(No Model.) 2 Sheets—Sheet 1.

I. F. ALLMAN.

GAS ENGINE.

No. 453,071. Patented May 26, 1891.

Fig: 3.

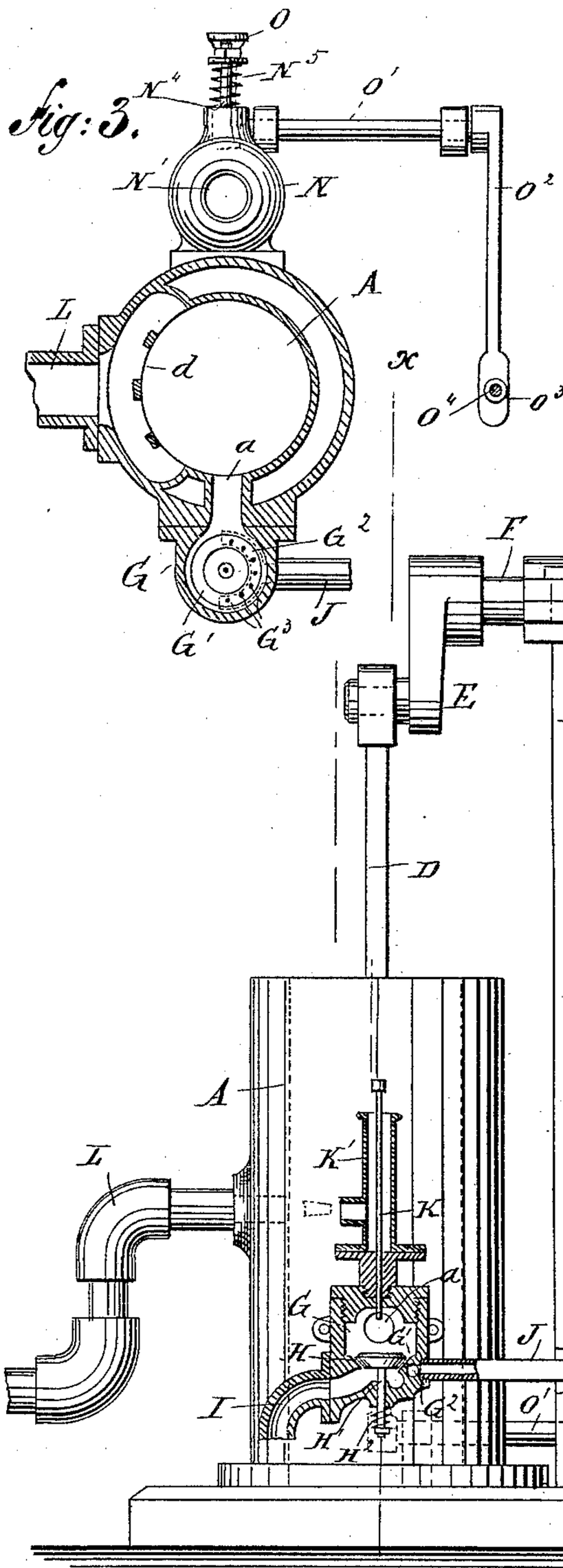
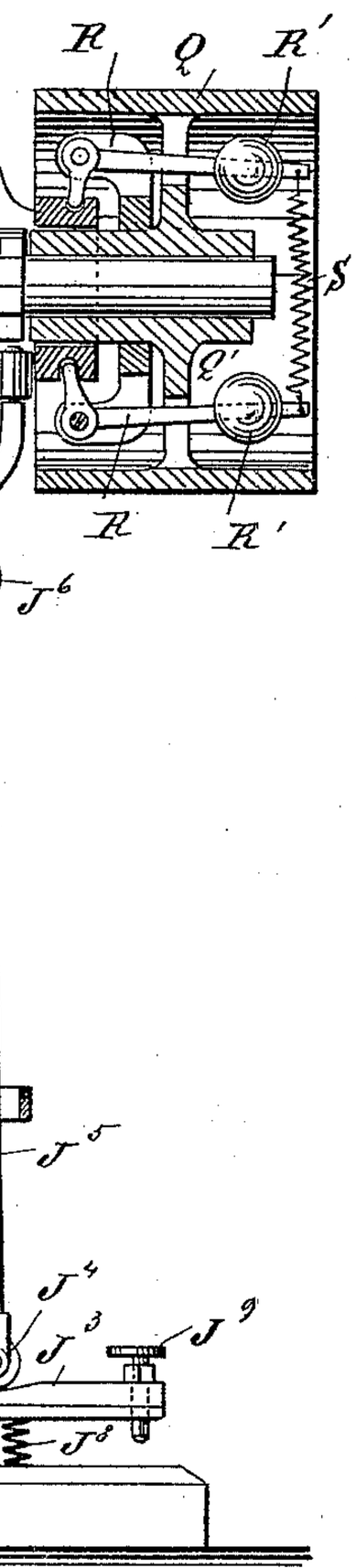


