(No Model.) 2 Sheets—Sheet 1.

J. CHARTER.

GAS ENGINE.

No. 356,447. Patented Jan. 25, 1887.

Fig. 1.

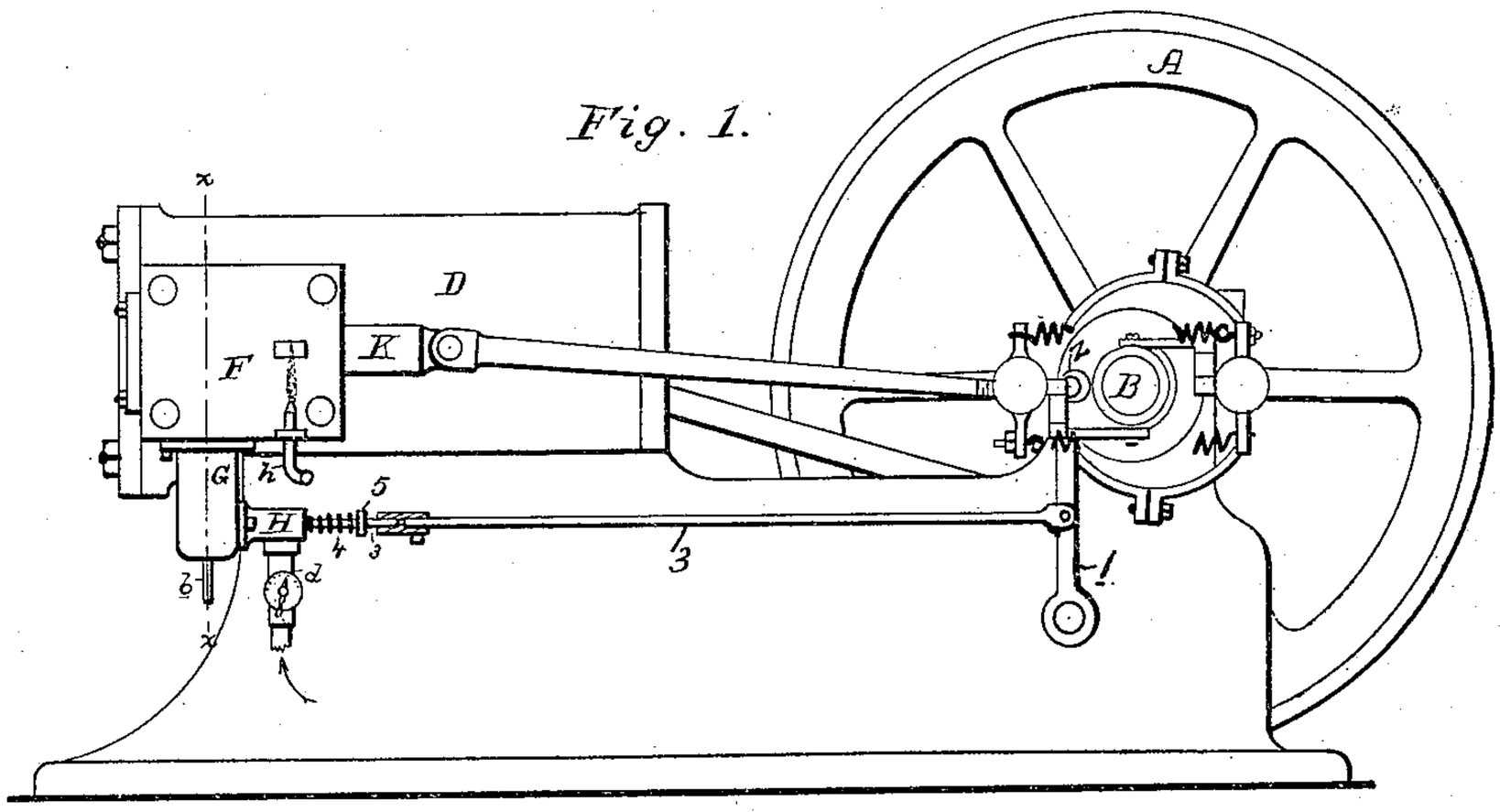


Fig. 4.

