(No Model.) 4 Sheets—Sheet 1.

A. F. HALL.

STEAM PUMP.

No. 567,978. Patented Sept. 22, 1896.

Fig. 1.

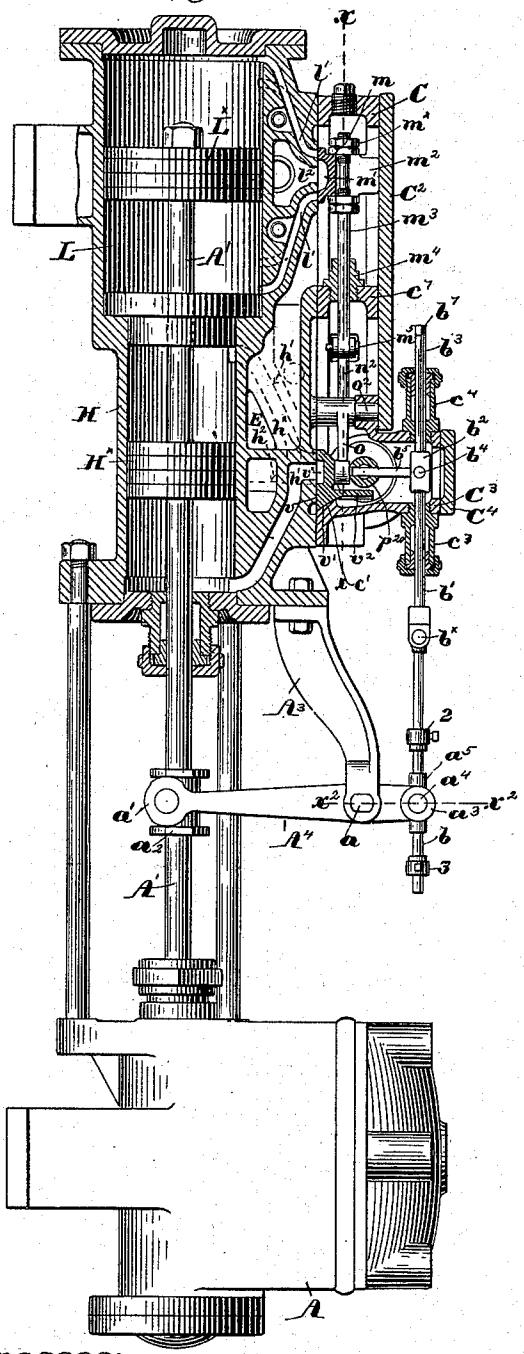


Fig. 2.

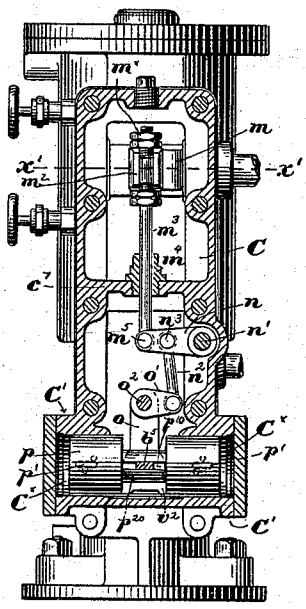


Fig. 3.

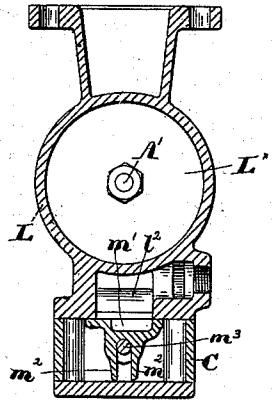
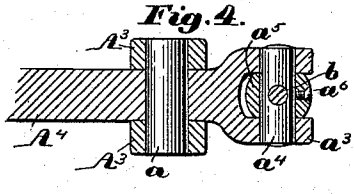


Fig. 4.



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(No Model.) 4 Sheets—Sheet 2.

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STEAM PUMP.

No. 567,978. Patented Sept. 22, 1896.

Fig. 5.

