

No. 737,609.

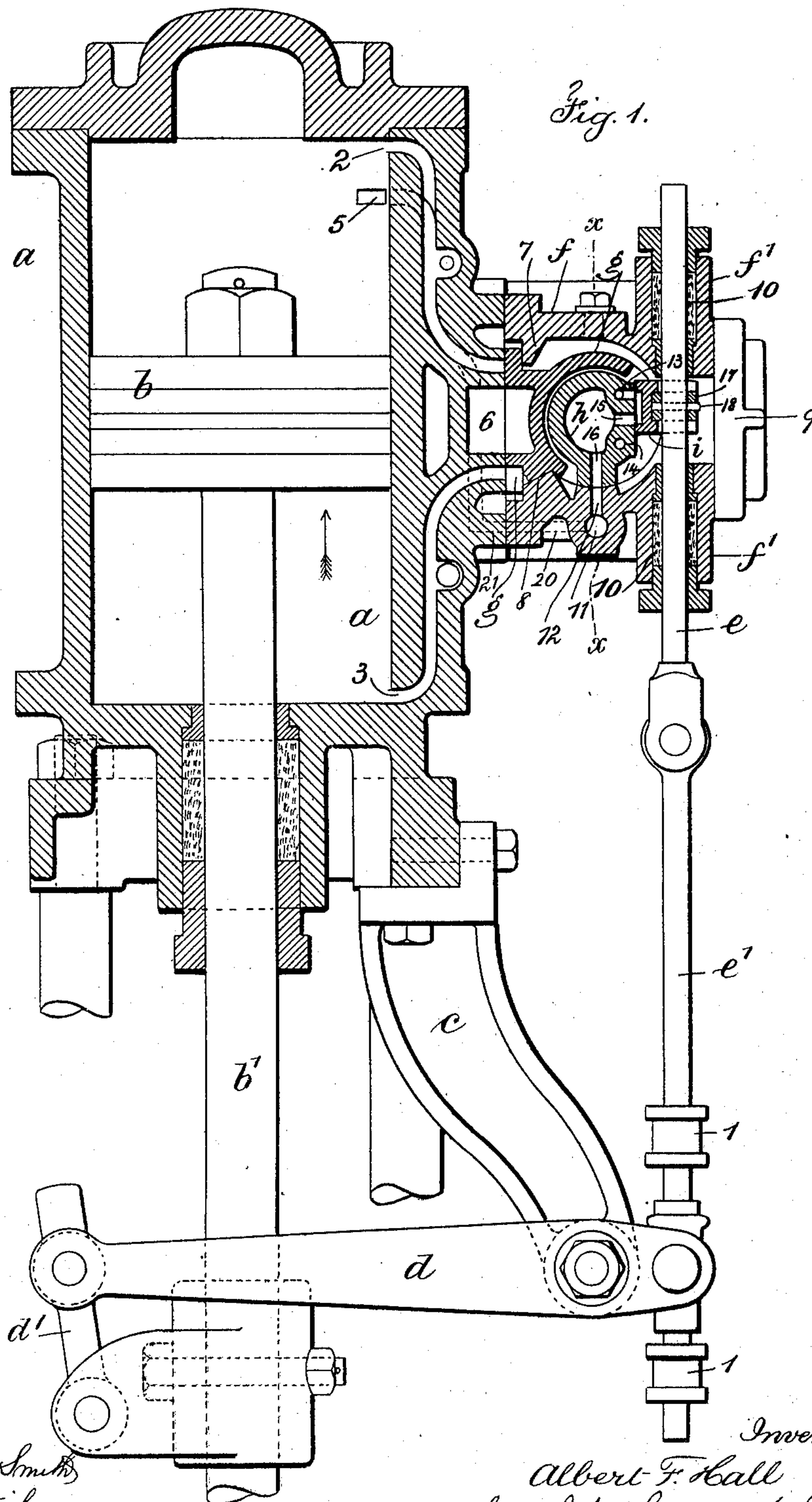
PATENTED SEPT. 1, 1903.

A. F. HALL.
ENGINE.

APPLICATION FILED JULY 21, 1902.