Fig: 1.



WITNESSES:

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(No Model.) 2 Sheets—Sheet 2.

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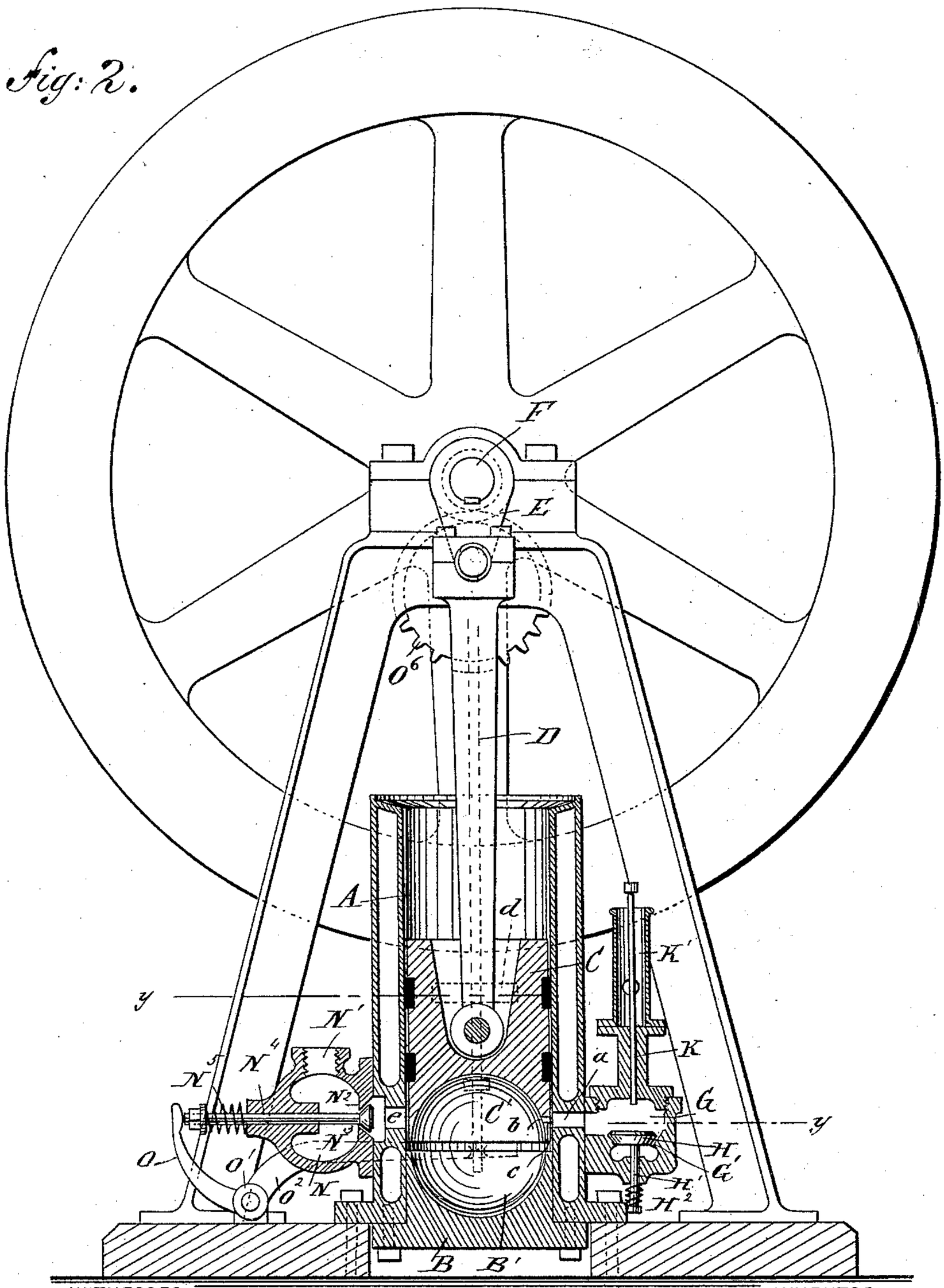
Fig: 2.



