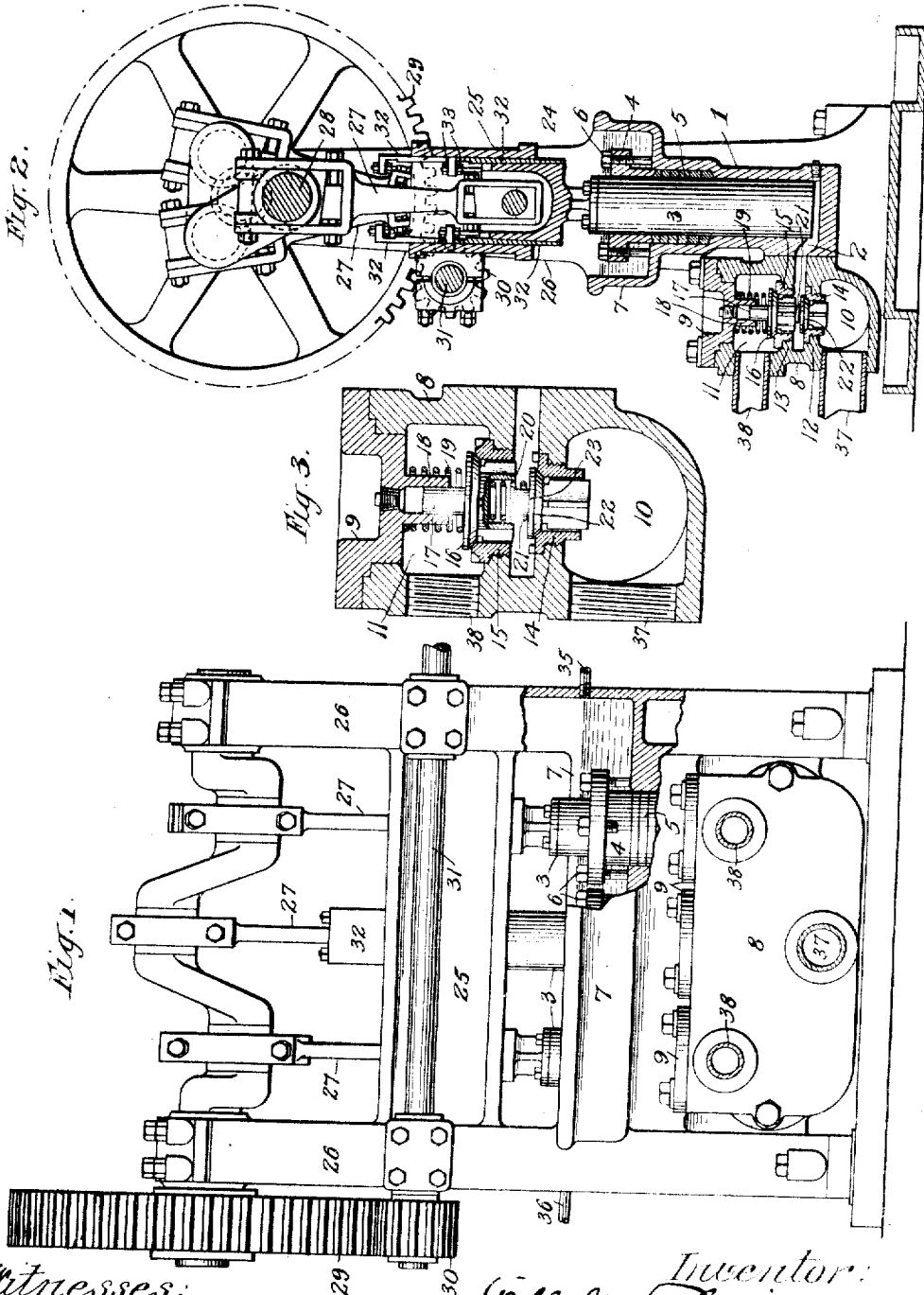


W. M. FLEMING.
PUMP.

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1,109,672.

Patented Sept. 8, 1914.



Witnesses:
J. J. Donnan
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UNITED STATES PATENT OFFICE.

