(No Model.) 2 Sheets—Sheet 1.

W. F. TROTTER.

OIL OR GAS ENGINE.

No. 603,297. Patented May 3, 1898.

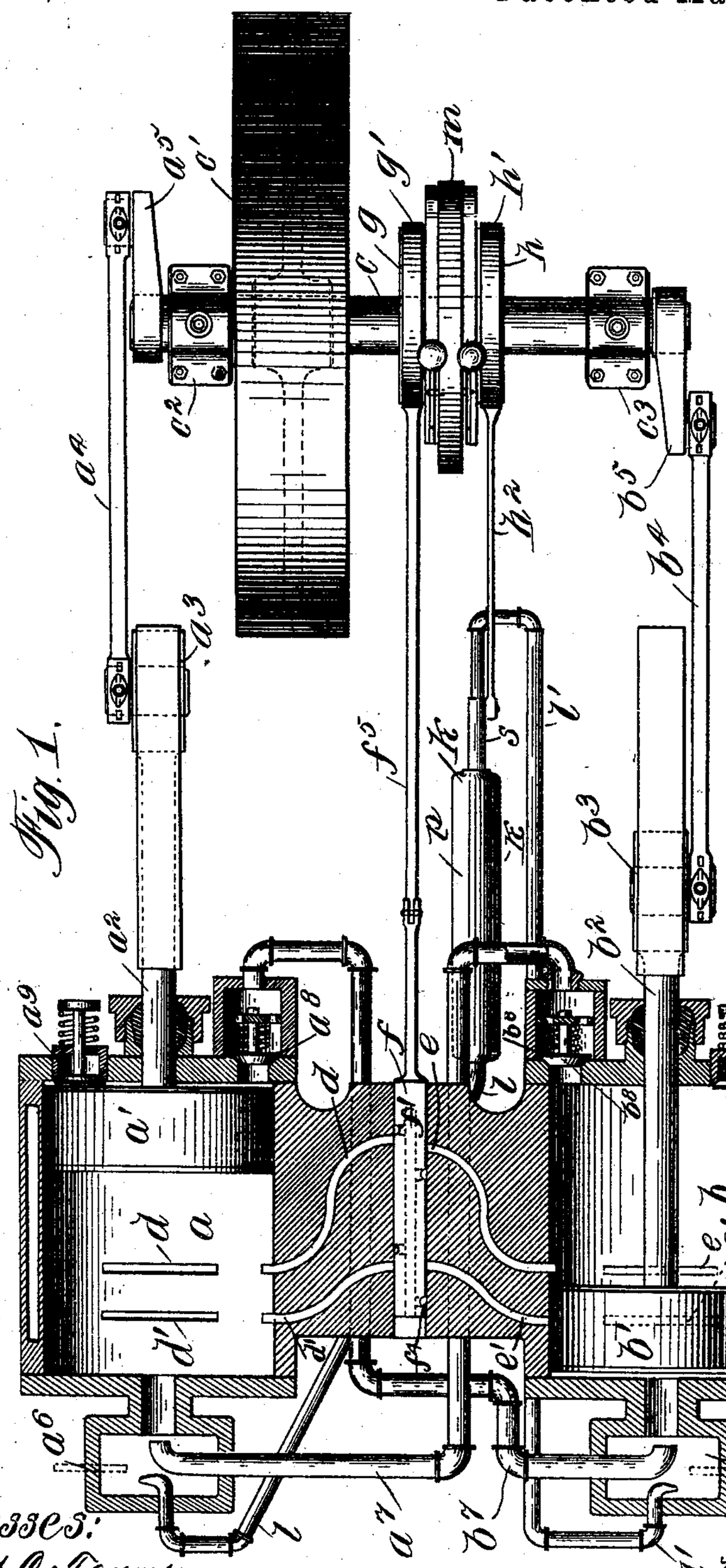

Fig. 1.

Witnesses:
Dr Fitt C. Tanney
W. Clyde Jones.

Inventor:
Walter F. Trotter,
By Barton & Brown
Attorneys

(No Model.)

