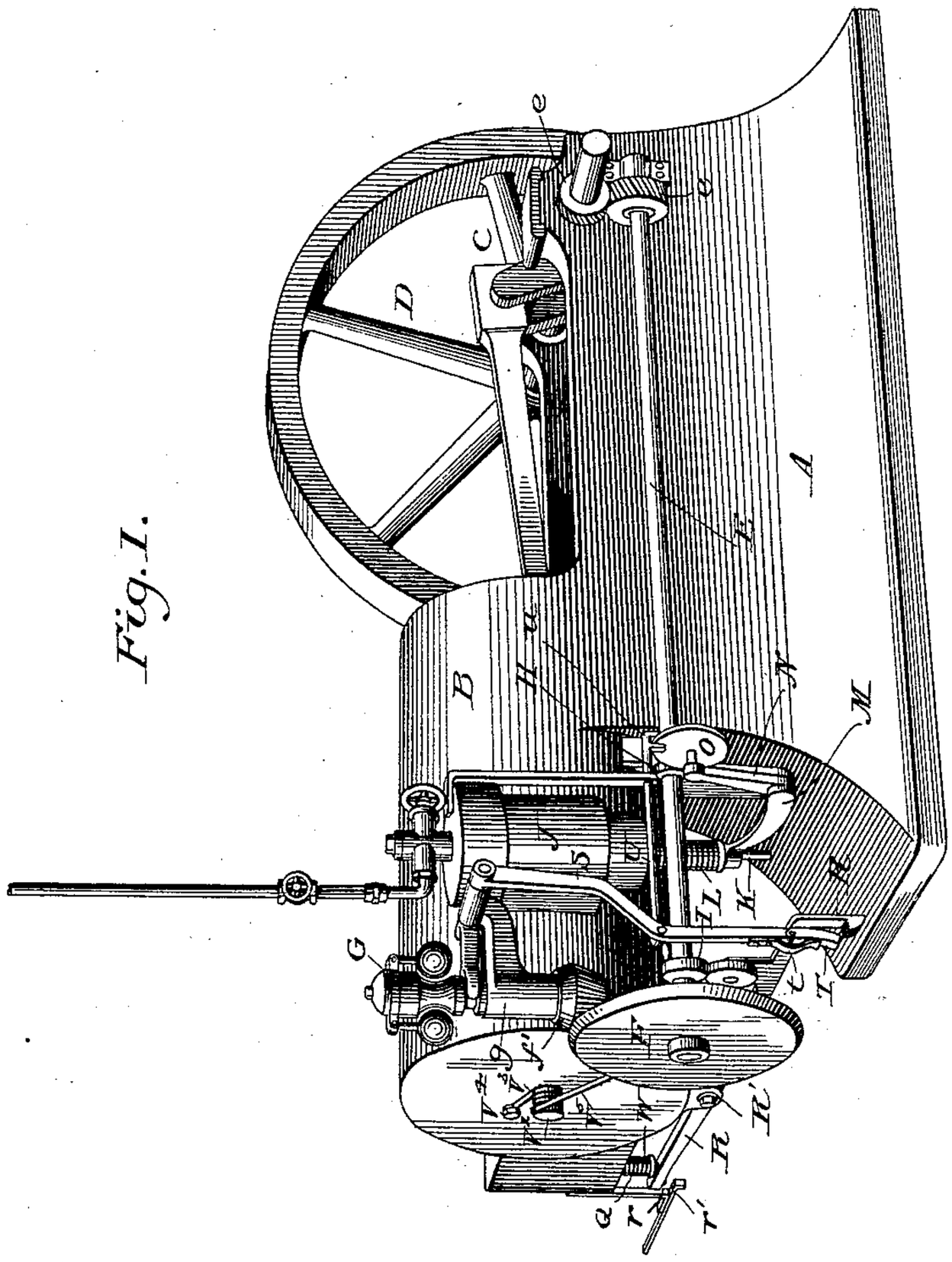
(No Model.) 3 Sheets—Sheet 1.

