

(No Model.)

2 Sheets—Sheet 1.

W. B. MASON
STEAM PUMP.

No. 500,590.

Patented July 4, 1893.

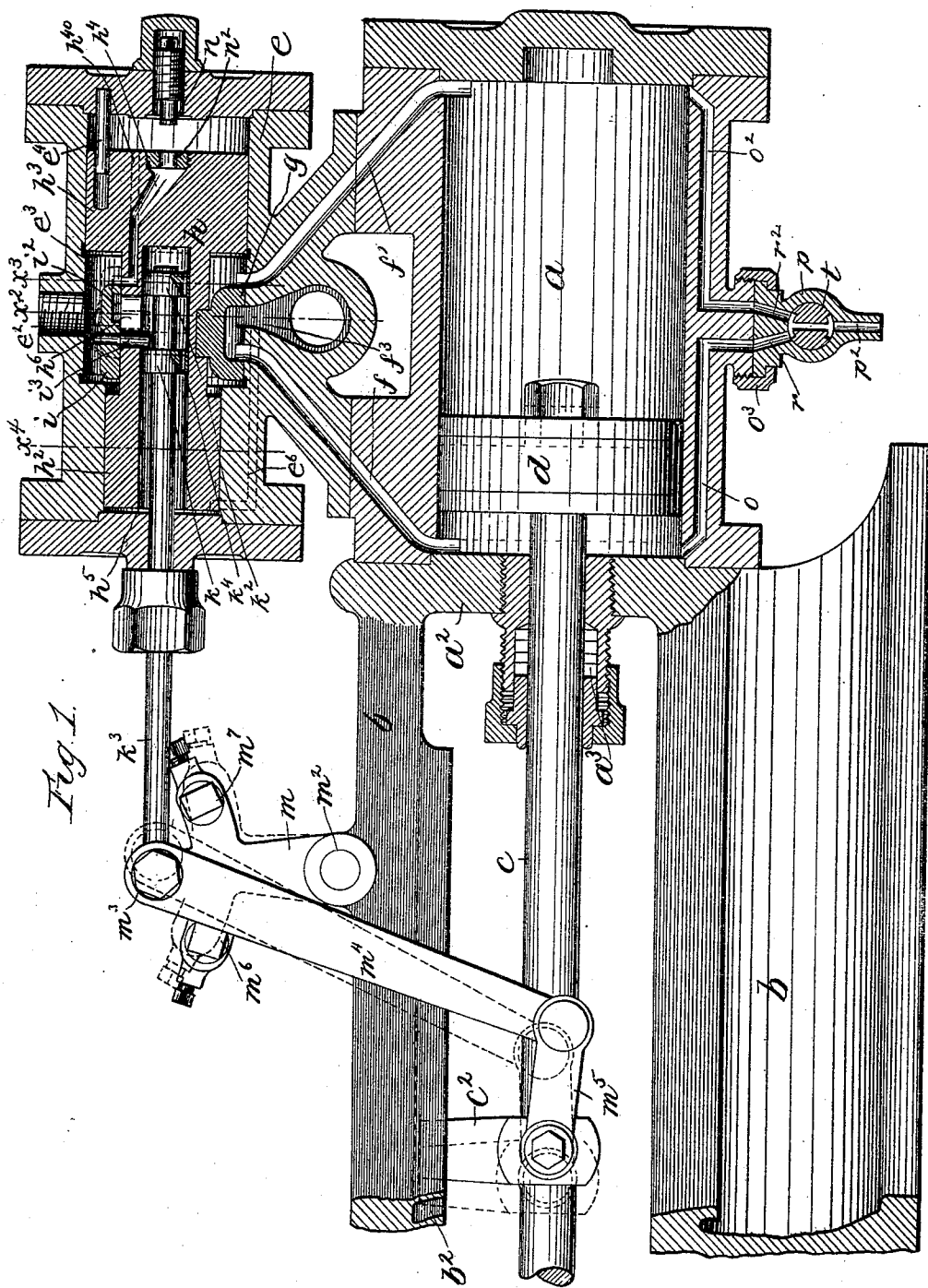


Fig. 1.

