Maxwell & Cope,

Slide Valve.

No. 94,015. Patented Aug. 24. 1869.

Fig 1

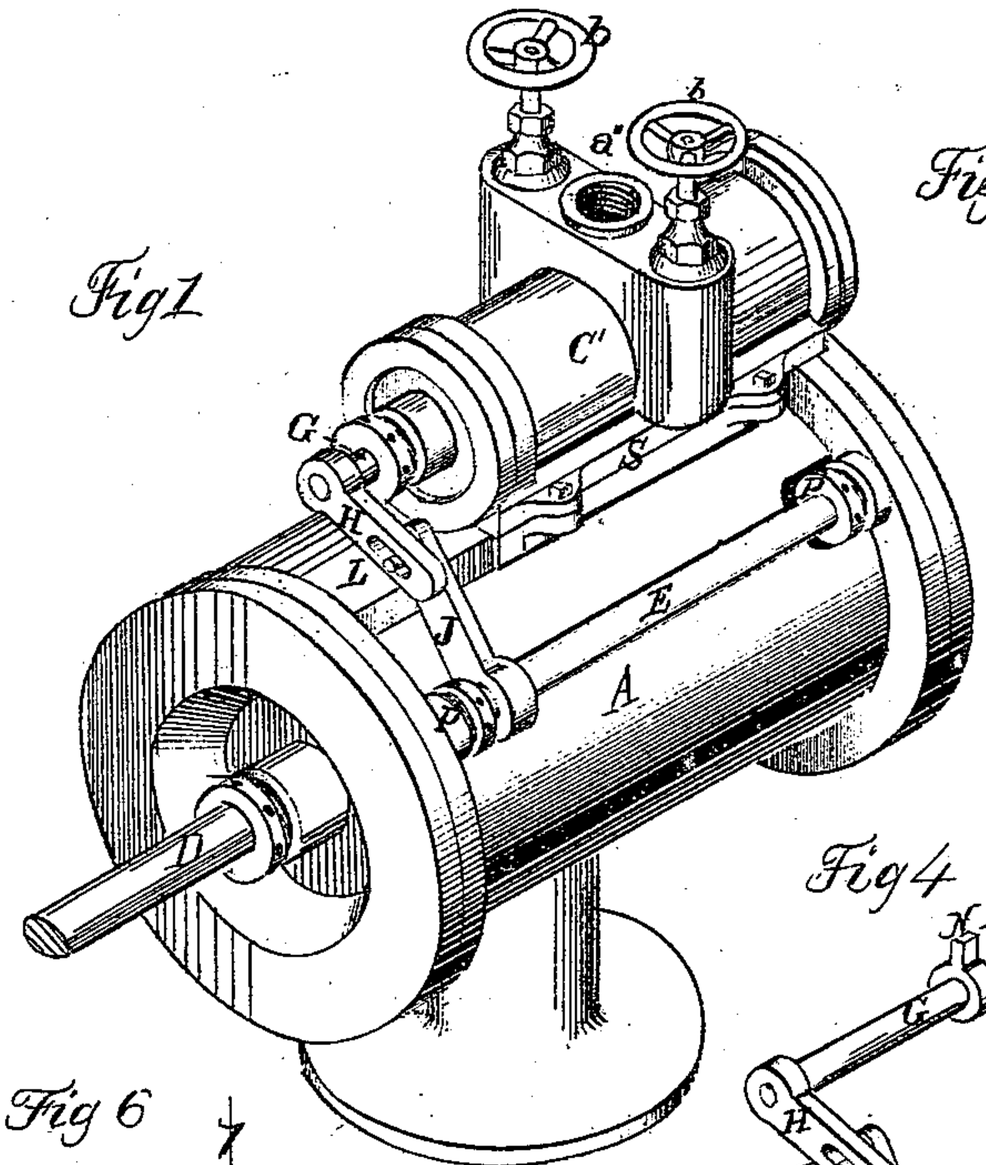


Fig 5

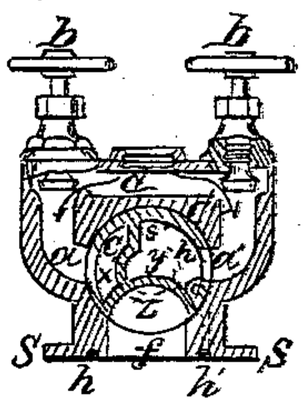


Fig 4

