(No Model.)

2 Sheets-Sheet 1.



(No Model.)



# UNITED STATES PATENT OFFICE.

### CHARLES F. CHANDLER, OF NEWARK, NEW JERSEY.

#### STEAM-ENGINE.

## SPECIFICATION forming part of Letters Patent No. 357,655, dated February 15, 1887.

Application filed March 17, 1886. Serial No. 195, 532. (No model.)

### To all whom it may concern:

Be it known that I, CHARLES F. CHANDLER, of Newark, in the county of Essex and State of New Jersey, have invented a new and Im-5 proved Steam Engine, of which the following is a full, clear, and exact description.

The object of my invention is to provide a

new and improved steam-engine in which the pressure of the steam is completely utilized, 10 and the power derived from the steam is equally applied to the crank-shaft in such a

manner as to avoid dead-centers. The invention consists of a steam-cylinder

- having two pistons which advance toward or 15 recede from each other; of a rotary valve in the steam chest; of pitmen connected with crank arms placed at angles to each other on the main shaft, and of a reversing-gear for the rotary valve.
- <sup>20</sup> The invention also consists of various parts and details, and combinations of the same, as will be fully described hereinafter, and then pointed out in the claims.
- Reference is to be had to the accompanying 25 drawings, forming a part of this specification, in which similar letters of reference indicate corresponding parts in all the figures.

Figure 1 is a plan view of my improvement. Fig. 2 is a longitudinal sectional elevation of

30 the same on the line x x, Fig. 1. Fig. 3 is a top view of the valve-seat; and Fig. 4 is a bottom view of the rotary valve.

The steam engine is mounted on a bed-plate, A, of suitable construction, and provided with

- 35 the cylinder B, having two pistons, C and D, of which the piston C has a piston rod, E, connected with a cross head, F, sliding in suitable bearings and connected with the crankarm G' on the main shaft G by the pitman H.
- 40 The piston D is provided with a piston rod, I, on the outer end of which is secured a crosshead, J, sliding in suitable bearings, J', and having each end  $J^2$  connected with a crankarm,  $G^2$ , attached to the main shaft G by the
- 45 rods or connecting arms K. The crank arm G' is set in such a position in relation to the crank arm G<sup>2</sup> that when one is in a dead-center position the other stands at an angle to the same.
- 50 The cylinder B is provided with the porthole *a*, which opens at its ends into the re-

spective ends of the cylinder, and connects with the valve seat by means of the opening b, and with a port, c, which leads from the center of the cylinder to the valve-seat L. The 55 exhaust-port d connects with the seat L and leads to the exhaust-pipe M.

The steam chest N is fastened to the cylinder B, and is provided with the usual steaminlet, N'. In the steam chest N operates the 60 rotary valve O, having a wedge-shaped aperture, O', and a recess, O<sup>2</sup>. The rotary valve O is provided with a vertical valve stem, O<sup>3</sup>, which passes through a suitable stuffing-box in the steam chest N, and is provided on its 65 outer end with the arm P, which connects by a link, Q, with the rocking arm R, pivoted at its lower end to the bed-plate A.

The eccentric S, mounted on the main shaft G, is provided with the eccentric rod T, hav- 70 ing a handle, T', and a notch, T<sup>2</sup>, which engages with a pin, R', on the rocking arm R. The eccentric rod T can be locked in place on the pin R' by means of the arm U, pivoted to the rocking arm R, which is also provided 75 with a handle,  $\mathbb{R}^2$ .

