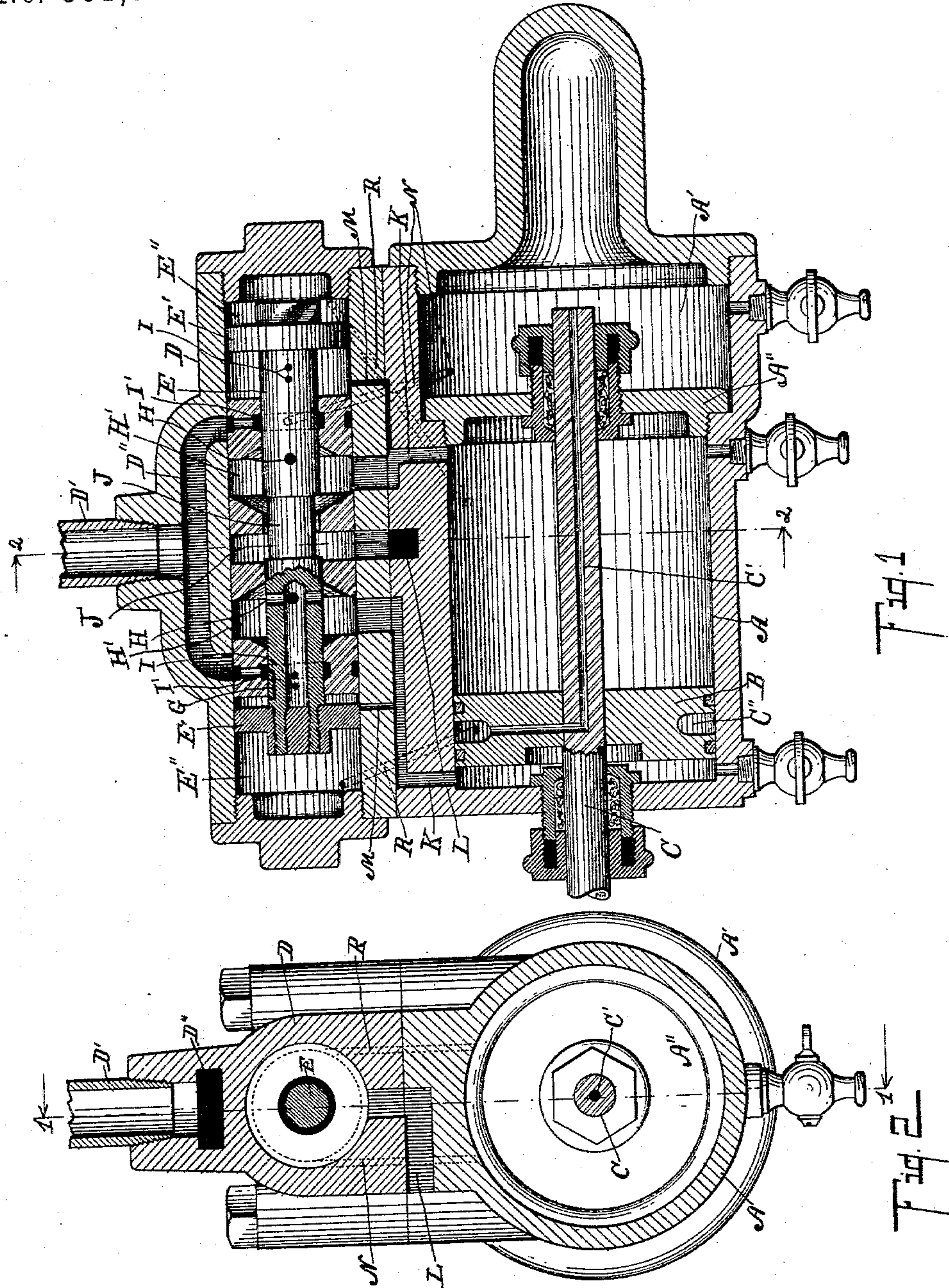


(No Model.)

I. N. MOORE.
STEAM ENGINE VALVE.

No. 561,682.

Patented June 9, 1896.



