No. 621,110.

Patented Mar. 14, 1899.

G. W. LEWIS.

GAS OR VAPOR ENGINE.

(Application filed July 15, 1895.)

(No Model.)

4 Sheets—Sheet 1.

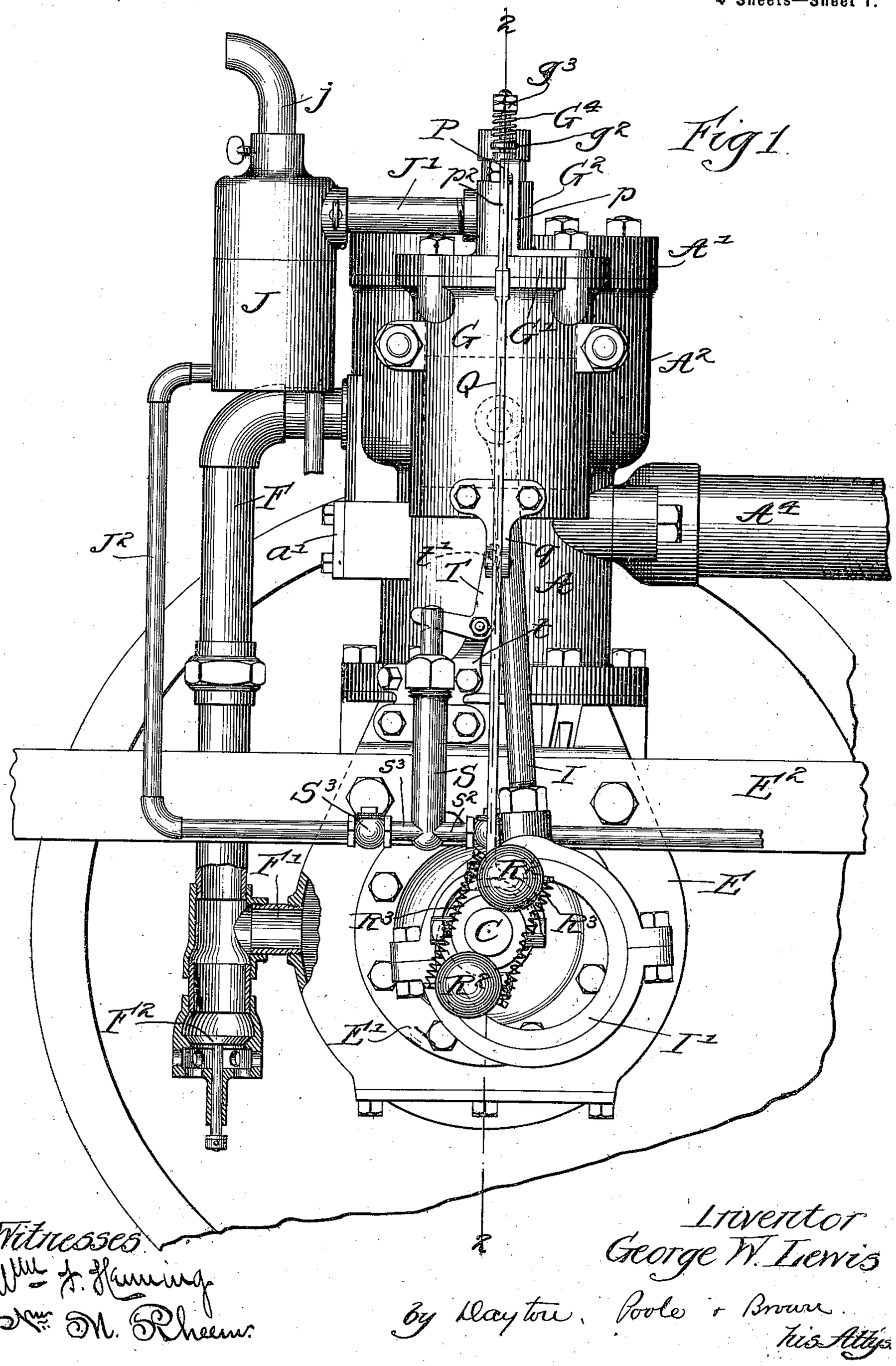


Fig 1.

Witnesses
Wm. H. Fleming.
Wm. N. Rheem.

Inventor
George W. Lewis
By Dayton, Poole & Brown.
His Attys.

No. 621,110. Patented Mar. 14, 1899.