WILLS M. FLEMING, OF HOLYOKE, MASSACHUSETTS, ASSIGNOR TO INTERNATIONAL STEAM PUMP COMPANY, A CORPORATION OF NEW JERSEY.

PUMP.

1,109,672.

Specification of Letters Patent.

Patented Sept. 8, 1914.

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To all whom it may concern:

Be it known that I, WILLS M. FLEMING, a citizen of the United States, residing at Holyoke, county of Hampden, and State of Massachusetts, have invented certain new and useful Improvements in Pumps, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

This invention relates to improvements in pumps,—and particularly, to a single-acting suction pump intended for use under conditions where the liquid supply to the pump is either hot or is intermittent or deficient.

There has existed much difficulty in the operation of pumps heretofore employed under such conditions, because the cylinder becomes air or vapor bound, owing to the fact that all the liquid is expelled, and air or vapor accumulating beneath the piston is compressed and expanded without actuating either the suction or discharge valves. For this reason, the pump will fail to operate until the cylinder clearance spaces are primed or filled with liquid. The conditions pointed out exist generally in pumping systems handling hot fluids or on closed systems, such, for example, as are employed in connection with the operation of sluice-gates, hydraulic governors, cyanid gold extraction filters, and the like. These conditions are very trying with the class of pumps hitherto employed for such purposes and partake somewhat of the conditions under which a condenser or hot-well pump must operate, while at the same time introducing the further difficulty that the pump must lift its own supply, whereas a hot-well or condenser pump usually receives its supply from a source higher than the pump inlet.

It is the purpose of the present invention to provide a pump which will work satisfactorily in practice under the special conditions outlined above and with this general object in view, my invention comprises a single-acting plunger pump, capable of acting as a vacuum pump and air compressor, or as a liquid pressure pump, and in the preferred embodiment of the invention three sets of such plunger pumps are arranged in conjunction with a common inlet and a common outlet chamber, the respective plungers being arranged to operate out of phase with each other and preferably 120° apart,

whereby not only the usual advantages of a constant pressure on the discharge pipe is obtained, but also some special advantages under the conditions hereinbefore pointed out.

The features, details of construction and combination of parts which constitute this invention will first be described in connection with the accompanying drawings and then particularly pointed out in the claims.

In the drawings, Figure 1 is a side elevation, partly in section of a three-cylinder pump embodying my invention in its preferred form. Fig. 2 is a vertical section of the same through one of the pump cylinders, some of the parts being shown in elevation. Fig. 3 is a detail, vertical section, partly in elevation, of the valve-chest, showing one set of valves.

Referring to the drawings, 1 indicates a pump cylinder of the outside packed plunger-pump type, having a single port or transverse passage 2 sloping upward, the inner face of said port having its lower edge coincident with the bottom of the pump cylinder, while its upper edge is not higher than the lower edge of the outer face of said port or passage. In this cylinder is located a plunger 3 of such length relative to the cylinder that when the plunger is at its extreme limit downward, it will leave a slight clearance space between its bottom and the bottom of the cylinder, while at the same time its upper end will project beyond the cylinder, a suitable outside packing gland 4 being provided, which gland serves to compress the packing 5 contained in a recess or counter bore at the upper end of the cylinder, stud bolts and nuts as indicated at 6 being provided to force the gland 4 against the packing. At the upper end of the cylinder and surrounding the plunger gland is a basin whose walls 7 extend considerably above said gland. This basin serves to contain a liquid and thus forms a means for sealing the plunger air-tight. Water may be used as the sealing liquid and its level should be automatically kept above the top of the gland in order to seal the plunger and thereby prevent leakage of air into the cylinder. Furthermore, the water serves to lubricate and cool the plunger when the pump is operating as an air compressor or vacuum pump.