J. W. LAMBERT.

GAS ENGINE.

No. 534,163. Patented Feb. 12, 1895.

Fig. 1.



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(No Model.) 3 Sheets—Sheet 2.

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Fig. 2.

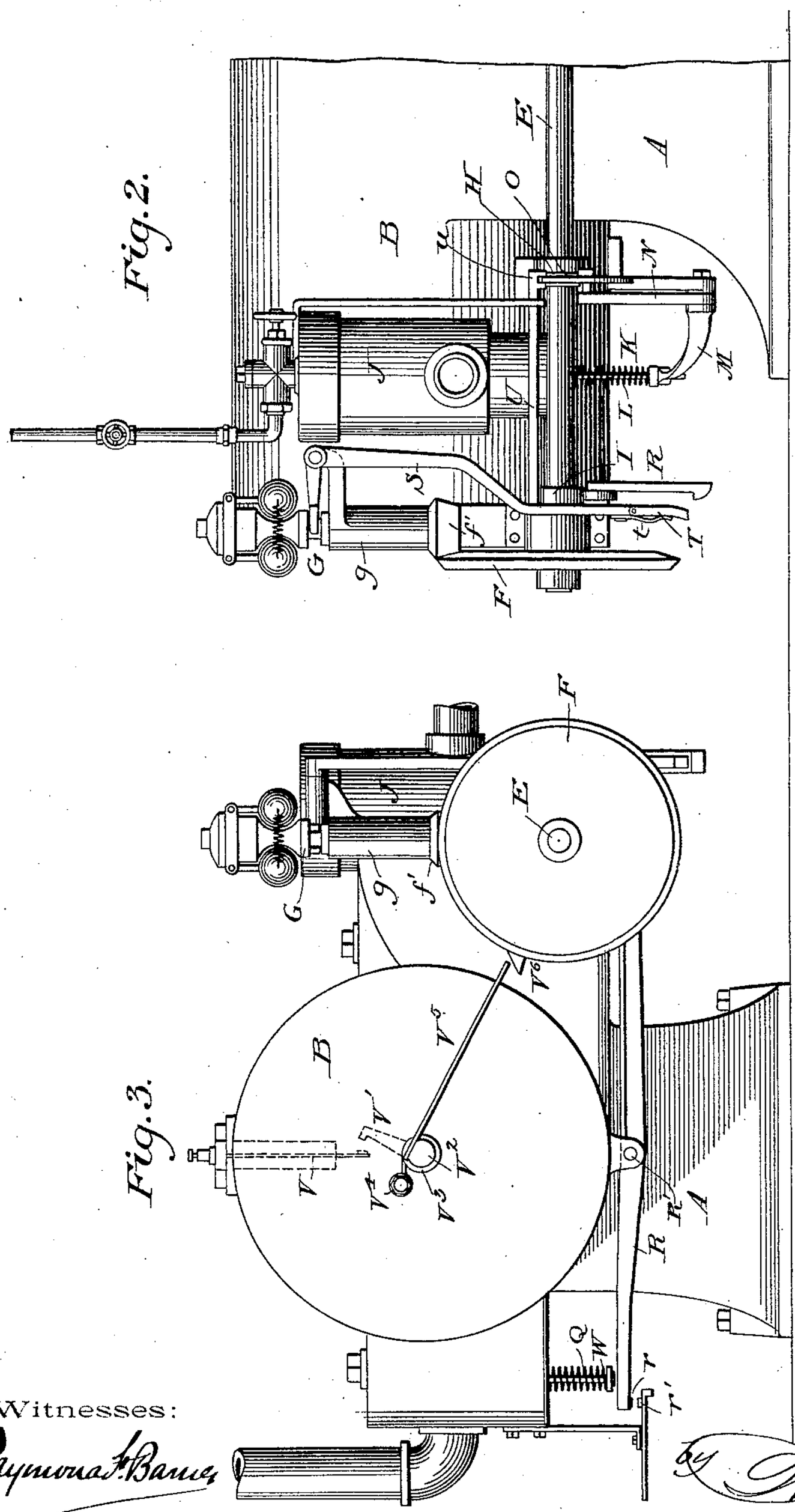

Fig. 3.