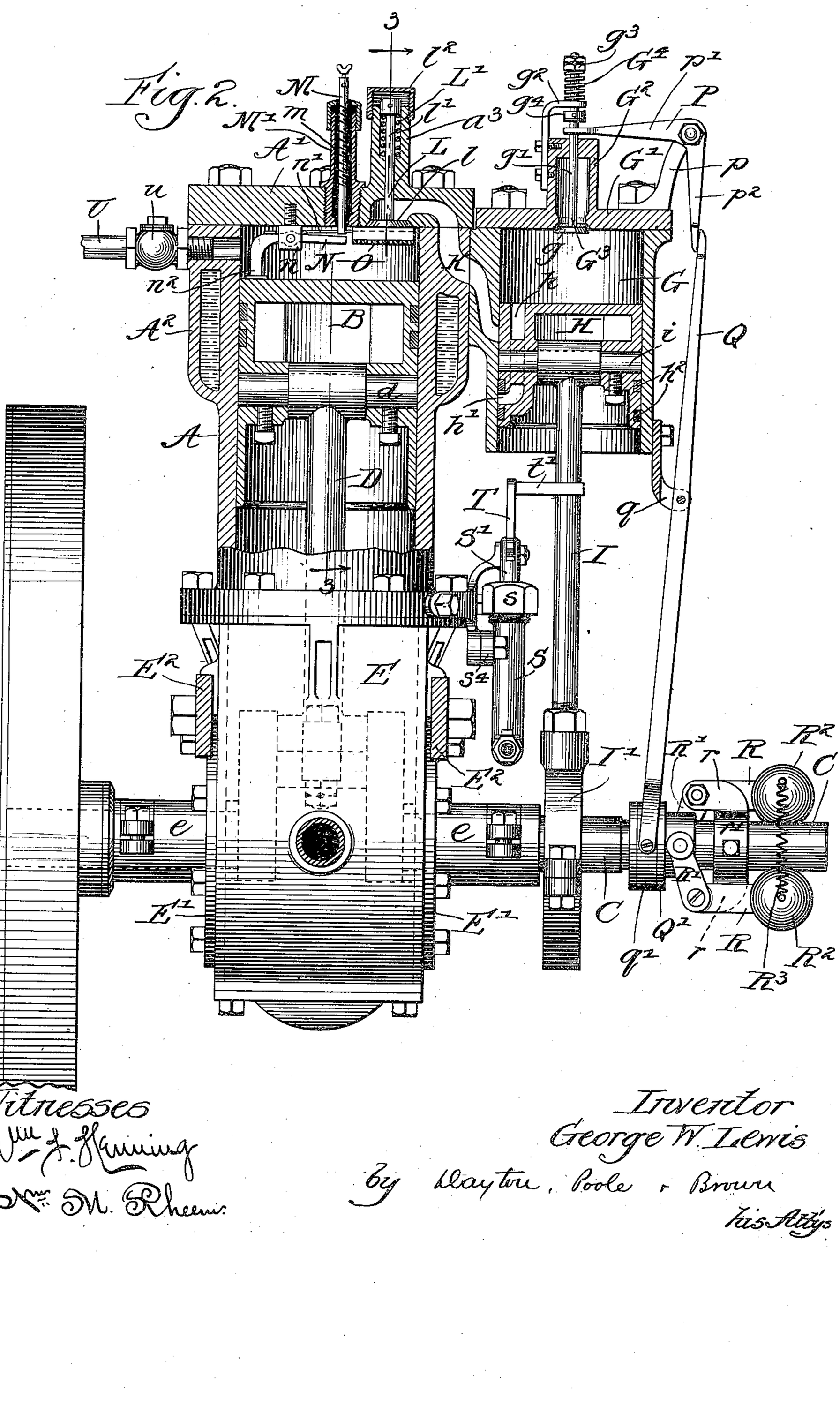
G. W. LEWIS.

GAS OR VAPOR ENGINE.

(Application filed July 15, 1895.)

(No Model.) 4 Sheets—Sheet 2.

Fig. 2.



Witnesses
Wm. L. Fleming
Wm. M. Rheems.

Inventor
George W. Lewis
by Clayton, Poole & Brown
his Att'ys

No. 621,110. Patented Mar. 14, 1899.

G. W. LEWIS.

GAS OR VAPOR ENGINE.

(Application filed July 15, 1895.)

(No Model.) 4 Sheets—Sheet 3.

Fig. 3.