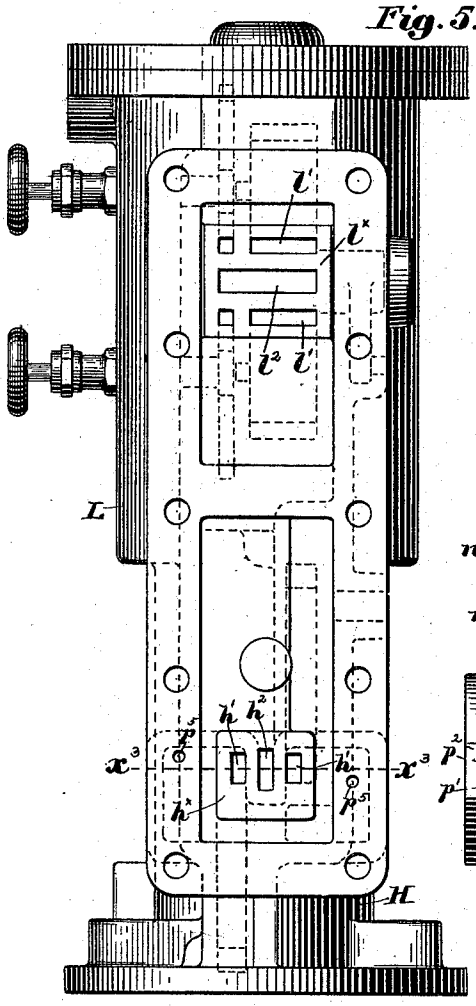


Fig. 6.

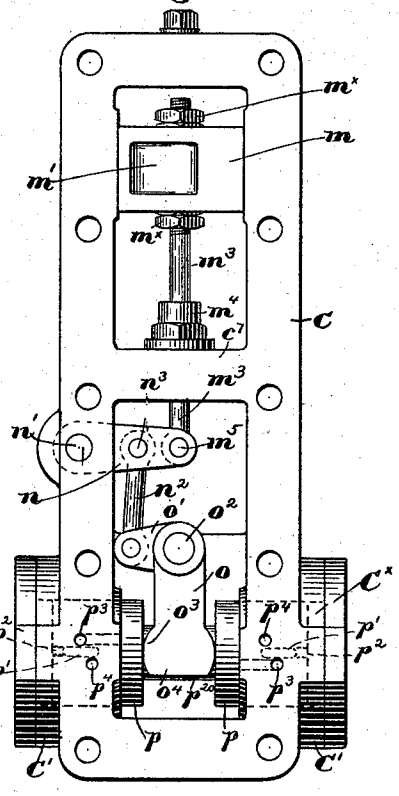
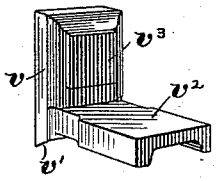


Fig. 8.



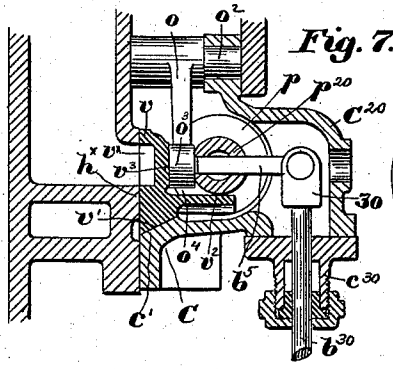
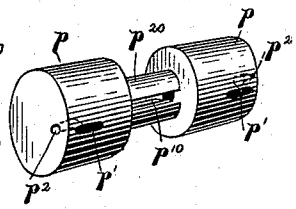


Fig. 7.

Fig. 9.



