No. 743,927. PATENTED NOV. 10, 1903.

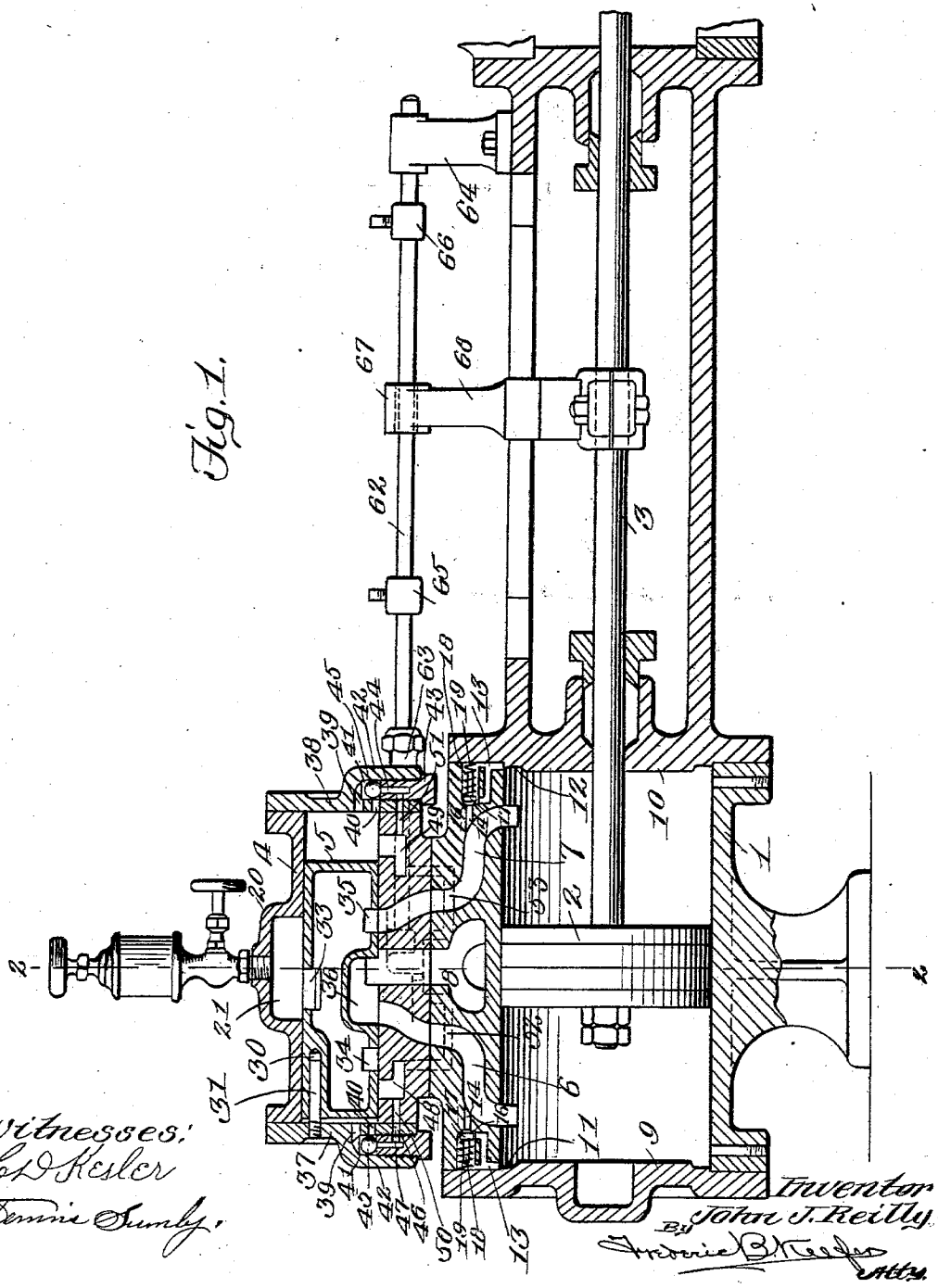
J. J. REILLY.

STEAM ENGINE.

APPLICATION FILED AUG. 25, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 743,927. PATENTED NOV. 10, 1903.

J. J. REILLY.

STEAM ENGINE.

APPLICATION FILED AUG. 25, 1902.

NO MODEL. 2 SHEETS—SHEET 2.

Fig. 2.

