No. 779,116. PATENTED JAN. 3, 1905.

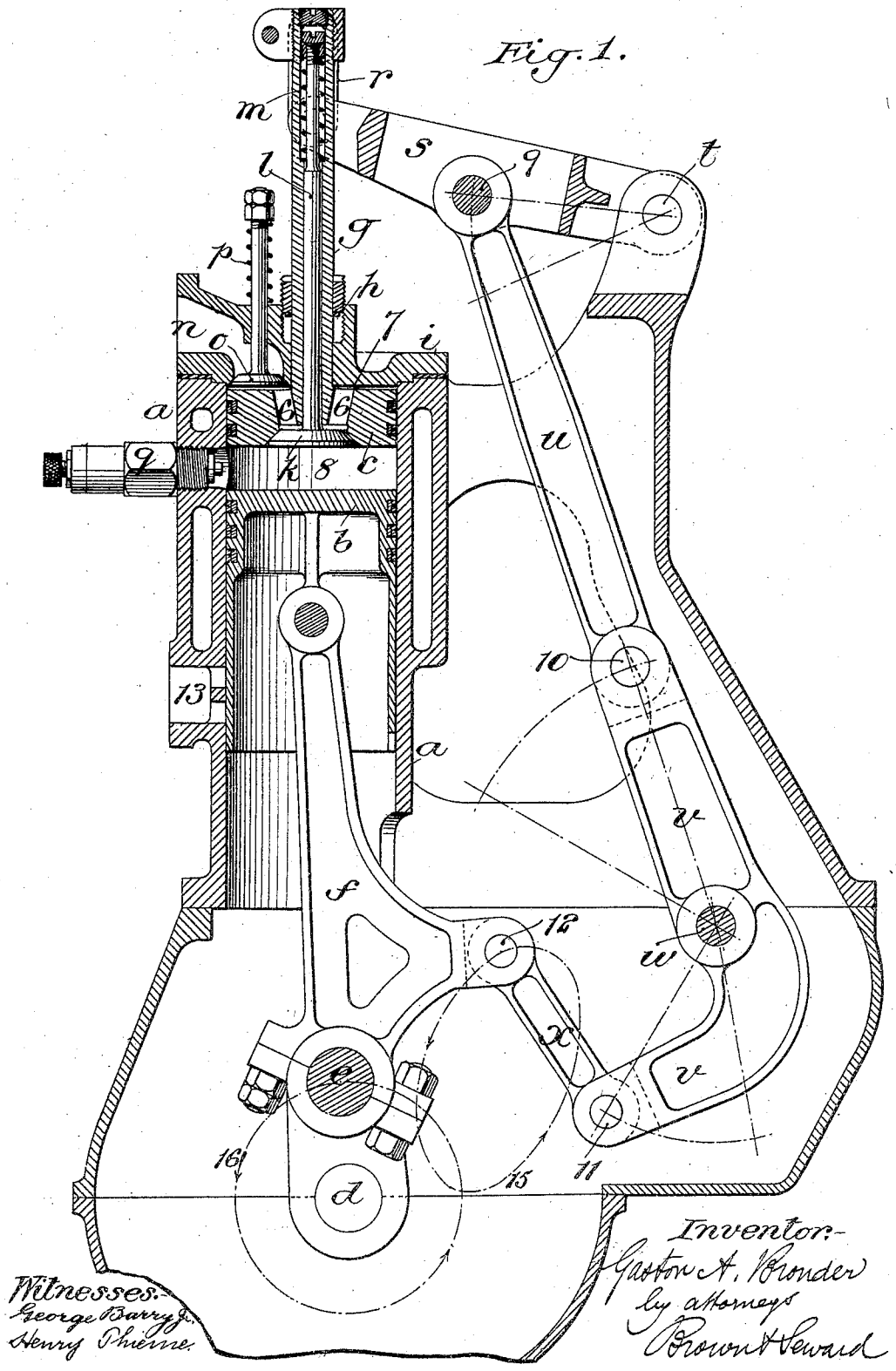
G. A. BRONDER.

GAS ENGINE.

APPLICATION FILED NOV. 14, 1900.

2 SHEETS—SHEET 1.

Fig. 1.



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Inventor:
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GAS ENGINE.

APPLICATION FILED NOV. 14, 1900.

2 SHEETS—SHEET 2.

Fig. 2.

