(No Model.)

2 Sheets—Sheet 1.

M. SCHULTZ.

STEAM ACTUATED VALVE.

No. 369,659. Patented Sept. 6, 1887.

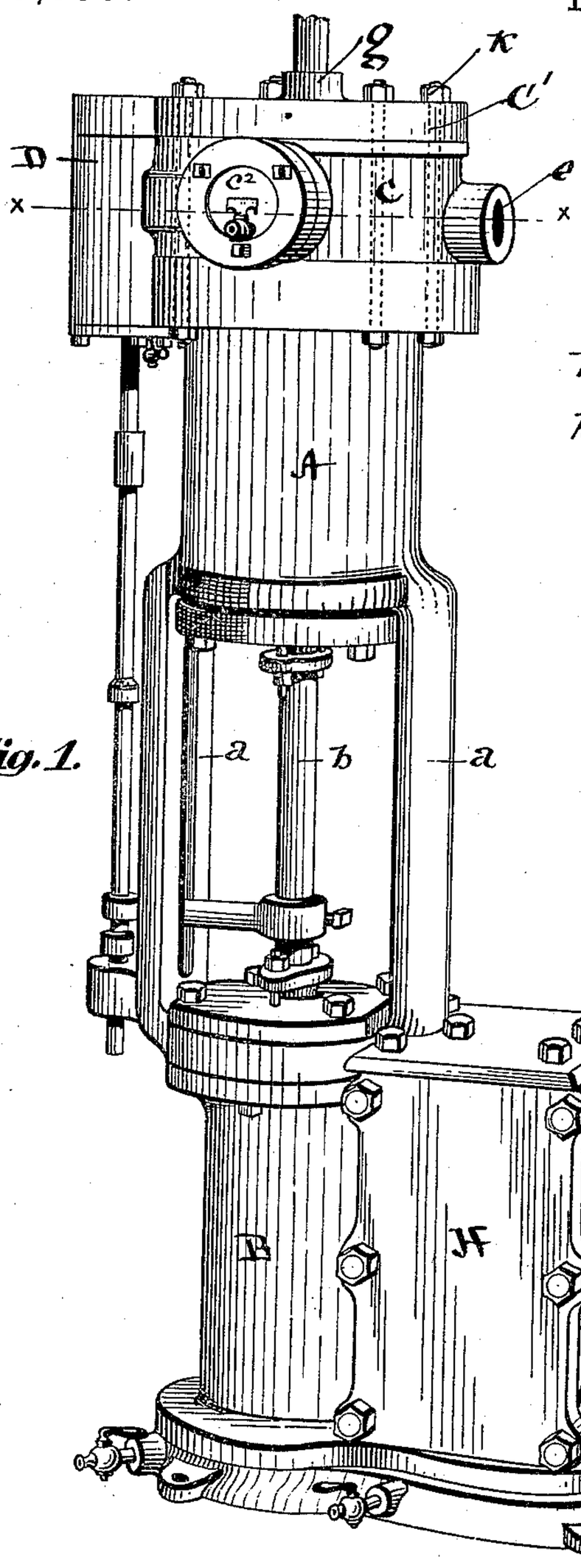


Fig. 1.

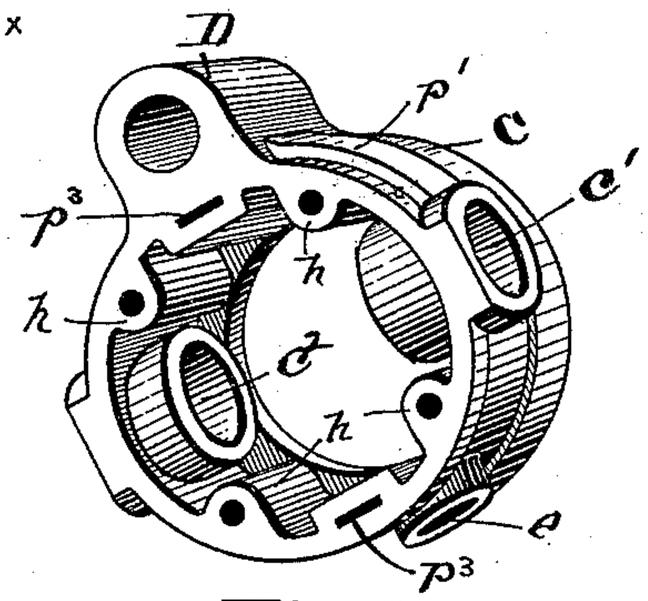


Fig. 2.

