No. 750,486. PATENTED JAN. 26, 1904.

E. W. PENFOLD.

STEAM ACTUATED VALVE.

APPLICATION FILED MAY 4, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

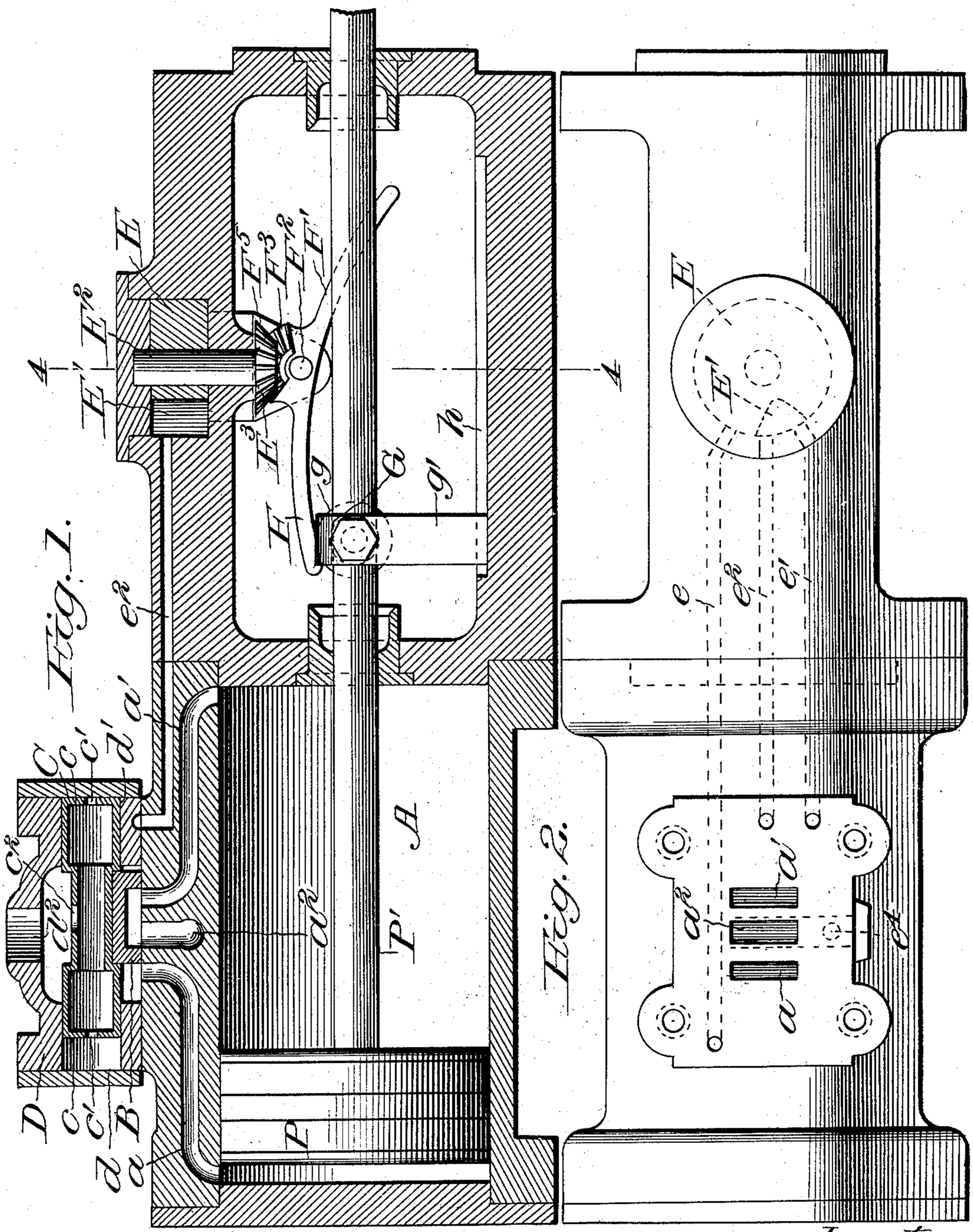

Fig. 1.