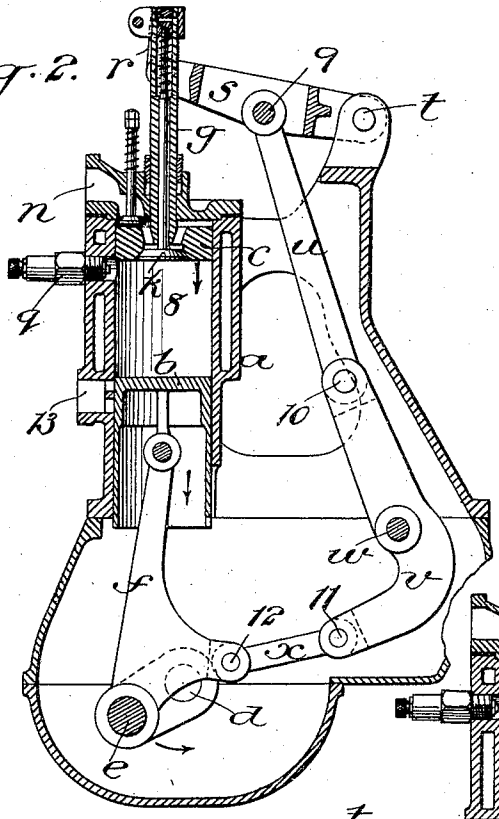


Fig. 3.

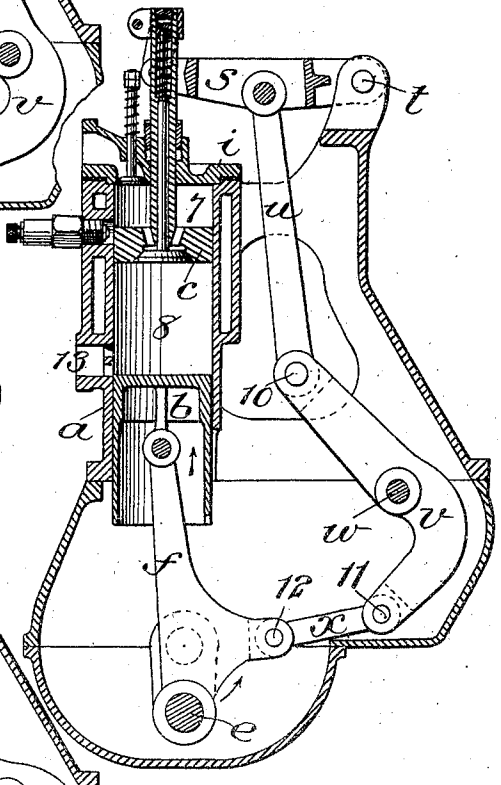
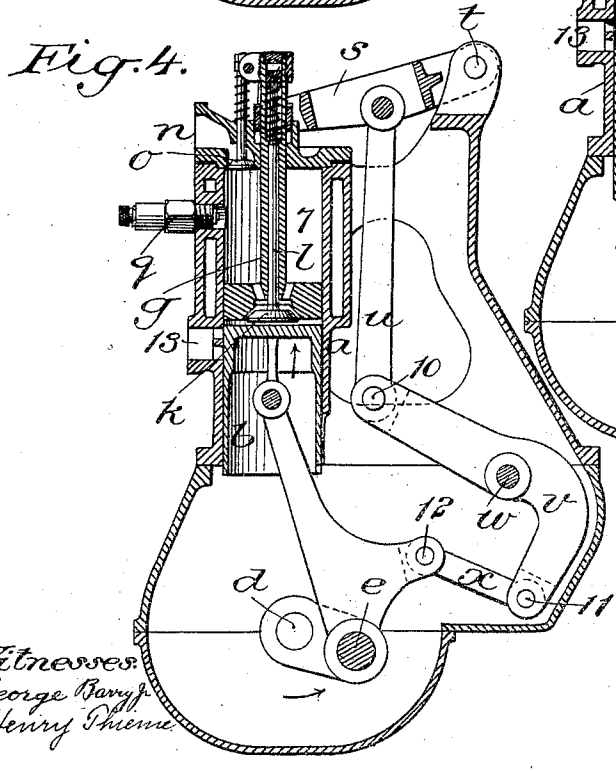


Fig. 4.



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No. 779,116. Patented January 3, 1905.

UNITED STATES PATENT OFFICE.

GASTON A. BRONDER, OF BROOKLYN, NEW YORK.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 779,116, dated January 3, 1905.

Application filed November 14, 1900. Serial No. 36,429.

To all whom it may concern:

Be it known that I, GASTON A. BRONDER, a citizen of the United States, and a resident of the borough of Brooklyn, in the city of New York and State of New York, have invented a new and useful Improvement in Gas-Engines, of which the following is a specification.

