(No Model.)

4 Sheets—Sheet 1.

J. H. CLARK.

GAS ENGINE.

No. 347,469. Patented Aug. 17, 1886.

Fig:1.

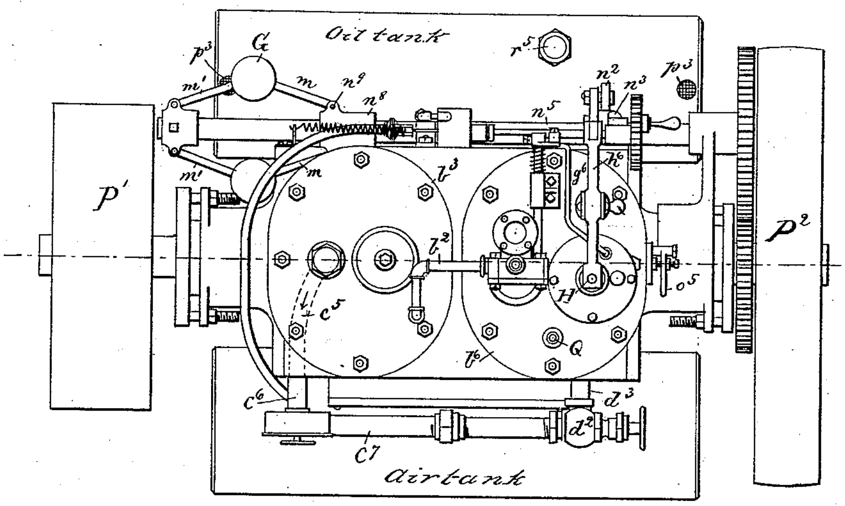
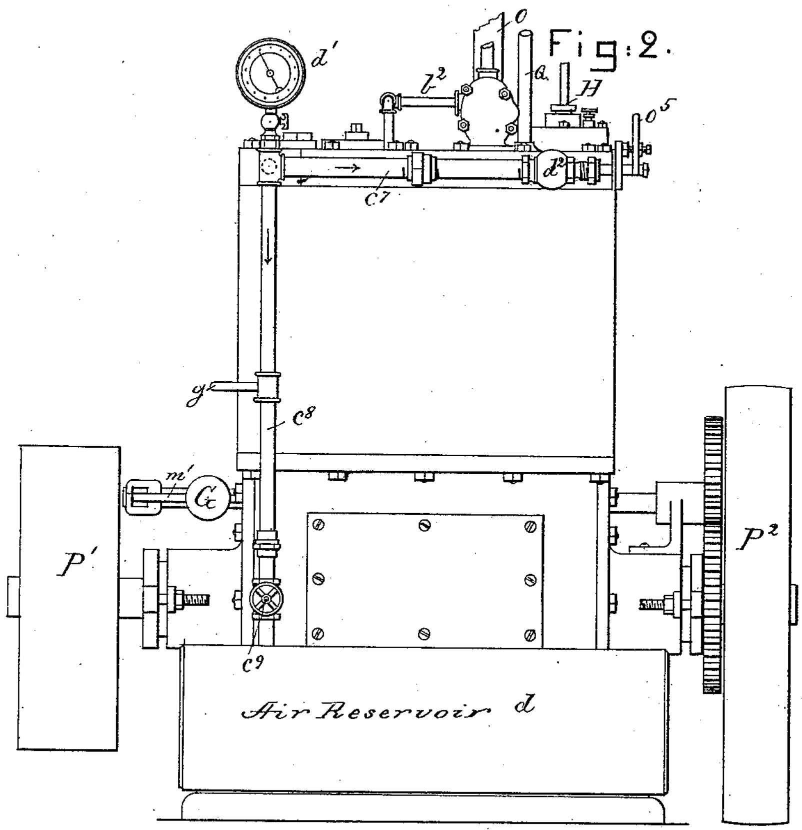


Fig:2.



Witnesses.
Fred L. Emery
John F.C. Prinkert

Inventor.
John H. Clark,
by Crosby & Gregory attys

N. PETERS. Photo-Lithographer, Washington, D. C.

(No Model.)

4 Sheets—Sheet 2.

J. H. CLARK.

GAS ENGINE.

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Fig: 3.

