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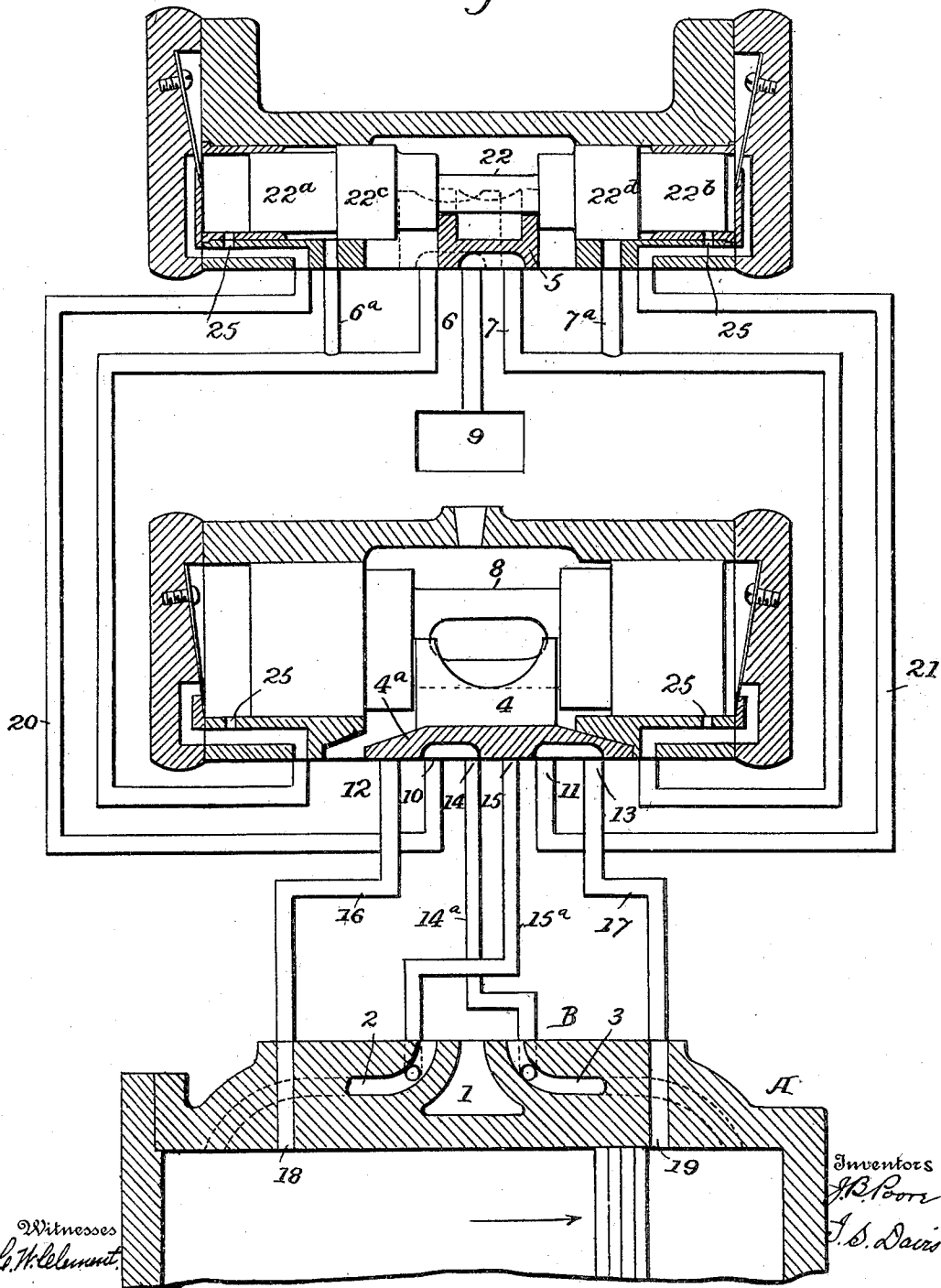
J. B. POORE & I. S. DAVIS.
STEAM ACTUATED VALVE.