This invention relates to that class of gas-engines in which a piston is actuated by the pressure produced by the explosive combustion of a mixture of air and gas or hydrocarbon vapor within the cylinder in which said piston works.

In an engine embodying my improvement two reciprocating pistons work in the same cylinder, one of the said pistons serving both the purpose of sucking in or inducting the explosive mixture to the cylinder and the purpose of displacing or expelling the spent gases therefrom and the other of the said pistons serving both the purpose of compressing the said mixture within the cylinder prior to its ignition and the purpose of a power-piston, the connections between the said pistons with each other and a with a crank-shaft being such as to constitute an exceedingly simple single-cylinder two-cycle gas-engine with positive motions for drawing in and compressing the explosive mixture and for displacing or exhausting the spent gases from between the pistons, with little clearance between the two pistons at the end of the exhaust-stroke of the displacement-piston and practically no clearance between the latter piston and its adjacent end of the cylinder at the end of the compression-stroke of the power-piston.

In the accompanying drawings, Figures 1, 2, 3, 4 represent vertical sectional views of a gas-engine embodying my invention, showing the engine in different positions.

a designates the cylinder, having a uniform bore. *b c*, the pistons, of which the lower one, *b*, is the power and compression piston, but will be hereinafter referred to as the "power-piston," and the upper one, *c*, is the suction and displacement piston, but will be hereinafter termed the "displacement-piston," *d* the crank-shaft, and *e* the crank arranged below the cylinder, the lower end of which is open for the passage of the connecting-rod *f*, which connects the power-piston directly with the crank *e*. The displacement-piston has a rod *g*, which passes through a stuffing-box *h* in the closed head *i*, with which the upper end of the cylinder is provided. The said piston has provided through it passages 6 for forming communication from the space 7 between the piston *c* and the cylinder-head *i*, which constitutes the receiving-chamber for the explosive mixture and the space 8 between the two pistons, which constitutes the combustion-chamber, and an upwardly-closing valve *k* is provided in the said piston for opening and closing these passages 6. The said valve *k* has a stem *l*, which projects upwardly into the piston-rod *g*, within which a coil-spring *m* is applied to said stem for keeping said valve normally closed. The inlet *n* for the explosive mixture is provided in the upper cylinder-head, and this inlet is provided at its inner orifice with a valve *o*, which opens toward the cylinder, but is kept normally closed by means of a coil-spring *p* applied to its stem. The said valve *o* when closed is flush with the interior of the cylinder-head *i*, so that, as shown in Fig. 1, the piston *c* may work so close to the said head as to give the least possible clearance. Through one side of the cylinder, in the upper part thereof, there is provided an opening, through which is inserted the electric sparking plug *q* for the ignition of the explosive mixture, and in the lower part of the cylinder there is provided in one side thereof an exhaust-opening 13 for the spent gases.

The displacement-piston *c* is connected with the power-piston *b* to derive its motion therefrom by the following means: The piston-rod *g* has a link connection *r* with a lever *s*, which works on a fixed fulcrum *t*. This lever *s* has connected with it at 9 the upper end of a rod *u*, the lower end of which is connected at 10 with the upper arm of a lever *v*, which works on a fixed fulcrum *w*, and the lower arm of which has a link connection *x* 11 12 with a projection from one side of the main connecting-rod *f* of the engine. These connections are so proportioned that during the whole or all but a very small portion of the

downward stroke of the power-piston *b*, in which the power is transmitted to the crank in the direction of the arrow 16, the displacement-piston *c* is held stationary, so that it forms the abutment between which and the power-piston the ignited and expanding gaseous mixture acts until the upper edge of the latter piston begins to pass the upper edge of the exhaust-opening 13. This may be understood by reference to Figs. 1 and 2, in the former of which the elliptical path 15, in which the center of the pin 12 moves, is indicated by a dotted line, and it will be seen that a part of said path coincides with the arc described from the center of the pin 11 by the radius of the link *x*. Hence during the downward stroke of the connecting-rod *f* the said rod holds the pin 11 and the lever *v* stationary, and the rod *u* being in line with the upper arm of the lever *v* serves as a brace to the lever *s* against the upward thrust of the displacement-piston until, as shown in Fig. 2, the power-piston is about to begin uncovering the exhaust-port 13. Then by the continued revolution of the crank and the consequent lateral movement of the connecting-rod *f* during about the lower third of the revolution of the crank the downward movement of the displacement-piston is produced. During the further continued upward movement of the power-piston the displacement-piston is carried up with it by the connecting-rod *f* acting through the link *x*, lever *v*, rod *u*, lever *s*, and link connections *r*.