At one side of the cylinder is secured a

valve-chest 8, which contains both the inlet and the outlet valves, which in the present example are in vertical alinement. This valve-chest is closed at the top by a cap 9 bolted to the valve-chest in the usual way. The valve-chest has an inlet chamber indicated at 10 and an outlet chamber indicated at 11. The top wall 12 of the inlet chamber and the bottom wall 13 of the outlet chamber are separated to form an intermediate space, which space registers with the outer face of the transverse port or passage 2 of the pump cylinder, the bottom wall of said intermediate space being above the bottom of the cylinder. The wall 12 is arranged to receive a removable seat 14 for the inlet valve, and the wall 13 is arranged to receive a removable seat 15 for the outlet valve. The seats 14 and 15 are advantageously threaded into their respective walls and have flanges received in counterbores in said walls. The outlet valve seat 15 is of greater diameter than the inlet valve seat 14, so that by removing the cap 9 the outlet valve and its seat may be removed, whereupon the inlet valve and its seat may then be removed. The outlet valve 16 has a guide pin 17 on its upper side, which guide pin is guided in a socket 18 extending from the under side of the cap 9, a helical spring 19 surrounding the socket 18 and bearing against the upper face of the outlet valve to press it yieldingly against its seat. The under side of the outlet valve is provided with a socket 20, in which is located a helical spring 21, whose lower end bears on the upper face of the inlet valve 22, which is provided with a pin 23 holding the end of said spring 21 against displacement. Each valve is provided with wings as shown, which serve to guide the respective valves in their vertical movements. By this telescopic arrangement of the valves, the height of the intermediate space is reduced materially.

For the purpose of operating the plunger, its upper end is connected to a crosshead 24 moving in slides 25 carried by uprights 26, advantageously cast integral with the cylinder 1. To the crosshead is connected a pitman 27 engaging a crank 28, the crank shaft being journaled in said uprights 26 and driven by any suitable means, as, for example, by a gear wheel 29, in the present example shown as driven by a pinion 30, mounted on a driving shaft 31, also journaled in the uprights 26, said shaft 31 receiving power from any suitable source, not shown.

In a pump intended for operation under the said conditions hereinbefore pointed out, it is important that the crosshead be kept truly centered in its slides in order to maintain the plunger absolutely concentric with its cylinder and stuffing box, and for this

purpose the crosshead is of the adjustable type, that is to say, is provided at each side with wedges, which can be tightened as may be necessary by suitable means. It has heretofore been customary to arrange these wedges so that an upward movement of the wedges would tighten the crosshead. In the present construction, however, the wedges are arranged to tighten the crosshead when moved downward, these wedges being indicated at 32, Fig. 2, and the means for moving the wedges are located at the upper end of the crosshead, these means in the present instance consisting of bolts and nuts as indicated at 33. The result of this arrangement is that any increase in friction which might be caused by a very slight play of the wedges relative to the correspondingly sloped surfaces of the crosshead would occur only on the up-stroke of the pump, at which time the load due to the cylinder pressure is not on the pump, so that thereby any breaking effects due to such increase of friction will not occur at the time of the maximum load on the operating device. Furthermore, the arrangement of the means for adjusting the wedges at the upper end of the crosshead makes such adjustment more convenient and also allows the crosshead to be kept close to the plunger, which would not be possible with a deep basin liquid-seal device around the upper end of the plunger, if the means for adjusting the wedges were located on the under side of the crosshead.

It will be noted that in a pump constructed as hereinbefore set forth, there is trapped in the intermediate space, the upwardly sloped transverse port 2, and the cylinder clearance, a sufficient amount of liquid to completely fill these spaces when the plunger is at the limit of its downward stroke. When the plunger rises, owing to the slope of the transverse port 2 toward the cylinder and the relative capacities of the intermediate space, port 2, and that part of the cylinder end below the horizontal plane of the bottom wall of the intermediate space, all of this trapped liquid may return to the cylinder bottom and will have a level not quite reaching to the top edge of the inner face of the said transverse port, whereby a space for the escape of air or vapor is left between said top edge and the trapped liquid, so that, at the times when the liquid supply to the pump is insufficient or lacking, on the descent of the plunger, the air or vapor will escape through the port to the intermediate space and then accumulate in the intermediate space.

