(No Model.)

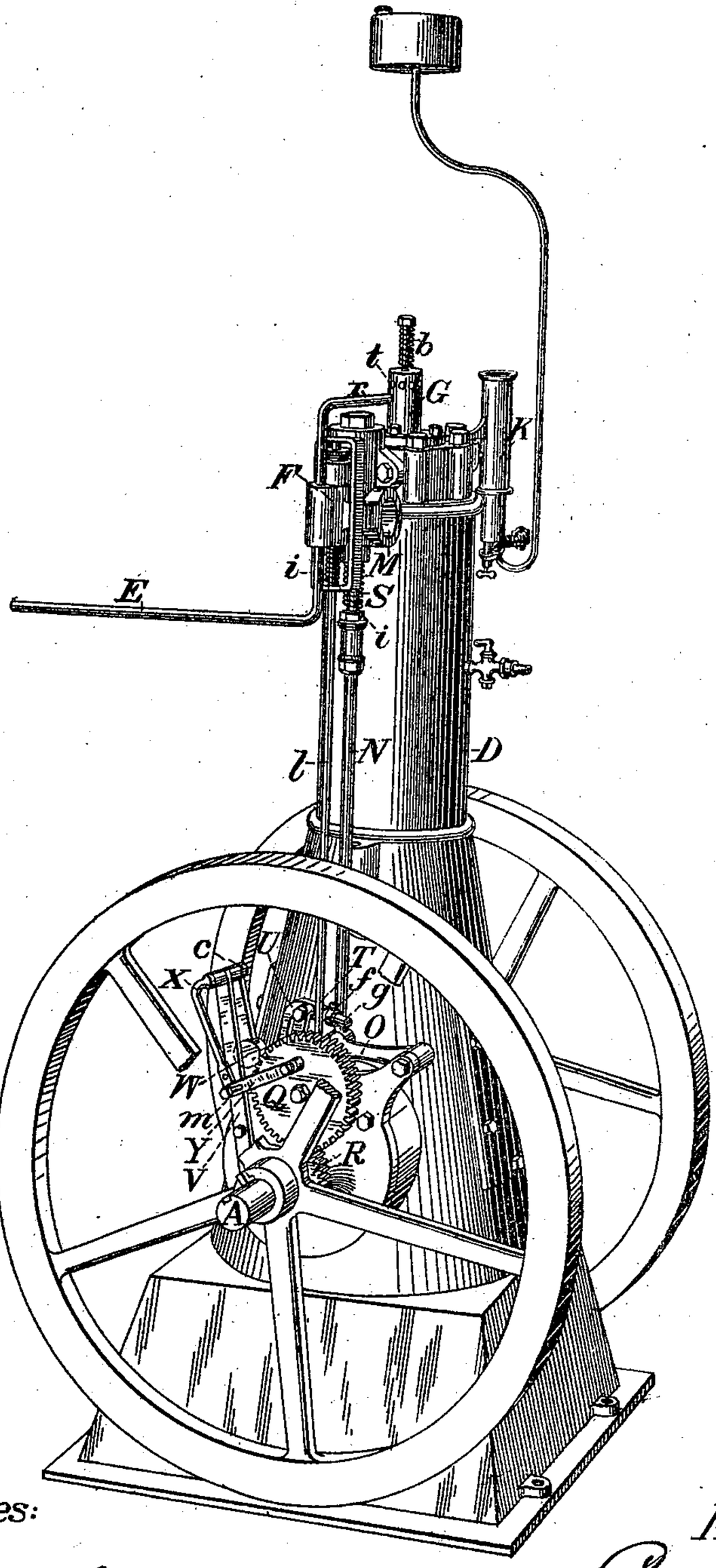
2 Sheets—Sheet 1.

G. E. HOYT.

GAS ENGINE.

No. 502,255. Patented July 25, 1893.

Fig. 1.



Witnesses:

E. A. Brandau

W. D. Bentley Jr.

Inventor:

George E. Hoyt

By his Atty

John Richards

(No Model.)

