No. 816,549. PATENTED MAR. 27, 1906.

W. HECKERT.

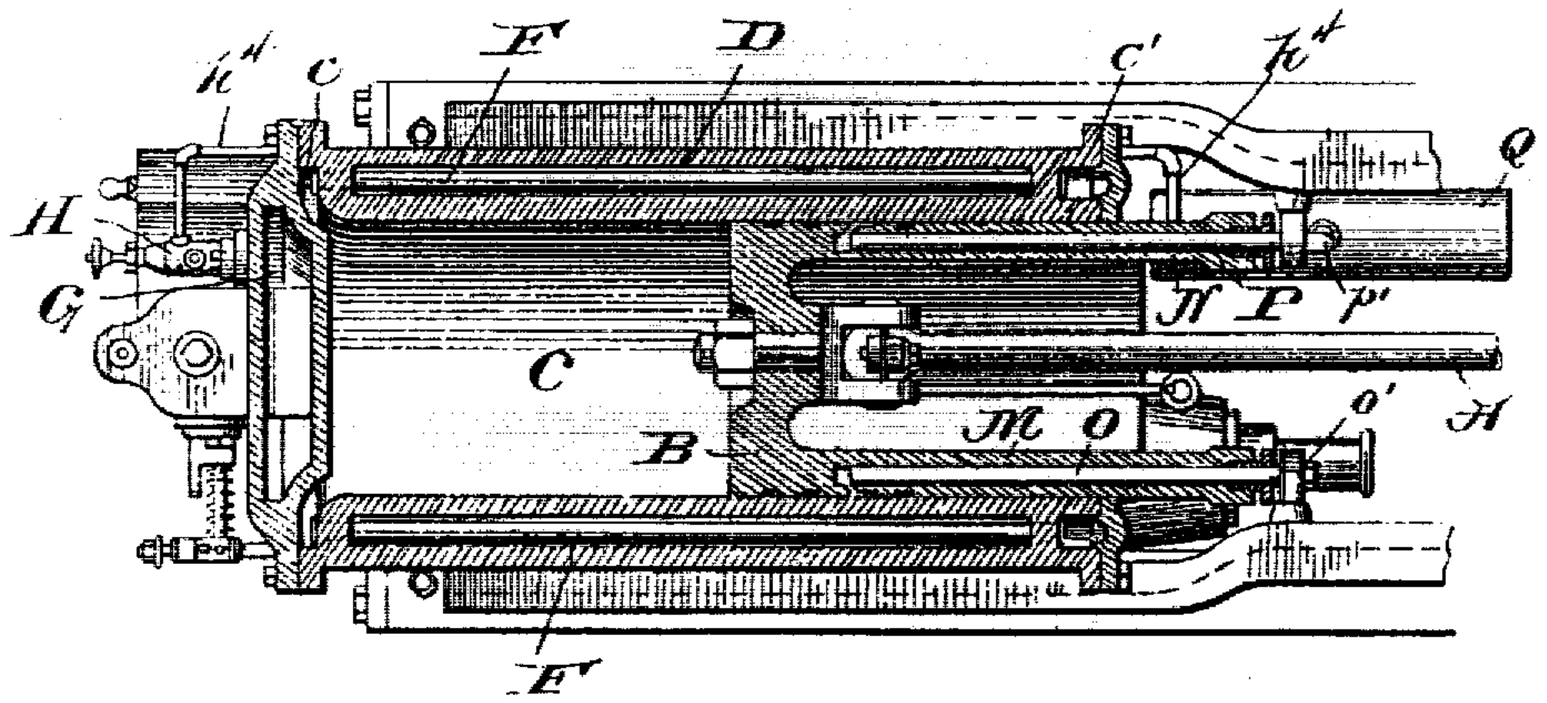
GAS ENGINE.

APPLICATION FILED MAY 16, 1903.

2 SHEETS—SHEET 1.

Fig. 1.

Fig. 2.



Witnesses
J. L. Mackaye
W. Lee Helms.

Inventor
William Heckert
By Adrian Chowell Son
his Attorneys

No. 816,549. PATENTED MAR. 27, 1906.

W. HECKERT.

GAS ENGINE.

APPLICATION FILED MAY 16, 1903.

2 SHEETS—SHEET 2.

Fig. 3.