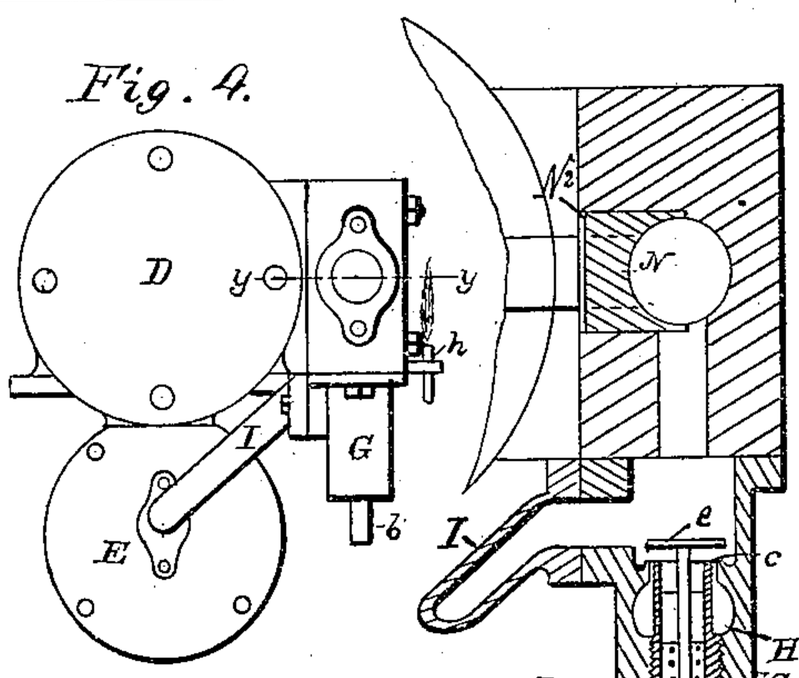


Fig. 5.

Fig. 6.

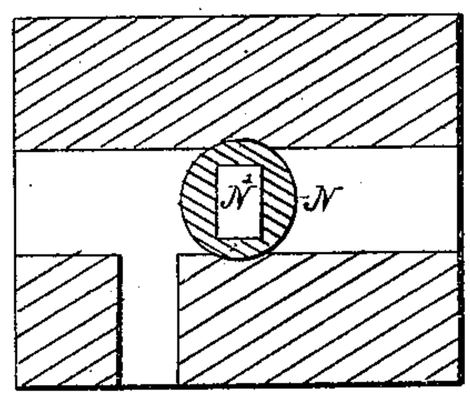
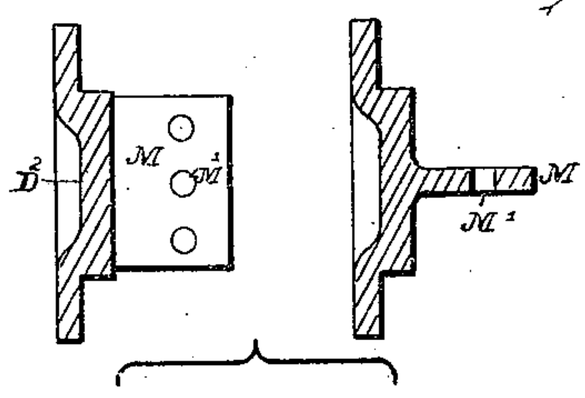


Fig. 7.



Witesses

F. L. Fischer.

H. B. Wyman.

Inventor

John Charter

By his Attorneys

Munn & Co.

(No Model.) 2 Sheets—Sheet 2.

J. CHARTER.

GAS ENGINE.