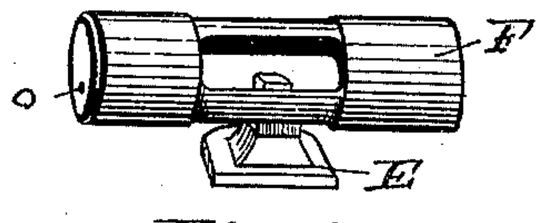


Fig. 3.

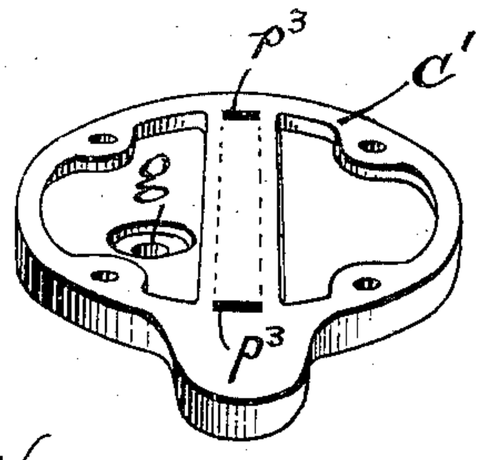


Fig. 4.

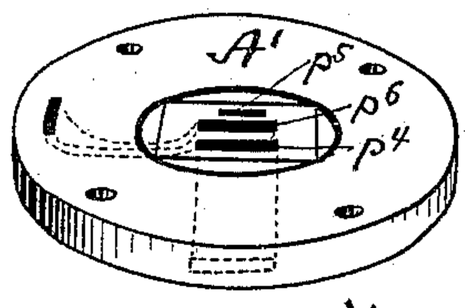


Fig. 5.

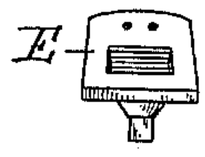


Fig. 11.

Attest.
C. W. Bogart.
L. D. Kerr.

Inventor.
Michael Schultz
by Lothrop & Atty.

(No Model.)

2 Sheets—Sheet 2.

M. SCHULTZ.

STEAM ACTUATED VALVE.

No. 369,659. Patented Sept. 6, 1887.

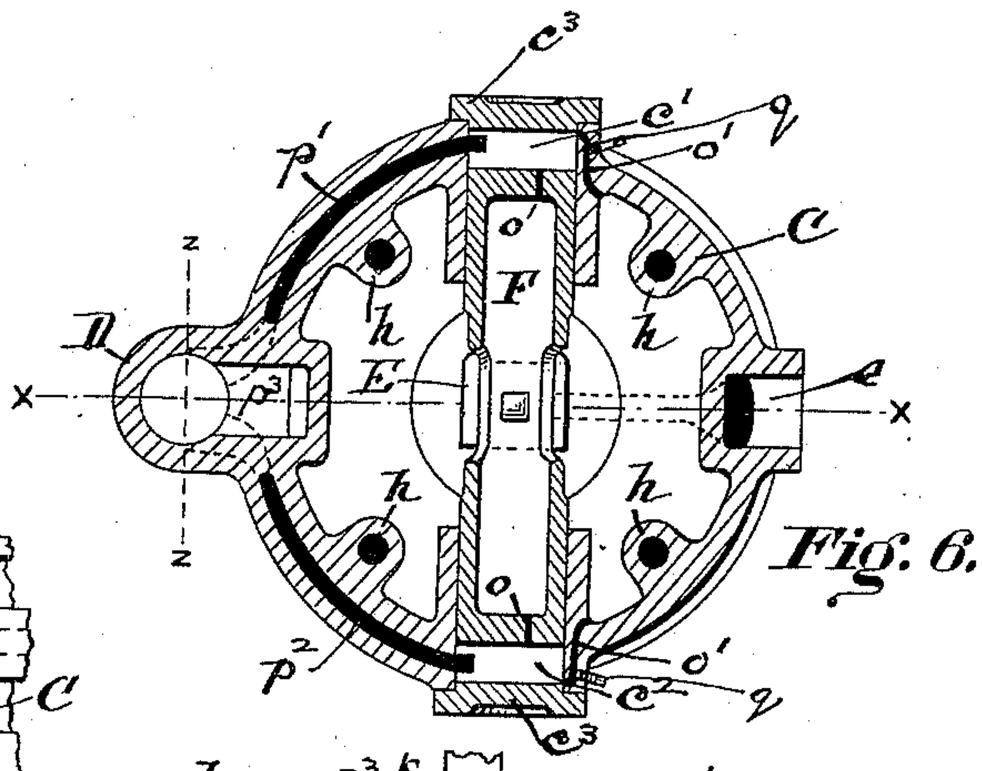


Fig. 6.