NO MODEL.

3 SHEETS—SHEET 1.



Witnesses
Chas. H. Smith
J. Staib

Inventor
Albert F. Hall
per L. W. Terrell & Son, atty

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3 SHEETS—SHEET 2.

Fig. 2.

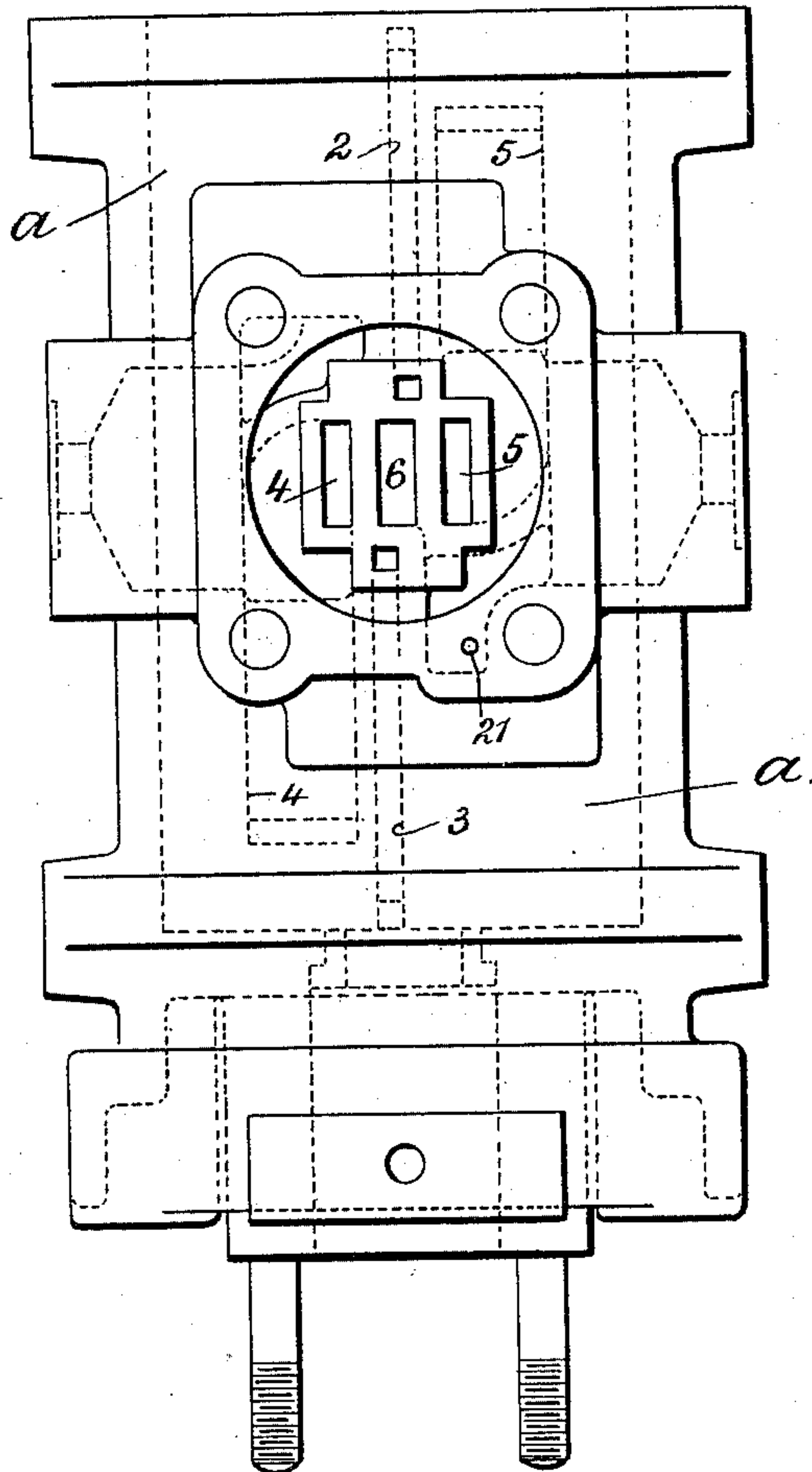


Fig. 4.