2 Sheets—Sheet 2.

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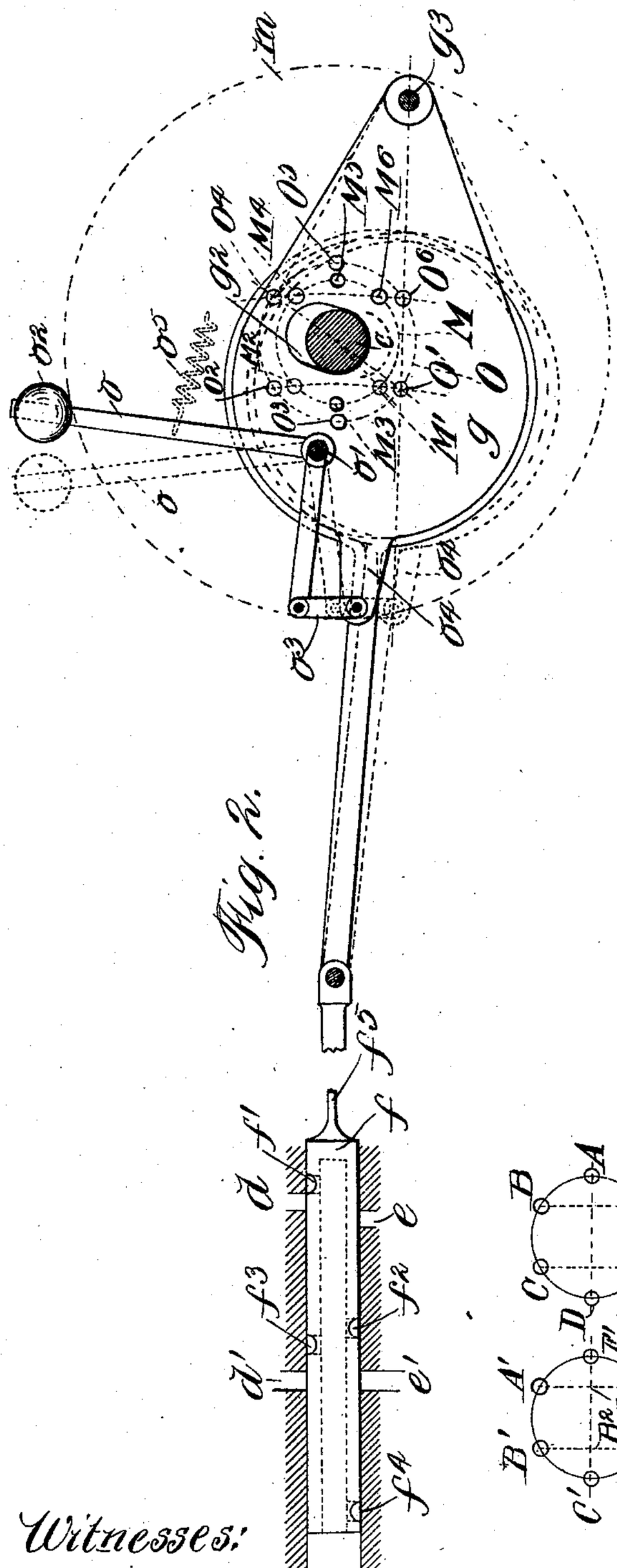

Fig. 2.

Fig. 4.