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(No Model.) 3 Sheets—Sheet 3.

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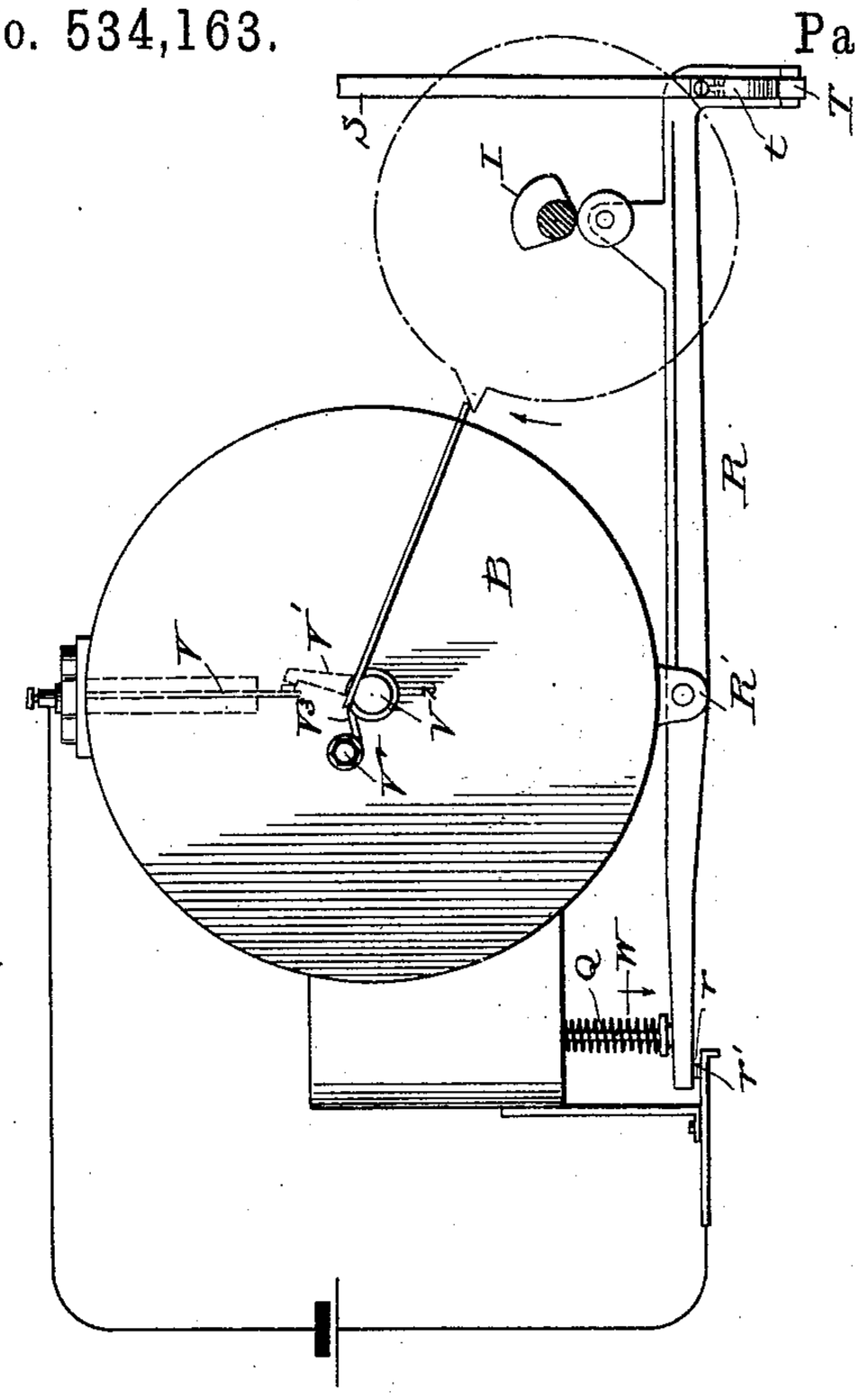

Fig. 5.

