No. 640,393. Patented Jan. 2, 1900.

G. W. LEWIS.

GAS ENGINE.

(Application filed June 21, 1899.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1

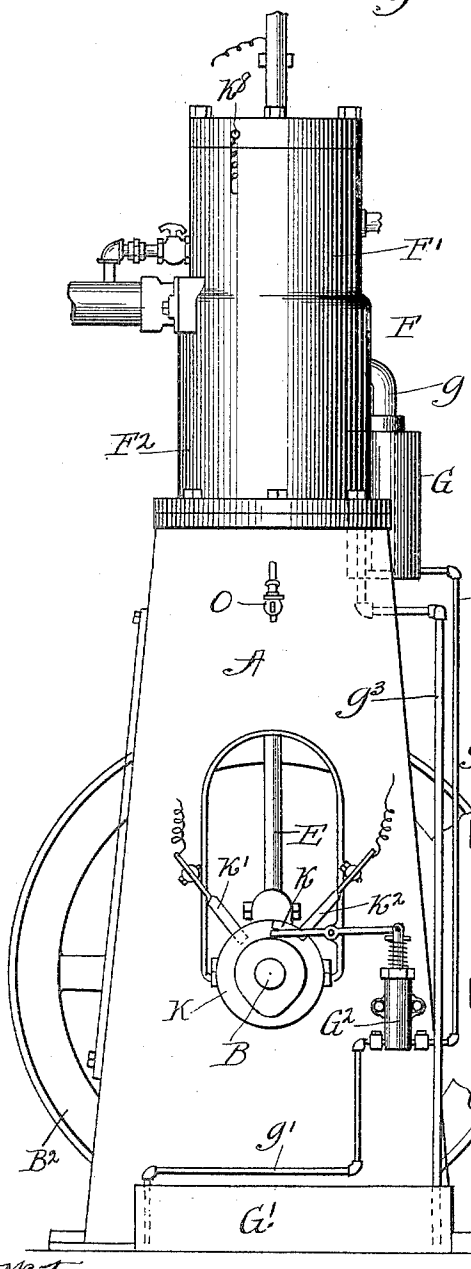


Fig. 4

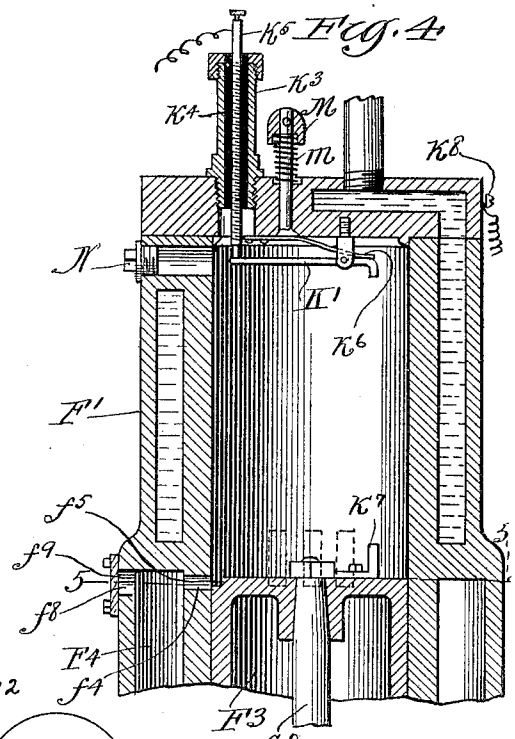
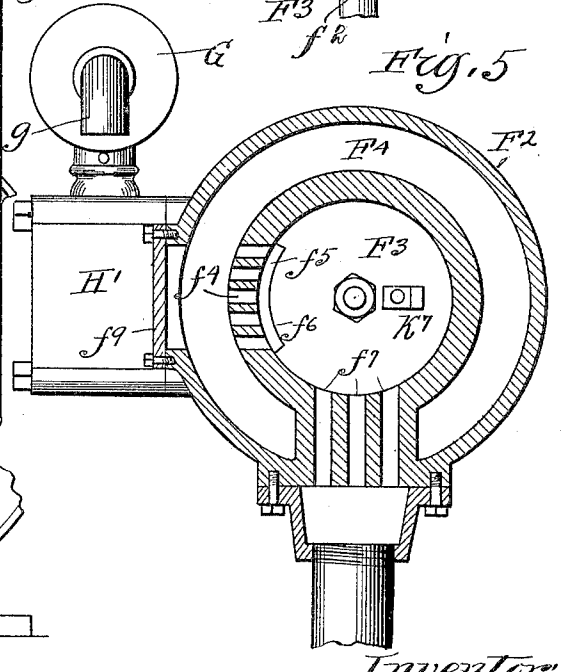


Fig. 5



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(No Model.) 3 Sheets—Sheet 2.

