No. 706,916. Patented Aug. 12, 1902.

J. B. FENNER.

FUEL VALVE FOR GAS ENGINES.

(Application filed Oct. 26, 1901.)

(No Model.) 2 Sheets—Sheet 1.

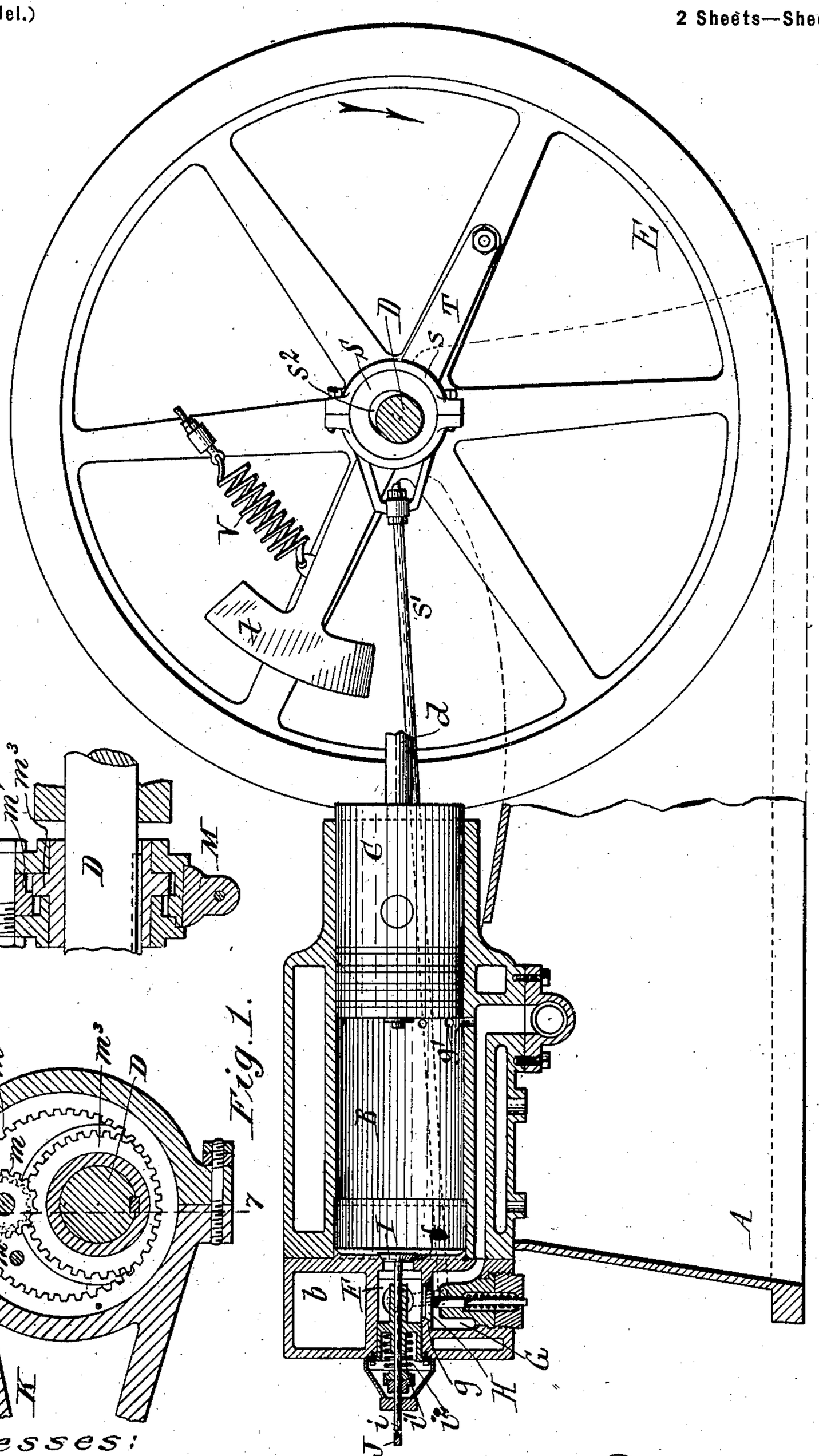

Fig. 1.

Fig. 7.

Fig. 6.

