No. 713,367. Patented Nov. 11, 1902.

H. F. WALLMANN.

INTERNAL COMBUSTION ENGINE.

(Application filed Mar. 21, 1900.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1

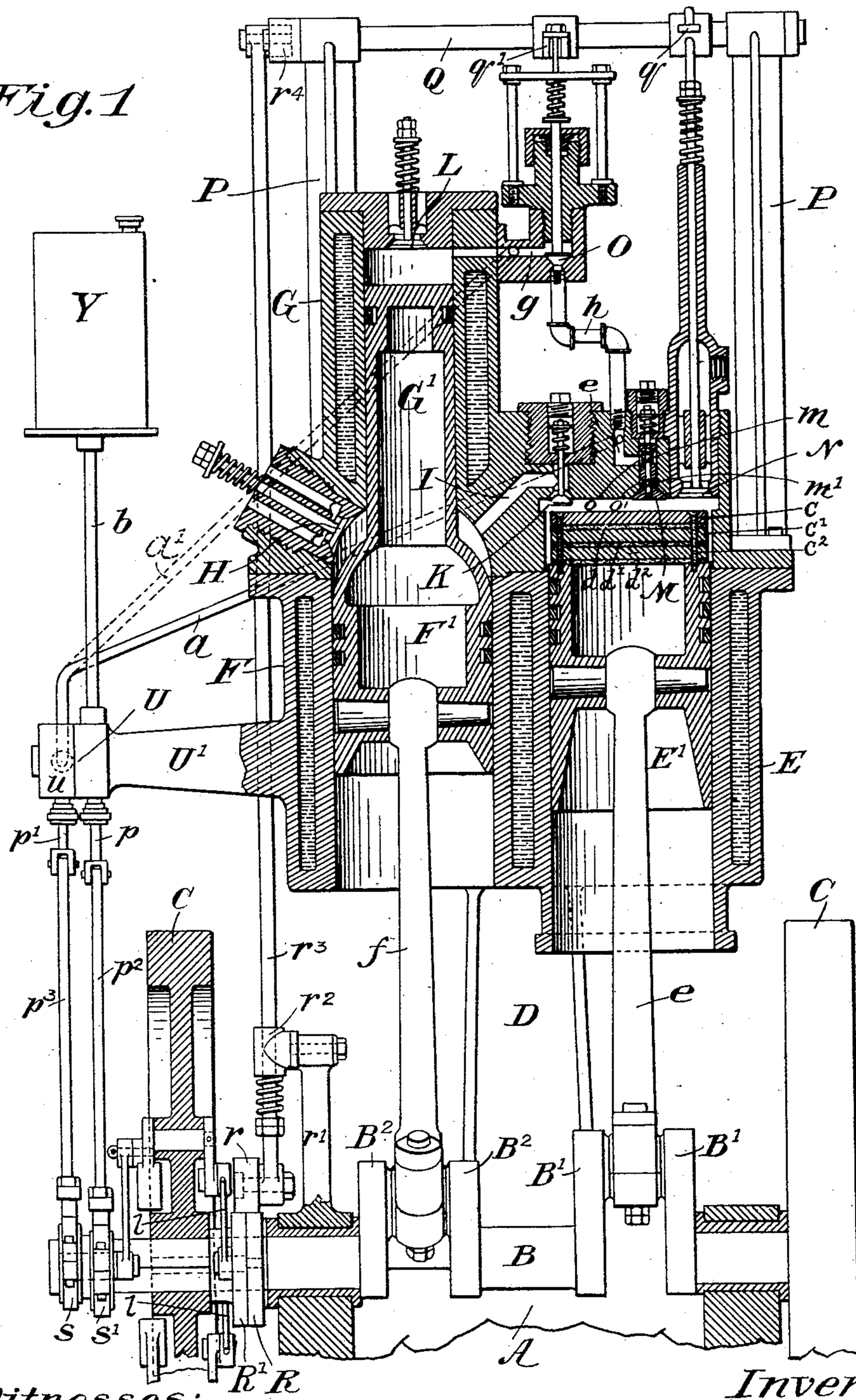

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Fig. 2

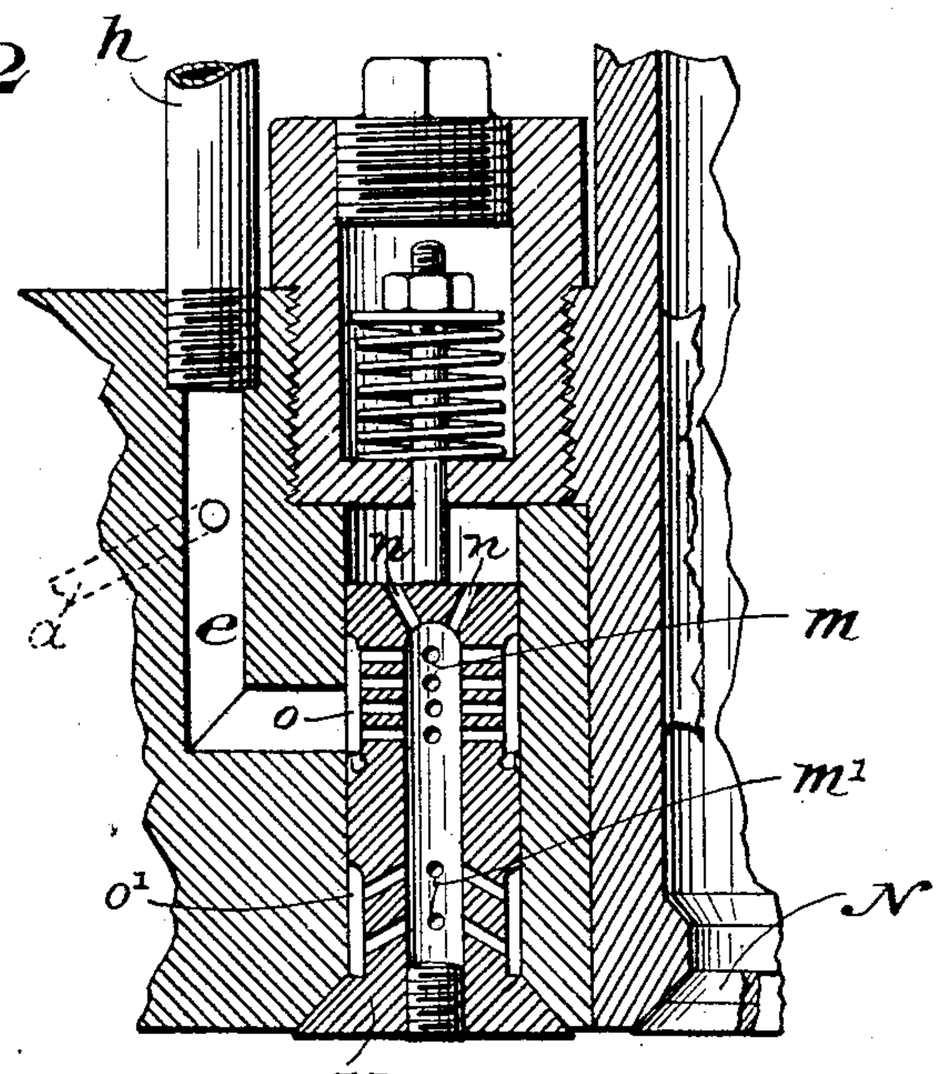
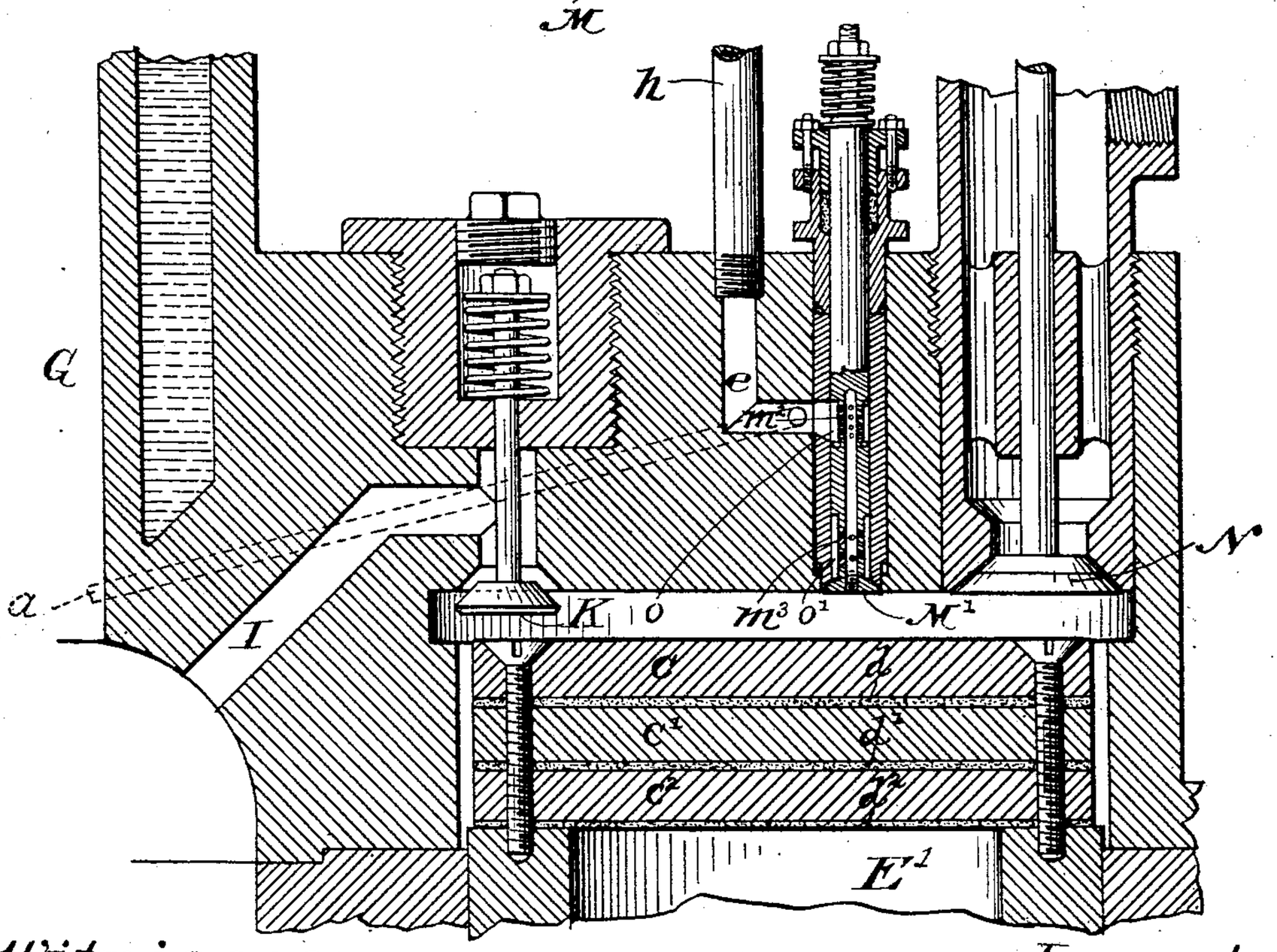