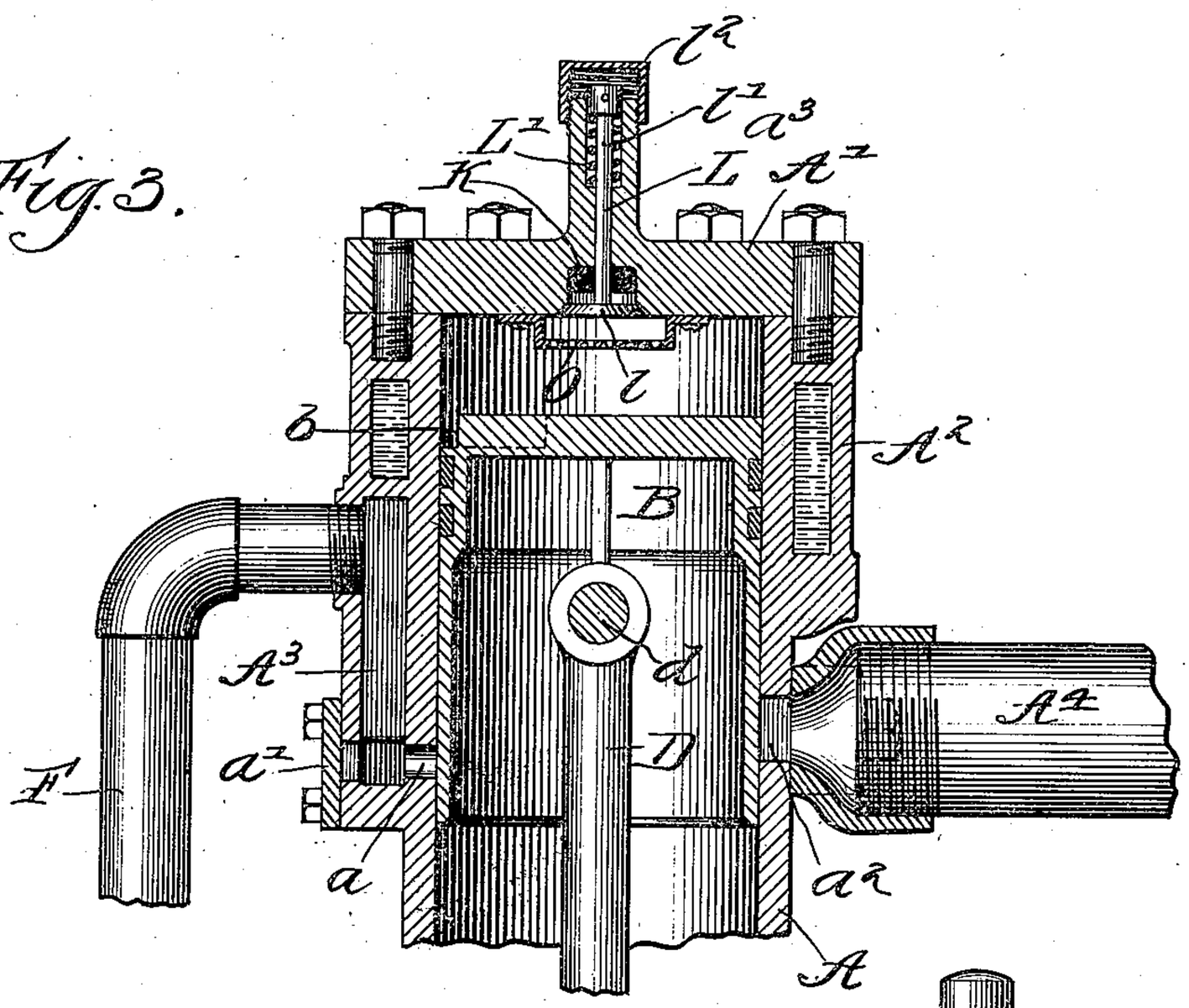


Fig. 4.

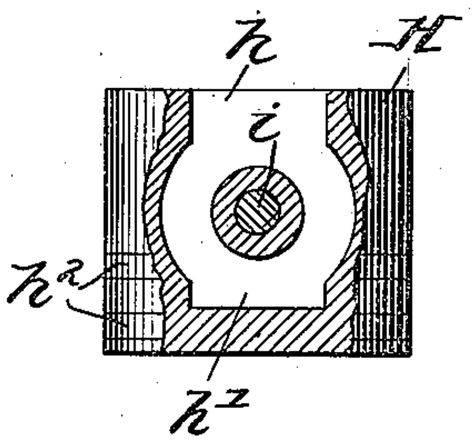
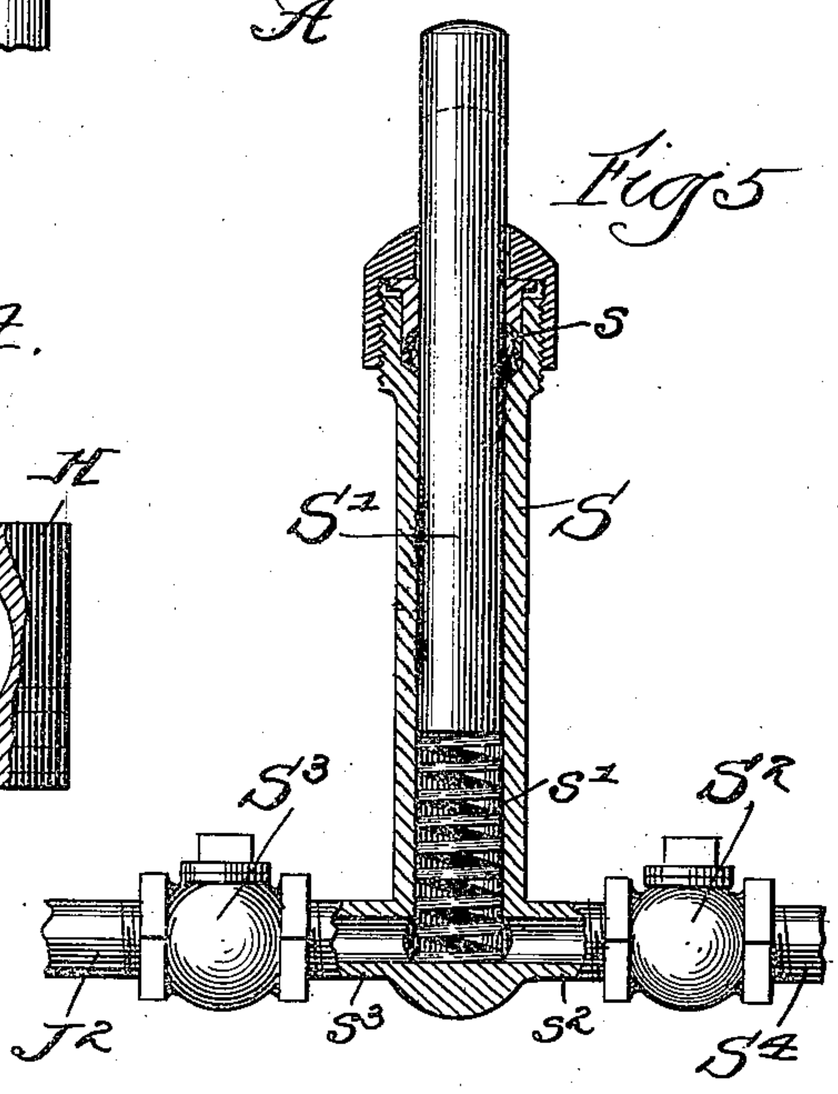