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(No Model.)

2 Sheets—Sheet 2.

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Fig. 2.

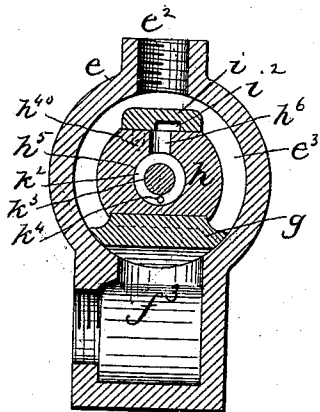


Fig. 3.

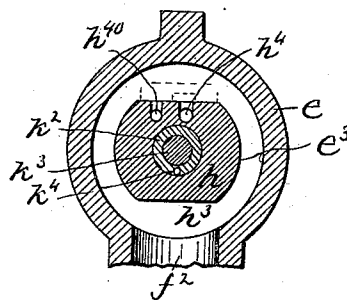


Fig. 4.

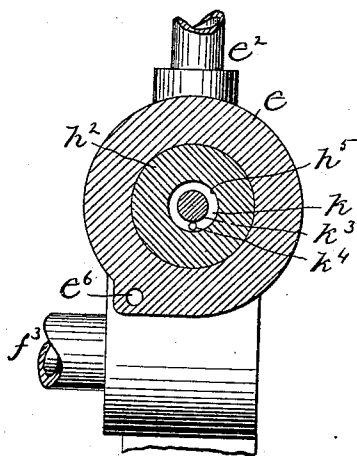


Fig. 5.

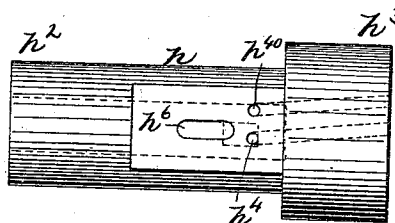
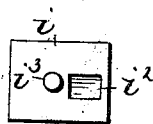


Fig. 6.



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UNITED STATES PATENT OFFICE.

WILLIAM B. MASON, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO THE MASON
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STEAM-PUMP.

SPECIFICATION forming part of Letters Patent No. 500,590, dated July 4, 1893.

Application filed May 9, 1892. Serial No. 432,296. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM B. MASON, 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 on the drawings representing like parts.

My invention is embodied in a direct acting steam pump, and consists mainly in a novel construction of the valve and valve gear for controlling admission and exhaust of steam. The steam cylinder is provided with the usual live steam ports leading from a point near the middle of the length of the cylinder to the ends thereof, and exhaust port located between the said live steam ports, so that said ports may be controlled by a D-slide valve in the usual manner. The said slide valve is actuated by a differential piston working in a valve cylinder, which also constitutes the steam-chest for the main cylinder, the said main valve actuating piston being actuated itself by steam from the steam chest which is admitted to and exhausted from the large end of the valve cylinder under control of a small controlling valve which is operated by the valve gear connections from the piston rod of the engine. The steam chest space is an annular space around the middle portion of the valve actuating piston, which is of reduced diameter and the controlling valve is a slide valve working on a seat on the valve actuating piston. The controlling valve and valve gear are so constructed that the controlling valve is first moved on its seat with relation to the valve actuating piston, by the valve gear, sufficiently to change the application of steam to said valve piston, after which the controlling valve remains stationary with relation to said piston but accompanies the latter in its stroke by which it shifts the main cylinder valve.

The invention further consists in details of construction of various parts which will be hereinafter described.

Figure 1 is a longitudinal section of the steam end of a steam pump embodying this invention, the pump cylinder being omitted as it may be of any usual construction, its specific construction constituting no part of

the present invention. Figs. 2, 3, and 4 are transverse sectional details on lines x^2 , x^3 , x^4 , Fig. 1; Fig. 5 a plan view of the valve actuating piston, detached, and Fig. 6 an under side view of the controlling valve detached.