Witnesses:
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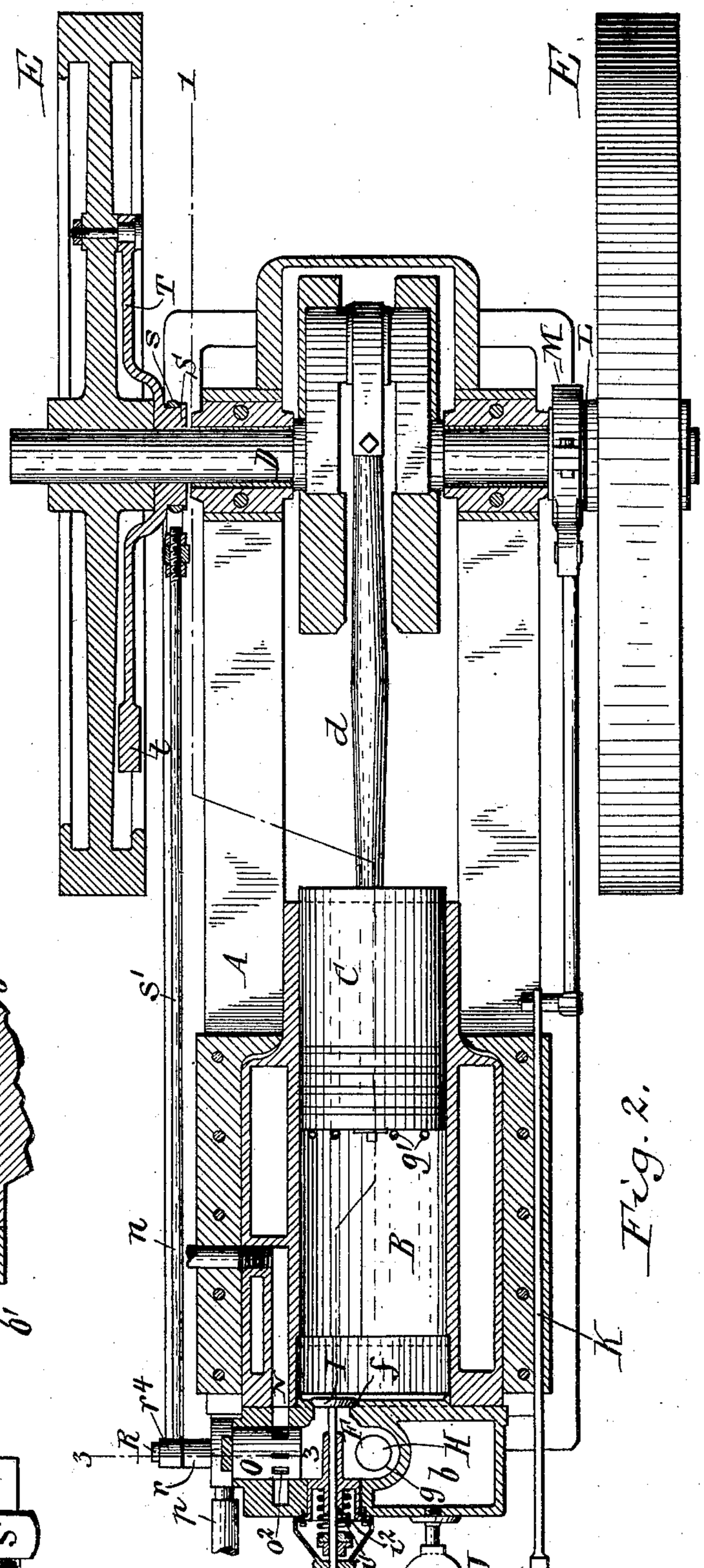

Fig. 2.

