(No Model.)

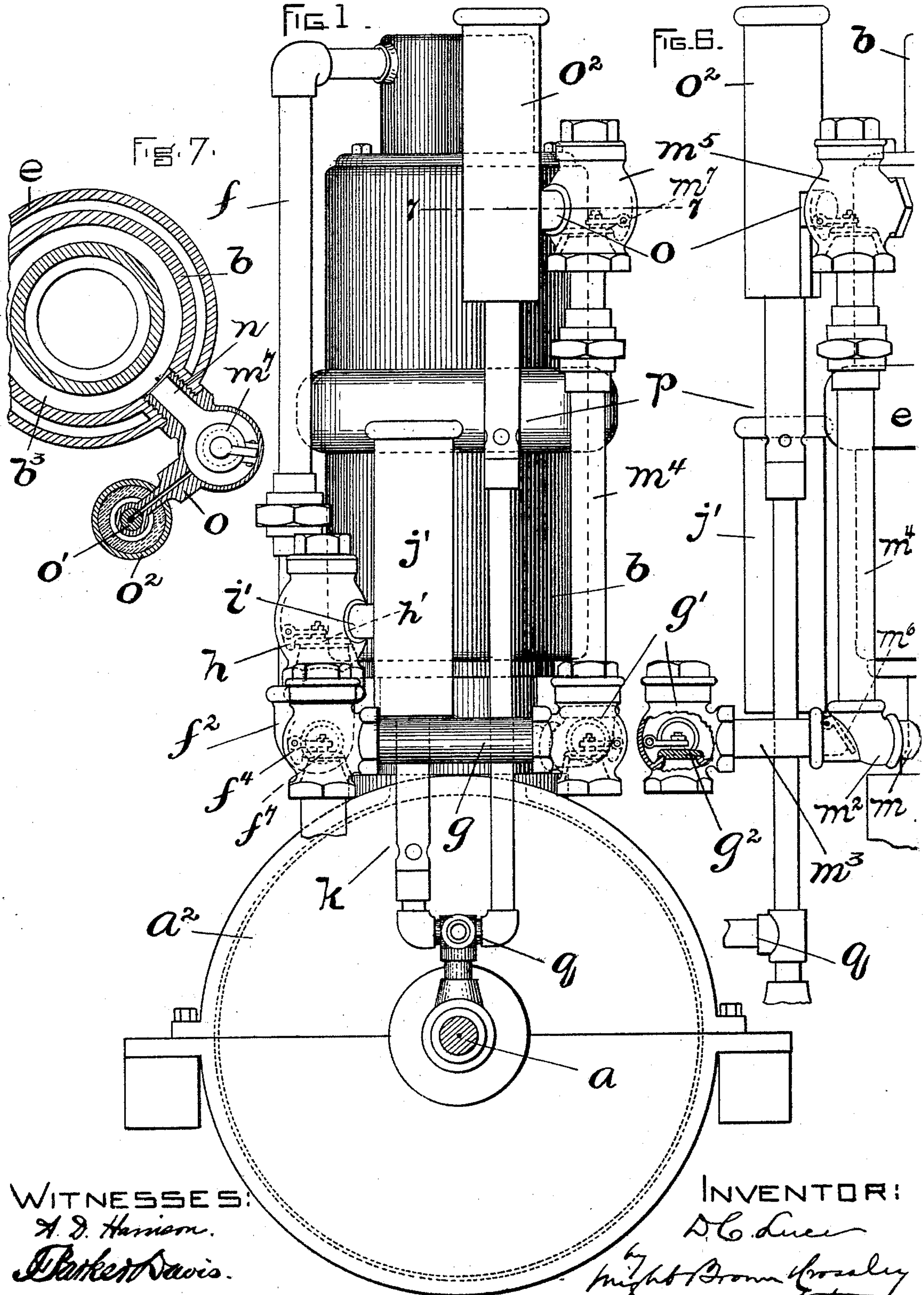
4 Sheets—Sheet 1.

