No. 667,590. Patented Feb. 5, 1901.

W. E. SIMPSON.

GAS OR OTHER HYDROCARBON ENGINE.

(Application filed Mar. 20, 1897.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 3.

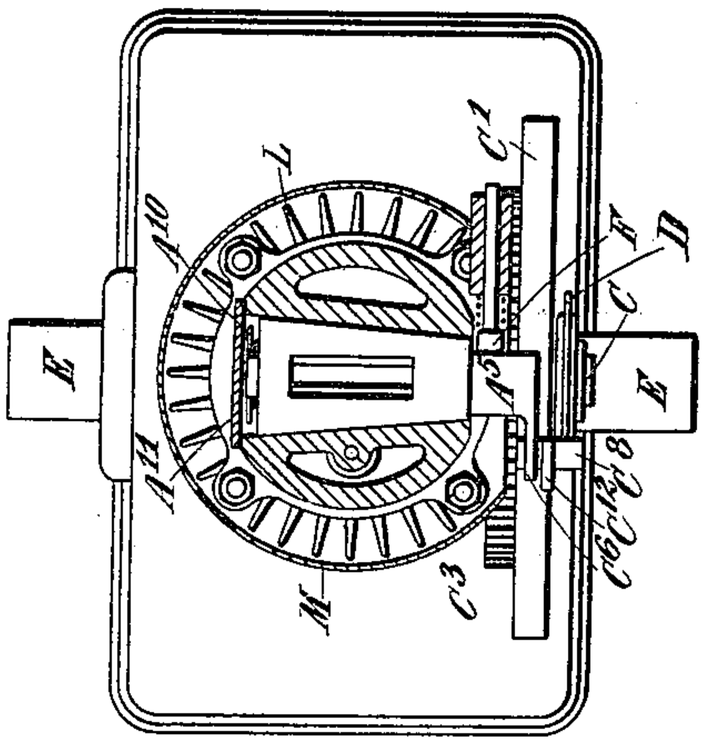


Fig. 5.

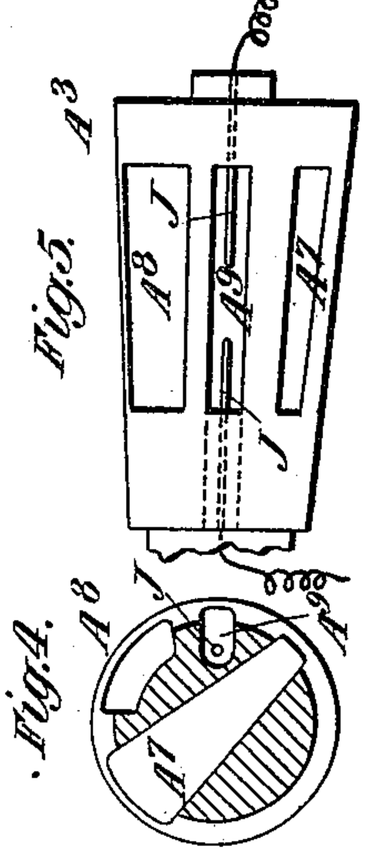


Fig. 6.

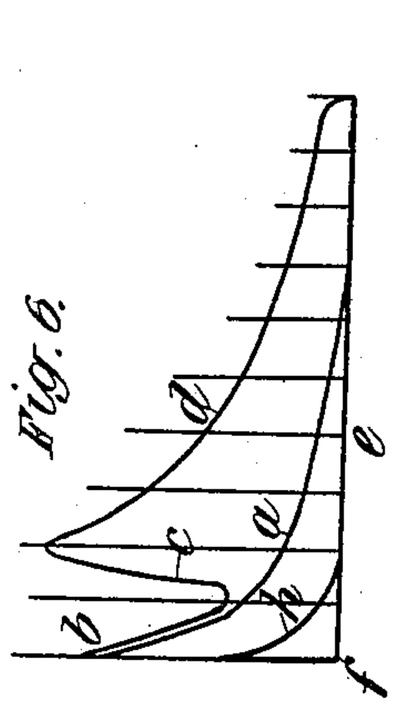


Fig. 2.

