(No Model.)

2 Sheets—Sheet 1.

H. & C. E. SKINNER.

GAS ENGINE.

No. 335,971. Patented Feb. 9, 1886.

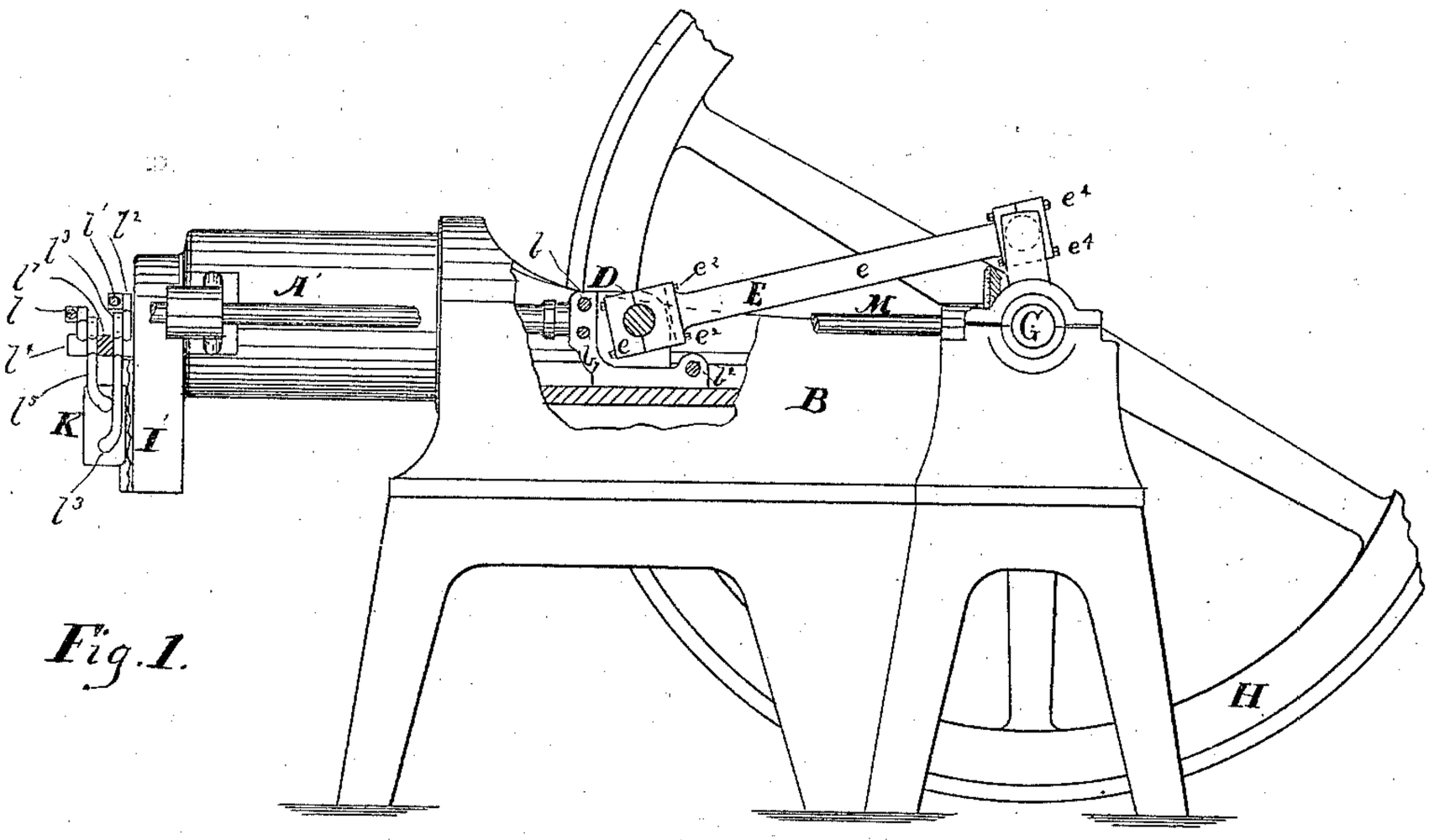

Fig. 1.