Witnesses:

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UNITED STATES PATENT OFFICE.

ILA N. MOORE, OF BATTLE CREEK, MICHIGAN.

STEAM-ENGINE VALVE.

SPECIFICATION forming part of Letters Patent No. 561,682, dated June 9, 1896.

Application filed September 9, 1895. Serial No. 561,954. (No model.)

To all whom it may concern:

Be it known that I, ILA N. MOORE, a citizen of the United States, residing at the city of Battle Creek, in the county of Calhoun and State of Michigan, have invented certain new and useful Improvements in Steam-Engine Valves, of which the following is a specification.

My invention relates to steam-engines, and more particularly to steam-engines for pumping purposes which have steam-actuated piston-valves, though the engine here disclosed is adapted to other purposes.

This engine is an improvement on the engine shown in Patent No. 431,045, issued July 1, 1890, to Richard L. Frost, for a steam-actuated valve. The valve and engine are similar to the above-named engine, except that they are not constructed nor intended to secure isochronal motion between the valve and engine-piston.

The objects of this invention are, first, to provide an engine with a valve so constructed that its motion shall be positive and exact; second, to provide an improved means of controlling the valve to avoid its sensitiveness to variations of steam-pressure due to a mere opening of the valve and to similar influence upon it under varying conditions while in operation; third, to provide in a valve of this class improved means of insuring a cushioning of the valve where the engine is used to operate a pump and the exhaust-steam is condensed in the cold water passing through the pump; fourth, to provide, in the construction and connection of valves and cylinders, improved and new means of governing the engine. I accomplish these objects of my invention by the mechanism shown in the accompanying drawings, in which—

Figure 1 is a vertical longitudinal sectional view through an engine cylinder and valve embodying all the principles of my invention, taken on line 1 1 of Fig. 2. Fig. 2 is a vertical transverse sectional view of the same, taken on line 2 2 of Fig. 1, both views being taken looking in the direction of the little arrows at the ends of the section-lines.

Similar letters of reference refer to similar parts throughout the several views.

Referring to the lettered parts of the drawings, A represents an engine-cylinder. Drep-

resents the steam-chest and valve-casing secured to the side of the same by suitable means and connected to the engine-cylinder by various ports hereinafter specially described.

B is the piston in the engine-cylinder.

C is the piston-rod. Around the piston B is an annular groove C', extending entirely around the same. Through the piston-rod C is a passage C', which passes from the end of the piston-rod through the same to the piston-head and out through the piston-head into the annular groove C'. The head A' is inserted in one end of the cylinder, and beyond this is a chamber A', into which one end of the piston-rod reciprocates. The piston-rod also extends out at the other end of the cylinder and is connected to a pump or other machine or mechanism which it is desired to operate, this engine being well adapted and intended for use as a pumping-engine.

The valve-chamber and steam-chest to one side of the cylinder are shaped like a hollow cylinder and divided into chambers E' E' at each end, which are to serve as cylinders for actuating the valve, and it is further divided into the recesses I' and I' and H' and H' to each side of the center and the recess J' by the center, which have passages for connecting with the various ports of the valve for actuating the engine. These recesses are formed by the insertion of suitable plug-like partitions which divide the elongated cylinder up into the recesses, which are all annular, as specified, the chambers I' being inner annular grooves in two of the plugs, as will be readily seen on examining Fig. 1. The valve E is a piston-valve and is steam actuated. On each end are enlarged piston-heads E' E', which reciprocate in cylindrical chambers E' E' and serve to actuate the valve. The piston-heads E' E' are united by the main body of the valve, which is cylindrical and hollow or tubular toward each end and is plugged at the ends, and there is solid metal between the tubular chambers thus formed in the body of the valve.

