No. 705,201. Patented July 22, 1902.

A. T. BROWN.

GAS ENGINE.

(Application filed Nov. 13, 1897.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

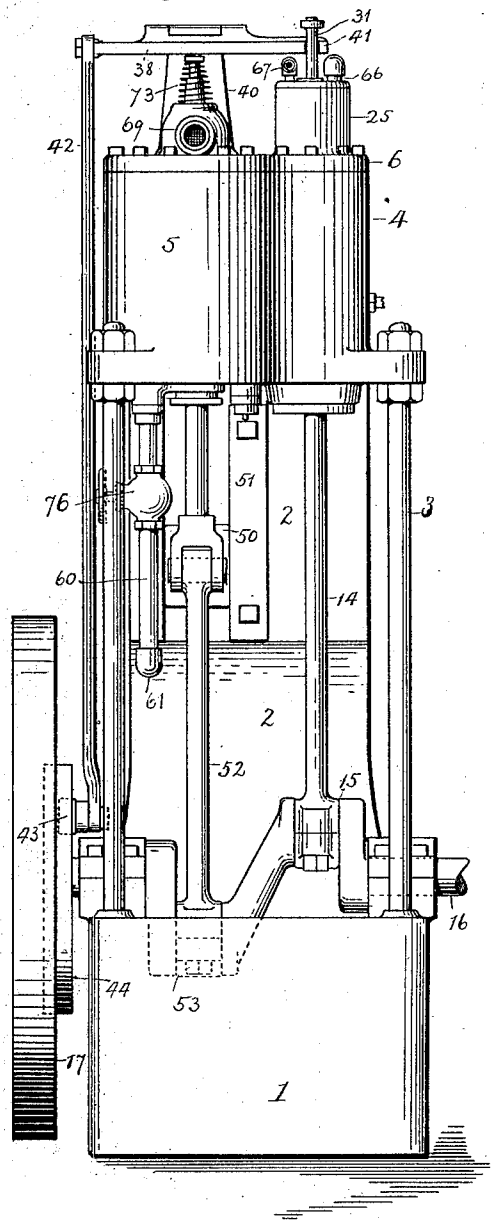
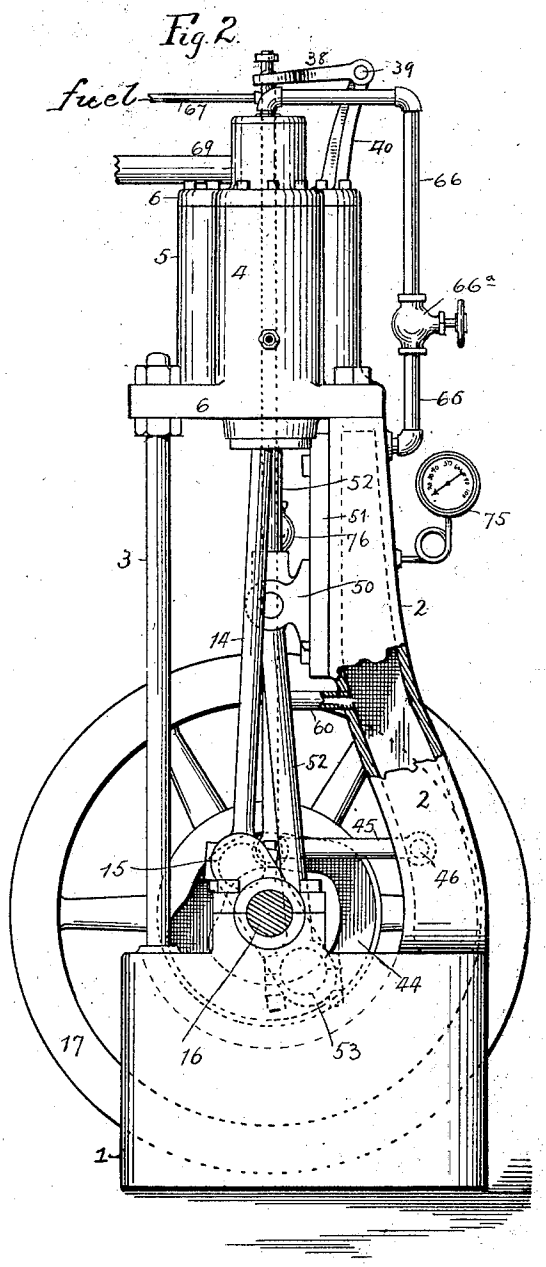


Fig. 2.