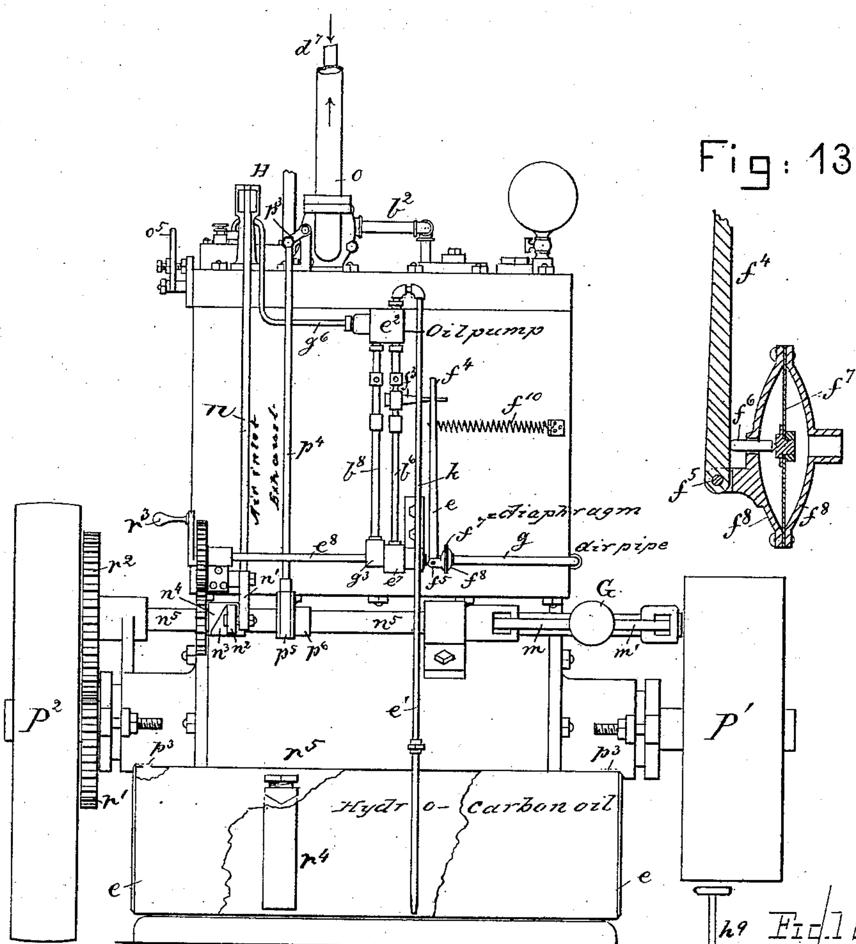


Fig: 13.

Fig: 15.

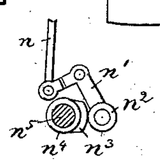


Fig: 14.

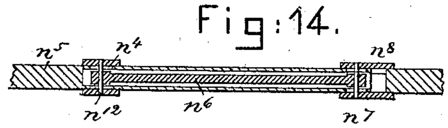
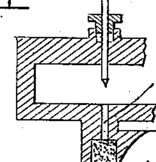


Fig. 16



Witnesses.

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(No Model.)

4 Sheets—Sheet 3.

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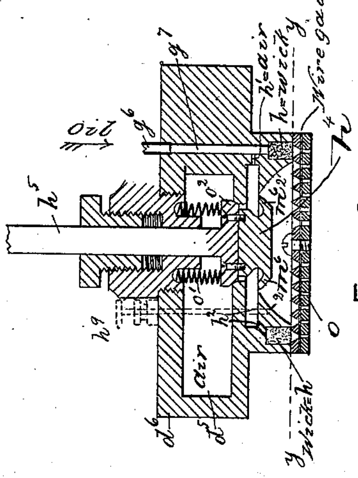

Fig: 7.

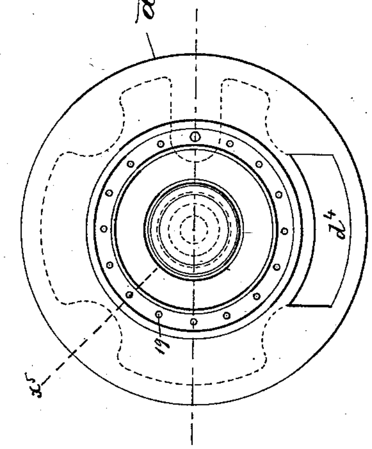

Fig: 8.