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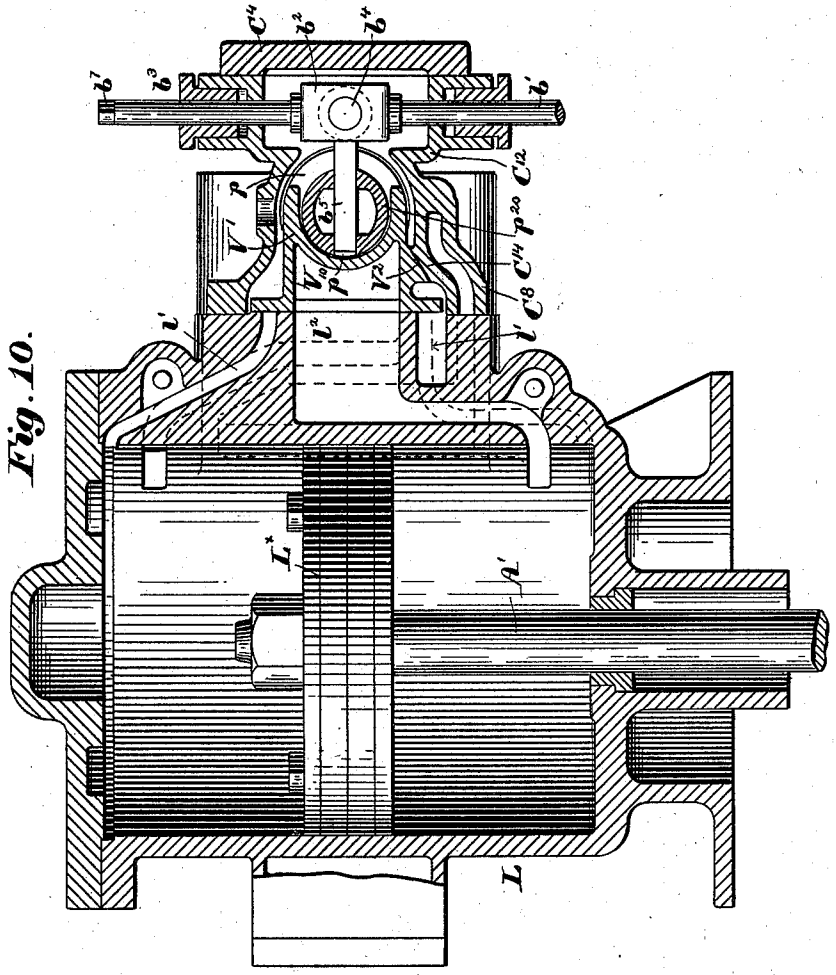
(No Model.) 4 Sheets—Sheet 3.

A. F. HALL.

STEAM PUMP.

No. 567,978. Patented Sept. 22, 1896.

Fig. 10.



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(No Model.) 4 Sheets—Sheet 4.

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STEAM PUMP.

No. 567,978. Patented Sept. 22, 1896.

Fig. 12.

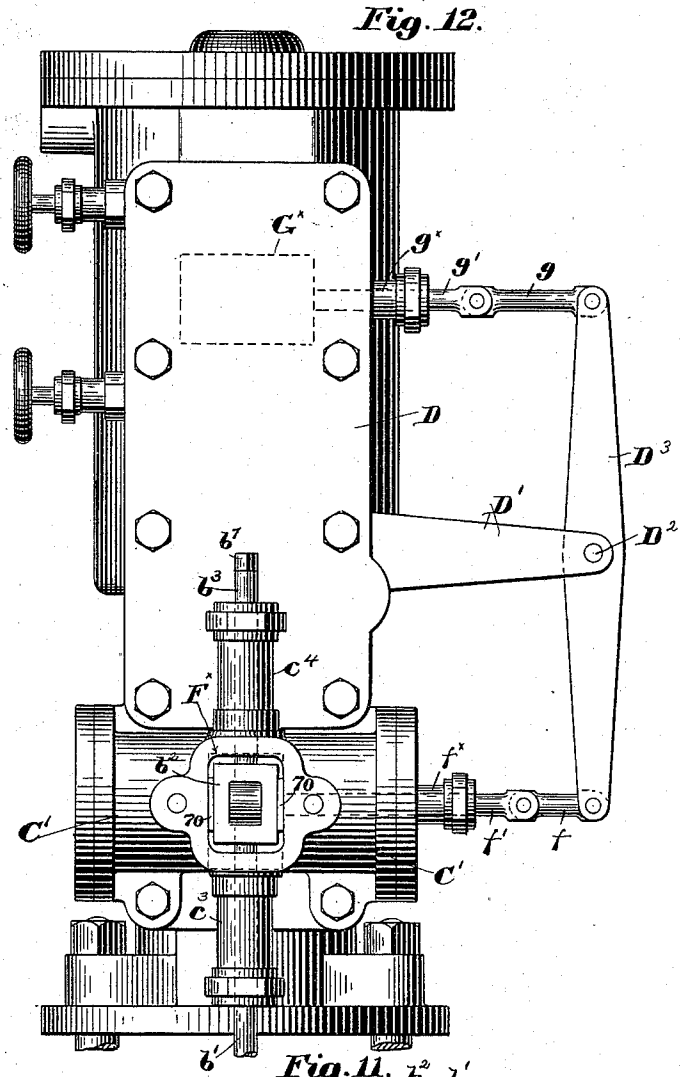
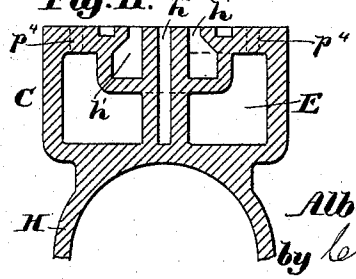


Fig. 11.



