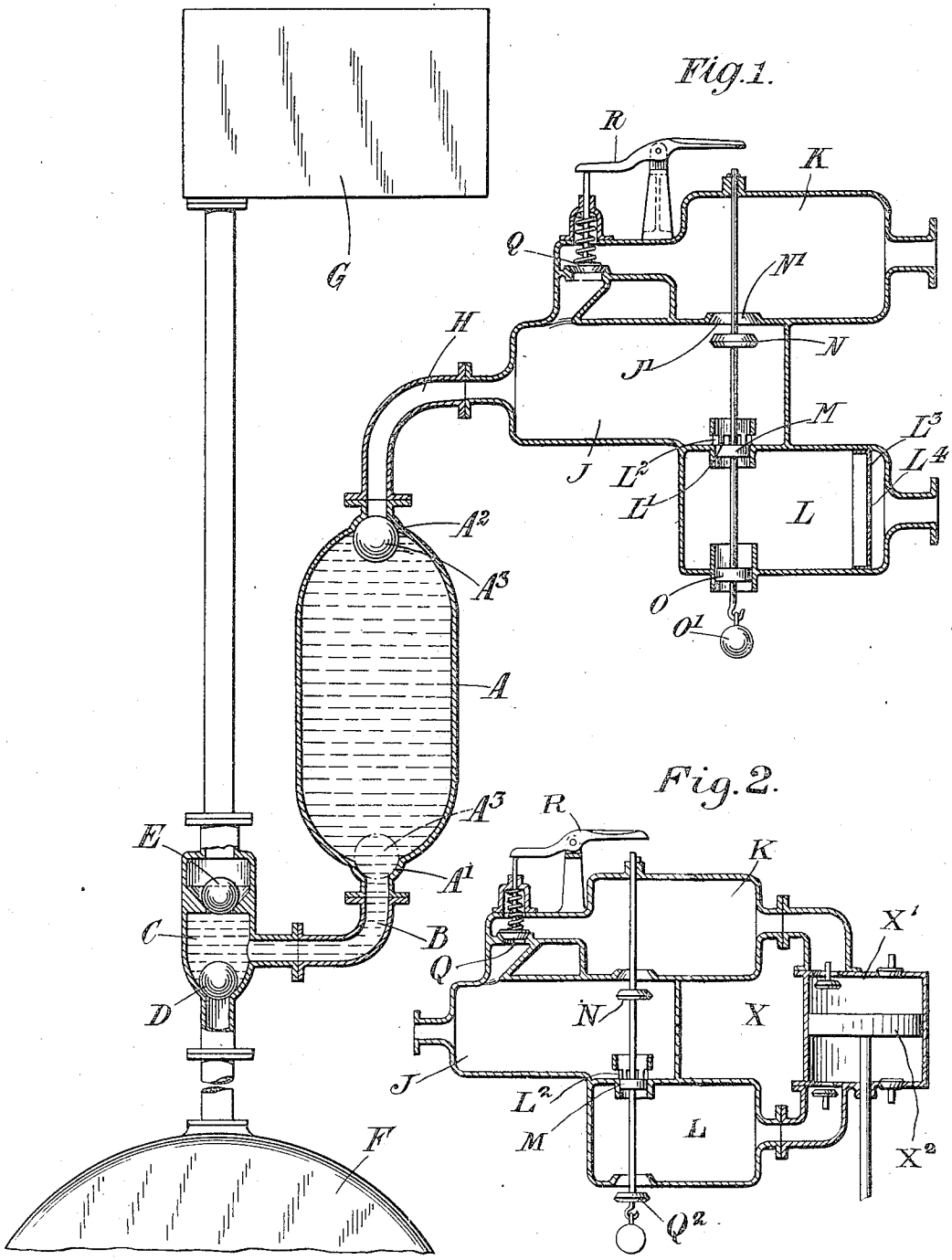


Fig. 2.

Witnesses

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APPARATUS FOR PUMPING LIQUIDS.

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To all whom it may concern:

Be it known that I, ARNOLD HENRY HUMAN, a subject of the King of England, residing at Gerrards Cross, Buckinghamshire, England, have invented certain new and useful Improvements in Apparatus for Pumping Liquids, of which the following is a specification.

This invention relates to pulsometer pumps for pumping liquids, that is to say to pumps of the type that is provided with a chamber into which the liquid to be dealt with is caused to rise and from which it is subsequently expelled by the direct action of fluid pressure against the upper surface of the liquid. Pumps of this type are particularly convenient for pumping acid liquids, for they contain but few parts subjected to the action of the liquid, and these parts can be easily made non-corrodible.

A primary object of this invention is to provide a simplified construction of pumping apparatus of the character described comprising relatively few valves and very few pipes.