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UNITED STATES PATENT OFFICE.

ISAAC F. ALLMAN, OF NEW YORK, N. Y.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 453,071, dated May 26, 1891.

Application filed February 11, 1891. Serial No. 381,021. (No model.)

To all whom it may concern:

Be it known that I, ISAAC F. ALLMAN, of the city, county, and State of New York, have invented a new and Improved Gas-Engine, of which the following is a full, clear, and exact description.

The invention consists of certain parts and details and combinations of the same, as will be described hereinafter, and then pointed out in the claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar letters of reference indicate corresponding parts in all the figures.

Figure 1 is a side elevation of the improvement with parts in section. Fig. 2 is a sectional front elevation of the same on the line *x x* of Fig. 1; and Fig. 3 is a sectional plan view of the cylinder on the line *y y* of Fig. 2.

The improved gas-engine is provided with a water-jacketed cylinder A, open at its upper end and closed at its lower end by a head B, extending partly into the cylinder A, and having in its inner end a semi-spherical recess B′, as is plainly illustrated in Fig. 2. In the cylinder A is fitted to reciprocate the piston C, having its inner end formed with a semi-spherical recess C′, similar to the recess B′, so that when the piston C is in its lowermost position, as indicated in Fig. 2, the two recesses form a hollow sphere. The piston C is pivotally connected with the pitman D, connected with the crank-arm E, secured on the main driving-shaft F.

In the cylinder A, near its lower end, is formed an inlet-port *a*, leading from a valve-chamber G, provided with a valve-seat G′, on which is adapted to be seated a self-closing valve H, provided with a valve-stem H′, extending to the outside and carrying on its outer end a spring H^2 for holding the valve H on its seat G′. The stem H′ is fitted to slide in suitable bearings in the casing forming the valve-chamber, the said valve-stem being placed vertically, so that the valve H is self-closing by gravity, assisted by the spring H^2.

The space below the valve H is connected with an air-inlet pipe I, through which air enters to form the explosive mixture with the gas which passes to the valve-chamber by a gas-pipe J, containing the usual valve J′ for regulating the amount of gas admitted to the valve-chamber. The gas-pipe J opens into a semicircular recess G^2, formed in the valve-chamber G next to the seat G′, small apertures G^3 leading from the said semicircular recess G^2 into the seat G′. Thus when the valve G is closed the said small apertures G^3 are closed and gas cannot pass from the pipe J to the valve-chamber. When, however, the valve H opens, air from the pipe I and gas from the pipe J can pass through the valve-seat G′ into the valve-chamber G and from the latter to the port *a*.

Into the valve-chamber G, above the valve-seat G′, opens the open end of the pipe K, secured in the valve-chamber and extending to the outside, its outer end being closed by a suitable cap. The outer end of the pipe K passes into a chimney K′, adapted to be heated by a Bunsen burner.

