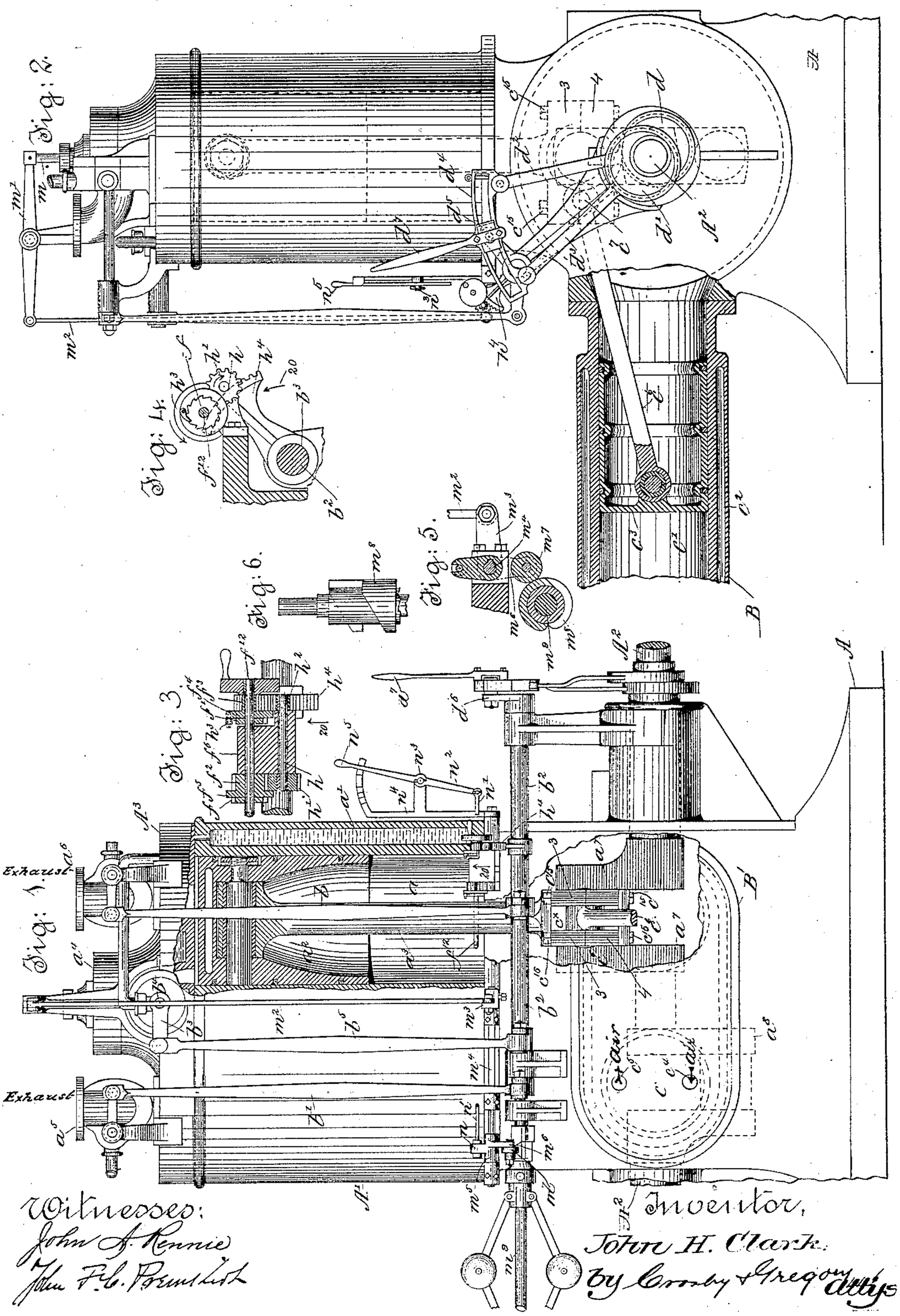
(No Model.)

J. H. CLARK.

REVERSIBLE GAS ENGINE.

No. 353,402. Patented Nov. 30, 1886.



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JOHN H. CLARK, OF BOSTON, ASSIGNOR TO OLIVER AMES, OF EASTON, MASS.

REVERSIBLE GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 353,402, dated November 30, 1886.

Application filed February 25, 1886. Serial No. 193,178. (No model.)

To all whom it may concern:

Be it known that I, JOHN H. CLARK, of Boston, county of Suffolk, and State of Massachusetts, have invented an Improvement in Reversible Gas-Engines, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

This invention relates to gas-engines of that class shown and described in United States application, Serial No. 176,921, dated September 12, 1885, and in application, Serial No. 182,223, dated November 9, 1885, and has for its object to produce a reversible gas-engine.