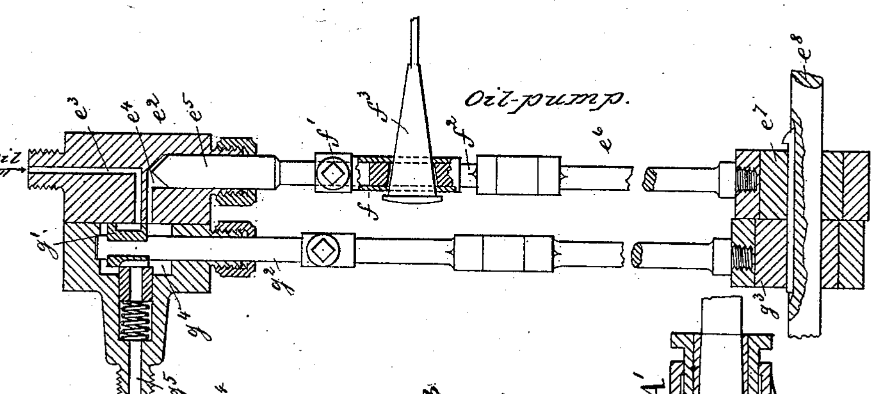

Fig: 6.

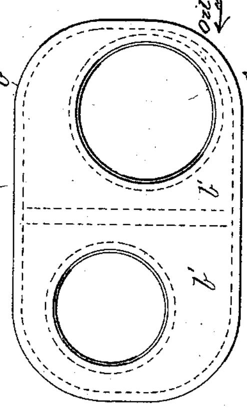

Fig: 5.

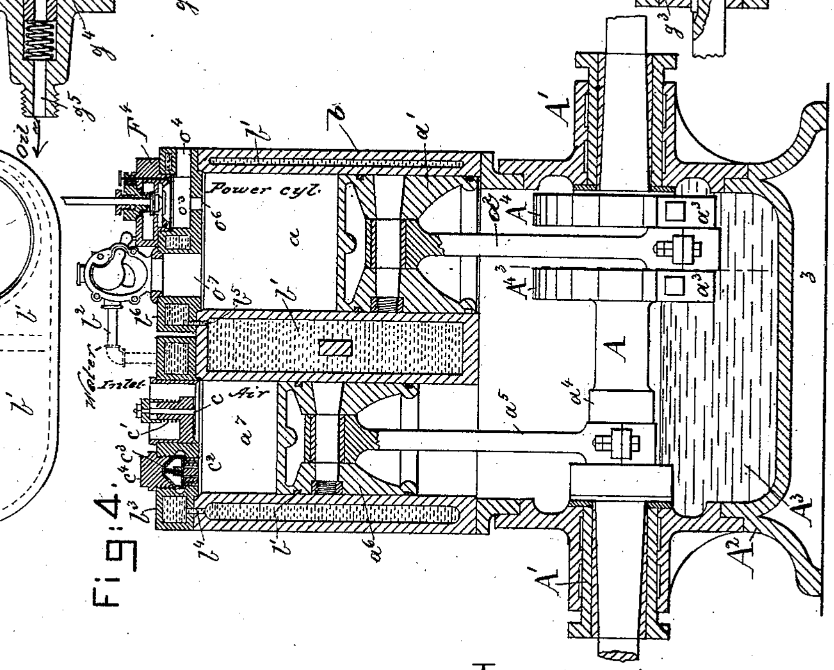

Fig: 4.

Witnesses.

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(No Model.)

4 Sheets—Sheet 4.

J. H. CLARK.

GAS ENGINE.