The effect of the relative movements of the two pistons and their functions in the operations of the engine will now be described with reference to Figs. 1, 2, 3. First, suppose the power-piston *b* to be at the upper end of its stroke, as shown in Fig. 1, the displacement-piston *c* is also at the upper end of its stroke. The combustion-chamber 8, which is formed within the cylinder between the two pistons, has received during the previous upstroke of the displacement or suction piston *c* a charge of the explosive mixture, which has been compressed by the just-completed upward stroke of the power-piston, and at this moment the charge is ignited by a spark from the plug *q*. The power-piston *b* is now forced downward by the expanded ignited gaseous mixture, while the displacement-piston *c* remains stationary until the power-piston *b* begins to uncover the exhaust-port, as it is about to do in Fig. 2, for the escape of the spent gases, the said piston *b* then constituting the exhaust-valve. At this instant the displacement-piston *c* begins to move downward, which movement is continued while the power-piston *b* moves to the bottom of its stroke and completely uncovers the exhaust-port, as shown in Fig. 3, and until the latter piston has moved up far enough to cover the exhaust-port again, as shown in Fig. 4, where it will be seen that the two pistons come so near together as to leave between them very little clearance in which spent gas can be retained. During the latter movement the piston *c*, its valve *k* having been closed by the spring *m* and kept closed by the pressure in the cylinder below it, has also drawn a fresh supply of the gaseous mixture from the inlet *n* through the valve *o* into the receiving-chamber 7. From the position last mentioned (represented in Fig. 4) the two pistons move upward together, the piston *c* moving for a time faster than the piston *b*, and, the valve *o* closing, the gas from the receiving-chamber 7 above the piston *c* passes through the valve *k* in the latter piston to the increasing space between the two pistons; but the upward movement of *c* being first completed the continued upward movement of *b* produces the compression of the gas between the two pistons, the valve *k* in the meantime closing, so that on the completion of the upward stroke of *b* the gas is sufficiently compressed for its ignition for the repetition of the several operations described. In these operations not only do the two pistons come so close together, as shown in Fig. 4, as to effect a practically complete expulsion of all the spent gases, but the suction-piston *b* comes so close to the top of the cylinder as to cause the transfer of practically all of the fresh gas from the receiving-chamber 7 to the combustion-chamber 8, so that there are practically no clearance-spaces for either the fresh gaseous mixture or the spent gases.

In the above-described operation the compression is performed entirely by the power-piston, and both the drawing in of the fresh gaseous mixture and the expulsion of the spent gases are performed by the displacement-piston. The spring *m* tends to keep the valve *k* closed at all times but during the transfer of the explosive mixture from the receiving-chamber 7 to the explosion-chamber 8, and therefore the passage of any small quantity of spent gas that may have been retained between the two pistons is prevented from passing by the piston *c* to mix with the incoming explosive mixture in the receiving-chamber 7.

The provision for igniting the explosive mixture at the proper time may be such as is well known and commonly used in explosive-gas engines, and therefore I have not thought it necessary to illustrate or describe it further than to indicate in the drawings by the representation of the sparking plug *q* the position of the igniting device with respect to the cylinder and pistons.

What I claim as my invention is—

1. In a gas-engine, the combination of a cylinder, a power-piston working in said cylinder, a power-transmitting crank and a rod connecting said piston therewith, a valved piston working in said cylinder for drawing the explosive mixture thereinto and expelling spent gas therefrom and connections between

said valved piston and a part of said connecting-rod whereby said valved piston is held stationary while the power-piston is moved from it by the expansion of the exploded gases between the two, substantially as herein described.

2. In a gas-engine, the combination of a cylinder having one end closed but provided with a valved inlet-port for the explosive mixture, a power-piston, a valved piston for drawing said mixture into and expelling spent gas from said cylinder, said valved piston arranged between the power-piston and said end, a crank and a connecting-rod between it and the power-piston, a lever having a fixed fulcrum and a link connection with said rod, a second lever having a fixed fulcrum and a connection with said valved piston, and a rod which connects said two levers for the purpose of alternately giving motion to the valved piston and serving as a brace to hold said piston stationary during one stroke of the power-piston, substantially as herein described.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of two witnesses, this 13th day of November, 1900.

GASTON A. BRONDER.

Witnesses:
FREDK. HAYNES,
GEORGE BARRY, Jr.