The central portion of the valve is reduced by a broad annular groove J, which is of sufficient length when the valve is reciprocated from side to side to connect the chambers J' and H' together alternately, which forms connections for exhausting the steam from the

engine-cylinder, and, of course, when the valve reciprocates, this exhaust is alternated from one end to the other of the cylinder. Through the body of the valve R, to each side of the center, are perforations H, which connect with the recesses H', formed in each end of the valve, and are adapted to register at all times with the said recesses H' H'. Still farther toward each end of the valve are rows or series of perforations I, extending transversely around the valve E and at different distances from the valve-head. These perforations extend inwardly to the central chamber in each end of the valve and serve to connect the recesses I' with the recesses H' through the ports H, and when the valve is moved to one side also register with annular recesses I' and serve to connect the said recesses I' with the recesses H' and deliver live steam from the passage D'' directly into the valve. Smaller ports G open at each end on the exterior surface of the valve E and form loops which, when the valve is reciprocated, connect the chambers E'' and the recesses I' together for a little distance during their operation.

The ports and steam-passages R R connect the outer ends of the valve-chambers E'' to the steam-cylinder A toward the outer ends of the same at such points that they will register with the annular groove C'' in the piston-head when it reaches the end of its stroke. Other ports M M connect the inner end of the chambers E'' to the main passages K K to the ends of the cylinder. The said ports M M enter the chambers E'' at a considerable distance from the inner end. The outer ends of passages G are situated at a little less distance from the piston-heads E' than the ports M are from the inner ends of the chambers E''. The main passages K extend from the chamber H' H' to each end of the cylinder to deliver and exhaust the steam which actuates the piston-head, and a passage N extends from the chamber A' up to connect through the passage around one end of the plug-partitions of the valve-chamber, as indicated, to the delivery-passage D'', which leads to the supply-pipe D'.

Having thus pointed out the construction and arrangement of the various parts of my improved engine, I will now state their operation and functions and what is accomplished by the various connections, and the reasons for the location of the various ports and their arrangement will more definitely appear.

In the operation of my improved engine steam passes down through the delivery-pipe D', through the passage D'' to the right of the engine, down around the plug-like partition, through the passage and port N into the steam-chamber A', through the passage C' in the piston-rod, out through the piston-head into the annular groove C'', up through the port R into the outer end of the left-hand chamber E'', and drives the valve E over toward the right to the position indicated in the

drawings. When the valve is carried to this position, steam enters through the passage D'', down into the left-hand annular recess I', through the port I, through the hollow left-hand end of the valve, out through the port H into the left-hand valve-recess H', down through the port and passage K into the cylinder to drive the piston-head to the opposite end of the cylinder. The steam from the right-hand end of the cylinder exhausts out through the right-hand port K into the right-hand recess H', through the passage formed by the annular depression J in the valve, down through the recess J', and out through the exhaust-passage L. When the annular groove C'' registers with the port and passage R at the right end, the steam is passed up to the outer end of the right-hand chamber E'' and drives the valve back toward the left and admits steam through the right-hand annular recess I', through the ports I, out through the port H into the right-hand recess H', and down through the right-hand passage and port K to the right-hand end of the cylinder. This indicates the passage of the steam to actuate the engine.

When the valve reciprocates and is driven from the left-hand end toward the right, it will be noted that the left-hand piston E', as it approaches the right hand in the recess E'', forces steam out through the little port M, and also that steam escapes through the ports I, through the hollow of the valve, out through the port H into the recess H'. When the left-hand piston E passes far enough to the right, it shuts off the ports M and also the ports I, and a small quantity of exhaust-steam is confined in the right-hand end of the recess E' and is compressed there and serves as a cushion to prevent a slamming of the valve in its chamber, which would soon destroy it. The same arrangement is duplicated at the right-hand end of the valve.

When the engine is used as a pumping-engine and exhaust-steam is turned into water passing through the pump and the water is very cold, it is frequently found that it will be condensed and a vacuum formed in all parts, and under these circumstances confining of the steam in the inner ends of the chamber E' is insufficient to amount to a perfect cushion. To overcome this tendency, the port G is made through the wall of the valve, as indicated in Fig. 1, and opens at a little distance from the head E', but nearer to the head than the distance between the port M and inner end of the chamber E''. The right-hand opening to the passage G is at such a distance that it will register with and open into the recess I' when the outer end of the port is close to the inner end of the chamber E''.