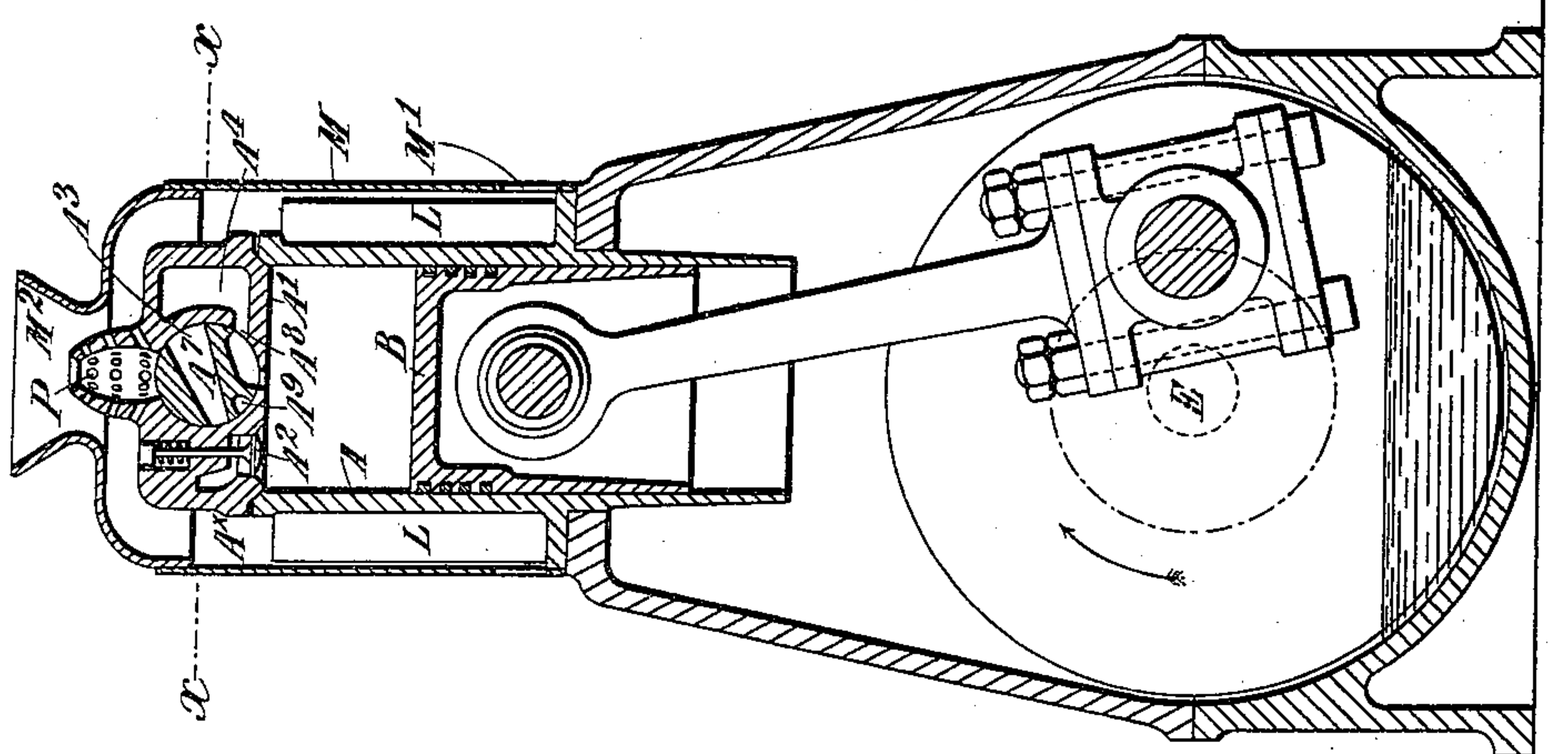