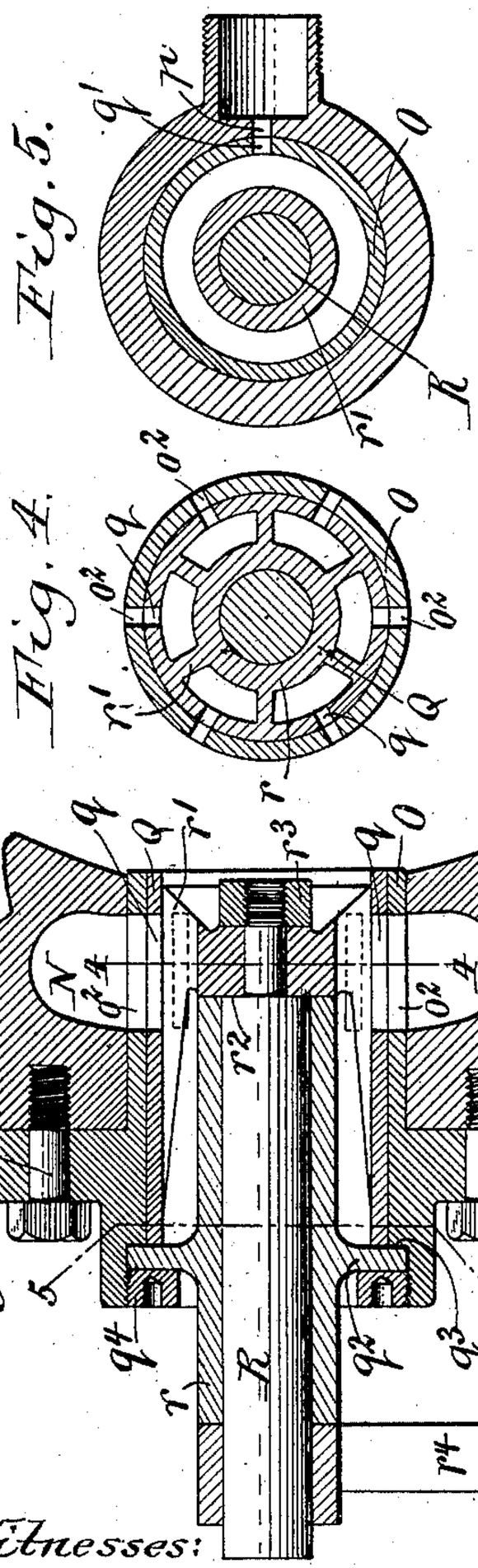

Fig. 5.

Fig. 4.

Fig. 3.

Witnesses:
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UNITED STATES PATENT OFFICE.

JESS B. FENNER, OF BUFFALO, NEW YORK, ASSIGNOR TO THE J. W. RUGER MANUFACTURING COMPANY, OF BUFFALO, NEW YORK.

FUEL-VALVE FOR GAS-ENGINES.

SPECIFICATION forming part of Letters Patent No. 706,916, dated August 12, 1902.

Original application filed March 21, 1900, Serial No. 9,536. Divided and this application filed October 26, 1901. Serial No. 80,034. (No model.)

To all whom it may concern:

Be it known that I, JESS B. FENNER, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented new and useful Improvements in Fuel-Valves for Gas-Engines, of which the following is a specification.

This invention relates to fuel-valves for gas-engines, and has the object to provide an improved valve for this purpose whereby the supply of fuel to the cylinder is automatically varied according to the speed of the engine for securing uniform working of the same.

This application is a subdivision of an application for patent for improvements in gas-engines filed by myself March 21, 1900, No. 9,536.

In the accompanying drawings, consisting of two sheets, Figure 1 is a vertical longitudinal section of a gas-engine embodying my improvements, taken in line 1 1, Fig. 2. Fig. 2 is a horizontal section of the same, taken centrally through the cylinder and crank-shaft. Fig. 3 is a fragmentary transverse section of the fuel-valve, taken in line 3 3, Fig. 2. Figs. 4 and 5 are vertical sections in lines 4 4 and 5 5, Fig. 3. Fig. 6 is a sectional elevation, on an enlarged scale, of the gearing whereby the main or cylinder valve is operated. Fig. 7 is a cross-section of the same in line 7 7, Fig. 6.

Like letters of reference refer to like parts in the several figures.

In the drawings my improved valve mechanism is shown applied to an engine of the four-cycle type, in which a working stroke of the piston is produced during every alternate forward movement of the same; but the application of this invention is not limited to this style of engine.

A represents the base of the engine; B, the cylinder, which is open at its rear end and which is closed at its front end by a valve head or chest *b;* C, the piston, arranged in the cylinder; D, the crank-shaft, journaled in bearings on the base; *d*, the pitman, connecting the piston with the crank of said shaft, and E the balance-wheels, mounted on opposite ends of the crank-shaft.

F represents a valve-chamber which is formed in the valve-chest and which communicates on its inner side with the front end of the cylinder by a main port or opening *f* and on its lower side with an exhaust-chamber G by a main exhaust port or opening *g*.

g' represents a number of auxiliary exhaust-ports, which connect the rear end of the cylinder with the exhaust-chamber and which are uncovered by the piston at the end of the stroke of the piston.