The main cylinder a is bolted to the main frame b which connects the steam and water cylinders and forms a support for the engine, said frame b having formed upon it one of the heads a^2 of the cylinder, which head may be provided with the usual stuffing box a^3 for the piston rod c connected with the piston d in the usual manner, the said piston rod c having an arm c^2 which works in a longitudinal guide b^2 in the main frame and is the part to which the valve gear to be hereinafter described, is connected.

Upon the cylinder a is supported the valve cylinder e which also constitutes the steam chest, the steam pipe from the boiler being connected therewith at e^2 , and the main and valve cylinders are connected by the usual live steam ports f , f^2 , and provided with the exhaust port f^3 which have their port openings in the valve cylinder arranged to be controlled by the main valve g which is a D-slide valve operating in the usual manner but having its face curved to fit the bore of the cylinder e as shown in Fig. 2. The said valve cylinder e has a bore of larger diameter extending from one end (which will be called for distinction the rear end) to a point slightly beyond the travel of the main valve g which works in said larger bore; and said cylinder has a smaller bore the rest of the way to its forward end, the sectional area of the two bores being preferably in about the ratio of two to one. The main valve g is actuated by a differential piston h working in said cylinder e and having a portion h^2 which fits the smaller bore of the said cylinder and a portion h^3 that fits the larger bore. The said larger portion h^3 of the piston is considerably shorter than the large bore of the cylinder thus leaving an annular space e^3 in the cylinder around the piston which always communicates with the steam pipe e^2 and is thus always filled with live steam when the engine is operating, and constitutes the steam chest of the engine, from which steam flows through the ports f , f^2 , to the main cylinder when per-

mitted by the main valve *g*. The said main valve is engaged with the piston in any suitable manner as by a projection entering a transverse notch in the piston as shown, so that it accompanies the piston in its longitudinal movement, and the piston is restrained from rotation in the cylinder in any suitable manner, shown in this instance as by a guide pin *e*⁴ (Fig. 1) secured in the rear head of the valve cylinder and entering a longitudinal bore in the valve piston.

The valve actuating piston is acted upon constantly by the pressure in the steam chest *e*³ which exerts an unbalanced pressure on the differential area by which the large end of the piston exceeds the small end, which pressure tends to throw the piston toward the rear end of the cylinder and in the absence of any other pressure would thus cause the main valve *g* to open the port *f*; and in order to cause the piston *h* to move forward or toward the left hand Fig. 1, it is necessary that the steam should be applied to some other part of said piston than that exposed directly to the steam in the steam chest *e*³. Such application of steam is afforded through the port *h*⁴ leading from the steam chest *e*³ to the space between the larger end of the piston and the rear head of its cylinder.

The portion of the piston contained in the steam-chest part of the cylinder is provided with a valve seat for a controlling valve *i* that governs the flow of steam through the port *h*⁴, said valve *i* being in the nature of a D-slide valve having an exhaust pocket *i*² in its under surface which in the dotted line position of the valve Fig. 1, connects the port *h*⁴ with a longitudinal port or bore *h*⁵ in the piston, which port constitutes a part of the exhaust passage from the larger end of the valve cylinder, as will be described.

The valve piston is preferably flattened to form the seat for the controlling valve *i* as best shown in Fig. 2. With the controlling valve *i* in the full line position Fig. 1, the port *h*⁴ is open and steam from the steam chest is thus permitted to pass into the space between the large end of the piston and the rear head of the cylinder (*i. e.*, to the larger end of the cylinder) where it acts upon the full larger area of the piston and thus overbalances the steam-chest pressure on the annular surface that constitutes the differential area between the two parts of the piston, and consequently with the controlling valve *i* in the full line position the steam acting on the full area of the large end of the piston moves it forward to the position shown in Fig. 1, thus opening the main cylinder port *f*² and connecting the port *f* with the exhaust passage *f*³ so that the main piston *d* is caused to make its forward stroke, it being shown in full lines Fig. 1 as having nearly completed its forward stroke at which point it begins to act on the controlling valve *i* through the valve gear, as will be hereinafter described.