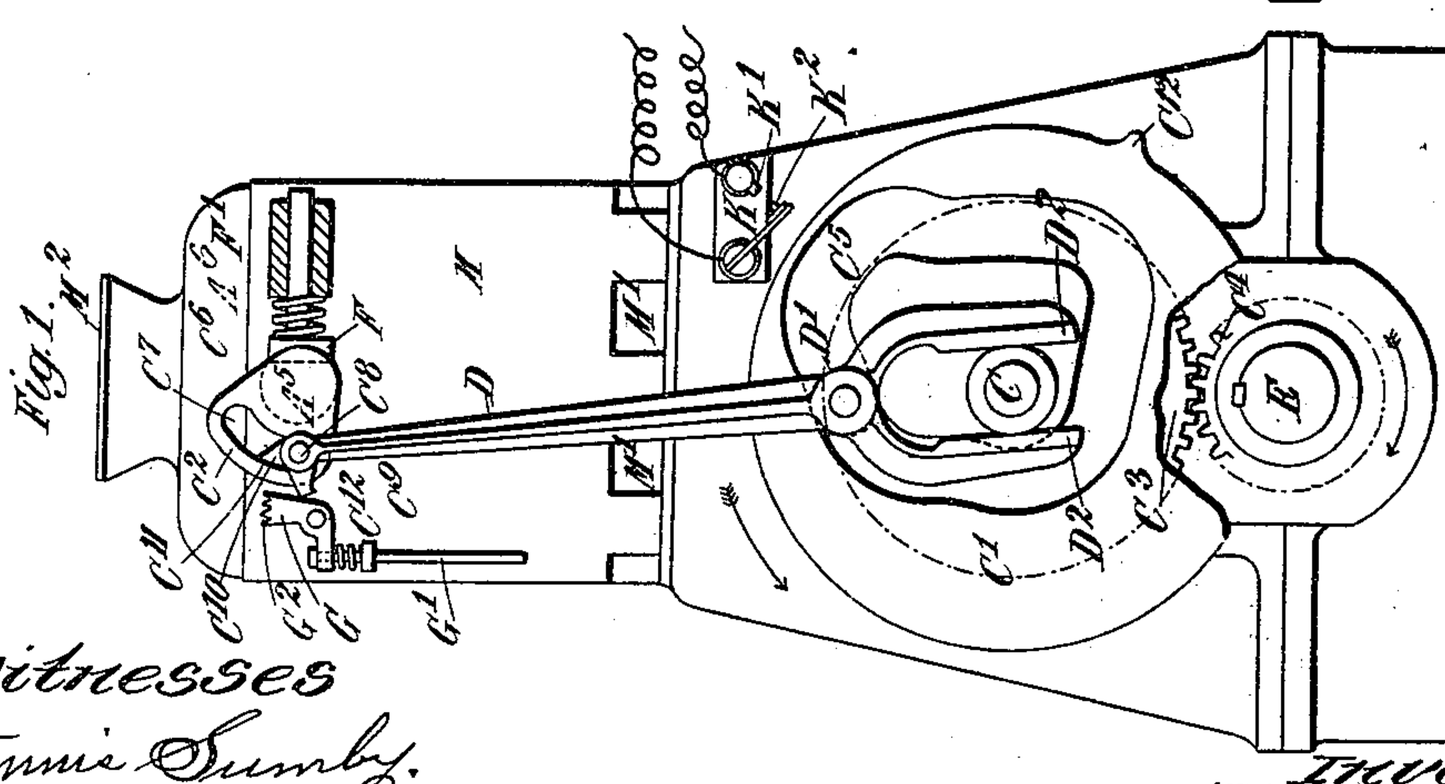