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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 5.

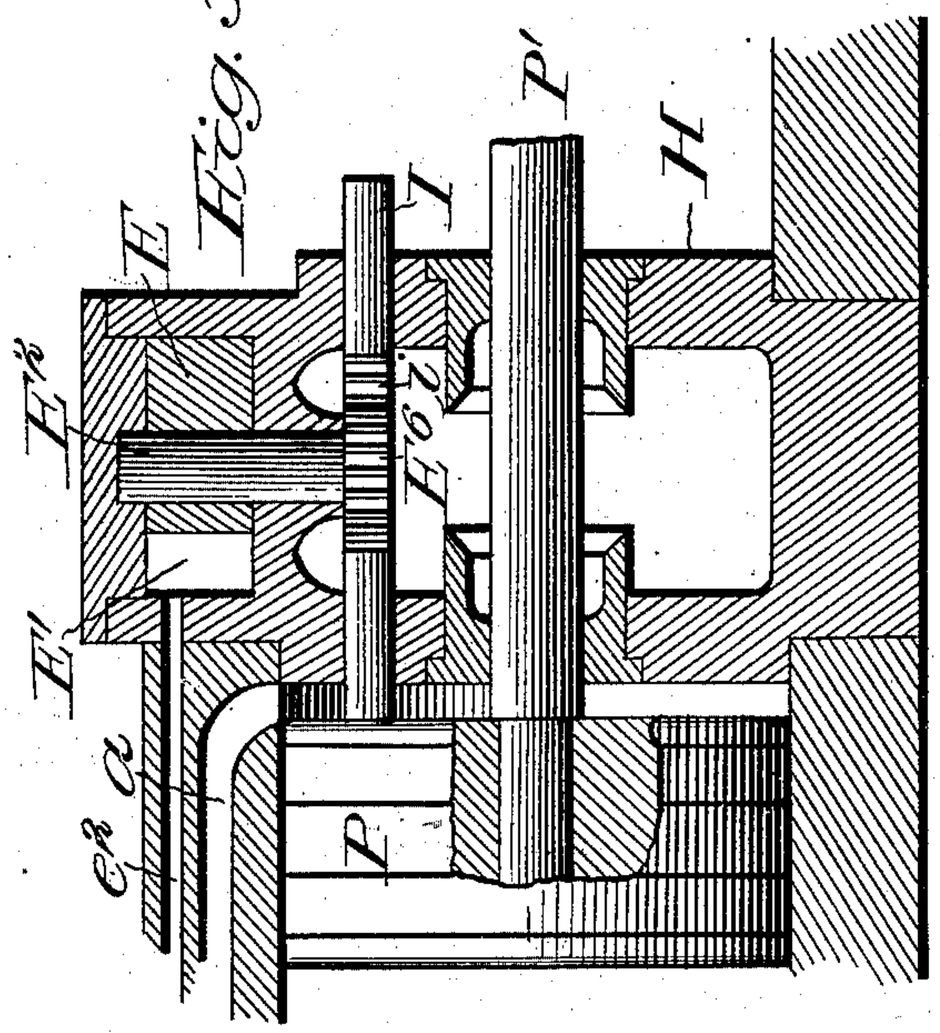


Fig. 3.