In order to reverse the main valve it is nec-

essary that the steam should be exhausted from the large end of the valve cylinder so as to leave the valve piston acted upon only by the pressure of the steam in the annular steam chest which will move it to the right as before described. Such exhaust is produced by the movement of the controlling valve *i* from the full to the dotted line position Fig. 1. The said valve *i* is provided with a pin or stud *i*³ which extends through a longitudinal slot *h*⁶ cut through from the seat of the valve *i* on the piston, to the port *h*⁵ in the said piston, said stud *i*³ extending into said slot and entering between collars or enlargements *k*, *k*², on the valve rod *k*³ which works through the forward end of the valve cylinder in the usual manner and is operated by the valve gear as will be hereinafter described. A short movement of said rod *k*³ in the direction opposite to that in which the main piston *d* is moving will throw the valve *i* from the full to the dotted line position Fig. 1, which movement cuts off the port *h*⁴ from communication with the steam chest *e*³ and at the same time connects the said port through the exhaust pocket *i*² in the valve, and the slot *h*⁶, with the bore *h*⁵ of the piston which leads to the small end of the cylinder, which is herein shown as connected by a port *e*⁶ (see Fig. 4 and dotted lines Fig. 1) with the main exhaust port *f*³ said port *e*⁶ passing by and not communicating with the main cylinder port *f*. The steam is thus permitted to exhaust from the large end of the cylinder leaving the steam chest pressure on said piston unbalanced as before described, so that it moves the said piston to the rear far enough to shift the main valve *g*. In this movement the valve *i* simply rides upon and is carried by the main valve piston, not changing its position with relation thereto, and there is sufficient space between the collars *k*, *k*², to accommodate such movement which however, carries the pin *i*³ up to the collar *k*² so that the valve *i* will be engaged and moved at once when the valve rod *k*³ makes its next stroke in the opposite direction to that last described.

The collars *k*, *k*², are provided with longitudinal passage as shown at *k*⁴ so as not to obstruct the flow of steam through the passage *h*⁵ and so that they themselves are not affected by the steam pressure and said collars in conjunction with the pin *i*³ cause the controlling valve *i* to be intermittently engaged with and operated by the valve stem, and permit the latter to have a movement independent of the former as is required for the proper operation of this apparatus. It is not essential that the exhaust port *e*⁶ should lead to the main exhaust port *f*³ but that is the most convenient arrangement. It is necessary only that the small end of the valve cylinder should be constantly open to exhaust.

From the foregoing it appears that it is necessary only for proper operation of the

main valve that the operating rod k^3 of the controlling valve i should be moved a short distance in the direction opposite to that in which the main piston d is moving as the said main piston arrives near the end of its stroke, and it is desirable in apparatus of this kind that the valve controlling movement should be prompt and should require but very little travel of the main piston to effect the reversal of the valve, so that the main piston may substantially complete its stroke in the main cylinder without danger of overthrowing and striking the head of the cylinder. These results are attained by the valve gear which will now be described. The valve rod k^3 is connected with an arm m pivoted at m^2 on the main frame b and having its free end pivotally connected at m^3 with one end of an arm m^4 the other end of which is connected in any suitable manner as by the link m^5 with the main piston rod c or the arm c^2 thereof, so that the said arm m^4 is oscillated upon its joint with the arm m at each stroke of the piston, such oscillation of itself, however, having no tendency to move the arm m . The said arm m is however, provided with tappets m^6, m^7 , which are rigidly connected with it, one at each side of the arm m^4 and with sufficient space between them to admit of the free oscillation of the arm m^4 for nearly the entire stroke of the piston, but just as the piston nears the end of its stroke as shown in full lines Fig. 1, the said arm m^4 engages with the one of the tappets (in this instance m^6) toward which it is moving. Such engagement prevents the further oscillation of the arm m^4 upon its joint with the arm m , and the arms m, m^4 , become practically locked together and the same as a rigid piece or lever fulcrumed at m^2 on the frame work and having one arm or end connected with the valve rod k^3 and the other with the piston rod c . Thus the further movement of the main piston tilts the said lever on the fulcrum m^2 to the dotted line position and thereby gives the required throw to the rod k^3 and controlling valve i which then operates as before described. By this construction the rate of movement of the controlling valve i relative to that of the main piston may be proportioned as desired by varying the position of the fulcrum m^2 , raising the said fulcrum or moving it nearer the connection with the rod k^3 decreasing the rate of movement of the valve i relative to that of the piston, while lowering the said fulcrum increases said relative rate, and by having the fulcrum about midway between the axes of the valve rod k^3 and piston rod c as shown, the rate of movement of the valve and piston is about equal, and consequently the piston causes the valve to be reversed during a movement of the said piston about equal to that required for the controlling valve i to be shifted with relation to the port h^4 controlled by it.