In operation it will be seen that live steam will be delivered through the annular recess I', through the passage G into the inner end of the chamber E'', and will therefore supply sufficient pressure to accomplish the cushion-

ing of the head E' at that point, even though all steam in the engine and in the chamber E'' has been condensed. By this construction perfect cushioning of the valve is accomplished at all times.

To accomplish the governing of my improved engine, I supply a double row or series of ports I in the valve at different distances from its center adapted to register with the annular live-steam recess I'. In the drawings only two of these small ports I appear, but their number can be increased and they be distributed laterally around the valve.

When the pump is working with a light pressure and with a light load, not so much steam-pressure will be exerted to actuate the same, and the movement of the engine-piston will tend to increase in rapidity. As it tends to increase in rapidity the interval of time which it will be allowed to cover and connect with the ports R will be shortened, and only sufficient steam will be admitted into the outer ends of the chamber E'' to carry the valve to its point of cushioning, and the valve at that point will be such a distance that one row, or only a part of the series of ports I, will come opposite the recess I', when the engine-piston will return and cut off the steam and stop the valve at that point, thus limiting the supply of steam delivered to the engine. When its tendency is to move too rapidly, by making the ports I very small and spreading a number of them over a considerable distance of the valve at that point, it will be seen that the mechanism can be made to form an engine which is almost perfect in its governing qualities, and it will only move the valve sufficiently to supply the steam to secure the rapidity of motion of the engine required.

When the engine is operating under a heavy load and operates slowly, the piston B will not return so quickly to reverse. More steam will be admitted into the end chambers E'' E'', the valve will consequently be moved farther and a greater number of the series of ports I will be exposed and more steam will be delivered to the engine-cylinder, and in consequence its action will become stronger and quicker. When the load is heavy, the pressure in the end of the cylinder is greater on account of the resistance to the piston, and will deliver a high pressure from the cylinder onto the valve-head E in the chamber E'', and will consequently increase the supply of steam to the cylinder, and so delivers the force required to overcome the greater resistance by exposing a larger or the full number of ports I in the valve. This shows how the engine is governed both in reducing and increasing speed by this device.

In the use for which my improved engine is intended it is found that two sets of ports I are sufficient for all practical purposes, and that the engine, where the load is constant, can be sufficiently adjusted at the throttle, as for pumping purposes, with only one port.

Having thus described my improved engine, I desire to state that it can be considerably varied in its details without departing from my invention, and that certain of the parts and ports which serve a very useful purpose in the engine may be dispensed with. For instance, the engine for ordinary work will be found to be all that is desired if the ports G are omitted, and it is only necessary to have these ports G where the engine is a pumping-engine and exhausts its steam into cold water. The engine will operate very well without the ports M leading from the passages to the engine-cylinder into the end recesses E''; but it will operate much better and will be much more convenient to construct and will operate in a much more satisfactory manner if these ports are present. The cushioning, in case these ports are dispensed with, would be effected by locating the ports I at a proper distance from the piston-heads E'. To persons skilled in the art other changes will readily suggest themselves without changing the features of my invention.

Having thus described my improved engine, what I claim as new, and desire to secure by Letters Patent, is—

1. In a steam-engine, the combination with the engine-cylinder, A, of the cylinder-head, A''; a steam-chamber, A', beyond the head, A'', of the cylinder; a piston-head, B, with an annular groove, C'', in said cylinder; a piston-rod, C, extending through the head, A'', into the chamber, A', containing a passage, C', which extends through the piston-rod and through the piston-head, B, out into the annular groove, C''; a valve-chamber and steam-chest, D, supported to one side of the engine-cylinder and containing a cylindrical valve-chamber which is divided by the plug-like partitions into the cylindrical end chambers, E'', E'', annular recesses, I', I', next to the outer chambers, E'', E''; and enlarged recesses, H', H', to each side of the central portion and a recess, J', at the center; a piston-valve, E, adapted to reciprocate back and forth through the partitions and through the recesses; pistons, E', E', on each end of said valve actuated in the cylindrical chambers, E'', E'', the said valve, E, being reduced in size by a broad, annular groove, J, at the center and being hollow or tubular at each end and solid at the middle, the said chambers, recesses and engine-cylinders being connected by ports, H, H, through the walls of said valve to the center situated to each side of the annular groove, J, and adapted to register with the recesses, H', H', at all times; a series of ports, I, through the walls of said piston-valve to the center adapted to register with the annular recess, I', at each end when the valve is moved from side to side; and an independent passage, G, toward each end of the valve opening at each of its ends to the outside, situated so that its inner end will register with the recess, I', and the outer end will de-