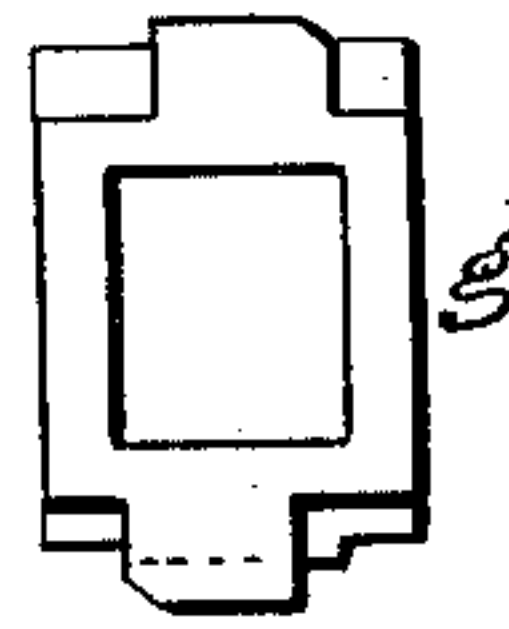
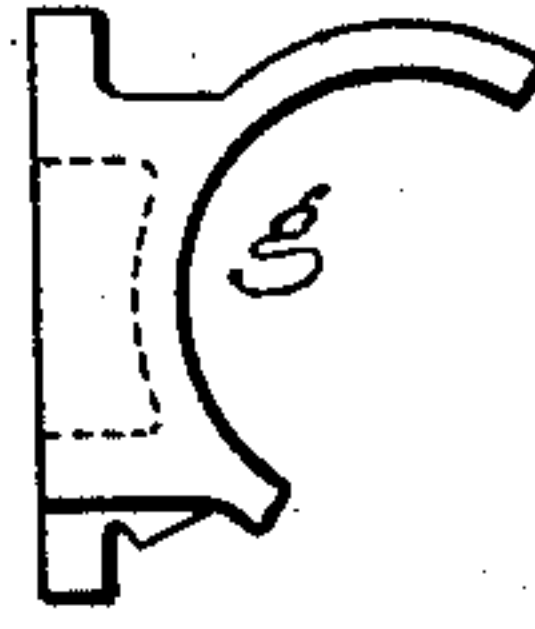


Fig. 3.



