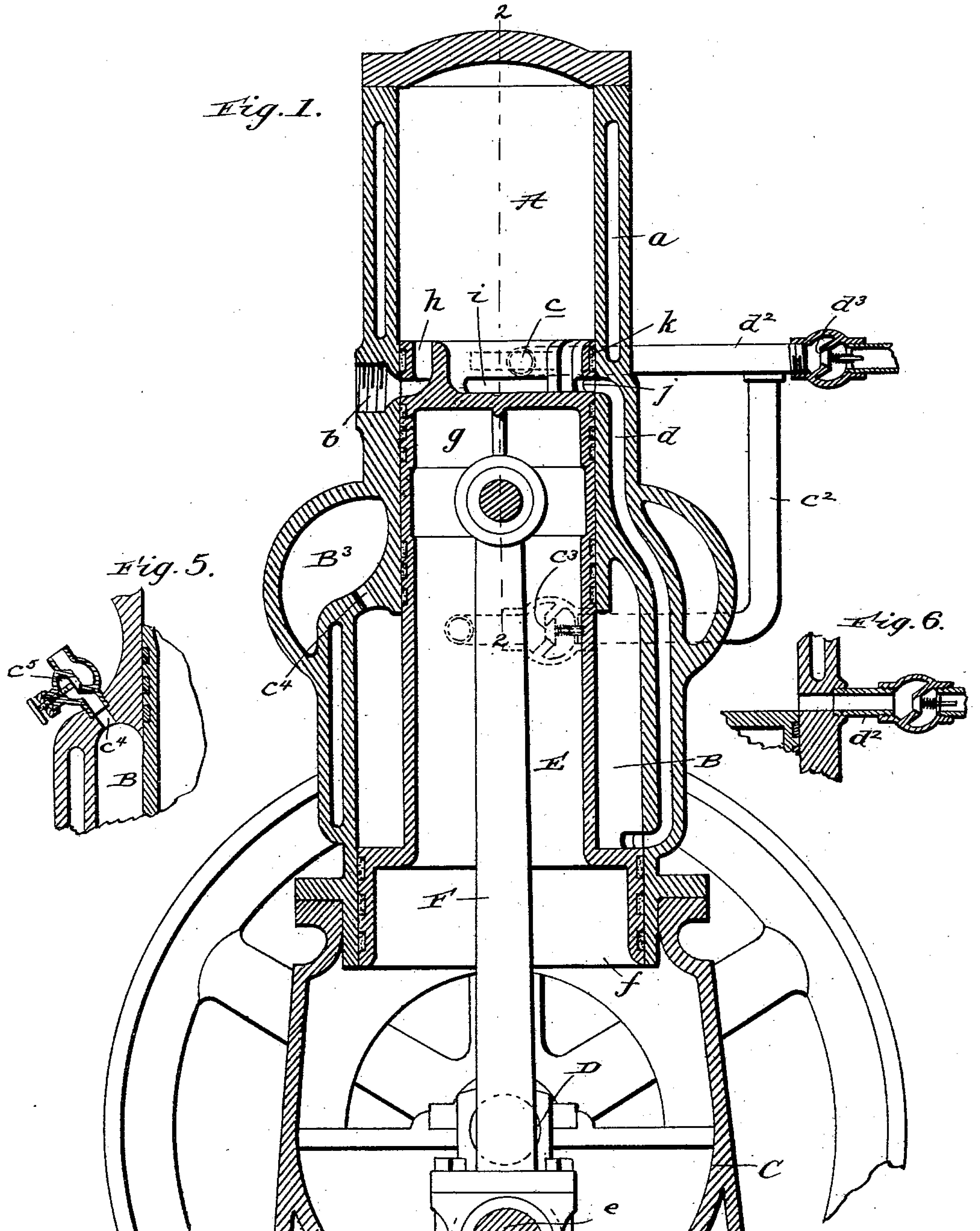
No. 632,918. Patented Sept. 12, 1899.

C. R. DAELLENBACH.

EXPLOSIVE ENGINE.

(Application filed Oct. 20, 1898.)

(No Model.) 2 Sheets—Sheet 1.