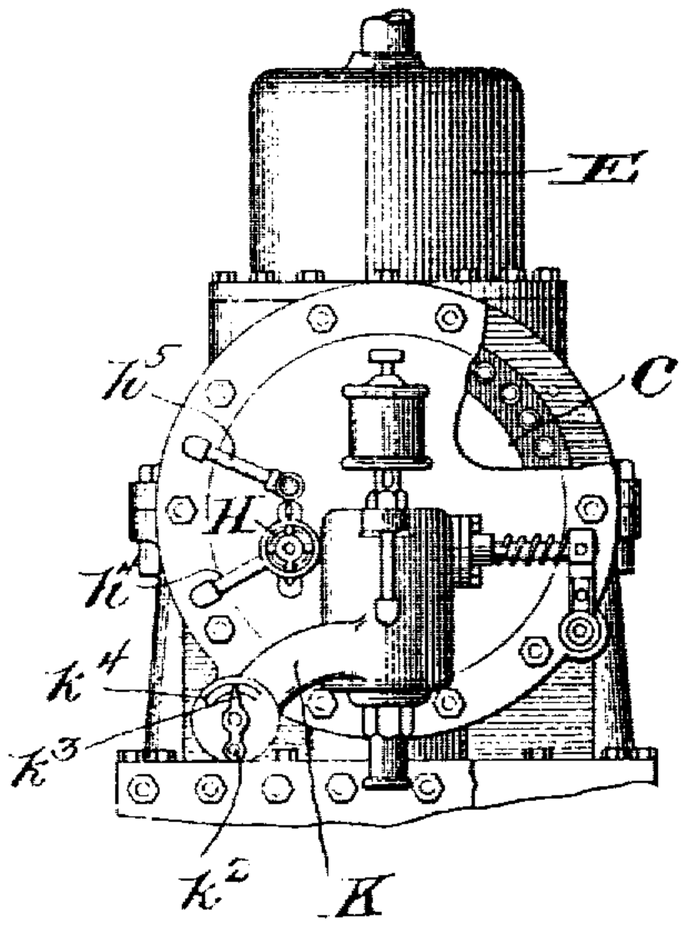


Fig. 4.

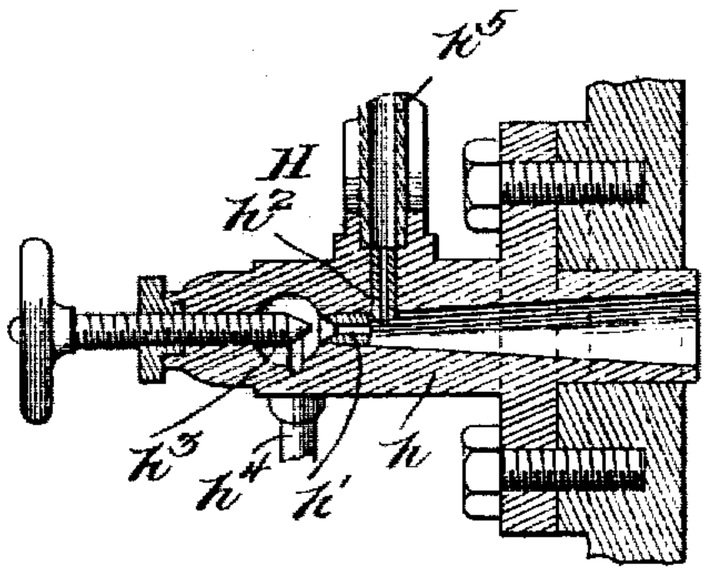


Fig. 5.

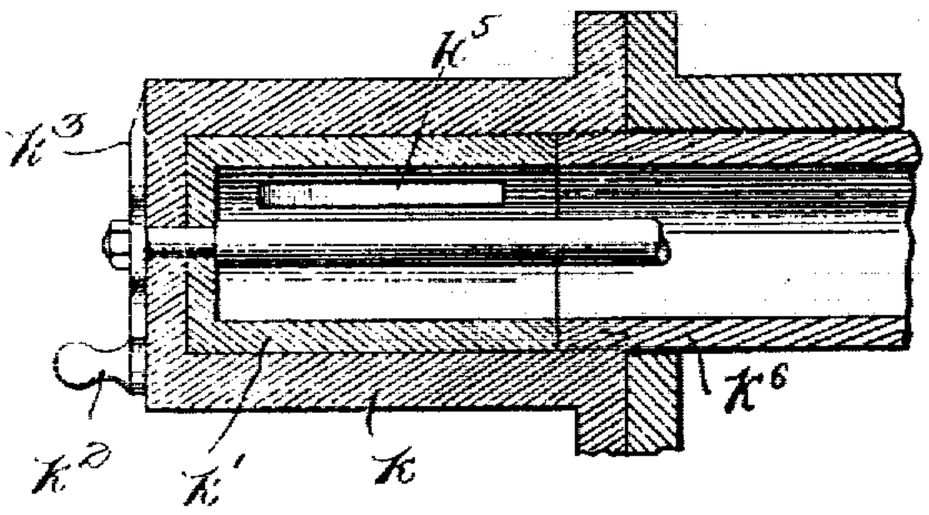


Fig. 6.

