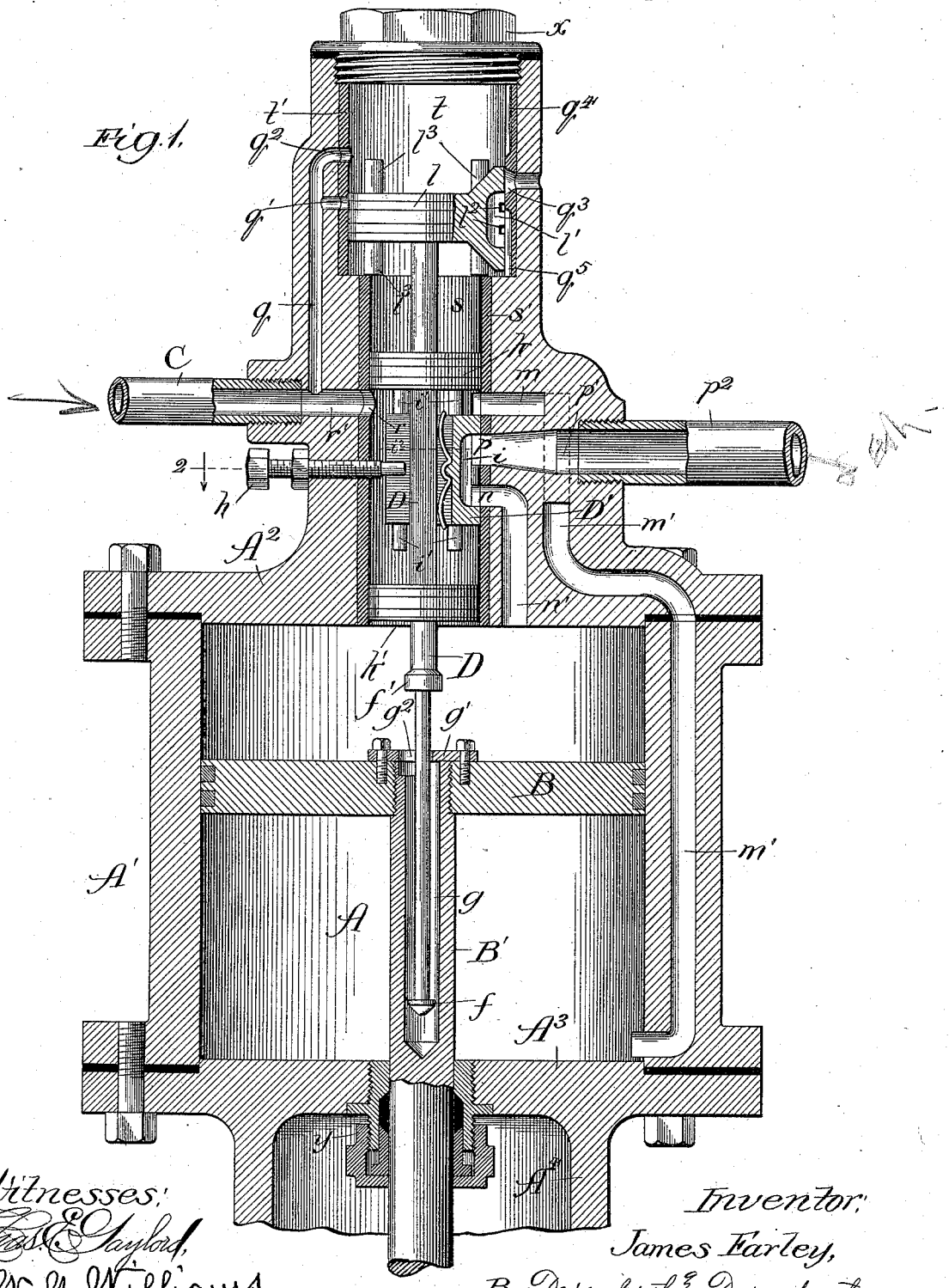
(No Model.) 2 Sheets—Sheet 1.

J. FARLEY.

VALVE FOR STEAM PUMPS.

No. 526,149. Patented Sept. 18, 1894.

Fig. 1.



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 2.