Fig. 3



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UNITED STATES PATENT OFFICE.

HENNING FRIEDRICH WALLMANN, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE WALLMANN ENGINE COMPANY, A CORPORATION OF ILLINOIS.

INTERNAL-COMBUSTION ENGINE.

SPECIFICATION forming part of Letters Patent No. 713,367, dated November 11, 1902.

Application filed March 21, 1900. Serial No. 9,530. (No model.)

To all whom it may concern:

Be it known that I, HENNING FRIEDRICH WALLMANN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Internal-Combustion Oil-Engines, of which the following is a specification.

My invention relates to internal-combustion engines of the two-cycle type, in which a charge of compressed air is mixed in suitable proportions with an inflammable oil-vapor, ignited and expanded within the combustion-cylinder, and made to perform work against the piston at every outstroke of the latter; and it consists in certain improvements on the construction of oil-engine shown and claimed in my former application, filed February 3, 1900, Serial No. 3,841. In the engine forming the subject-matter of the application above referred to both the air for the scavenging charge and the air and oil for the combustible charge are caused to enter the combustion-cylinder through a mixing device and past a common inlet-valve. One undesirable result of this construction is that any unvaporized oil or oil-vapor remaining in the mixer after any working stroke of the piston is swept into the cylinder and out of the exhaust-valve by the succeeding scavenging-blast, and thus wasted. My present improvements are designed to overcome this objection by causing the scavenging-blast to enter the cylinder through a different valve from that which controls the admission of fuel from the mixer to the cylinder.

My invention also contemplates securing a thorough and instant vaporization of the fuel upon its introduction to the combustion-cylinder by means of a simple vaporizing device carried by the working piston, which where heavy hydrocarbon oils are employed is essential to economy and a thorough combustion of the fuel.