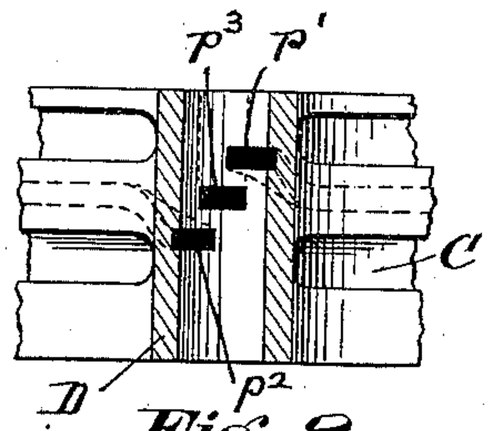


Fig. 8.

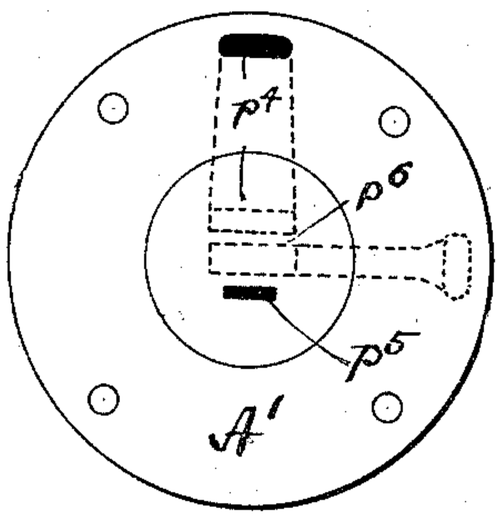
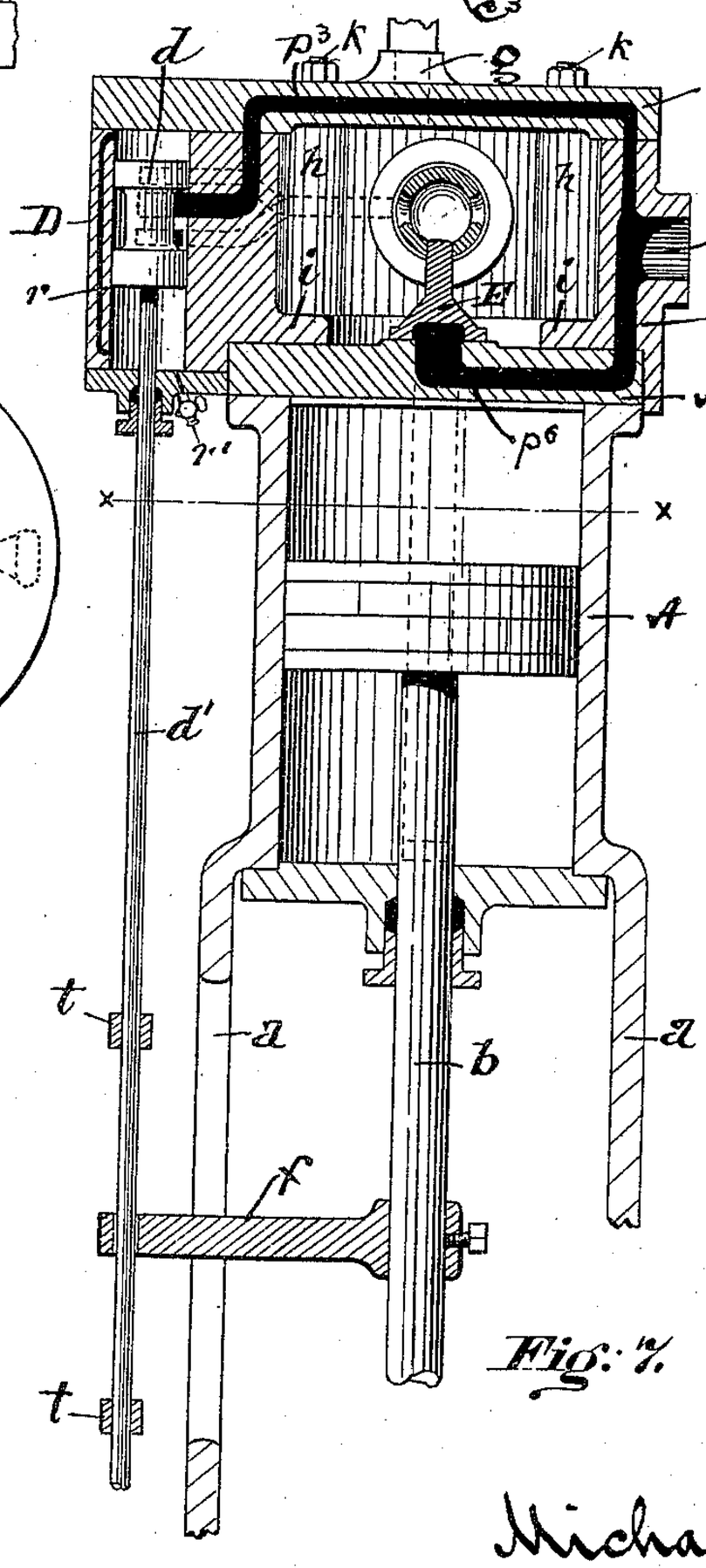