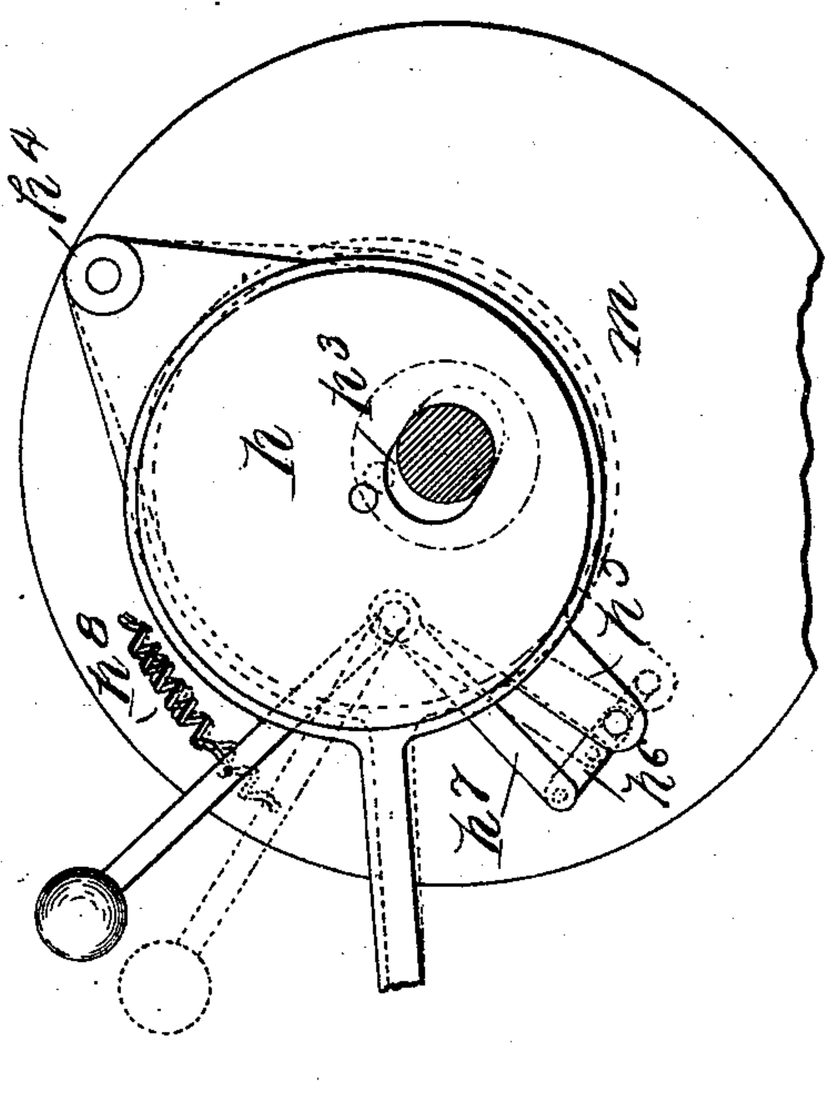

Fig. 1.

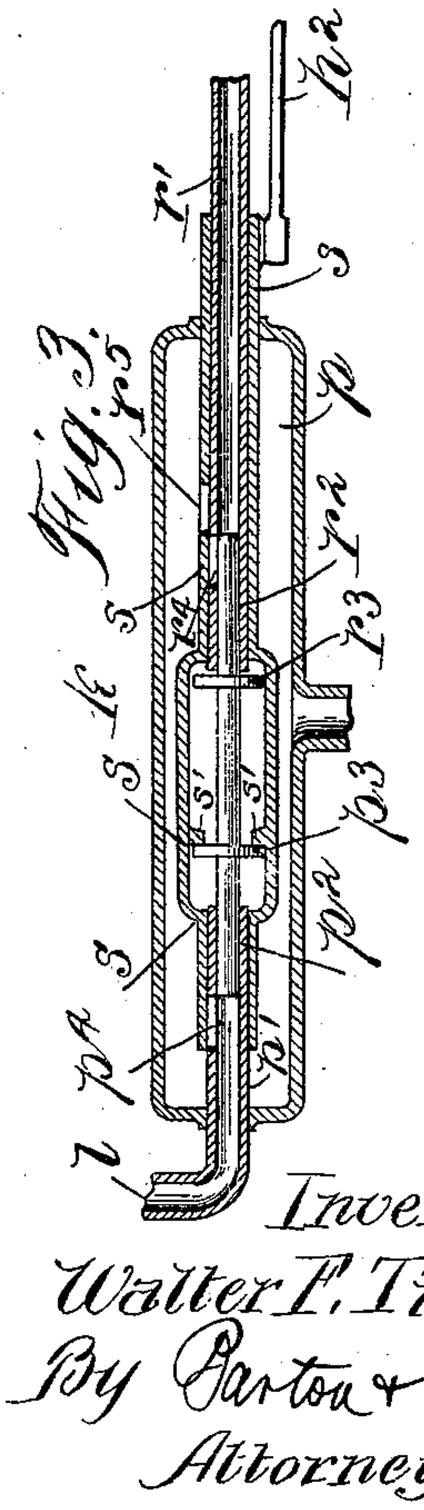

Fig. 3.