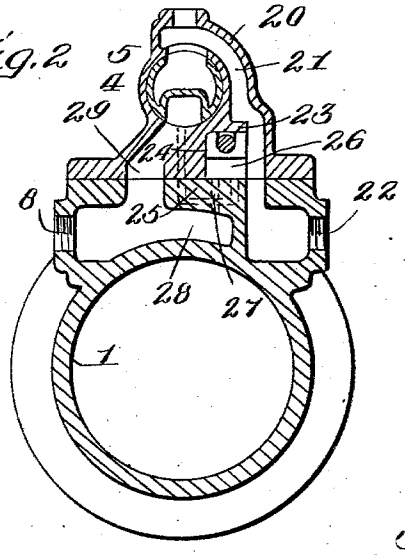


Fig. 4.

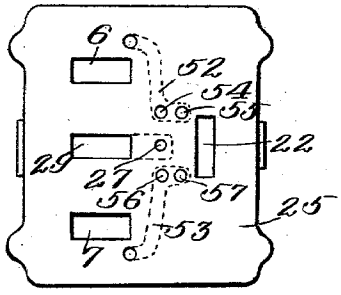


Fig. 3

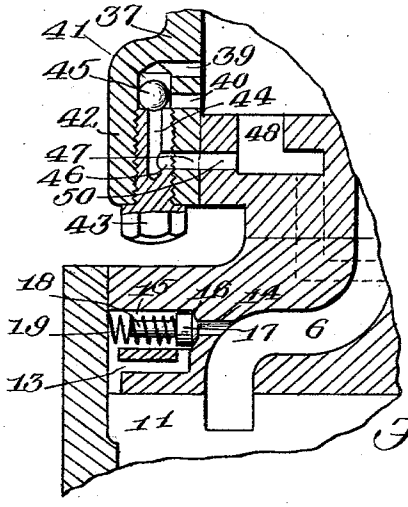


Fig. 5

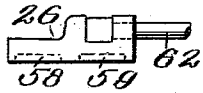


Fig. 6

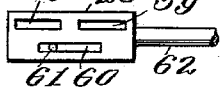


Fig. 7

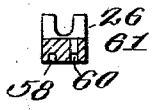


Fig. 8.

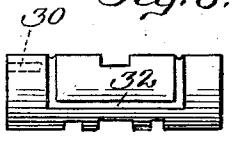


Fig. 9.



Fig. 10.



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No. 743,927. Patented November 10, 1903.

UNITED STATES PATENT OFFICE.

JOHN J. REILLY, OF LOUISVILLE, KENTUCKY.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 743,927, dated November 10, 1903.

Application filed August 25, 1902. Serial No. 120,976. (No model.)

To all whom it may concern:

Be it known that I, JOHN J. REILLY, a citizen of the United States, residing at Louisville, Kentucky, have invented certain new and useful Improvements in Steam-Engines, of which the following is a specification.

My invention relates to reciprocating steam-engines especially designed for the operation of pumps, the same residing particularly in the construction of and means for operating the piston-slide valve thereof.

One of the main objects of the invention is to provide novel means for the formation of a steam-cushion in the engine-cylinder to prevent the jamming of the piston against the cylinder-heads and means for introducing steam behind the piston when the same is at the limit of its stroke in one direction or the other.

A further object of the invention is to provide a novel construction and arrangement of auxiliary valve between the engine-cylinder and the piston-valve for automatically controlling the flow of steam to the valve-chest on opposite sides of the valve therein.

Other objects of the invention will hereinafter appear, and that which I regard as new will be set forth in the claims.

In the drawings forming part of this specification, Figure 1 is a longitudinal section of the cylinder and valve-chest of an engine embodying my improvements. Fig. 2 is a transverse section on the line 2 2 of Fig. 1. Fig. 3 is an enlarged detail sectional view of one end of the cylinder and valve-chest. Fig. 4 is a detail plan view of the web or flange on the upper side of the engine-cylinder. Figs. 5, 6, and 7 are detail views of the auxiliary valve. Figs. 8 and 9 are similar views of the piston-slide valve, and Fig. 10 is a detail side elevation and end view of one of the check-valves employed.

Like reference-numerals indicate like parts in the different views.