Fig. 9.



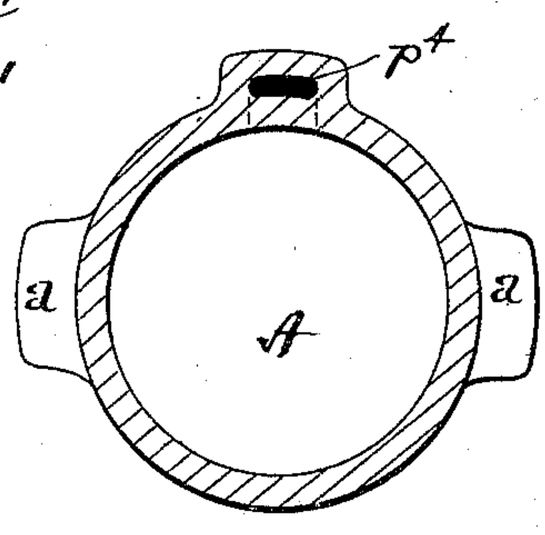


Fig. 10.

Fig. 7.

Attest.

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Inventor.

Michael Schultz

by Robt. Mason

Atty.

UNITED STATES PATENT OFFICE.

MICHAEL SCHULTZ, OF CINCINNATI, OHIO.

STEAM-ACTUATED VALVE.

SPECIFICATION forming part of Letters Patent No. 369,659, dated September 6, 1887.

Application filed March 15, 1887. Serial No. 231,064. (No model.)

To all whom it may concern:

Be it known that I, MICHAEL SCHULTZ, a citizen of the United States, residing at Cincinnati, Ohio, have invented new and useful Improvements in Steam-Actuated Valves, of which the following is a specification.

My invention relates to direct-acting steam-engines, particularly to that class in which the steam and pumping cylinders are connected in the same axial line, and in which the movements of the main piston are regulated by a reciprocating slide-valve actuated by an independent steam-moved piston, in turn controlled by a valve actuated directly by the main piston, its object being to simplify and economize these constructions and produce a uniform and positive full-stroke action of the main piston in both directions without crank or fly-wheel attachments.

The exact nature of my invention in detail will be more fully pointed out hereinafter; but it may be premised as among its substantial advantages that it combines and embodies in compact and efficient form various desirable features existing elsewhere separately in older structures, together with certain novel features of my invention tending to secure a more perfect realization of the main principle of an independent steam-actuated valve-mover in structures of this class.

Another feature of my invention tends to secure, also, a more perfect and uniform action of the main piston in all pumping-engines.

To these ends my invention may be said to consist in the construction and combination of parts, as hereinafter specified, and as set forth in the claims.