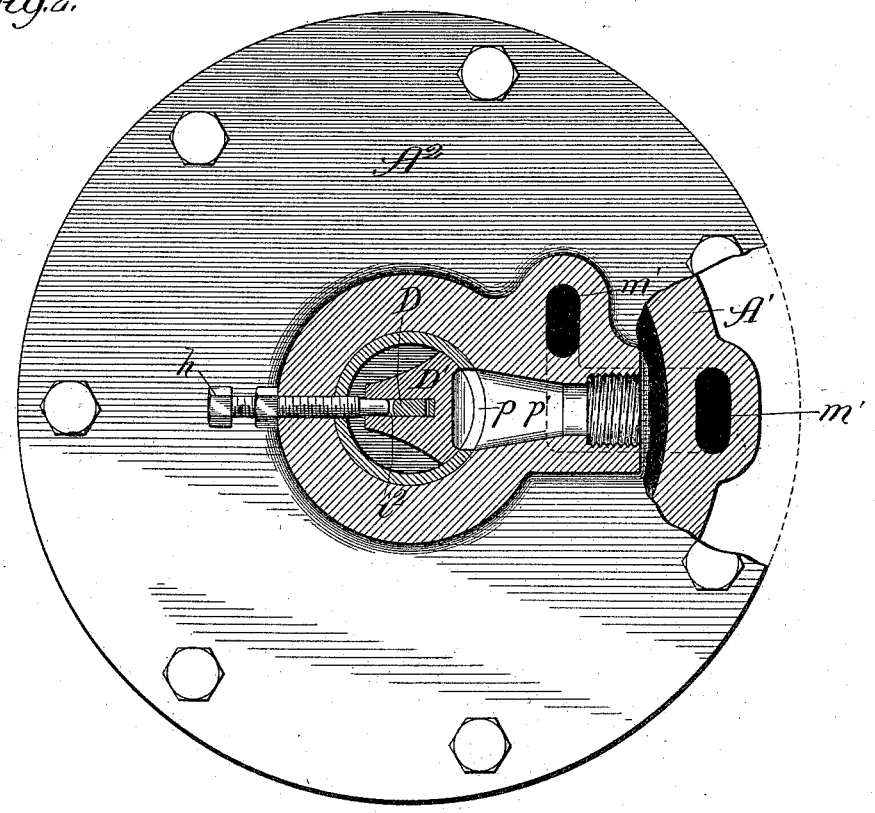
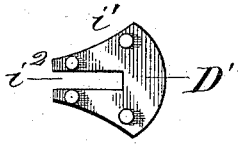


Fig. 3.



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UNITED STATES PATENT OFFICE.

JAMES FARLEY, OF WAUKESHA, WISCONSIN.

VALVE FOR STEAM-PUMPS.

SPECIFICATION forming part of Letters Patent No. 526,149, dated September 18, 1894.

Application filed March 6, 1894. Serial No. 502,488. (No model.)

To all whom it may concern:

Be it known that I, JAMES FARLEY, a citizen of the United States, residing at Waukesha, in the county of Waukesha and State of Wisconsin, have invented a new and useful Improvement in Valves for Steam-Pumps, of which the following is a specification.

My invention relates to valve-motion of improved construction for use in connection with fluid-actuated pumps generally; and it relates more especially to improved valve-motion for use in connection with the steam-actuated pumps of air compressors, of the class generally employed in connection with the air-brake systems of railway trains.

My object is to provide a valve-motion, of an improved construction, which will overcome dead points, in the movement of the valve which controls the ingress and egress of steam which actuates the main piston; which will operate automatically to cushion the steam-cylinder piston at the end of each stroke to maintain the proper clearance and prevent pounding or jarring of the parts; and it is my object further to provide a valve-motion which will be of a simple and durable construction and particularly effective in its operation.

In the drawings—Figure 1 is a vertical central section of a steam-cylinder, and valve-gear for alternately directing steam to and exhausting it from the opposite sides of the steam-cylinder piston; Fig. 2, a plan section taken on line 2 of Fig. 1; and Fig. 3, an end view of a slide-valve.

A is a steam-cylinder formed with an annular shell or body-portion A′ provided with heads A^2 and A^3. The cylinder-head A^2 forms a casing for the valve-gear or valve-motion, to which my invention relates, and the cylinder head A^3 may be an integral part of a separating or center piece A^4 which is formed at its opposite end integrally, as usually constructed, with one of the cylinder-heads of an air-compressor.