Fig 5



Witnesses
Wm. L. Fleming
W. N. Rheem

Inventor
George W. Lewis
By Dayton, Poole & Brown
His Attys.

No. 621,110. Patented Mar. 14, 1899.

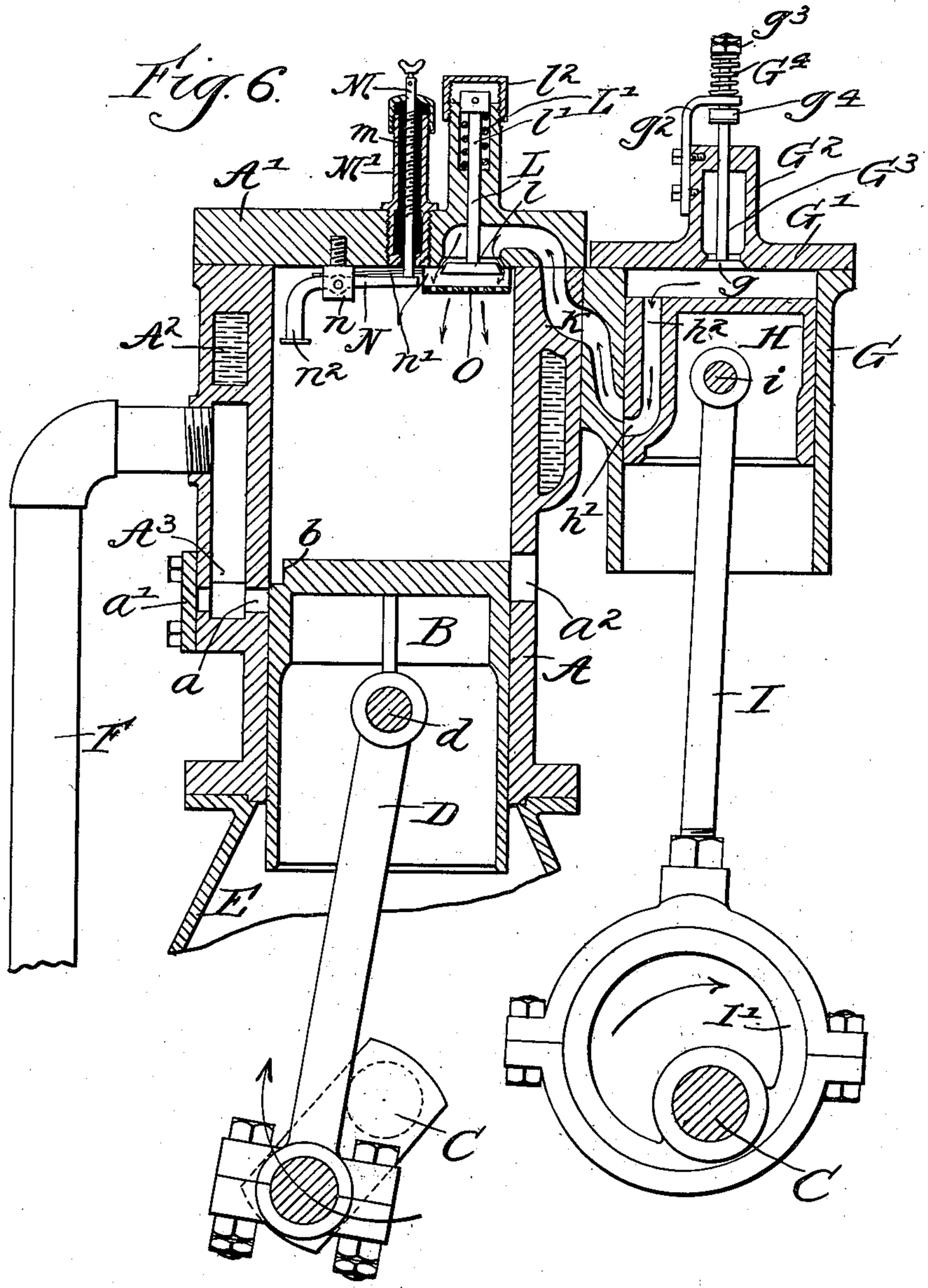
G. W. LEWIS.