liver steam to the inner ends of the valve-chambers, E'', a passage, R, connecting the outer ends of the valve-chambers, E'', with the outer ends of the engine-cylinder to register with the annular groove, C'', to actuate the valve; passages, K, K, leading from the valve-recesses, H', H' to the ends of the engine-cylinder to actuate the piston of the engine; and passages, M, leading from toward the inner ends of the chambers, E'', to the steam-passages, K, K, to the engine; an independent passage, N, connecting the chamber, A', to the steam-delivery passage, D''; and a delivery-pipe, D', to deliver steam through the passage, D'', to the valve to actuate the same to actuate the engine, all coacting together substantially as described for the purpose specified.

2. In a steam-engine, the combination with the engine-cylinder, A, of the cylinder-head, A''; a steam-chamber, A', beyond the head, A'', of the cylinder; a piston-head, B, with an annular groove, C', in said cylinder; a piston-rod extending through the head, A'', into the chamber, A', containing a passage, C', which extends through the piston-rod and through the piston-head, B, out into the annular groove, C''; a valve-chamber and steam-chest, D, supported to one side of the engine-cylinder and containing a cylindrical valve-chamber which is divided by the plug-like partitions into the cylindrical end chambers, E'', E''; annular recesses, I', I', next to the outer chambers, E'', E''; and enlarged recesses, H', H', to each side of the central portion, and a recess, J', at the center; a piston-valve, E, adapted to reciprocate back and forth through the partitions and through the recesses; pistons, E', E', on each end of said valve actuated in the cylindrical chambers, E'', E'', the said valve, E, being reduced in size by a broad, annular groove, J, at the center and being hollow or tubular at each end and solid at the middle, the said chambers, recesses and engine-cylinders being connected by ports, H, H, through the walls of said valve to the center situated to each side of the annular groove, J, and adapted to register with the recesses, H', H', at all times; a series of ports, I, through the walls of said piston-valve to the center adapted to register with the annular recess, I', at each end when the valve is moved from side to side; a passage, R, connecting the outer ends of the valve-chambers, E'', with the outer ends of the engine-cylinder to register with the annular groove, C'', to actuate the valve; passages, K, K, leading from the valve-recesses, H', H', to the ends of the engine-cylinder to actuate the piston of the engine; and passages, M, leading from toward the inner ends of the chambers, E'', to the steam-passages, K, K, to the engine; an independent passage N, connecting the chamber, A', to the steam-delivery passage, D''; and a delivery-pipe, D', to deliver steam through the passage, D'', to the valve to actuate the same to actuate the

engine, all coacting together substantially as described for the purpose specified.

3. In a steam-engine, the combination with the engine-cylinder, A, of the cylinder-head, A''; a steam-chamber, A', beyond the head, A'', of the cylinder; a piston-head, B, with an annular groove, C', in said cylinder; a piston-rod, C, extending through the head, A'', into the chamber, A', containing a passage, C', which extends through the piston-rod and through the piston-head, B, out into the annular groove, C''; a valve-chamber and steam-chest, D, supported to one side of the engine-cylinder and containing a cylindrical valve-chamber which is divided by the plug-like partitions into the cylindrical end chambers, E'', E''; annular recesses, I', I', next to the outer chambers, E'', E''; and enlarged recesses, H', H', to each side of the central portion, and a recess, J', at the center; a piston-valve, E, adapted to reciprocate back and forth through the partitions and through the recesses; pistons, E', E', on each end of said valve actuated in the cylindrical chambers, E'', E'', the said valve, E, being reduced in size by a broad, annular groove, J, at the center and being hollow or tubular at each end and solid at the middle, the said chambers, recesses and engine-cylinder being connected; ports, H, H, through the walls of said valve to the center situated to each side of the annular groove, J, and adapted to register with the recesses, H', H', at all times; a series of ports, I, through the walls of said piston-valve to the center adapted to register with the annular recess, I', at each end when the valve is moved from side to side; a passage, R, connecting the outer ends of the valve-chambers, E'', with the outer ends of the engine-cylinder to register with the annular groove, C'', to actuate the valve; passages, K, K, leading from the valve-recesses, H', H', to the ends of the engine-cylinder to actuate the piston of the engine; an independent passage, N, connecting the chamber, A', to the steam-delivery passage, D''; and a delivery-pipe, D', to deliver steam through the passage, D'', to the valve to actuate the same to actuate the engine, all coacting together substantially as described for the purpose specified.