In the lower part of the cylinder C is arranged a small igniting-port *b*, opening into the semi-spherical recess C′, and adapted to connect with the port *a* when the said piston nears its lowermost position. (See Fig. 2.) A feed-groove *c* leads from the port *b* to the extreme lower end of the cylinder C, and serves to feed gas through the port *a* to the valve-chamber G. At about the middle of the cylinder A is arranged a large main exhaust-port *d*, connecting with an exhaust-pipe L discharging into a pot (not shown) connected with the chimney.

In the lower part of the cylinder A, about opposite the port *a*, is arranged an exhaust-port *e*, leading to a relief-valve N, provided with an outlet N′, adapted to be connected by a pipe with the pot into which the main exhaust-pipe L discharges. The relief-valve N is provided with a valve-seat N^2, on which is seated an inwardly-opening valve N^3, secured on a valve-stem N^4, fitted to slide in the valve N, and extending to the outside, carrying on its outer end a spring N^5 for holding the valve N^3 to its seat N^2. The extreme outer end of the valve-stem N^4 is adapted to be pressed by an arm O, secured to a shaft O′, extending transversely and carrying an arm O^2, adapted to be pressed by a collar O^3, fastened on an eccentric-rod O^4, connected with an eccentric O^5, held on a gear-wheel O^6, in mesh with a pinion O^7, secured to the main shaft F. When the latter is rotated, the pinion O^7 imparts a

rotary motion to the gear-wheel O^6, which, by the eccentric O^5, the rod O^4, and the collar O^3, acts on the arm O^2, so that the shaft O′ is turned, whereby the arm O presses on the valve-stem N^4 to move the valve N^3 inward to establish communication of the relief-valve N with the port *e*. The proportion of the pinion O^7 and the gear-wheel O^6 is such that the valve N^3 is held open during every second downstroke of the piston C.

The governor for controlling the amount of gas passing through the pipe J to the valve-chamber G is arranged as follows: The stem of the valve J′ rests on the free end of the lever J^2, provided with a wedge-shaped top J^3, on which is adapted to travel a friction-roller J^4, held on the lower end of a lever J^5, pivoted at J^6 to the main frame. The lever J^5 extends upward and carries on its extreme upper end a friction-roller J^7, resting against the outer face of a collar P, mounted to slide on the hub Q′ of the pulley Q, secured to the main driving-shaft F. The collar P is provided with an annular groove engaged by arms of two bell-crank levers R, each fulcrumed in the pulley Q, and each carrying a weight R′, as is plainly shown in Fig. 1. The outer or weighted ends of the levers are connected with each other by a spring S. A spring J^8 presses on the lever J^2 under the wedge J^3, and the said lever is also provided with a set-screw J^9 for limiting the swinging motion of the said lever.