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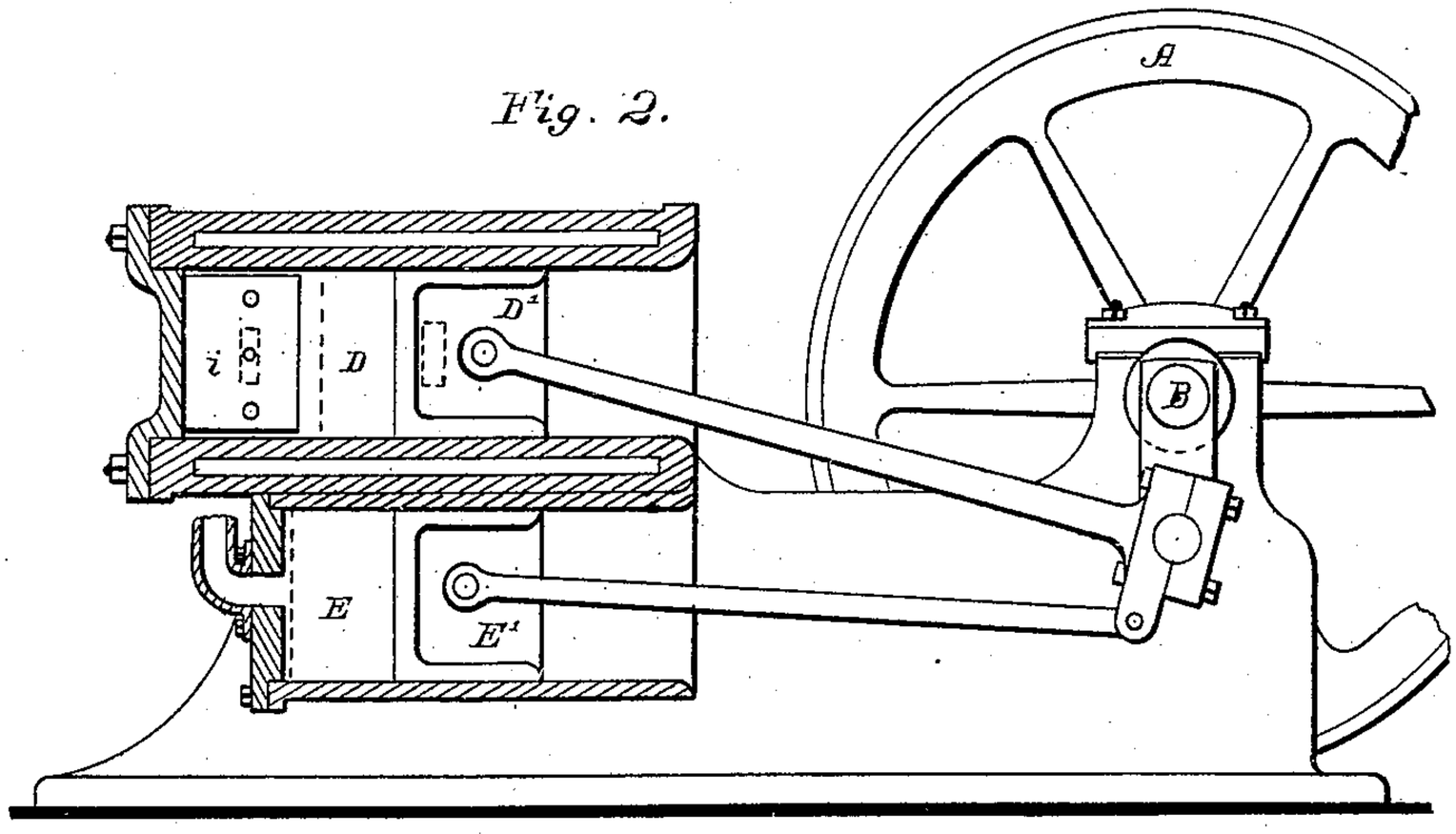
Fig. 2.