D. C. LUCE.

GAS ENGINE.

No. 519,863.

Patented May 15, 1894.



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WASHINGTON, D. C.

(No Model.)

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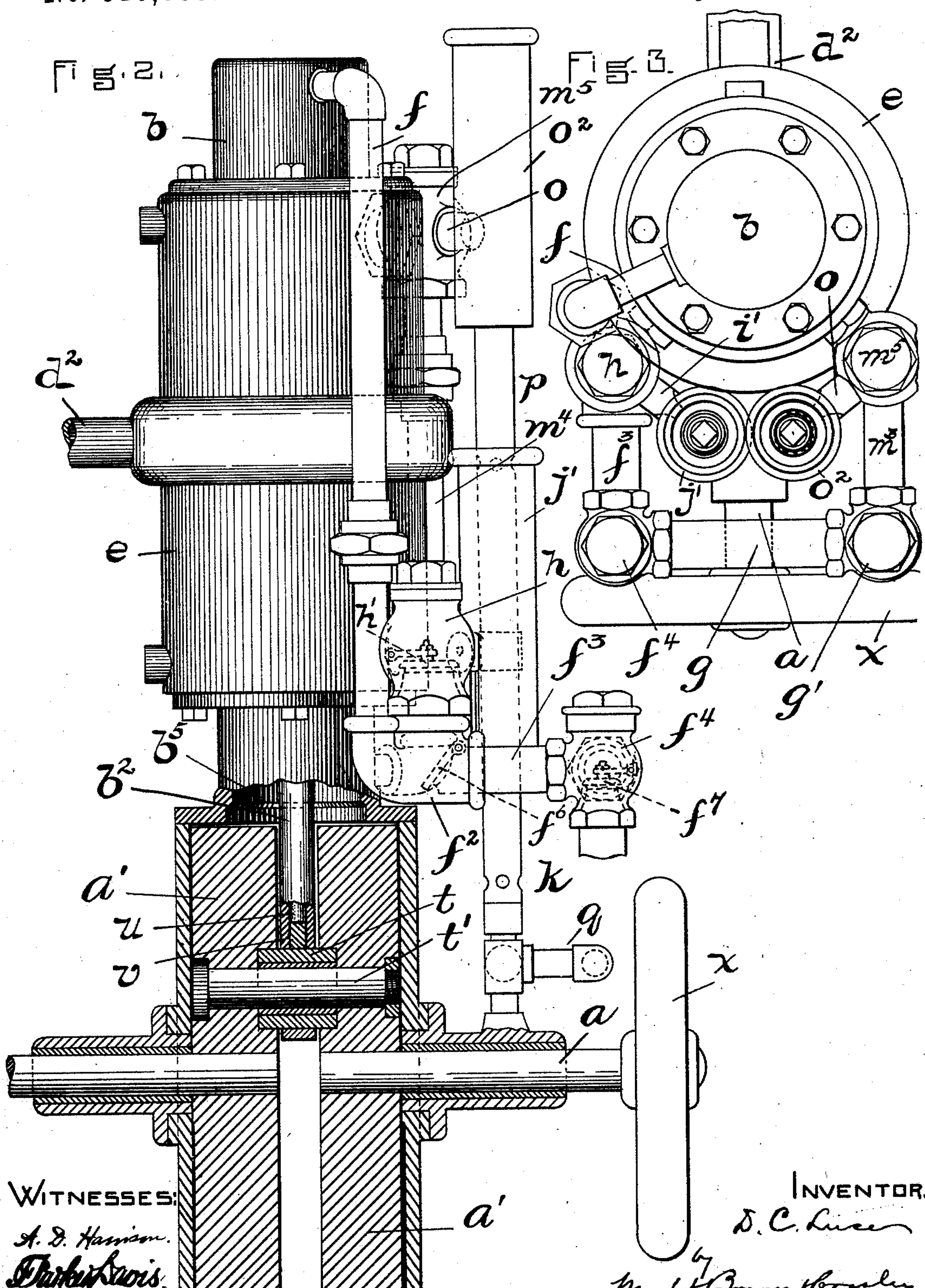
Fig. 2.