Witnesses

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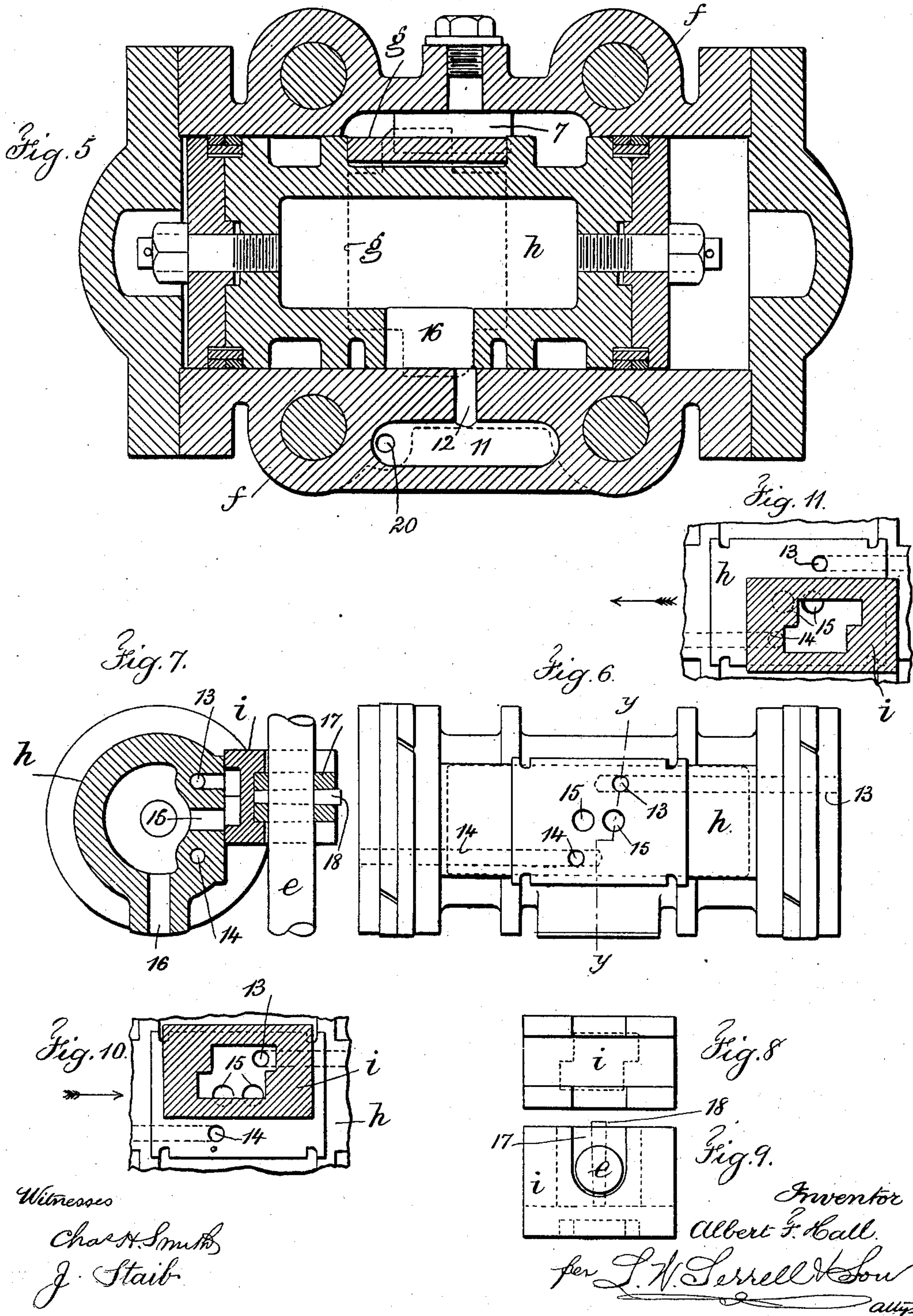
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3 SHEETS—SHEET 3.



UNITED STATES PATENT OFFICE.

ALBERT F. HALL, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO THE GEO. F. BLAKE MANUFACTURING COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

ENGINE.

SPECIFICATION forming part of Letters Patent No. 737,609, dated September 1, 1903.

Application filed July 21, 1902. Serial No. 116,312. (No model.)

To all whom it may concern:

Be it known that I, ALBERT FRANCIS HALL, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts; have invented an Improvement in Engines, of which the following is a specification.

My invention relates to the class of engines applicable for actuating fluid-pumps in which the main slide-valve is operated by an auxiliary piston. This auxiliary piston is connected with the slide-valve in such a manner that the valve will be moved by the reciprocating movement imparted to the auxiliary piston.

My present invention is an improvement upon the device shown and described in Letters Patent granted to me September 22, 1896, No. 567,978; and the object of my invention is to simplify the construction, to dispense with numerous ports, with the rocking of the auxiliary piston, and the devices for effecting such movement, and to cause the engine in its construction and operation to fulfil all requirements.

In carrying out my invention I provide an auxiliary piston coacting with and moving the main slide-valve, and the piston is hollow and performs the additional function of an exhaust-port. This auxiliary piston moves in a steam-chest and has a flat outer seat perforated with one or more exhaust-ports and with ports for steam to the respective ends thereof. An auxiliary valve lies upon and is held against the flat seat of the auxiliary piston upon the valve-rod by which the same is moved over the seat of the auxiliary piston, while the latter with its seat moves under or beneath the auxiliary valve to cover and uncover the steam-ports and to arrest or cut off the exhaust at the desired moment, and so produce a cushion at the ends of the respective movements or strokes of the auxiliary piston.

The details of the structure are hereinafter more particularly described.

