No. 811,809. PATENTED FEB. 6, 1906.

J. A. WILLIAMS.

EXPLOSIVE ENGINE.

APPLICATION FILED SEPT. 27, 1904.

2 SHEETS—SHEET 1.

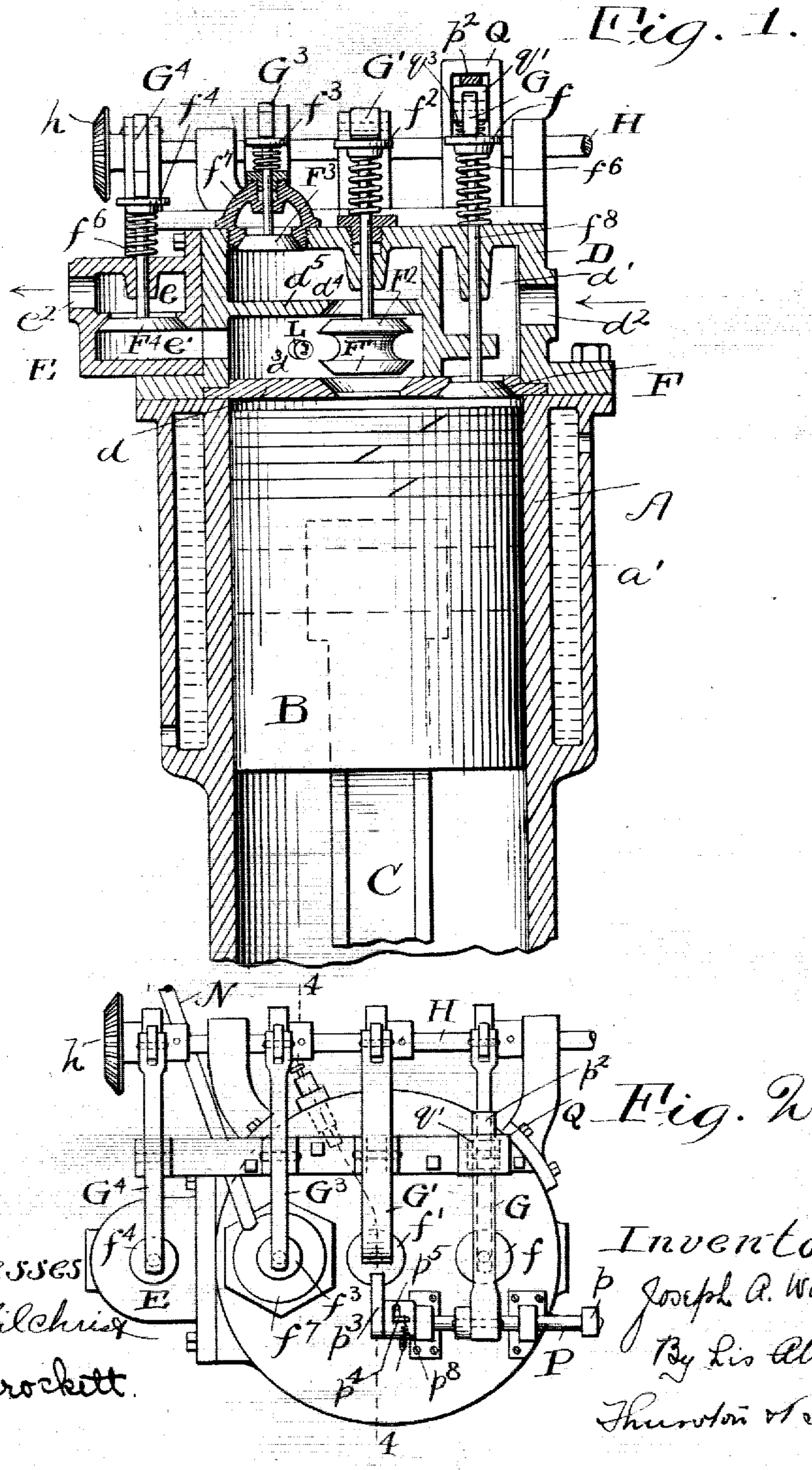

Fig. 1.

Fig. 2.