Witnesses:
C. H. Raeder
J. G. Croney

Inventor
C. R. Daellenbach
BY James J. Sheehy
Attorney

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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Fig. 2.

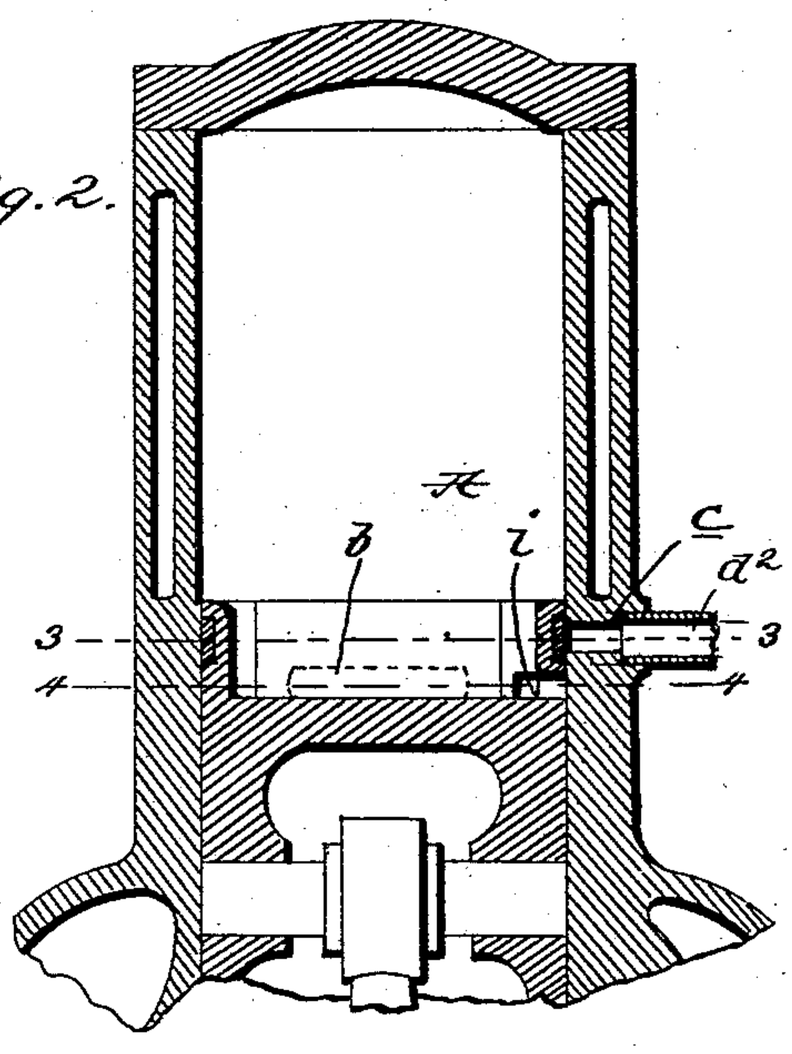


Fig. 3.