My invention consists, essentially, of one or more fire-cylinders provided with gas admitting and exhaust valves, a fire-bonnet communicating with said fire-cylinders and provided with a valve to admit air to said bonnet, combined with one or more air-cylinders provided with air inlet and outlet valves, and with means to reverse in unison the operation of the valves in the fire-cylinders.

My invention also consists of one or more fire-cylinders provided with gas admitting and exhaust valves, a fire-bonnet communicating with said fire-cylinders and provided with a valve to admit air to said bonnet, combined with one or more air-cylinders provided with air inlet and outlet valves, and with means to reverse in unison the operation of the valves in the fire-cylinders, and with means, substantially as described, to reverse the operation of the air-valve of the fire-bonnet substantially in unison with the valves of the fire-cylinders to thereby reverse the rotation of the crank-shaft.

My invention further consists of mechanism, as will be described, by which the oil-pump, (shown in the application No. 176,921, above referred to, and common to this class of engines) is positively driven in one direction, irrespective of the direction of rotation of the crank-shaft, to thereby maintain a constant supply of oil to the fire-bonnet.

My invention consists, also, in a novel manner of joining the connecting-rod of an air-piston directly to the connecting-rod of a co-operating fire-piston to diminish the strain on the crank-shaft and to economize in space.

My invention also consists in an engine containing two fire-cylinders arranged side by side, two air-cylinders arranged side by side and at an angle to the said fire-cylinders, and pistons in the said fire and air cylinders, and attached connecting-rods, combined with a crank-shaft to operate all the said pistons, substantially as will be described.

Figure 1 is a front elevation of a reversible gas-engine embodying my invention, the drawing being broken out to show the manner of joining together the connecting-rods of the fire and air cylinders; Fig. 2, a right-hand side elevation of Fig. 1, with one of the air-cylinders in section and with the head broken off; Fig. 3, an enlarged detail of the oil-pump-driving mechanism. Fig. 4 is a left-hand end view of Fig. 3; Fig. 5, a detail of mechanism to operate the valve controlling the admission of air to the fire-bonnet, and Fig. 6 a detailed view of the cam actuating the mechanism for opening the valve in the fire-bonnet.

The base A, the jacketed casting A′, containing two fire-cylinders side by side, one cylinder, *a*, being partially broken out, each cylinder being surrounded by a water-space, *a′*, the crank-shaft A^2, the fire-piston a^2, connecting-rod a^3, one in each fire-cylinder, the cylinder-head A^3, fire-bonnet a^4, exhaust-valves a^5 a^6 for the fire-cylinders, links *b b′*, connecting the exhaust-valves with the rock-shaft b^2, arm b^3, connected to the hollow spindle b^4 of the oscillating valve, (not shown,) and link b^5, joining the said valve to the rock-shaft b^2, are all substantially as shown in the said applications, to which reference may be had.

The base A, as herein shown, has attached to it by bolts or in other usual manner a second casting, B, containing two air-cylinders, *c c′*, side by side, and provided with a jacket and water-space, c^2, having suitable ports for the circulation of water in the said space. These air-cylinders, as herein shown, occupy a position substantially at right angles to the fire-cylinders, and each of the said air-cylinders contains a piston, only one of which, as c^3, is shown, the said cylinders having a suitable head, B′, the head having for each cylinder a suitable air-inlet valve, c^4, and an air-outlet valve, c^5, as shown in Fig. 1, at the left-hand cylinder, said valves being the same as shown in application, Serial No. 176,921, dated Sep-

tember 12, 1885, in connection with the air-cylinder therein described.

The connecting-rod of each air-piston is joined to the connecting-rod of a corresponding fire-piston; and to illustrate I have herein shown the connecting-rod c^6 of one air-piston, c^3, as joined to the connecting-rod a^3 of the fire-piston a^2. The connecting-rod c^6 is extended into a slot, $c^\times$, formed in the usual caps, 3, and foot-pieces 4 of the connecting-rod a^3, and is held securely in place by a pin, c^7, inserted through said caps and foot-pieces and the connecting-rod c^6, the said caps and foot-pieces being held together by bolts c^{15}, the rod c^6 being permitted to turn on the pin c^7 as a pivot. This manner of joining the said connecting-rods effects a saving in space and obviates torsional strains upon the crank-shaft.

The pistons in the fire-cylinders are joined through their connecting-rods to cranks a^7 and a^8 on the crank-shaft A^2, the crank a^8 being shown in dotted lines, Fig. 1. The cranks a^7 a^8 are set opposite or at an angle of one hundred and eighty degrees, so that while one piston, as a^2, is at the top of its stroke, as shown in Fig. 1, the other fire-piston (not herein shown) will be at the bottom of its stroke.