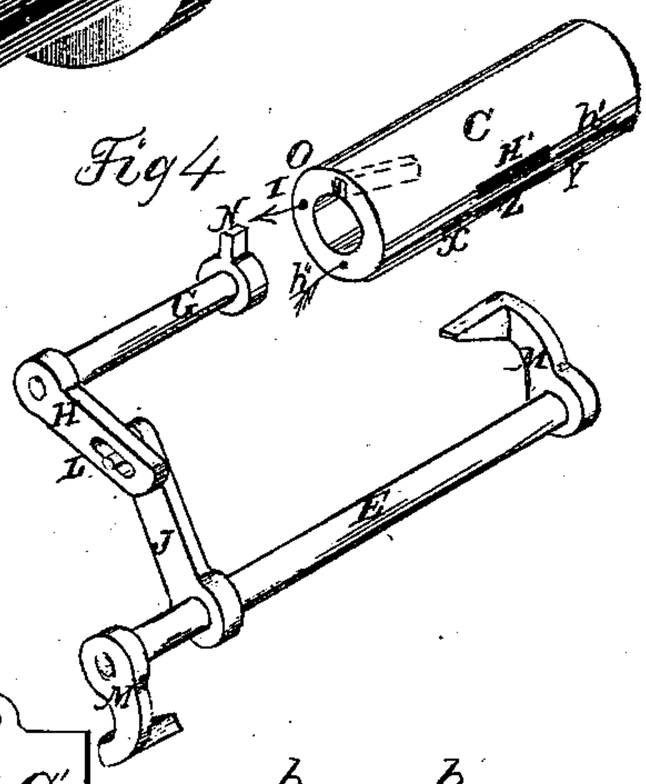


Fig 6

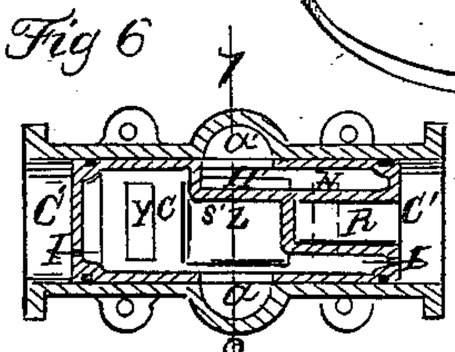


Fig 7

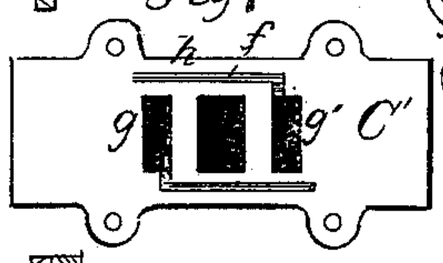


Fig 2

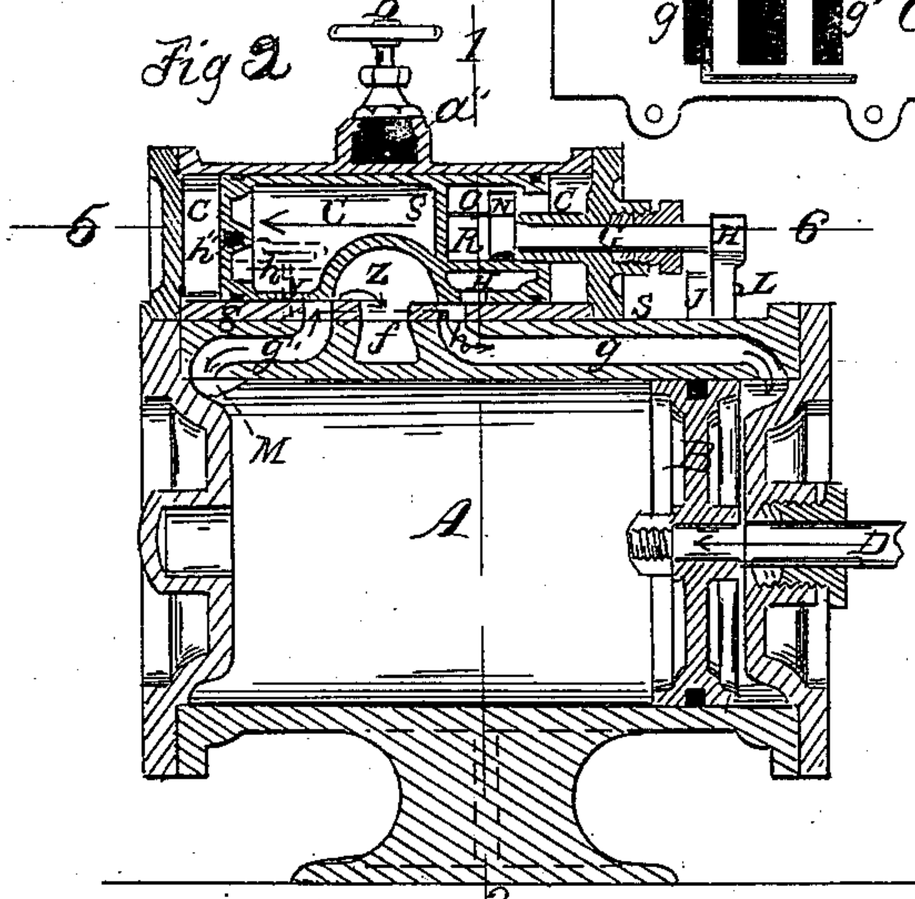