H represents an outwardly-opening exhaust-valve, which is held by a spring against a seat formed around the outer end of the main exhaust-port *g*.

I represents a main or cylinder valve, which moves toward and from a seat around the inner end of the main port and whereby the admission of fuel into the cylinder and the exhaust from the cylinder are controlled. This valve is provided with a valve-stem *i*, which projects forwardly through a guide *i'* on the valve-chest and which is moved outwardly against its seat by a spring i^2, bearing with its ends against shoulders on said guide and valve-stem.

J represents a horizontal rock-lever, which bears with its inner arm against the stem of the main valve for opening the same. This lever may be actuated from the crank-shaft by any suitable gearing which will rock the lever J and open and close the main valve I once during every two rotations of the crank-shaft. The mechanism for this purpose shown in the drawings is substantially the same as that shown in Letters Patent No. 634,207, granted to me October 3, 1899, and is constructed as follows: L represents an eccentric composed of two disks mounted on the crank-shaft, but capable of turning independent thereof. M is an eccentric-strap surrounding the eccentric-disks and connected with the outer arm of the valve-lever J by a slide K, guided on the main frame. *m m'* represent a pair of connected gear-pinions, which are pivoted on the eccentric-disks and which mesh, respectively, with an internal gear-rim m^2 on the eccentric-strap and a gear-wheel m^3 on the crank-shaft. The

relation of these gears is such that the eccentric is turned once during every two turns of the crank-shaft in the manner described fully in the Letters Patent referred to.

N represents an air-chamber which is formed partly in the valve-chest and partly in the side of the cylinder and which is connected with an air inlet or pipe *n*.

O represents the case of a fuel-valve whereby the admission of air and gas into the cylinder is controlled. This case is of cylindrical form and arranged in a cylindrical opening or socket which is formed transversely in the side of the valve-chest and which extends from the outer side of the valve-chest into the valve-chamber, whereby the valve-case extends across the air-chamber. The valve-case is secured to the chest by screws *o'*, passing through ears on the outer end of the valve-case, and the latter is provided with a circumferential row of openings or ports o^2 in its side, which register with the surrounding air-chamber.

p represents a gas inlet or port, which extends laterally through the outer part of the valve-case, as shown in Figs. 2 and 5, and which is connected with a supply of gas, gasolene, or similar motive agent.

Q represents a cylindrical rock-valve fitting in the fuel-valve case and provided with a circumferential row of air-ports *q*, which are adapted to register with the air-inlet openings o^2 of the valve-casing, and a fuel-port *q'*, which is adapted to register with the gas-inlet *p* of the valve-casing. The inner end of the rock-valve opens into the valve-chamber.

q^2 is a disk or head which bears against the outer end of the rock-valve and closes the same and also against a shoulder q^3 on the valve-case. The head is held in place by a clamping-ring q^4, bearing against the outer side of the head and having an external screw-thread which engages with an internal thread on the outer end of the valve-case.

R represents a rock-shaft or spindle which is arranged axially in the cylindrical fuel-valve and journaled in a bearing *r*, formed centrally on the head q^2. The fuel-valve is provided with an internal open hub or spider *r'*, which is mounted on the inner end of the rock-shaft R and which is secured between a shoulder r^2 and a screw-nut r^3 on this shaft. The outer end of the valve rock-shaft R is provided with a depending rock-arm r^4.

In the operation of the engine the rocking movement of the fuel-valve alternately places the valve-chamber in communication with the gas and air supply and cuts the same off from the gas and air supply.

S represents an eccentric provided with a surrounding eccentric-strap *s*, which is connected by a rod *s'* with the rock-arm r^4. The eccentric is arranged on the inner side of the hub of one of the balance-wheels and is provided with a slot s^2, through which the main shaft passes.

T represents a governor-arm, which is arranged substantially diametrically on the inner side of said balance-wheel and pivoted at one end to the same on one side of the main shaft, while its other free end is provided on the opposite side of the main shaft with a weight *t*. The eccentric S is preferably formed integrally with the central part of the governor-arm, as shown in Fig. 2; but the eccentric may be made separate and secured to said arm.