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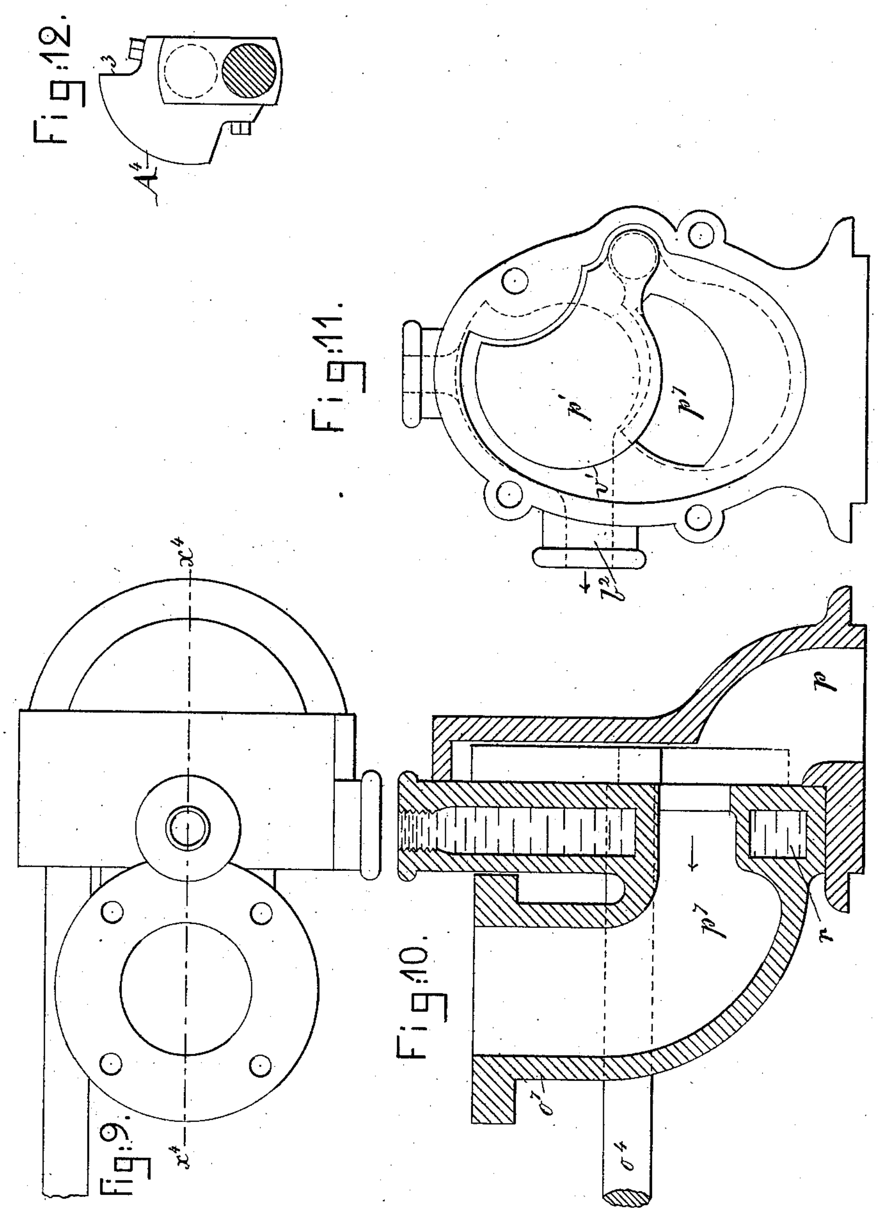

Witnesses.

Fred L. Emery

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UNITED STATES PATENT OFFICE.

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

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 347,469, dated August 17, 1886.

Application filed September 12, 1885. Serial No. 176,921. (No model.)

To all whom it may concern:

Be it known that I, JOHN H. CLARK, of Boston, county of Suffolk, State of Massachusetts, have invented an Improvement in 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 has for its object, generally, to improve and simplify that class of engines operated by gas, and known as "gas-engines," the gas being produced by the volatilization of usual hydrocarbons, and being mixed with atmospheric air.

In the class of engines upon which this invention is an improvement the gas has been flashed or ignited in one end of a cylinder at one side of a piston therein, and the movement of the said piston into the other end of the cylinder has acted to supply the air to be carbureted, the opposite end of one and the same cylinder serving for both the fire and the air. This form of construction has proved objectionable, owing to the fact that gases escaping by the piston into the air-cylinder tend to destroy the lubricant employed therein and render the valves inoperative; and so, also, in this form of gas-engine the air is most compressed when the piston is at or near the end of its stroke, which necessitates a very heavy balance-wheel to insure steadiness or regularity of motion. This class of engines has also been provided with an independent air-pump, but under such an arrangement that the air-conducting pipe leading from the pump to the fire-cylinder was so long as to result in cooling the air so much as to destroy its efficiency.

In my invention the air and fire cylinders are formed in a single casting, the cylinders being side by side, but, as herein shown, they are not in the same line, and the shell of the said casting has by suitable cores been provided with water-chambers, the casting thus becoming a one-piece jacketed casting. Making the casting for both cylinders as an integral piece, the contraction and expansion of the exterior of the casting, and also those parts of the cylinder in which the piston reciprocates, are uniform, which would not be the case if the jacket or outer portion of the casting were in a separate piece. Making the casting, including the cylinders and jacket, in one piece insures equal expansion, and obviates leakage of water into the cylinders between the casting and the two head-plates therefor, in which latter are placed the air and gas valves, to be described.