In order to cushion the movements of the main valve piston h the exhaust port e^5 opens

into the cylinder at a short distance from the end thereof, so that in the forward stroke some of the exhaust steam is trapped at the forward end of the cylinder and thus cushions the movement of the piston. The stroke in the other direction is caused to be cushioned by a pin n which enters the port opening h^4 which may be provided with a bushing n^3 to secure a proper fit, the said pin n constituting a stopper to close the port h^4 (which is then exhausting steam from the large end of the cylinder) just before the piston completes its movement thus trapping sufficient of the exhaust steam in the large end of the cylinder to cushion the piston. This leaves the port h^4 closed at n, n^3 , so that at the next movement of the valve i to open the steam chest end of the port the steam will be prevented from passing through the said port so as to operate the piston, and the piston is therefore provided with a second port h^{40} , (see Figs. 3 and 5) having its port opening in the valve seat in line with that of the port h^4 so as to be controlled by the same movement of the valve i , the pocket i^2 of which however, is not wide enough to cover the said port opening h^{40} , which leads to the large end of the cylinder at one side of the port opening n^2 . Thus when the valve i is in position to exhaust the large end of the cylinder (dotted line position Fig. 1) its blank or unpocketed portion closes the port h^{40} , leaving the port h^4 only to operate as an exhaust port which is closed to trap the exhaust and cushion the piston as before described. The position of the exhaust pocket of the valve i at such time is indicated in dotted lines Fig. 5. When, however, the valve i moves to the position to admit steam to the large end of the cylinder (full line position Fig. 1) the port h^{40} , is effective as it is not closed by the pin n and admits steam to start the piston after which the port h^4 becomes effective so that the piston makes its movement very promptly. By this valve and valve gear the main piston d can make its stroke very nearly the full length of the cylinder without danger of overthrow and striking the cylinder head, and there is thus no considerable clearance and waste of steam.

The main cylinder a is shown as provided with two drip passages o, o^2 , leading from its opposite ends to a boss or projection near the middle of the cylinder, with which is connected in any suitable manner (as shown in this instance by a coupling nut o^3) a pet-cock p having a single outlet p^3 and two inlets r, r^2 , communicating with the passages o, o^2 . The plug t of said cock is provided with a transverse passage widened at its ends so that when in intermediate position as shown, the said passage communicates with both passages r, r^2 , connecting them with the outlet p^3 so that both ends of the cylinder may be drained. When the said plug is turned in one or the other direction just far enough to close one or the other of the ports r, r^2 , it leaves the port p^3 still uncovered so that one

end of the cylinder may be drained without the other end, and by turning the plug to bring its passage about at right angles to the passage p^2 both the drip passages are closed.