To these ends my invention consists in an internal-combustion oil-engine possessing certain novel features of construction and operation, as hereinafter described, and particularly pointed out in the claims.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 is a view, principally in central vertical section, broken away, of my improved oil-engine. Fig. 2 is a detail, enlarged, of the fuel-inlet valve; and Fig. 3 is a detail, enlarged, of the head of the combustion-cylinder, showing a modified form of fuel-inlet valve.

Similar letters of reference refer to similar parts throughout the several views.

A represents the base or bed plate of the engine, in which is journaled the crank-shaft B, carrying a pair of fly-wheels C. Supported vertically on the bed-plate A is a framework D, which supports at its upper end a combustion-cylinder E and an air-pump cylinder F. Arranged tandem with and forming an extension of the air-pump cylinder F is the cylinder G of another and smaller air-pump, the plungers F′ and G′ of the said pumps, respectively, being formed integral, as shown, or rigidly connected together, so as to move simultaneously under impulses imparted from the crank-shaft B through crank B^2 and connecting-rod *f*. Within the combustion-cylinder E is the working piston or plunger E′, the latter connected to and operating the crank-shaft B through the agency of connecting-rod *e* and crank B′. It will be noticed that the two cranks B′ and B^2 are not set in parallel relation to each other on the crank-shaft B, but about one-eighth of a revolution apart, the crank B′, connected to the working piston E′, being approximately forty-five degrees in advance of the crank B^2, which actuates the pump-plungers F′ and G′. The purpose of this relative arrangement of cranks will be disclosed later in the description of the operation of the engine.

Referring to the larger air-pump F it will be noticed that the presence of the elongated plunger G′, formed directly on the upper face of the air-pump plunger F′, creates an annular air-compression chamber within the cylinder F, to which air is admitted on the suction-stroke through the inlet-valve H and out of which it is forced on the compression-stroke through a port I past valve K into the combustion-cylinder E. The function of this air-pump is to scavenge the combustion-cylinder at and during the proper time in the latter's operation and later to supply compressed air

for the combustible charges introduced into cylinder E, while the function of the smaller air-pump G, to which air is admitted on the suction-stroke through an inlet-valve L, is to facilitate the introduction of the oil-fuel to the combustion-cylinder in a sprayed and finely-divided condition by causing a blast of air under somewhat-greater pressure than the air in cylinder F to impinge upon the oil on its way to the combustion-cylinder, as hereinafter more particularly described.

Referring now to the combustion-cylinder, K is its air-inlet valve, M represents its fuel-inlet valve, and N designates its exhaust-valve. The latter is normally held to its seat by a spring, as shown; but is positively opened at and during the proper period in the engine's operation to effect the exhaust and scavenging of the combustion-cylinder, as hereinafter described.

A duct *g*, connected with the discharge-port of the air-pump G, communicates through an intermediate pipe *h* with an L-shaped duct *e*, formed in the head of the combustion-cylinder E, and the discharge of fuel therethrough is timed and controlled by a positively-actuated controlling-valve O, which by means hereinafter described is opened after the closing of the exhaust-valve of the combustion-cylinder to effect the passage of the oil-fuel, forced and sprayed by compressed air from the pump G past the fuel-inlet valve M into the cylinder. In order to effect a thorough division of the fuel on its way to the combustion-cylinder, I make the integral stem of the inlet-valve M hollow through a portion of its length (see Fig. 2) and provide it with two series of fine lateral ports *m* and *m'*, adjacent its upper and lower ends, respectively, which lateral ports provide communication between the hollow interior of the valve-stem and two shallow grooves *o* and *o'*, respectively, formed in the cylindrical surface of the valve-stem opposite said lateral ports. With the upper of said grooves *o* the fuel-duct *e* communicates, as shown. The upper end of the hollow portion of the valve-stem may be apertured or ported, as at *n*, to enable the pressure to open the valve by securing an abutment against the inner or upper end of the valve-casing.

Referring next to the means for supplying oil for the combustible charge, U indicates an oil-pump secured to a bracket U', shown as formed integral with the air-pump cylinder F.

Y is an oil-tank, and *b* is a pipe through which the oil flows by gravity to the upper end of the oil-pump. The plunger *p* of the oil-pump is actuated through a rod p^2 from an eccentric *s'*, while the slide-valve *p'*, that controls the discharge of oil from the valve-chest, is actuated through a similar rod p^3 and eccentric *s*. The specific construction of this oil-pump is not herein shown and described, as it is practically the same as the well-known Brayton oil-pump and possesses no novelty of itself.