2 Sheets—Sheet 2.

G. E. HOYT.

GAS ENGINE.

No. 502,255. Patented July 25, 1893.

Fig. 2.

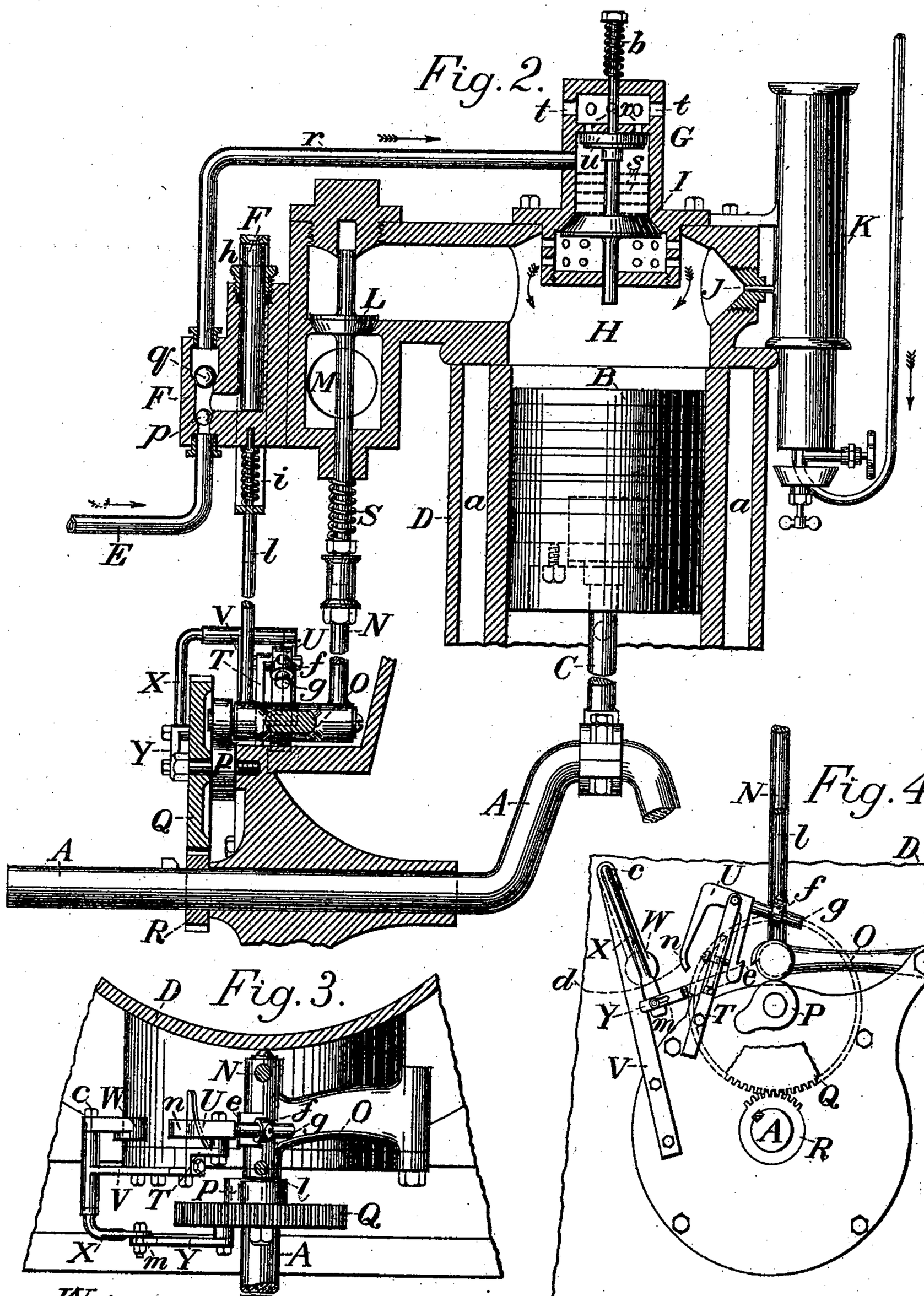


Fig. 3.