GAS OR VAPOR ENGINE.

(Application filed July 15, 1895.)

(No Model.) 4 Sheets—Sheet 4.

Fig. 6.



Witnesses
Wm. F. Fleming
Wm. M. Sheem.

Inventor
George W. Lewis
by Dayton, Poole & Brown
his Att'ys

UNITED STATES PATENT OFFICE.

GEORGE W. LEWIS, OF CHICAGO ILLINOIS, ASSIGNOR TO THE J. THOMPSON & SONS MANUFACTURING COMPANY, OF BELOIT, WISCONSIN.

GAS OR VAPOR ENGINE.

SPECIFICATION forming part of Letters Patent No. 621,110, dated March 14, 1899.

Application filed July 15, 1895. Serial No. 555,973. (No model.)

To all whom it may concern:

Be it known that I, GEORGE W. LEWIS, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Gas or Vapor Engines; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in explosive gas or vapor engines, and more particularly to single-acting engines of that class in which an explosion or impulse takes place at every forward or power stroke of the piston and in which is employed an air-compression chamber which is in communication with the cylinder and in which air is compressed at each power-stroke of the piston preparatory to its admission to the cylinder behind the piston at the termination of the power-stroke of the latter. Certain of the features herein illustrated and described may, however, be employed in connection with engines of other than the particular kind described.

The invention may be more readily understood by reference to the accompanying drawings, in which—

Figure 1 is a view in side elevation of an explosive-engine embodying my invention. Fig. 2 is a sectional elevation of the same, taken on line 2 2 of Fig. 1, the power and gas-supply cylinders being shown in central longitudinal section. Fig. 3 is a section taken upon line 3 3 of Fig. 2, showing the upper part of the main cylinder in central vertical section. Fig. 4 is a view in side elevation, with parts in section, of the piston of the supply-cylinder. Fig. 5 is a view in central vertical section of the gasolene-pump. Fig. 6 is a diagrammatic section of the power and supply cylinders, showing the relative positions of the pistons therein and their connections with the crank-shaft.

As shown in said drawings, A indicates the power-cylinder of the engine, and B a piston therein, which is connected with the crank-shaft C through the medium of the pitman D. Said cylinder A is open at one end and closed at its opposite end, or at that end in which the explosion takes place, by means of the head A'. The piston B is what is known as a "trunk-piston," the same having the form of a cylinder closed at one end and the pitman D being pivoted directly thereto by means of a pivot-rod *d*. Surrounding the cylinder A at its end adjacent to the head A' is an exterior casing or jacket A^2, forming an annular space to contain water for cooling the cylinder, as heretofore common.

To the open end of the power-cylinder A is secured a hollow casing or chamber E, which supports the bearings *e e* of the shaft C and also forms a chamber within which air is compressed at each forward stroke of the piston, said chamber forming a housing or inclosure which surrounds the crank-shaft and connecting-rod. As far as the operation of said chamber E as a compression-chamber is concerned, however, its attachment to the open end of the cylinder in a manner to form a casing or housing for the crank is not essential, and the same result may be produced by a location of the said chamber elsewhere than in the position shown, provided it is in open communication with that end of the cylinder toward which the piston moves in its forward or power stroke.