Mounted in one of the fly-wheels C, I have indicated a governor mechanism for automatically regulating the stroke of the oil-pump plunger in accordance with the speed of the engine. As this mechanism, however, forms no part of my present invention and is fully shown and described in a companion application, Serial No. 3,841, hereinabove referred to, the same need not be herein described in detail. The oil-pump on its forcing stroke delivers oil from the valve-chest *u* to some point of the delivery passage from the air-pump G to the inlet-valve M of the combustion-cylinder. As shown in the drawings, the oil-delivery pipe *a* taps said passage at the duct *e* in the cylinder-head of the combustion-cylinder; but it may, if preferred, tap the same at the duct *g*, as indicated by dotted lines at *a'*, or at any intermediate point.

Referring now to the mechanism for actuating and controlling the valves O and N, P P designate a pair of standards mounted on top of the cylinders E and F. In the upper ends of these standards is suitably journaled a horizontal rock-shaft Q. Rigidly secured on this rock-shaft are a pair of tappets *q* and *q'*, which at their outer ends engage the stems of the valves N and O, respectively, at the right times to effect the proper actuation of said valves, as hereinafter described. The rock-shaft Q is positively actuated from the crank-shaft B through the agency of a governor-controlled cam-disk R on said crank-shaft, said cam-disk engaging and actuating a roller *r*, journaled in the lower end of a rod r^3, which is slidably supported in a sleeve r^2, pivoted to a bracket *r'*, supported on the bed-plate A. The upper end of the rod r^3 is connected to a short arm r^4, fast on one end of the rock-shaft Q. On the shaft B, adjacent to the cam R, is rotatably mounted a disk R', which is connected on opposite sides of its center by links *l l* with the centrifugal governor in the fly-wheel, so as to be oscillated on its central bearing by the variations of the governor-arms. This disk R' is so formed and arranged relatively to the cam R that during the normal operation of the engine it has no effect on the cam R to vary the latter's actuation of the valve N; but when the speed of the engine exceeds the normal or desired limit it has the effect of prolonging the cam-face of the cam-disk R, and consequently delaying the closing of the exhaust-valve N. This cam-adjusting mechanism is shown and described in detail in the companion application, Serial No. 3,841, hereinabove referred to, and as it forms no part of my present invention need not be more fully described here. On the upper or inner face of the working piston E' are secured a series of metal plates *c*, *c'*, and c^2, insulated from each other and from the face of the piston by thin disks *d*, *d'*, and d^2, of some suitable heat-insulating material, as compressed asbestos. The purpose or object of this construction is to maintain the inner end of the piston as hot as possible, so that

after the engine has started in operation by the direct impingement of the fuel past the valve M upon the upper or inner plate *c* any part of said fuel which may enter the cylinder in a liquid state will be instantly and thoroughly vaporized.

Any approved form of igniter may be used, or where a fuel is employed which will ignite at the internal temperature of the combustion-cylinder the igniter can be dispensed with.

The operation of the engine may be briefly described as follows: The plungers F′ and G′ of the air-pumps F and G, respectively, as well as the plunger of the fuel-pump U, follow the plunger E′ of the combustion-cylinder E about one-eighth of a revolution behind the latter. With the parts in the positions shown the exhaust-valve N has just closed, the oil-pump U is forcing a charge of fuel to the duct *e* or *g*, the air-pump F, having through the first part of its compressing stroke scavenged the combustion-cylinder, is now supplying compressed air past the valve K for the next combustible charge, and the tappet *q*′ is just about to raise the controlling-valve O to permit a blast of compressed air from the pump G at a somewhat higher pressure than that of the air supplied by the pump F to force and spray the fuel into the combustion-cylinder. As now the working piston E′ starts on its downward or outward stroke the valve O opens, and the air from pump G, carrying the fuel supplied to duct *g* or impinging on the fuel supplied to duct *e*, (as the case may be,) forces said fuel in a finely-divided condition through the upper series of ports *m*, the hollow valve-stem, and the lower series of ports *m*′, and thence past the cone-shaped valve M into the combustion-cylinder, where it mingles with the air supplied to said cylinder by the pump F past the valve K, forming therewith a highly-combustible mixture, and impinging on the hot top plate *c* of the piston is thoroughly vaporized by the heat of the latter and is ignited thereby or by means of a suitable igniter. The pressure created by the internal combustion of the gases instantly drives the valves K and M to their seats, and the piston E′ under the impulse of the expanding gases performs a working stroke on the crank-shaft. During this working stroke of piston E′ the valve-actuating mechanism permits the valve O to close and at the completion of the working stroke opens the exhaust-valve N for the expulsion of the burned products of combustion. During about five-sixths of the upward or return stroke of the piston E′ the products of combustion are exhausted past the open valve N by the inward travel of the piston and the scavenging-blast supplied by pump F. Upon the closing of valve N compression of air for the next combustible charge takes place within the combustion-cylinder until the parts again assume the positions shown, whereupon the above-described cycle of operations is repeated.