Near the end of its downward stroke the plunger overruns the upper edge of the inner face of the transverse port and thus drives out a portion of the liquid which was trapped in the bottom of the cylinder, the

last outward flow of this liquid into the intermediate space serving to seal the inlet valve, and the remaining outflowing liquid finally again filling the intermediate space and thus driving all of the air or vapor before it through the outlet valve. Upon the next upward stroke of the pump, the liquid again flows back from the intermediate space to the bottom of the cylinder and thereby frees the inlet valve, thereby allowing the same to lift relatively easily, and permitting the use of a sensitive inlet valve. Owing to this sealing of the inlet valve by the retained liquid in combination with the liquid seal at the top of the pump, the latter is able to operate in a sufficiently satisfactory manner as in air or vapor compressor, while at the same time owing to the withdrawal of the sealing liquid from the inlet valve upon the commencement of the upward movement of the plunger, the said inlet valve can be made to lift easily and thereby the pump will work satisfactorily as a vacuum pump.

Of course, under those conditions where the supply of liquid to the pump is sufficient, the plunger pump operates in the well-known way, the cylinder filling with liquid on the suction stroke, the principal part of which is discharged on the delivery stroke. Thus the pump is eminently satisfactory for use under the special conditions hereinbefore outlined.

The description thus far given is directed to a single cylinder pump, but in the best embodiment of my invention three such pumps are combined to form a three-cylinder, single-acting, outside-packed, plunger-pump, the cranks of the respective plungers being arranged 120° apart so that the plungers operate in a three-phase relation to each other. In this form of pumping apparatus, the inlet and outlet chambers of the valve-chest are common to all the pump cylinders, while the intermediate spaces between the respective inlet and outlet valves of each cylinder are individual for the respective cylinders; furthermore, the liquid sealing device at the top of the cylinders is common to all, that is to say, constitutes a trough-like basin, and is provided with means for causing a circulation of liquid through said basin while maintaining a level of said liquid above the respective packing glands of the cylinders. The means indicated in Fig. 1 consist of an inlet pipe 35 and an outlet pipe 36 located at the desired height to maintain the required liquid level. By this arrangement of the plunger sealing device, not only is the sealing and lubrication accomplished as hereinbefore explained, but, in addition, there is an equalization of temperature of the several plungers and cylinders, thus avoiding the disadvantages due to unequalled expansion and contraction.

The common inlet chamber may be provided with as many suction pipes as is desired, but in the construction illustrated I have shown only one such pipe, as indicated at 37. Furthermore, any desired number of outlet pipes may be attached to the outlet chamber of the valve-chest, two being shown in Fig. 1, as indicated at 38.

It is to be noted, furthermore, that the arrangement of the adjusting means for the crosshead at the upper part of the same in connection with a crank driving mechanism is particularly advantageous, in that when the crank is up the crosshead also is up above the slides and hence the adjusting device for the crosshead is particularly accessible.

What I claim is:—

1. In a pump, the combination, with a vertical cylinder having a transverse port extending upward from the lower end of the cylinder, of a valve-chest having inlet and outlet valve-seats separated by an intervening space whose bottom wall is above the bottom of the cylinder and arranged to drain therein, with which space the upper end of the transverse port connects, upward-opening inlet and outlet valves coacting with the respective seats, a single-acting plunger movable in the cylinder and longer than the same, said plunger fitting the cylinder to confine all cylinder clearance to the lower end of the cylinder below the plunger, means for reciprocating the plunger, said means being arranged to give the plunger a clearance at its lower end whose height is less than that of the transverse port, and a liquid seal device around the plunger at its upper end.

2. In a pump, the combination, with a vertical cylinder having a transverse port extending upward from the lower end of the cylinder, of a valve-chest having inlet and outlet valve seats in vertical alinement with each other, and separated by an intervening space whose bottom wall is above the bottom of the cylinder and arranged to drain therein, with which space the upper end of the transverse port connects, upward-opening inlet and outlet valves coacting with the respective seats, a single-acting plunger movable in the cylinder and longer than the same, said plunger fitting the cylinder to confine all cylinder clearance to the lower end of the cylinder below the plunger, means for reciprocating the plunger, said means being arranged to give the plunger a clearance at its lower end whose height is less than that of the transverse port, and a liquid-seal device around the plunger at its upper end.