(Application filed Nov. 22, 1900.)

(No Model.)

4 Sheets—Sheet 2.

Fig. 4.



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No. 684,716.

Patented Oct. 15, 1901.

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STEAM ACTUATED VALVE.

(Application filed Nov. 22, 1900.)

(No Model.)

4 Sheets—Sheet 3.

Fig. 5.

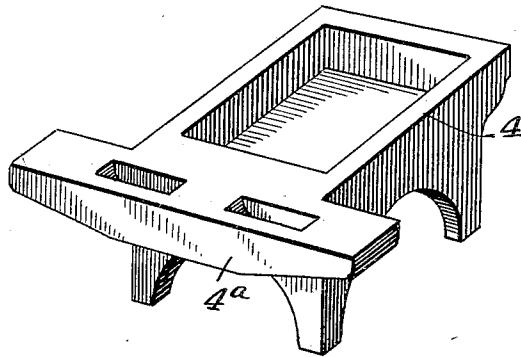
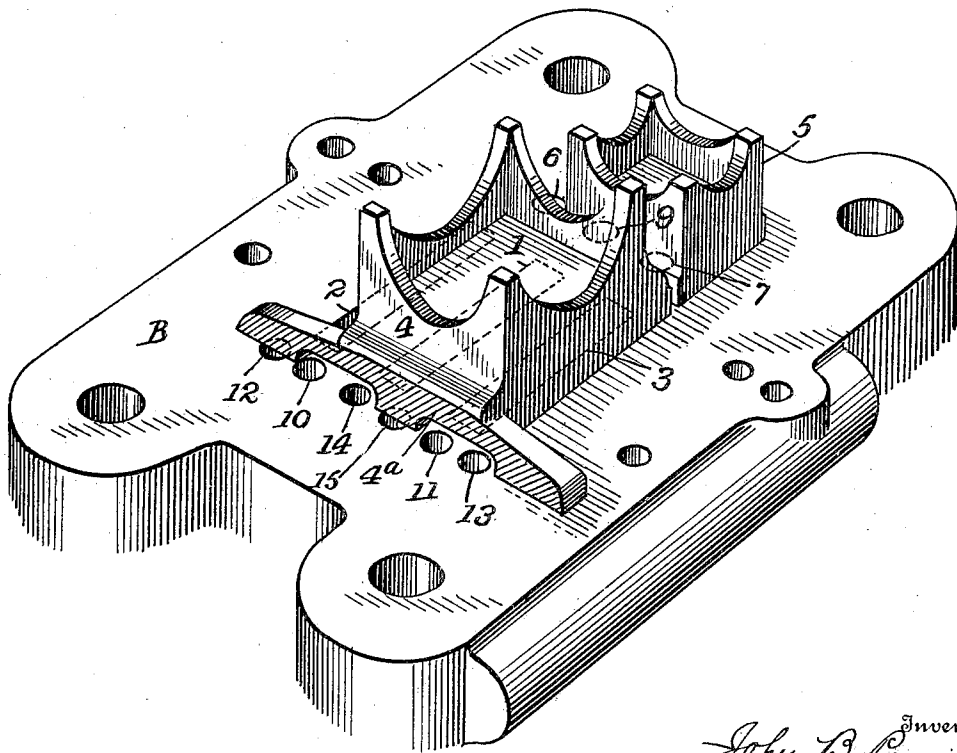


Fig. 6.