In the particular construction illustrated the chamber E consists of a hollow casting having apertures in its sides which are covered or closed by separate plates E', on which are cast the bearing-sleeves *e*. Said casing in this instance, moreover, forms the frame of the engine, and it may be provided with any suitable means for supporting it on a foundation or otherwise, the same being herein shown as attached to horizontal and parallel bars E^2, constituting part of the framework of the vehicle which this particular engine is designed to drive. The said cylinder A is provided at one side with a plurality of admission-ports *a*, which are covered by the piston, excepting when the latter is at the outward limit of its movement. Said ports open into a passage or chamber A^3, the side and outer walls of which are herein shown as cast integral with the cylinder. The chamber is, however, provided with an opening opposite

the said ports, which opening is closed by a cap or plate a', bolted to the cylinder in the manner illustrated. The passage or chamber A^3 is connected with the compression-chamber E through the medium of a pipe or passage F, attached at its upper end to the wall of said passage A^3 and connected at its lower end with the compression-chamber by means of a branch pipe F', Fig. 1. Said pipe F is shown as extended past the branch F' and provided at its lower end with air-admission openings and with an inwardly-opening check-valve F^2. Said extension of the pipe F and the valve F^2 are for the purpose of admitting air to the compression-chamber E during the upward or back stroke of the piston, the ports a being at such time covered by the piston, so that air can enter the compression-chamber at such time only through the said check-valve. In the power or outward stroke of the piston the check-valve F^2 is closed by the air-pressure and the air is compressed within the compression-chamber until the piston approaches the outer limit of its stroke and uncovers the ports a, when the air theretofore compressed within the chamber passes into the power-cylinder.

At the side of the power-cylinder A, in position to be uncovered by the piston when it reaches the outward limit of its stroke, is located an exhaust-port a^2, which exhaust-port communicates with the exhaust-pipe A^4, leading to a desired point of discharge. As in other similar engines, said exhaust is for the discharge of the spent or dead gases resulting from the explosion, and these latter are forced from said exhaust-port at the end of the outward stroke of the piston by the entrance of air through the ports a from the compression-cylinder.

To now refer to the charging device for supplying the gas or vapor to the cylinder, these are constructed as follows: G indicates a supply or charging cylinder which contains a piston H, operated through the medium of a pitman I from an eccentric I' on the crank-shaft. The cylinder G, like the cylinder A, is open at one end, being closed at the other by the head G'. The piston H is of trunk form, the pitman being pivoted within the same by pivot-rod i. J, Fig. 1, indicates a carbureter for supplying a mixture of air and vapor to the charging-cylinder, said carbureter being constructed in the same manner as that shown in a prior patent, No. 511,535, granted to me on the 26th day of December, 1893. Said carbureter is connected with the cylinder G by means of a pipe J', which leads into a tubular extension G^2, rising from the head G' of the said cylinder. Said carbureter consists generally of a main tank or vessel constituting the body of the carbureter, an air-inlet pipe j, which enters the top of the vessel and reaches to a point near the bottom of the same, and a supply-pipe J^2 for the carbureting liquid, such as gasolene. The connecting-pipe J', which leads to the supply-cylinder, is connected with the top of the tank J and in the downstroke of the piston within said cylinder delivers to the latter the vapor-laden air produced by the impingement of the air entering the pipes j against the liquid held in the bottom of the vessel. A governing device is provided for controlling the admission of the mixture of air and vapor to the cylinder G and also a pump for supplying liquid to the carbureter, as will be hereinafter described.

To now refer more particularly to the means for delivering the mixture of air and vapor to the power-cylinder, these features are constructed as follows: K is a passage leading from the side of the charging-cylinder G to the power end of the cylinder A, said passage being herein shown as formed in the adjacent walls of the two cylinders and extending through the cylinder-head A', so as to open at the inner face of said head. At the discharge end of the passage K is located a check-valve L, which opens toward the power-cylinder, said valve, as shown, consisting of a valve-disk l, the margins of which rest against an annular seat formed on the cylinder-head A', and a stem l', to which the disk is attached. The said valve is held against the seat by a spring L', preferably made of coiled form and located in a tubular extension a^8 of the head A', around the valve-stem, between a shoulder at the inner end of said tubular extension and a head at the outer end of the stem. A cap l^2, applied to the extension a^2, covers the outer end of the stem and protects the parts from the admission of dust or dirt.

The piston H of the charging-cylinder is provided with a passage h, extending from its inner face toward its outer end and opening at the side of the piston at some distance from its said inner face. The exit port or opening h' of the said passage is arranged to come opposite the passage K at the time when the said piston H is at the upper or inward limit of its stroke. To prevent escape of air from said port h', the piston is shown as provided with annular packing-rings h^2 h^2, arranged at opposite sides of said opening in the manner illustrated, Figs. 2 and 4.

G^3 indicates a check-valve located in the passage from the carbureter to the cylinder G and opening inwardly or toward said cylinder. Said check-valve is preferably located at the inner end of the tubular extension G^2, being adapted to rest against an annular bearing surface or seat formed in the cylinder-head G', around the passage which leads from the cylinder into the said tubular extension. The valve illustrated consists of a disk g, which is attached to a valve-stem g', extending upwardly through the closed end of the tubular extension G^2 and passing through a bracket g^2, between which bracket and a nut g^3 on the outer end of the stem is located a coiled spring G^4, which acts by expansion to hold the disk normally against its seat. Said disk usually and in the upward stroke of the piston H is closed; but in the down-

stroke of the piston it opens under atmospheric pressure to admit the admixture of air and vapor coming from the carbureter to the upper end of the said cylinder G.