The operation is as follows: The rotary valve O is so arranged that when its aperture O' is over the opening b of the port a steam is admitted to both ends of the cylinder B, and at 30 the same time the other port, c, connects, by means of the cavity O<sup>2</sup>, with the exhaust port d, and when the opening O' is over the port csteam is admitted to the center of the cylinder B, and the port b is connected with the exhaust- 85port d by means of the cavity O<sup>2</sup> in the rotary valve O. As shown in the drawings in Fig. 2, the pistons C and D are in their innermost position, and steam being admitted to the cylinder B by means of the port c and the 90 rotary valve O, as above described, the pistons C and D will recede from each other and impart motion by means of their piston-rods to their respective cross-heads, which in turn actuate the crank-arms on the main shaft G by 95 means of the pitman H and the connectingrods K. Before the pistons C and D have reached the end of their outward stroke the rotary valve will close the port c and open the port b, so as to admit steam to the ends of the 100 cylinder. This movement of the valve O is derived from the main shaft G by the eccentric S and its arm T, imparting a rocking motion to the arm R, which in turn, by means of the link Q and the arm P, turns the valve O. The motion of the pistons C and D will be
reversed by the steam entering through the port a, so as to force the pistons C and D toward each other. The exhaust takes place through the port c into the cavity O<sup>2</sup>, and out through the exhaust-port d, when the pistons are receding from each other the exhaust takes place by the port a, its opening b, the cavity O<sup>2</sup>, and the exhaust d, as before described.

The engine can be run by hand when necessary—as, for instance, when it stands on centers—by disengaging the arm U from the eccentric arm T, and lifting the eccentric rod upward by means of the handle T', so as to disengage the notch T<sup>2</sup> from the pin R' of the

rocking arm R, and by taking hold of the handle R<sup>2</sup> on the rocking arm R the rotary valve O can be thrown in such a position that the opening O' will come directly over the 25 port b, or over the port c, as the case may be. The eccentric arm T is then again engaged with the pin R' on the rocking arm R and locked in place by the arm U.

Having thus fully described my invention, 30 I claim as new and desire to secure by Letters Patent—

In a steam-engine, the combination of a cylinder provided with a port opening at the ends of the cylinder, a port opening at the 35 center of the cylinder, and an exhaust-port, and two pistons operating in the said cylinder and actuating the main shaft by suitable connections, with an eccentric placed on the said main shaft and operating a rocking arm, and 40 an oscillating valve having an aperture and a recess in its bottom and suitably connected with the rocking arm operated by the eccentric, substantially as shown and described.

2. In a steam-engine, the combination of a
steam-cylinder provided with inlet and outlet ports, and an oscillating valve connected by suitable links to a rocking arm pivoted on the

bed plate of the engine, with an eccentric placed on the main shaft of the engine and provided with an eccentric-rod, which can be 5° detached from the rocking arm or locked in position on the same by a pivoted arm, substantially as shown and described.

3. In a steam-engine, the cylinder B, provided with a port, a, leading to the ends of 55 the cylinder and opening into the valve seat L by means of the opening b, the port c, leading to the center of the cylinder, and the exhaust-port d, leading to the exhaust-pipe M, in combination with the pistons C and D, op- 60 erating the cranks G' and G<sup>2</sup> on the main shaft G by suitable connections, and the oscillating valve having the aperture O' and the recess O<sup>2</sup>, and operated from the main shaft G by the eccentric S, having an eccentric-rod, T, con- 65 nected with the rocking arm R, connected to the arm P of the stem O<sup>3</sup> of the valve O by the link Q, substantially as shown and described.

4. In a steam-engine, the cylinder B, having 70 the ports a, c, and d, the pistons C and D, operating the main shaft G by suitable connections, and the oscillating valve O, having the aperture O' and the recess O<sup>2</sup>, in combination with the rocking arm R, pivoted to the bedplate and connected, by means of the link Q, to the arm P of the valve-stem O<sup>3</sup>, substantially as shown and described.

5. In a steam-engine, the cylinder B, having the ports a, c, and d, the pistons C and D, operating the main shaft G by suitable connections, and the oscillating valve O, having the aperture O' and the recess O<sup>2</sup>, in combination with the eccentric S, the eccentric-rod T, having a handle, T', and a notch, T<sup>2</sup>, the rocking 85 arm R, having the pin R', the handle R<sup>2</sup>, and the rocking arm U, and the link Q, attached to the arm P of the valve-stem O<sup>3</sup>, substantially as described.

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Witnesses:

CARL LENTZ, FREDERICK F. HEY.

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