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GAS ENGINE.

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(No Model.) 2 Sheets—Sheet 2.

Fig. 3.

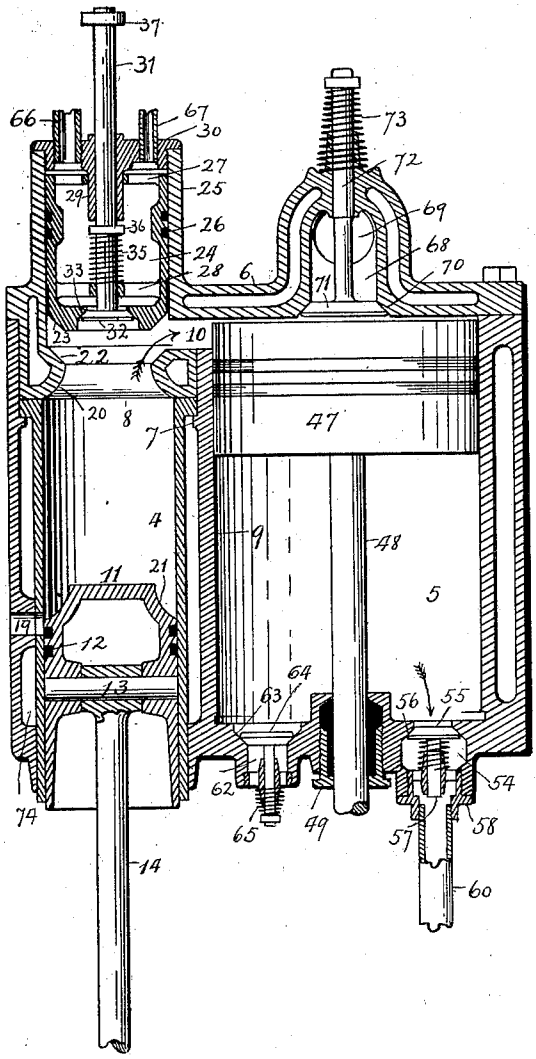
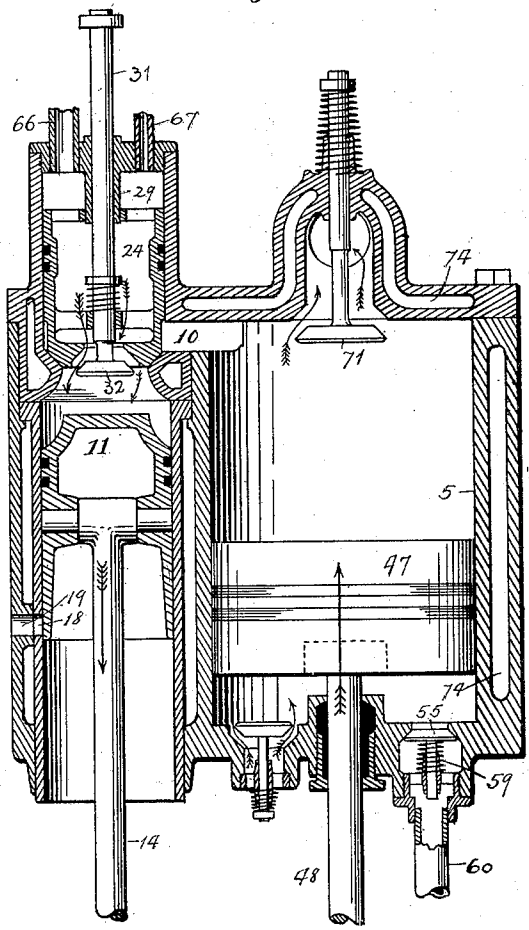


Fig. 4.