Witnesses:
Dr Witt C. Tanner
W. Clyde Jones.

Inventor:
Walter F. Trotter,
By Parton & Brown
Attorneys.

UNITED STATES PATENT OFFICE.

WALTER F. TROTTER, OF MARSHALLTOWN, IOWA.

OIL OR GAS ENGINE.

SPECIFICATION forming part of Letters Patent No. 603,297, dated May 3, 1898.

Application filed September 13, 1895. Serial No. 562,422. (No model.)

To all whom it may concern:

Be it known that I, WALTER F. TROTTER, a citizen of the United States, residing at Marshalltown, in the county of Marshall and State of Iowa, have invented a certain new and useful Improvement in Oil or Gas Engines, (Case No. 1,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to an oil or gas engine, and more particularly to an engine of that class in which the explosion is caused by a compression of the explosive gas or vapor to a critical pressure—that is, a pressure at which explosion takes place. Some features of my invention, however, are applicable to gas-engines of that type in which the explosion is caused by ignition.

I will describe my invention more in particular by reference to the accompanying drawings, in which—

Figure 1 is a plan view, partially in section, showing a specific form of engine embodying my invention. Fig. 2 is a view illustrating the exhaust-valve, the eccentric for operating the same, and the governor for changing the throw of the eccentric. Fig. 3 is a view of the pump, the eccentric for operating the same, and the governor for changing the throw of the eccentric. Fig. 4 is a diagram illustrating the relation between the movement of the crank and the eccentric operating the pump.

Like letters refer to like parts in the several figures.

Two cylinders a b are provided, within which move pistons a' b', the piston-rods a^2 b^2 being connected with cross-heads a^3 b^3, while connecting-rods a^4 b^4 connect the cross-heads with the cranks a^5 b^5, respectively, the cranks being set at one hundred and eighty degrees apart. Upon the main shaft c of the engine is provided the usual fly-wheel c', the shaft being journaled in bearings c^2 c^3. Upon the ends of the cylinders a and b are provided the mixing-chambers a^6 b^6, respectively, the mixing-chambers communicating with the cylinders. The mixing-chamber a^6 is connected by a pipe a^7 with the end of cylinder b, a valve b^8 being provided which permits flow from the cylinder b to the pipe a^7 while checking a backward flow. Likewise the mixing-chamber b^6 is connected by pipe b^7 with the cylinder a, a check-valve a^8 being provided which permits flow from the cylinder a to the pipe b^7 while checking the flow in the opposite direction. Inlet-valves a^9 b^9 are provided in connection with the cylinders a and b, respectively, for permitting the entrance of air when the pistons are moving toward the left. Exhaust-ports d d' are provided in connection with the cylinder a, and likewise exhaust-ports e e' are provided in connection with the cylinder b, a valve f being provided for opening and closing the exhaust-ports. The valve is connected with a connecting-rod f^5, which is mounted at its end upon the strap g' of the eccentric g, the eccentric g being mounted upon the shaft c and adapted to reciprocate the valve f. Upon the shaft c is also provided an eccentric h, the strap h' of which is connected with connecting-rod h^2, which operates the movable element of the pump k. One end of the pump k is connected by means of a pipe l with the mixing-chamber a^6, while the opposite end is connected by pipe l' with the mixing-chamber b^6. As the movable element of the pump k is moved in opposite directions by the eccentric h, oil is forced first into one of the mixing-chambers and then into the other.

With the parts in the position illustrated in Fig. 1 an explosion takes place within the mixing-chamber b^6, thus driving the piston b' forward. This movement moves the piston a' backward and expels, through the exhaust-port d, the gases which were exploded upon the previous forward stroke of the piston a', the valve f moving to the left and bringing the port f' opposite the port d to thus permit the escape of the gases. The air within the cylinder b and in front of the piston b' is forced through the valve b^8 and pipe a^7 into the cylinder, thus assisting the piston in expelling the exploded gases. At a definite point in the backward stroke of the piston a' the exhaust-port d is closed, and further movement of the piston a' serves to compress the explosive product within the mixing-chamber, and when the piston has reached the end of its stroke the critical pressure is such that explosion takes place (or the igniter is actuated) and the piston a' moves forward on its work-

ing stroke, thus moving the piston b' backward and drawing air into the cylinder b through the valve b^9. Air is forced from the cylinder a, through the valve a^8 and pipe b^7, into the cylinder b, and oil-vapor is at the same time forced into the mixing-chamber by pump k, and when the piston b' reaches the forward end of its stroke an explosion takes place.