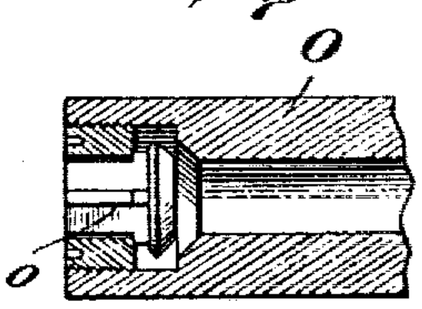


Fig. 7.

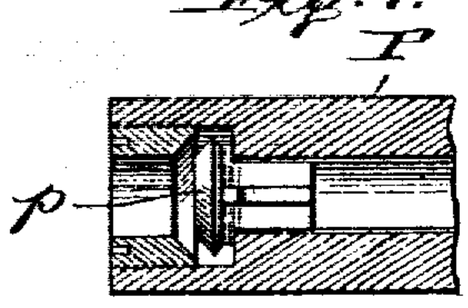
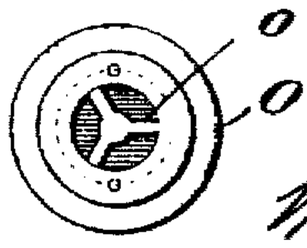


Fig. 8.



Witnesses
J. L. Mocdam
W. Lee Holmes

Inventor
William Heckert
By Julian C. Dowell & Son
his Attorneys

UNITED STATES PATENT OFFICE.

WILLIAM HECKERT, OF FINDLAY, OHIO, ASSIGNOR OF ONE-HALF TO HENRY W. SENEY, OF TOLEDO, OHIO.

GAS-ENGINE.

No. 816,549. Specification of Letters Patent. Patented March 27, 1906.

Original application filed June 13, 1902, Serial No. 111,537. Divided and this application filed May 18, 1903. Serial No. 157,608.

To all whom it may concern:

Be it known that I, WILLIAM HECKERT, a citizen of the United States, residing at Findlay, in the county of Hancock and State of Ohio, have invented certain new and useful Improvements in Gas-Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates more particularly to gas-engines of that class in which the explosive charge is produced by an admixture of air and gas or air and vaporized oil, naphtha, and the like. An engine of such character embodying my present invention is illustrated and described in my pending application, filed June 13, 1902, Serial No. 111,537, of which the present application is a division.

The principal object of the invention is to provide an efficient gas generating and mixing apparatus with improved means for atomizing and injecting oil into the gas-generating chamber thereof and with improved means for supplying said apparatus with heated air and for heating such air by contact with the interior surface of the cylinder, thus also cooling the cylinder-walls.

The invention will hereinafter first be described with reference to the accompanying drawings, which form a part of this specification, and then be pointed out more particularly in the annexed claims.

In said drawings, wherein corresponding parts in the several views are indicated by like symbols of reference, Figure 1 is a longitudinal central vertical section of the cylinder and adjacent parts of an engine embodying my invention. Fig. 2 is a central horizontal section thereof. Fig. 3 is a rear end elevation of the same. Fig. 4 is an enlarged longitudinal sectional view of the oil feeding and atomizing device. Fig. 5 is a similar view of an air-valve for regulating the supply of air to the gas-generating chamber. Figs. 6 and 7 are detail sectional views of the valves in the piston-actuated air-pump, and Fig. 8 is a front end view of one of the hollow valved plunger-rods of said air-pump.