The engine-cylinder 1 has the piston 2 mounted for reciprocation therein, and the latter has connected with it the usual piston-rod 3, which extends through one of the heads of the cylinder 1, as clearly shown. Mounted upon the cylinder 1 is a valve-chest 4, in which is located a reciprocating piston-slide valve 5. Extending from the valve-chest 4 and communicating with the interior of the cylinder 1, adjacent to the opposite ends thereof, are the inlet-ports 6 and 7 for live steam. An exhaust-port 8 is located between the ports 6 and 7, and the said ports 6, 7, and 8 extend through the lower wall of the valve-chest 4 and the upper wall of the engine-cylinder 1. The ports 6 and 7 are designed for the supply of live steam upon opposite sides of the piston 2; but their lower ends terminate a short distance from the heads 9 and 10 of the engine-cylinder. The inner surfaces of the heads 9 and 10 are formed with annular recesses 11 12, and leading into the extreme opposite ends of the cylinder 1, adjacent to the recesses 11 and 12, are the ports 13. The ports 13 communicate with the live-steam ports 6 and 7, respectively, through the ports 14, which enter the ports 6 and 7 at points adjacent to the discharge ends of the latter. At the point of connection of each of the ports 13 and 14 with each other an enlarged cylindrical recess 15 is provided, which forms at one end of the port 14 a valve-seat 16. Coöperating with the seat 16 is a check-valve 17, having an enlarged head provided with a tapering end and a contracted stem 18. The said stem is surrounded by a coil-spring 19, which normally urges said valve to its seat to cut off communication between the ports 6 and 13 by way of the port 14. Now it will be observed that when steam is being admitted into the cylinder 1 through the port 7 the piston 2 in said cylinder will be moved to the left, the steam in the opposite end of said cylinder exhausting through the port 6. As soon, however, as the piston 2 passes beyond the lower end of the port 6 communication between said cylinder and said port is cut off, with the result that a cushion of steam is formed between the piston 2 and the head 9 of the cylinder 1, which prevents the jamming of said piston against said head. When the flow of live steam is reversed from the port 7 to the port 6, it is obvious that the same cannot pass directly from said port 6 into the cylinder 1, as the discharge end of the latter port is closed by the piston 2. At this time, however, the valve 17 is opened against the action of the spring 19, with the result that the steam passes from the port 6 through the ports 14 and 13

into the cylinder 1 behind the piston 2 therein. The initial or starting movement of the piston 2 in the reverse direction is effected by this means. As soon, however, as the piston 2 in its movement toward the right passes beyond the discharge end of the port 6 the valve 17 is automatically closed through the action of the spring 19, and the further supply of steam to the cylinder 1 is effected through the port 6. By reason of the fact that the recesses 11 and 12 are formed in the heads 9 and 10 of the cylinder 1 a space is always left, which cannot be closed by the piston 2, into which steam from the port 13 may enter the cylinder behind the piston. By the construction described all jamming or knocking of the piston against the cylinder-heads is effectually avoided and the operation of the engine is perfectly noiseless. Furthermore, there is no danger of knocking out the heads of the cylinder by the impact of the piston against the same. The valve 17 may, if desired, be provided with a small longitudinal opening 17^a for slowly releasing the steam cut off thereby. This construction is clearly shown in Fig. 10.

The inner surface of the valve-chest 4 is cylindrical in form and the same communicates through its bottom wall with the exhaust-port 8, heretofore referred to. It is also provided at its center with a lateral enlargement 20, extending up to the top thereof and forming a passage 21 for the entrance of live steam. Said passage 21 communicates with a live-steam port 22 in the upper wall of the cylinder 1, to which may be attached a pipe leading from a boiler or other source of steam-supply. The body of the chest 4 is formed at a point near its lower end with a laterally-extending flange 23 and beneath said flange with a recess 24, which communicates with the live-steam passage 21. Just beneath the recess 24 and on one side of the port 22 the cylinder 1 is formed with a narrow web or flange 25, which constitutes a support for an auxiliary valve 26 and has a port 27 extending therethrough, which communicates with a chamber 28, from which the exhaust-port 8 leads. The exhaust-port 8 communicates with the valve-chest 4 by way of a port 29, extending through the bottom wall of said chest and through the top wall of the cylinder 1.