The movement of the exhaust-valve is best illustrated in Fig. 2. The eccentric g carries a slot g^2 whereby the throw of the eccentric may be increased, the eccentric being pivoted at g^3 to the disk m, mounted upon the shaft c. Upon the disk m is also pivoted at o' a bell-crank o, carrying upon its end a ball o^2, the opposite end of the bell-crank being connected by a link o^3 to the arm o^4, which is mounted upon the eccentric g. When the load on the engine decreases and the speed increases, the ball o^2 is thrown outward toward the position indicated by dotted lines against the tension of the spring o^5, thus rocking the eccentric g upon its pivot g^3 and increasing the throw of the eccentric. In the normal position of the eccentric the travel of the center of the eccentric is indicated by the dotted line M, the exhaust-valve beginning to open the port at the point M′ and to close at the point M^2—that is, when the center of the eccentric is at the point M′ the port f' is just beginning to open the port d, and when the center of the eccentric reaches the point M^3 the port d is completely opened. When the center of the eccentric reaches the point M^2, the port d is closed again. While the center of the eccentric is traveling from the point M^2 to the point M^4 both ports d and e are closed, but at the point M^4 the port f^2 begins to open the port e, and at the point M^5 the port e is completely opened. The valve f then begins its backward travel and at the point M^6 the port e is closed, both ports remaining closed until the center of the eccentric reaches the point M′ again. During the travel of the valve f under these conditions the ports d' and e' are never opened, but when the load of the engine is decreased and the governor-ball g^2 moves, for instance, into the position indicated in dotted lines the throw of the eccentric is increased, the center of the eccentric now moving in the circle O. The port f' begins to open the port d at the point O′, and as the valve continues to move the port d is first completely opened, after which the port f^3 begins to open the port d', and at the point O^3 the port d' is completely opened. The ports d' and d are then successively closed, and at the point O^2 the port d is completely closed. At the point O^4 the port f^2 begins to open the port e, the port e being completely opened, after which the port f^4 opens the port e', the port e' being completely opened at the point O^5. The ports e' and e are then successively closed, and at the point O^6 the port e is again closed.

In Fig. 3 is illustrated the pump which I preferably employ, the pump comprising a chamber p, communicating with the oil-reservoir. Into one end of the chamber extends the pump-barrel p', communicating with mixing-chamber a^6. Into the other end of the chamber extends the pump-barrel r', communicating with the mixing-chamber b^6. In the pump-barrel p' moves the plunger p^2, while in the pump-barrel r' moves the plunger r^2, the plungers p^2 and r^2 being formed from a rod which carries at intermediate positions the disks p^3 and r^3. Sliding longitudinally upon the exterior of the barrels p' and r' is a sleeve s, connected with the connecting-rod h^2. In the barrel p' is provided a port p^4, while in the barrel r' is provided the port r^4 for the admission of the oil, the end of the sleeve s serving in its movement to open and close the port p^4, while a port r^5 is provided in the opposite end of the sleeve for opening the port r^4. Upon the interior of the sleeve s are provided projections s' s', which in their movement engage the disks p^3 and r^3 to move the plungers longitudinally. As the sleeve s moves to the left the port p^4 is closed, after which the projections s' s' engage the disk p^3 and move the plunger p^2 to the left, thus forcing the oil from the barrel p^7 into the mixing-chamber connected therewith. As the sleeve s moves in the opposite direction the plungers remain at rest for a period until the projections s' engage the disk r^3, when the plunger r^2 is moved within its barrel to force oil into the mixing-chamber connected therewith, the sleeve s having closed the port r^4 before beginning to move the plunger r^2. The eccentric h is provided with a slot h^3 whereby the eccentric may be moved to decrease the throw, the eccentric being pivoted at h^4 and carrying an arm h^5, connected by a link h^6 with the end of the bell-crank h^7, which is pivoted to the disk m, a spring h^8 being provided for opposing the movement of the bell-crank. When the speed increases, the bell-crank is moved toward the dotted position to decrease the throw of the eccentric, and thus to decrease the quantity of oil pumped into the mixing-chambers.