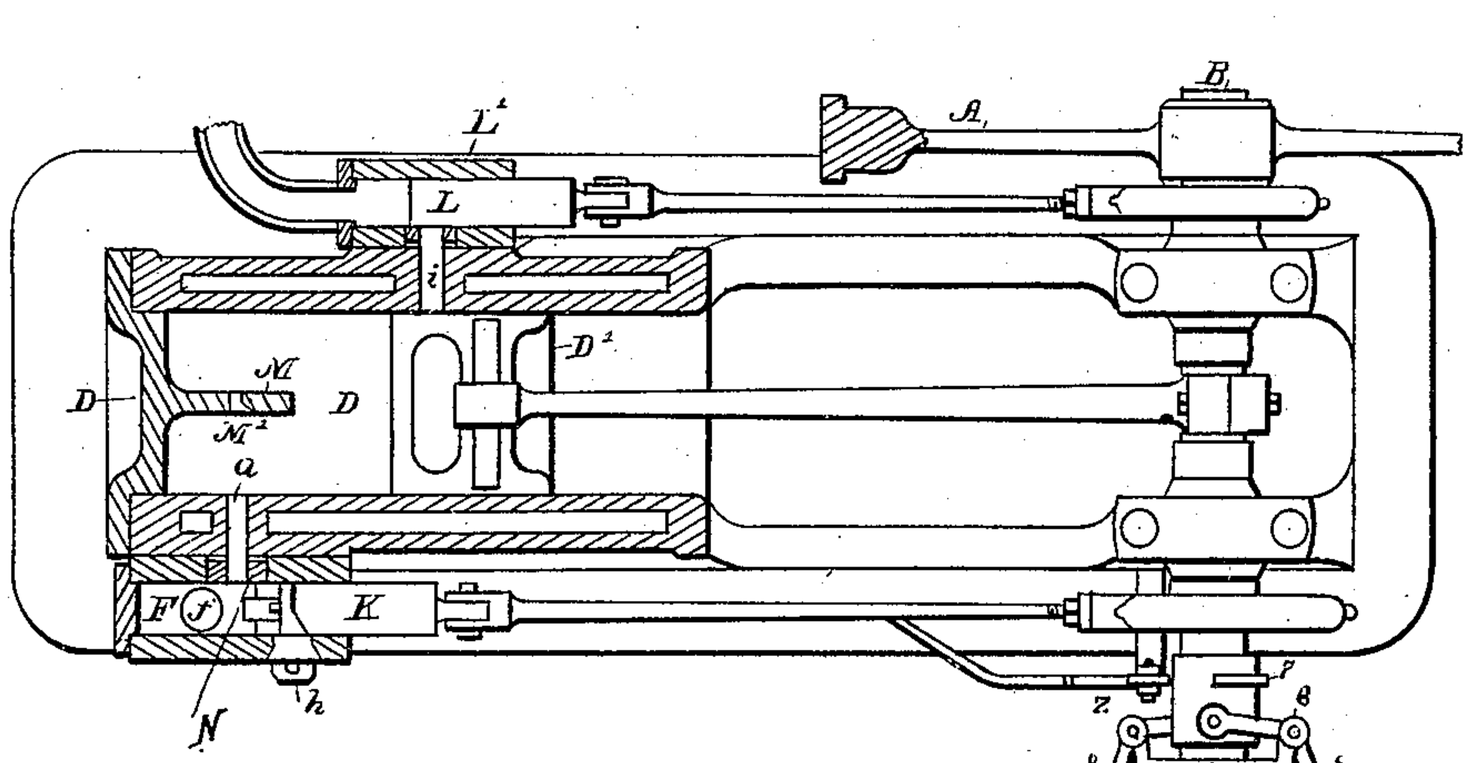


Fig. 3.

Witnesses

F. G. Fischer

H. B. Wyman

Inventor

John Charter

By his Attorneys

Munn & Howard.

UNITED STATES PATENT OFFICE.

JOHN CHARTER, OF STERLING, ILLINOIS.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 356,447, dated January 25, 1887.

Application filed March 3, 1886. Serial No. 193,904. (No model.)

To all whom it may concern:

Be it known that I, JOHN CHARTER, a citizen of the United States, residing at Sterling, in the county of Whiteside and State of Illinois, 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, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

My invention has reference to gas-engines, and pertains especially to that class of gas-engines in which each forward movement of the working-piston is effected by the explosion of a charge of mixed air and gas; and my improvement consists in constructing the engine, as fully set forth hereinafter, so as to insure an instantaneous explosion of the entire charge.