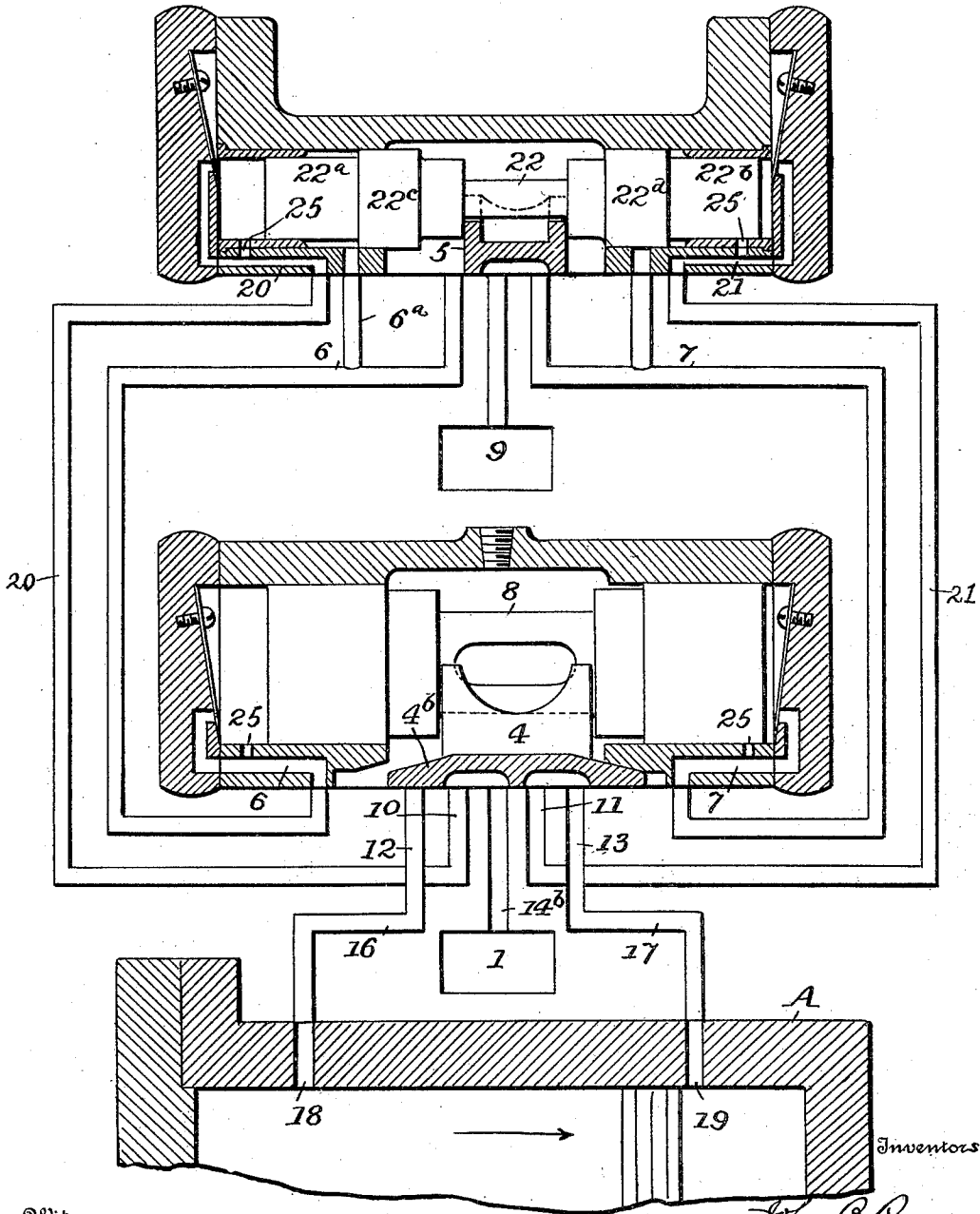


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Fig. 7.



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UNITED STATES PATENT OFFICE.

JOHN B. POORE AND IRVING S. DAVIS, OF SCRANTON, PENNSYLVANIA.

STEAM-ACTUATED VALVE.

SPECIFICATION forming part of Letters Patent No. 684,716, dated October 15, 1901.