The engine illustrated is of the same general construction as that shown and described in my United States Letters Patent, No. 708,637, dated September 9, 1902, and also in the drawings and specification accompanying my aforesaid pending application. The letter A denotes the pitman or rod which connects the crank (not shown) on the crank-shaft of the engine with the piston B, which works within the open-ended cylinder C, a reciprocatory movement being imparted to the piston by the explosion of gases in the closed end or combustion-chamber of the cylinder, as will hereinafter be explained. The cylinder is shown provided with a water-space D around it, having a surmounting steam-dome E, the outlet-opening of which may be connected to a pipe or other means for conducting the steam to any apparatus where the steam is to be used for heating, motive, or other purposes. At its front or gas end the cylinder is shown provided with an annular gas-space *c*, opening into the combustion-chamber within the cylinder at such end, while at its opposite end it is provided with a distinct gas space or chamber *c'*, having an exhaust-valve c^2. The said gas-spaces *c* and *c'* are connected by a series of fire-flues F within the annular water-space D, so that the exhaust-gases from the combustion-chamber or gas end of the cylinder can pass from the gas-space *c* through said flues into the gas-space *c'* and thence through the exhaust-valve, thus heating the water in said water-space. The exhaust-valve may be operated automatically by suitable connections with the crank-shaft or other means, thus also controlling the admission of the explosive charges into the combustion-chamber.

The particular construction of the cylinder and surrounding parts constitutes the subject-matter of my aforesaid application, and it will be understood that the present invention is independent of such construction and is applicable to any ordinary form of gas-engine.

The front cylinder-head is hollow, thereby providing an annular gas-generating chamber G, into which a supply of gas or atomized oil, naphtha, or the like may be admitted through any suitable feeding device, though I preferably employ an oil atomizing and feeding device H, Figs. 2, 3, and 4, operating in conjunction with air and gas mixing devices, whereby crude oil may be atomized and injected into said gas-generating chamber. This hollow cylinder-head forming the front end of the explosion-chamber is se-

2

cured to the flaring or enlarged end of the cylinder, providing the annular fire-space *c*, surrounding the gas-generating chamber G. Said annular fire-space *c* is of greater diameter than the cylinder and is open to the explosion-chamber thereof and is also in direct communication with the fire-flues F, as aforesaid. The oil injected into the generating-chamber G by reason of the intense heat to which it is subjected is vaporized therein. The vaporized oil or gas then passes through a suitable port *g* into a distinct mixing-chamber J to be commingled with air, and from said mixing-chamber the commingled gas and air passes through a suitable valve *j* and through a passage leading centrally through the gas-generating chamber into the combustion-chamber, wherein it is compressed on the return or reverse stroke of the piston and then exploded by means of any suitable igniter. Any suitable air and gas mixing devices may be employed. As such devices do not *per se* form a part of my present invention, they are not specifically described herein. The form shown is similar to the construction disclosed in my United States Letters Patent No. 425,132, dated April 8, 1890.

The illustrated construction, as above described, provides a simple compact structure notably free from the elaborateness and complications which characterize many gas-engines, and it provides in this simple structure a most efficient means for producing the explosive charges and introducing the same into the cylinder, for the generating-chamber G, into which the atomized oil or gas is injected, has its inner wall forming the front of the explosion-chamber, and, furthermore, said generating-chamber is surrounded by the annular fire-space *c*, so that the material injected into said generating-chamber is instantly subjected to the intense heat from the explosion-chamber and surrounding fire-space *c*. The vaporized oil or gas thence passes into the adjacent but distinct mixing-chamber J, where it is commingled with air, and thence the commingled air and gas pass through the valve-controlled passage to the explosion-chamber of the cylinder, said valve-controlled passage leading through the generating-chamber G.

The said oil atomizing and feeding device H may consist of a tubular body *h*, bolted or otherwise secured to the cylinder-head at the gas end of the engine and having a conical bore opening into the generating-chamber and provided with two nozzles h' and h^2, which are inserted in suitable apertures therein at an angle to each other, one of which nozzles h' is provided with an adjustable needle-valve h^3 and is in communication with a feed-pipe h^4, leading from an air-reservoir or any suitable source of compressed air, while the other nozzle h^2 communicates with a feed-pipe h^5, leading from an oil-reservoir or any suitable supply of gas or oil. By such construction crude oil or naphtha introduced through the pipe h^5 and nozzle h^2 is intercepted by a jet of air issuing through the valved nozzle h', whereby the oil is atomized and then injected into the gas-generating chamber G. A waste valve or cock L is placed beneath the generating-chamber to permit the removal of tar or other waste material resulting from the generation of gas in said chamber.