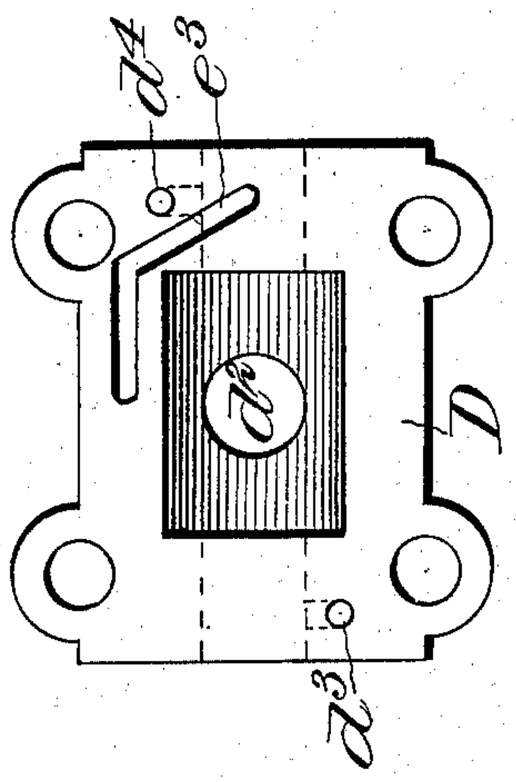
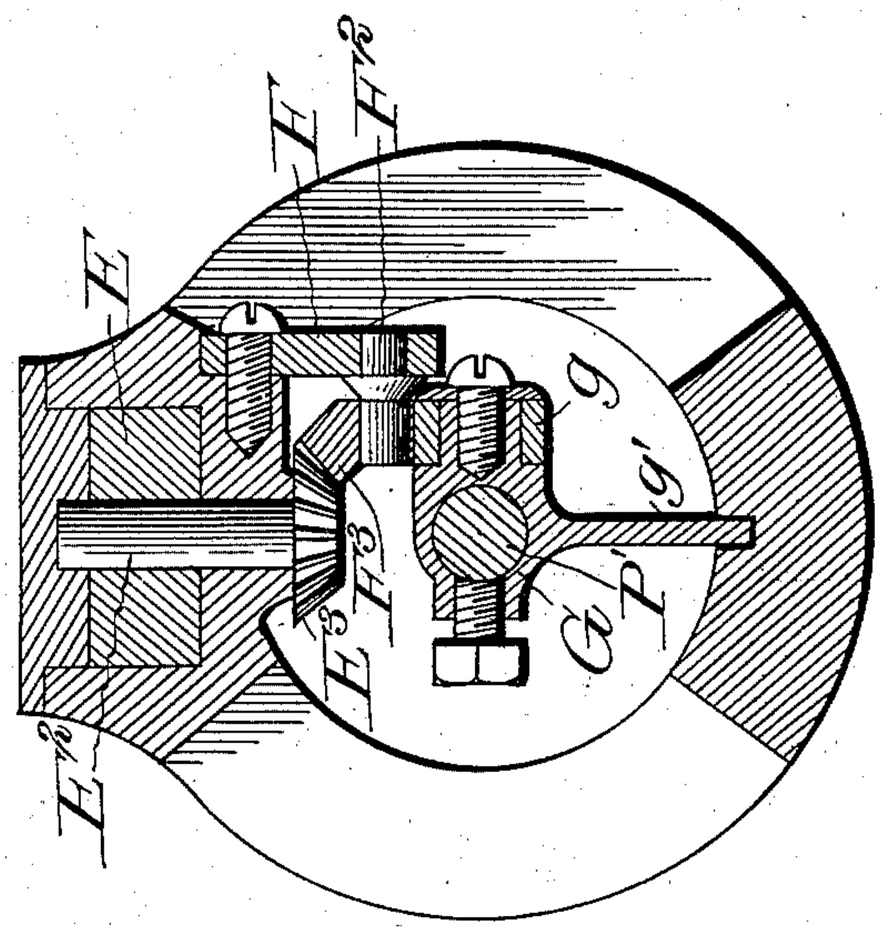


Fig. 4.



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UNITED STATES PATENT OFFICE.

EDWIN W. PENFOLD, OF BATTLECREEK, MICHIGAN.

STEAM-ACTUATED VALVE.

SPECIFICATION forming part of Letters Patent No. 750,486, dated January 26, 1904.

Application filed May 4, 1903. Serial No. 155,648. (No model.)

To all whom it may concern:

Be it known that I, EDWIN W. PENFOLD, of Battlecreek, in the county of Calhoun and State of Michigan, have invented certain new and useful Improvements in Steam-Actuated Valves; and I hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, which form part of this specification.

This invention is an improved mechanism for pumps, engines, &c.; and its object is to provide a steam-actuated main valve which will be certain in operation, will be held in position by the steam-pressure until it should move, will then move quickly and remain shifted until it should be reversed.