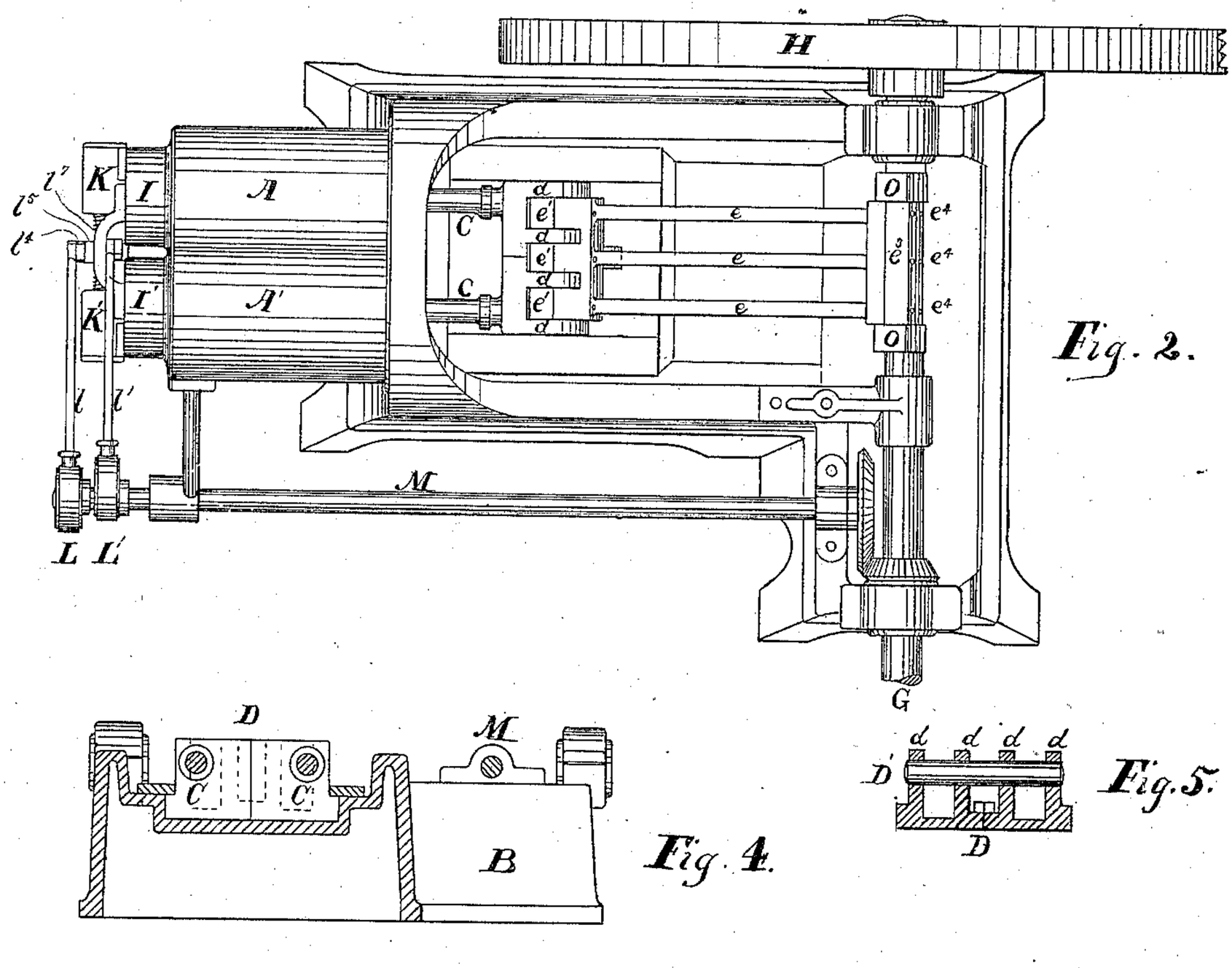

Fig. 2.

Fig. 4.

Fig. 5.

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(No Model.) 2 Sheets—Sheet 2.

H. & C. E. SKINNER.

GAS ENGINE.