Fig. 6.

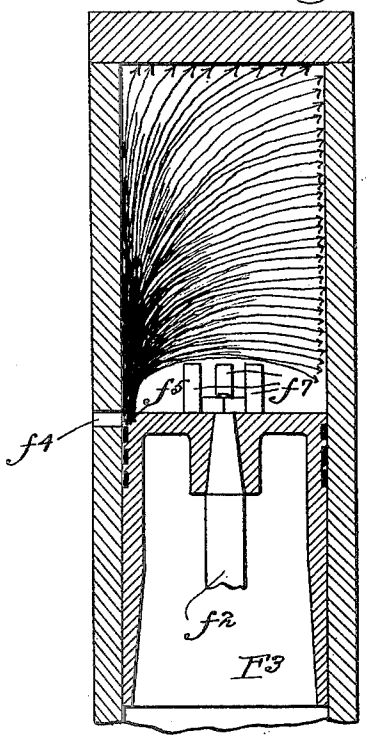

Fig. 7.

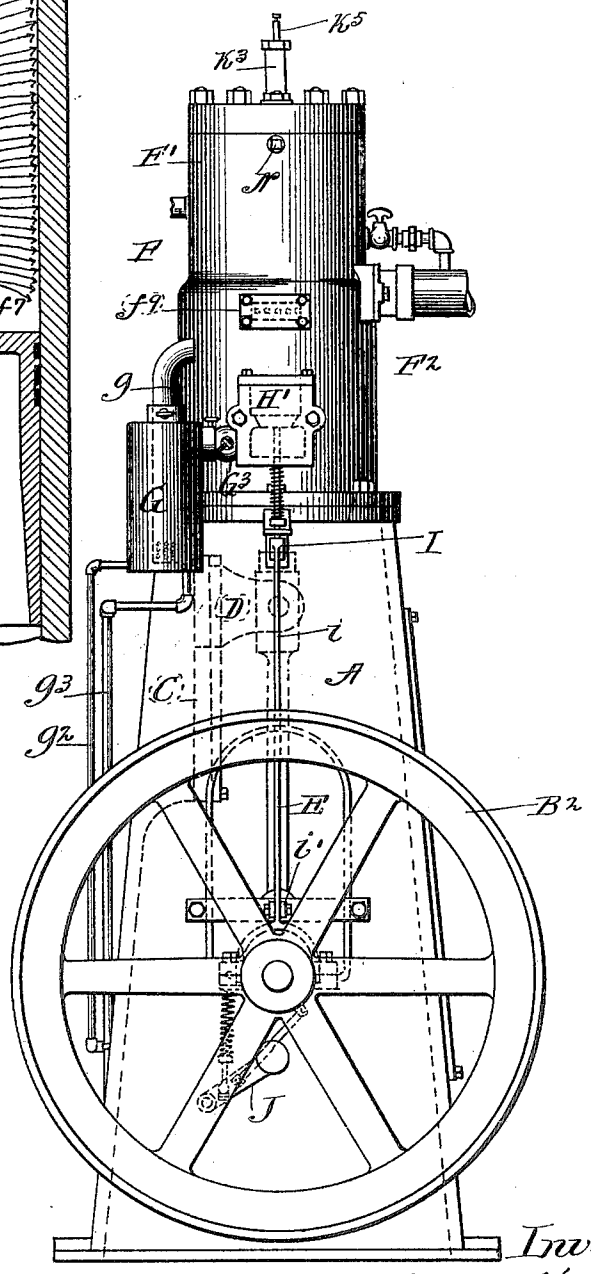

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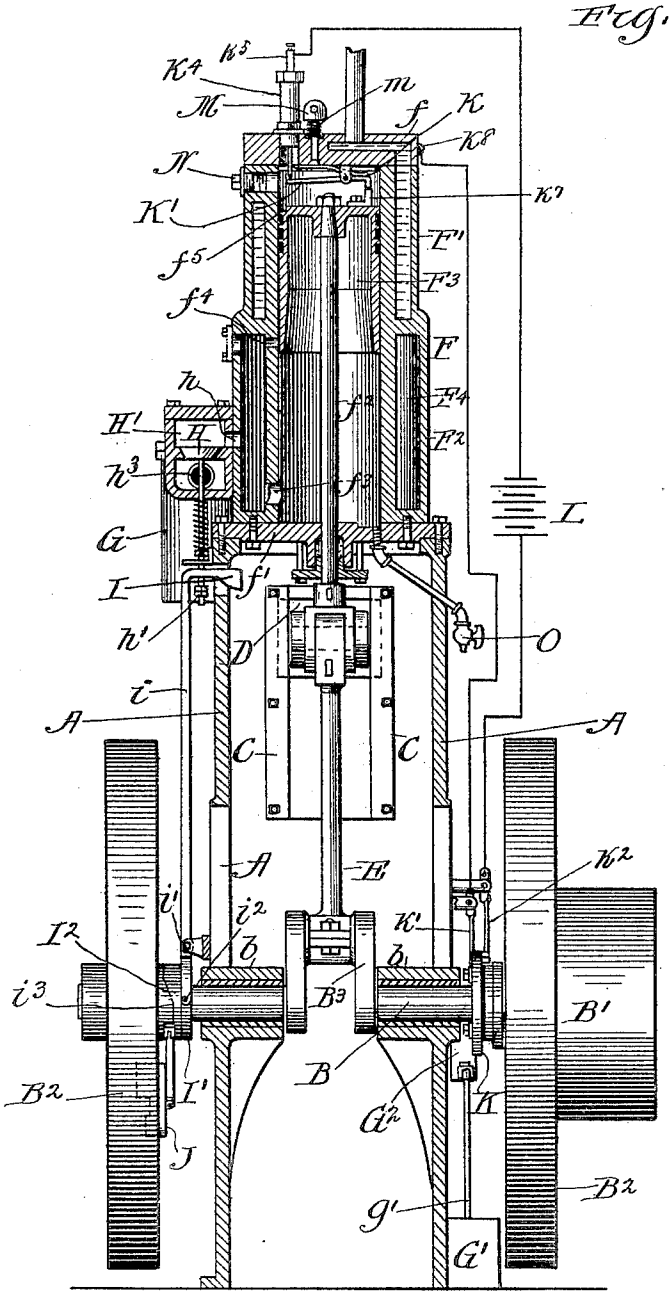
Fig. 3



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UNITED STATES PATENT OFFICE.

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

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 640,393, dated January 2, 1900.

Original application filed November 8, 1894. Renewed September 22, 1898, Serial No. 691,629. Divided and this application filed June 21, 1899. Serial No. 721,376. (No model.)

To all whom it may concern:

Be it known that I, GEORGE W. LEWIS, of the city of Philadelphia, county of Philadelphia, and State of Pennsylvania, formerly of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Gas-Engines, (Case B;) 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 gas or vapor engines, and has for a primary object to provide a practical, simple, and otherwise advantageous construction in a single-acting engine adapted to give an impulse at every round.

The invention consists in the matters hereinafter set forth, and more particularly pointed out in the appended claim.

In the drawings, Figures 1 and 2 are side elevations showing opposite sides of a vertical form of engine provided with my invention. Fig. 3 is a vertical section of the engine shown in Figs. 1 and 2 in the axis of the bearing of the crank-shaft, said crank-shaft, the fly-wheels, and the pulley thereon being shown in elevation. Fig. 4 is an enlarged axial section of the power end of