The invention consists in the novel arrangement of the steam-ports controlling the main valve, the novel controlling-valve governing the exhaust, and in other novel combinations and constructions of parts as will be hereinafter claimed, and the accompanying drawings illustrate the invention clearly and I will now describe the invention as illustrated in the drawings, in which—

Figure 1 is a longitudinal vertical section through the main cylinder, main-valve chamber, and controlling-valve chamber, showing the controlling-valve-operating devices in full lines. Fig. 2 is a top plan view of Fig. 1 with main valve removed, showing the controlling-ports. Fig. 3 is a detail inverted view of the main-valve casing. Fig. 4 is a vertical section on line 4 4, Fig. 1; and Fig. 5 a detail sectional view illustrating a slight modification of controlling-valve-operating mechanism.

The main cylinder A has the two main ports a a', extending from its opposite ends to near the center of main-valve seat, the exhaust-port a^2 opening into the valve-chamber between ports a a' and extending out to the atmosphere or exhaust-pipe, as usual. The main valve B is of the "D" type and is adapted to uncover one port a (or a') and simultaneously connect the other port a' (or a) with the exhaust-port a^2, as usual. The main valve B is operated by a piston-valve C, having heads c c fitted into cylindrical bores or chambers d d' in the ends of the valve-casing D, the central part of piston-valve C being preferably constricted so as to set into a semicylindrical recess in the top of valve B and cause valve B to move therewith. Steam enters the main-valve chamber through an aperture d^2 in the casing and can circulate around and above valve B and pass freely into either port a or a', which is uncovered. Preferably valve C is hollow and has small apertures c' in its ends and a central aperture c^2, so that steam can pass through the valve and "balance" it on its seats. The chamber d communicates with a passage e, which extends forwardly to and communicates with the controlling-valve chamber, which is located in a casting H, attached to the end of the cylinder. In said controlling-valve chamber is a rocking controlling-valve E. Similarly chamber d' connects with a passage e', leading into said controlling-valve chamber. Communicating with said controlling-valve chamber intermediate the passages e e' is a third exhaust-passage e^2, which leads back to the main-valve chamber and connects there with a by-pass e^3 in the bottom of the valve-casing, which by-pass leads to a port e^4, connecting with the exhaust-passage a^2.

The controlling-valve E is provided with a single port E′, which is adapted to establish communication between either passage e or e' and passage e^2, (closing communication with e before opening communication with e', however,) according to the position of valve E. The passages e e' open into chambers d d', respectively, through ports d^3 d^4 in the casing D, said ports being so located that if piston C be fully shifted to the right port d^4 in chamber d' will be closed, and if valve C be fully shifted to the left port d^3 in chamber d will be closed. The controlling-valve E is rocked by the direct action of the piston or piston-rod. As shown in Figs. 1 and 4, valve E is fast on a vertical stem E^2, which extends out of the controlling-valve chamber and has on its lower end a bevel-pinion E^3, meshing with a segment F^3, pivoted on a bolt F^2, attached to a bracket F^5, depending from the wall of the controlling-valve chamber, and said segment

F^3 is provided with oppositely-extending curved arms F F′, lying beside the piston-rod P′, and on this rod P′ is fastened a bracket G, carrying a roller *g*, adapted to work under the arms F F′ and raise and lower them alternately as the piston reciprocates. Bracket G is shown provided with a depending guide-finger *g′*, engaging a guide-slot *h* in the lower part of the casting H, which supports and partly incloses the controlling-valve mechanism.

As shown in Fig. 5, the valve-stem E^2 has a small pinion E^6 on its lower end meshing with a rack *i* on a sliding rod I, which extends through an opening in the cylinder-head and is attached to the piston, so as to be reciprocated thereby. The rack and pinion should be so proportioned to the stroke of the piston that the valve will be operated in the proper times and manner to control the main valve, as hereinafter explained.