Fig. 3.



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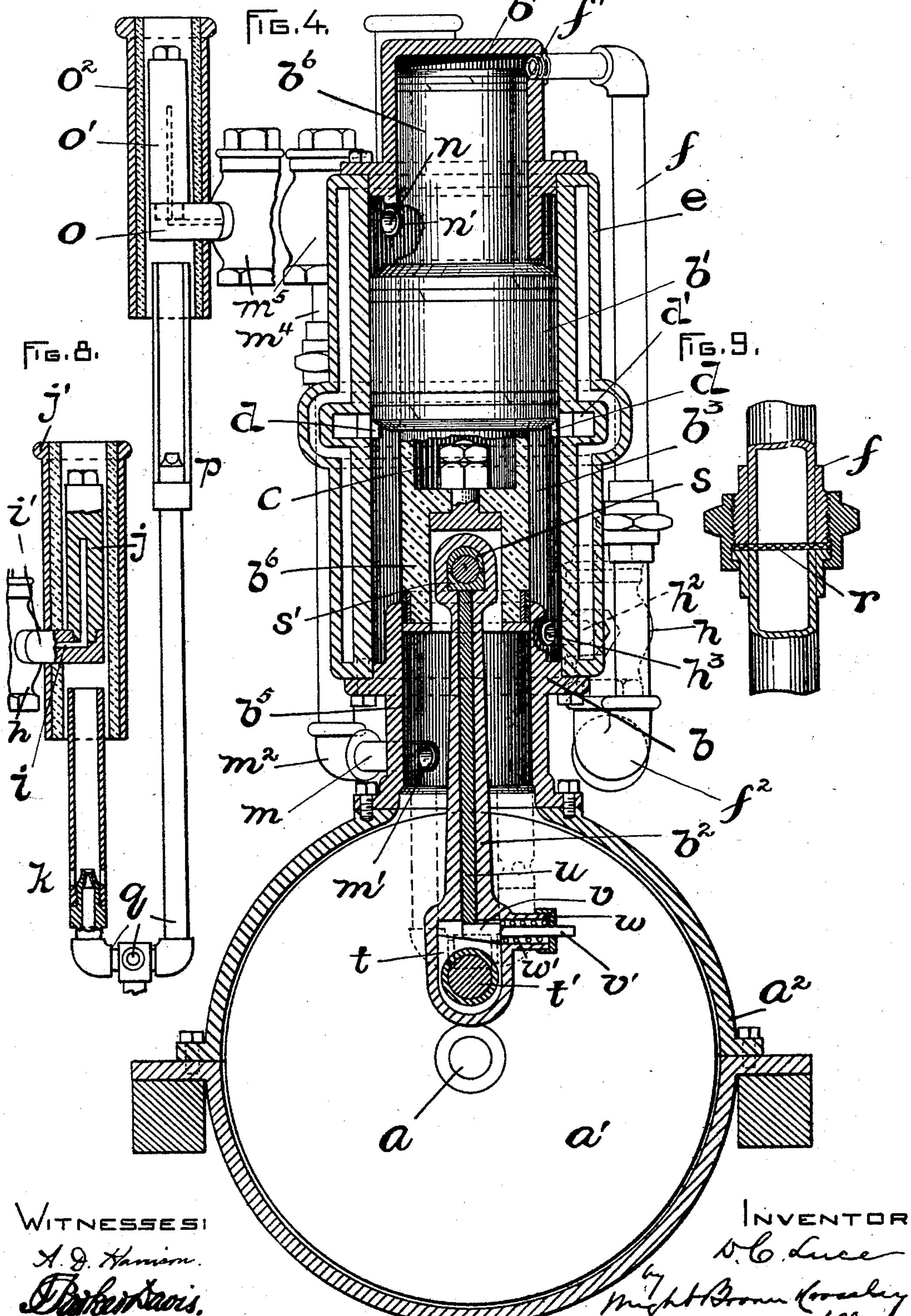

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(No Model.) 4 Sheets—Sheet 4.