In the drawings, Figure 1 is a side elevation of a gas-engine embodying my invention. Fig. 2 is a vertical longitudinal section thereof. Fig. 3 is a horizontal longitudinal section thereof. Fig. 4 is an end view thereof. Fig. 5 is a partial cross-section in the line *x x* of Fig. 1. Fig. 6 is a partial longitudinal section in the line *y y* of Fig. 4. Fig. 7 sectional details of the head of the working-cylinder.

A is the usual balance or fly wheel, rigidly seated on the shaft B, from which latter the power is communicated to the machinery to be operated by such engine, either by means of the belt-pulley C, seated on such shaft, or in any other suitable mode.

D′ is the power-piston, attached at its outer end, in the usual way, to the shaft B, and having its action in the power-cylinder D.

E is the supply-cylinder, placed beneath and parallel with the power-cylinder D.

E′ is the supply-piston, which traverses the supply-cylinder E, and has its action derived from and coincident with the crank-wrist, to which the power-piston is attached.

F is a cylindrical horizontal cut-off and ignition-chamber seated against and communicating by means of inlet *a* with the power-cylinder D.

G is a mixture and transition chamber seated beneath the chamber F, and to the chamber G air is supplied from beneath through the vertical tube *b*, and gas through an annular opening, *c*, around the upper end of the tube *b*, the lower portion of the opening *c* communicating with the horizontal chamber H, into which latter gas is introduced through the tube *d*.

Communication is established between the supply-cylinder E and the chamber G by means of a tube, I, Fig. 4. The outstroke of the supply-piston E′ draws the mixed charge through the chamber G and tube I into the supply-cylinder E, the valve *e*, seated in the bottom of the chamber G, (and normally closing the tube *b* and opening *c*,) rising to admit the gas and air, and communication with the chamber F being intermittently suspended, as hereinafter described. The instroke of the supply-piston E′ forces the charge back through the tube I and chamber G (the valve *e* by its own gravity meanwhile closing the tube *b* and opening *c*) and inlet *f* into the chamber F, and thence through the inlet *a* into the power-cylinder D.

A plunger, K, reciprocated horizontally in the chamber F, by being eccentrically attached to the axle B, opens and closes the inlets *f* and *a* at the proper intervals, and such plunger is so arranged as not to uncover the inlet *a* until the supply-piston E′ has advanced slightly on its instroke, and thereby created a slight compression of the mixture in the supply-cylinder E. The plunger K also performs the additional function of carrying ignition from the external gas-jet, *h*, to the charge within the power-cylinder D; but as the construction and operation of the igniter is the same as that fully described in Letters Patent of the United States No. 335,564, granted me for improvements in gas-engines of date February 9, 1886, on which no claim is herein made, I do not deem it essential to here repeat the organization or operation of the plunger K as an igniter.

An exhaust-port, *i*, is formed in the opposite side of the power-cylinder D, and is opened and closed at proper intervals by the cut-off L, reciprocated from the shaft B in the open-ended chamber L′, with which the exhaust-port *i* communicates. About the limit of the outstroke of the power-piston D′ the cut-off L opens the exhaust-port *i*, and closes such exhaust at or shortly before the return of such piston to the port *i*. The piston D′ may be made to itself close the port *i* at the inner ex-

tremity of the latter. Soon after the beginning of the instroke of the piston D′ the inlet *a* is opened, as aforesaid, by the plunger K, and at this time the supply piston E′ has advanced slightly on its instroke and the charge been somewhat compressed. The charge is therefore introduced into the power-cylinder D during part of the instroke of the piston D′, the introduction of such charge having its initiative shortly after the beginning of the instroke of the supply-piston E′. The charge is therefore compressed by the coincident action of both pistons. The supply-piston E′ contributes to the compression of the charge by forcing the latter into a chamber constantly decreasing in capacity—to wit, the power-cylinder. The power-piston D′ co-operates in the compression of such charge by directly decreasing the capacity of that end of the power-cylinder into which the charge is the while being forced by the supply-piston E′, as aforesaid. The exhaust-port *i* is not closed until the power-piston D′ has advanced nearly half of its instroke, and such incoming piston D′ therefore expels through the exhaust-port *i* that portion of the products of combustion contained in the power cylinder between such exhaust-port and the outer limit of the power-piston. The coincidently incoming charge prevents such residuum from passing into the inner end of the power-cylinder.