I have provided the engine with a novel pump and valve to control the quantity of oil delivered into the engine, and I have also provided the engine with a novel valve to control the admission of atmospheric air into the fire-cylinder, the said air being forced through the wick or other porous material holding the oil, the said valve and its co-operating parts being so shaped as to deflect or turn the air in such direction as to sweep across and keep the fire-plate clean and its perforations open.

In my engine the cranks on the main shaft are set at quarters, and spraying devices, connected preferably with the cranks, dip into and intermittingly throw or spray the said oil and water, contained in a box in which the said cranks rotate, into the fire-cylinder, below the piston therein, thus keeping the fire-cylinder and piston properly cooled and lubricated. The quarter-cranks are joined by connecting-rods to pistons placed, respectively, one in the fire and the other in the air cylinder, the centers of which cylinders are at opposite sides of the center line of the crank-shaft, such location in a single-acting engine affording a more direct thrust, and gaining in leverage.

Figure 1 is a plan view of a gas and air engine embodying my invention; Fig. 2, a front elevation of Fig. 1; Fig. 3, a rear elevation of Fig. 1, the oil-tank being broken out to show its safety appliances; Fig. 4, a sectional elevation on line $x\ x$ of Fig. 1; Fig. 5, a detail of the one-piece casting containing the cylinders; Fig. 6, a detail of the oil-pumping apparatus on a larger scale; Fig. 7, a sectional detail of the bonnet or burner on a larger scale; Fig. 8, an under side view of Fig. 7, with the intercepter removed; Fig. 9, a top or plan view of the case containing the exhaust-valve and passage, and the water-passage to keep it cool; Fig. 10, a section of Fig. 9 in the dotted lines $x^4\ x^4$; Fig. 11, a right-hand side elevation of Fig. 10, with the cap at the right-hand side thereof removed; Fig. 12, a detail of the sprayer on line $z\,z$ of Fig. 5; Fig. 13, a detail of the diaphragm regulating the stroke of the oil-pump; Fig. 14, a sectional detail of part of the shaft, and Fig. 15 is a sectional detail of the sleeve and cam thereon for operating the valve for admitting compressed air into the bonnet. Fig. 16 is a partial section of Fig. 8 on line x^5.

The main shaft A of the engine has its tapering journals supported in bearings A′ at opposite ends of a box, A^2, herein shown as containing water and oil, as at A^3, the water and oil therein being used both to cool and to lubricate the fire-cylinder a, to be described. The sprayers A^4, connected to the cranks a^3, have faces 3, of suitable shape (see Fig. 12) to dip at each rotation of the shaft A into the water and oil, lift and throw the same as a spray into the lower end of the fire-cylinder a, below the piston a' therein, the said piston being joined by the connecting-rod a^2 with the crank a^3 of the shaft A, a second crank, a^4, being joined by the connecting-rod a^5 with the piston a^6 in the air-cylinder a^7, the crank a^4 being about ninety degrees distant from the crank a^3. The two cylinders a and a^7, or the cylindrical chambers in which the pistons a' and a^6 are respectively arranged to reciprocate, are made in a single casting, b, (represented in top view, Fig. 5, and in section, Fig. 4,) the center of said cylinders being at opposite sides of the center line of the crank-shaft. With such arrangement of the shaft A and cylinders $a\,a^7$ it will be seen that the thrust of the connecting-rods $a^2\,a^5$, when their pistons $a'\,a^6$ are doing work, is more directly in the center line of the cylinders than when said pistons and their connecting-rods are not doing work, and the more direct the thrust the greater the leverage gained and the less the side strains. This casting has formed in it by coring large water-chambers b', entirely surrounding each of the said cylinders, the water introduced into the said chambers b' coming therein through a pipe, b^2, in the head b^3, and thence into the chamber b' at the port b^4, (see Fig. 4,) and thence the water rises in the said chamber b' around both the cylinders in which the pistons a' and a^6 reciprocate, the entering water, while yet cool, first acting on the air-cylinder a^7, which it is especially desired to keep cooler from an economical point, the water as it becomes heated in its passage through the chamber b' issuing through the port b^5 into the head b^6 of the fire-clyinder, the hotter the water therein and surrounding the casting holding the bonnet, the hotter the air which enters therein to be carbureted.