Witnesses
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Inventor:
Joseph A. Williams
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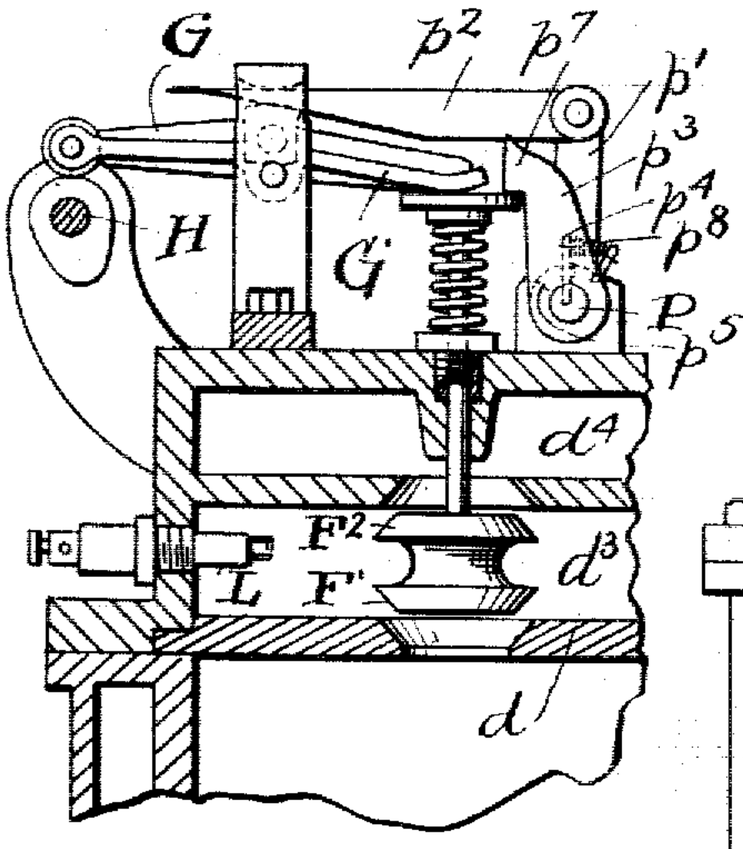

Fig. 4.