In the drawings, Figure 1 is a vertical section and partial elevation representing my improvements. Fig. 2 is an elevation of the steam-cylinder and the valve-seat thereof.

Fig. 3 is a side elevation of the main slide-valve. Fig. 4 is an elevation of the operative face of the valve moving over the valve-seat of the steam-cylinder. Fig. 5 is a vertical longitudinal section approximately on the line $x x$, Fig. 1. Fig. 6 is an elevation of the auxiliary piston, showing the seat upon which the auxiliary valve bears and the ports of said auxiliary piston. Fig. 7 is a vertical and cross section of the auxiliary piston at $y y$ of Fig. 6 and a section of the auxiliary valve, together with an elevation of the valve-rod as connected to the auxiliary valve. Fig. 8 is an elevation of the auxiliary valve alone, and Fig. 9 an edge view of the same. Figs. 10 and 11 are diagrammatic views in which the flat outer surface of the auxiliary piston upon which the auxiliary valve bears is shown with its steam and exhaust ports and a section of the auxiliary valve in different positions, so as to indicate the movements of the parts. Figs. 5 to 11, inclusive, are upon the same scale and are of exaggerated size in relation to the preceding figures for the purpose of clearness.

The steam-cylinder a , piston b , and piston-rod b' may be of ordinary or well-known construction, and the piston-rod b' , which in Fig. 1 is shown as broken off, may extend to a pump cylinder. A bracket c is secured to one side of the steam-cylinder, and d represents a rocker-arm which is pivoted to the lower free end of the bracket c and at one end pivotally connected to a link d' , which link is in turn pivoted to a head secured to the piston-rod b' and which head moves with the movement of the piston and piston-rod to move the link d' and to swing the rocker-arm d upon its pivotal connection with the bracket c .

e represents the valve-rod, and e' an auxiliary valve-rod pivotally connected thereto and upon which auxiliary valve-rod there are secured collars 1. Upon the auxiliary valve-rod and between these collars there is a moving sleeve having trunnions to which the short end or ends of the rocker arm or arms d are pivotally connected, the movement of the rocker-arm, as hereinbefore described, shifting the sleeve connected therewith upon

the auxiliary valve-rod *e'* and longitudinally of said rod and into engagement with either one or the other of the collars 1, so as to impart to the auxiliary rod *e'* and the valve-rod *e* reciprocating movements in opposite directions.

The steam-chest *f* is secured in any well-known manner to the steam-cylinder *a*, preferably by bolts passing through lugs of the steam-chest into lugs of the steam-cylinder. The steam-chest *f* is preferably provided with stuffing-boxes or guide-sleeves *f'*, and through these and through packings 10, formed in connection therewith, the valve-rod *e* passes. The steam-cylinder *a* is provided with steam-inlet ports 2 3. These are preferably arranged almost in line, (see Fig. 2,) opening at one end through the valve-seat of the steam-cylinder and at the opposite ends into the ends of the steam-cylinder, and there are exhaust-ports 4 5 6, which are in the valve-seat of the steam-cylinder, the central port 6 passing to the discharge for the exhaust and the ports 4 and 5 passing through the cylinder and opening near the respective ends thereof and preferably upon opposite sides of the steam-ports. The exhaust-ports 4 and 5 are purposely not continued to the extreme ends of the steam-cylinder with the object of cutting off the exhaust near the respective ends of the stroke of the piston, so as to cause the piston to slightly cushion at its extreme movements.

The steam-chest *f* is made with parts 7 8, forming guides for opposite surfaces of the main slide-valve *g*, the flat face of which moves over the flat valve-seat of the steam-cylinder *a*. This main slide-valve is very similar in form to that shown and described in my Letters Patent hereinbefore enumerated, the same being formed with a semicylindrical outer face and with a recess in the flat opposite face or back of the valve, said valve being held in position between the parts 7 and 8 of the steam-chest and the flat valve-seat of the steam-cylinder. The steam-chest *f* has a main cylindrical aperture and a central opening in the end covered by a cap-plate 9, secured thereto. In the lower portion of the steam-chest *f* there is an exhaust-steam chamber 11 and a passage-way 12 to the same from within the steam-chest and a port 20 from the same connecting with a port 21, leading to the exhaust 6 of the steam-cylinder.