Mechanism embodying my invention is illustrated in the accompanying drawings, in which—

Figure 1 is a perspective elevation of a steam-pump complete, embodying my invention; Fig. 2, a perspective view of the steam-chest shell detached, showing the construction; Fig. 3, a perspective elevation of the main valve and its actuating double piston; Fig. 4, a plan view, inverted, of the steam-chest cover detached; Fig. 5, a plan view of the upper head of the main steam-cylinder, constituting also the seat for the main slide-valve; Fig. 6, a horizontal section of the steam-chest in the plane *x x* of Fig. 1, showing the valve-mover in position; Fig. 7, a vertical axial section of the steam-chest and the main steam-cylinder in the plane *x x* of Fig. 6; Fig. 8, a vertical axial section of the supplemental valve-cylinder, taken in the plane *z z* of Fig. 6; Fig. 9, an inverted plan view of the upper head of the main steam-cylinder, showing the face opposite that shown in Fig. 5; Fig. 10, a horizontal section of the main steam-cylinder, taken in the plane *x x* of Fig. 7; and Fig. 11, a perspective view of the main slide-valve.

The parts referred to in the course of the following description are indicated in the drawings by the letters of reference.

Referring, now, more particularly to the drawings, A B designate the steam and pumping cylinders, respectively, of a steam-pump, mounted vertically in the same axial line and connected by the braces *a a* in the usual manner.

H designates the water-valve chamber, attached to the water-cylinder, which may be of any desired construction, and, as the same forms no part of my present invention, need not be further described.

Referring, now, to the parts more particularly embodying my invention, C designates the steam-chest, which in the present case is preferably of general cylindrical form, as indicated in Figs. 1, 2, 6, and 7. It is provided at one side exteriorly with an enlargement, D, which, when bored parallel with the main axis of the chest, constitutes a supplemental valve-chest for the reception of a supplemental valve, *d*, whose construction and functions will be explained later. The steam-chest C is also provided at opposite sides with two small cup-cylinders, c' c^2, extending through the shell of the steam-chest in a common horizontal axis. In the complete apparatus these are closed by external heads, c^3, in the usual manner. The chest is also provided with passages connecting the outer ports, respectively, of the supplemental valve-chest D with those of the cup-cylinders c' and c^2—that is to say, the supplemental valve-chest D is provided with three ports, p' p^2 p^3, arranged in the ordinary succession of slide-valve ports, and the two outer ports, p' and p^2, of the series are carried in opposite directions, respectively, through and

around the chest C into the cup-cylinders c' c^2, respectively, near the outer ends of the same, the central port, p^3, being carried upward through the shell of the chest C, and ultimately extended by a corresponding passage through the general cover C′ of the steam-chest C into the general exhaust-orifice e at the opposite side of the chest. Steam is admitted from the boiler to the steam-chest C by a pipe, g, opening through the head C′.

The ports p', p^2, and p^3 of the supplemental chest D are employed solely for the exhaust of steam from the cup-cylinders c' c^2, and are governed by a valve, d, preferably consisting substantially of two piston-heads spaced apart in proper adjustment upon an actuating-rod, d', moved by the engagement of a finger, f, upon the main piston-rod b, acting upon tappets t, secured to the valve-rod, or by any other suitable engaging mechanism positively actuated by the main piston. I find the piston-valve d most effective and economical for the purpose in view here, and to facilitate the reciprocation and carry the leakage condensation downward I provide in the shell of the supplemental cylinder D a longitudinal passage, r, Fig. 7, extending the length of the cylinder D and communicating with each end. This prevents any retardation of the valve d by air-pressure or vacuum, and also enables any leakage to concentrate in the lower end, where it may be drawn off by a stop-cock, r'.