5 The herein described valve gear, comprising an arm as m pivoted to the frame work and provided with tappets, and a connecting arm m^2 pivotally connected with said tappet arm and with the main piston rod, so that it first
10 swings or fulcrums on the tappet arm, and then causes the fulcrum of movement of both arms to be transferred to the pivotal connection of the tappet arm with the frame work, may be varied in its arrangement and proportions
15 without departing from the invention, and its use and application is not limited to valves having the construction and mode of operation of the valve herein described. The pressure of the valve i against its seat by the
20 steam is sufficient to prevent it from moving on the seat until positively engaged by the projections k or k^2 , and thus said pressure causes said valve to accompany the main piston in its movement that is caused by the
25 shifting of the said valve. The rod k^3 also will remain in the position in which it is left at the end of its last movement so that the arm m^4 will swing on its pivot on the arm m without moving the latter or the valve rod,
30 until the positive engagement with the tappet on the arm m takes place. The valve rod k^3 at the end of its stroke by which it shifts the valve i from the full to the dotted line position Fig. 1, positively engages the valve piston
35 h so that it would start the said piston if it should stick slightly and in the return movement the said piston is also positively engaged through the collar k^2 and pin i^3 , the valve gear thus in each case tending to assist
40 (if need be) the steam pressure in operating the valve.

I claim—

1. The combination of the valve cylinder and differential piston therein constructed to
45 afford an annular space or steam chest between the larger and smaller portions of said piston, and provided with a valve seat and a port leading from the steam chest to the larger end of the valve cylinder, and an exhaust
50 port; and a controlling valve working on said seat and governing the flow of the steam through said ports, said controlling valve being carried by said differential piston without relative movement thereon while said
55 piston is making its stroke; and a valve stem adapted to intermittingly engage with said controlling valve and move the same on its seat with relation to said differential piston, substantially as described.

60 2. The combination of the main cylinder and piston with a controlling valve that causes the admission of steam to said cylinder and its exhaust therefrom to be properly governed; and a valve rod and tappet arm pivotally connected therewith and also pivotally connected,
65 with the main frame, and an actuating arm connected with the main piston rod and piv-

otally connected with the said tappet arm and cooperating with the tappets thereof, substantially as and for the purpose described.

70 3. The combination of the main cylinder and main valve, with a valve cylinder and differential actuating piston therein, having its differential area constantly exposed to steam pressure, a port leading to the large end of
75 the valve cylinder, and a controlling valve for said port and a pin that closes said port to cushion the valve actuating piston, when approaching the cylinder head at the large end of the valve cylinder, substantially as described

80 4. The combination of the valve cylinder and differential piston therein, constructed to afford an annular space or steam chest between the larger and smaller portions of said
85 piston; a longitudinal passage leading from the small end of said piston and valve stem working therein and a controlling valve working on a seat on said piston provided with a projection passing through a slot in said
90 piston into the longitudinal passage thereof, to be engaged by projections on said valve stem, substantially as described.

95 5. The combination of the valve cylinder and differential piston therein constructed to provide an annular space or steam chest between its larger and smaller portions and provided with a valve seat in said steam chest, and an exhaust port having an opening in
100 said valve seat, and two ports leading from said valve seat to the large end of the cylinder and a controlling valve governing the admission of steam from the steam chest to said
105 ports and having an exhaust pocket for connecting one only of said ports with the exhaust port in the valve seat, said controlling valve closing the other of said ports while the steam is being exhausted from the large end of the cylinder substantially as and for the
110 purpose described.

115 6. The combination of the valve cylinder and differential piston therein constructed to provide an annular space or steam chest between its larger and smaller portions and provided with a valve seat in said steam chest, and an exhaust
120 port having an opening in said valve seat, and two ports leading from said valve seat to the large end of the cylinder and a controlling valve governing the admission of steam from the steam chest to said
125 ports and having an exhaust pocket for connecting one only of said ports with the exhaust port in the valve seat, and a pin for closing the other of said ports as the piston approaches the cylinder head, substantially as described.

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

WILLIAM B. MASON.

Witnesses:

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LAWRENCE BOND.