As my invention relates only to the construction and operation of the parts which control the ingress of steam to the cylinder and its exhaust therefrom, it is not thought necessary to illustrate the air-compressor, which may be of any desired form.

In the cylinder A is a piston B on one end of a stem B′ which works through a stuffing-box y in the cylinder-head A^3. In practice the piston-stem B′ extends through a stuffing-box in one of the heads of an air-compressor cylinder and connects with the piston therein.

Extending centrally through the head or casing A^2 is an opening, which is closed by a screw-cap x, and affords a circular chamber or auxiliary cylinder t, provided with a bushing t', and a circular steam-chamber s, of smaller diameter than the chamber t, and provided with a bushing s'.

In the bushing s' is an inlet port r communicating, through a passage r' in the shell of the casing A^2, with a steam-induction pipe C. Cored in the casing, and extending from the passage r', is a branch passage q which communicates with the chamber t through ports q' q^2, in the bushing t', and in the relative positions shown.

In the bushing t' midway of the planes of the ports q' q^2 is a port q^3 leading to the outside air; and above and below the port q^3 are vertical grooves q^4 q^5, respectively, which are in line with but do not extend to the said port. In the bushing s' is an exhaust port p communicating through a passage p' with a steam-cylinder exhaust-pipe p^2, which may extend, in practice, to the smoke-box of the locomotive. Above and below the port p are cylinder ports m n, respectively, in the bushing s' and in the relative positions shown. The port n communicates with a cored-passage n' extending to the upper side of the main-cylinder A above the main-piston B; and the port m communicates with a cored-passage m' extending to the lower side of the main-cylinder A, below the main-piston B.

D is a valve-stem extending centrally of the chambers A, s and t. At the upper end of the stem is an auxiliary-piston l fitting and sliding in the auxiliary-cylinder t against the bushing t'. The piston l is constructed to perform the functions of a piston and slide-valve, and its side adjacent to the port q^3 is enlarged and provided with a cavity l' to afford a slide-valve of the D type, as shown. The piston l may be provided with the usual packing-rings l^2, and the cavity l' may extend beneath the rings, as shown.

On opposite sides of the piston l I provide projections or stops l^3 l^3, which, in the move-

ment of the piston, impinge against the upper and lower parts of the chamber t, to limit the traverse of the piston, in opposite directions, as hereinafter described. On the stem D, in the chamber s, and fitting and sliding against the bushing s' are balanced pistons k and k', of equal area, and working, respectively, in the upper and lower parts of the chamber s. Between the pistons k and k' the stem D is squared, or otherwise rendered noncircular; and fitting over the squared portion of the stem is a main slide-valve D', of the D type, having a cavity i, and provided at opposite ends with lugs i'. The slide valve D', with its lugs, extends short of the distance between pistons k k', whereby in the movement of the said pistons, as hereinafter described, they will have movement, to a limited extent, independent of the slide-valve. The socket i^2 in the back of the slide valve D' is squared to receive and fit the stem D; and passing through the casing and bushing s' is a screw h, which extends loosely into the socket i^2, to prevent turning of the slide-valve, the stem and pistons on their axes. The screw h thus operates as a guide and prevents turning of the slide-valves D' l and maintains their cavities in line with the ports they control. The stem D extends into a socket g in the piston stem B' and is provided at its end in the said socket with a button or stop f. On the stem D near the piston k' is an annular shoulder or stop f'; and on the piston B is a plate g' having a recess g^2 affording an opening, through which the stem D extends between its stops f and f'.

The distance of movement of the piston B is somewhat in excess of the distance between the stops f and f', whereby as the piston nears the limit of its traverse in the downward direction, the plate g' engages the stop f and draws down the stem D; and as the piston nears the limit of its traverse in the upward direction, the plate or stop g' engages the stop f' and raises the stem D.

Fig. 1 of the drawings shows the piston B on the upstroke, whereby the stop g' is moving in the direction of the stop f'. The cavity i of the slide-valve D' registers with the ports p n, causing steam in the chamber A above the piston B to exhaust through the passage n', ports n p, passage p' and pipe p^2; and the port m is uncovered, whereby live steam, entering the chamber s from the pipe C, through the passage r' and port r, flows through the port m and passage m' to the chamber A below the piston B, to raise the latter. The piston and slide-valve l covers the port q', leaving the port q^2 uncovered, whereby steam enters the chamber t above the piston through the branch passage q and port q^2; and the slide-valve cavity l' registers with the groove q^5 and port q^3, whereby steam between the pistons l and k exhausts to the outside air. The steam pressure in the chamber t against the upper side of the piston l tends to hold the parts in the positions shown, against the back pressure of the steam in the chamber A above the piston B exerted against the piston k'.