the cylinder in the same plane as the parts shown in Fig. 3. Fig. 5 is a horizontal section in the plane of line 5 5 of Fig. 4. Fig. 6 is a longitudinal section of the power-cylinder, showing by a series of arrows the direction taken by the inflammable mixture when admitted to the upper end of said cylinder.

As shown in said drawings, A designates the frame supporting the various parts of the engine.

B designates a centrally-cranked power-shaft, mounted in bearings *b* on said frame and carrying a driving-pulley B′ and fly-wheels B^3 B^2.

C C are guides for a cross-head D, said guides being secured to the frame, as shown in dotted lines in Fig. 2 and full lines in Fig. 3, or otherwise, as may be preferred.

E is a pitman connecting the cross-head D with the crank B^3 on the shaft B.

F is a cylinder, of which F′ is the power end, and F^2 the pump end. Said cylinder F is closed by heads *f f′* at both ends, the heads *f*, closing the pump end of the cylinder, being provided with a stuffing-box, through which works the piston-rod f^2, connected, respectively, to the cross-head D and to the piston or plunger F^3.

G is a carbureter, which in some form will be employed when the engine is intended to use the vapor of a liquid hydrocarbon with air as the explosive mixture.

g is an inlet-pipe having a straight portion which passes through the upper head of the chamber for the liquid hydrocarbon and has its lower end perforated at its sides, as indicated by dotted lines in Fig. 2. The said pipe G is shown as being vertically adjustable within the carbureting-chamber.