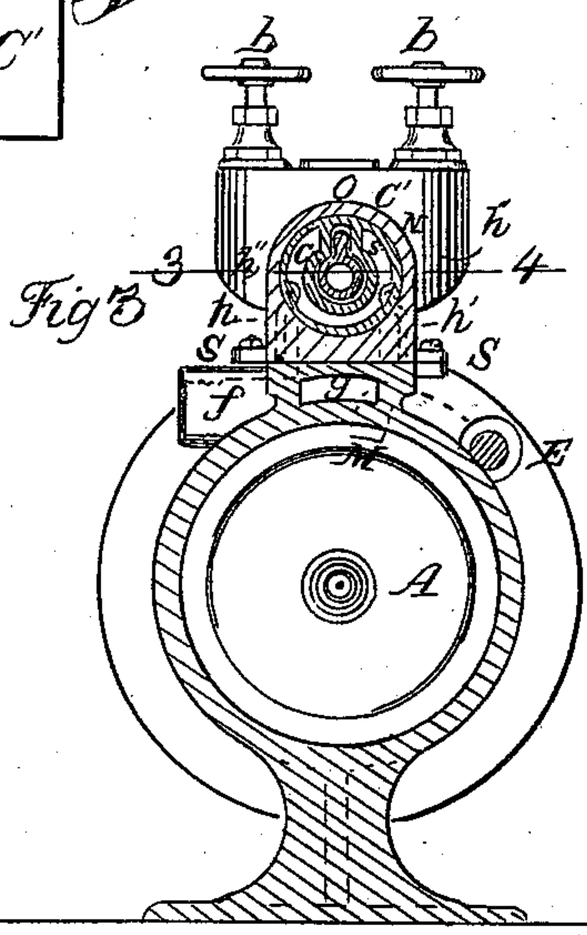


Fig 3



Attest[2]

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UNITED STATES PATENT OFFICE.

JAMES R. MAXWELL AND EZRA COPE, OF CINCINNATI, OHIO.