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UNITED STATES PATENT OFFICE.

ALBERT F. HALL, OF BOSTON, MASSACHUSETTS.

STEAM-PUMP.

SPECIFICATION forming part of Letters Patent No. 567,978, dated September 22, 1896.

Application filed May 14, 1896. Serial No. 591,473. (No model.)

To all whom it may concern:

Be it known that I, ALBERT F. HALL, of Boston, county of Suffolk, State of Massachusetts, have invented an Improvement in Steam-Pumps, of which the following description, in connection with the accompanying drawings, is a specification, like letters and figures on the drawings representing like parts.

This invention relates to that class of steam-pumps, simple or compound, wherein the main slide-valve is actuated by means of an auxiliary valve-piston so connected with the valve that the latter will partake of the reciprocating movement of the auxiliary valve-piston. I have herein shown the auxiliary valve-piston as in direct engagement with and adapted to rock relatively to the main valve, thereby dispensing with the jointed connection heretofore employed between said valve and auxiliary valve-piston. By dispensing with a yoke I am enabled to attain a much stronger and simpler construction of parts with a more direct coöperation and action. Trouble has also been experienced in practice with vertical pumps in maintaining the valve firmly upon its seat, but in this invention I have overcome this objection by beveling the lowermost edge of the valve to rest and move upon a correspondingly-beveled supporting portion of the valve-seat, the weight of the valve and the pressure of the steam thereupon all acting to retain it firmly upon its seat. I have herein shown my invention as embodied in both simple and compound pumps, and in the case of the latter I have provided novel connecting devices between the valves of the high and low presssure cylinders, whereby the one is operated by the other without intermediate stuffing-boxes. I am thereby enabled greatly to simplify the casting of the parts in the large cylinder, as the valve has a movement as in ordinary engines—viz., parallel to the axis of the cylinder. Means have also been provided for moving the auxiliary valve-piston in its cylinder by hand from the exterior, and said piston can also be rocked by the same means, which may be at times an advantage, for when a pump has been standing for a long while and becomes dry, or perhaps rusted, the valve-piston is thereby prevented from sticking, causing it to center.

Other novel features of my invention will be hereinafter described in the specification, and particularly pointed out in the claims.

Figure 1 is a longitudinal sectional view of a compound vertical pump embodying my invention, the pump-cylinder, of usual construction, being shown in elevation. Fig. 2 is a sectional view taken through the center of the steam-chest on the line $x\,x$, Fig. 1, looking toward the left. Fig. 3 is a transverse sectional view on the line $x'\,x'$, Fig. 2, through the valve of the low-pressure cylinder. Fig. 4 is an enlarged detail in section on the line $x^2\,x^2$, Fig. 1, of the connection between the rocker-arm and slide-rod for moving the actuator of the auxiliary valve-piston. Fig. 5 is an enlarged plan view of the lower portion of the steam-chest and steam-cylinder valve-seats, with the steam-chest cover or upper portion and the valves omitted. Fig. 6 is an under side view, also enlarged, of the steam-chest cover with the high-pressure valve omitted. Fig. 7 is an enlarged longitudinal sectional view of the main valve and auxiliary valve-piston, and showing a slightly-different form of mechanism for moving the actuator of the auxiliary valve-piston. Fig. 8 is a detached perspective view of the main high-pressure valve. Fig. 9 is a perspective view of the auxiliary valve-piston. Fig. 10 is a longitudinal sectional view of my invention as embodied in a single steam-cylinder. Fig. 11 is a transverse section on the line $x^3\,x^3$, Fig. 5, through the exhaust-chamber and valve-ports of the high-pressure cylinder; and Fig. 12 is a detail view of a modified form of connection between the high and low pressure valves and also showing the guides for the slide-rod yoke, the cap being removed from the head.

Referring to Fig. 1, the pump-cylinder A, high and low pressure cylinders H and L, their pistons $H^{\times}$ $L^{\times}$, respectively, and the common piston-rod A′ for the steam and pump cylinders may be and are of any usual or well-known construction.