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UNITED STATES PATENT OFFICE.

ALEXANDER T. BROWN, OF SYRACUSE, NEW YORK.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 705,201, dated July 22, 1902.

Application filed November 13, 1897. Serial No. 658,383. (No model.)

To all whom it may concern:

Be it known that I, ALEXANDER T. BROWN, a citizen of the United States, and a resident of Syracuse, in the county of Onondaga and State of New York, have invented certain new and useful Improvements in Gas-Engines, of which the following is a specification.

Figure 1 is a front view of the engine. Fig. 2 is a side elevation with the compressed-air reservoir partly in section or broken away. Fig. 3 is an enlarged sectional view of the piston and valve mechanism more particularly; and Fig. 4 is a similar view, but with these parts in different positions.

The main objects of the invention are to provide, first, a self-starting engine; secondly, a construction by which the pistons are enabled to exhaust or scavenge the cylinders of the burned or exploded gases after performing their work, and, thirdly, a simple, economical, and efficient construction.

My invention consists of the various features of construction and combinations of devices hereinafter more fully described, and particularly pointed out in the appended claims.

Referring now to the drawings, in which the same part will be found marked with the same numeral of reference, 1 designates the bed-plate or base of the engine, from which rises at the rear side a hollow or tubular standard which forms a part of the framework and also constitutes the compressed-air reservoir 2, and rising from the front side of the base are two rods or posts 3 3. Supported upon the top of the air-reservoir and upon said posts and properly secured by means of bolts and nuts is a casting constructed to form two cylinders 4 and 5, and bolted upon said casting is a cover or cap-plate 6, forming a head for each cylinder. Said casting is formed interiorly with a circular horizontal ledge 7, upon which rests the flanged upper end of the cylinder 4 and which is held in position by a horizontal ring 8, formed integral with the cover or head-plate and bearing upon the flanged end of the cylinder 4. The cylinder 5 is formed directly in the casting itself, but is separated from the cylinder 4 by means of a wall 9, which extends up to the top of the ring 8, but terminates a short distance from the cover or head 6, thus providing a port or passage-way 10 between the cylinder 4 and the cylinder 5.

Within the cylinder 4 is a piston 11, which may be of any desired or suitable construction and which may, as usual, be provided with packing-rings 12. The said piston is provided with a cross-pin 13, to which is pivotally connected the upper end of a connecting-rod 14, whose lower end is attached to a crank 15 on a crank-shaft 16, which at one end carries a fly or balance wheel 17 and which at the other end may also carry driving-pulleys adapted to a power-belt, or may in the case of a marine engine carry a propeller-blade, or it may be otherwise geared or connected so as to transmit the power of the engine.

At the lower end of the stroke of the piston the cylinder 4 is formed with an opening 18, which coincides with a similar opening 19 in the casting, for the insertion and support of any known burner or other suitable igniter.

The ring 8 at the top of the cylinder 4 is beveled or tapered, preferably on curved lines, as shown at 20, and the top of the piston 11 is likewise tapered or curved, as shown at 21, to match the contour of the inner wall of the said ring. The said ring 8 is also formed on its upper side with a beveled valve-seat 22 to match the beveled end 23 of a hollow sliding valve 24, which is contained within a chamber 25, preferably cast integral with the head or cover 6. The said hollow valve 24 may be provided with packing-rings 26, and at its upper and lower ends may also, though not necessarily, be formed with spiders 27 and 28. The eye of the spider 27 surrounds a neck 29, projecting downwardly from a threaded cap-piece 30, screwed into the chamber 25, and the eye of the spider 28 surrounds the stem 31 of a supplemental valve 32, which stem passes through the said neck and through the said threaded cap and is connected to an operating mechanism, as will be presently explained. The supplemental valve 32 is adapted to a seat 33, formed at an opening in the lower end of the main hollow valve 24, and a coiled spring 35, surrounding said valve-stem and bearing at its lower end against the eye of the spider 28 and at its upper end against a collar 36 on said stem, tends to hold said valve 32 against its seat.