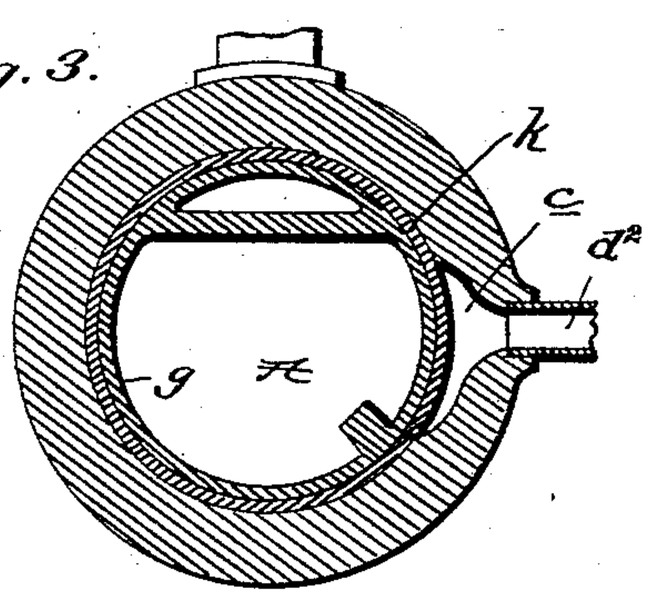
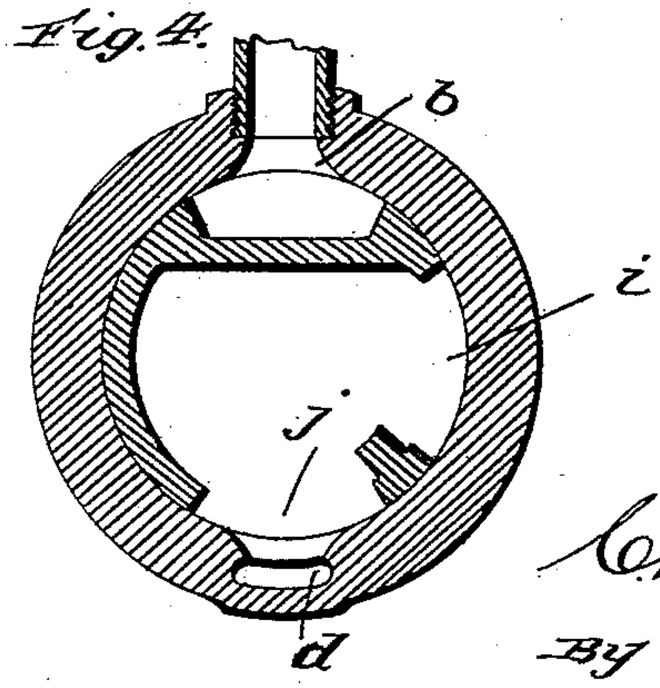


Fig. 4.



Witnesses:
C. H. Hauder
J. G. Mooney.

Inventor
C. R. Daellenbach
By James J. Shuby
Attorney

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

CHARLES R. DAELLENBACH, OF ELLWOOD CITY, PENNSYLVANIA, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO THE ELLWOOD CITY GAS ENGINE COMPANY, OF SAME PLACE.

EXPLOSIVE-ENGINE.

SPECIFICATION forming part of Letters Patent No. 632,918, dated September 12, 1899.

Application filed October 20, 1898. Serial No. 694,103. (No model.)

To all whom it may concern:

Be it known that I, CHARLES R. DAELLENBACH, a citizen of the United States, residing at Ellwood City, in the county of Lawrence and State of Pennsylvania, have invented new and useful Improvements in Gas-Engines, of which the following is a specification.

My invention relates to gas-engines, and contemplates the provision of a simple, durable, and highly-efficient engine, in which the drive-shaft is caused to make a complete revolution incident to each explosion.

With the foregoing in view the invention will be fully understood from the following description and claims when taken in conjunction with the annexed drawings, in which—

Figure 1 is a vertical section, partly broken away, of an upright gas-engine constructed in accordance with my invention. Fig. 2 is a detail vertical section taken in the plane indicated by the line 2 2 of Fig. 1. Figs. 3 and 4 are transverse sections taken in the planes indicated by the lines 3 3 and 4 4, respectively, of Fig. 2. Fig. 5 is a detail section of a modification. Fig. 6 is a detail section of another modification.

In the said drawings similar letters designate corresponding parts in all of the several views.

The engine is by preference of the upright type, with an explosion-chamber A at the upper end of the piston-cylinder, an offset forming a vacuum-chamber B below the explosion-chamber, and a base-housing C. The explosion-chamber is surrounded by the usual water-jacket *a* and is provided with an inlet-port *b* for explosive and an exhaust-port *c*, disposed in a plane slightly above the port *b*, as shown. Said explosion-chamber is connected with the vacuum-chamber B by a port *d*, which opens into the explosion-chamber in the same plane as the port *b* for a purpose presently described. The vacuum-chamber is directly connected by a pipe c^2 with a pipe d^2, communicating with the exhaust-port *c* and containing an outwardly-opening check-valve d^3.

D is a transverse drive-shaft journaled in suitable bearings in the housing C and provided within the same with a crank *e*.