Referring to Fig. 5, the valve-seat $h^{\times}$ of the high-pressure cylinder is provided with steam-ports h' and an exhaust-port h^2, so arranged that the travel of the slide-valve v will be transverse to the length of the cylinder, the valve being shown separately in Fig. 8. The valve is substantially L-shaped, as therein

illustrated, its face having the usual recess $v^{\times}$ therein to connect one of the steam-ports with the exhaust at the proper time, and the lower edge of the valve proper is beveled, as at v', to form an acute angle with the face, said beveled edge resting upon a support c' on the inner side of the steam-chest C and correspondingly beveled.

As clearly shown in Fig. 7, the weight of the valve itself and the pressure of steam thereupon tends to maintain it firmly upon its seat $h^{\times}$, such construction of course being applicable in the vertical style of pump. Adjacent the main valve the steam-chest cover has cast therewith lateral cylindrical extensions C′, having their axis parallel to the line of travel of the slide-valve v, said extensions receiving the heads of an auxiliary valve-piston reciprocable and partially rotatable therein, the said valve-piston (shown separately in Fig. 9) consisting of two like cylindrical heads $p\ p$ and a smaller connecting-piston p^{20}. Each head has in its cylindrical face a recess p', communicating by a passage p^2 with the outer end of the head, whereby communication is established between the recess and the clearance $C^{\times}$ of the adjacent extension C′.

Steam inlets or ports p^3, formed in the steam-chest C, lead from the interior thereof and have their inner ends in the paths of the recesses p' when the auxiliary valve-piston is rocked and partially rotated to at times convey steam into one or the other of the extensions C′ to act upon the head of the valve-piston therein and slide said piston longitudinally. Exhaust-ports p^4, also in the paths of the recesses p', register with passages p^5 in the walls of the steam-chest, leading therefrom into the exhaust-chamber E, Fig. 11, the auxiliary valve-piston being shown in Fig. 6, with the recesses p' midway between the inlet and exhaust ports.

From the foregoing it will be obvious that partial rotation of the auxiliary valve-piston at the proper times will admit steam behind one head and open the exhaust from behind the other head, and vice versa, to cause reciprocation of said piston.

The slide-valve v has an arm v^2 extended therefrom to enter the space between the valve piston-heads p, as shown in Figs. 1, 2, and 7, whereby the valve will be actuated by and moved in unison with the reciprocation of the auxiliary valve-piston to regulate the admission of steam to the high-pressure cylinder H. As herein shown, the arm v^2 extends beneath the reduced portion p^{20} of the valve-piston, thereby aiding in preserving the valve in proper position.

Referring now to Figs. 1 and 4, a bracket A^3 is bifurcated to receive the rocker-arm A^4, pivotally connected by a pin a to the bracket, one end of said rocker-arm being forked at a' to embrace an annularly-grooved collar a^2, fast on the piston-rod A′, reciprocation of the latter swinging the rocker-arm on its fulcrum a. The other end of the rock-arm is also forked to form a yoke a^3, in which is rotatably mounted a pin a^4, extended through a sleeve a^5, to which it is secured by a suitable set-screw a^6, Fig. 4. A valve-rod link b is connected by a joint at $b^{\times}$ to the valve-rod b', said link b sliding loosely within the sleeve a^5 and having adjustable collars 2 3 fast thereon to be engaged alternately by the ends of the sleeve, and thereby reciprocate the link and slide-rod b' intermittingly. By the construction described the slide-rod may be rotated in the sleeve when desired for a purpose to be described. In Fig. 1 the slide-rod b' is extended completely through a stuffing-box c^3 at the bottom of a head C^3, erected on the steam-chest cover above the main-valve seat $h^{\times}$, said rod b' having secured thereto within the head a yoke b^2, to which is also secured an extension-rod b^3, extended through a stuffing-box c^4 on the top of the head C^3. The yoke b^2 has a transverse pin b^4, on which is hung a finger b^5, connected to the auxiliary valve-piston to rock or partially rotate it while permitting free reciprocation of the said piston. I effect such sliding connection between the valve-piston and its actuator b^5 herein by making a longitudinal slot p^{10} in the reduced part p^{20} of the piston, into which slot the actuator b^5 enters freely, as shown in Figs. 1, 2, 7, and 10, the slot being long enough to permit the full stroke of the piston. The valve-piston is thus completely under control of its actuator at all times without being hampered in its reciprocation, the contacting parts being large enough to provide good bearing-surfaces. I have shown the outer end of the extension-rod b^3 as squared at b^7 to receive a wrench, whereby said extension may be rotated from the outside of the steam-chest by hand, if desired, to thereby swing the actuator or finger b^5 in the direction of the longitudinal axis of the auxiliary valve-piston by omitting the guide 70 of the yoke b^2. (Shown in Fig. 12.) Should the pump have been standing for some time and the valve-piston become dry, or even rusted, in its cylinder, it may be thus started, and by moving the slide-rod in the direction of its length the piston can be rotated by hand to ease it up if it should stick. This may be an important feature in actual practice, the connection of the link-rod b with the rocker-arm yoke a^3 permitting the rotative movement of the slide-rod and its yoke b^2 without disconnecting the parts.