On the upper end of the valve-stem 31 is secured a collar 37, which is adapted to be acted upon by a rocker-arm or plate 38, pivoted at 39 at the upper end of a bracket 40, secured to the head or cover 6, the said rocker-arm or plate being preferably bifurcated at 41 to embrace the said valve-stem. To the rocker-arm is connected one end of a vertical rod 42, whose lower end is provided with a stud or roller 43, which is acted upon by a grooved cam 44, preferably cut in the hub of the fly-wheel 17. The lower end of the connecting-rod 42 is preferably supported and guided by a link 45, which is pivoted at one end 46 to the side of the reservoir 2 and pivotally connected at its free end to the said rod. At the proper times, determined by the shape of the cam, the rocker-arm 38 is vibrated to raise the valve-stem and also to release it, as well as to actuate the exhaust-valve, in the manner and for the purposes hereinafter more fully explained.

Within the larger cylinder 5 is arranged a piston 47, which is larger than the piston 11, in this instance being about four times the area of the last-mentioned piston. To the under side of the piston 47 is attached a piston-rod 48, which passes through a suitable stuffing-box 49 at the lower end of the cylinder 5, and the lower opposite end of the said piston-rod is attached to a slide or cross-head 50, working in parallel guides 51, attached to the front side of the air-reservoir. Also connected to the said cross-head is a rod 52, whose lower end is attached to another crank 53, formed in or on the shaft 16, but disposed oppositely from that of the crank 15, to which the connecting-rod 14 is connected.

At the bottom of the cylinder 5 is formed an opening 54, which is controlled by a valve 55, adapted to a seat 56 at said opening. Said valve has a valve-stem 57, which is guided in the elongated eye of a spider formed in a threaded cap 58, which is screwed into a neck projecting downwardly from the cylinder, and the said valve-stem is surrounded by a coiled spring 59, which tends to press the valve upwardly against its seat. Screwed into the cap-piece or cover 58 is a pipe 60, which extends downwardly and then laterally by means of an intervening elbow 61 and is screwed into or connected with the interior of the air-reservoir 2, and thus communication is established between the interior of the larger cylinder 5 and the air-reservoir. At the bottom of the said cylinder 5 is also formed an opening 62, having a valve-seat 63 for a valve 64, which opens upwardly and whose stem is provided with a spring 65, tending normally to keep said valve down upon its seat. This valve is the fresh-air-inlet valve, to be referred to hereinafter.

At the upper end of the compressed-air reservoir is connected a pipe 66, which by suitable bends or elbows is connected to the valve-chamber in which the hollow valve 24 is arranged, and said pipe is provided with a globe, throttle, or other suitable hand-operating valve 66^a, adapted to control the admission of the compressed air from the reservoir into the hollow valve 24. The upper end of the pipe 66 is preferably screwed into the cap-nut 30 at the top of the valve-chamber 25 and to one side of the valve-stem 31. On the opposite side of said valve-stem is screwed into the said cap-piece 30 a pipe 67, proceeding from or connected with any suitable tank or reservoir for containing gas, gasolene, oil, alcohol, or other suitable ingredient capable of mixing with the compressed air and forming an explosive charge. In connection with the said inlet-pipe 67 and the said tank or reservoir may be employed any suitable pumping apparatus or mechanism for forcing into the said hollow valve at the desired times any suitable quantity or supply of the fuel. Inasmuch as said fuel-pumping apparatus is old and well known in connection with engines of this description, I have omitted to illustrate same in order to simplify the drawings as much as possible. For the same reason I have omitted to show the usually-employed igniting device at the combustion chamber or cylinder 4. Above the larger piston 47 there is formed in the cylinder-head 6 an opening 68, which communicates with a lateral passage-way 69, leading out into the atmosphere, and said opening 68 is formed with a valve-seat 70 for an exhaust-valve 71, having a stem 72, which is suitably guided and provided with a spring 73, operating normally to hold said valve up against its seat. The upper protruding end of the stem 72 is, like the supplemental valve 31, also adapted to be actuated at the proper time by the rocker-arm 38, so as to open said valve and permit the escape of the burned gases.