Fig. 1.



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No. 667,590. Patented Feb. 5, 1901.

W. E. SIMPSON.

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Fig. 8.

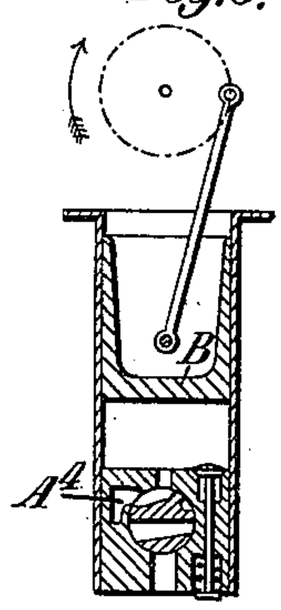


Fig. 7.

Fig. 10.

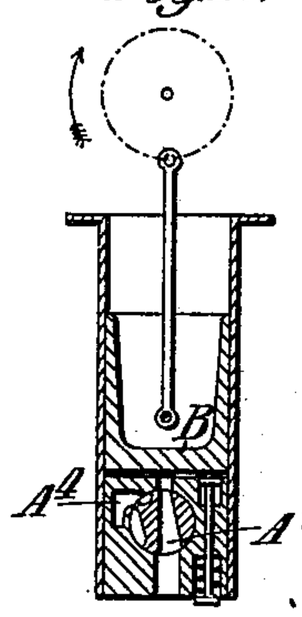
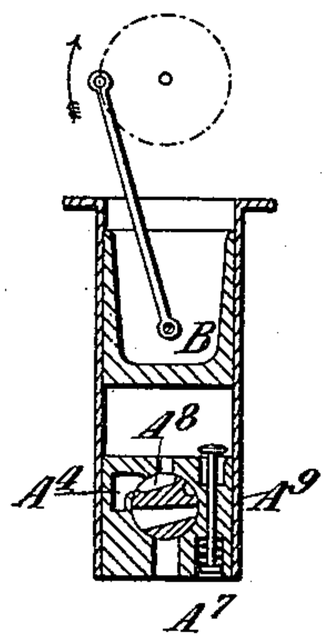
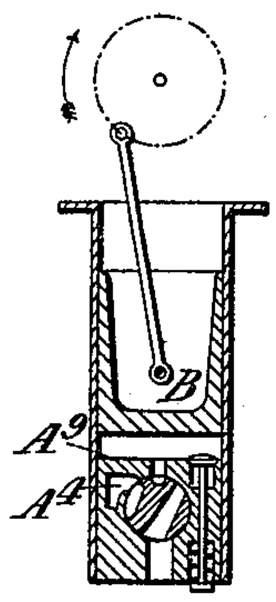


Fig. 9.





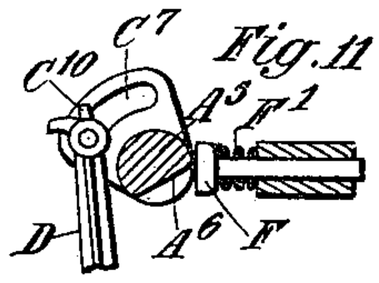


Fig. 11.

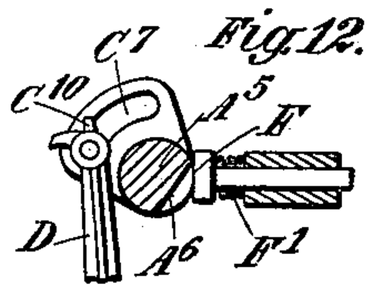


Fig. 12.

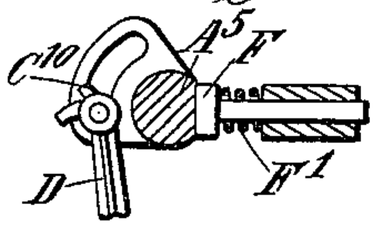


Fig. 13.

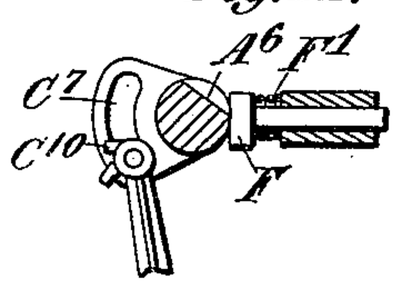


Fig. 14.

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Atty.

UNITED STATES PATENT OFFICE.

WILLIAM EDMUND SIMPSON, OF NOTTINGHAM, ENGLAND.

GAS OR OTHER HYDROCARBON ENGINE.

SPECIFICATION forming part of Letters Patent No. 667,590, dated February 5, 1901.

Application filed March 20, 1897. Serial No. 628,517. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM EDMUND SIMPSON, engineer, a subject of the Queen of Great Britain, residing at Albert Works, Mansfield, Nottingham, England, have invented certain new and useful Improvements in Gas or other Hydrocarbon Engines, of which the following is a specification, reference being had to the accompanying drawings.

This invention relates chiefly to gas and other hydrocarbon engines working upon the "Otto" or "Beau de Roches" cycle, and comprises improvements whereby the products of combustion can be more completely discharged during the exhaust-stroke, the speed more efficiently and economically controlled, the cooling of the cylinder effected by means of an air-current induced by the exhaust-gases instead of a water-jacket, as in engines of ordinary construction, and the engine restarted after stoppages.

In order that the said invention may be fully understood and readily carried into effect, I will proceed to describe the same by aid of the accompanying drawings, wherein—

Figure 1 is a side elevation of one construction of vertical gas-engine embodying my improvements. Fig. 2 is a vertical central section of the said engine, certain of the parts being left in elevation. Fig. 3 is a horizontal section on the line *x x* of Fig. 2. Figs. 4 and 5 are respectively a transverse section and an elevation to a larger scale, showing a specially-constructed exhaust-valve, hereinafter referred to. Fig. 6 is an indicator-diagram, illustrating the variations of pressure during different strokes or stages in the cycle. Figs. 7, 8, 9, and 10 show diagrammatically the relative positions of the piston and the aforesaid valve at certain periods. Figs. 11, 12, 13, and 14 show the positions of the valve-gear corresponding, respectively, to the positions of the parts shown in Figs. 7, 8, 9, and 10.