Application filed November 22, 1900. Serial No. 37,365. (No model.)

To all whom it may concern:

Be it known that we, JOHN B. POORE and IRVING S. DAVIS, citizens of the United States, residing at Scranton, in the county of Lackawanna and State of Pennsylvania, have invented certain new and useful Improvements in Steam-Actuated Valves, of which the following is a specification.

Our invention relates to improvements in valve mechanism for steam-pumps, whereby the auxiliary valve which controls the ports leading to the main valve is operated automatically by steam-pressure instead of being mechanically operated in the usual manner by means of rods and tappets. In our improved steam-pump the valves are all operated without mechanical appliances external to the steam-chest, and hence the liability to derangement of the valves from flying fragments of rock in blasting or from rough handling or other causes is eliminated.

In the accompanying drawings, which illustrate our invention, Figure 1 is a plan view of the valve-seat and cylinder. Fig. 2 is a section on the line 2 2 of Fig. 1. Fig. 3 is a cross-section through the steam-chest, showing the relative arrangement of the valves. Fig. 4 shows sections through the steam-chest longitudinally of the main and auxiliary valves and a diagrammatic arrangement of the various steam passage-ways and ports. Fig. 5 is a perspective view showing the lower side of the main valve and the valve which controls the ports leading to the auxiliary valve. Fig. 6 is a similar view showing the valves arranged upon the valve-seat; and Fig. 7 is a view similar to the one shown in Fig. 4, illustrating a modified arrangement of steam passage-ways.

Referring to the drawings, Figs. 1 to 6, inclusive, A indicates the steam-cylinder of a pump, having upon its upper surface a valve-seat B. This valve-seat has the usual exhaust-port 1 and steam-ports 2 and 3, leading to the opposite ends of the cylinder, which ports are controlled by the main valve 4. An auxiliary valve 5 is also provided and adapted to control the steam passage-ways 6 and 7, leading to the opposite ends of the main-valve piston 8 and the exhaust 9.

In this invention instead of operating the auxiliary valve mechanically in the custom-

ary way by means of a rod and tappet we have arranged to operate said valve by means of steam admitted from the cylinder A to the opposite ends of a piston connected with said auxiliary valve, the steam-ports leading to said piston being controlled by a third valve 4^a, operatively connected with the main valve. As shown, there are six ports 10, 11, 12, 13, 14, and 15 in the valve-seat, arranged at one side of the main ports 1 to 3, inclusive, and these ports are controlled by the B-valve 4^a, connected to the main valve 4. The outside ports 12 and 13 are connected by steam passage-ways 16 and 17, respectively, to the interior of the cylinder through ports 18 and 19, arranged near its opposite ends, and between the inner ends of the steam-ports 2 and 3. The passage-ways 14^a and 15^a, which are the exhaust passage-ways for the cylinders of the auxiliary-valve piston, lead from the ports 14 and 15 in the valve-seat to the main steam-ports 3 and 2, respectively. For convenience these exhaust passage-ways are connected to the interior of the cylinder through the main steam-ports; but they may enter the cylinder directly at suitable points between the ends of the cylinder and the ports 18 and 19 of the steam passage-ways 16 and 17. The ports 10 and 11 are connected through passage-ways 20 and 21, respectively, to the steam-chambers at the opposite ends of the piston 22, which operates the auxiliary valve 5. The cylindrical chambers within which the opposite ends of this piston operate have two diameters, the outer portions being of less diameter than the inner portions, and the piston is made to correspond, the outer portions 22^a and 22^b having a smaller diameter than the intermediate parts 22^c and 22^d. This construction leaves annular shoulders between the outer and intermediate portions of the piston whose areas are less than the areas of the ends of the pistons, the ratio being preferably about as two to five. Passage-ways 6^a and 7^a, connected to the passage-ways 6 and 7, respectively, lead to the larger portions of the piston-casing, as shown, and are arranged so that they will be opened and closed alternately by the parts 22^e and 22^f of the piston.