For regulating the admission of air into the mixing-chamber J for admixture with the gas or vapor issuing thereinto from the generating-chamber I may provide a hollow projection or horn K, Fig. 3, extending out from the casing of said mixing-chamber and uniting with a hollow boss *k* on or secured to the cylinder-head and having an aperture in the outer end thereof through which passes a stud projecting from one end of a rotary or oscillating valve k', said stud having a handle k^2 and a pointer k^3, operating in connection with an index k^4 for adjusting and indicating the position of the port or ports k^5 in said valve registering with a similar port or ports in the boss *k* for controlling the admission of air through such ports into the mixing-chamber. A pipe extension k^6 may be screwed into the boss *k* with its rear end open to the air at a point just below the cylinder, so as to receive heated air for conducting into the mixing-chamber, or air may be drawn directly into the rear open end of the boss.

For the purpose of utilizing the heat absorbed by the piston and cylinder in heating air to be used in the production of the explosive charges and at the same time cooling the piston and interior cylinder-surface I have provided a piston-actuated air-pump for causing a circulation of air around the piston in contact with the interior walls of the cylinder. To this end the piston is interiorly bored or provided on opposite sides thereof with tubes or barrels M and N to receive hollow plungers or piston-rods O and P, respectively, the latter having their outer ends fixed and thence extending through suitable stuffing-boxes in the tubes or barrels therefor in the piston. A check-valve *o*, fitted in the piston-rod O, Fig. 6, opens inwardly or in the direction of the reverse movement of the engine-piston, and a similar valve *p* in the other plunger or piston-rod, Fig. 7, opens outwardly or in the direction of the opposite or working movement of the piston, and the former piston-rod is provided with an air-inlet, as at o', Fig. 2, while the latter piston-rod is provided with an air-outlet, as at p', leading to an air-reservoir Q, having a pipe connection with the gas-generating apparatus. As shown, said reservoir is connected to the pipe h^4, which supplies air to the oil atomizing and feeding device, though, if desired, said pipe connection may lead into the

mixing-chamber. The longitudinal bores or tubes M and N are provided one with an outlet and the other with an inlet port, leading to a groove or channel *b*, connecting said ports around the piston in order that the air admitted at one side may circulate around the piston in contact with the hot interior walls of the cylinder and be forced out at the other side into the compressed-air reservoir Q. The air-pump thus described acts on the principle of a suction and force pump—that is to say, on the reverse stroke of the engine-piston a vacuum is formed in the bore or tube M at the inlet side thereof, which causes a suction of air into such bore or tube, while on the working stroke the check-valve *o* closes and the air is forced out through the inlet-port into and around the channel in the piston, taking up heat from the interior cylinder-surface, and thence through the opposite port into the bore or tube N at the opposite side of the piston and through the backwardly-opening check-valve *p* out from the hollow piston-rod at that side and into the air-reservoir.

The operation of the engine will be well understood. In starting, as the piston moves forward an initial charge of mixed air and gas is admitted into the cylinder and then compressed on the reverse stroke, then exploded, forcing forward the piston, and on the next reverse stroke the waste products of combustion are forced through the flues F and exhausted. On the next forward stroke, the exhaust-valve having closed, a vacuum is formed in the gas end of the cylinder, causing the air and gas inlet valve to open, thereby again admitting a change of air and gas, which is compressed on the next reverse stroke and exploded at the proper time by means of any suitable device or igniter, and so on, so as to impel the piston by the action of the expansion-gases at every second stroke.

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

1. In a gas-engine, the combination with the cylinder and its working piston, of the hollow cylinder-head constituting an annular generating-chamber adjacent immediately to and encircled by the explosion-chamber of the cylinder, means for introducing oil or explosive-rendering material into said generating-chamber, a mixing-chamber on the cylinder-head having a port for admitting gas thereinto from said generating-chamber and having communication with an air-supply, a distinct passage leading from said mixing-chamber through the generating-chamber into the explosion-chamber, and a valve controlling admission of explosive mixture to said passage adapted to open on the suction-stroke of the piston.

2. In a gas-engine the combination of a cylinder having a flaring end providing an annular fire-space of greater diameter than the cylinder and open to the explosion-chamber thereof, a hollow cylinder-head closing said end of the cylinder and having its inner face or wall projected inward and having an internal gas-generating chamber encircled by said annular fire-space, means for introducing oil or explosive-rendering material into said generating-chamber, and means for admitting generated gas into the explosion-chamber of the cylinder.

