(No Model.) 4 Sheets—Sheet 1.

J. W. EISENHUTH.

GAS ENGINE.

No. 558,369. Patented Apr. 14, 1896.

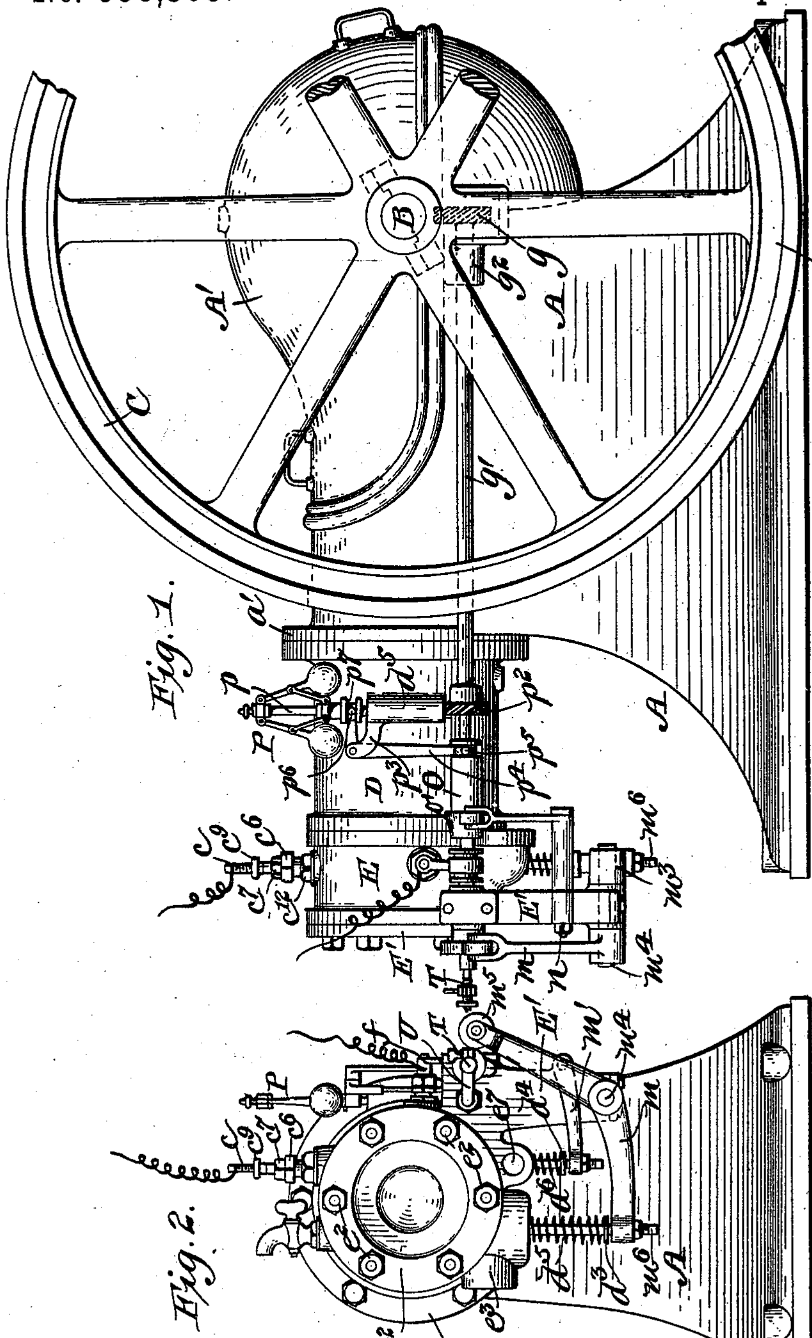


Fig. 1.

Fig. 2.

WITNESSES

INVENTOR

John W. Eisenhuth
by his Attys

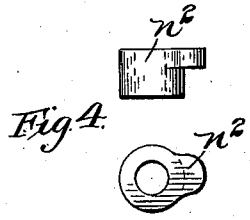
ANDREW B. GRAHAM, PHOTO-LITHO. WASHINGTON, D.C.