Another object is to obviate the necessity of using relay-motors or like devices for actuating the valves.

A further object is to provide a compact automatic arrangement of valves in the form of a unit having only three branch connections, one for the air-main and two for the suction and pressure sides of a combined vacuum and pressure pump.

The invention consists in the construction, arrangement and combination of parts described hereinafter and pointed out in the claims.

One embodiment of the invention and a modification thereof are diagrammatically represented by way of example in the accompanying drawings, wherein:—

Figure 1 represents a central sectional view of one form of pulsometer pump and its valves in combination with the sources of high- and low-pressure air, and automatic means whereby the pulsometer is actuated from these supplies;

Fig. 2 represents a modification of the arrangement shown in Fig. 1, by the employment of a combined vacuum and pressure pump directly connected to the air-conduits and a different form of automatic air-control valve in the air-conduits.

Like letters indicate like parts throughout the drawings.

Referring first to Fig. 1, the pulsometer water-chamber or pump-chamber A is connected at its lower end by a passage B to the valve-chamber C containing the suction-valve D and the delivery-valve E for the liquids to be pumped. On the suction side of the valve D is a connection to the tank F containing the liquid to be pumped, and on the delivery-side of the valve E is a connection to the storage-tank G into which the liquid so pumped is to be delivered. At the upper end of the pulsometer pump-chamber A is an air-main H.

Situated in the lower part of the pulsometer chamber A is a valve-seating A^1. A similar valve-seating A^2 is formed at the upper part of the pump-chamber A at its junction with the air-main H. Within the chamber A is a buoyant spherical valve A^3 which fits each of these seatings.

The pump-chamber A communicates by means of the air-main H with a valve-chamber J. An air-conduit K connected to a vacuum-pump, not shown in the drawing, communicates with the valve-chamber J by a passage J^1, and another air-conduit L connected to a high-pressure air-supply, not shown in the drawings, also communicates with the valve-chamber J by a passage L^1. In the passage L^1 is situated a high-pressure delivery valve in the form of a piston-valve M adapted to slide therein and to close ports L^2 connecting the chambers J and L. The piston-valve M is carried upon a valve-rod, upon which is also situated a suction operated non-return valve N having a coöperating seating N^1 in the passage J^1. When the valve N is on its seating the piston-valve M has uncovered the ports L^2 giving communication between the chambers J and L and when the valve N is open in the position shown in the drawing, these ports L^2 are closed. An extension of the valve-rod beyond the non-return valve is provided for a purpose hereinafter to be described.

On the side of the piston-valve remote from the non-return valve a further extension of the piston-rod carries a balance-piston O, which is on one side subjected to the high-pressure air, and on the other side to atmospheric pressure. The valves so mounted upon the valve-rod are weight-

loaded at O^1 so that in their normal position the non-return valve N is open, thus giving communication between the valve-chamber J and the air conduit K, while the piston-valve is so situated as to close the ports L^2. At the entrance to the conduit L is situated a "wire-drawing" device, shown in the figure as a diaphragm L^3 perforated by a hole L^4 of relatively small diameter. A relief valve Q loaded to open at a predetermined pressure is arranged to control a by-pass passage connecting the valve chamber J with the air-conduit K.

The action of the pulsometer pump is as follows:—

In the normal or first position of the pump at starting, the pump-chamber A is empty of liquid and the buoyant valve A^3 rests upon the lower seating A^1. The ports L^2 between the valve chamber J and the air-pressure chamber L are closed by the piston-valve M and the non-return valve N is off its seating N^1, thus giving communication between the valve-chamber J and the conduit K connected to the vacuum-pump. Under the action of the vacuum-pump, liquid to be pumped is drawn from the tank F past the suction-valve D into the pump-chamber A, when the buoyant valve A^3 rises from its seat and floats upon the entering liquid. While the liquid flows into the chamber A, the degree of vacuum in the air-main H and conduit K is maintained approximately constant. As soon as the liquid fills the pump-chamber A, the buoyant valve A^3 seats itself on the upper seating A^2 thereby shutting off the pump chamber A from the vacuum-pump. In consequence of this action and of the continued operation of the vacuum-pump, the vacuum in the air-main H, the chamber J and the conduit K is augmented so that the non-return valve N is drawn up against the loading O^1 to its seating N^1 thus closing communication of the air-main H with the vacuum-pump. When the suction-operated non-return valve N is thus brought to bear against its seating N^1, the piston-valve M which is connected to the said non-return valve N will have opened the ports L^2 giving communication between the air-main H and chamber J and the high-pressure air-conduit L whereby the high-pressure air then flows into the chamber J and by way of the air-main H into the pulsometer chamber A. In entering the pulsometer chamber A the high-pressure air forces the buoyant valve A^3 off its seating A^2 and the pressure of the air then acts upon the surface of the liquid to drive it out of the pulsometer chamber, and by way of the delivery-valve E into the storage-tank G. This action continues until the pulsometer chamber A is cleared of liquid, by which time the buoyant valve A^3 will be found to be down on the lower seating A^1, when it will prevent any further expulsion of the liquid or any escape of high-pressure air.