The piston-slide valve 5, which is mounted to reciprocate in the valve-chest 4, is hollow and is generally cylindrical in form. To prevent the turning movement of said valve in the cylindrical valve-chest 4, I form in said valve a longitudinally-extending eccentrically-disposed bore or recess 30, in which fits a pin or screw 31 in one of the heads of the chest 4. The pin 31 fits freely within the recess 30, so as to provide for the reciprocating movement of the valve 5, while preventing the turning movement thereof. The said valve 5 is further provided with a peripheral groove or channel 32, in which is located a mass of antifrictional material, such as Babbitt metal. The groove or channel 32 is preferably shaped and disposed with the two end portions thereof extending at right angles to the axis of the valve around the upper side thereof, the lower ends of said end portions terminating slightly below the longitudinal center of the valve and connected by the longitudinal side portions, which extend substantially parallel to the axis. By the construction just described I am enabled to secure a perfectly tight joint between the valve 5 and the casing 4, in which it fits and moves, so that leakage between these parts is reduced to a minimum, if not absolutely prevented. Furthermore, in the event of wear between the valve and its casing it is merely necessary in order to restore the tight joint between these parts to remove the valve 5 and insert a new mass of antifrictional metal within the groove or channel 32. This tends to increase the life of the valve as a whole, and leakage may be overcome by a simple and inexpensive procedure.

The valve 5 is provided in its upper wall at the center with a port 33, which communicates with the live-steam passage 21, and said valve is also provided with ports 34 35 in its bottom wall, which are adapted to communicate, respectively, with the ports 6 and 7 when said valve is at opposite ends of its stroke. Between the ports 34 and 35 the valve 5 is formed with a recess 36 in its bottom wall, which is adapted to connect one or the other of the ports 6 7 with the exhaust-passages 29 and 8. Said recess 36 acts as an ordinary D-valve, whose construction and method of operation are well understood.

The heads 37 and 38 of the valve-chest 4 are each provided with laterally-extending ports 39 40, which are located one above the other and communicate with the interior of the valve-chest 4 at opposite ends thereof. The said ports 39 and 40 communicate at their outer ends with a chamber 41 in an enlarged portion of the head 37 or 38 in which said ports are formed, which chamber 41 is produced by boring out from the bottom the enlarged portion of said head. Fitting within the bore in the enlarged portion 42 of each head 37 38 is a screw or pin 43, having a head upon the lower end thereof and a longitudinally-extending bore 44 in the upper end thereof, which constitutes a port and communicates with the chamber 41. A ball-valve 45 is seated in each of the chambers 41 and rests upon the upper end of the screw or pin 43. The said valve controls the passage between the port 44 and the ports 39 and 40. The said valves are normally maintained in their closed position by gravity, but may be readily elevated by the pressure of steam from below. Each of the screws 43 is provided with a lateral port 46, which communicates with a port 47 in the adjacent face of the head 37 or 38. Leading into the valve-chest 4, adjacent to but slightly removed from

the opposite ends of said chest, are the ports 48 49, the port 48 communicating through a narrow passage 50 with the port 47 in the head 37 and the port 49 communicating through the narrow passage 51 with the port 47 in the head 38. Leading from the port 48 down through the bottom wall of the valve-chest 4 into the upper wall of the cylinder 1 and terminating in the upper wall of the web 25, heretofore referred to, is a port 52. Leading from the port 49 down through the bottom wall of the chest 4 into the cylinder 1 and terminating in the upper surface of the web 25 is a port 53. The port 52 has two outlets 54 55 in the web 25, and the port 53 has two outlets 56 57 in said web. The outlets 54 and 56 of the ports 52 and 53, respectively, and the upper end of the port 27 in the web 25 are all located in line with each other, and the outlets 55 and 57 of the ports 52 and 53, respectively, are in line with each other, the auxiliary valve 26, heretofore referred to, being mounted for reciprocation within the recess 24 upon the upper surface of the web 25. The bottom wall of the valve 26 is provided with the recesses 58, 59, and 60, the recesses 58 and 59 being located in line with each other and in line with the port 27 and the outlets 54 and 56 of the ports 52 and 53, the recess 58 being designed when the valve 26 is in one position to connect the outlet 54 of the port 52 with the port 27 and the recess 59 being designed when said valve is in its other position to establish communication between the outlet 56 of the port 53 and the port 27. The recess 60 is located in line with the outlets 55 and 57 of the ports 52 and 53 and communicates with one of said outlets when the valve is in one position and with the other of said outlets when said valve is in its other position. Extending vertically through the valve 26 and communicating at its lower end with the recess 60 is a port or passage 61, which communicates at its upper end with the live-steam port 21.