V represents a spring which connects the governor-arm with the adjacent balance-wheel and which constantly tends to move said arm so as to move the eccentric away from the center of the main shaft, this movement of the lever being limited by the inner end of the slot in the eccentric. During the normal operation of the engine the balance-wheel turns in the direction of the arrow, and the governor-arm by reason of its inertia lags behind, thereby straining the spring somewhat and moving the eccentric inwardly from its outermost position. The governor mechanism is so adjusted that when the engine runs at a normal speed the eccentric rocks the fuel-valve during each rotation of the main shaft and opens and closes the gas and air ports, so as to admit a normal quantity of fuel. When the speed of the engine rises above the normal, the governor-arm lags behind a greater extent, and the eccentric is moved nearer to the center of the axis of rotation, whereby the rocking movement which is imparted by the eccentric to the fuel-valve is reduced, and the air and gas ports thereof are opened to a less extent during each rocking movement of the valve, thereby reducing the charge of fuel which is admitted to the cylinder and reducing the speed of the engine. When the speed of the engine drops below the normal, the governor-arm lags behind less than under normal conditions, and the eccentric is moved farther outwardly from the center of rotation, whereby the throw of the fuel-valve is increased and its gas and air ports are opened wider, thereby increasing the charges of fuel to the cylinder. By this means of regulating the supply of fuel a charge of fuel is delivered to the engine during each suction-stroke of the piston; but the quantity of fuel in each charge is varied automatically according to the speed of the engine, whereby the engine is caused to run more uniformly and with less vibration than engines in which the cylinder receives either a full charge of fuel or no fuel at all. The fuel-valve Q is opened and closed once during each rotation of the crank-shaft; but the main valve I is opened and closed once during every two rotations of the crank-shaft. The movement of the fuel-valve Q is so timed that the same is closed during the exhaust-stroke of the piston, opened during the suction-stroke, closed during the compression-stroke, and opened during the working stroke. The main valve I is opened posi-

tively to allow the products of combustion to escape on the return or exhaust stroke of the piston and remains open during the next suction-stroke to admit fuel. The valve I is then closed during the subsequent compression and working strokes of the piston. During the exhaust-stroke the main valve is opened, but the fuel-valve is closed to prevent spent gases from entering the fuel-supply passages. During the suction-stroke of the piston the main valve and fuel-valve are open at the same time, so that fuel is admitted to the cylinder. During the subsequent compression and working strokes of the piston the main valve is closed; but the fuel-valve is closed during the compression-stroke and opened during the working stroke, which idle closing and opening movements of the fuel-valve are not necessary, but permit of an advantageous construction of the engine, inasmuch as it avoids the necessity of employing a reducing-gearing for driving the fuel-valve. The idle opening movement of the fuel-valve does not interfere with the operation of the engine, because at this time the main valve is closed and the piston is effecting its working stroke.

I claim as my invention—

1. In a gas-engine, the combination with the cylinder, the piston arranged in the cylinder and the crank-shaft connected with the piston, of a valve-chest communicating by a main port with the cylinder, a main valve controlling the main port, a speed-reducing-gear mechanism which is interposed between the crank-shaft and the main valve and which is constructed to open the same once during every two rotations of the shaft, a rocking fuel-valve whereby the fuel-supply to the cylinder is controlled, and an actuating mechanism which is interposed between the crank-shaft and the fuel-valve and which is constructed to open the same once during each rotation of the shaft, substantially as set forth.

2. The combination with the cylinder and the piston therein, of a chest arranged at the end of the cylinder and having a valve-chamber communicating with the cylinder, a socket extending from the outer side of the chest into the valve-chamber, and a fuel-conduit opening into the side of the socket; a valve-case fitting in said socket and having ports in its side which communicate with said fuel-conduit; and a hollow rock-valve arranged in said case and having ports in its side which register with the ports of said case and opening at its inner end into the valve-chamber of said chest, substantially as set forth.

3. The combination with the cylinder and the piston therein, of a chest arranged at the end of the cylinder and having a valve-chamber communicating with the cylinder, a socket extending from the outer side of the chest into the valve-chamber, and a fuel-conduit opening into the side of the socket; a valve-case fitting in said socket and having ports in its side which communicate with said fuel-conduit; a hollow rock-valve arranged in said case and having ports in its side which register with the ports of said case and opening at its inner end into the valve-chamber of the chest; a head bearing against the outer end of the valve and the valve-case and provided with a bearing; a screw-ring whereby said head is clamped against said case; and a rock-shaft journaled in said bearing and carrying said rock-valve, substantially as set forth.

Witness my hand this 7th day of October, 1901.

JESS B. FENNER.

Witnesses:
THEO. L. POPP,
CARL F. GEYER.