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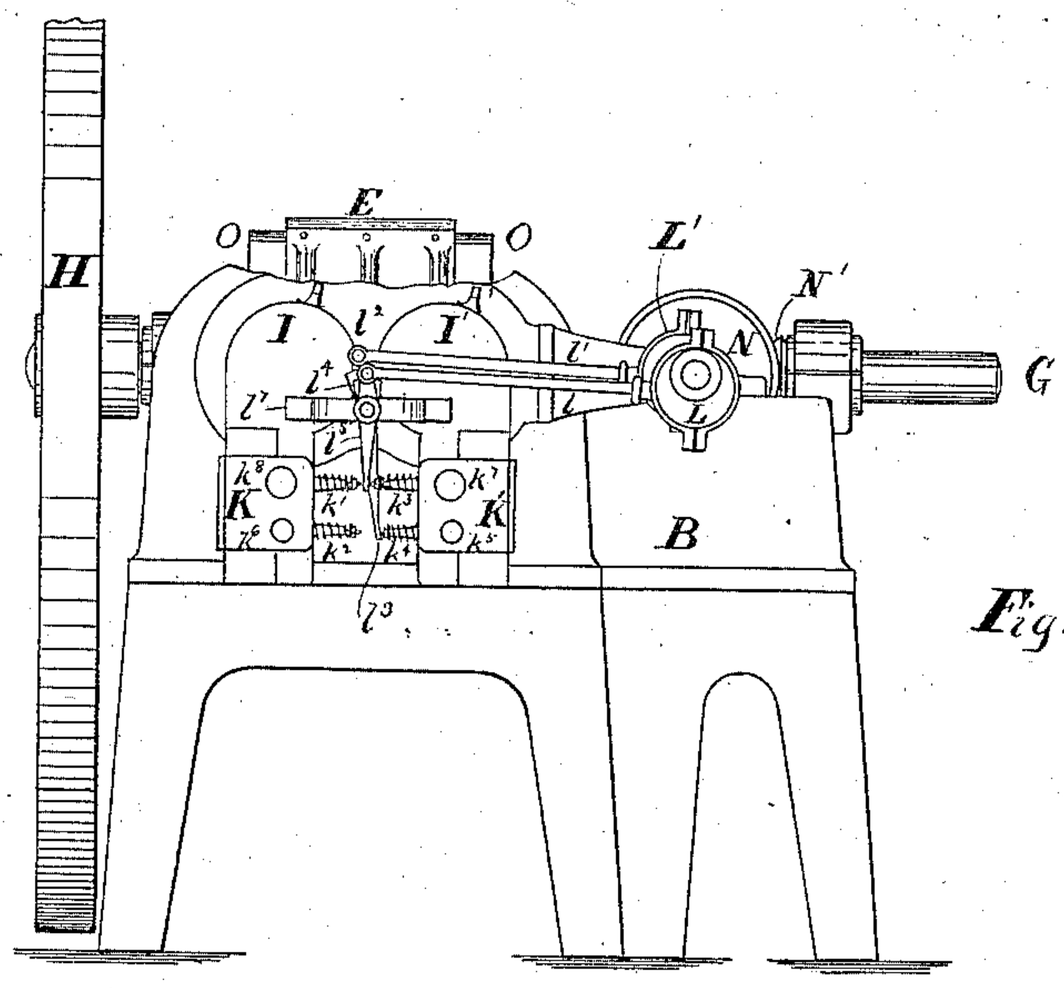

Fig. 3.

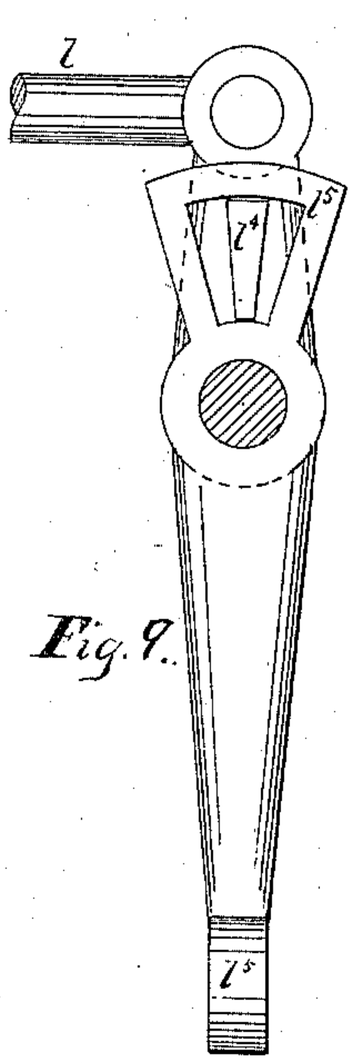

Fig. 9.