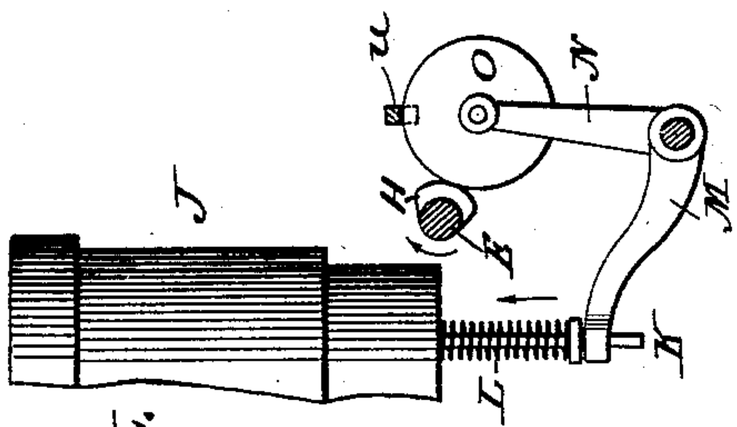

Fig. 4.

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UNITED STATES PATENT OFFICE.

JOHN W. LAMBERT, OF UNION CITY, OHIO.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 534,163, dated February 12, 1895.

Application filed February 16, 1894. Serial No. 500,351. (No model.)

To all whom it may concern:

Be it known that I, JOHN W. LAMBERT, a citizen of the United States, residing at Union City, in the county of Darke and State of Ohio, have invented certain new and useful Improvements in Gas-Engines; and I do 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, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

My invention relates to gas engines and has particular reference to mechanism for controlling the action of the gas inlet and exhaust valves by the direct action of the governor, and to means for producing electric sparks for igniting the gas in the cylinder and controlling the current by which the spark is produced by the same action of the governor which controls the valve movements.

It is necessary in the operation of gas engines that where through changes in load or other causes operating to increase the speed of the engine beyond a certain limit, the supply of gas should be cut off and the exhaust valve opened to its fullest extent to prevent the compression of the contained air, to allow the products of combustion to be completely expelled and to give the engine freedom in working until it regains its normal speed. It is desirable also that when this condition exists, the sparking device which ignites the gas in the cylinder should cease to operate, in order that the battery or other source of electric energy may be more economically used and that premature and partial explosion may be prevented. To these ends I provide the engine with a cam shaft for operating the valves and with mechanism operated direct from a governor by means of which the valves may be thrown into or out of connection with the operating mechanism as the speed of the engine may require. I also provide means under control of the governor for breaking the continuity of the electric circuit which produces the spark when more than normal speed is reached, and the exhaust valve is open and the gas inlet closed.

In order that the invention may be fully understood reference will be had to the accompanying drawings, in which—

Figure 1, is a perspective view of an engine constructed in accordance with my invention; Fig. 2, a side elevation of the same; Fig. 3, an end elevation viewed from the cylinder end; and Figs. 4 and 5, details showing the operation of the parts.

Referring to the drawings, A is a base or casting supporting at one end a horizontal cylinder B, and at the other a shaft C mounted in suitable bearings and carrying a fly wheel D. The shaft is provided with a crank as usual, and connected by a pitman with the piston working in the cylinder B. All of these parts may be of any ordinary construction, and are common to many forms of engine. Mounted at one side of the base plate in suitable bearings is a longitudinal shaft E, carried in bearings secured to the base plate and driven by skew gears *e*, *e*, from the main shaft of the engine. The longitudinal shaft carries upon it at the cylinder end, a bevel gear F, which drives a bevel pinion *f'*, mounted upon the lower end of the shaft of a governor G, which is carried in a bracket *g* projecting from the cylinder of the engine. The longitudinal shaft also carries two cams H and I operating the inlet and exhaust valves of the engine, as will be presently described.