The stem 62 of the auxiliary valve 26 extends out through the head 38 of the valve-chest 4, the same being mounted in the bearing-sleeve 63 and in the bracket 64. The said valve-stem is provided with adjustable stops 65 66 and has loosely surrounding it between said stops a collar 67 upon the upper end of an arm 68, secured to the piston-rod 3. The said collar 67 during the operation of the piston 2 is adapted to engage the stops 65 and 66 to move the auxiliary valve 26 to the limit of its movement in opposite directions, and by adjusting said stops the extent of movement of said auxiliary valve may be accurately controlled.

From the foregoing description it is thought that the operation of my improved device will be readily understood. Assuming the piston 2 to be at the limit of its movement to the right and the piston slide-valve 5 to be at the limit of its movement to the left, the operation is as follows: Live steam is admitted through the port 22, the passage 21, and the port 33 to the interior of the hollow piston-valve 5. At this time the port 35 registers with the port 7, whereas the port 6 is connected with the exhaust-port 8 by means of the recess 36 in the valve 5, which bridges the space between the upper end of the port 6 and the passage 29, which communicates with said exhaust-port 8. Live steam from the interior of the valve 5 therefore passes down into the port 7 and thence through the ports 14 and 13 into the recess 12 in the head 10 of the cylinder 1 behind the piston 2. Said piston is therefore started on its movement to the left until the same passes the lower end of the port 7, when the valve 17 between the ports 14 and 13, which was heretofore open, is automatically closed by the spring 19, and the live steam enters the cylinder 1 through the port 7. During the movement of the piston 2 to the left the spent steam at the left-hand end of the cylinder 1 is exhausting through the port 6, the recess 36 in the valve 5, the passage 29, and the exhaust-port 8. When the piston 2 approaches the limit of its movement to the left, it closes the lower end of the port 6, and the further exhaust of steam through said port is prevented. At the same time the spent steam located in the cylinder 1 between the port 6 and the head 9 forms a cushion which arrests the movement of the piston 2 and prevents the same from jamming into said head 9. Escape of steam at this time through the ports 13 and 14 at the left-hand end of the cylinder 1 is prevented by reason of the fact that the valve 17 is closed and is held in its closed position. During the movement of the piston 2 above referred to the collar 67 on the arm 68 is brought into engagement with the stop 65 on the stem 62 of the auxiliary valve 26, with the result that the valve 26 is moved to the limit of its movement to the left. When this is done, the recess 60 in said valve is moved from a point above the outlet 57 of the port 53 into communication with the outlet 55 of the port 52. At the same time the recess 58 is moved out of communication with the port 27 and the recess 59 is moved so as to establish communication between the port 27 and the outlet 56 of the port 53. A means for the exhaust of the steam at the right-hand end of the valve 5 within the chest 4 is thereby provided over the following path: port 49, port 53, through the outlet 56 thereof, recess 59 in the valve 26, port 27, and chamber 28 to exhaust-port 8. At the same time, however, live steam is admitted to a point behind the left-hand end of the piston-valve 5 over the following path: live-steam passage 21, port 61 in valve 26, recess 60 in the bottom wall of said valve 26, port 52, through the outlet 55 thereof, which is in communication with the recess 60 of valve 26, port 48, contracted passage 50, and ports 47, 46, 44, and 40 in the head 37 of the valve-chest 4. When steam is admitted into the port or bore 44 of

the screw 43 in the head 37 of the valve-chest 4, the ball-valve 45 is instantly raised, so as to permit the passage of steam through the port 40 into the left-hand end of the chest 4. The port 39 provides for the escape of any accumulated water of condensation above the ball-valve 45. The steam acts over the path last above traced until the left-hand end of the piston-valve 5 passes to a point above the port 48, when the steam passes wholly through said port 48 to a point behind the valve 5, the ball-valve 45, which was heretofore opened, having at this time returned to its normally closed position. While the valve 5 is being moved to the right the steam at the right-hand end thereof is exhausting through the ports 49 and 53, recess 59 in valve 26, port 27, chamber 28, and exhaust-port 8. When, however, the right-hand end of the valve 5 passes beyond the right-hand end of the port 49, the further exhaust of steam from the valve-chest 4 is prevented. The consequence is that a cushion of steam is formed between the valve 5 and the head 38 of the valve-chest 4, which prevents the jamming of the valve against said head. When the valve 5 has reached the limit of its movement to the right, the port 34 therein is brought to a point opposite the upper end of the port 6, and communication is established between the port 7 and the discharge-passages 29 and 8 by way of the recess 36 in the valve 5, which bridges the space between the port 7 and the passage 29. Live steam then passes from the interior of the piston-valve 5 down through the ports 34 and 6 to the left-hand end of the cylinder 1, and the operations above described are repeated in the opposite direction.