I preferably connect the pump so that it begins to pump oil when the piston has moved through one-fourth of its travel and ceases pumping when the piston is one-fourth of the distance from the end of its travel. Referring to Fig. 4, the circle upon the right indicates the path of the crank-pin, and while the crank-pin is traveling between the points B and C and the points E and F the pumps are in operation. The travel of the center of the eccentric is indicated by the circle upon the left, and while the crank is traveling from A to B the center of the eccentric travels from A′ to B′. While the crank travels from B to C the eccentric center travels from B′ to C′ and moves the pump-plunger to pump oil. While the crank is traveling from C to D and from D to E the eccentric travels from C′ to E′, and during this time no oil is being pumped.

While the crank is traveling from E to F the eccentric travels from E′ to F′, and thus pumps oil, and during the travel from F to A the eccentric center travels from F′ to A′ and no oil is pumped. The stroke of the plunger p^2 of the pump should correspond to the distance C′ B² of Fig. 4, while the distance through which the projections s' s' move without engaging the disks p^3 and r^3 should correspond to the distance C′ E² of Fig. 4.

Instead of depending upon compression for causing explosion an igniter may be placed in each of the mixing-chambers, as indicated in dotted lines.

The present application is to be considered subsidiary to the claims of Letters Patent No. 575,661, granted to me January 19, 1897.

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

1. In a gas or oil engine, the combination with two cylinders of a mixing or explosion chamber for each cylinder communicating with one end thereof by a constricted passage, an inlet-valve at the opposite or air-feeding end of each cylinder, a pipe or duct extending from the air-feeding end of each cylinder to the other cylinder and opening into the cylinder at the end which communicates with the mixing-chamber, means for maintaining said ducts open during the return stroke of the piston in the cylinder to which the air is fed, and closed during the forward stroke, a fuel-inlet for each of said mixing-chambers for supplying fuel directly thereto, an exhaust-port in each of said cylinders situated at an intermediate portion of the cylinder whereby the admitted air and the returning piston coact in ejecting the exploded gases from the cylinder, and means for closing the exhaust-port at a predetermined point in the return stroke, whereby air is drawn into the air-feeding end of each cylinder on the return stroke and on the forward stroke the air assists the working piston of the other cylinder in driving out the burned gases during part of the stroke and during the remainder of the stroke the pistons of both cylinders act in forcing fresh air into the combustion-chamber of the cylinder whose piston is next to make a working stroke, substantially as described.

2. In a gas or vapor engine, the combination with a cylinder, of two exhaust-ports leading therefrom, and means for opening one or both of said exhaust-ports according as the load on the engine is great or small; substantially as described.

3. The combination with two cylinders, each provided at one end with a mixing-chamber communicating with the opposite end of the other cylinder, each of said cylinders being provided with two exhaust-ports, of means for opening one or both of said exhaust-ports according as the load on the engine is great or small; substantially as described.

4. In a gas or oil engine, the combination with two cylinders of two pumps, one provided in connection with each of said cylinders for feeding oil or other fuel thereto, the plungers of said pumps being arranged to alternately perform their working strokes, an eccentric for operating both of said pumps and a governor for varying the throw of said eccentric, substantially as described.

5. In a gas or vapor engine, the combination with a cylinder, of a pump for feeding the fuel thereto, an eccentric for operating said pump, said eccentric being mounted upon a pivoted or swinging arm and a governor for rocking said pivoted arm upon its pivot to vary the throw of the eccentric and thereby the stroke of the pump; substantially as described.

In witness whereof I hereunto subscribe my name this 7th day of September, A. D. 1895.

WALTER F. TROTTER.

Witnesses:

W. CLYDE JONES,

JOHN W. SINCLAIR.