After the valve A^3 is thus seated the pressure of the air in the air-main H, the valve-chamber J, and the conduit L rises; this rise eventually lifts the relief-valve Q (which is loaded to a suitable pressure, predetermined) and by acting on the top side of the valve N coöperates with the weight O^1 to open the said valve N. This makes communication between the valve-chamber J and the conduit K, and at the same time closes by the valve M, the ports L^2, and shuts off the high-pressure air supply to the pump. The valves M and N, being thus restored to their original or starting position, the cycle of operations already described above is repeated in regular succession as long as the pump is in action.

If desired, a pivoted lever tappet R may be used to give operative connection between the relief-valve Q and the extension previously referred to of the valve-rod carrying the valves M and N, the length of this rod being so adjusted that it does not come into contact with the lever R when the valve N is upon its seating.

The modified arrangement in Fig. 2 shows a combined vacuum- and pressure-pump X directly connected to the air-conduits K and L. In place of the balance-valve O shown in Fig. 1 a venting-valve in the form of a non-return valve O^2 is employed, opening directly into the atmosphere from the conduit L. This non-return valve O^2 is similar to the non-return valve N and is so connected with it that the two valves seat simultaneously.

The combined vacuum and pressure pump X as illustrated, comprises a cylinder X^1 and piston X^2, the chamber on one side of the piston operating as the vacuum pump, and that on the other side operating as the pressure pump. On the vacuum side a suction valve is connected to draw from the conduit K and to discharge through a delivery valve to the atmosphere. On the pressure side of the pump, a suction valve communicates with the atmosphere and a delivery valve with the conduit L. This pump may be operated by an electro-motor or other appropriate driving means. In the normal position of the automatic distribution valves the non-return valve N is off its seating, the piston-valve M has closed the ports L^2, and the pump chamber A is in communication with the vacuum side of the pump X. The pressure side of the pump X is meanwhile discharging to the atmosphere through the open valve O^2. When the buoyant valve A^3 rises upon the entering liquid and lies upon its upper seating A^2, and the augmentation of the vacuum in the air-main H then occurs, the valve N is sucked up to its seating, thus closing the connection to the

vacuum pump and at the same time opening the communication of the pump chamber with the pressure side of the pump by means of the piston-valve M. Simultaneously with the change of position of the valves N and M, the valve O^2 has closed the outlet from the pressure side of the pump to the atmosphere, and thereby the pressure rises within the chamber J and the air-main H by the working of the pressure pump. This rise of pressure in the air-main H operates as before to expel the liquid from the pump chamber A until the buoyant valve A^3 seats itself on the lower seating A^1 of the pump chamber. When this occurs the pressure within the air-main H and the chamber L continues to increase by the action of the pressure pump, until air escapes at a predetermined pressure past the relief-valve Q into the conduit K and by its action upon the upper face of the valve N, the said valve is forced off its seat, simultaneously closing by the valve M the communication between the chamber J and the pressure conduit L and the pressure pump, and putting the chamber J, and air-main H into communication with the vacuum side of the pump past the now open valve N in readiness for the next suction stroke in the pump-chamber A. This completes the cycle of operations according to this arrangement of the apparatus, and the previously described operations are repeated continuously as long as the pulsometer pump and the combined vacuum and pressure pumps are working.

Where desired, a wire-drawing device, such as L^3 L^4 shown in the conduit L may also be employed in the conduit K, such devices being beneficial by preventing or damping down fluctuations of pressure which may occur by action of the pressure and vacuum pumps in the respective air-conduits.

It will be apparent from the description above contained that various modifications can be made in the details and arrangements connected with the operation and construction of the automatic valve controlling the distribution of the air to the pulsometer chamber, without departing from the spirit of this invention as defined in the claims, and that the methods so employed are dependent upon the changes of pressure produced in the air-main by the action of the buoyant valve in the pump-chamber.

What I claim as my invention and desire to secure by Letters Patent is:—

1. In pumping apparatus, the combination with a water-chamber having a top air inlet and a bottom water outlet, means which close the top inlet when the water in the chamber rises thereto and close said bottom outlet when the water in the chamber falls thereto, and an air-main communicating at one end with the top inlet, of a suction air-conduit having a suction-port opening into said air-main, a pressure air-conduit having a delivery-port opening into said air-main, a suction-operated check-valve that controls the suction port and is loaded so that it tends to open but closes when there is an increase of suction to a predetermined degree in the suction air-conduit, a by-pass passage connecting the air-main with the suction air-conduit, a by-pass valve in the by-pass passage loaded to keep shut except when there is an increase of pressure to a predetermined degree in the air-main, a delivery-valve that controls the delivery-port, and means operatively connecting the suction and delivery-valves so that when the suction-valve is open the delivery-valve shall be shut and vice versa, substantially as described.