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FIG_10_

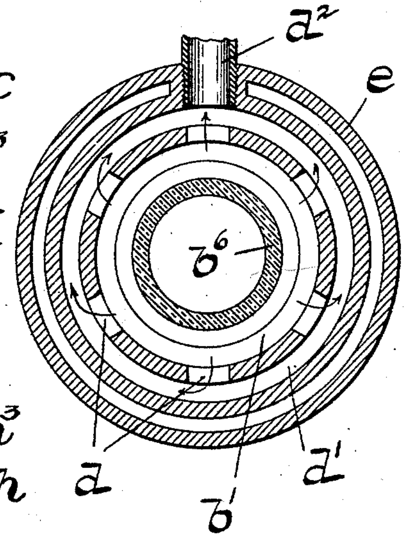
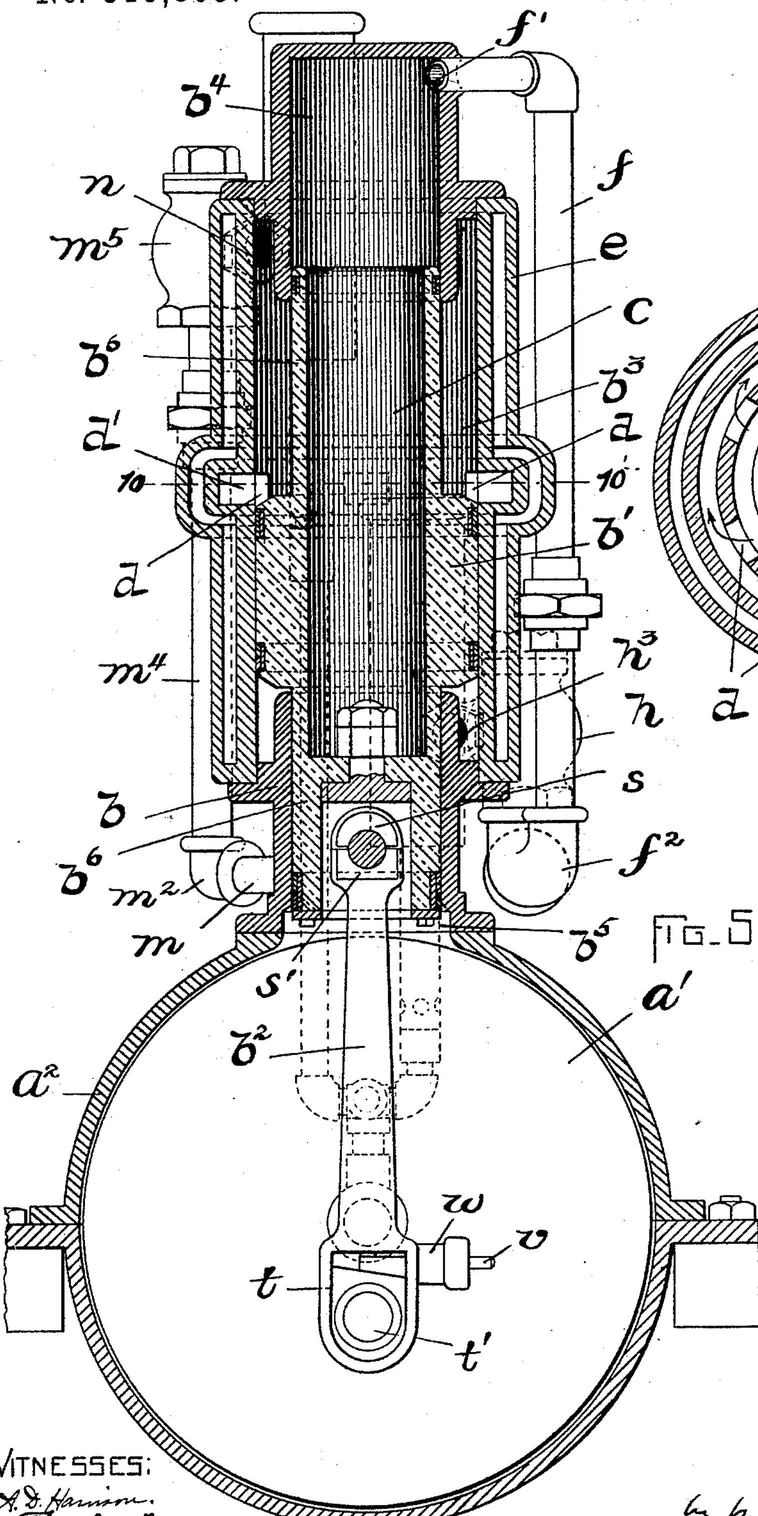