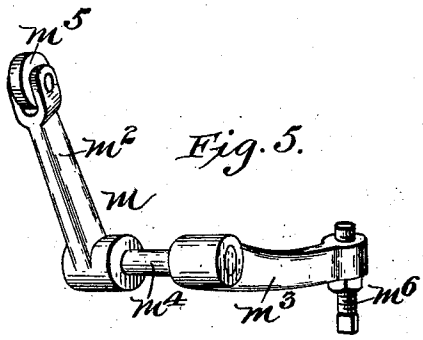
(No Model.) 4 Sheets—Sheet 2.

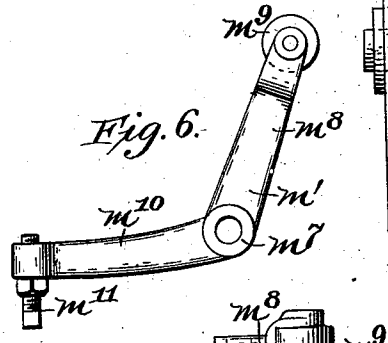
J. W. EISENHUTH.

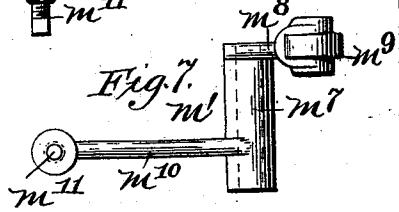
GAS ENGINE.

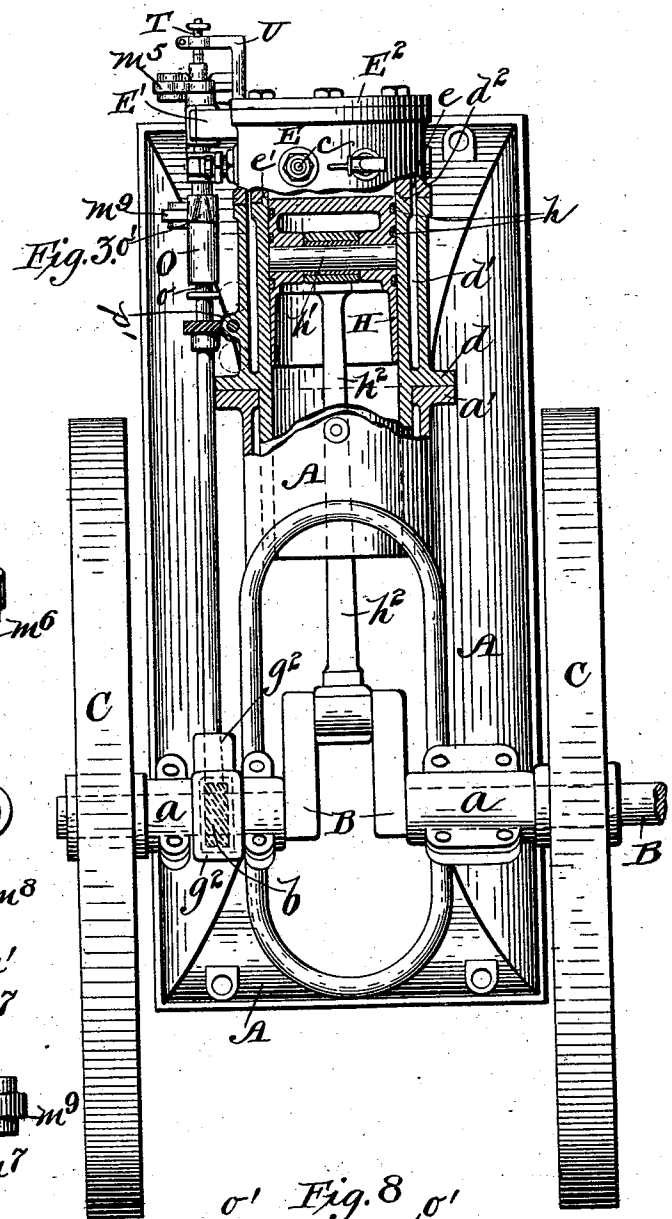
No. 558,369. Patented Apr. 14, 1896.