The position of the parts at the time the compressed charge is exploded is illustrated in Fig. 2. The piston B of the power-cylinder is then at the upward limit of its movement, and the piston H of the supply or charging cylinder is near the lower limit of its movement and in the act of descending, so as to draw the air into the same through the carbureter. At this time the port h' of said piston H is below the passage K, while the said passage K is closed by the upper part of said piston H, which in no case moves far enough to uncover said passage, the said piston H being made of a length greater than its stroke. In Fig. 6 the position of the parts is shown at the time the piston B of the power-cylinder has begun its upward stroke and has moved so far as to close the inlet-port a and to nearly close the exhaust-port a^2. At this time the piston H is approaching the end of its stroke and the port h' has reached the passage K, so as to permit the charge of mixed air and vapor which has been compressed in the upper end of the supply or charging cylinder to escape from the same past the check-valve L to the power-cylinder. The piston H, with its port h', together with the passage K, constitute in effect a valve by which the passage of gas or vapor to the power-cylinder is "controlled." In said Fig. 6 is shown the relative positions of the main crank and the eccentric I', from which it will be seen that the said crank and eccentric are set at such angles that the piston H will approach the upper limit of its movement as the main piston B is starting upward. As will be readily understood from the above, the air compressed within the chamber E in the outward or power stroke of the piston is forced through the pipe F and inlet-ports a into the power-cylinder when the main piston B passes beyond and uncovers the said inlet-ports at the limit of its power-stroke. The quantity of air forced from the chamber E being practically equal to that required to fill the cylinder, it follows that the incoming air from the inlet-ports, which will be thrown toward the head of the cylinder by the shoulders b of the piston as it enters the cylinder, will drive all of the spent gas out of the cylinder through the exhaust-port, so that when the piston starts back on its return and has covered the inlet-ports the cylinder will be filled with air only. A charge of mixed air and gas has meanwhile been compressed in the supply-cylinder G, and when the exhaust-port has been closed, or nearly so, by the movement of the main piston the charge of mixed air and vapor, which is held in the said supply-cylinder under a pressure much greater than that of the air within the power-cylinder, is then forced into the latter partially by expansion, which takes place as soon as it is admitted to the passage K, and partially by the direct action of the piston H, which is preferably made to reach the cylinder-head G', or nearly so, in its upward stroke, thereby forcing from the supply-cylinder practically all of the mixture remaining therein. The piston B need not completely cover the exhaust-port a^2 before the charge is admitted to the main cylinder; but it is preferred that the exhaust-port should be fully closed very shortly after the charge begins to enter the cylinder in order that none of the vapor or gas may reach the exhaust-port before the same is completely closed.

The ignition devices of the engine illustrated are of electrical character and consist of an electrode M, formed by a bar which is inserted a mass of insulation m within a tube M', inserted through the cylinder-head, and a lever N, pivoted in a bracket n on the head and one end of which is held against the electrode M by means of a spring n'. An outwardly-extending end n^2 of the lever is adapted for contact with the piston B, so as to draw the lever away from the electrode, and thus produce a spark at the time the piston reaches the inward limit of its movement.

As a further and separate improvement in gas-engines I place over the vapor or gas inlet to the cylinder a perforated plate O, which plate is so arranged as to break up the stream of air and gas coming from the supply-cylinder and to partially confine the same at the power end of the cylinder and in the neighborhood of the ignition device there located. In other words, the said perforated plate prevents the incoming mixture from entering in the form of a stream or jet, which would pass to the opposite end of the cylinder, and thus delay the mixing of gas with that part of the air adjacent to the cylinder-head and igniting device thereon by breaking up such stream or jet and distributing the same in the part of the cylinder adjacent to the head, so that it will become intermingled with the air there located.

The governing device illustrated is of that kind which acts by limiting the opening of the check-valve through which the mixture of air and gas or vapor is admitted to the engine, the same, as hereinbefore stated, being applied in this instance to the inlet-valve G^8 of the supply-cylinder G. Said governing device embraces features as follows: P is a bell-crank lever mounted on the bracket p, attached to the cylinder G and having a horizontal arm p', which reaches to the valve-stem g' and is adapted for contact with the collar g^4 on said valve-stem, which collar is located between the bracket g^2 and the end of the tubular projection G^2, and is adapted for contact with the end of the lever-arm p' when the valve is moved inwardly for opening the inlet-port. The second arm p^2 of the bell-crank lever engages an actuating-lever Q, which is pivoted between its ends to a bracket q and is connected at its opposite end