IMPROVEMENT IN STEAM-ENGINES.

Specification forming part of Letters Patent No. **94,015**, dated August 24, 1869.

To all whom it may concern:

Be it known that we, JAMES R. MAXWELL and EZRA COPE, of Cincinnati, in the county of Hamilton and State of Ohio, have invented a new and Improved Steam-Engine; and we hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

Figure 1 is a perspective view of the steam-cylinder. Fig. 2 is a longitudinal and vertical section of the same. Fig. 3 is a cross-section through the line 1 and 2, Fig. 2. Fig. 4 is a perspective view of the rock-shaft E, inclined arms M M′, arms J and H, rock-shaft G, finger N, hollow cylindrical slide-valve C, with its ports at X′, X, Y, and Z, and *h′*, holes *h″* and I, spiral groove O, chamber R, and wrist-pin L. Fig. 5 is a vertical cross-section through the valve-chest and throttle-valves, on line 7 and 8, Fig. 6, showing the steam-pipe *a″*, throttle or regulating valves *b b*, steam-ports to valve C *a a′*, exhaust-port Z and *f*, small exhaust-ports *h′ h′* from valve, port *h* in valve, also steam-ports *x* and *y*, and partition S′. Fig. 6 is a longitudinal section through the lines 3 and 4, Fig. 3, and 5 and 6, Fig. 2, showing the valve-chest C′, ports *a a′*, the hollow cylindrical slide-valve C, with its ports *x*, *y*, and *z*, chamber R, holes I I, and partition S′. Fig. 7 is a plan view of the joint between the steam-cylinder A and the valve-chest C, at S, Figs. 1, 2, 3, and 5, showing the steam-ports to the main cylinder at *g g*, the main exhaust-port at *f*, and the exhaust-ports from the valve-chest at *h h′*.

We make the main steam-cylinder in the usual manner, except that there is provided a stuffing-box at each end to receive the rock-shaft E parallel to the cylinder. Each end of the rock-shaft E is made to carry an arm with an oblique surface extending into the interior of the cylinder, in position to be moved outwardly by the piston alternately as its stroke terminates. The arm J is also secured on the rock-shaft E, to engage, by means of wrist-pin and slot, with the arm H, secured on the rock-shaft G, which enters the valve-chest through a stuffing-box, and is connected with the valve C by having a full end-bearing within the valve, and a finger, N, fitted to work in a short diagonal or spiral groove formed within the valve.

The hollow cylindrical slide-valve C has one small steam-port, I, additional at each end, to pass steam from the interior of the valve to the valve-chest or chamber C′; also two exhaust ports or openings, made larger than the small steam-ports just described, one commencing at each end, coming to the surface at *h′*, Fig. 4, but on opposite sides and ends. The surface-openings are of a length equal to the play of the valve, and communicate, through the ports *h′ h′* formed in the lower part of the valve-chamber C′, with the main steam-ports *g g* leading to the steam-cylinder, as shown at the joint S.

The exhaust-port Z of the valve is made to be in full communication with the exhaust-port and exit *f* of the main steam-cylinder. The partition S′ in the valve is made when two throttle or regulating valves are designed to be used in an engine that has unequal duties to perform on the two ends, as in the case of an upright or inclined pumping-engine. Then the two throttle-valves *b b* control and regulate the flow of steam admitted through the separate passages *a a′* to their respective ends of the steam-cylinder; but in cases where no such unequal duties are required, we make, as ordinarily, one throttle-valve and steam-passage to suffice, and dispense also with the partition S′ in the valve.

In Fig. 1 the rock-shaft E is shown to pass through two stuffing-boxes, P P, with the arm J placed between them, which plan we prefer for engines of long stroke; but for engines of short stroke the rock-shaft E can be surrounded by the metal of the cylinder A′ for its whole length, and extend through the cylinder-head and stuffing-box thereon; then the arm J, with its engaging-arm H, can be arranged clear of the length of the steam-cylinder. In this construction the shortest connection with a pump can be had, requiring merely room for the piston-rod glands and packing. The rock-shaft and its arms may be connected to and operate with the pump-cylinder and piston in like manner.