h represents the auxiliary piston, which is made hollow and performs the additional function of an exhaust-port. This piston is fitted to slide in the steam-chest, is provided with suitable packings to form steam-tight joints at its respective ends, and is centrally and for part of its circumference recessed to receive the curved portion of the main slide-valve *g*. This auxiliary piston is provided with a valve-seat (shown as a vertical face) in the side farthest from the steam-cylinder. In the seat of the auxiliary piston *h* there are steam-ports 13 14, which pass through the piston to the respective ends, (see especially

Figs. 6 and 7,) and one or more facial exhaust-ports 15, extending to the interior of the auxiliary piston. The auxiliary piston is also provided with an exhaust-port 16, passing through the lower portion and connecting with the port 12 of the steam-chest. I provide an auxiliary valve *i* with a flat recessed face adapted to lie upon the seat of the auxiliary piston *h*. This auxiliary valve is recessed in its outer face longitudinally and also transversely. The transverse recess or recesses receive the valve-rod *e* and the longitudinal recess a locking-block 17, through which the valve-rod passes, said locking-block and the valve-rod *e* being connected by a cotter-pin 18. With this form of connection it will be apparent that the valve-rod *e* is securely held to the auxiliary valve *i* and said valve *i* held between the valve-seat of the auxiliary piston *h* and said valve-rod, so that there cannot be any slip lengthwise of the valve-rod or transverse thereof between the parts. These parts, however, are very readily disconnected after the removal of the face-plate 9 by taking out the cotter-pin 18 and first removing the valve-rod *e* and then the locking-block 17. In this device the movement of the piston *b* and piston-rod *b'* and the movement of the rocker-arm *d* and the rods *e e'* thereby cause a vertical movement of the auxiliary valve *i* in the steam-chest with the vertical movement of the valve-rod *e*. This movement permits steam to pass from within the steam-chest alternately through the steam-ports 13 14 to the respective ends of the auxiliary piston *h*, so as to move the same first in one direction and then in the other and with this movement to automatically move the main slide-valve *g* so as in one position to permit the steam to enter the port 2 and pass to one end of the steam-cylinder and in the other position permit the steam to pass through the steam-port 3 to the opposite end of the cylinder and effect the reciprocating movement of the piston *b* and piston-rod *b'*. The auxiliary piston *h* is the sole device for automatically effecting the movement of the main slide-valve *g*, and when the steam passes through the port 2 of the steam-cylinder to move the piston from the upper to the lower end, as shown in the drawings, the main slide-valve is so placed upon the valve-seat of the steam-cylinder that the port 3 is covered and the exhaust is by the port 4 to the port 6 through the recess of the valve, the port 5 being opened for the passage of steam after the piston moves past its opening into the steam-cylinder, and when the position of the valve is reversed steam passes through the port 3 and almost simultaneously through the port 4. The steam-port 2 is covered, and the exhaust is by the port 5 into the port 6 by the recess in the valve. In the movement of the auxiliary piston and the auxiliary valve the latter is moved by the piston-rod *e* over the seat of the aux-