The head C^3 is provided with a cover-plate C^4, by means of which ready access may be had to the parts in the head or to the valve.

In Fig. 5 the valve-seat $l^{\times}$ of the low-pressure cylinder L is shown as provided with the steam-ports l' and the exhaust l^2, arranged as in ordinary engines, that is, for travel of the valve in the direction of the length of the cylinder or at right angles to the movement of the high-pressure valve v.

The low-pressure valve m has the usual

recess m' in its face to coöperate with the ports, and it is herein shown as provided with projecting lugs m^2 on its outer side to receive between them a valve-rod m^3, having suitable check-nuts $m^\times$ thereon. Said valve-rod is extended through a bearing m^4 in the partition c^7, separating the high and low pressure ends of the steam-chest cover C, and is jointed at m^5 to a lever n, fulcrumed at n' to one side wall of the chest-cover. A bell-crank lever o o' is fulcrumed on a stud o^2 in alinement with the line of movement of the valve-rod m^3, its arm o' being jointed to a link n^2, pivotally connected at n^3 to the lever n between its fulcrum and the pivot m^5. The outer end of the arm o of the bell-crank is enlarged and rounded at o^3 to enter freely the space between the heads p of the auxiliary valve-piston, as clearly shown in Fig. 6, the extremity of said rounded portion being slabbed off, as at o^4, to clear the arm v^2 of the slide-valve v, as shown in Fig. 7. Reciprocation of the auxiliary valve-piston thus rocks the bell-crank, and the latter, through the link n^2 and lever n, reciprocates the valve-rod m^3, and thereby the low-pressure valve m, all the connections between the two valves being contained within the steam-chest and obviating the use of outside stuffing-boxes. The flattened side of the enlargement o^3 of the lever-arm o of the bell-crank engages a bearing v^3 on the outer side of the valve v and assists in retaining the valve seated without undue friction.

In Fig. 7 the extension-rod is omitted, the actuator b^5 for the auxiliary valve-piston being connected to a yoke 30 on the end of the slide-rod b^{30}, the latter passing through a stuffing-box c^{30} on a hood or head C^{20} of the valve-chest cover. With this exception the construction shown in Fig. 7 is precisely like that shown in Figs. 1 and 2.

In the single steam-cylinder construction shown in Fig. 10 the valve V has on its outer side a concaved seat V', in which the reduced portion p^{20} of the auxiliary valve-piston enters the piston-heads p, engaging opposite ends of the seat.

The slide-rod b', yoke b^2, extension-rod b^3, and the actuator or finger b^5, enter a slot p^{10} in the part p^{20} of the valve-piston, substantially as hereinbefore described, the actuator being jointed at b^4 to the yoke, the yoke, however, being somewhat nearer the piston, owing to the decreased height of the head C^{12}.

The valve V is shown as having a beveled portion V^2 at its lower side to slide on a correspondingly-beveled seat C^{14} of the steam-chest cover C^8.

In Fig. 12 I have shown a modified form of connection between the high and low pressure valves, the steam-chest D having secured to its outer wall a bracket D', upon which is fulcrumed at D^2 a lever D^3, to the ends of which are pivotally connected links f and g. The links are respectively jointed to slide-rods f' g', which enter the steam-chest through stuffing-boxes $f^\times$ $g^\times$ and are attached to the valves $F^\times$ $G^\times$, the high-pressure valve, as $F^\times$, being reciprocated by the auxiliary valve-piston, as hereinbefore described, and communicating motion to the other or low-pressure valve $G^\times$ by the outside connections. In this modification the two valves are moved in parallelism transversely to the length of the cylinders.

My invention is not restricted to simple or compound pumps, nor to pumps of the vertical type as herein shown, for it will be obvious that my invention is equally well adapted for horizontal-acting pumps.