Fig. 4.

Witnesses:

E. A. Brandau

W. D. Bentley.

Inventor:

George E. Hoyt

By his Atty

John Richards

UNITED STATES PATENT OFFICE.

GEORGE E. HOYT, OF SAN FRANCISCO, CALIFORNIA, ASSIGNOR TO THE PALMER & REY, OF SAME PLACE.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 502,255, dated July 25, 1893.

Application filed June 20, 1891. Serial No. 396,936. (No model.)

To all whom it may concern:

Be it known that I, GEORGE E. HOYT, a citizen of the United States, residing in the city and county of San Francisco, State of California, have invented certain new and useful Improvements in Gas-Engines; and I hereby declare the following specification and drawings accompanying the same to be a true and exact description of my invention.

My present invention relates to certain improvements in motive engines, operated by the impulse of explosive gases derived from the vapor of petroleum or in any other manner, and especially to mechanism for controlling the speed and power of such engines and generating and distributing the gas thereto, the object of the invention being to simplify, perfect and make more efficient engines of this class, and the invention therefore consists essentially in the construction, arrangement and combination of parts, and in numerous details thereof, substantially as will be hereinafter described and then more particularly pointed out in the ensuing claims.

In the annexed drawings illustrating my invention: Figure 1 is a perspective elevation of a gas engine, arranged for hydro-carbon or liquid fuel, and provided with my improvements for regulating. Fig. 2 is a central vertical section of the cylinder and other fixed parts of the same engine, showing also the various working details. Fig. 3 is an enlarged plan view taken on top of the governing mechanism for controlling the exhaust valve and also in the present case, the supply of liquid fuel, and Fig. 4 is an enlarged front view of the same mechanism.

Similar letters of reference on the different figures indicate corresponding parts of the engine.

In the operation of that class of motive engines, impelled by the combustion of hydrocarbon vapor or other inflammable gases, the usual method is to charge the cylinders and ignite the gas at each alternate revolution of the engine, or at every fourth stroke of the piston. The other or intermediate revolutions of the engines being employed, on one inward stroke of the piston, to expel the residual gases of combustion, and on the outward stroke of the piston to create a partial vacuum and draw in a new charge of the inflammable gas. The gas thus drawn into the cylinder is compressed by the next inward stroke of the piston and then ignited, giving an impulse proportionate to the nature and volume of the charge of gas. In this method of operating, the usual method of regulating the speed and power of such engines has been to control the inlet of gas to the engine, the same as steam is supplied to a steam engine, cutting off the supply for one or more strokes, when not required, or admitting a volume of gas, as the speed of the engine or its required power might demand. Also, in other cases, regulation is performed by closing the exhaust valve before the completion of the outward working stroke of the engine when there is an excess of power, retaining or entrapping the residual gases of combustion in the cylinder and causing a compression therein on the return stroke, and in this manner resisting any excess of speed or power. This method also determines the amount of new gas drawn in, which is in such cases as much less in volume as the entrapped or retained gases. I do not employ either of these methods for the regulation of speed and power. On the contrary, on all idle strokes, and when no gas is required, I keep the exhaust valve open, so there is free circulation between the engine piston and the external air, and as there is for this reason no vacuum formed in the cylinder there is no force to draw the gas in, and no resistance to the free movement of the piston. In this manner the charging of the cylinder with gas, and consequent regulation of the speed and power of the engine, is made contingent on the opening and closing of the exhaust valve, and the function of the governor and its connected mechanism is to hold this valve open until a charge of gas is required, and then let the valve close so a charge will be drawn in.