FIG_5



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UNITED STATES PATENT OFFICE.

DON CURTIS LUCE, OF BROCKTON, MASSACHUSETTS, ASSIGNOR OF TWO-THIRDS TO HARVEY F. CRAWFORD, OF SAME PLACE.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 519,863, dated May 15, 1894.

Application filed April 14, 1893. Serial No. 470,319. (No model.)

To all whom it may concern:

Be it known that I, DON CURTIS LUCE, of Brockton, in the county of Plymouth and State of Massachusetts, have invented certain new and useful Improvements in Gas-Engines, of which the following is a specification.

This invention relates to an improvement in gas engines, and the object is to provide a compact, simple and durable structure in which valve-gear and reversing-gear are dispensed with, and in which two explosions take place with each revolution, whereby the engine is capable of great speed and power.

With these ends in view, the invention consists in certain novel features of construction and combinations of parts, which will be fully described hereinafter and specified in the claims.

The accompanying drawings illustrate a construction by which the invention may be carried out.

Figure 1 shows a side elevation of the engine, with the crank-shaft in section. Fig. 2 shows a part elevation, as viewed from the right of Fig. 1, and a part section. Fig. 3 shows a top view of the engine. Fig. 4 shows a central vertical section, taken on the line 4—4 of Fig. 2, parts being broken out to more clearly disclose the ports in the different chambers, and the piston being only partially in section and represented as at the upper end of its stroke. Fig. 5 shows a section on substantially the same line as Fig. 4, the piston being here represented as at the lower end of its stroke. Fig. 6 shows a fragmentary elevation of parts, as viewed from the right of Fig. 1. Fig. 7 shows a section on line 7—7 of Fig. 1. Fig. 8 shows a sectional view of the hot-tubes for igniting the gas. Fig. 9 shows a sectional detail of a diaphragm employed to block explosions. Fig. 10 shows a cross-section on line 10—10 of Fig. 5.

The same letters of reference indicate the same parts in all the figures.

In the drawings: the letter a designates the crank-shaft of the engine, which is divided, and on its confronting ends are fixed crank-disks a', which are inclosed within a casing a^2. A vertical cylinder b is erected on the said casing, and a piston b' within said cylinder is connected by a pitman b^2 with the crank-disk a'. The cylinder b comprises a central chamber b^3, in which the explosions take place on opposite sides of the piston b whose central portion fits said central chamber; and end-chambers b^4 and b^5, whose diameters are less than that of the central chamber, and which are engaged by elongated extensions b^6 of the piston, and separated from the central chamber by said piston-extensions. The piston is made hollow and open at the upper end, so as to provide a chamber c, in communication with the upper end-chamber b^4 of the cylinder, whereby the capacity for gas on the upper side of the piston is increased. The lower end-chamber b^5 opens into the space between the two crank-disks a', and this space is utilized for gas, so that the capacity above and below the piston is equalized. A series of exhaust-orifices or ports d are formed at the middle of the cylinder, and communicate with an annular passage d', out of which an exhaust-pipe d^2 leads. A water-jacket e surrounds the cylinder.