WITNESSES

Severance
R. H. Ermann

INVENTOR

John W. Eisenhuth
by his Attys
Mason Fenwick & Lawrence

(No Model.)

4 Sheets—Sheet 3.

J. W. EISENHUTH.

GAS ENGINE.

No. 558,369. Patented Apr. 14, 1896.

Fig. 10.

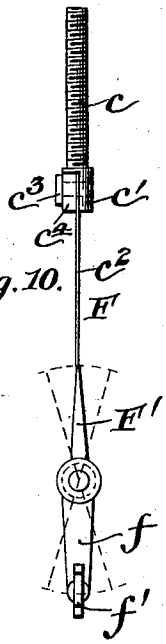


Fig. 9.

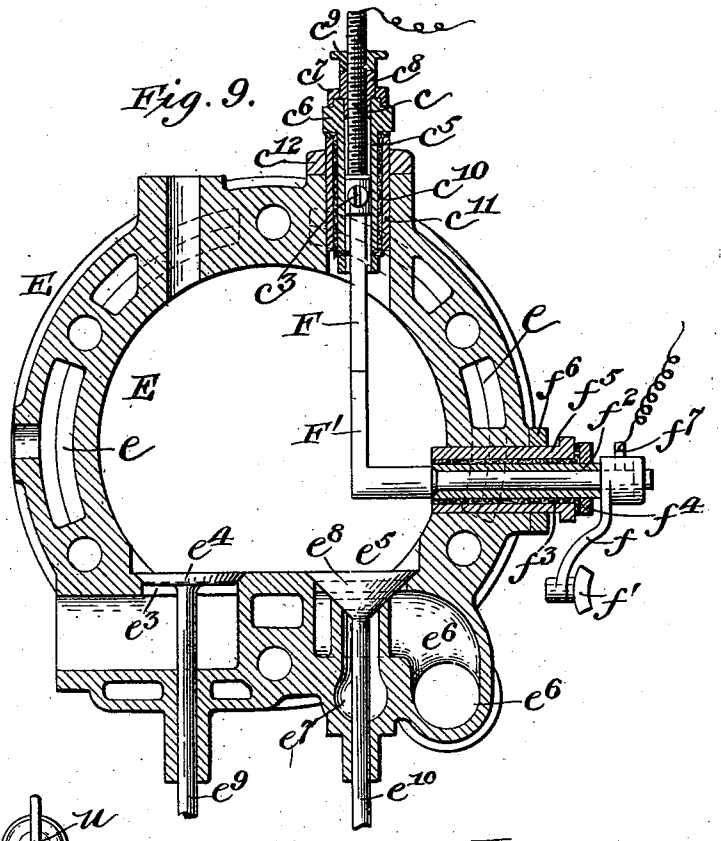


Fig. 12.

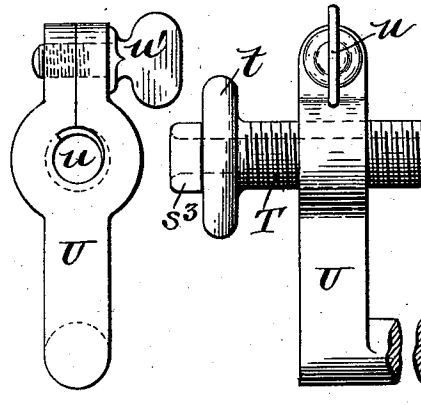


Fig. 11.

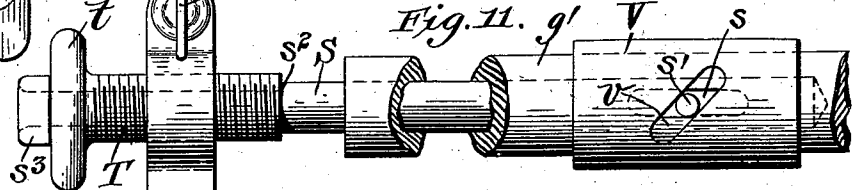


Fig. 13.