The combination of a supply pump for liquid fuel and a carburetor for converting such fuel to vapor or gas, with my present means of controlling such engines by the action of their exhaust valves, relates only to the use of liquid fuel and the coincidence required between the action of the exhaust valve and the means of injecting and con-

verting the liquid to vapor or gas. When the engines are driven by vapor or gas previously or independently prepared, the pump and carburetor are not required, but the governing mechanism and movements of the exhaust valve remain the same, irrespective of the kind of inflammable gas, or the means of its supply to the engine. Such construction of the engines are shown in my application for Letters Patent for improved igniting apparatus for gas engines, filed June 22, 1891, Serial No. 397,047.

I will now, by the aid of the drawings, proceed to explain the method of constructing and applying my improvements for regulating the speed and power of gas engines; also, in the case of hydro-carbon fuel, the method of supplying and preparing the gas therefor.

The various details, so far as embodied in my present application for Letters Patent, are shown in the enlarged views—Figs. 2, 3 and 4, to which reference is made. The crank shaft A, is connected to the piston B, by the rod C, in the usual manner. The engine cylinder D, is surrounded by an annular chamber *a a*, in which water is circulated to prevent overheating. In the case of employing hydro-carbon fuel, as with the present engine, it enters through the pipe E, and is forced by the pump F, into the carbureting or volatilizing chamber G, where it is diffused and mingled with air and afterward drawn into the chamber H, and the cylinder D, through the inlet valve I. The charge is ignited at J, by a flame jet in the tube K, the construction and operation of which form the subject of the before named application for Letters Patent, and need not be further explained here. The exhaust valve L, by which the regulation of the speed and power of the engine is performed, opens and closes communication between the chamber H and the external air through the pipe M. This valve L, is fastened on a long stem N, extending down to and connected with a vibrating arm or lever O, which is operated by a cam P, on the axis of the wheel Q. This wheel Q, meshes into and is driven by the pinion R, on the crank-shaft A. The pinion R, contains one half as many teeth as the wheel Q, so the latter makes but one revolution to two of the crank-shaft A, and the rod N, and the exhaust valve L, are raised at every other revolution of the engine, or at alternate inward strokes of the piston B, and when not held open descend on the outward stroke of the piston B, by means of the spring S, on the rod N, and by weight of the vibrating arm or lever O. The valve L, is not permitted to close unless a charge of gas through the valve I, is to be drawn in, but is kept open in the following manner:

Attached to a stationary part of the frame is a standard T, on which is pivoted a catch-pawl U, provided with a hook that engages a similar hook on the link O, as shown at *e*, in Fig. 4. When these hooks are engaged the exhaust valve L, is held up and open, so there is free circulation of air from the piston and chamber H, through the waste pipe M. As long as the valve L remains open no vacuum is formed in the chamber H, and no gas is drawn in through the valve I, which is then kept closed by means of the spring *b*.

The pawl piece U, is operated in the following manner: To the stationary framing I attach a standard V, on which is mounted a vibrating weight W, swinging from the axis *c*, and driven by the bell crank X and link Y, connecting to the wheel Q, and thus producing a reciprocating movement of the weight W, on the curved line *d*, corresponding to alternate revolutions of the crank-shaft A. When the engine is running at its normal speed and receiving gas at alternate revolutions, the pawl U is unaffected, except by its gravity, and swings into a position as shown in Fig. 4, so the hooks at *e* do not engage, the exhaust valve L, opening and closing at each alternate revolution of the engine, and charges of gas being drawn in at every second outward stroke of the piston B. If the speed of the engine is increased, then the momentum and range of the vibrating weight W, increases accordingly, and the slot at *m*, in the link Y, permits the weight W to strike the arm *n* of the pawl-piece, driving it forward so as to engage the hooks at *e*, thereby holding the exhaust valve L open and permitting the engine to run freely without gas until the speed is reduced to the required limit; then the weight will fail to reach and strike the arm *n*, and the hooks at *e* will disengage, so the valve L will open at alternate revolutions of the engine, charges of gas being drawn in at the valve I, accordingly. The time of engaging the hooks at *e*, or the degree of speed required to cause these hooks to engage, is modified by the small sliding weight *f*, on the arm *g*, of the pawl-piece U. This small weight *f*, which can be slid out or in on the arm *g*, determines the static position of the pawl-piece U, when hanging free, and consequently determines the time of contact between the arm *n*, and the weight W, so the adjustment of this small weight *f*, on the arm *g*, serves for regulating the speed and power of the engine within the limits of its practical operation.