2. In pumping apparatus, the combination with a water-chamber having a top air inlet and a bottom water outlet, means which close the top inlet when the water in the chamber rises thereto and close said bottom outlet when the water in the chamber falls thereto, and an air-main communicating at one end with the top inlet, of a suction air-conduit having a suction-port opening into said air-main, a pressure air-conduit having a delivery-port opening into said air-main, a suction-operated check valve that controls the suction-port and is loaded so that it tends to open but closes when there is an increase of suction to a predetermined degree in the suction air-conduit, a by-pass passage connecting the air-main with the suction air-conduit, a by-pass valve in the by-pass passage loaded to keep shut except when there is an increase of pressure to a predetermined degree in the air-main, a delivery-valve that controls the delivery-port, means operatively connecting the suction and delivery-valves so that when the suction-valve is open the delivery-valve shall be shut and vice versa, a venting port leading to the atmosphere from the pressure air-conduit, and a venting-valve controlling said venting port and so connected to the delivery-valve that each of these two valves counterbalances the tendency of the other to open under the pressure in the pressure air-conduit and so also that when either is opened it will shut the other, substantially as described.

3. In pumping apparatus, the combination with a water-chamber having a top air inlet and a bottom water outlet, means which close the top inlet when the water in the chamber rises thereto and close said bottom outlet when the water in the chamber falls thereto, and an air-main communicating at one end with the top inlet, of a suction air-conduit having a suction-port opening into said air-main, a pressure air-conduit having a delivery-port opening into said air-main,

a suction-operated check-valve that controls the suction-port and is loaded so that it tends to open but closes when there is an increase of suction to a predetermined degree in the suction-air conduit, a by-pass passage connecting the air-main with the suction air-conduit, a by-pass valve in the by-pass passage loaded to keep shut except when there is an increase of pressure to a predetermined degree in the air-main, a delivery-valve that controls the delivery-port, means operatively connecting the suction and delivery-valves so that when the suction-valve is open the delivery-valve shall be shut and vice versa, and a combined vacuum and pressure pump having its vacuum side connected to said suction air-conduit and having its pressure side connected to said pressure air-conduit, substantially as described.

4. In pumping apparatus, the combination with a water-chamber having a top air inlet and a bottom water outlet, means which close the top inlet when the water in the chamber rises thereto and close said bottom outlet when the water in the chamber falls thereto, and an air-main communicating at one end with the top inlet, of a suction air-conduit having a suction-port opening into said air-main, a pressure air-conduit having a delivery port opening into the said air-main, a suction-operated non-return disk-valve that controls the suction port and is loaded so that it tends to open but closes when there is an increase of suction to a predetermined degree in the suction air-conduit, a by-pass passage connecting the air-main with the suction air-conduit, a by-pass valve in the by-pass passage loaded to keep shut except when there is an increase of pressure to a predetermined degree in the air-main, a delivery piston-valve that controls the delivery port, a rod connecting the said disk-valve and the said piston-valve so that when the disk-valve is open the piston-valve shall shut and reversely, a venting port leading to the atmosphere from the pressure air-conduit, a venting disk-valve controlling said venting port, and a rod so connecting the venting-valve to the piston-valve that each of these two valves counter-balances the tendency of the other to open under pressure in the pressure air-conduit and so also that when either is opened it will shut the other, substantially as described.

5. In pumping apparatus, the combination with a water-chamber having a top air inlet and a bottom water outlet, means which close the top inlet when the water in the chamber rises thereto and close said bottom outlet when the water in the chamber falls thereto, and an air-main communicating at one end with the top inlet, of a suction air-conduit having a suction-port opening into said air-main, a pressure air-conduit having a delivery-port opening into said air-main, a suction-operated check-valve that controls the suction-port and is loaded so that it tends to open but closes when there is an increase of suction to a predetermined degree in the suction air-conduit, a by-pass passage connecting the air-main with the suction air-conduit, a by-pass valve in the by-pass passage loaded to keep shut except when there is an increase of pressure to a predetermined degree in the air-main, a tappet operated by the by-pass valve and arranged to operate the said check-valve, a delivery-valve that controls the delivery-port, and means operatively connecting the suction and delivery-valves so that when the suction-valve is open the delivery-valve shall be shut and vice versa, substantially as described.

In testimony whereof I affix my signature.

A. H. HUMAN.