with a sliding sleeve Q′ on the crank-shaft C by means of a ring q', which engages a groove in the sleeve, with which said lever is connected by a slot-and-pin connection in a familiar manner. R R are two weighted governor-levers arranged parallel with the shaft and pivoted upon arms r, attached to a ring r', secured on the shaft. Said levers have inwardly-extending crank-arms R′, which engage the sleeve Q′ in such manner that the sleeve is moved endwise on the shaft by the inward and outward movement of the governor-weights R^2, which are attached to the free ends of the levers. Springs R^3, herein shown as of a coiled contractile form, serve to hold the governor-weights inwardly or adjacent to the shaft against their centrifugal action. Said governor-weights hold the sleeve Q′ normally in such position that the lever-arm p' of the bell-crank lever is free from the collar g^4; but when the normal speed of the engine is exceeded the said sleeve is shifted endwise and the said arm p' thereby moved outwardly, so as to limit the extent of opening of the valve by the contact of the said collar g^4 therewith. The governing device thus constructed operates to lessen the amount of gas or vapor delivered to the charging-cylinder when the speed of the engine exceeds the normal rate. The reduction in the charge is effected by the pressure which tends to hold closed, or partially so, the inlet-valve, thereby lessening the admission area, so as to prevent the entrance of the mixture rapidly enough to fill the space behind the receding piston at atmospheric pressure, and thus producing a partial vacuum and giving a charge having less than the usual quantity of gas or vapor, according to the degree to which the entrance of the mixture has been retarded.

As a simple means of maintaining a constant supply of liquid in the carbureter J, I have provided a pumping mechanism which is constructed as follows: S is an upright pump-barrel containing a solid cylindric piston S′, which passes through a stuffing-box s at the top of the barrel. Within the barrel below the piston is placed a coiled expansion-spring s', which tends to throw the piston upwardly. To the bottom of the pump-barrel are attached suction and delivery pipes s^2 s^3, which are connected with check-valves S^2 S^3, which latter perform the functions of the check-valves in an ordinary single-acting force-pump. To the casing of the check-valve s^2 is attached an oil-supply pipe S^4, while the supply-pipe J^2 of the carbureter is connected with the casing of the check-valve S^3. The pump-barrel is located at the side of the main or power cylinder adjacent to the connecting-rod I of the supply or charging cylinder, and motion is given to the pump-piston by means of a bell-crank lever T, which is pivoted on a bracket t, attached to the cylinder and which is actuated through the lateral movement of said connecting-rod by means of a horizontal arm t', attached to the upper end of the vertical arm of the bell-crank lever and extending outwardly into the path of the connecting-rod. The horizontal arm of said bell-crank lever rests in a slot in the upper end of the pump-piston, which latter being forced upwardly by a spring beneath it tends to lift the horizontal arm of the bell-crank lever and thus throw and hold the arm t' thereof against the said connecting-rod. The pump-barrel is shown as secured to a cross-bar s^4, which latter is attached to a depending bar of the bracket t in the manner illustrated.

As a further improvement in explosive-engines of the character described I propose to provide the power-cylinder with an inlet-passage provided with a check-valve which opens inwardly or toward the cylinder, but which is adapted to close positively to prevent the outward escape of air or gas from the cylinder. Such passage is shown in Fig. 2 as having the form of a pipe U, connected with the upper part of the cylinder and provided with a gravity-acting check-valve u, adjacent to the cylinder. The purpose of such passage and check-valve is to prevent the formation of a vacuum within the cylinder and loss of power which would arise by the formation of such vacuum. The presence of a vacuum within the cylinder is not liable to occur in the ordinary running of an engine; but it may occur in starting the engine or in cases where by the action of the governor no explosion takes place, under which latter circumstances the quantity of air within the cylinder at the beginning of the downstroke will be that which was contained in the cylinder at the beginning of the previous upstroke, less any quantity which may have escaped during the act of compressing the air. It follows that where an escape of air has taken place the amount of air within the cylinder may be insufficient to fill the same at normal pressure when the piston reaches the outward or downward limit of its power-stroke.

I claim as my invention—

1. The combination with a power-cylinder and means for supplying air thereto at the termination of each stroke of the piston, of means for supplying gas or vapor to the power-cylinder comprising a charging-cylinder connected with the power-cylinder by a port or passage, a carbureting device connected with the inlet-opening of said charging-cylinder, an igniting device, a check-valve in said port or passage and a perforated plate extending over the opening of said passage within the power-cylinder, and forming an inclosure opening into the cylinder adjacent to the igniting device.

2. The combination with a power-cylinder, a charging-cylinder provided with a piston and a connecting-rod through the medium of which said piston is given motion from the crank-shaft, of a carbureter and a pump for supplying liquid to the carbureter comprising a pump-barrel, a spring-actuated plunger therein, and a bell-crank lever, one arm of

which engages said plunger and the other arm of which engages the side of said connecting-rod and is held in contact with the same by the spring which actuates the pump-plunger.

In testimony that I claim the foregoing as my invention I affix my signature, in presence of two witnesses, this 11th day of July, A. D. 1895.

GEORGE W. LEWIS.

Witnesses:
C. CLARENCE POOLE,
WILLIS D. SHAFER.