Referring now to the fuel or gas: When hydro-carbon fluids are employed, the liquid is drawn through the pipe E, and the pump F, which has a plunger or ram *h*, operated by a yoke *i*, connected by the rod *l* to the vibrating arm or lever O, so that the strokes of the plunger *h* correspond to those of the rod N and the valve L, the two acting in concert for reasons to be presently explained. The fluid being drawn in through the pipe E, passes the valves *q* and *p*, of the pump F, and is forced through the pipe *r*, to the carbureting chamber G, at *x*, where it falls on the perforated screens *s*, and is diffused and vaporized by mingling with air drawn in through the holes *t* and valve *u*, the resulting vapor or gas being from there drawn into the chamber H and

ignited at J, as hereinbefore explained. The coincident movement of the pump F, and the valve L, and their like control by the governing or regulating mechanism of the engine, will be apparent, because the closing of the valve L, or the contrary, demands accordingly a supply of the fuel liquid, and charges of gas for the engine. It will be understood that this method of supplying the fuel to the engines in liquid form is not contingent upon, and does not in any manner modify the method of regulation by means of the exhaust valve L, or the mechanism for operating the same, and that the engine would, in respect to these features, perform the same, if supplied directly with gas obtained by passing air through a body of the liquid, and then conducting the entrained vapor or gas to the engine, or in the case of using illuminating gas.

My object in supplying the liquid fuel in the manner shown is to insure a uniform quality of the gas when derived from hydrocarbon, and to avoid the more extensive apparatus necessarily required when the liquid is carbureted in a separate vessel and apart from the engine.

Having thus described the nature and objects of my invention and the manner of applying the same, what I claim as new, and desire to secure by Letters Patent, is—

1. In a gas engine, which has its feed controlled and governed by the exhaust valve, the combination of the exhaust valve and its stem, a vibrating arm or lever connected to said stem, a pawl-piece pivoted on the frame and adapted to engage and uphold the vibrating lever at certain times for the purpose of keeping the exhaust valve open, the main engine shaft, the main piston which it operates, the swinging weight pivotally supported on the frame and operated from the main engine shaft with which it is connected for the purpose of causing it to impinge upon the pawl-piece and thereby cause an engagement between said pawl-piece and the vibrating lever when required, substantially in the manner and for the purpose specified.

2. In a gas engine, which has its speed governed and controlled by the exhaust valve, the combination of the exhaust valve and its spring-provided stem, a vibrating lever connected to the lower end of said stem, a pawl-piece pivoted on the frame and having a projecting arm provided with an adjustable weight thereon whereby the static position of the pawl-piece is determined, a swinging weight pivotally supported on the frame and connected to and operated from the main engine shaft, said weight being so arranged that at a pre-determined rate of movement it will strike the pawlpiece and cause an engagement between said pawl-piece and the vibrating lever for the purpose of holding the exhaust valve of the engine open so that no charge of gas and air will be drawn in until the speed of the engine is reduced or regulated, substantially as described.

3. In a gas engine which has its speed controlled and regulated by the exhaust valve, the combination of the exhaust valve and its spring-provided stem, a vibrating lever connected to the end of said stem, a pawl-piece pivoted on the frame and adapted to engage the vibrating lever at certain times and thereby support the latter and keep the exhaust valve temporarily open, a swinging weight pivotally supported on the main frame and connected to and operated from the main engine shaft, said weight being so arranged that at a pre-determined rate of movement it will strike the pawl piece and cause an engagement between it and the vibrating lever for the purpose of holding the exhaust valve of the engine temporarily open, a pinion on the main engine shaft a gear wheel engaging said pinion and provided with a cam located beneath and operating upon the vibrating lever, substantially as described.