Similar letters indicate corresponding parts in all the drawings.

A is the cylinder of the engine, and B is the piston thereof, the usual compression or cartridge space at the end of the cylinder being dispensed with and the clearance between the piston and the cylinder-cover A being sufficient only for safe working.

A^2 is a gas and air valve, which is arranged at the upper end of the cylinder in communication with an inlet-passage $A^\times$ for a mixture of air and gas and is acted upon by a spring, which permits it to open in the suction or charging stroke of the piston. A^3 is the specially-constructed exhaust-valve above referred to, which serves also as a distributing-valve. This valve is of taper or plug form. It is worked by a cam C′ upon the usual cam-shaft C of the engine and is controlled by means of trip-gear hereinafter described and by a valve-rod D, carrying a roller D′, engaging in a groove C^5 of the cam C′. A^4 is a compression-chamber which receives the compressed charge from the cylinder. This chamber is separated from the cylinder itself by the valve A^3. The valve-rod D has a forked extremity provided with a pair of guides D^2, one on each side of the shaft C. E is the crank-shaft from which the cam-shaft C is driven at half the speed of the said crank-shaft by the spur-wheel C^3 and pinion C^4.

The means for operating the valve A^3 consists of a trip-gear C^2, comprising a plate or sector C^6, secured to a neck A^5 at the end of the valve and having a slot C^7, in which works a stud C^8 on the valve-rod. The stud C^8 is capable of sliding in the slot C^7, but is normally kept at the bottom C^9 of said slot by means of a trip or trigger C^{10} engaging in a notch C^{11} in the said plate.

The neck A^5 of the valve is formed at one side with a flat surface A^6, against which a presser F is normally forced by a spring F′, and tends to maintain the plug in the position shown in Figs. 1 and 13.

The trip or trigger C^{10} is provided with an arm C^{12}, adapted to come in contact with the governor-lever G and throw the said trip or trigger out of engagement with the notch C^{11} when the said valve A^3 is being closed by the downward movement of the rod D under the action of the cam C′, and the trip or trigger being thus disengaged from the rod the valve A^3 is closed by the pressure of the spring-presser F earlier than it would be by the action of the said cam C′. Thus by connecting the governor-lever G by the rod G′ with any ordinary form of governor (not shown) the said governor-lever G is moved over by increased speed of the engine, so as to bring

one or other of a set of steps G^2 on the end of the said governor-lever in the path of the trip or trigger, and thus effect a more or less early cut off of the compressed mixture flowing into the cylinder from the chamber A^4.

A^7 is the exhaust port or passage of the valve A^3, and A^8 is another port or passage therein through which communication between the chamber A^4 and the cylinder takes place.

A^{10} is a spring which is compressed between the valve and a plate A^{11} and serves to keep the former on its seat.

The action of the engine is as follows: The exhaust-port A^7 being closed and the compression-space A^4 open to the cylinder by the port A^8, the piston B moves outward, drawing in a charge of gas and air at or near atmospheric pressure through the valve A^2, as shown in Fig. 7, (the trip-gear being in the position shown in Fig. 11.) The piston then moves inward, compressing the said charge into the compression-space A^4 (see Figs. 8 and 12) to a pressure higher than that which is usually obtained in gas-engines prior to the explosion occurring. The line *a*, Fig. 6, shows the progress of the compression. The piston again moves outward and (the compression-space being still open to the cylinder) the charge expands again into the cylinder (see line *b*, Fig. 6) until the pressure has fallen approximately to that to which compression is usually carried. The chamber A^4 is then cut off from the cylinder (see Figs. 9 and 13) and that portion of the charge which has reentered the cylinder is ignited by an electric igniter in a recess A^9 of the valve, and the expansion of the burning gases completes the outstroke. The lines *c* and *d*, Fig. 6, show the variations in pressure during the working stroke. The exhaust-port A^7 being then opened, the piston, moving inward, discharges the burned gases. (See Figs. 10 and 14, also line *e*, Fig. 6.) The exhaust-port is next closed and the compression-space is opened to the cylinder, and as the piston moves outward the portion of the explosive mixture which was retained in the compression-space expands again (see line *f*, Fig. 6) to atmospheric pressure, after which the piston, continuing its outward stroke, as in Fig. 7, draws in a fresh quantity of gas and air approximately equal to that which was consumed during the previous explosion or working stroke, and the cycle of operations is continued. Thus the exhaust-products are almost entirely expelled from the cylinder during the exhaust-stroke and variable impulse given, as required for different loads. The time at which the ignition takes place may be varied for mixtures of different proportions of gas and air.