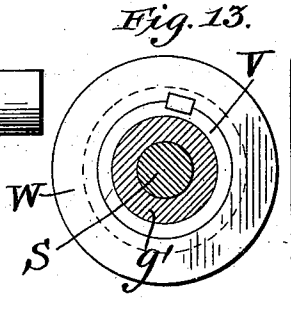
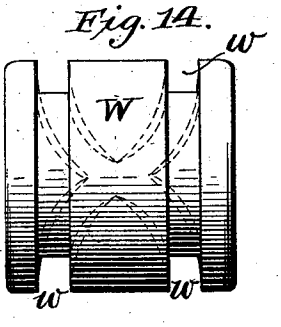


Fig. 14.



WITNESSES

Severance
P. Herman

INVENTOR

John W. Eisenhuth
by his Attys
Wilkinson Fennick & Lawrence

(No Model.) 4 Sheets—Sheet 4.

J. W. EISENHUTH.

GAS ENGINE.

No. 558,369. Patented Apr. 14, 1896.

Fig. 15.

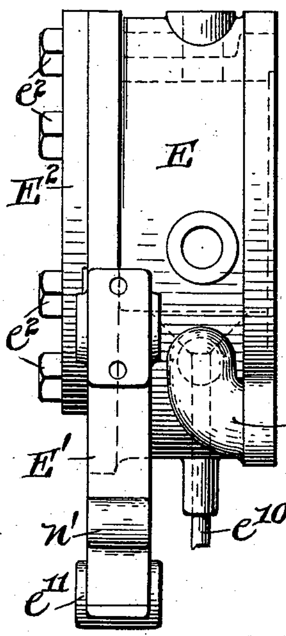


Fig. 16.

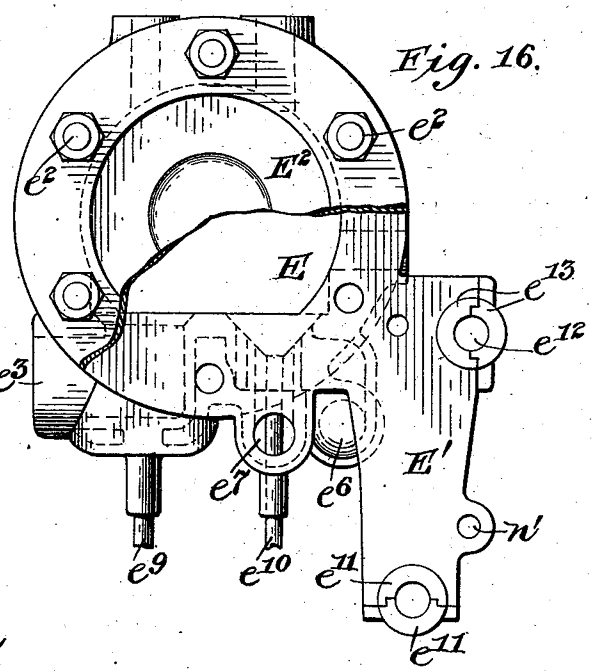


Fig. 17.