The operation is as follows: When the several parts are in the position shown in Fig. 2 and the piston C makes its first upward stroke, the valve N^3 is seated and the lower end of the piston soon uncovers the port *a*, whereby full communication is established between the valve-chamber G and the interior of the cylinder A. The suction caused by the upwardly-moving piston C opens the valve H against the tension of its spring H^2, so that the air can pass to the said chamber from the pipe I, and gas also enters from the pipe J, passing through the annular recess G^2 and the small apertures G^3, opening into the seat G′. The air passing through the seat G′ thus readily mixes with the gas passing through the apertures G^3, so that a complete mixture of gas and air takes place, the mixture passing through the port *a* into the cylinder A. As soon as the piston ceases its upstroke the suction ceases and the valve H seats itself on its seat G′, so that the gas and air are shut off. The piston on its downstroke compresses the mixture of gas and air in the cylinder A, and at the same time part of the mixture is pressed into the valve-chamber G. When the piston nears its lowermost position, the feed-groove *c* still maintains communication between the cylinder A and the valve-chamber G, and when finally the igniting port *b* registers with the port *a* then an ignition of the mixture takes place, caused by the gas being ignited in the hot pipe K. The force of the explosion forces the piston C on its second upward stroke, and when it nears the limit of its upward stroke its lower end uncovers the main exhaust-port *d*, so that the main part of the utilized explosive mixture passes out through the said port *d* into the exhaust-pipe L. When the piston C moves downward on its second stroke, the valve N^3 opens, as previously described, and is held open by the action of the arm O, so that the residue of the exhaust of the explosive mixture can pass out through the port *e* into the relief exhaust-valve N and from the latter to the pot into which the main exhaust had previously been discharged. It is understood that when the explosion takes place the valve H remains on its seat by the pressure in the cylinder, so that the said valve will not open on the second upward stroke of the piston. It is further understood that when the piston C is on its first upward stroke sucking in the explosive mixture, then the latter cannot escape through the port *d* when it is uncovered by the piston C, as the back-pressure from the pot and pipe L is sufficient to prevent the escape of the explosive mixture. When, however, the explosion has taken place on the second upward stroke of the piston, a ready escape is furnished by the exhaust-port *d*, which is made sufficiently large for the purpose. (See Fig. 3.) The residue of the exhaust is discharged through the exhaust relief-valve, as previously mentioned. When the shaft F exceeds its normal speed, the weighted balls R′ of the governor fly outward, thus moving the collar P inward, whereby the inner end of the lever J^5 swings inward with the collar P and its lower end J^4 moves down on the incline of the wedge J^3. The spring J^8 now acts on the lever J^2, so that the valve J′ closes, thereby cutting off the supply of gas, whereby the mixture of gas and air in the cylinder loses some of its force, thus finally reducing the speed of the main shaft F. When the shaft F runs at a normal rate of speed, the balls R′ again assume their natural position, aided by the action of the spring S, so that the collar P slides outward and moves the lever J^5 to its former position, whereby the friction-roller J^4 again presses on the wedge J^3, thereby opening the valve J′ sufficiently to admit the regular amount of gas to the valve-chamber G.

It will be seen that the valve-chamber G and the relief-valve N are arranged on the outside of the cylinder A, and can thus be readily taken off and examined and replaced, if necessary, without disturbing the cylinder A and its piston C.

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

1. The combination, with the cylinder having an imperforate head, opposite inlet and outlet ports *a e* in the cylinder above the head, the main exhaust *d* in the cylinder above said ports, and the piston C, working in the cylinder and provided with a port *b* to register with

port *a*, of the chamber G at the port *a*, having a gas and air inlet and a valve controlling both and provided with a stem leading outward, and the exhaust-chamber N, having a spring-seated valve controlling port *e* and provided with a stem extending outward and actuated from the main shaft, substantially as set forth.

2. The combination, with the cylinder, the piston and the main shaft, the gas and air chamber G, communicating with the cylinder and having a valve-seat G′, air-inlet I, recess G^2 under the seat, apertures G^3, leading from the recess through the seat, gas-pipe J, leading to said recess and having a valve J′, provided with a downward-extending stem, the valve H, closing down on the valve-seat and apertures and having a downward-extending stem H′, and a spring holding the valve closed, of the horizontal lever pivoted between its ends to rock vertically and extending at its inner end under the stem of valve J′, a spring J^8 under the opposite end of the lever, a cam J^3 on the upper side of the outer end of the lever, a vertically-extending lever J^5, pivoted at J^6 and having its lower end provided with a roller engaging the said cam, a sliding collar on the main shaft engaging the upper end of the lever J^5, and governor-balls mounted on pivoted levers or arms engaging the said collar, substantially as set forth.

3. The combination, with the cylinder A, having an imperforate head B, closing its lower end, and having a concavity B′ in its inner face, the diametrically-opposed inlet and outlet ports *a e* and their valve mechanisms, and the upper exhaust-port *d*, of the piston C, having a lower concave end and provided in said concave portion with a lateral ignition-port *b* to register with the port *a*, substantially as set forth.

4. In a gas-engine, the combination, with a cylinder provided with an inlet-port, of a piston fitted to slide in the said cylinder and provided with an igniting-port and a feed-groove adapted to register with the said inlet-port, a valve-chamber held on the said cylinder and connected with the said port, and an externally-heated pipe extending at its open end into the said valve-chamber, substantially as shown and described.

ISAAC F. ALLMAN.

Witnesses:
THEO. G. HOSTER,
EDGAR TATE.