Surrounding the cylinders and various other parts which might become unduly heated are water-jackets, (designated by the numeral 74.)

The air-reservoir may be provided, as shown, with any suitable pressure-gage 75, and at 76 may be arranged a hand-valve to cut off communication from the reservoir to the cylinder 5 when the engine is to be left inoperative for a long time, thus providing against leakage, as before explained.

Having thus described the general construction of the engine embodying my improvements, I shall now describe the mode of operation of the same.

Assuming that there is no compressed air at all in the reservoir 2, the balance-wheel may be turned a few times to operate the pistons, and thereby cause a quantity of air to be forced into the said reservoir up to the required pressure. This is accomplished, primarily, by the larger piston 47 and the check-valves 55 and 64. When the piston 47 ascends, the valve 64 is drawn up from its seat and fresh air is admitted to the cylinder 5, and when the said piston descends the valve 64 is closed and the pressure of the air opens the valve 55,

which thus permits the air to pass through the pipe 60 into the reservoir 2. When the reservoir has thus once been properly supplied with air under pressure, the engine is then in condition for action and thereafter will always be in such condition, and hence ready for starting without previous special manipulation of the balance-wheel or any other part to bring the engine into working condition, except as presently explained. If now it be desired to start the engine, the fly-wheel is turned enough to bring the piston 11 to the upper part of its cylinder, and with its crank just off the dead-center and the piston ready to descend. Then the valve 66^a is opened, and the compressed air from the reservoir 2 is permitted to enter into the hollow valve 24, and at the same time or previously a drop or two or any other suitable quantity of fuel is forced into the said valve through the pipe 67, so as to provide a suitable charge of the explosive mixture for the cylinder 4. At this time said hollow valve will be down on its seat, and the supplemental valve will be open, as shown at Fig. 4. The valve 24 being on its seat will prevent the charge from entering the larger cylinder 5, as shown at Fig. 4. At this time the small piston 11 is nearly at the upper end of its stroke, and hence the admission into its cylinder of the compressed air will cause said piston to descend, and when it has descended to the lower end of its stroke the explosive charge behind said piston will come into contact with the burner or igniter at the said cylinder, and the charge will thereby be exploded. Owing to the employment of the oppositely-disposed cranks it will be understood that when the smaller piston 11 descends the larger piston 47 will rise and that at the time of the said explosion the larger piston will be at the top of its cylinder, as shown at Fig. 3. Just before the explosion occurs the cam acts through its connecting-rod 42 to vibrate the rocker-arm upwardly and carry the valve 32 to its seat, and then by a further movement of said rocker-arm acting on the valve-stem 31 the hollow valve 24 is lifted from its seat to the position shown at Fig. 3, so that when the explosion takes place the passage-way 10 between the two cylinders is open, and the gases immediately rush over onto the top of the larger piston 47 and force it downwardly, the total pressure upon the said piston 47 being now greater than on the piston 11, owing to the enlarged area of the former. Of course when the piston 47 goes down the piston 11 goes up. When the larger piston 47 ascends, it opens the check-valve 64 by suction and draws in behind it a supply of fresh air, which when the said piston descends is forced back through the passage-way controlled by the check-valve 55 and through the pipe 60 into the compressed-air reservoir 2, thus keeping said reservoir fully supplied with fresh air and at the requisite pressure, and as the valve 66^a is open said compressed air may flow around into the hollow valve 24 to furnish, with the gasolene or other fuel, a proper charge for the next operation of the pistons. When the piston 47 has descended under the force of explosion, the exhaust-valve 71 is opened by means of the rocker-arm 38, and hence the gases within the cylinder 5 after performing their work exhaust into the open air through the passage-way 69. At this time the main valve 24 is down upon its seat, as shown at Fig. 4, and the supplemental valve has just been opened to admit a new charge of the explosive material into the first cylinder, and hence by reason of the seating of the main valve the burned gases are prevented from returning into the first cylinder. The burned gases in the first cylinder are driven out by the ascent of the piston 11, at which time the exhaust-valve 71 is closed and the main valve 24 is off its seat and the supplemental valve is on its seat. The upper end of the piston 11 in its upstroke passes up into the ring 8, and the curved or tapering perimeter 21 of said piston fits around the convex-tapered surface 21 of said ring as close as possible without actual contact. Thus in this stroke or movement of the piston 11 practically all the burned gases in the cylinder 4 are driven into the cylinder 5. While the piston 11 is making the final part of its upward stroke the valve 24 is descending, and about the time the piston fits within the ring the valve is brought down onto its seat. Instantly the supplemental valve is then opened by the rocker-arm, and about the same moment the exhaust-valve 71 is likewise opened by the said rocker-arm, with the results, first, that a new charge of explosive mixture is let down onto the top of the piston 11, and, next, the burned gases in the cylinder 5 are permitted to escape into the open air as the piston 11 descends and the piston 47 rises. Thus it will be seen that the burned gases or products of combustion are driven first out of the cylinder 4 and then escape out of the cylinder 5, thereby rendering the engine self-cleaning in respect to the elimination of the burned gases, which is an important desideratum. The exhaust-valve 71 closes at about the end of the upward stroke of the piston 47 and simultaneously with the closing of the supplemental valve 32. The supplemental valve, as explained, is closed by the upward vibration of the rocker-arm, and as soon as this closure is effected the further vibration of said arm operates to lift the hollow valve from its seat, and as soon as this occurs the new charge in the cylinder 4 is exploded.