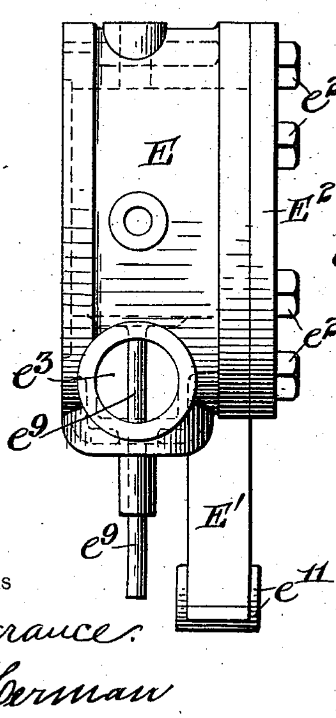
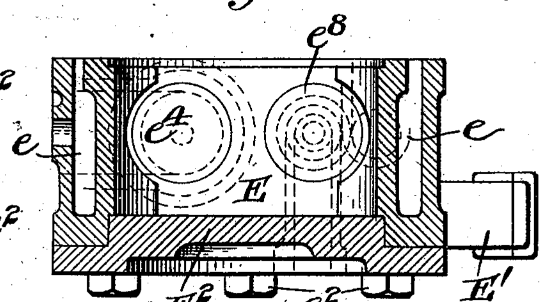


Fig. 18.



WITNESSES

C. Severance.

R. Herman

INVENTOR

John W. Eisenhuth

by his Atty

Wm. Frederick Lawrence

UNITED STATES PATENT OFFICE.

JOHN W. EISENHUTH, OF SAN FRANCISCO, CALIFORNIA.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 558,369, dated April 14, 1896.

Application filed March 30, 1895. Serial No. 543,830. (No model.)

To all whom it may concern:

Be it known that I, JOHN W. EISENHUTH, a citizen of the United States, residing at San Francisco, in the county of San Francisco and State of California, have invented certain new and useful Improvements in Gas-Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to explosive gas-engines, and has particular relation to engines in which the compressed gases are exploded by electrodes.

The invention consists of certain novel constructions, combinations, and arrangements of parts, all of which will be hereinafter more particularly set forth and claimed.

In the accompanying drawings, forming part of this specification, Figure 1 represents a side elevation of an engine embodying my invention. Fig. 2 represents an end elevation of the same. Fig. 3 represents a top plan view of said engine, partly in section. Fig. 4 represents a side elevation and top plan view of the cam for operating the lever of the exhaust-valve. Fig. 5 represents a detail perspective view of the lever for operating the exhaust-valve. Fig. 6 represents a side elevation of the lever for operating the inlet-valve. Fig. 7 represents a top plan view of the same. Fig. 8 represents side and end elevations of the movable cam for operating the said latter lever. Fig. 9 represents a central vertical transverse section through the compression-chamber. Fig. 10 represents a detail end elevation of the two electrodes. Fig. 11 represents a detail side elevation of the devices for adjusting the movement of the movable electrode. Fig. 12 represents a detail end elevation of the support for said device. Fig. 13 represents a detail vertical transverse section through the device shown in Fig. 11, the cross-grooved cam-switch being shown in end elevation. Fig. 14 represents a side elevation of the said cam-switch. Fig. 15 represents an enlarged detail side elevation of the compression-chamber. Fig. 16 represents an end elevation of the same partly broken away. Fig. 17 represents a side elevation of the same, taken on the opposite side from that shown in Fig. 15; and Fig. 18 represents a central horizontal section through the same.

A in the drawings represents the base of the engine; B, the crank-shaft; C, the fly-wheels mounted thereon; D, the operating-cylinder; E, the compression-chamber, and F and F′ the stationary and movable electrodes, respectively. The base is provided on opposite sides with bearing-boxes a, in which the crank-shaft is journaled. A gear-wheel b, having diagonal teeth, is mounted rigidly on said shaft near one end and engages a similar gear-wheel g, mounted on a horizontal shaft g'. A dust-proof casing g^2 surrounds said gearing and forms a bearing for the inner end of the shaft g'. The opposite end of the said shaft g' is mounted in a pendent portion E′ of the chamber E. The front portion of the hollow frame or base A is provided with a circular opening surrounded by a flange a'. The cylinder D is provided near its middle with an external annular flange d, corresponding with the flange a', to which it is secured, the rear half of the cylinder extending into the hollow frame. The portion of the cylinder forward of this flange has a double wall, forming a water-jacket d', the inner wall being provided with an annular bead d^2. The compression-chamber E is also formed with double walls, forming a water-jacket e. Both of the water-jackets d' and e have suitable water-supply and outlet pipes. The inner of said walls forming the jacket e is provided with a recess e', adapted to receive the bead d^2 when the chamber is applied to the cylinder. A cup-shaped piston H is adapted to reciprocate in the cylinder D, and is provided externally with suitable packing-rings h and internally with a lateral journal-pin h'. A piston-rod h^2 has one end journaled on this pin and the other journaled on the crank-shaft.