In Fig. 3 I have shown in enlarged detail a slightly-modified form of fuel-inlet valve M′, which is adapted to be positively opened by a cam or tappet connected with a moving part of the engine instead of opening automatically under the pressure of the injected fuel, as in Figs. 1 and 2. In this form the lower end of the valve-stem is made hollow between the two series of lateral ports m^2 and m^3, and the stem of the valve extends up through a suitable packing or stuffing box Z to any suitable or required height to enable it to be engaged at the proper time by a valve-actuating device connected with a moving part of the engine.

From the foregoing description of my improved engine it will be seen that by reason of the fact that the scavenging-air and the fuel are admitted to the combustion-cylinder through separate and distinct valves and by reason of the further fact that the exhaust-valve is closed before the admission of fuel takes place all possibility of waste of unconsumed fuel by the scavenging-blast is avoided unless the fuel fails to burn properly and is not thoroughly consumed, and possibility of waste through the latter causes is prevented by means of the hollow ported fuel-inlet valve in combination with the hot insulated plate or plates on the inner end of the piston, whereby the fuel being caused to enter the combustion-cylinder in a finely-divided condition and being instantly and completely vaporized is thus brought into the most perfect condition for complete and thorough combustion.

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

1. In an oil-engine, the combination with a combustion-cylinder having an air-inlet valve, a fuel-inlet valve, and an exhaust-valve, all located in the head of the cylinder of an air-compressor which delivers compressed air to the combustion-cylinder past said air-inlet valve, the initial portion of said compressed air serving as a scavenging-blast and the remainder forming part of the next combustible charge, a second air-compressor whose delivery is connected to the casing of the fuel-inlet valve, and a fuel-pump whose delivery-pipe taps the air-duct between the discharge-port of said second air-compressor and the casing of the fuel-inlet valve, substantially as set forth.

2. In an oil-engine, the combination with a combustion-cylinder having an air-inlet valve, a fuel-inlet valve, and an exhaust-valve, all located in the head of the cylinder of an air-compressor which delivers compressed air to the combustion-cylinder past said air-inlet valve, the initial portion of said compressed air serving as a scavenging-blast and the remainder forming part of the next

combustible charge, a second air-compressor whose delivery is connected to the casing of the fuel-inlet valve, a positively-actuated valve controlling the discharge of said second air-compressor, and a fuel-pump whose delivery-pipe taps the air-duct between the discharge-port of said second air-compressor and the casing of the fuel-inlet valve, all substantially as and for the purpose set forth.

3. In an oil-engine, a fuel-inlet valve for the combustion-cylinder having an integral hollow stem and two annular series of fine lateral ports formed through said stem adjacent its upper and lower ends, respectively and communicating with the hollow interior, the fuel, on its way to the combustion-cylinder, entering said hollow stem by the upper series of lateral ports and leaving it by the lower, whereby it enters the combustion-cylinder in a sprayed and finely-divided condition, substantially as shown and described.

4. In an oil-engine, a combustion-cylinder having a fuel-inlet valve located in the cylinder-head, said valve having an integral hollow stem and two separated annular series of fine lateral ports formed through said stem and communicating with the hollow interior, through which the fuel is forced in opposite directions on its way to the combustion-cylinder, in combination with a working piston having a vaporizing device formed on and constituting its working face upon which the fuel impinges in a finely-divided condition, whereby the fuel is brought into the most favorable condition for complete and thorough combustion, all substantially as shown and described.

In testimony that I claim the foregoing as my invention I have hereunto signed my name in the presence of two witnesses.

HENNING FRIEDRICH WALLMANN.

Witnesses:

SAMUEL N. POND,

GEORGE E. HALEY.