iliary piston, and by the action of the steam the auxiliary piston is moved transversely, or, in other words, at right angles to the movement of the valve-rod *e*, its valve-seat moving beneath the auxiliary valve, so that while the auxiliary valve has its effect in covering and uncovering the ports the movement of the auxiliary piston also has its effect in covering and uncovering the ports and providing progressively for the exhaust and for the confining of steam at the respective ends of said piston. Figs. 7 and 10 show illustratively a medium or midway position of the auxiliary valve with reference to the auxiliary piston. In these views steam is supposed to be passing through the steam-port 14 to the left-hand end of the auxiliary piston and to be moving said auxiliary piston, as well as the main slide-valve, in the direction of the arrow, Fig. 10. The steam from the opposite or right-hand end of the auxiliary piston is exhausting by the port 13 into the ports 15 to the interior of the hollow auxiliary piston *h* by the port 16 and the port 12, exhaust-chamber 11, and ports 20 and 21 to the port 6 of the steam-cylinder. Referring to Fig. 10, and with the further movement to the right of the auxiliary piston *h* the same passes beneath or underruns the auxiliary valve *i*, so as to close off the entrance to the port 13. This happens before the extreme movement to the right of the auxiliary piston, and at this moment the steam is confined in the end of the steam-chest. From this latter position, and referring to Fig. 11, the auxiliary valve has moved from the position Fig. 10, the steam-port 13 has been uncovered, and the steam-port 14 covered, so that steam passes by the port 13 into the right-hand end of the steam-chest to move the auxiliary piston *h* toward the left and in the direction of the arrow, Fig. 11, the exhaust being then by the port 14 into the recess of the valve and through the ports 15 within the hollow auxiliary piston, and so by the ports 16, 12, 11, 20, and 21 to 6, as hereinbefore described. With the movement from the left of the auxiliary piston *h* into the position shown exactly in Fig. 11, the said auxiliary piston has passed beneath or underrun the auxiliary valve, so that the aperture of the port 14 is closed, and in this position the steam is confined in the left-hand side of the steam-chest against the left-hand end of the auxiliary piston prior to the parts shifting to repeat the movements hereinbefore described.

In the engine of my improvement the respective parts are not only brought into a co-acting relation, but the movement of the auxiliary valve is positively effected by the valve-rod from the piston-rod, and the movement of the auxiliary piston is directly effected through this movement by the steam simultaneously with the movement of the main slide-valve and the passage of steam into the steam-cylinder to effect the operation of the piston and piston-rod.

The structure is exceedingly simple and not in any respect complex. Its movements are positive and efficient. The engine, generally speaking, is adapted for any use, but is especially employed by me for actuating fluid-pumps.

I claim as my invention—

1. In an engine, the combination with the steam-cylinder, piston and piston-rod, and the steam-chest, of a main slide-valve, an auxiliary piston for actuating the slide-valve and an auxiliary valve coacting with the auxiliary piston and devices for positively moving the auxiliary valve with the movement of the piston-rod, and at right angles to the movement of the auxiliary piston, substantially as set forth.

2. In an engine, the combination with the steam-cylinder, piston and piston-rod and the steam-chest, of a main slide-valve, an auxiliary piston coacting with the main slide-valve and for positively moving the same in unison therewith, an auxiliary valve coacting with the auxiliary piston and moving over a seat of said auxiliary piston, and means for imparting to the auxiliary valve a movement in one direction which is at right angles to the movement imparted by the steam to the auxiliary piston, substantially as set forth.

3. In an engine, the combination with a steam-cylinder, a steam-chest connected therewith, a piston and piston-rod, of a main slide-valve for admitting steam to the cylinder and for providing a path for the exhaust, an auxiliary piston in part receiving and co-acting with the main slide-valve and having a movement in the same direction as the main slide-valve and at right angles to the line of movement of the piston-rod, an auxiliary valve coacting with the auxiliary piston and having a movement in the same direction as the piston and at right angles to the movement of the auxiliary piston, said movement being across a seat of the auxiliary piston, a valve-rod to which the auxiliary valve is connected, and means for effecting the movement of the valve and valve-rod in unison with and by the reciprocating movement of the piston-rod, substantially as set forth.

4. In an engine, the combination with a steam-cylinder having steam and exhaust ports, a piston and piston-rod, of a steam-chest having a main aperture circular at its ends, and a surface-aperture and a cap-plate covering the same and internally having parts forming guides at opposite sides, a main slide-valve having parts resting against and the movement of which is directed by said guides and having an outer surface of substantially semicircular form, an auxiliary piston hollow and having a recess receiving and engaging the curved part of the main slide-valve and having an outer valve-seat with ports therein, an auxiliary valve lying upon the valve-seat of the said auxiliary piston and in the outer aperture of the steam-chest, a

valve-rod movable longitudinally through the steam-chest and to which the auxiliary valve is connected, and means actuated by the movement of the piston for simultaneously
 5 imparting a movement to the auxiliary valve across the seat of the auxiliary piston to admit steam to the ports thereof so as to impart to the auxiliary piston and the main slide-valve reciprocating movements at right angles to the movement of the auxiliary valve,
 10 substantially as set forth.