The compression-chamber is provided with a solid removable head E^2, secured in position by suitable bolts e^2. The said chamber is also provided with an exhaust-opening e^3, closed by a valve e^4, and a combined gas and air supply inlet e^5, the air entering through a pipe e^6 and the gas through a pipe e^7 and both of the discharging ends of the said pipes being closed by a conical valve e^8. The valves are each provided with a pendent stem e^9 e^{10}, respec-

tively. These stems are provided at their lower ends with head d^3 d^4, respectively. Spiral springs d^5 d^6 are mounted on the respective stems and bear against the heads d^3 d^4 and the under side of the compression-chamber. The office of these springs is to keep the valves e^4 e^8 normally closed.

The valve-stems are actuated to force them upward and open the valves by pivoted angular levers m m', respectively. The lever m, as shown in Fig. 5, is composed of two arms m^2 m^3, rigidly attached to a short shaft m^4, so as to extend approximately at right angles to each other. The arm m^2 is provided at its outer end with an antifriction-roller m^5, and the arm m^3 is in turn provided at its outer end with an adjusting-screw m^6, which is adapted to engage the under side of the head d^3 and can be adjusted so as to cause the valve e^4 to open either more or less when the lever m is operated. This lever m is secured in the lower end of the portion E′ by the half journal-boxes e^{11}, said shaft m^5 being surrounded by said boxes, with the arm m^2 on one side and the arm m^3 on the other side of said portion E′. The lever m' is composed of a central hollow hub m^7, provided at one end with an arm m^8, having an antifriction-roller m^9, journaled in its outer end, and near the opposite end with an arm m^{10}, extending approximately at right angles to the arm m^8. The outer end of this arm is provided with an adjusting-bolt m^{11}, similar to bolt m^6 and for a like purpose. The hub m^7 is supported by a bolt n, which passes through said hub and is secured in the pendent portion E′ at n' by a nut. The position of the levers m m' is such that their bolt-supporting arms are approximately horizontal and the wheel-supporting arms extending diagonally upward, with their antifriction-wheels in proximity to the shaft g'. The said shaft g' passes through the pendent portion E′ at e^{12} and is secured in position by half journal-boxes e^{13}.

A cam n^2 of the form shown in Fig. 4 is applied on the end of the shaft g', so that as said shaft revolves the cam engages the antifriction-wheels m^5 of the lever m and thus operates the valve e^4.

A cam O of the form shown in Fig. 8 is keyed to the said shaft g', so that it will rotate therewith, but can be slid longitudinally thereon when so desired. This cam O is provided with an annular groove o at one end and an inclined cam projection o' at the other, said cam engaging the antifriction-wheel m^9 and thus operating the lever m' and the valve e^8.

A centrifugal speed-governor P is mounted on the cylinder D with its vertical shaft p passing through an apertured elongated projection d^5 on the side of the cylinder D. The lower end of the said shaft p is provided with a gear-wheel p', having diagonal teeth, which mesh with a similar wheel p^2 on the shaft g'. The said projection d^5 is provided with a bracket p^3, in the outer end of which is journaled a bell-crank lever p^4. This lever is provided at its lower end with a yoke p^5, adapted to fit within the groove o, and at its upper end with a similar yoke p^6, which engages a grooved sleeve p^7, secured to the shaft p so as to be vertically movable thereon, but rotate therewith. The links of the governor are connected to said sleeve, so that as the balls of said governor rise the sleeve will be elevated on the shaft and operate the bell-crank lever p^4 and move the cam O back on the shaft g' and thus present to the antifriction-roller m^9 a surface of less eccentricity, because of the inclined projection o'. The consequence is that the lever m' has less movement and the valve e^8 is not opened so wide and the supply to the compression-chamber is diminished and the speed of the engine thus decreased to the desired degree.