Water may be introduced into the chamber b' so slowly as to be evaporated therein, and the steam formed be passed out through the port b^5 into the head b^6 of the fire-cylinder.

The head b^3 of the air-cylinder a^7 has an inwardly-opening inlet-valve, c, normally kept closed by the spring c', and an outwardly-closing outlet-valve, c^2, normally kept to its seat by a spring, c^3, the seat of the latter valve being herein shown as held in place in the head b^3 by the screw-plug c^4. The valve c^2 is in communication by a passage, c^5, with the pipe c^6, having branches $c^7\,c^8$, the latter provided with a valve, c^9, entering the air reservoir or tank d, the pressure of the air therein being indicated by a pressure-gage, d'. The branch pipe c^7 contains a throttle-valve, d^2. The short pipe d^3 at one side of the said valve is in communication with a cored passage in the fire-head b^6, The passage is open to permit an outlet at the top of the said head, and on the said head is secured the bonnet d^6,(see Figs. 7 and 8,) having at its under side the throat d^4.

The piston a^6, when drawn into the air-cylinder, takes air through the inlet-valve, and at its opposite stroke forces the said air through the outlet-valve into the pipes c^6, c^7, and c^8, the excess of air not required for carbureting purposes being forced into the air reservoir or tank d, where it is kept under pressure in the usual manner.

The oil to be used for fuel, it being contained in the tank e, is drawn therefrom by the pump e^2 through the pipe e', the lower end of which is extended well down into the said tank into the pump e^2, the pump having an inlet-port, e^3, and a port, e^4, which is entered by the piston e^5, joined by a two-part or socketed connecting-rod e^6 with an eccentric, e^7, keyed to the pump-shaft e^8.

The connecting-rod referred to is made in two parts, one part consisting of the sleeve f, connected to the plunger e^6 by a screw, f', the sleeve being entered loosely by the other part, f^2. The sleeve f and the upper end of the part f^2 are both slotted to receive a wedge-shaped regulator, f^3, joined with a lever, f^4, (see Figs. 3 and 13,) pivoted at f^5, the said lever at one side of its fulcrum being acted upon by a pin, f^6, moved by a diaphragm, f^7, arranged in a case, f^8, connected with the pipe g, in communication with the air-pipe c^8, the lever f^4 and the wedge-shaped key being made to occupy different positions longitudinally in the said sleeve, and with relation to the slotted rod or part f^2, to thereby automatically lengthen and shorten the stroke of the plunger e^5, in accordance with the pressure of the air in the tank d, thus automatically regulating the quantity of oil supplied in accordance with the work to be done or power required.

Referring to Fig. 6, the wedge-shaped regulator f^3 is shown with its broadest part as in the sleeve f, and in line with the upper end of the part f^2, and in such position the stroke of the piston e^5 is the greatest. By moving the regulator f^3 to the left from its position, Fig. 6, the narrower portion will be placed in the sleeve and next the end of the part f^2, and as said part f^2 is moved by the eccentric there will be a certain amount of lost motion before the part f^2 strikes the regulator f^3, and consequently the effective stroke of the piston e^5 will be shortened and less oil will be pumped from the tank e.

The lever f^4 has connected to it a spring, f^{10}, which keeps the lever up to the pin f^6 and the latter pressed against the diaphragm f^7.

The pump has a sliding valve, g', attached to the valve-rod g^2, which is reciprocated through the eccentric g^3 on the shaft e^8. The valve g', shaped somewhat like a "D-valve," is arranged to permit the inlet e^3 and the space e^4 to be in communication when the plunger e^5 is drawn from the pump to thus enable oil to be drawn from the tank, and thereafter the valve is moved into the position, Fig. 6. As the plunger enters the space e^4 of the pump, it acts to force the oil therefrom into the space g^4 and along out through the outlet g^5 into the pipe g^6, (see Figs. 1 and 3,) in communication with the passage g^7 in the bonnet, the oil flowing into a wick, h, held in an annular groove at the lower side of the bonnet d^6, the crown of the bonnet having a series of air-passages, h^{10}, which lead from the wick-groove into the annular space h^2, only one of such passages being shown in Fig. 7. The annular space h^2 is herein shown as communicating with the oil-passage g^7 by a capillary passage or opening, $h^\times$, and by means of which passage or opening a small quantity of oil is conducted into the said annular space, thus carbureting that portion of the air in the annular space h^2, which passes by the circular flange m^6 and through the center of the intercepter o. The crown of the bonnet is also provided with passages h^{12}, only one of which is herein shown in Fig. 16, said passages connecting the air-chamber d^5 with the annular groove containing the wick h, the said passages supplying air to the combustion-chamber o^3, (see Fig. 4,) to maintain a continuous flame in said chamber.