The upper end-chamber b^4 of the cylinder is adapted to communicate with an air and gas supply, and with the lower end of the central chamber b^3, through the following channels: A pipe f leads from a port f' in the upper end of the upper chamber b^4, and is connected by an elbow f^2,—in which is an upward-opening check-valve f^6,—with a short pipe f^3, connected with a three-way coupling f^4, in which is an upward-opening check-valve f^7. One branch of said three-way coupling below the check-valve is in communication with a gas-supply. Another branch of said three-way coupling above the check-valve is connected by a pipe g with the corresponding branch of another three-way coupling g', containing an upward-opening check-valve g^2 (see Fig. 6). The branch of said latter coupling below the valve is in communication with an air-supply. A head h is erected on the elbow f^2, and contains an upward-opening check-valve h'. A short pipe h^2 connects said head above the check-valve h' with a port h^3 at the lower end of the central chamber b^3 of the cylinder. The said head h also communicates by a restricted passage i in a tube i' above the check-valve with a hot-tube j, inclosed in an asbestus-lined casing j', and over the flame of a Bunsen burner k.

The lower end-chamber b^5 of the cylinder is adapted to communicate with an air and gas supply, and with the upper end of the central chamber b^3, through the following channels: A short pipe m leads from a port m' at the lower end of the chamber b^5, and enters a three-way coupling m^2, in which is an upward-opening check-valve m^6. One branch of said coupling m^2 is connected by a pipe m^3 with a branch of the three-way coupling g' above the check-valve g^2. Another branch of the coupling m^2 is connected by a vertical pipe m^4 with a head m^5, in which is an upward-opening check-valve m^7. Said head communicates by a pipe n above the check-valve with a port n' at the upper end of the central chamber b^3 of the cylinder. Said head also communicates by a restricted passage in a tube o with a hot-tube o', inclosed in an asbestus lined casing o^2 and acted upon by the flame of a Bunsen burner p. Both of the Bunsen burners k and p are supplied with gas from the same source through pipes q.

The operation of the engine is as follows:—Beginning with the piston at the upper end of the stroke, as shown in Fig. 4, the downward movement of the piston draws a fresh supply of mixed gas and air into the chamber b^4, the course of said gas and air being as follows: The air lifts the check-valve g^2, and passes through the pipe g and into the elbow f^4. The gas lifts the check-valve f^7 in said elbow f^4, and the mixed gas and air passes through the pipe f^3 elbow f^2, (lifting the check-valve f^6 therein) and pipe f, to the chamber b^4. The parts being now in the position shown in Fig. 5, an explosion takes place below the piston, and the latter is returned upward, and expels the gas and air which it has drawn into the chamber b^4, and drives the same into the central chamber b^3 below the piston, *via* the pipe f, the check-valve in the head h, and the pipe h^2,—the check-valve f^6 blocking the passage to the supply. An explosion takes place above the piston, and the down-stroke of the same compresses the gas and air which has been drawn into the chamber b^3 below it. This gas and air has communication with the hot-tube j, and, as the piston reaches the end of its down-stroke, such gas and air is compressed to an extent which causes the hot-tube to ignite it, and effect an explosion which returns the piston upward again. The upward movement recharges the cylinder below the piston, in the manner previously explained, and the burned gas is expelled through the exhaust-orifices d. The upward stroke also draws a supply of air and gas into the chamber b^5, *via* the elbows f^4 and g', and the pipe m^3, coupling m^2 (lifting the check-valve m^6), and pipe m; and the down-stroke expels this supply, and drives it into the central chamber b^3 above the piston, *via* vertical pipe m^4, head m^5, and pipe n. Hence the next upward-stroke of the piston compresses this supply of gas and an explosion is brought about at the end of the stroke, by reason of the communication with the hot-tube o'. The explosion drives the piston down again, and the burned gas is discharged through the exhaust-orifices d, as a fresh supply is driven into the explosion-chamber above the piston, in the manner described. To provide against the possibility of an explosion reaching either of the charging-chambers b^4 or b^5, perforated diaphragms r are inserted in the pipes f and m^4, and they will act to block an explosion which might take place in the explosion-chamber on either side of the piston while a supply of fresh gas was entering on that side.