G′ is a supply-tank, G^2 being a pump operated conveniently by a peripheral cam on the main shaft B, as indicated in Fig. 1, and connected with the supply-tank G′ by a pipe *g′* and with the carbureter by a pipe g^2. An overflow-pipe leading from the carbureter back to the supply-tank is shown at g^3, said overflow-pipe being indicated as having its opening within the carbureter at a suitable distance above the bottom of the latter to give the desired or predetermined level to the liquid within said carbureter.

H is a valve for admitting the explosive mixture into the cylinder, said valve, as herein shown, opening directly from the carbureter into the valve chamber or chest H′, which communicates with the cylinder. When other gas than hydrocarbon vapor is used, this valve H may similarly admit the mixture of gas which is delivered to it in any suitable manner.

The cylinder F is connected with the chamber F^4, which as a separate improvement is shown as being external to and concentric with the cylinder proper or as transverse externally to its lower portion only, said chamber F^4 being in communication with the lower end of the exterior end of the cylinder proper by one or more wide passages f^3, and also in communication with the valve-chamber H′ through one or more passages *h*. The chamber F^4 is also in communication with the

power end F′ of the cylinder F when the piston F^3 is at or near the extreme end of its power throw, which is the downstroke. The piston F^3 is shown as being of trunk form in order that the communicating spaces, consisting of a space directly below the piston and the outer space F^4, may be as large as possible in proportion to the space behind the piston after the power-stroke has been completed within the least practical limits, the relative proportions of these spaces in the engine shown being about four to one. In other words, the space within the cylinder and below the piston when the latter is elevated or at the end of its compression-stroke, plus the space F^4, is about four times the contents of the space behind the piston when the latter has completed its down or power stroke.

Advantages are gained by the construction in which the chamber F^4 is made of annular form and surrounds the cylinder from the port f^3 to the port f^4, the principal one being that in this construction immediate communication is afforded between the said chamber and the power end of the cylinder by the port f^3, extending through the thickness of the cylinder-wall only, so that the compressed air may expand directly from the chamber into the cylinder. The entrance of air is thus made much more prompt and the speed of the engine correspondingly more rapid than in the construction in which the air is located at a distance from the power-cylinder, so that the air must be forced through a long passage in passing from the air-chamber to the said cylinder.

The piston F^3 covers the passages f^4 except when the said piston is at and near the end of its power-stroke, as fully indicated in Figs. 3, 4, and 6. The piston is provided with a recess f^5, as best seen in Figs. 4, 5, and 6, which recess is arranged to come opposite the inlet-ports f^4 when the cylinder is at the end of its power-stroke, as also indicated in Figs. 4 and 6, said recess having its rear wall A^6 abrupt, so as to deflect the incoming mixture of gas and air toward the power-head of the cylinder, as indicated in Fig. 6. The exhaust-ports f^7 of the cylinder are arranged at right angles to the inlet-ports f^4, as plainly shown in Figs. 4, 5, and 6, instead of opposite said inlet-ports, as heretofore. By this means the escape of the explosive mixture admitted by the inlet-ports is prevented, said mixture being forced toward the adjacent head of the cylinder and gradually filling the power end of the cylinder from that end toward the piston in the gradual opening of said inlet-ports, as seen in Fig. 6, and forcing the dead gases out through the exhaust-ports f^7 without a material escape of the live mixture, said economy in this particular being attained by the rectangular arrangement of the inlet and exhaust ports shown and described.

In the integral cast construction shown I have provided an opening f^8 through the outer wall of the external chamber F^4, which is ordinarily closed by a cap f^9, as shown in Figs. 2 and 5, said opening serving in the original construction to permit the drilling of the ports f^4 and the removal of the cap f^9, giving access to said ports f^4 for the purpose of inspecting and clearing them.

G^3 designates a stop-cock in the pipe for the supply of gas or mixture to the lower compartment of the valve-chest H′, which stop-cock may obviously be more or less remote from the engine, according to the particular arrangement of the source of supply of the mixture.

It will be observed that in the construction above set forth but a single valve is employed in the entire engine—to wit, the supply-valve H. It will also be observed that this valve is remote from the heated end of the power-cylinder and is isolated from the parts connected with the power-cylinder by the interposed chamber F^4, to which the cooled mixture is supplied on its way to the power end of the cylinder.

The supply-valve H is operable at each rotation of the crank-shaft B, but may be controlled as to the length of its opening stroke, and therefore as to the amount of mixture supplied through the same, by any suitable form of controlling mechanism. The valve is opened by suction, or, in other words, upon the back stroke of the piston F^3, in which stroke the explosive mixture passes from the outer chamber F^4, through the port f^3, into the space directly below the piston and from the carbureter or other source of supply to the valve H into the said outer chamber F^4, the said valve H being of course lifted off its seat in this operation by the superior atmospheric pressure beneath it.