The action of the two pistons is so related that at the time one-half the contents of the supply-cylinder has been forced into the power-cylinder the power-piston D′ has reached the exhaust *i* on its instroke and expelled the products of combustion to that point, as aforesaid. From this time onward during the residue of the instroke of both pistons the compression of the charge is the joint act of each, the supply-piston completing its injection of the charge a sufficient interval before the power-piston reaches the limit of its instroke to permit the closing of the inlets *a* and *f* without interrupting the injection of such charge.

The explosion generates intense heat in the power-cylinder D, and even after the exhaust *i* is open and the heat of the products of combustion largely reduced as the result of the escape thus afforded the residuum of such products remaining in the cylinder D are at a very high temperature, but greatly rarefied. The introduction of a new charge at its normal temperature so reduces the temperature of such residuum, and thereby so greatly shrinks its volume, that no objectionable results are experienced from its presence. The instroke of the plunger K closes the inlets *f* and *a* immediately after the introduction of the charge.

The supply-piston E′, by reason of its crank-connection, as shown, is on its instroke slightly in advance of the power-piston D′, and therefore forces the charge into the power-cylinder D slightly in advance of the power-piston D′ reaching the limit of its instroke, and thereby time is afforded, as aforesaid, for closing the inlets *f* and *a* without interrupting the ingress of the charge.

In order that the residuum of the products of combustion may be suddenly cooled, and thereby shrunk in volume, it is essential that the incoming charge be instantly distributed throughout the interior of the power-cylinder D.

In practice I find that this can be effectually accomplished by placing a vertical partition or deflection, M, on the inner side of the head D^2 of the power-cylinder D. The partition M extends into the cylinder D to nearly the limit of the instroke of the piston D′, and is provided with orifices M′, and is nearly or quite the width of the internal diameter of the cylinder D. As the incoming charge strikes the adjacent face of the partition M and the nearer half of the head D^2, it is instantly deflected toward the piston D′ as far as the exhaust *i*, and from thence to the opposite side of such partition, thereby at once permeating, cooling, and shrinking the residuum of the products of combustion remaining in such cylinder. This process is assisted by a portion of such charge passing through openings M′ in such partition.

The feed of gas, and thereby the velocity of the engine, is regulated as follows: A vertical arm, 1, is pivoted at its lower end to the bed A′, and is provided at its upper end with the friction-roller 2. A horizontal rod, 3, is pivoted at its outer end about midway of the arm 1, and at its opposite end extends into the gas-chamber H, and in such chamber, beyond the juncture of the gas-pipe *d* therewith, is provided with a circular head adapted, on the withdrawal of such rod, to close the opening of the tube *d*. A coiled spring, 4, placed on the rod 3 and held between a fixed collar, 5, thereon and the end of the chamber H, tends to hold the roller 2 against a collar, 6, on the shaft B, and to draw the head of such rod over the opening into the tube *d*. A loose collar, 6, is placed on the shaft B and provided with a semi-annular external flange, 7. Two bell-crank levers, 8, Fig. 3, are pivoted at their angle to the collar 9, attached to the shaft B, and their inner ends pivoted in slots to opposite sides of the collar 6. The outer ends of the levers 8 are projected within the pulley C, and provided with governor-balls 10, which latter are adjustably connected by means of a spiral spring, 11. In the normal condition of the engine the friction-roller 2 with each revolution of the shaft B traverses the flange 7, and thereby the gas-tube is intermittently opened into the chamber H. Any accelerated speed of the engine causes the balls 10 to separate, and thus draw the collar 6 outward and flange 7 out of the path of the roller 2, and the latter then traversing only the smooth exterior of such collar, the tube *d* remains nearly or quite closed until the reduced speed again brings the flange 7 into the path of such roller, and thereby forces the

arm 1 inward and increases the said opening of the tube *d*.