When the speed is below the normal, the cam O is pushed in the opposite direction and the movement of the lever m' increased, which increases the supply to the compression-chamber by opening the valve e^8 wider. The outer end of the shaft g' is hollow and is provided with a longitudinal slot s, through which passes a pin or stud s' of a sliding rod S, mounted in said hollow shaft. This rod has its size decreased near its outer end, thus forming an annular shoulder s^2. A hollow screw T, having an operating-head t, surrounds the small end of said rod S and bears with one end against the shoulder s^2, the said rod passing through a nut s^3, which bears against the head t, and being struck outward or flared at its end, so as to secure said nut in position. It will thus be seen that while the rod S can rotate freely in the screw T it cannot move longitudinally therein. The said screw T is supported by a bracket U, mounted on the head of the compression-chamber. The outer end of this bracket is split longitudinally and is provided with a screw-threaded aperture u. A thumb-screw u' passes through the split ends, binding them together. A sleeve V, having a diagonal slot v, is mounted loosely upon the shaft g', with the pin s' projecting through the diagonal slot. A cam-switch W, having cross-grooves w, is keyed rigidly to the sleeve V, so as to revolve therewith.

It will be seen from the foregoing that if it is desired to rotate the cam-switch irrespective of the shaft upon which it is mounted and whether the shaft is rotating or not, so as to cause the electrode connected thereto to spark sooner or later, the thumb-screw u' is loosened and the screw T revolved, which causes the rod S to move longitudinally in the shaft g' and thus move the pin s' against the walls of the diagonal slot v and revolve the sleeve V and cam-switch W, while the shaft g' remains stationary.

The electrode F′ consists of an angular arm provided at its outer end with a curved operating-lever f, rigidly secured thereto, the lower end of said lever being provided with a pivoted segmental block f', adapted to travel in the grooves of the cam-switch W. The angu-

lar portion of the said electrode is tapered, as shown in Fig. 10, so as to terminate in a sharp flat edge, which is adapted to engage the lower end of the spring-electrode F.

The electrode F′ is loosely mounted in a sleeve f^2, which sleeve is in turn mounted in an insulating-sleeve f^3, having an annular flange at one end for the locking-nut f^4 to bear against. A sleeve f^5 surrounds said insulating-sleeve f^3 and is rigidly secured in the wall of the compression-chamber by a lock-nut f^6. A binding-post f^7 is mounted on the hub of the lever f for securing one of the wires of an electric circuit in electrical connection with electrode F′.

It will be seen from the foregoing that the electrode F′ is only oscillated once during the revolution of the cam-switch W, as the grooves of the latter are only crossed on one side and pass straight around at the opposite side. The electrode F is mounted in the wall of the compression-chamber, so as to extend into said chamber in a vertical line with the angular portion of the electrode F′. This electrode consists of two parts—a screw-threaded shank c, having a head c', and a flat spring contact-piece c^2, secured in said head by a bolt c^3 and block c^4. This electrode is surrounded by a sleeve c^5, having an annular flange c^6, and is secured therein by nuts c^7, c^8, and c^9. The sleeve c^6 is surrounded by an insulating-sleeve c^{10}, and this in turn is surrounded by a sleeve c^{11}, which is secured in the wall of the compression-chamber by a lock-nut c^{12}, the other wire of the electric circuit being connected to the top of the electrode F. As the flat portion of the eloctrode F′ is oscillated it contacts with the end of the spring c^2 and bends it slightly to one side and then snaps by thus causing a spark in the compression-chamber.

It will be noticed that the electrode F can be readily removed from the compression-chamber without breaking the insulation by simply loosening the nuts c^7, c^8, and c^9 and drawing the electrode upward, when the injured or burned spring c^2 can be removed from the screw c and a new one inserted.