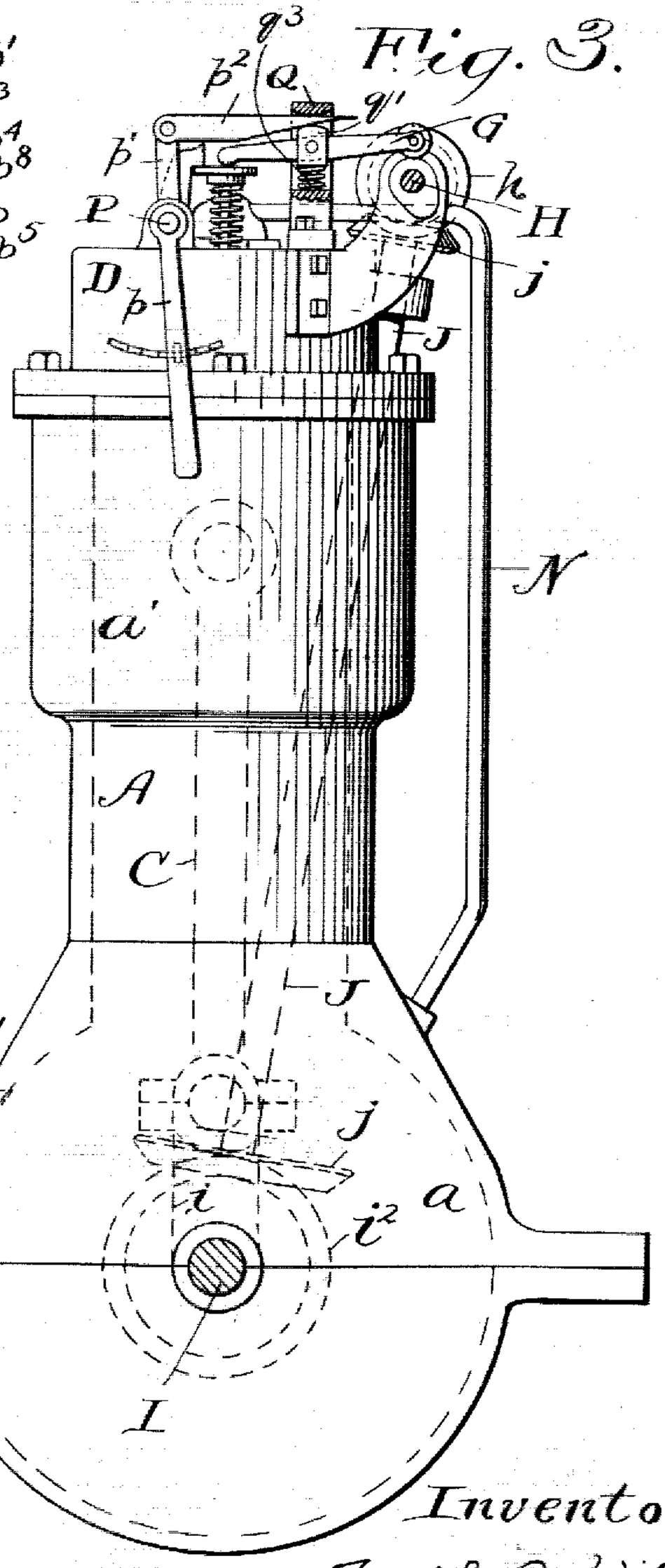

Fig. 3.

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UNITED STATES PATENT OFFICE.

JOSEPH A. WILLIAMS, OF CLEVELAND, OHIO.

EXPLOSIVE-ENGINE.

No. 811,809. Specification of Letters Patent. Patented Feb. 6, 1906.

Application filed September 27, 1904. Serial No. 226,119.

To all whom it may concern:

Be it known that I, JOSEPH A. WILLIAMS, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Explosive-Engines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

The object of this invention is to provide an explosive-engine which while being simple in construction shall be economical in use and regular and certain in its action. I accomplish these results by providing a separable combustion-chamber and arranging a scavenging charge of compressed air which flows from the crank-chamber through the combustion-chamber after the firing and entirely clears out the combustion-chamber. This insures certainty in action of the engine and increases the efficiency and economy by preventing contamination of the fresh charge.

My invention may be summarized as consisting of the means employed to attain the above ends, as hereinafter more fully explained and as definitely set out in the claims.

In the drawings, Figure 1 is a longitudinal central section through the cylinder and valve-chambers of my engine. Fig. 2 is a top view thereof. Fig. 3 is a side elevation of the engine at right angles to Fig. 1, and Fig. 4 is a section of the upper part of the engine substantially on the line 4 4 of Fig. 2.

The same letters of reference designate the same part of each figure.

Referring to the parts by letters, A represents the cylinder of the engine. In this cylinder slides a reciprocating trunk-piston B, and the connecting-rod C connects the piston with the crank *i* in the chamber *a*, which is closed about the lower end of the cylinder. A water-jacket *a'* is shown around the upper portion of the cylinder. At the upper end of the cylinder, above the piston, is an extension or hood D, which, as shown, is a separate part secured to the cylinder. This hood and the plate *d* held in place thereby act as a head for the cylinder. Within the head is a small space *d'*, which constitutes the admission-chamber. Air and gas are sucked into the same at the proper time through a suitable opening d^2. The most of the space between the plate *d* and the upper end of the hood is devoted to a series of combustion-chambers. In the drawings two combustion-chambers d^3 d^4 are shown, being separated from each other by the partition d^5.

E represents a bonnet, which is shown as secured to the side of a hood D and carries an exhaust-chamber *e*, which communicates with the exhaust-pipe through the opening e^2 and with the lowermost combustion-chamber through a passage-way *e'*.