4. In a valve for a steam-engine, the combination with the steam-chest, B, containing a cylindrical valve-chamber which is divided by plug-like partitions into cylindrical end chambers, E'', E''; annular recesses, I', I', next to the outer chamber, E'', E''; enlarged recesses, H', H', each side of the central portion, and a recess, J', at the center; a piston-valve, E, adapted to reciprocate back and forth through the partitions and through the recesses; pistons, E', E', on each end of said valve actuated in cylindrical chambers, E'', E'', the said valve E, being reduced in size by a broad, annular groove, J, at the center and being hollow or tubular at each end and solid at the middle, the said chambers and recesses being connected to each other and to a suitable engine-

cylinder by the ports, H, H, through the walls of said valve to the center situated to each side of the annular groove, J, and adapted to register with the recesses, H', H', at all times; series of ports, I, through the walls of said piston-valves to the center adapted to register with the annular recesses, I', at each end when the valve is moved from side to side; an independent passage, G, toward each end of the valve-opening at both ends to the outside thereof situated so that its inner end will register with the recess, I', and the outer will deliver steam to the inner ends of the chambers, E''; passages, R, with suitable ports opening into the outer ends of the chambers, E'', to admit steam into them to actuate the valves; and exhaust-passages, M, leading from toward the inner ends of the chambers, E'', for exhausting the steam from the inner ends of the chambers, E'', when the piston approaches, and adapted to shut off steam or vapor at that point to serve as a cushion for the valve, all coacting together for the purpose specified.

5. In a valve for a steam-engine, the combination with the steam-chest, B, containing a cylindrical valve-chamber which is divided by plug-like partitions into cylindrical end chambers, E'', E''; annular recesses, I', I', next to the outer chamber, E'', E''; enlarged recesses, H', H', each side of the central portion, and a recess, J', at the center; a piston-valve, E, adapted to reciprocate back and forth through the partitions and through the recesses; pistons, E', E', on each end of said valve actuated in cylindrical chambers, E'', E'', the said valve, E, being reduced in size by a broad, annular groove, J, at the center and being hollow or tubular at each end and solid at the middle, the said chambers and recesses being connected to each other and to a suitable engine-cylinder by the ports, H, H, through the walls of said valve to the center situated to each side of the annular groove, J, and adapted to register with the recesses, H', H', at all times; series of ports, I, through the walls of said piston-valves to the center adapted to register with the annular recesses, I', at each end when the valve is moved from side to side; passages, R, with suitable ports opening into the outer ends of the chambers, E'', to admit steam into them to actuate the valve; and exhaust-passages, M, leading from toward the inner ends of the chambers, E'', for exhausting the steam from the inner ends of the chambers, E'', when the piston approaches, and adapted to shut off steam or vapor at that point to serve as a cushion for the valve, all coacting together for the purpose specified.