In practice the bonnet will be provided with a series of vertically-moving pins, h^9, located above and in line with the air-passages h^{12}, the depression of the said pins preventing the said air-passages from becoming stopped by the accumulation of dust and oil, the said pins being normally withdrawn from said passages, as shown in Fig. 16.

The annular space h^2 receives air from the air-chamber d^5 of the bonnet whenever the valve h^4, connected with the valve-stem h^5, pivoted to the lever h^6, is raised through the action of the link n, pivoted to the angle-lever n', the latter having at one end a roll or pin, n^2, which is acted upon once during each rotation of the governor-shaft n^5 by a tapering cam, n^3, attached to a sleeve, n^4, (see Figs. 3, 4, and 15,) arranged outside of the governor or shaft n^5, which is made hollow, the said sleeve being joined by pin n^{12} to a rod, n^6, extended through the governor-shaft longitudinally, and connected by pin n^7 to a second sleeve, n^8, which has joined to it by pins n^9 (see Fig. 1) the links m of the governor G, the other arms, m', of the governor being pivoted, as usual, to the end of the hollow shaft n^5. The pin n^{12}, connecting the rod n^6 with the sleeve n^4, moves in a slot in the hollow shaft n^5, (see Fig. 14,) as does also the pin n^7, connecting the rod with the sleeve n^8, to which are attached the governor-arms. The governor, by its change of position, owing to variations of speed, moves the cam n^3 longitudinally, so that more or less of its tapering surface is made effective in moving the lever n', to thus insure the opening of the valve h^4 for a longer or shorter period during each rotation of the main shaft, thereby permitting more or less compressed air to escape from the chamber d^5 of the bonnet into the annular space h^2, and through the wick h, part of the air so permitted to escape from the bonnet being made by the concave lips m^6 of the valve h^4 to impinge against the inclined wall 2 and be deflected down against the intercepter o, which is composed of two perforated metal plates having between them a layer of fine-meshed wire-gauze.

The intercepter (shown best in Fig. 7) is of usual construction, and the air is so deflected and directed across and against its upper side as to keep the intercepter clean from the soot and its holes open, which is a matter of very considerable advantage.

The valve h^4 is kept seated by means of the springs o', acting between the roof of the chamber d^5 and the head o^2 of the valve stem.

The head b^6 of the fire cylinder has a combustion-chamber, o^3, provided with an ignition-opening, o^4, which is normally closed by the gate o^5. (See Figs. 1 to 3.) The gas arising from the ignition of the carbureted air escapes through the outlet o^6 into the fire-cylinder a and forces the piston before it, turning the crank-shaft A. The exhaust from the fire-cylinder passes through the outlet o^7 into the case p, provided, as herein shown, with a swinging valve, p', connected with a rock-shaft having an arm, p^3, joined by a link, p^4, which, as herein shown, has a strap, p^5, which surrounds an eccentric, p^6, attached to the governor-shaft n^5, the said valve being moved to uncover the outlet-passage p^7 for the proper escape of the exhaust. The case p (see Fig. 10) is shown as chambered at r to receive water, the latter entering the said chamber before entering the pipe b^2, heretofore referred to.

The crank-shaft is provided with a toothed gear, r', which engages a gear, r^2, connected with and rotating the governor-shaft n^5, the shaft e^8, carrying the eccentrics for operating the oil-pump, and its valve must be rotated by hand when the engine is to be started, and to do this the said shaft is provided with a hand-crank, r^3.

The pipe e', connecting the pump e^2 with the tank e, is extended through the oil to near the bottom of the tank, as shown in Fig. 3, an inlet-pipe, r^4, also extended to near the bottom of the tank, affording means for filling the said tank, a cover, r^5, closing the mouth of the said pipe. The oil-tank is also provided with openings p^3, which permit the volatilized oil to escape into the atmosphere, and to insure perfect safety the said openings may be covered with wire-gauze, so that if the gases issuing from the openings ignite the flame cannot penetrate or enter the tank.

The crank-shaft A has the usual balance-wheel, P^2, and driving-pulley P′, mounted upon and rotating with it.