In the construction shown in the drawings the extent of the opening movement on the part of the valve H is shown as controlled by a centrifugal governing mechanism, which is like that shown and described in my prior application for United States Letters Patent, Serial No. 691,629, renewed September 22, 1898, and of which this is a divisional application. Such governing mechanism consists of a wedge-shaped gage I, which is connected with the vertical arm i, pivoted at i', near its lower end, and which arm is bifurcated at its lower end and pivoted at i^2 to a collar I′ on the main shaft. Between this collar I′ and the hub of the fly-wheel B^2 is inserted a second collar I^2, having one of its edges inclined, as shown at i^3, in conformity to the contiguous end of the wheel-hub, and with this interposed beveled or inclined collar I^2 is connected a lever J, of a familiar form of centrifugal governor. The stem h of the valve H extends through the wall of the valve-chest below the gage I and is provided with a nut h', which strikes the lower edge of said gage when the valve is lifted. The farther outward the gage I is thrown the less dis-

tance therefore to which the valve H will be lifted, and as the greater outward throw of said gage will result from the higher speed of the engine (through the operation of the centrifugal governor) the higher the speed of the engine the less opening of the supply-valve H and the less explosive mixture will be supplied to the engine.

The electric mechanism for producing the spark in the power end of the cylinder for igniting the inflammable gas is of that kind shown and described in an application for United States Letters Patent filed simultaneously herewith, Serial No. 721,375, and which is also a division of the said renewal application, Serial No. 691,629, above mentioned.

As herein shown, K is a disk on the crank-shaft B, and *k* a laterally-projecting contact or cam thereon. *k' k²* are electrodes, of which the former bears continuously against the even side of the disk, and the latter is in position to be struck by said projection *k* at each revolution of the crank-shaft. *k⁵* designates an electrode which passes through insulating material *k³*, contained in the tube *k⁴*, inserted into the power end of the cylinder, said electrode protruding into the interior of the cylinder, as shown in Fig. 4. K' is a lever in the power end of the cylinder pivoted between its ends to vibrate toward and from the adjacent end of the cylinder, the longer arm being arranged to strike the inner end of the electrode *k⁵*, in contact with which it is normally held by a spring *k⁶*. *k⁷* is a stud on the piston arranged to strike the short end of the lever K' as the piston approaches the end of its compression-stroke. The electrode *k'* is connected with the upper end of the cylinder, as shown at *k⁸*, Figs. 3 and 4, and the electrode *k²* is connected with the outer end of the electrode *k⁵*, as shown in Fig. 3. In the circuit is shown a battery L or other source of supply of electricity. The operation of said sparking mechanism is like that shown in my application above referred to and need not be described here.

When it is desired to start the engine, gas may be pumped into the power end of the cylinder either by a suitable pumping device or by rotation by hand of the main crank-shaft of the engine when the engine is so small as to permit.

M designates a pin which passes freely through the head *f* of the cylinder and is provided at its inner end with an enlargement fitted to a countersink in the inner surface of said head *f* and serving as a valve to close the space around the freely-movable pin, said valve being normally held to its seat by means of a spring *m*, arranged external to the cylinder-head *f* about the pin and between the cylinder-head and a knob on the outer end of the pin. This pin M is adapted to be pushed against the long arm of the lever K', so that by this means the operator may break the circuit and produce a spark by hand.

N designates a plug fitted to an opening arranged opposite the sparking devices in the power end of the cylinder F, by which from time to time these parts may be inspected without removal of the cylinder-head. O is a valved oil-pipe leading from the lower end of the cylinder F.

It will be understood that the essential features of the foregoing improvements in the construction of the engine described may be applied to a horizontal type of engine—such, for instance, as shown in my said prior application, Serial No. 691,629. I do not wish, therefore, to be restricted to the precise details herein shown.

I claim as my invention—

In a single-acting engine, a cylinder and piston, said cylinder having a medial lateral inlet-port which is uncovered by the piston when near the end of its power-stroke, and also having a medial exhaust-port situated at or about ninety degrees of the circumference of the cylinder from the inlet-port, said exhaust-port being also uncovered by the piston on its approach to the end of its power-stroke, but before the uncovering of the inlet-port.

In testimony that I claim the foregoing as my invention I affix my signature, in presence of two witnesses, the 1st day of June, A. D. 1899.

GEORGE W. LEWIS.

Witnesses:
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F. E. BECHTOLD.