Because of the rapidity with which the engine moves it is desirable to have the compressed gases ignited just before the commencement of the forward stroke of the piston, so that the full force of the explosion takes effect upon said piston from the very commencement of the forward stroke, and thus the injurious shock, which would be inevitable if the explosion took place after the piston had started its forward movement, is avoided. This adjustment of the time for the sparking of the electrodes is fully provided for in the devices shown in Fig. 11 and before described.

I provide a cover or dust-shield A′ for the crank-shaft and piston-rod. It will be observed that by making the compression-chamber separate from the cylinder I provide a means for applying a new compression-chamber without also having to put in a new cylinder. The reason for such a construction is very manifest in this type of machine.

When the explosion takes place, whatever shock or injurious effect is consequential to the same is exerted on the piston and the walls of the compression-chamber only, as said piston is then at the forward end of the cylinder and none of the exploded gases can reach the walls of the cylinder until the piston moves forward, when the gases have lost a great deal of their injurious force.

Gas and air are admitted through the opening e^5 as the piston moves forward, and on its return stroke the piston compresses said gases in the compression-chamber, the valve e^8 having closed on the commencement of the back stroke. When the piston nearly reaches the end of the back stroke, the electrode F′ is operated and creates a spark in the compression-chamber and explodes the gases. This explosion forces the piston forward. Upon the return stroke of the piston the valve e^4 opens and the spent gases are forced out of the cylinder by said pistons. As the piston moves forward again the valve e^4 closes and the valve e^8 opens, and a fresh supply of air and gas passes into the cylinder and the operation is repeated as before.

The gearing connecting the shaft g' with the moving parts of the engine is so proportioned that the cam-switch will only travel through one revolution during two reciprocations of the piston, and thus only one spark is created by the electrodes during said reciprocations.

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

1. In a gas-engine the combination of sparking electrodes mounted in the compression-chamber, operating devices connecting one of said electrodes to the moving parts of the engine whereby it is oscillated, and means for adjusting said operating devices to any desired extent while they are in operation and without interfering with their action so that the sparking of the electrodes will take place at any desired time, substantially as described.

2. In a gas-engine, the combination with a suitable base, crank-shaft and balance-wheels, of a cylinder, a piston and connections, a valve-controlled compression-chamber connected to the cylinder, electrodes mounted in the compression-chamber, operating devices connecting one of said electrodes to the movable parts of the engine for oscillating said electrode, and means for adjusting said operating devices while they are in motion and without interfering with their action so that the sparking of the electrodes will take place at any desired time, substantially as described.

3. In a gas-engine the combination of a cyl-

inder, a compression-chamber connected thereto, electrodes mounted in the compression-chamber, a rotary shaft connected to the moving parts of the engine, a cross-grooved frog cam-switch mounted on said shaft and adapted to rotate therewith and engaging a portion of one of said electrodes to oscillate the same, and means for adjusting the frog-cam switch on said shaft so that said electrodes will spark sooner or later, substantially as described.

4. In a gas-engine the combination with a cylinder, a compression-chamber connected thereto, electrodes in said chamber, a frog cam-switch for operating one of said electrodes a rotatable hollow slotted shaft, a slotted sleeve mounted on the same and carrying said cam-switch, a longitudinally-adjustable rod having a lateral pin projecting through the slots of the shaft and sleeve and adapted when moved in or out to rotate said sleeve independently of the shaft, substantially as described.

5. In a gas-engine the combination with a cylinder, a compression-chamber connected thereto, electrodes in said chamber, a frog cam-switch for operating one of said electrodes, a rotatable hollow slotted shaft, a slotted sleeve mounted on the same and carrying said cam-switch, a longitudinally-adjustable rod having a pin laterally projecting through the slots of the shaft and sleeve, a hollow screw surrounding the end of said rod, and passed through a bracket in which it is adapted to be adjusted to move the rod in and out, substantially as described.

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

JOHN W. EISENHUTH.

Witnesses:
LEE D. CRAIG,
S. C. LEWIS.