It will be understood, of course, that while I have shown a vertical engine a horizontal engine embodying my improvements may be made as well, and, moreover, that although I have shown the cylinders as arranged side by side they may be arranged one under or in line with the other in tandem form without departing from the gist of the main part of my invention, and in such tandem ar-

rangement it will be understood that in lieu of the oppositely-disposed cranks the pistons may be connected together by a rod or rods or otherwise, as is well known in other forms of engines.

Various other changes in construction and arrangement may be made without departing from the principle of my invention.

In the above description I have used the terms "upwardly" and "downwardly" with reference to the movements of the pistons, which terms of course would not strictly apply where the parts are arranged in a horizontal position. In order to use terms which would apply to any and all positions and movements of the parts, I shall employ in the claims the words "outward" and "inward" or the like, meaning by the former the movement of each piston away from its head and by the latter the movement of the piston toward its head.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a gas-engine, the combination of two cylinders communicating with each other, two pistons connected together to traverse said cylinders, and an igniting device at substantially the end of the outward stroke of one of said pistons, a valve adapted to the head of one of said cylinders for opening and closing the passage-way between said cylinders, a supplemental valve for admitting under pressure a charge of the explosive mixture to the first cylinder when the main valve is seated, a source of fuel-supply connected to the main valve, and a compressed-air reservoir also connected to said main valve and to the second of said cylinders.

2. In a gas-engine, the combination of a pair of cylinders communicating with each other, a pair of connected pistons adapted to traverse said cylinders, a hollow valve adapted to a seat at the head of the first cylinder, a supplemental valve carried by said main valve, a source of fuel-supply discharging into said hollow valve, and a source of compressed-air supply connected to said valve and to the second cylinder, and means for igniting the charge in the first cylinder after the compressed-air charge has driven its piston outwardly.

3. In a gas-engine, the combination of two cylinders communicating with each other, a pair of pistons connected together and adapted to traverse said cylinders, an igniting device connected to one of said cylinders, a hollow valve adapted to move to and from the head of the ignition-cylinder, a fresh-air inlet arranged at the outer end of the second cylinder, a compressed-air reservoir connected to the outer end of said second cylinder, and to the said hollow valve, and means for supplying fuel to said hollow valve.