The piston of each fire-cylinder receives upon it when it has reached the top of its stroke a charge of ignited gas from the valve-chamber containing the oscillating valve shown in application No. 182,223, the said charge being admitted first to one and then to the other fire-cylinder, as described in said application, the piston receiving upon it the said charge of ignited gas being at the top of its stroke, while the other piston is at the bottom of its stroke.

The oscillating valve and exhaust-valves referred to are connected to and operated by a rock-shaft, b^2, which is herein shown as operated by one of two eccentrics, d d', on the crank-shaft A^2. The eccentrics d d' are connected, respectively, by their rods d^2 d^3 to a link, d^4, the said link having within it a slide-block, d^5, which is connected to a crank, d^6, fast on the rock-shaft b^2, the said link also having attached to it a handle, d^7, by which to move it over the block d^5, the position of the link with relation to the slide-block determining which one of the said eccentrics shall actuate the said rock-shaft, and consequently which way the engine shall run.

To enable the oil-pump, common to the engines shown in the application, Serial No. 176,921, hereinbefore referred to, to be used in connection with a reversible gas-engine, I have keyed or secured the ratchets f f' upon the shaft f^{12}, on which in practice are mounted the eccentrics driving the oil-pump, as shown in the said application, and said shaft has loosely mounted on one end of it a collar, f^4, and pinion f^3 integral therewith, and a second collar, f^5, and pinion f^2 integral with the collar f^5 on the opposite end of the said shaft, the said collar being separated, as shown in Fig. 3, by a bearing, f^6, for the shaft f^{12}. The bearing f^6 also supports a second short shaft, h, on which is fastened at opposite ends of the said bearing a gear, h', and pinion h^2. Each collar f^4 f^5 has secured to it a push-pawl, h^3. (Shown in Figs. 3 and 4.) The rock-shaft b^2 has secured to it a segmental gear, h^4, which meshes with the pinion h^2 on the shaft h and pinion f^3 on shaft f^{12} and rotates the said pinion in a direction opposite to the direction of movement of said rock-shaft, the oscillation of said segmental gear imparting rotation to the oil-pump shaft through the gearing described and in a manner as will now be set forth.

Referring to Fig. 3, it will be seen that the pinion h^2 rotates the shaft h and the gear h', fast on the said shaft, and the latter gear meshes with and rotates the gear f^2 and collar f^5, loose on the shaft f^{12}, the pinion f^3 and collar f^4, loose on the shaft f^{12}, being also rotated by the segmental gear h^4. When the segmental gear h^4 is oscillated in the direction of the arrow 20, the pinion h^2 and gear h', fast on the shaft h, and the pinion f^3, loose on the shaft f^{12}, are all rotated in the direction of the arrow on them in Fig. 4. The gear h' engages and drives the gear f^2 and collar f^5, loose on the shaft f^{12}, and the pawl h^3 on the collar f^5 pushes the ratchet f, fast on the shaft f^{12}, thereby rotating the said shaft, the collar f^4 at such time being moved in the opposite direction through the segmental gear h^4 and pinion f^3, permitting the pawl h^3 on the collar f^4 to slip over the teeth of the ratchet f', fast on the said shaft f^{12}. When the segmental gear h^4 is oscillated in a direction reverse of that indicated by arrow 20, then the pawl carried by the collar f^4 becomes the driver for the shaft f^{12}. Thus it will be seen that the oil-pump shaft f^{12} is rotated positively in one direction, irrespective of the direction of rotation of the crank-shaft A^2.

The valve in the fire-bonnet a^4, which controls the admission of air to said bonnet, is opened at each half-revolution of the crank-shaft, in order to admit a fresh supply of air to be carbureted, which carbureted air is ignited, and, expanding, is admitted first to one and then to the other fire-cylinder by the oscillating valve in the manner as described in the application No. 182,223, referred to.

The valve-stem m of the air-admitting valve referred to is pivoted to one arm of a lever, m', the other arm of which has connected to it a link, m^2, pivoted to a lever, m^3, on a shaft, m^4. (See Fig. 5.) The shaft m^4, as herein shown, has splined to it a hub, m^5, provided with an arm, m^6, which carries a roller or pin, m^7, said roller or pin being acted upon by one member of a double cam, m^8, (see Fig. 6,) on the governor-shaft m^9, the component parts of said double cam being in reverse relation to each other. The hub m^5 also has extended from it a second arm, n, to which is secured a rod, n', which will preferably be extended across the engine and be pivoted to a lever,

n^2, as shown in Fig. 1, said lever being fulcrumed at n^3 to a frame, n^4, and provided with a handle, n^5, by which the lever n^2 may be turned on its pivot to move the rod n', so as to slide the hub m^5 on the shaft m^4, so that the roller or pin m^7 may engage the second member of the double cam m^8, to reverse the operation of the air-admitting valve substantially in unison with the reversal of the oscillating and exhaust valves, as above described.