In operation, as the piston B nears the upper end of the chamber A, the plate g' engages the stop f' and lifts the stem D and the pistons k' k l, carried thereby. In the initial upward movement of the stem D and its pistons, the piston k' moves to the lugs i' and then through engagement with the latter moves the slide-valve to close, or nearly close, both the ports n and m. The piston l is moved to cover the port q^2 and uncover the port q', and the slide-valve portion of the piston l is moved to carry its cavity l' above the groove q^5 and cause it to register with the groove q^4 and outlet q^3. In the closing of the ports n m by the slide-valve D' the pressure against the under side of the piston B is gradually reduced, and the escape of steam from the upper side of the piston B gradually cut off, whereby the piston comes gradually to a stop, leaving a slight clearance between its upper side and the adjacent surface of the head A^2. Immediately upon the ports m n being closed, or nearly closed, as described, steam enters the chamber t through the port q' below the piston l.

The difference in area between the pistons l and k, in favor of the former, causes predominating pressure to be exerted against the piston l to raise it, the stem D and attendant parts, until the stops l^3 impinge against the cap x. When the piston B thus reaches the upper limit of its traverse the port q^2 is still covered and the steam in the upper side of the chamber t continues to vent through the groove q^4, cavity l' and outlet port q^3. The slide-valve D' uncovers the port n, and through its cavity i opens communication between the ports m p. Steam entering at the port r will pass through the port n and passage n' to the chamber A above the piston B, and the steam below the piston B will exhaust through the passage m', port m, cavity i, port p, passage p' and pipe p^2. This causes the piston B to start immediately on the downward stroke; and, when it nears the limit of its traverse in that direction, the plate g' engages the stop f and moves the stem D in the downward direction. In the movement of the stem, brought about by the movement of the piston B in the downward direction, the piston l is caused to overlap and close the port q' and open the port q^2, and the slide-valve portion of the piston l is caused to close the outlet from the chamber t, through the groove q^4, cavity l' and port q^3, and to open a passage from the under side of the piston l, through the groove q^5, cavity l' and port q^3. The piston k is moved into engagement with the lugs i, on the upper side of the slide-valve D', and then by its engagement with the said lugs, moves the said slide-valve until it closes or nearly closes the ports m n, to shut off the supply of steam to the upper side of the piston B, and the exhaust of steam from the un-

der side of said piston, and bring the latter to a gradual stop at a slight distance from the head A^3 to leave the proper clearance. When this movement of the piston l occurs, as described, steam enters the chamber t through the port q^2, and owing to the preponderance of area of the piston l over the piston k', moves the stem D, pistons and slide valve D' to the positions shown in Fig. 1, whereby the port m is uncovered and the port n is opened to the exhaust.

In practice steam from the port q' q^2 exerts itself against the piston l to move the slide-valve D' immediately upon or slightly in advance of the closing of the ports m n and thus overcomes dead points; and movement of the piston l under pressure of steam in the chamber t follows upon the movement of the stem D, under engagement of the piston B, so quickly that there is no appreciable pause in the movement of the slide-valve. In practice the steam-pressure may be caused to exert itself against the piston l just before the dead points are reached, so that there is virtually no pause in the movement of the slide-valve D' from the time that it is started until it reaches the limit of its traverse. Thus the piston B has a perfectly even stroke and comes to a stop at the limit of its traverse without shock.

All the parts employed in the construction of my improved valve-motion are comparatively large and strong, and little apt to get out of order. By removing the screw cap x and withdrawing the screw h the entire valve-motion may be withdrawn through the top of the casing for purposes of cleaning it or for the repair or renewal of any of its parts. To remove the parts, the piston B is drawn to the top of the chamber A, and the stem D with its pistons is drawn upward until the stop f reaches the plate g'. At such time the small piston k will be in the chamber t, and a tool may be inserted to spring the lower part of the stem D to one side, whereby the button f will pass through the opening g^2. It will thus be seen that there is no necessity of removing the head A^2 when it is desired to get at the valve-motion.