It will be observed that, in this gas engine, an explosion takes place with each stroke of the piston; or, in other words, two explosions occur for each revolution, which is due to the novel arrangement, whereby the piston not only performs its usual function in driving the crank, but also constitutes a double-acting pump to recharge the combustion-chamber as it is impelled by the explosion. By this arrangement, I produce a very powerful engine, which is capable of great speed. The structure is exceedingly compact, and may be included in small compass, which especially recommends it for marine use, and wherever economy of space is an item.

The wear of connections between the crank and the piston is taken up through the following instrumentalities: The pitman b^2 fits over a two-part bushing s s' on a pin in the piston, and over a sleeve t on the crank-pin t', said sleeve having an inclined upper side. The pitman is hollow, and a rod u fits loosely through it, and at its upper end abuts the under member s' of the two-part bushing around the pin in the piston, while its lower end stands over the inclined upper side of the sleeve t on the crank-pin. A wedge v is interposed between the rod u and the sleeve t, and has a straight upper side, engaging the end of the rod, and an inclined under side, engaging the inclined side of the sleeve. The wedge has a stem v', which extends through a laterally-projecting tubular extension w of the pitman, and a spring w' is inclosed within said extension, and acts to press the wedge in between the rod and sleeve. It will be seen that wear between the piston and crank will be taken up by the wedge. A hand-wheel x is mounted on the crank-shaft a, and the engine may be started in either direction by turning this hand-wheel. No reversing-gear is necessary.

It is evident the invention may be embodied in different forms from that here shown, and is not therefore limited to the particular construction by which I have chosen to illustrate it.

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

1. A gas-engine, comprising in its construction a cylinder having an induction-port on one side of the piston and communicating with a fluid-supply, a check-valve between said port and the fluid-supply, and a check-valved passage adapted in the operation of the engine to afford communication between that part of the cylinder on one side of the piston toward which the piston is advancing and that part of the cylinder on the opposite side of the piston away from which the piston is moving.

2. A gas-engine, comprising in its construction a cylinder having ports on opposite sides of the piston, means of communication between one of said ports and a fluid-supply whereby the piston-stroke in one direction inducts a supply of fluid through said port, and means of communication between the two ports whereby the piston-stroke in the opposite direction drives the said supply of fluid to the opposite side of the piston.

3. A gas engine comprising in its construction a cylinder having a combustion chamber in which the piston is reciprocated and charging chambers on opposite sides of the piston and receiving extensions thereof, means of communication between the charging chambers and a fluid supply and means of communication between each charging chamber and the combustion chamber on the side of piston opposite said charging chamber.

4. A gas-engine, comprising in its construction a cylinder having a central combustion-chamber provided with an inlet-port at each end and a centrally-located exhaust-port, and charging-chambers at each end of the combustion-chamber and of less diameter than the latter, and each having a port; a piston having a central portion which fits the combustion-chamber and receives the impact of the explosions, and extensions which fit the charging-chambers; check-valved passages connecting the ports of the charging-chambers with a fluid-supply; and check-valved passages connecting said first-named passages respectively with the ports of the combustion-chamber.

5. A gas-engine, comprising in its construction a cylinder having a central combustion-chamber provided with an inlet-port at each end and a centrally-located exhaust-port, and charging-chambers at each end of the combustion-chamber and of less diameter than the latter, and each having a port; a piston having a central portion which fits the combustion-chamber and receives the impact of the explosions, and extensions which fit the charging-chambers; check-valved passages connecting the ports of the charging-chambers with a fluid-supply; check-valved passages connecting said first-named passages respectively with the ports of the combustion-chamber; and hot-tubes communicating by restricted passages with the second check-valved passages.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 5th day of April, A. D. 1893.

DON CURTIS LUCE.

Witnesses:
ARTHUR W. CROSSLEY,
F. PARKER DAVIS.