The valves are all of the puppet type, being held to their seats by springs f^6 and opened positively by cam-levers. F is the admission-valve. F' and F^2 are double seat-valves controlling the combustion-chambers. F^3 is a valve controlling the scavenging charge, as hereinafter explained, and F^4 is the exhaust-valve. The stems of these valves have heads *f*, *f'*, f^3, and f^4, respectively, which are adapted to be engaged and depressed by the forward ends of levers G, G', G^3, and G^4. These levers are all operated by cams suitably placed on a cam-shaft H, which receives motion from the crank-shaft. The gearing shown between the cam-shaft and the crank-shaft consists of a bevel-gear *h* on the end of the cam-shaft, a meshing gear *j* on a lay-shaft J, the lower end of which carries the bevel-gear *j'*, meshing with the bevel-gear i^2 on the crank-shaft I. This mechanism provides means for positively opening the valves as desired, according to the adjustment of the cams on the cam-shaft H, as will be readily understood. Fig. 1 shows the piston in the position at the end of the compression-stroke, the charge being fully compressed into the combustion-chamber ready for firing.

The speed of the engine is regulated by governing in the manner hereinafter explained the amount of opening of the admission-valve F. To insure the proper compression of the mixture with its varying amount, I vary the combustion-chambers. As shown, there are two parts to the combustion-chambers, and the valve F^2 operates, as hereinafter explained, to shut off or leave connected the upper chamber, as desired. If less than one-half of the full charge is drawn, the valve F^2 is seated during the compression and firing strokes, thus restricting the combustion-chamber to the lower compartment d^3. If, on the other hand, more than one-half of the full charge is drawn in, then the valve F^2 does not seat and both chambers d^3 and d^4 are used as combustion-chambers. The two

combustion-chambers are to be taken as illustrations of two or more chambers, as becomes desirable in practice. When two chambers are employed, the charge may be compressed into the whole compression-space or one-half of it. If three chambers be employed, the regulation is more close and the charge may be compressed into one-third of the space, two-thirds of the space, or the whole of it. As shown in Fig. 1, both of the combustion-chambers are in use, the valves F′ F² being off their seats, the remaining valves all closed. At this point the charge is exploded by a spark caused by the igniter L, which is placed in the lowermost combustion-chamber. This explosion drives the piston downward and compresses into the crank-chamber the air below it. As the piston reaches the lower end of the stroke and starts on its expulsion-stroke the cam acting on the lever G⁴ opens the exhaust-valve F⁴ and the charge is expelled through the exhaust-passage e^2. Just as the piston reaches the extreme upper movement on the expulsion-stroke the cam acting on the lever G′ forces the valve F′ tightly against its seat and holds it there throughout the admission-stroke. During this admission-stroke the the valve F is opened, exhaust-valve F⁴ remains open, and the scavenging-vave F³ is opened by its lever G³, the result being that air compressed in the crank-chamber by the downwardly-moving piston rushes through the pipe N and through the bonnet f^7 and through the combustion-chambers and out through the exhaust-valve, thoroughly cleaning the combustion-chambers. The next stroke of the cycle is the compression-stroke. On this stroke the valves F, F³, and F⁴ are all closed, and the valve F′ is away from its seat, and the valve F² may be away from its seat, as shown in Fig. 1, the charge being thus compressed into the two compression-chambers, or this valve F² may be on its seat, restricting the compression to the chamber d^3. A suitable check-valve M, opening into the crank-chamber, allows the admission of air thereinto on the upward stroke of the piston. To provide for the corresponding control of the admission and combustion chamber valves, I have the following mechanism: Mounted above the hood D is a rock-shaft P, which is under control of the operator by suitable means, as illustrated, by the rock-lever p, mounted on said shaft. Extending upward from the shaft is a rock-arm p', to which is connected a bar p^2, which extends beneath a yoke Q, in which the bearing q' of the cam-lever G is slidably mounted. The bar p^2 is inclined on its under face, and a spring q^3 presses the bearing q' upward against said bar. Now if the lever p is pulled in the direction to force the bar p^2 into the yoke Q, the bearing q' is forced downward, wherefore the lever G when acted on by its cam forces farther downward the stem f^8 of the valve F, opening that valve wider, thus increasing the amount of charge admitted. Loosely journaled on the rock-shaft P is a pawl p^3. A pin p^4 extends from the rock-shaft through a slot p^5 in the hub of this pawl. This results in allowing independent movement of the pawl and rock-shaft to the extent of the space provided by the slot p^5, but compels the two to rotate in unison with any further movement of the rock-shaft. Now during the first positions of the lever p—that is, those at the right of the positions shown in Fig. 3—the incline of the bar p^2 is depressing but slightly the bearing q' and the cam-lever G opens the admission-valve for something less than one-half the full admission. In these first positions of the lever p the pin p^4 is against the forward wall of the slot p^5 and holds the pawl p^3 out of action. The spring around the shank of the valve F² is thus enabled to hold this valve against its seat, shutting off the upper combustion-chamber and restricting the compression to the lower chamber d^3. When the lever p is moved into its positions for greater speed, (being those at the left of that shown in Fig. 3,) the wedge-bar p^2 forces down the bearing q' sufficiently so that the admission-valve is opened much wider by the cam-lever. This also swings the pin p^4 away from the end of the slot p^5 and allows the nose p^7 on the upper end of the pawl to spring over the head of the stem of the valve F². As soon as this valve is depressed, as it is always during the scavening operation, the spring p^8 insures the pawl assuming this position when the position of the rock-lever allows it.