4. In a gas-engine, the combination of a pair of cylinders communicating with each other, a pair of connected pistons adapted to traverse said cylinders, an igniting device at the outer end of the stroke of the first piston, a hollow valve adapted to be forced to its seat at the head of the first cylinder by means of compressed air, a supplemental valve for admitting the charge into the first cylinder when said hollow valve is seated, a compressed-air reservoir connected to said hollow valve and to the second cylinder, and a suitable source of fuel-supply discharging into said hollow valve.

5. In a gas-engine, the combination of a pair of cylinders communicating with each other, a pair of connected pistons adapted to traverse said cylinders, an igniting device at the first cylinder, means for compressing air and delivering it to the first cylinder, and for also delivering fuel thereto, a hollow valve adapted to receive the compressed air and the fuel and to close the communication between the said two cylinders at the time of the delivery of the charge and on the outward stroke of the first piston, and means for passing the charge from the hollow valve into the first cylinder.

6. In a gas-engine, the combination of a pair of cylinders communicating with each other, a pair of pistons connected together and adapted to traverse said cylinders, an igniting device at the end of the outward stroke of the first piston, a valve-controlled inlet and a valve-controlled outlet at the outer end of the stroke of the second piston, a compressed-air reservoir connected to said second cylinder, a communication between said reservoir and the first cylinder, a valve for controlling the admission of compressed air and fuel to said cylinder, and a valve for closing the communication between the two cylinders.

7. In a gas-engine, the combination of a pair of cylinders communicating with each other, a pair of pistons connected together and adapted to traverse said cylinders, an igniting device situated at the end of the outward stroke of the first piston and entering its cylinder, a valve-controlled inlet and a valve-controlled outlet at the outer end of the stroke of the second piston, a compressed-air reservoir connected to said second cylinder, a communication between said reservoir and the first cylinder, and valves for controlling the admission of the charge and for closing the communication between said cylinders.

8. In a gas-engine, the combination of a pair of cylinders communicating with each other, a pair of connected pistons adapted to traverse said cylinders, an igniting device situated at the outer end of the stroke of the first piston and entering the cylinder thereof, a valve for controlling the passage-way between said two cylinders, and an exhaust-valve for the second cylinder.

9. In a gas-engine, the combination of two cylinders communicating with each other, a pair of pistons adapted to traverse said cylinders and connected to oppositely-disposed cranks, a valve for controlling the passage-way between said two cylinders, a supple-

mental or inlet valve for the first cylinder, an exhaust-valve, a fresh-air-inlet valve and a fresh-air-outlet valve for the second cylinder, a rocker-arm connected to the crank-shaft for operating the inlet or supplemental valve and also the exhaust-valve, a compressed-air reservoir connected to the first and second cylinders, a source of fuel-supply connected to discharge into the first cylinder, and a valve for controlling the supply of compressed air from the reservoir to the first cylinder.

10. In a gas-engine, the combination of a pair of cylinders communicating with each other, a pair of connected pistons adapted to traverse said cylinders, the piston of the first cylinder having a tapered or concaved portion adapted to a tapered or convex ring at the head of its cylinder, a valve-seat on said ring and a valve adapted to close the passage-way between said two cylinders adapted to said valve-seat.

11. In a gas-engine, the combination of a pair of cylinders communicating with each other, a pair of pistons connected together and adapted to traverse the same, a ring at the head of the first cylinder provided with a valve-seat and with an interior convex portion adapted to receive the circular concaved portion of the head of the piston, and a valve adapted to said seat and operating to close the passage-way between said two cylinders.

12. In a gas-engine of the character specified, the combination of a ring at the head of the first cylinder, a hollow valve adapted to seat upon said ring and close the passage-way between said two cylinders, a supplemental valve carried by said hollow valve, a compressed-air inlet to the said hollow valve, and a fuel-inlet to said valve.

Signed at New York city, in the county of New York and State of New York, this 11th day of November, A. D. 1897.

ALEXANDER T. BROWN.

Witnesses:

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K. V. DONOVAN.