6. In a valve for a steam-engine, the combination with the steam-chest, B, containing a cylindrical valve-chamber which is divided by plug-like partitions into cylindrical end chambers, E'', E''; annular recesses, I', I', next to the outer chambers, E'', E''; enlarged recesses, H', H', each side of the central portion, and a recess, J', at the center; a piston-valve, E, adapted to reciprocate back and

forth with the partitions, and through the recesses; pistons, E', E', on each end of said valve actuated in cylindrical chambers, E'', E'', the said valve, E, being reduced in size by a broad, annular groove, J, at the center and being hollow or tubular at each end and solid at the middle, the said chambers and recesses being connected to each other and to a suitable engine-cylinder by the ports, H, H, through the walls of said valve to the center situated to each side of the annular groove, J, and adapted to register with the recesses, H', H', at all times; series of ports, I, through the walls of said piston-valves to the center adapted to register with the annular recesses, I', at each end when the valve is moved from side to side; passages, R, with suitable ports opening into the outer ends of the chambers, E'', to admit steam into them to actuate the valves, all coacting together for the purpose specified.

7. In a piston-valve for engines, the combination with the valve-casing, of a piston-valve reciprocating therein; cylindrical chambers at each end; piston-heads on the ends of said piston-valve for reciprocating in said cylindrical chambers; suitable steam-ports for admitting and exhausting steam from said cylindrical chambers to actuate said valve; annular recesses in the casing around said valve connected with the steam-delivery pipe; a series of small ports adapted to be moved to register with said recesses by the force of steam on the pistons at the ends of the valve so as to register an amount of portage proportionate to the rapidity of motion of the piston to control the supply of steam to the engine-cylinder to govern the same, as specified.

8. In an engine-valve, the combination of a cylindrical casing; a piston-valve adapted to reciprocate therein; suitable piston-heads on the ends of said valve adapted to reciprocate in suitable cylindrical chambers to actuate the valve; independent passages through the body of said valve connecting to the inner ends of said cylindrical chambers to the live-steam ports as the valve nears the end of its stroke to supply a small quantity of live steam to cushion the valve, as specified.

9. In a piston-valve for engines, the combination of a cylindrical valve-chamber, the ends of which are partitioned off to form cylindrical chambers; a valve adapted to reciprocate in said valve-chamber with suitable piston-heads on the ends thereof to be actuated by the steam-port opening into the valve a little distance from the piston-head and extending along the same into the exhaust-passage to permit the valve to cut off the steam when the piston is a little distance from the inner end of its stroke to form a cushion for the valve to prevent its slamming, as specified.

10. In a steam-engine, the combination of a cylindrical valve; a steam-cylinder; a piston in said steam-cylinder; piston-heads on the ends of said valves operating in suitable cylindrical chambers; a series of ports in said

valve for the delivery of live steam; a passage
connecting the cylindrical valve-chambers to
the ends of the steam-cylinder; a suitable
passage through the piston for delivering live
5 steam to trip the valve; an exhaust-passage
from the chambers at the end of the valve
opening at a considerable distance from the
inner ends thereof to form a cushion for the
valve so that when in operation under a heavy
10 load, the pressure of the steam actuating the
engine will be delivered into the ends of the
valve to compress the steam-cushion and by
so doing move the valve to increase the live-
steam portage to the steam-cylinder to in-
15 crease the speed, as specified.

11. In a steam-engine in which the valve is
actuated by steam-pressure from the engine-
cylinder, the combination with the engine-
cylinder, of a piston containing a passage for
20 the live steam to the valve; piston-heads on
the ends of the valve acting in suitable cy-
lindrical chambers; passages connecting the

outer ends of said cylindrical valve-chambers
to the outer ends of the steam-cylinder; pas-
sages a considerable distance from the inner 25
ends of the cylindrical valve-chambers for
the exhaust of steam to form a cushion to pre-
vent further motion of the valve; a series of
ports along the valve adapted to deliver steam
to the engine-cylinder in proportion to the 30
movement of the valve from side to side, all
coacting together so that as the resistance to
the engine increases the pressure in the cyl-
inder will increase and will be delivered
against the piston-heads of the valves to move 35
the valve farther to increase the supply of
live steam to the steam-cylinder, for the pur-
pose specified.

In witness whereof I have hereunto set my
hand and seal in the presence of two witnesses. 40

ILA N. MOORE. [L. S.]

Witnesses:

F. A. ALLWARDT,
N. Y. GREEN.