When the piston 8 is moved to either end of the casing, the main valve and the valve

4^a are carried with it. The valve 4^a is arranged so that when the main valve is moved to admit steam to the left-hand end of the pump-cylinder the ports 12 and 15, connected to that end, will be closed, and when steam is applied to the right-hand end the ports 13 and 14, connected to the right-hand end, will be closed until the valves shift at the end of the stroke. During the stroke the passage-ways leading from the exhaust end of the pump-cylinder are connected through the valve 4^a to the chambers on the opposite ends of the auxiliary-valve piston. When the main and auxiliary valves are in the right-hand position, as shown in Fig. 4, steam is admitted through the steam-port 2 to the left-hand end of the cylinder and the pump-piston moves to the right, as indicated by the arrow. The exhaust passage-ways 15^a and steam passage-way 16, leading from the left-hand or steam end of the cylinder, are closed by the valve 4^a, while the exhaust passage-way 14^a and steam passage-way 17, leading from the exhaust end of the cylinder, are in communication with the passage-ways 20 and 21, respectively. These passage-ways 20 and 21 lead to opposite ends of the auxiliary-valve piston 22 and the pressures on the ends of the piston are practically equalized. In this position of the valves it will be noted that live steam from the steam-chest is admitted from the passage-ways 6 and 6^a to the rear of the shoulder 22^c, thus holding the piston 22 positively over in the right-hand position during the stroke of the pump-piston. As soon as the pump-piston passes the port 19 when nearing the end of the stroke live steam from the cylinder is admitted through the passage-ways 17 and 21 to the right-hand end of the auxiliary-valve piston 22, moving the latter to the left and with it the valve 5. The left-hand position of the valve 5 is indicated in dotted lines. This movement of said valve permits steam to enter the passage-ways 7 and 7^a to the rear of the shoulder 22^d, thus holding the auxiliary-valve piston positively over to the left, and it also permits the steam to pass through the passage-ways 7 to the right-hand end of the main-valve piston 8, thereby causing said piston to move to the left and with it the valves 4 and 4^a. The left-hand position of the latter is indicated in dotted lines. This movement of the valves 4 and 4^a to the left opens the main port 3 to admit steam to the right-hand end of the cylinder and also closes the ports 13 and 14, leading to said end, and opens communication between the passage-ways 16 and 20 through the ports 12 and 10 and between passage-ways 15^a and 21 through ports 15 and 11. As the ports 13 and 14 are then closed by the valve 4^a the live steam admitted to the right-hand side of the pump-piston cannot pass through to the auxiliary-valve piston. The passage-ways 20 and 21 being then in communication with the exhaust end of the cylinder, the pressures on opposite ends of the auxiliary-valve piston will be equal-

ized. When, however, the piston in its travel toward the left-hand end of the cylinder passes the port 18, live steam is admitted from the cylinder through the passage-way 16 and ports 12 and 10 to the passage-way 20 and thence to the left-hand end of the auxiliary-valve piston 22, forcing the latter to the right against the pressure of the live steam on the shoulder 22^d, which has a smaller area than the end of the piston, into the position shown in full lines in Fig. 4. This movement of the auxiliary piston and valve to the right cuts off the live-steam pressure from the passage-ways 7 and 7^a and admits steam through the passage-ways 6 and 6^a to the left of the shoulder 22^c, thus holding the piston positively in the right-hand position, and it also admits steam through the passage-way 6 to the left-hand end of the piston 8, moving said piston to the right and carrying with it the valves 4 and 4^a, thus again closing the ports 12 and 15 and establishing communication between the ports 10 and 14 and between ports 11 and 13 and admitting steam through the main port 2 to the left-hand end of the pump-cylinder. The steam admitted through the passage-ways to the rear of the valve-pistons escapes after the valves are thrown over through openings 25, and thence passes out through the passage-ways to the exhaust-ports in an obvious manner.