At one side, the cylinder is provided with a chamber J, in which is mounted a valve which regulates the admission of gas to the cylinder. This chamber is connected by suitable pipes with the gas supply tank, and is provided with an opening by means of which connection may be made with the air supply, in order that the air and gas may be suitably mixed before admission to the cylinder of the engine. The spindle K projecting downward from the valve projects beneath the chamber, and is surrounded by a spiral spring L, bearing against an adjustable nut on the lower end of the spindle in such manner as to retain the inlet valve upon its seat, and normally prevent the admission of gas.

The valve stem and valve are lifted by the action of a rocking lever M, pivoted to a projection from the frame of the engine, and having an upwardly extending arm N, carrying at its end a friction disk O, normally

within the path of movement of a cam carried by the longitudinal shaft E, in such relation to the same that the arm will be rocked and the valve lifted by the rotating movement of the cam. The exhaust valve is mounted in a similar chamber on the opposite side of the cylinder, and is also retained upon its seat by a spiral spring W, around its spindle Q. The exhaust valve is lifted by one end of a lever R, pivoted at its center beneath the cylinder of the engine as at R′, and at its outward end being carried beneath the longitudinal shaft E, in such position to be operated upon by the rotating cam I, and receive a movement to lift the exhaust valve.

As will be seen, in the normal position of the working parts of the engine, the inlet valve and the exhaust valve will be continuously operated by the rotation of the cam shaft to admit gas to, and exhaust the products of combustion from, the cylinder at a speed due to the speed of revolution of the cam shaft. This speed will be determined by the proportion of the skew gears by which the cam shaft receives motion from the main shaft of the engine.

In order to relieve the engine of the extra strain due to an increase of speed, and to allow it to resume its normal rate of motion, I provide means controlled directly by the governor, by which the operation of both the inlet and exhaust valves may be stopped until normal speed is regained. This mechanism, shown more particularly in Figs. 1 and 2, consists of an elongated bell crank lever S, pivoted at its angle to the bracket which holds the governor, its shorter arm being connected to the governor sleeve, and its longer arm projecting downward to a point in close proximity to the end of the lever R. The end of the lever R is provided with a notched or serrated step which acts as a stop to the motion of the lever. The lower end of the bell crank lever S is provided with a similarly serrated surface, and the movement of the governor in shifting the lever will bring the end of the lever in such position as to act upon the stop upon the end of the lever R, and withhold it from contact with the cam, thereby retaining the exhaust valve in an open position.

In order to prevent jar to the parts, and to impart smoothness of motion in working, the lower end of the bell crank lever is provided with a hinged section T, held in its normal position by a flat spring *t*. Connected to the bell crank lever S at a point at or midway of its length, is a rod U, having a fork *u* at its end, within which fork the friction disk or roller upon the end of the gas inlet lever rests. This roller has a limited movement upon its spindle, and the motion of the bell crank lever will, as the speed of the engine is increased, so move the roller as to take it out of the path of action of the cam H, thus throwing the inlet valve out of action. It will be seen by reference to the drawings, that the construction of the mechanism is such that these two movements are practically simultaneous, and that where the speed of the engine goes beyond a certain point, the gas supply is cut off, and the exhaust valve thrown wide open at the same time, and that this condition holds until normal speed is regained.

In order to ignite the gas within the cylinder after admission, I provide a fixed insulated contact point V within the cylinder projecting to a point near its center, and place at the central point on the cylinder M and within the cylinder, a rocking arm V′, mounted upon a short shaft V^2, and held normally out of contact by a spiral spring V^3 surrounding the shaft and secured at one end thereto, and at the other to an adjusting nut V^4 mounted upon the end of the cylinder. The tension of this spring is such that the parts are thrown out of contact and retained at a certain predetermined distance from each other. Connected to the short shaft V^2, outside the cylinder, is a projecting arm V^5 one end of which projects within the path of movement of an incline or cam V^6, carried by the bevel gear *f*, upon the end of the longitudinal shaft E. By the rotation of this wheel, the incline or cam is brought against the end of the projecting arm, the short shaft rotated, and the terminals brought into contact and a spark produced by their retreat from each other.