5. In an engine, the combination with the steam-cylinder having ports, a piston and piston-rod and a main slide-valve, of a steam-
 15 chest receiving the main slide-valve and having internal recesses at its ends and having an exhaust-chamber 11 and passage-ways 12 and 20 from the interior of the steam-chest to said exhaust-chamber and from said exhaust-chamber to the exhaust of the steam-
 20 cylinder, an auxiliary piston hollow and having a port 16 connecting the hollow interior with the said ports 11 and 12 and said auxiliary piston coacting with the main slide-valve, and an auxiliary valve coacting and
 25 contacting with the said auxiliary piston, and a valve-rod to which said auxiliary valve is connected, and means for imparting a vertical movement to the auxiliary valve, substantially as set forth.

6. In an engine, the combination with the steam-cylinder having ports, a piston and piston-rod and a main slide-valve, of a steam-
 35 chest receiving the main slide-valve and having internal recesses at its ends and having an exhaust-chamber 11 and passage-ways from the interior of the steam-chest to said exhaust-chamber and from said exhaust-chamber to the exhaust of the steam-cylinder, an auxiliary
 40 piston hollow and having a port 16 connecting the hollow interior with said passage-ways and said auxiliary piston coacting with the main slide-valve and having an outer valve-seat and steam-ports 13 and 14 therein
 45 and running longitudinally of the said auxiliary piston, and one or more exhaust-ports 15 through said outer seat connecting with the hollow interior, and an auxiliary valve lying upon and contacting with the outer
 50 valve-seat of the auxiliary piston and having a recessed inner surface to provide for the passage of the exhaust-steam, a valve-rod to which the said auxiliary valve is secured, and means for imparting a movement to said aux-

iliary valve across the seat of the auxiliary
 piston so as to alternately uncover the steam-
 ports and provide for the exhaust and by the
 steam-pressure impart to said auxiliary piston longitudinal reciprocating movements at
 right angles to the movement of the auxiliary
 60 valve, substantially as set forth.

7. In an engine, the combination with the steam-cylinder, a steam-chest and a main slide-valve, of an auxiliary piston engaging and coacting with the main slide-valve, an
 65 auxiliary valve contacting and coacting with the auxiliary piston, said auxiliary valve having in its outer face longitudinal and transverse recesses, a valve-rod lying in the transverse recesses of said auxiliary valve, a locking-
 70 block lying in the longitudinal recess of said valve and a cotter-pin or equivalent device connecting the valve-rod with the locking-block and suitable guides for the valve-rod in the steam-chest, substantially as set
 75 forth.

8. In an engine, the combination with the steam-cylinder, piston, piston-rod and the steam-chest, of a main slide-valve, an auxiliary piston for actuating the slide-valve, and
 80 an auxiliary valve coacting with the auxiliary piston and ports arranged in the auxiliary piston and controlled by the position of the auxiliary valve, so that the exhaust is
 85 closed to the respective ends of the auxiliary piston before the same reaches the limit of its stroke in either direction to confine the steam, substantially as set forth.

9. In an engine, the combination with the steam-cylinder, piston and piston-rod, and
 90 the steam-chest, of a main slide-valve, an auxiliary piston for actuating the slide-valve, steam-ports running through the auxiliary piston from the ends thereof and terminating in adjacent apertures in a seat of said piston,
 95 and exhaust-ports also adjacent to said steam-ports and an auxiliary valve coacting with the auxiliary piston, which ports are controlled by the position of the auxiliary valve so that the escape of the exhaust-steam is
 100 cut off and the auxiliary piston caused to cushion thereon at the ends of its respective strokes, substantially as set forth.

Signed by me this 10th day of July, 1902.

ALBERT F. HALL.

Witnesses:

JAMES H. SHEDD,
 ALICE M. GEE.