From the foregoing it will be seen that as soon as the auxiliary valve is thrown over at the end of the stroke live-steam pressure is admitted behind the proper shoulder on the auxiliary-valve piston to hold the valve positively in place during the stroke of the pump and that the movement of the main valve, which immediately follows, opens communication between the opposite ends of the auxiliary-valve piston and the exhaust end of the pump-cylinder, so that the pressure of the exhaust-steam is applied to both ends of the auxiliary-valve piston instead of to one end only, thus preventing any disturbance of the piston by the exhaust-pressure. If in Fig. 4 the exhaust passage-way 14^a were not connected to the exhaust end of the cylinder, so that the pressure of the exhaust-steam would be applied to the left-hand end of the auxiliary-valve piston, it will be apparent that the exhaust-steam pressure acting through the passage-ways 17 and 21 would have a tendency to throw the auxiliary-valve piston back to the left as soon as it had been moved over by the live-steam pressure through the passage-ways 16 and 20 at the end of the previous stroke. It is necessary, therefore, for the proper operation of the invention that the passage-ways leading from the steam end of the cylinder to the auxiliary-valve piston should be closed while the passage-ways leading from the exhaust end of the cylinder to the opposite ends of the auxiliary-valve piston should be open during the stroke of the pump-piston in order that the valves may be moved by the live steam when the pump-pis-

ton passes the steam passage-way at the end of the cylinder and to neutralize the pressure of the exhaust-steam by admitting it to both ends of the piston. The valve 4^a, which controls these passage-ways, as shown in the drawings, is connected integrally with the main valve; but it may be arranged in any suitable manner so as to operate simultaneously with the main valve.

10 In Fig. 7 we have illustrated a modification the arrangement of which is similar to that shown in Fig. 4, excepting that no provision is made for neutralizing the effect of the exhaust-steam pressure upon the ends of the auxiliary-valve piston. This arrangement is somewhat more simple than the plan shown in Fig. 4, although not quite so satisfactory in its operation. In Fig. 7 instead of having the two cross-connected passage-ways 14^a and 15^a leading to the opposite ends of the pump-cylinder we have but a single passage-way 14^b leading to the exhaust, and the valve 4^b, which corresponds with the valve 4^a in Fig. 4, is arranged so as to connect this passage-way with the passage-ways 20 and 21 alternately. In this figure, wherein the valves are moved over to the right, it will be noted that the pressure from the exhaust end of the cylinder is conveyed through the passage-ways 17 and 21 to the right-hand end of the piston 22, while there will be no appreciable counteracting exhaust-steam pressure upon the left-hand end of the piston, for the reason that the passage-way 20 is connected directly to the main exhaust-opening 1 through the passage-way 14^b. This arrangement is not as positive in its action as the arrangement shown in Fig. 4, where the exhaust-pressure is great, and movement of the auxiliary-valve piston is apt to result from this source. Referring to Fig. 4, we find it desirable to connect the passage-ways 14^a and 15^a to points in the cylinder where the exhaust-pressure through said passage-ways will be practically equal to the exhaust-pressure through the passage-ways 16 and 17. Otherwise the exhaust-pressure upon the opposite ends of the auxiliary-valve piston would not be equal.

50 Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In a steam-pump the combination with a steam-cylinder having the main steam and exhaust ports and a piston-operated main valve therefor, of an auxiliary valve controlling the ports leading to the main-valve piston, a piston for operating said valve, and means for operating said auxiliary-valve piston by live-steam pressure and for holding said valve in position by steam-pressure during the stroke of the pump.

2. In a steam-pump the combination with a steam-cylinder having main steam and exhaust ports and a piston-operated main valve therefor of an auxiliary valve operated by a piston and controlling the ports leading to the

main-valve piston, means for admitting live-steam pressure from the cylinder alternately to the opposite ends of the auxiliary-valve piston at the end of each stroke, means for holding said valve in position by live-steam pressure during the stroke, and means for admitting exhaust-steam pressure to both ends of said piston during the stroke.