When the speed of the engine is above the normal, and the gas inlet and the exhaust are not in operation, it is desirable that the sparking device should cease to operate. In order to throw this device out of circuit, I provide the end of the lever R, with a contact point *r*, acting to break circuit at the second contact point *r′*, carried by an insulated bracket projecting from the frame of the engine, and include these parts in the electric circuit in which the sparking device is located. As a result of this arrangement when the exhaust valve is thrown open and the gas valve closed, the current through the sparking point is cut off, and even if the contacts are brought together, no spark is produced. By this means I economize current, and prevent possible accidental and premature explosion.

While I have described what I deem to be the best manner of applying my invention to an engine, it is quite obvious that the details may be modified in many ways, and the construction changed to meet the requirements of different forms of engine, all such variations coming within the limits of my invention. I believe myself to be the first to combine a circuit-breaking device and means directly controlled by the governor of the engine for opening the exhaust and closing the gas inlet, and such combination I claim broadly.

Having thus described my invention, what I claim is—

1. In a gas engine the combination with a cylinder, a piston fitted within the cylinder and connected with a driving shaft, a governor, a gas inlet valve and an exhaust valve,

of a lever having one end connected with the stem of the exhaust valve, another lever connected with the stem of the inlet valve and having on the opposite side of its fulcrum from such connection a laterally movable disk, a shaft geared to the driving shaft and carrying cams adapted to contact with operating lever of the exhaust valve and with the disk on the operating lever of the inlet valve, a bell crank lever having one arm connected with the governor and its other arm adapted to move the operating lever of the exhaust valve out of the path of its actuating cam, and a rod connected at one end to the bell crank lever and provided with means for engagement with the laterally movable disk on the operating lever of the inlet valve, substantially as shown and described, for the purpose specified.

2. In a gas engine, the combination with a cylinder, a piston fitted within the cylinder and connected with a driving shaft, a governor, a gas inlet valve and an exhaust valve, of a lever fulcrumed below the cylinder and connected near one end with the stem of the exhaust valve, a lever having one end connected with the stem of the inlet valve and provided near its other end with a laterally movable disk, a shaft geared to the driving shaft and carrying cams adapted to contact with the operating lever of the exhaust valve, near the free end thereof, and with the disk on the operating lever of the inlet valve, a bell crank lever having one arm connected with the governor and its other arm provided, at its free end, with a yielding finger adapted to engage a stop on the operating lever of the exhaust valve and hold such lever out of the path of its actuating cam and a rod carried by said arm of the bell crank lever and provided with a fork the members of which extend on opposite sides of the laterally movable disk on the operating lever of the inlet valve, substantially as shown and described, for the purpose specified.

3. In a gas engine, the combination with a cylinder, a piston fitted within the cylinder and connected with a driving shaft, a gas inlet valve and an exhaust valve, of a lever connected with the stem of the inlet valve and carrying a laterally movable disk, a stationary electrode arranged within the cylinder, a movable electrode mounted on a rock shaft within the cylinder, a spring for normally holding the electrodes apart, an arm attached to the outer end of the rock shaft on which the movable electrode is mounted, a lever fulcrumed below the cylinder and connected with the stem of the exhaust valve, an electric circuit including the electrodes, a source of electric energy and the operating lever of the exhaust valve, a cam shaft geared to the driving shaft and having secured thereon cams adapted to contact with the operating lever of the exhaust valve and with the laterally movable disk on the operating lever of the inlet valve, a disk secured on said shaft and provided with a cam adapted to contact with the free end of the arm on the rock shaft carrying the movable electrode, a bell crank lever having one arm connected with the governor and the free end of its other arm adapted to contact with the operating lever of the exhaust valve, and a rod connected to the bell crank lever and carrying a fork that receives the laterally movable disk on the operating lever of the inlet valve, all combined and arranged substantially as shown and described for the purpose specified.

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

JOHN W. LAMBERT.

Witnesses:
GEO. WELLS SMITH,
G. A. LAMBERT.