Operation: Starting with the parts shown in the position indicated in Fig. 1, (piston P being at the left-hand end of its stroke, valves B and C at right-hand end of stroke, and valve E in position, holding passages *e′* and e^2 in communication,) the steam entering the valve-chamber will pass through port *a* behind piston P and drive it forward, the exhaust-steam escaping through ports *a′* a^2. The movement of piston-rod P causes roller *g* to first move from beneath arm F (valve E remaining stationary for the first part of the piston's outward movement) and then under arm F′ and lift it, causing valve E to first close communication between passages *e′* e^2 and then connect passages *e* e^2, whereupon the steam is exhausted from chamber *d*, and the pressure in the valve-chamber on piston C throws it to the left quickly, moving valve B with it, connecting port *a* with exhaust a^2 and port *a′* with the valve-chamber, so that steam is admitted to the right of piston P and it is moved backward. On the reverse stroke the valve E remains stationary until roller *g* begins to raise arm F. Then valve E is caused to first close communication between passages *e* e^2 and then connect passages *e′* e^2, whereupon steam is exhausted from chamber *d′* and immediately valves C B are forced to the right and held there by the steam-pressure in the valve-chamber until piston P is again moved to the right. These operations continue alternately and in proper sequence no matter how rapidly the engine may operate, and when once properly adjusted the valve mechanism will continue to act properly as valves C B are moved fully and quickly every time and cannot crawl back. The amount of "cut off" is easily controllable by varying the curvatures of arms F F′ or the diameter of roller *g*.

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

1. In combination, the engine-cylinder, piston, inlet and exhaust ports, and main valve; with a main-valve casing beside the cylinder having chambers in its ends, a piston-valve in said casing, connected with the main valve and having its head in said chambers, a controlling-valve chamber in advance of the cylinder and adjacent to the piston-rod, steam-passages leading through the walls of the cylinder and valve-chamber from the opposite chambers in said casing to said controlling-valve chamber, and an exhaust-passage leading from the latter chamber back to the exhaust-port in the main-valve chamber, an oscillating valve in the controlling-valve chamber adapted to establish communication between either steam-inlet passage and the exhaust-passage, and means actuated by the piston-rod for operating said controlling-valve, substantially as described.

2. In combination with the cylinder, piston, ports, main valve and piston-valve connected therewith, the main-valve casing having chambers in which the piston-valve heads work, and ports leading from the cylinder to said chambers; with the controlling-valve chamber adjacent to the piston-rod and in advance of the main-valve casing, the valve in said controlling-valve chamber, steam inlet and outlet parallel passages in the walls of the cylinder and controlling-valve chamber, leading respectively from the opposite piston-valve chambers forward to the controlling-valve chamber, an exhaust-passage in the walls of the cylinder and controlling-valve chamber and leading from the controlling-valve chamber to the exhaust-port in the main-valve chamber, and means substantially as described for operating the controlling-valve from the main piston.

3. In combination with the cylinder, its inlet and exhaust ports, the main valve, the main-valve casing having chambers in its ends, the piston-valve connected with the main valve and having its heads working in said chambers, the controlling-valve chamber, passages leading from said controlling-valve chamber to the chambers in the main-valve casing, respectively, and an intermediate exhaust-passage leading from the controlling-valve chamber, with an oscillating valve in said controlling-valve chamber rocking arms exterior to the controlling-valve chamber and adjacent to the piston-rod, gearing between said arms and said controlling-valve, and means on the piston-rod adapted to engage and rock said arms, substantially as described.

4. The combination with the main cylinder, its piston and ports, the main-valve chamber, the main valve, the steam-actuated piston-

valve, connected with the main valve, steam-passages for controlling the said piston-valve, and the oscillating controlling-valve for said passages; with a segment pivoted beside the piston-rod, gearing between said segment and the controlling-valve, oppositely-extending arms on said segment, a bracket on the piston-rod, a roller thereon adapted to alternately engage said arms as the piston-rod reciprocates, and a guide for said bracket, all substantially as described.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

EDWIN W. PENFOLD.

In presence of—

JAMES MCMILLAN,

WALLACE E. BRYANT.