Various modifications may be made in the details of construction herein shown, as, for instance, I may slot the actuator for the auxiliary valve-piston to be entered by a rib on the reduced portion of the latter, which would be a mere reversal of the construction shown, without departing from the spirit and scope of my invention.

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

1. In an apparatus of the class described, the main engine, including a cylinder, steam-chest, and inlet and exhaust ports, a main valve in said steam-chest, a reciprocable auxiliary valve-piston to move said main valve, and an actuator operated from the main engine, directly engaging and having a sliding connection with and to rock said valve-piston, to thereby control its reciprocation, substantially as described.

2. In an apparatus of the class described, the main engine, including a cylinder, steam-chest, and inlet and exhaust ports, a main valve in said steam-chest, a reciprocable auxiliary valve-piston reduced centrally to engage the main valve and thereby reciprocate it, and an actuator operated from the main engine, directly engaging and having a sliding connection with and to rock the said piston, to thereby control its reciprocation, substantially as described.

3. In an apparatus of the class described, the main engine, including a cylinder, steam-chest, and inlet and exhaust ports, a main valve in said steam-chest having a laterally-extended arm, a reciprocable valve-piston having a reduced central portion to embrace the valve-arm and cause said valve to be reciprocated with said valve-piston, and an actuator operated from the main engine, directly engaging and having a sliding connection with and to rock the valve-piston, to thereby control its reciprocation, substantially as described.

4. In an apparatus of the class described, the main engine, including a cylinder, steam-chest, and inlet and exhaust ports, a main valve in said steam-chest, a reciprocable auxiliary valve-piston to move said valve, said valve-piston having a longitudinally-slotted portion, an actuator to freely enter said slotted portion and having a sliding connection

therewith, and means connected with the main engine to move the actuator to rock the valve-piston and thereby control its reciprocation, substantially as described.

5. In an apparatus of the class described, the main engine including a cylinder, steam-chest and inlet and exhaust ports, the steam-valve, a main vertical seat therefor, and an auxiliary seat below and forming an acute angle with the main seat, the valve having its lower edge beveled to rest upon the auxiliary seat, a reciprocable valve-piston to move the said valve, and an actuator operated from the main engine, in direct engagement and having a sliding connection with and to rock the said valve-piston, to control its reciprocation, substantially as described.

6. In an apparatus of the class described, the main engine, including a cylinder, steam-chest, and inlet and exhaust ports, an auxiliary reciprocable valve-piston, an actuator directly engaging and having a sliding connection with and to rock said valve-piston, to control its reciprocation, a slide-rod having a yoke to which the actuator is pivoted, and a rocker-arm to reciprocate the slide-rod, the latter being rotatable relatively to the rocker-arm, said rocker being operated by the main engine as and for the purpose described.

7. In an apparatus of the class described, the main engine, including a cylinder, steam-chest, and inlet and exhaust ports, an auxiliary reciprocable valve-piston, an actuator in direct engagement and having a sliding connection therewith to rock it, a slide-rod to move the actuator, a rocker-arm, operated by the main engine, and connections between it and the slide-rod, whereby the latter may be rotated without disconnection, substantially as described.

8. In an apparatus of the class described, a main engine, including high and low pressure steam-cylinders, a steam-chest and an independent slide-valve for each, an auxiliary reciprocable valve-piston to operate one of said valves, an actuator operated by said main engine, in direct engagement with and to rock and thereby control the reciprocation of said valve-piston, and connections between the high and low pressure valves, whereby one is operated by the other, substantially as described.

9. In an apparatus of the class described, a main engine, including high and low pressure steam-cylinders, and their steam-chests, an independent valve for each, movable at right angles to each other, means to reciprocate one of said valves, and connections, including a bell-crank, link, and lever, between said valves, whereby reciprocation is imparted from one to the other, substantially as described.

10. In an apparatus of the class described, high and low pressure steam-cylinders, steam-chests therefor, and inlet and exhaust ports connecting said chests and cylinders, a valve for each cylinder, movable at right angles to each other, a reciprocable auxiliary valve-piston to move one of said valves, a bell-crank in engagement with and rocked by said valve-piston, a valve-rod connected to the other valve, a lever and a link connecting said valve-rod and bell-crank to reciprocate said second valve, and an actuator having a sliding connection with and to partially rotate said auxiliary valve-piston, to thereby control its reciprocation, substantially as described.

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

ALBERT F. HALL.

Witnesses:
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