The upper head, A′, of the main steam-cylinder A constitutes the bottom of the steam-chest C, and constitutes, also, a valve-seat for an ordinary slide-valve, E, directly governing the action of steam in the main cylinder A. The ports for this purpose (indicated in Figs. 5 and 10) are arranged as follows: One end port, p^4, is carried through the material of the head A′ laterally, and ultimately downward through a passage cast upon the outside of the cylinder A, as indicated in Fig. 10 and by dotted lines in Fig. 7, and communicating with the lower end of the main steam-cylinder A below the main piston. The other end port, p^5, extends directly through the head or plate A′, thus communicating with the main steam-cylinder A above the main piston. The central or exhaust port, p^6, is carried laterally by a passage through the plate A′ and upward through the shell of the steam-chest C into the exhaust-orifice e. The slide-valve F, governing these ports, is an ordinary D-valve with abnormally-extended lap at one side, pierced through the lap by a narrow slit or series of apertures, as shown in Fig. 11, to register with the port p^5 at the proper time to admit steam in limited quantity on the downstroke. The object of thus limiting the steam-supply on the downstroke is to compensate the weight of the piston-rod and plunger and the increased area of the piston at that side. The construction, as will be seen, while it limits the supply of live steam on the downstroke, leaves the exhaust full and free on the upstroke, and thus the reciprocations of the piston and plunger are rendered uniform and regular in vertical engines. This improvement is capable of independent application in all vertical slide-valve engines and in all single-acting pumps when the resisting force, as in boiler-feeders, is in excess at one part of the stroke.

The valve E is provided with a vertical tongue extending into a corresponding orifice or other suitable engagement with a double piston, F, which latter extends into the cup-cylinders c' and c^2, its ends operating as pistons in the same. I prefer to form the double piston F as a hollow cylinder, and by its longitudinal movement in the cup-cylinders the valve E is reciprocated upon its seat, this movement being effected as follows: The cylinder F is closed at the ends, but open centrally to admit steam from the steam-chest C.

As a means of carrying steam to the outer ends of the cup-cylinders beyond the piston E, I provide small passages o' from the interior of the chest C through the shell of the cup-cylinders, terminating outwardly in the interior of the cup-cylinders, and from the outside of the shell insert screw-plugs g, entering those passages in such manner as to form regulating-valves to contract or enlarge the area of the passages, according to the adjustment of the screws, which may be done from the outside as occasion requires. By the proper adjustment of these plugs the tension of steam entering the cup-cylinders may be conveniently adjusted to the work required, in order that when the pump or engine is working under heavy loads with steam of high tension the action of steam on the piston E may be moderated to the proper degree and violent movement and waste of steam avoided.

I have shown in the drawings also apertures o piercing the ends of the piston E, which is the ordinary method of accomplishing this result; but apertures so placed are inaccessible during the operation of the valve, and are therefore incapable of regulation. The movements of the piston E are therefore too violent when the engine or pump is working under heavy pressure, and perhaps too light when working under lighter pressure, it being impracticable without means of adjustment to provide for both extremes.

It will now be understood that by means of the construction and arrangement of the parts as before explained whenever the valve d is at one extreme position and the exhaust-port of the corresponding cup-cylinder is opened the pressure is thereby relieved in the last-mentioned cup-cylinder, and the valve mover or cylinder F is, by the excess of pressure in the opposite cup-cylinder, forced over until in such movement the hollow piston F covers the open exhaust-port and is prevented from further movement by the steam cushion formed beyond such port. The movement of the hollow piston F is in practice almost instantane-

ous, yet under no circumstances can it pass beyond its proper limit of movement by reason of its own closure of the open exhaust-port and the steam cushion formed beyond the same by the live steam issuing through the appropriate orifice *o'*. During the travel of said piston F between its extreme limits there occurs of course a slight escape of live steam into the open exhaust; but such loss is obviously trifling, and is more than compensated by the certainty and perfection of movement obtained. It will also be observed that so long as the supplemental valve *d* remains in a given position no rebound of the piston F or jarring of the machine can displace the valve E, for should said piston F, by rebound or otherwise, recede from its proper limit it would partially open the exhaust-port of its proper cup-cylinder, and so disturb the normal equilibrium of steam-pressure as to at once restore it to its proper position, for by reference to the valve *d* and its actuating mechanism it will be seen that it reciprocates positively just at the conclusion of the stroke of the main piston, and during the intervals of such reciprocation remains in the last-assumed position, holding the exhaust-port p^3 open to one or the other of the ports p' or p^2, as the case may be. Thus the piston F possesses a highly-sensitive self-regulating function, which is desirable in a high degree in constructions of this character, as it insures absolutely a full stroke of the main piston at all times and under all circumstances.

While I prefer to construct the piston F as a hollow cast cylinder in the manner described as more economical in construction, it will be obvious that two ordinary piston-heads or trunk-pistons united by an axial rod could be substituted with identical results.