To operate our engine, steam is admitted at *a″*, Figs. 1, 2, and 5, and passes in the direction of the arrows through the regulating-valves *b b* into the valve C. The main piston B, Fig. 2, has completed its stroke in one direction, and is at the point of beginning its stroke in the reverse direction, as indicated by the arrows. The steam is being supplied

through the relating ports, and passes *x* in the valve C and *h g* into the cylinder. The valve C is also moving in the same direction, as shown by the arrows, while the exhaust-steam is escaping from the opposite end of the cylinder through the relating ports, and passes *g*, *z*, and *f* to the atmosphere. When the piston B approaches the end of its stroke it will come in contact with the arm M and move it outward, causing the partial rotation of the shaft E, which, in turn, imparts motion through the arms J and H to the shaft G and finger N; also, the valve C, bringing the port *h''* in the valve C, Fig. 3, in communication with the port *h* in the valve-chamber C', Figs. 3, 4, and 5, which will allow the steam to pass freely from the valve-chamber into the exhausting end of the steam-port *g'*, thus unbalancing the steam-pressure on the ends of the valve, moving it in the opposite direction to the piston, changing the steam, and reversing the piston continuously as long as the steam is supplied. The contact of the piston with the arm M' at the other end of the shaft E alternate the movements described.

The office of the small ports I I is to pass steam continually to the ends of the valve-chamber, preserving the balance of pressures on each end of the valve until the motion of the valve, first proceeding from the rock-shaft E, opens communication through the ports *h''* *h* with the interior of main cylinder on the exhaust side of the piston, when the valve will be in proper position and relation to the pressures to be reversed, and to direct the main flow of steam through the ordinary ports and passages *x* and *g* to the same side of the piston at the termination of its stroke, producing the equilibrium of pressures upon the ends of valve, and affording a perfect cushion to the end movement of the valve. The return or travel of the valve on the reverse movements brings all the ports and passages belonging to the opposite ends of the valve and cylinder in relation, the pressures on the ends of the valve become unbalanced by the escape of steam through the port *h''* and passages to the exhaust side of the piston, until the valve is in position and changes the direction of the main flow of steam to the exhaust side of piston, to begin the stroke in the opposite direction, when the pressures on the ends of the valve again become balanced, and the whole set of movements alternated.

The office of the diagonal groove O in the valve is to continue the motion of the valve initiated by the rock-shaft E further around than the throw of the finger N first accomplishes, in order to more fully open the exhaust-ports, and thus insure more promptness of action in the valve when the engine is moving slow.

If the character of the duty required of the engine be such as to need one pressure for the direct stroke, and a greater or less pressure for the reverse stroke, the amount of steam admitted to each end is varied and regulated by the two throttle-valves *b b*, Figs. 1, 3, and 5, adjusted to control the flow of steam, each separately to the end of steam-cylinder, respectively, as they belong.

Having fully described the construction and operation of our invention, what we claim, and desire to secure by Letters Patent, is—

1. The rock-shaft E, parallel to the cylinder, actuated by contact of oblique surfaces of the arms M M' thereon and the piston within the cylinder, constructed, combined, and arranged as herein set forth.

2. The rock-shaft E and the valve C, having a diagonal groove, O, in combination with their intervening gear, substantially as described.

3. The rock-shaft G and the finger N, in combination with the diagonal groove O, substantially as described.

4. The valve C with the steam-supply openings I I', exhaust-openings *h' h'*, constructed and arranged with reference to the chamber C' C'', and the induction and eduction ports thereof, substantially as described.

5. The steam-cylinder A, in combination with the two separate throttle or regulating valves *b b*, arranged to control the flow and quantity of steam admitted through separate passages, respectively, to each end of the steam-cylinder, substantially as described.

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EZRA COPE.

Attest:
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F. MARCHANT.