E is the piston, and F the rod connecting the same with the crank *e*. The piston E is provided with the lower diametrically-enlarged portion *f*, movable in the chamber B, and the upper portion *g*, movable in the chamber A. It is also constructed with a view of shutting off direct communication between the chambers A and B and is provided with the port *h*, having the laterally-disposed portion to register with the induction-port *b* and the vertically-disposed portion opening into the chamber A, and the ports *i j*, designed to register with the ports *c d*, respectively. The ports *i j* and the receiving end of the port *h* are disposed in the same plane below the upper end of the piston, and the part of the piston above them is provided with suitable packing *k*, so as to enable it to effectually close the port *c* when the ports *b h* and the ports *d j* are coincident and port *b* is open, and thereby prevent the products of combustion flowing into the explosion-chamber when communication is established between the explosion-chamber and vacuum-chamber, as hereinafter pointed out.

The general operation of the engine is as follows: After a charge of explosive mixture is let into the chamber A, as described, the piston E moves up and by so doing compresses the charge, which is ignited at the proper time by any suitable sparking mechanism, which I have not deemed it necessary to illustrate. The resulting explosion drives the piston downwardly, and when the port *i* registers with port *c* a portion of the products of combustion escape through said port *c* and the pipe d^2, all of the said products being prevented from escaping, because the registration of the ports *i c* is but momentary. When the piston reaches its lowermost position, as shown in Fig. 1, the port *c* will be closed and communication will be established between the induction-port *b* and port *h* and between the port *j* and the port *d*. With this done the products of combustion in chamber A will by reason of the vacuum created in chamber B by the down movement of the piston be

drawn into the said chamber B, and at the same time explosive mixture will be drawn into the chamber A, the vertical disposition of the port *h* serving to cause said mixture to take an upward course in the chamber A and prevent it from taking passage to the ports *j d*. On the subsequent upstroke of the piston the products of combustion will be forced from the chamber B through pipes c^2 d^2 and pass the non-return valves c^3 d^3 therein to the atmosphere, the piston in the position shown in Fig. 1 serving to close the port *c* to the chamber A, so as to prevent the explosive mixture from escaping through said port and at the same time prevent the discharged products of combustion from gaining access to the explosion-chamber. On the upstroke of the piston the charge will be compressed in the explosion-chamber and the operation described will be repeated.

When desirable, the portion of the piston above the port *i* may be dispensed with, in which case an inwardly-seating valve should be provided in the pipe d^2 at a point between the pipe c^2 and the port *c*, as shown in Fig. 6, in order to prevent the discharged products of combustion from returning to the explosion-chamber.

For the purpose of enlarging the vacuum-chamber and thereby preventing the vacuum from interfering with or retarding the downward strokes of the piston the chamber B is connected by one or more ports c^4 with a circular chamber B^3, which surrounds the upper end of chamber B, as shown. When desired, however, the chamber B^3 may be omitted and a valve c^5 (see Fig. 5) connected to the port c^4, the said valve having for its purpose to admit air, as desired, incident to the downstroke, and thereby prevent the vacuum or partial vacuum from retarding the downstrokes of the piston. It follows from this that the attendant is enabled, through the medium of the valve c^5, to regulate the speed of the engine.

It will be appreciated from the foregoing that an explosion will take place at the completion of each upstroke of the piston, or, in other words, there will be one explosion to each revolution of the crank-shaft, and in consequence the engine is rendered capable of developing great power and speed. It will also be appreciated that the engine is very simple and durable and embodies no complicated mechanism that is liable to get out of order after a short period of use.

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

1. In an explosive-engine, the combination with a piston-cylinder containing an explosion-chamber and a vacuum-chamber and having an induction-port for explosive communicating with the explosion-chamber, and a port connecting the explosion-chamber and the vacuum-chamber; of a reciprocatory piston movable in the explosion and vacuum chambers and arranged to simultaneously uncover the induction-port and the receiving end of the port between the explosion and vacuum chambers, whereby the withdrawal of the products of combustion from the explosion-chamber is utilized to draw a charge of explosive into said chamber, substantially as specified.

2. In an explosive-engine, the combination of a piston-cylinder containing an explosion-chamber and a vacuum-chamber and having an induction-port for explosive communicating with the explosion-chamber, a port connecting the explosion-chamber, and an exhaust-port; of a reciprocatory piston movable in the explosion and vacuum chambers and arranged to simultaneously uncover the induction-port and the receiving end of the port between the explosion-chambers, and also arranged to uncover the exhaust-port prior to the uncovering of the induction-port and the port between the chambers, and suitable non-return means controlling the exhaust-port, substantially as specified.