It will be understood from the above description that the amount of charge may be regulated to a nicety by the lever p' or its equivalent and that as the charge increases at a certain point the size of the combustion-chamber is increased. In the embodiment shown this point is at half-charge, anything less than half-charge using only the lower chamber d^3 and anything more than half-charge using both chambers. The arm G′, which operates the combustion-chamber valve, is itself a rather stiff leaf-spring, resulting in the valve F′ being snugly seated when the cam closes it.

I claim—

1. The combination with an explosive-engine including a cylinder and a separable stationary combustion-chamber, of means for forcing a scavenging charge of air through the same at a time when the combustion-chamber is not in communication with the cylinder.

2. In a four-cycle explosive-engine, in combination, a cylinder, a separable stationary combustion-chamber, and exhaust-passage for the cylinder leading from said combustion-chamber, and means for forcing a scav-

enging charge of air through said combustion-chamber at a period of the cycle when the engine is not exhausting.

3. In an explosive-engine, in combination, a cylinder, a stationary combustion-chamber, a valve between the same and the cylinder, and means for forcing the air through the combustion-chamber when said valve is closed.

4. In an explosive-engine, in combination, a cylinder, a crank-casing connected thereto, a separable stationary combustion-chamber, a passage-way leading from the crank-chamber to the combustion-chamber, and a valve for controlling said passage-way.

5. In an explosive-engine, in combination, a cylinder, a stationary combustion-chamber, a valve for controlling communication between the two, means for forcing a scavenging charge through the combustion-chamber, a valve for controlling such charge, and means for opening said valve when the combustion-chamber valve is closed.

6. In an explosive-engine, in combination, a cylinder, a crank-casing connected thereto, a separate stationary combustion-chamber, a passage-way leading from the crank-chamber to the combustion-chamber, a scavenging-valve for controlling said passage-way, a partition between the combustion-chamber and cylinder, a valve controlling an opening in said partition, and means for opening the scavenging-valve when the last-mentioned valve is closed.

7. In an explosive-engine, in combination, a cylinder, a combustion-chamber divided into compartments, a valve for controlling communication between the compartments, means for admitting a scavenging charge into the compartment farthest from the cylinder, and means for simultaneously holding open the valve between the compartments, and the exit-valve from the compartment nearest the cylinder.

8. In an explosive-engine, in combination, a cylinder, a closed crank-casing connected therewith, a plurality of combustion-chambers communicating with each other and one communicating with the cylinder, an igniter in the combustion-chamber which communicates with the cylinder, a valved exhaust passage-way from said combustion-chamber, means controlling communication between the combustion-chambers, a valved passage-way from the crank-casing leading into the combustion-chamber farthest from the igniter to admit a scavenging charge of air thereto.

9. In an explosive-engine, in combination, a cylinder, a stationary combustion-chamber, a valve controlling communication between the two, a crank-shaft, mechanism operated from the motion thereof to operate said valve, and means for forcing a scavenging charge through the combustion-chamber when the valve is closed.

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

JOSEPH A. WILLIAMS.

Witnesses:

ALBERT H. BATES,

B. W. BROCKETT.