The feature herein described as to the direction of the flow of water through the chambers surrounding the cylinders will, it is obvious, be advantageous, even were the shell not in one piece, as preferred, but was composed of two pieces, with the water-chambers suitably connected.

By the term "quartering," as herein employed with relation to the cranks, I mean cranks not set coincidently with relation to each other, or in direct opposition to each other.

I claim—

1. The one-piece cast-metal shell b, containing the independent air and fire cylinders a^7 and a, and provided with the water-chamber b', surrounding said cylinders, and having the inlet b^4 and outlet b^5, all constructed and arranged substantially as described.

2. The one-piece cast-metal shell containing the independent air and fire cylinders, and provided with the water-chamber b', and having an inlet, b^4, and an outlet, b^5, combined with the chambered head b^3 of the air-cylinder and its inlet and outlet valves, and with the chambered head b^6 of the fire-cylinder, the said head having a combustion-chamber, substantially as described.

3. In a gas-engine, the main shaft provided with cranks set quartering, substantially as described, and the shell containing the fire-cylinder and the air-cylinder, both located therein, with their centers at opposite sides of the center line of the crank-shaft, combined with the pistons a and a^7, and the connecting-rods a^2 and a^5, to operate substantially as described.

4. The box A^2, to contain water and oil, and the crank-shaft and its attached sprayers, combined with the fire-cylinder, into which the water and oil are thrown by the sprayers, substantially as described.

5. The bonnet provided with the air-chamber d^5, the annular space h^2, and annular wick-receiving groove and wick therein, and the air-passages h^{10}, connecting the said space and groove, combined with the valve to control the admission of compressed air into the said space and passage and through the wick, all substantially as described.

6. The bonnet provided with the chamber d^5 to contain compressed air, and having a second chamber provided with the inclined walls 2, combined with the intercepter, and with the valve having the circular flange m^6, whereby the air permitted to escape from the chamber of the bonnet is made to cleanse the intercepter and keep the holes therein open, substantially as described.

7. The hollow governor-shaft n^5, the rod n^6 therein, the governor having its arms connected with the said shaft and rod, the sleeve, and the tapering cam connected with the said rod and made longitudinally movable with relation to the governor-shaft, combined with the bonnet, its valve h^4, and the lever h^6, and with means, substantially as described, to operate the said lever and valve from the said cam, as set forth.

8. The oil reservoir or tank, the pipe e', the pump provided with passages e^3 e^4, and the plunger, and means, substantially as described, to regulate the stroke of the latter, combined with the valve g', and with means, substantially as described, to operate it.

9. The fire-cylinder and exhaust-outlet o^7 and case p, combined with the pivoted exhaust-valve p', and with means, substantially as described, to positively automatically open and close the said valve.

10. The head of the fire-cylinder, the case p, provided with chambers to contain water, combined with the exhaust-valve p', surrounded by said water, and means, substantially as described, to positively operate the said valve, as and for the purpose set forth.

11. The bonnet, its wick h, and the oil-pump supplying oil to the said wick, and pipe e', combined with the oil-tank provided with the safety supply-pipe r^4, extended to near its bottom, and with vents p^3, substantially as described.

12. In a gas-engine, the safety oil-tank consisting of the reservoir e, and the supply-pipe r^4 for said reservoir, and extended to near its bottom, and the discharge-pipe e', also extended to near the bottom of the said reservoir, and vents p^3, to allow volatilized oil to escape into the air, substantially as described.

13. In a gas-engine, a cast-metal shell having two passages to constitute cylinders, and having surrounding water-chambers, combined with a chambered cylinder-head, the said head and shell having ports or passages, substantially as described, whereby the cooler water first enters the said chamber at the air-cylinder side of the shell, and then flows into and through the fire-cylinder side of the shell, thereby effectually cooling the air-cylinder, substantially as set forth.

14. The bonnet provided with the air-chamber d^5, the annular space h^2, the annular wick-receiving groove, the air-passages h^{10}, connecting said space and groove, the oil-passage h', and the air-passages h^{12}, connecting the chamber d^5 with the wick-receiving groove, combined with the valve to control the admission of air into the space h^2 and passage h^{10}, and with the pins h^9, to free the passage h^{10}, as and for the purpose specified.

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

JOHN H. CLARK.

Witnesses:

GEO. W. GREGORY,
JAS. H. CHURCHILL.