From the foregoing description it will be seen that I have provided novel means for the formation of a cushion of steam between the piston and the head of the cylinder in which it works and means for introducing live steam behind the cylinder when at the limit of its stroke in either direction. Furthermore, it will be noted that I have provided novel means for automatically actuating the piston slide-valve 5 by steam which is instantaneous in its action and in which friction is reduced to a minimum. It will be noted, further, that I have provided a simple and inexpensive construction of ball-valve in the opposite heads of the valve-chest which is effective in its operation and which cannot be rendered inoperative by the accumulation of water of condensation thereon.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination with the cylinder of a steam-engine having ports leading thereinto at points slightly removed from its opposite ends and having annular recesses in the inner surfaces of its heads, and a valve for alternately admitting live steam to one of said ports and establishing communication between the other of said ports and an exhaust, of branch passages leading from said ports and communicating with the interior of the cylinder in line with said recesses and outwardly-opening cushion-valves, each provided with a small hole through the center for releasing the condensation, in said passages.

2. In a steam-engine, a piston slide-valve, a valve-chest in which said valve is mounted to reciprocate, the said chest having ports communicating therewith at points a short distance from its opposite ends, means for alternately admitting live steam through one of said ports and for establishing communication between an exhaust and the other of said ports, supplemental passages leading respectively from said ports, a plurality of transverse ports, located one above the other, leading from said passages to the adjacent ends of said chest, and ball-valves in said passages, adapted to be opened by a pressure of steam in said passages toward said chest and normally maintained in closed position by gravity.

3. In a steam-engine, a piston slide-valve, a valve-chest in which said valve is mounted to reciprocate, the said chest having ports communicating therewith at points a short distance from its opposite ends and having each of its heads provided with a longitudinal bore and with transverse passages leading from said bore through the inner wall thereof, the upper passages in said heads communicating directly with the interior of said chest and the lower passages communicating respectively with said ports, a screw fitting within the bore in each of said heads, forming a chamber from which the upper of said passages leads, the said screw having a central longitudinal opening or recess therein and a transverse port communicating with the lower passage in the head in which said screw is located, a ball-valve fitting within said chamber and normally closing the passage at the upper end of the opening in said screw, and means for alternately admitting live steam through one of said ports, and for establishing communication between an exhaust and the other of said ports.

4. In a steam-engine, a piston slide-valve, a valve-chest in which said valve is mounted to reciprocate, the said chest having ports communicating therewith at points a short distance from its opposite ends, an auxiliary valve for alternately admitting live steam through one of said ports and for establishing communication between an exhaust and the other of said ports, means for automatically operating said auxiliary valve, supplemental passages leading respectively from said ports, a plurality of transverse ports, located one above the other, leading from said passages to the adjacent ends of said chest, and ball-valves in said passages adapted to be opened by the pressure of steam in said passages toward said chest, and normally maintained in closed position by gravity.

5. In a steam-engine, a piston slide-valve, a valve-chest in which said valve is mounted to reciprocate, having ports 48, 49, communicating therewith at points a short distance from its opposite ends, a live-steam port communicating with the center of said valve-chest, a web or diaphragm on the engine-cylinder located on one side of said live-steam port, and having an exhaust-port on its other side, a port 27 extending through said web, supplemental passages leading respectively from said ports 48, 49 to the adjacent ends of said chest, check-valves in said passages opening toward said chest, ports 52, 53, leading respectively from the ports 48, 49 and having outlets 54, 55, and 56, 57 in said web, and an auxiliary valve mounted to reciprocate on said web and adapted to be automatically operated from the piston of the engine, the said auxiliary valve having a series of recesses in its lower surface and a port extending therethrough, the said port communicating with said live-steam port at its upper end and with one of said recesses at its lower end, the latter recess being located and movable in line with the outlets 55, 57 and adapted to connect one or the other of the same with said live-steam port, and the other of said recesses being located and movable in line with the outlets 54, 56, and the port 27, and adapted to alternately connect one or the other of the latter outlets with the latter port.

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

JOHN J. REILLY.

Witnesses:
H. M. ESKRIDGE,
A. J. EARLEY.