3. In a gas-engine the combination with a piston-cylinder containing an explosion-chamber and a vacuum-chamber and having an induction-port for explosive communicating with the explosion-chamber, a port connecting the explosion-chamber and vacuum-chamber and having its receiving end arranged in the same plane as the induction-port, and an exhaust-port leading from the explosion-chamber and having its receiving end arranged in a plane between the induction-port and the outer end of the explosion-chamber; of a reciprocatory piston movable in the explosion and vacuum chambers and having ports arranged to simultaneously register with the induction-port and the port between the explosion-chamber and the vacuum-chamber, and a port arranged to open the exhaust-port before the other ports are open, and also having an extension to close the exhaust-port when the other ports are open, substantially as specified.

4. In a gas-engine, the combination with a piston-cylinder containing an explosion-chamber and having an offset forming a vacuum-chamber and also having an induction-port for explosive communicating with the explosion-chamber, a port connecting the explosion-chamber and the vacuum-chamber, and having its receiving end arranged in the same plane as the induction-port, an exhaust-port having its receiving end arranged in a plane between that of the induction-port and the outer end of the cylinder, a conduit d^2 connected to the exhaust-port, a conduit c^2 connecting the vacuum-chamber and the conduit d^2; and outwardly-opening check-valves in the conduits c^2 d^2; of a reciprocatory piston movable in the explosion and vacuum chambers and having ports arranged to simultaneously register with the induction-port and the port between the explosion-chamber and vacuum-chamber, and a port arranged

to open the exhaust-port before the other ports are opened and also having an extension to close the exhaust-port when the other ports are open, substantially as specified.

5. In an explosive-engine, the combination with a piston-cylinder containing an explosion-chamber and a vacuum-chamber comprising connected portions B B^3, and having an induction-port for explosive communicating with the explosion-chamber, and a port connecting the explosion-chamber and the portion B of the vacuum-chamber; of a reciprocatory piston movable in the explosion and vacuum chambers and arranged to simultaneously uncover the induction-port and the receiving end of the port between the explosion and vacuum chambers, whereby the withdrawal of the products of combustion from the explosion-chamber is utilized to draw a charge of explosive into said chamber, substantially as specified.

6. In an explosive-engine, the combination with a piston-cylinder containing an explosion-chamber and a vacuum-chamber and having a manually-operated valve connected with the vacuum-chamber and also having an induction-port for explosive communicating with the explosion-chamber, and a port connecting the explosion-chamber and the vacuum-chamber; of a reciprocatory piston movable in the explosion and vacuum chambers and arranged to simultaneously uncover the induction-port and the receiving end of the port between the explosion and vacuum chambers, whereby the withdrawal of the products of combustion from the explosion-chamber is utilized to draw a charge of explosive into said chamber, substantially as specified.

7. In an explosive-engine, the combination with a piston-cylinder having an induction-port and a vacuum-port arranged in the same plane and opposite each other, and also having an exhaust-port arranged in a plane between the induction and vacuum ports and the outer end of the cylinder; of a piston provided with packing *k;* said piston being arranged, in its innermost position, to establish communication between the induction and vacuum ports while the packing *k* closes the exhaust-port, substantially as specified.

8. In an explosive-engine, the combination with a piston-cylinder having an induction-port and a vacuum-port arranged in the same plane and opposite each other, and also having an exhaust-port arranged in a plane between the induction and vacuum ports and the outer end of the cylinder; of a piston containing induction, vacuum and exhaust ports arranged in the same plane, substantially as specified.

9. In an explosive-engine, the combination with a piston-cylinder having an induction-port and a vacuum-port arranged in the same plane and opposite each other, and also having an exhaust-port arranged in a plane between the induction and vacuum ports and the outer end of the cylinder; of a piston having a projection at its outer end containing induction, vacuum and exhaust ports, and provided with packing *k*, substantially as specified.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

CHARLES R. DAELLENBACH.

Witnesses:

JOHN F. HAINES,

H. N. MARSHALL.