While I prefer to construct my improvements in every respect as shown and described, the construction may be modified in the matter of details without departing from the spirit of my invention as defined by the claims.

What I claim as new, and desire to secure by Letters Patent is—

1. In a fluid-actuated pump, in which the main slide-valve for the main-cylinder ports is moved by movement of the main-piston, means for supplementing the action of the main-piston to carry the main slide-valve beyond the dead-point, comprising, in combination, an auxiliary steam-cylinder, piston and valve, and stop-mechanism connected with and actuated from the main-piston and also connected with the auxiliary piston and valve, and operating to open the ports of the auxiliary-cylinder and thereby advance the auxiliary-piston, and with it the main slide-valve, when the latter reaches or approximates the dead-point, substantially as described.

2. In a fluid-actuated pump, a main-piston, in a main-cylinder, and auxiliary-piston in an auxiliary-cylinder controlling ports therein for the admission and exhaust of the fluid, said auxiliary-piston being on a stem presenting stops to the main-piston on opposite sides thereof, the main-piston being reciprocably movable between the stops on said stem, and a slide-valve, for controlling the fluid inlet and outlet ports of the main-cylinder, positively engaged through the medium of the stem by the main-piston to be moved, toward the dead-point over the ports it controls, the auxiliary-piston being moved by the stem, in its movement under the action of the main-piston, to open the fluid-supply to the auxiliary-piston and admit fluid-pressure thereto for continuing its motion, thereby supplementing the action of the main-piston to carry the slide-valve past said dead-point, substantially as described.

3. The combination, with the main steam-cylinder, main-piston therein, steam-chamber, steam-induction and exhaust ports and cylinder-ports at said chamber, and main slide-valve controlling the supply and exhaust of steam through the cylinder-ports, of an auxiliary steam-cylinder having steam-induction ports and an exhaust-port, an auxiliary-piston in the auxiliary-cylinder operating, when moved initially in either direction, to open one induction-port, to direct steam against one side of the piston, open the piston at its opposite side to the exhaust and close the other induction-port, whereby the final movement of the auxiliary-piston in either direction is brought about by steam entering the auxiliary-cylinder, a stem, connected with the auxiliary-piston, controlling the movement of the main-slide valve, and having stops in the path of the main-piston, the parts being so arranged with relation to each other, that, in the final movement of the main-piston, in either direction, it will move the said stem, to move the main slide-valve and close, approximately, the cylinder-ports, and move the auxiliary-piston initially, whereby in the final movement of the auxiliary-piston, the stem and main slide-valve are moved to open the cylinder-ports, substantially as and for the purpose set forth.

4. In a steam-actuated pump, the combination, with the steam-cylinder A, and piston B therein, of a chamber s, at one end of the cylinder, having a steam-induction port, r, an exhaust-port p, and ports m and n, at opposite sides of the port p, communicating with opposite ends, respectively, of the cylinder, an auxiliary-cylinder t, having steam-induction ports q' q^2 and an exhaust-port q^3, and valve-gear, comprising a stem D, carrying a

piston and valve in the auxiliary-cylinder and controlling the ports therein, a main slide-valve in the chamber *s* governing the ports *m p n*, and actuated by movement of the stem, and stops on the stem in the path of the piston B, the valve-gear being arranged to operate substantially as and for the purpose set forth.

5. The combination, with the main-cylinder A and main-piston B, of a cylinder-head affording a casing, and having an opening through it, from the cylinder, closed by a removable cap, and affording a steam-chamber *s* of small diameter and auxiliary cylinder *t* of larger diameter, a steam-induction port, an exhaust-port *p*, and cylinder-ports *m* and *n* at opposite sides of the port *p*, in the chamber *s*, steam-induction ports q' and q^2, and an exhaust port q^3 in the auxiliary-cylinder, and valve-gear, comprising a stem D, carrying a piston and valve, in the auxiliary cylinder governing the ports therein, and balanced pistons in opposite end-portions of the chamber *s*, a main slide-valve, between the balanced pistons, governing the ports *m p n*, and actuated by movement of the stem, and stops on the stem in the path of the piston B, the whole being constructed and arranged to operate substantially as described.

JAMES FARLEY.

In presence of—
M. J. FROST,
W. U. WILLIAMS.