The electric igniter shown in the drawings consists of platinum or other points J, connected to a battery or induction coil (not shown) and to a circuit-closing device comprising a fixed contact K and a movable contact A′ carried by a spring. The ignition is timed by means of a projection $C^{12\times}$ upon the cam C′, which presses the contact K′ against the contact K and completes the circuit so as to pass a spark between the point J and ignite the mixture in the cylinder.

In order to obtain an initial impulse for restarting the engine, means may be provided whereby when the engine is being stopped the passage A^8 in the valve is closed at the end of the compression-stroke, so as to retain the whole of the charge in the compression-space, and in some cases in order to better retain the said charge for a lengthened period an additional valve, preferably of the screw-down type, as shown at H, may be provided at the entrance to the compression-space A^4. When the engine is to be restarted, there is therefore no need for effecting the compression by external aid, and the mere pressure of the gases is sufficient to start the piston into motion.

Instead of the usual water-jacket the cylinder A is provided with gills or ribs L and surrounded by a casing M of sheet metal or other suitable material. The said casing is provided at its lower end with air-inlets M′ and at the top with an orifice M^2, through the center of which projects a jet or nozzle P, serving for the discharge of the exhaust-gases. The orifice M^2 and the jet or nozzle P are so shaped that the said gases issuing from the jet induce a current of air which enters through the inlets M′, passes over the gills or ribs L, and out through the orifice M^2, thus cooling the cylinder.

Although the invention is described above as applied to a gas-engine, it may obviously be adapted to petroleum or other liquid-hydrocarbon engines.

What I claim is—

1. In a gas or other hydrocarbon engine, the combination of a cylinder, a piston, a separate compression-chamber for the explosive fluid and means to permit of withdrawing a portion of the explosive fluid from said chamber at a reduced pressure to form the explosive charge and for allowing the remainder of said fluid to expand completely during the next charging-stroke of the piston, substantially as described.

2. In a gas or other hydrocarbon engine, the combination of a cylinder, a piston, a separate compression-chamber into which the explosive fluid is compressed more highly than at the moment of ignition, and means to permit of using a portion of said fluid for the next explosion, and for allowing complete expansion of the remainder upon the next charging-stroke of the piston, substantially as described.

3. In a gas or other hydrocarbon engine, the combination of a working cylinder, a compression-chamber in communication with said cylinder, a rotary valve controlling said cylinder, a slotted plate or sector secured to said valve, a valve-rod actuated by an eccentric,

a trip or trigger carried by said rod and engaging said sector, a projecting arm on said trip or trigger, and a governor-lever adapted to be brought into the path of said arm when the speed increases, so as to alter the point at which the valve cuts off the communication between the chamber and cylinder, substantially as described.

4. In a gas or other hydrocarbon engine, the combination of a rotary distributing-valve, a cam driven from an engine-shaft, a rod for working said valve and operated by said cam, a slotted plate or sector mounted on the end of the valve, a trip or trigger connecting said rod and sector, a governor-lever provided with steps for operating said trip or trigger at different times, and a presser acting on the valve-stem and tending to keep said valve in position for igniting the charge, substantially as described.

5. In a gas or other hydrocarbon engine, the combination of a working cylinder, a separate compression-chamber, a rocking or oscillating distributing-valve situated between said cylinder and chamber, means for operating said valve, a recess or cavity in said valve and an electric igniter situated in said recess, substantially as described.

6. In a gas or other hydrocarbon engine, the combination of a working cylinder, a compression-chamber connected with said cylinder, a plug-valve controlling the communication-passage between said chamber and cylinder, an exhaust port or passage in said valve, a communication-passage therein serving to connect the cylinder and the compression-chamber, and a recess in said valve containing an electric igniter, substantially as described.

In testimony whereof I have hereunto set my hand this 15th day of February, 1897.

WILLIAM EDMUND SIMPSON.

Witnesses:
ALBERT WILLIAM PERKINS,
FREDERICK WILLIAM SLACK.