4. In a gas engine, the combination with the engine cylinder, main piston and main engine shaft, a carbureting chamber and an injector pump, of an exhaust valve and its stem, a vibrating arm connected to said stem and to the injector pump, a pivoted pawl-piece having thereon a hook adapted to engage a corresponding hook on the said vibrating arm, a swinging weight pivotally supported on the main frame, a bell crank for driving said weight and a link connecting it to some constantly running part of the engine, a pinion on the main engine shaft and a cam-provided gear which engages the pinion and is arranged so that the cam may act on the vibratory lever, all substantially in the manner and for the purposes specified.

5. In a gas engine, governed by the exhaust valve, the combination of the pivoted pawl-piece U, swinging upon a point on the frame and having a projecting arm *g* provided with an adjustable weight thereon and having also an engaging hook, the exhaust valve and its stem, a vibratory arm connected to said stem and having a hook corresponding in shape to the hook on the pawl-piece which hooks are adapted to engage with each other, a swinging weight W connected to and operated from the main engine shaft and so arranged that at a pre-determined rate of movement it will strike the pawl-piece and cause an engagement thereof with the vibratory arm for the purpose of holding the exhaust valve open so that no charge of gas and air will be drawn in until the speed of the engine has been reduced, substantially as described.

6. In a gas engine operated by hydro-carbon fuel, a pump for injecting the fuel connected by a pipe with the carbureting chamber having valves at its top and bottom, one to admit air and the other to permit air and gas to enter the cylinder, said carbureting chamber being provided with perforated screens or plates to diffuse the liquid fuel and to cause it to mingle with the air, substantially as described.

7. In a gas engine, a pump for injecting liquid fuel or hydrocarbons, combined with a carbureting chamber or vessel as herein described, having an air inlet and a gas outlet valve on the same stem, a perforated air inlet division at the top, a middle chamber provided with perforated plates or screens and a lower perforated chamber projecting within the main cylinder, having a series of lateral apertures at the sides to mix and diffuse the air and gas as they enter the cylinder and are ignited, substantially in the manner and for the objects described.

8. In a gas engine, a carbureting chamber or vessel constructed substantially as herein described, having an air inlet and a gas outlet valve on the same stem, a perforated air inlet division at the top, a middle chamber provided with perforated plates or screens and a lower perforated chamber projecting within the main cylinder and having lateral apertures to mix and diffuse the air and gas, substantially as described.

9. In a gas engine, the combination of the exhaust valve and its stem, a vibratory arm connected to said stem, a pivoted pawl-piece adapted to engage with and support the vibratory arm and valve stem at certain times for the purpose of keeping the valve open, a swinging governor weight connected to and operated from the main engine shaft which weight impinges upon the pivoted pawl-piece and causes engagement between the latter and the vibrating arm when required, and the force pump for injecting the fuel, said pump having a plunger operated by a rod connected to the aforesaid vibrating arm or lever so that the strokes of the plunger may correspond with those of the exhaust valve, substantially as described.

10. In a gas engine, the combination of the pump for injecting liquid fuel or hydrocarbons, a carbureting chamber or vessel, substantially as herein described having an air inlet and a gas outlet valve on the same stem, a perforated air inlet division at the top, a middle chamber provided with perforated plates or screens and a lower perforated chamber having lateral apertures to mix and diffuse the air and gas as they enter the cylinder and are ignited, the exhaust valve and its stem, a vibrating arm connected to said stem, a pivoted pawl-piece on the frame having a hook adapted to engage said vibrating arm, a swinging governor weight operated from the main engine shaft and impinging at times upon the said pawl-piece and an operating rod connected to the said vibrating arm for the purpose of actuating the pump plunger in order that said plunger and the exhaust valve may move in unison, substantially as described.

In testimony whereof I have hereunto affixed my signature in the presence of two witnesses.

GEORGE E. HOYT.

Witnesses:
ALFRED A. ENQUIST,
W. D. BENT, Jr.