3. In a pump, the combination, with a vertical cylinder having a transverse port extending upward from the lower end of the cylinder, of a valve-chest having inlet and

outlet valve-seats separated by an intervening space whose bottom wall is above the bottom of the cylinder and arranged to drain therein, with which space the upper end of the transverse port connects, upward-opening inlet and outlet valve coacting with the respective seats, a single-acting plunger movable in the cylinder and longer than the same, said plunger fitting the cylinder to confine all cylinder clearance to the lower end of the cylinder below the plunger, means for reciprocating the plunger, said means being arranged to give the plunger a clearance at its lower end whose height is less than that of the transverse port, an outside packing device for the plunger and a liquid-holding basin having walls surrounding the packing device and spaced away laterally therefrom, said walls extending above the packing and arranged to contain liquid at a level such that said liquid will contact with the plunger.

4. In a pump, the combination, with a vertical cylinder having a transverse port extending upward from the lower end of the cylinder, of a valve-chest having inlet and outlet valve seats separated by an intervening space whose bottom wall is above the bottom of the cylinder and arranged to drain therein, with which space the upper end of the transverse port connects, upward opening inlet and outlet valves coacting plunger movable in the cylinder and longer than the same, said plunger fitting the cylinder to confine all cylinder clearance to the lower end of the cylinder below the plunger, slides above the plunger, an adjustable crosshead connected to the plunger and movable in the slides, means located at the upper face of the crosshead for adjusting it in the slides, means for moving the crosshead plunger, said means being arranged to give

the plunger a clearance at its lower end whose height is less than that of the transverse port, an outside packing device at the upper end of the plunger, and a liquid-holding basin having walls surrounding the plunger and packing device and spaced away laterally therefrom, said walls extending above the packing device to hold liquid at a level such that said liquid will contact with the plunger.

5. The combination, with a three-cylinder single-acting outside packed plunger pump, and means for driving the plungers in three-phase relation to each other, each cylinder having an upwardly extending transverse port opening into the lower end of said cylinder, of a valve-chest having an inlet-chamber and an outlet-chamber, and a plurality of intermediate spaces, one for each cylinder, each connected to the upper end of the respective transverse port and having its bottom wall above the bottom of its respective cylinder, inlet valves between the inlet chamber and the respective intermediate spaces, outlet valves between the outlet chamber and the respective intermediate spaces, a liquid-holding basin having walls surrounding the outside packing devices of all the cylinders and spaced away laterally therefrom, said basin having walls extending above the packing devices, and means for causing a circulation of liquid through said basin at a level such that said liquid will contact with the plungers.

In testimony whereof, I have hereunto set my hand, in the presence of two subscribing witnesses.

WILLS M. FLEMING.

Witnesses:

EDMUND V. BARNES,
RAYMOND H. PETTEGROVE.

outlet valve-seats separated by an intervening space whose bottom wall is above the bottom of the cylinder and arranged to drain therein, with which space the upper end of the transverse port connects, upward-opening inlet and outlet valve coacting with the respective seats, a single-acting plunger movable in the cylinder and longer than the same, said plunger fitting the cylinder to confine all cylinder clearance to the lower end of the cylinder below the plunger, means for reciprocating the plunger, said means being arranged to give the plunger a clearance at its lower end whose height is less than that of the transverse port, an outside packing device for the plunger and a liquid-holding basin having walls surrounding the packing device and spaced away laterally therefrom, said walls extending above the packing and arranged to contain liquid at a level such that said liquid will contact with the plunger.

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the plunger a clearance at its lower end whose height is less than that of the transverse port, an outside packing device at the upper end of the plunger, and a liquid-holding basin having walls surrounding the plunger and packing device and spaced away laterally therefrom, said walls extending above the packing device to hold liquid at a level such that said liquid will contact with the plunger.

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RAYMOND H. PETTEGROVE.

Correction in Letters Patent No. 1,109,672.

It is hereby certified that in Letters Patent No. 1,109,672, granted September 8, 1914, upon the application of Wills M. Fleming, of Holyoke, Massachusetts, for an improvement in "Pumps," an error appears in the printed specification requiring correction as follows: Page 4, line 33, after the word "acting" insert the words *with the respective seats, a single-acting*; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 13th day of October, A. D., 1914.

[SEAL.]

J. T. NEWTON,

Acting Commissioner of Patents.

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[SEAL.]

J. T. NEWTON,

Acting Commissioner of Patents.