It remains to point out more particularly the special features of construction by which economy and accuracy in the manufacture are secured in the type of structures given as an illustration of my invention. Recurring to the outer shell of the steam-chest C, it will be observed that it is generally cylindrical in form, whereby, when properly centered in the lathe, the end faces, including the end faces of the supplemental cylinder D, may be turned off at one and the same operation, and the cylinder D bored with accuracy before removal from the lathe-centers, while upon the same centers the cup-cylinders c' and c^2 are also bored at one operation, insuring perfect alignment. It will be observed also, Figs. 2, 6, and 7, that I cast inner projections or ribs, *h*, extending on the inside from end to end of the shell, which terminate below in an annular rim or internal collar, *i*, recessed below to receive the plate A', constituting the upper head of the main steam-cylinder A. I am thus enabled to secure the upper head, C', to the chest C and the chest C to the plate A', and all of these together to the flanges of the cylinder A by a single series of long bolts, *k*, passing through the projecting ribs *h* of the shell C. The upper head, C', of the chest C extends over and constitutes also the closure of the supplemental valve-chest D, the lower cover of said valve-chest being independently removable for obvious convenience.

I have shown in the present illustration of my invention the valve *d* as a piston reciprocated by the usual tappet engagement with the main piston-rod *b*; but the formal construction and actuating arrangements of this valve are immaterial, and, if preferred, any other suitable form of reciprocating slide-valve or semi-rotary piston-valve and actuating mechanism may be substituted.

It will be obvious, without further reference, that by a proper change in the arrangement of the parts the steam movement above described may be adapted with equally beneficial results to an engine in which the cylinder or cylinders are arranged in a horizontal plane.

I claim as my invention and desire to secure by Letters Patent of the United States—

1. In a slide-valve steam-engine, the combination of a steam-chest provided with cup-cylinders at opposite ends open interiorly to the steam-space of said chest, a double piston acting in said cup-cylinders and reciprocating the main slide-valve, adjustable steam-openings connecting each of said cup-cylinders beyond the piston with the steam-space of the valve-chest, exhaust-ports in said cup-cylinders in the path of and controlled by said double piston, with passages leading thence to the main exhaust-pipe, and a balanced exhaust-valve controlling said exhaust-passages, operated by the reciprocation of the main piston, substantially as set forth.

2. The combination of the valve-chest C, the cup-cylinders provided with the exhaust-ports, and the steam-passages *o'*, provided with regulating-plugs *q*, accessible from the outside, and the auxiliary piston or valve-mover F, actuated by alternately exhausting the cup-cylinders, substantially as set forth.

3. The combination of the vertical cylinder A, its head A', constituting the valve-seat, the valve-chest casing C, formed with an inner flange below and provided with inner ribs, *h*, terminating in said flange, the cover C', and the bolts *k*, constructed and arranged as described.

4. In a vertical steam-engine of the character described, in combination with the steam-cylinder A and its upper head, A', constituting a valve-seat, the cylindrical chest C, seating upon the head A', formed with cup-cylinders opening through the casing at opposite sides horizontally, and a supplemental cylinder, D, exterior to the casing, parallel with the axis of the latter, and connecting-ports cast in the body of the casing, substantially as set forth.

5. In a steam-engine of the character described, the combination, with the cylinder A and its head A', provided with ports p^4 p^5

p^6, of the valve-chest casing C, provided with cup-cylinders c' c^2, supplemental valve-chest D, ports and passages p', p^2, p^3, p^6, and e, and the cover C', provided with the continuation of passage p^3, substantially as set forth.

6. In a steam-engine of the character described, in combination with the three-ported valve-seat, a D slide-valve having an extended lap at one side, with a more or less contracted aperture through said lap to register with the corresponding seat-port, substantially as set forth.

7. In a steam-engine of the character described, in combination with the main slide-valve and steam-actuated piston controlling the same, a supplemental cylinder with exhaust-ports connecting the cylinders of the valve-mover with the main exhaust-pipe, and a balanced piston-valve operating in said supplemental cylinder, controlling said exhaust-ports, and actuated directly by the main piston, substantially as set forth.

8. In a steam-engine of the character described, in combination with the main slide-valve, a steam-actuated valve-mover, and a piston-valve actuating the valve-mover by controlling the exhaust, the cylinder D, constructed with a longitudinal aperture in its shell connecting the two ends of the cylinder around the valve, substantially as described.

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

MICHAEL SCHULTZ.

Witnesses:
L. M. HOSEA,
C. D. KERR.