Difficulty has heretofore been experienced in sufficiently sealing the communication between the igniter and power-cylinder to prevent the escape of a portion of the mixture at the time of explosion. To obviate this I seat in the side of the chamber F and around the inlet *a*, Figs. 5 and 6, an adjustable plug, N, having the central opening, N′.

The plug N, at its outer end, extends halfway around the interior of the chamber F, and has its upper edge seated in a recess formed in the wall of such chamber and its lower portion held from outer movement on the withdrawal of the plunger K by the projected lower portion of the latter.

A slight recess, N^2, is formed at the interior end of the plug N for the admission and outward pressure of the mixture, so as to hold the concave end of such plug firmly against the cylindrical plunger K when the latter closes the inlet *a*. Thus the outer margin of the inlet *a* is held firmly against such plunger, and any wear of such contiguous parts compensated by the outward pressure of the mixture, and any escape of the latter around the outer end of such inlet wholly prevented.

What I claim as my invention, and desire to secure by Letters Patent of the United States, is—

1. The cylinder D, provided on its head D^2 with the partition M, projected into such cylinder from the inner face of such head, substantially as shown, and for the purpose specified.

2. The combination of the cylinder D, provided with the interiorly-projected partition M and the inlet *a*, the piston D′, and means for forcing the mixture into such cylinder through such inlet, whereby such mixture is quickly distributed throughout the internal area of such cylinder, substantially as shown, and for the purpose described.

3. In combination with the power-cylinder of a gas-engine provided with an inlet, *a*, the partition M, projected interiorly from the head of such cylinder in front of such inlet, substantially as shown, and for the purpose mentioned.

4. The construction, substantially as shown, of a power-cylinder having inlet *a* and a partition, M, extended interiorly from the head of such cylinder, so as to intercept the charge in its ingress through such inlet.

5. The combination of the power-cylinder D, the chamber F, provided with recess N^2, the inlet *a*, communicating from said cylinder to said chamber, the cylindrical plunger K, and the plug N, having the upper edge of its outer end seated in a recess formed in the wall of said chamber and provided with central opening, N′, and the concaved outer end to partially embrace such plunger laterally, substantially as shown, and for the purpose described.

6. The combination of a power-cylinder provided with exhaust-port *i*, a power-piston, a supply cylinder and piston, an inlet, *a*, communicating from one of said cylinders to the other, the cut-off L, and plunger K, said parts being so arranged and their coaction timed that said plunger K prevents the admission of the mixture into the inlet *a* until the supply-piston has partially advanced on its instroke and then opens the passage into said inlet, and the cut-off L opens the exhaust *i* about the limit of the outstroke of said power-piston, and closes such exhaust when the power-piston on its instroke has nearly or quite reached such exhaust, whereby the inlet *a* is opened after partial compression of the mixture has been accomplished in the supply-cylinder, and said exhaust-port remains unclosed until after said mixture has been introduced in part within said power-cylinder.

7. The combination of the arm 1, suitably pivoted at one end and provided at its other end with the friction-roller 2, the rod 3, pivotally connected at its outer end to the arm 1 and having its inner end projected into the chamber H, and adapted to adjustably open and close the communication of the tube *d* with such chamber, the spring 4, chamber H, the collar 6, provided with external semi-annular flange, 7, and levers 8, pivotally connected to collar 6 and adapted to be actuated in the usual way by governor-balls 10, substantially as shown, and for the purpose specified.

8. In a gas-engine, the combination, substantially as shown, of a power cylinder and piston, a supply-piston, a supply-cylinder provided with the admission and exit tube I and communicating intermittently with said power-cylinder, and a plunger, K, adapted to intermittingly open and close said communication and so timed in its action as to open said communication between said cylinders for the admission of the charge into said power-cylinder only after said supply-piston shall have advanced somewhat on its instroke, for the purpose described.

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

JOHN CHARTER.

Witnesses:
WALTER N. HASKELL,
V. S. FERGUSON.