3. In a steam-pump the combination with a steam-cylinder having main steam and exhaust ports and a piston-operated main valve therefor of an auxiliary valve operated by a piston and controlling the ports leading to the main-valve piston, means for admitting live-steam pressure from the cylinder alternately to the opposite ends of the auxiliary-valve piston at the end of each stroke, means for admitting live-steam pressure to a portion only of said piston during the stroke, and means for admitting exhaust-steam pressure to both ends of said piston during the stroke.

4. In a steam-pump the combination with the steam-cylinder having main steam and exhaust ports and a piston-operated main valve therefor of an auxiliary valve operated by a piston and controlling the ports leading to the main-valve piston, means for admitting live-steam pressure from the cylinder alternately to the opposite ends of the auxiliary-valve piston at the end of each stroke and for admitting steam-pressure from the steam-chest to a portion only of said piston during the stroke of the pump.

5. In a steam-pump, the combination with the steam-cylinder having main steam and exhaust ports and a piston-operated main valve therefor, of an auxiliary valve operated by a piston and controlling the ports leading to the main-valve piston, and means for admitting live-steam pressure from the cylinder alternately to the opposite ends of the auxiliary-valve piston at the end of each stroke, and for admitting exhaust-steam pressure to both ends of said piston during the stroke.

6. In a steam-pump the combination with a steam-cylinder having main steam and exhaust ports and a piston-operated main valve therefor, of an auxiliary valve operated by a piston and controlling the ports leading to said main-valve piston, exhaust passage-ways leading from the ends of the cylinder to a valve-seat, steam passage-ways leading from the interior of the cylinder between said exhaust passage-ways to said valve-seat, passage-ways leading from said seat to the opposite ends of the auxiliary-valve piston, and a valve operating simultaneously with the main valve and adapted to maintain communication between the opposite ends of the auxiliary-valve piston and the passage-ways leading to the exhaust end of the cylinder and to close the passage-ways leading from the steam end of the cylinder during the stroke of the pump-piston.

7. In a steam-pump, the combination with a steam-cylinder having main steam and exhaust ports and a piston-operated main valve

therefor, of an auxiliary valve operated by a piston and controlling the ports leading to the main-valve piston, means for admitting live steam-pressure from the cylinder alternately to the opposite ends of the auxiliary-valve piston at the end of each stroke, to reverse the position of the auxiliary valve, and for cutting off such pressure after reversal, and means for admitting live-steam pressure behind a portion of said piston to hold it in position after reversal during the succeeding stroke of the pump.

8. In a steam-pump, the combination with a steam-cylinder having main steam and exhaust ports, and a piston-operated main valve therefor, of an auxiliary valve controlling the ports leading to said main valve, a piston for operating said auxiliary valve, said piston having annular shoulders near its opposite ends, exhaust passage-ways leading from the ends of the pump-cylinder to a valve-seat, steam passage-ways leading from the interior of the cylinder between said exhaust passage-

ways to said valve-seat, passage-ways leading from said seat to the opposite ends of the auxiliary-valve piston, a valve operating simultaneously with the main valve and adapted to maintain communication between the opposite ends of the auxiliary-valve piston and the passage-ways leading to the exhaust end of the cylinder and to close the passage-ways leading from the steam end of the cylinder during the stroke of the pump-piston, and passage-ways leading from the steam-chest to the rear of the shoulders upon the auxiliary-valve piston, said passage-ways being adapted to be opened and closed by the auxiliary-valve piston.

In testimony whereof we affix our signatures in presence of two witnesses.

JOHN B. POORE.
IRVING S. DAVIS.

Witnesses:

ROBERT WATSON,
M. F. SANDO.