3. In a gas-engine, the combination of a cylinder having at one end of its explosion-chamber an annular fire-space of greater diameter than the cylinder, a series of fire-flues surrounding the cylinder and communicating with said annular fire-space, a hollow head closing said end of the cylinder and having an internal gas-generating chamber encircled by said annular fire-space, means for introducing oil or explosive-rendering material into said generating-chamber, and means for admitting generated gas into the explosion-chamber of the cylinder.

4. In a gas-engine, the combination with the cylinder and piston, of an air-reservoir and pipe connections leading therefrom to the gas end of the cylinder, and means for causing a current of air to circulate around the piston in contact with the interior walls of the cylinder and to pass thence into said reservoir for supplying heated air to the gas generating and mixing apparatus.

5. In a gas-engine, the combination with the cylinder and reciprocating piston therein having a groove or channel around its periphery and longitudinal bores or tubes on opposite sides thereof with ports opening into said channel, hollow piston-rods fitting said tubes or bores, one having an air-inlet and the other having an air-outlet leading to an air-reservoir, an inwardly-opening valve in the former rod, and an outwardly-opening valve in the other rod, whereby on reciprocation of the piston a current of air is forced around said piston in contact with the interior walls of the cylinder and thence into said reservoir.

6. In a gas-engine, the combination with the cylinder and reciprocating piston therein having a groove or channel around its periphery, of an air-reservoir, and an air-pump connected with the said channel around the piston for pumping air into said channel and thence to said reservoir during reciprocation of the piston.

7. In a gas-engine, the combination with the cylinder and piston, of the cylinder-head formed between its outer and inner walls with a gas-generating chamber therein substantially surrounded by the explosion-chamber of the cylinder, means for introducing explosive-rendering material into said generating-chamber, an outer adjacent mix-

ing-chamber having communication with said generating-chamber and with a source of air-supply, and a valved conduit leading from said mixing-chamber through the generating-chamber to the explosion-chamber.

8. In a gas-engine, the combination with the cylinder and its working piston, of the hollow cylinder-head constituting a gas-generating chamber into which oil or explosive-rendering material is introduced, an annular fire-space surrounding said generating-chamber and opening into the explosion-chamber of the cylinder, a distinct mixing-chamber into which gas from said generating-chamber and air from an air-supply are introduced, a distinct passage leading from said mixing-chamber into the explosion-chamber of the cylinder, and a valve for admitting explosive mixture from said mixing-chamber into said passage on the suction-stroke of the piston.

9. In a gas-engine, the combination of a cylinder whose explosion-chamber merges into an enlarged annular space at one end, a hollow cylinder-head inclosing said cylinder and space and having its inner face or wall projected inward and having its internal chamber serving as a gas-generating chamber surrounded by said annular space, means for introducing oil or explosive-rendering material into said generating-chamber, a valve for admitting the gas generated therefrom into the explosion-chamber on the suction-stroke of the piston, and an annular series of fire-flues communicating with said annular fire-space for conveying off the exhaust-gases.

10. In a gas-engine, the combination with the cylinder and its working piston, of the cylinder-head having a gas-generating chamber therein adjacent to the explosion-chamber of the cylinder, an oil-feeding device associated with the cylinder-head consisting of a member having a conical bore the larger end of which opens into said generating-chamber and a longitudinal air-nozzle at the smaller end of said bore for injecting air thereinto and an adjustable needle-valve for controlling said air-nozzle and an oil-nozzle in said member behind and at an angle to said air-nozzle, and a distinct mixing-chamber adjacent to the generating-chamber and having a port for admitting vaporized oil or gas thereinto from said generating-chamber, means for supplying air into said mixing-chamber for commingling with the gas, and a distinct valve-controlled passage leading from said mixing-chamber into the explosion-chamber of the cylinder for conducting the commingled explosive mixture thereto on the suction-stroke of the piston.

11. In a gas-engine, the combination with the cylinder and its working piston, of the cylinder-head having a gas-generating chamber therein adjacent to the explosion-chamber of the cylinder, means for introducing explosive-rendering material into said generating-chamber, an adjacent mixing-chamber having a port into which vaporized oil or gas is admitted from said generating-chamber, a cylindrical air-chamber in connection with said mixing-chamber, a tubular rotary or oscillatory valve in said air-chamber, registering ports in said valve and the wall of said air-chamber, the port in the latter being in connection with said mixing-chamber, and a valve-controlled passage leading from the mixing-chamber into the explosion-chamber of the cylinder.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM HECKERT.

Witnesses:
A. L. PORTER,
C. H. FERVEL.