I claim—

1. In a reversible gas-engine, one or more fire-cylinders provided with gas admitting and exhaust valves, a fire-bonnet communicating with said fire-cylinders and provided with a valve to admit air to said bonnet, combined with one or more air-cylinders provided with air inlet and outlet valves, and with means, substantially as described, to in unison reverse the operation of the valves in the fire cylinders, substantially as specified.

2. In a reversible gas-engine, one or more fire-cylinders provided with gas admitting and exhaust valves, a fire-bonnet communicating with said fire-cylinders and provided with a valve to admit air to said bonnet, combined with one or more air-cylinders provided with air inlet and outlet valves, and with means, substantially as described, to in unison reverse the operation of the valves in the fire-cylinders, and with means, substantially as described, to reverse the operation of the air-valve of the fire-bonnet substantially in unison with the valves of the fire-cylinders, substantially as set forth.

3. In a reversible gas-engine, one or more fire-cylinders provided with gas admitting and exhaust valves, a fire-bonnet communicating with said fire-cylinders and provided with a valve to admit air to said bonnet, combined with one or more air-cylinders set at an angle to the said fire-cylinders and provided with air inlet and outlet valves, and with means, substantially as described, to reverse in unison the operation of the valves of the fire-cylinders, and with means, substantially as described, to reverse the operation of the air-valve of the fire-bonnet substantially in unison with the valves of the fire-cylinders, substantially as specified.

4. In a reversible gas-engine, one or more fire-cylinders provided with gas admitting and exhaust valves, a fire-bonnet communicating with said fire-cylinders and provided with a valve to admit air thereto, combined with one or more air-cylinders provided with air inlet and outlet valves, and having the connecting-rod of each air-piston joined directly to the connecting-rod of a fire-piston, substantially as described.

5. In a reversible gas-engine, one or more fire-cylinders provided with gas admitting and exhaust-valves, a fire-bonnet communicating with said fire-cylinders and provided with a valve to admit air thereto, combined with one or more air-cylinders provided with air inlet and outlet valves and having the connecting-rod of each air-piston joined directly to the connecting-rod of a fire-piston, and with means, substantially as described, to reverse the operation of the valves in the fire-cylinders, substantially as set forth.

6. In a reversible gas-engine, one or more fire-cylinders provided with gas admitting and exhaust valves, a fire-bonnet communicating with said fire-cylinders and provided with a valve to admit air thereto, combined with one or more air-cylinders provided with air inlet and outlet valves and having the connecting-rod of each air-piston joined directly to the connecting-rod of a fire-cylinder, and with means, substantially as described, to reverse the operation of the valves in the fire-cylinders, and with means, substantially as described, to reverse the operation of the air-valve of the fire-bonnet to correspond to and co-operate with valves of the fire-cylinders, substantially as set forth.

7. In a reversible gas-engine, one or more fire-cylinders provided with gas admitting and exhaust valves, a fire-bonnet communicating with said fire-cylinders and provided with a valve to admit air thereto, combined with one or more air-cylinders set at an angle to the said fire-cylinders, said air-cylinders being provided with air inlet and outlet valves, and having the connecting-rod of each air-piston joined directly to the connecting-rod of a fire-piston, substantially as described, and with means, substantially as described, to reverse the operation of the valves of the fire-cylinders, and with means, substantially as described, to reverse the operation of the air-valve of the fire-bonnet to correspond to and co-operate with the valves of the fire-cylinder, substantially as set forth.

8. In a reversible gas-engine, the air-cylinder casting B and fire-cylinder casting A, provided with a fire-bonnet, to which oil is fed, combined with the shafts h and f^{12}, and gearing, substantially as described, on said shafts, and with the gear h^4, to actuate the gears on the said shafts, whereby the oil is fed continuously into the fire-bonnet irrespective of the direction of rotation of the crank-shaft, substantially as described.

9. In a gas-engine, two fire-cylinders arranged side by side, two air-cylinders arranged side by side and at an angle to the said fire-cylinders, and pistons in said fire and air cylinders and attached connecting-rods, combined with a crank-shaft to operate all the said pistons, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOHN H. CLARK.

Witnesses:

J. H. CHURCHILL,

F. CUTTER.