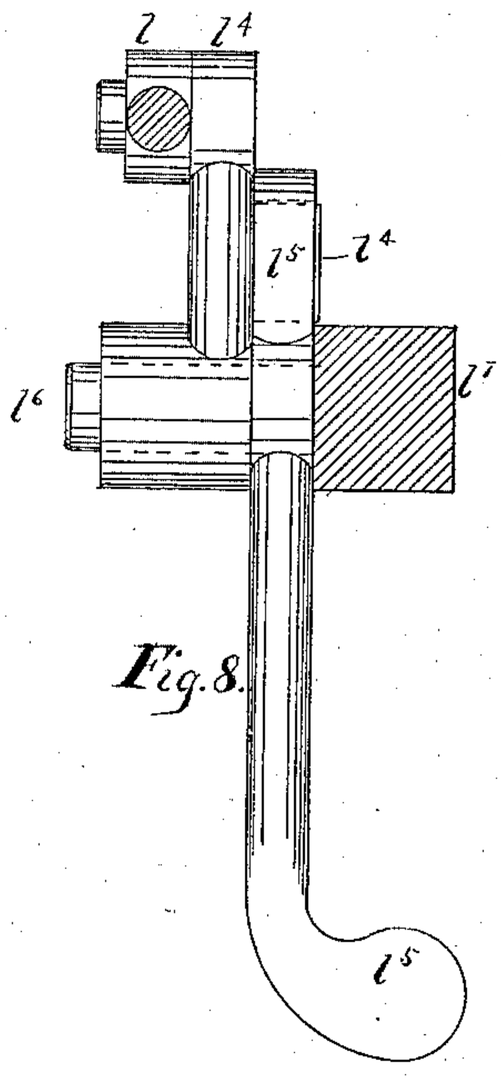

Fig. 8.

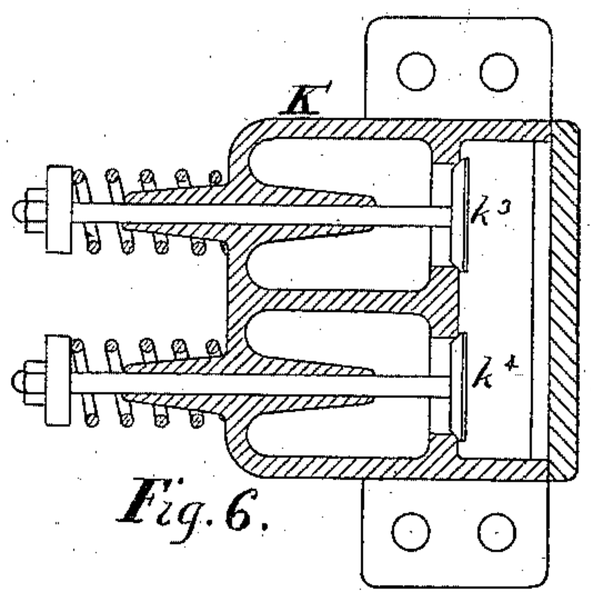

Fig. 6.

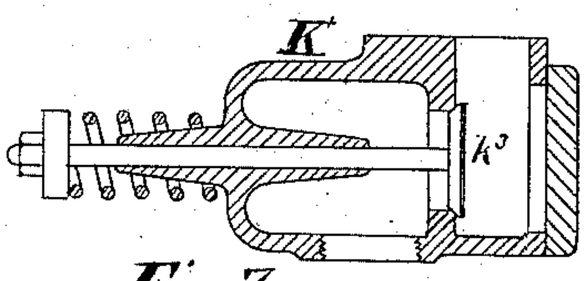

Fig. 7.

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UNITED STATES PATENT OFFICE.

HALCYON SKINNER AND CHARLES E. SKINNER, OF YONKERS, NEW YORK.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 335,971, dated February 9, 1886.

Application filed April 2, 1885. Serial No. 161,084. (No model.)

To all whom it may concern:

Be it known that we, HALCYON SKINNER and CHARLES E. SKINNER, of the city of Yonkers, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Gas-Engines; and we declare the following to be a full, clear, and exact description of the invention, reference being had to the accompanying drawings, which form part of this specification.

Our invention relates to an improvement in that class of gas-engines in which the explosive charge is drawn into the cylinder by one outstroke of the piston and compressed into explosion-chambers by its return. The second outstroke of the piston is produced by the explosion of the charge, and the second return clears the cylinder of the products of the explosion. As will be seen, the pressure is applied to the piston during a quarter of the time only, the remainder of the time the engine being moved by the momentum of the fly-wheel. This leads to considerable variation in speed; and the object of this invention is to supply means whereby an impulse is given to the piston at each revolution, also a simple and compact arrangement of the valves and the mechanism for operating them.

To this end the engine is furnished with two cylinders lying side by side, and preferably cast together. These have pistons joined together at the cross-head, and by means of a single connecting-rod transmit power to the crank.

In the accompanying drawings, Figure 1 is an elevation, Fig. 2 a plan, and Fig. 3 an end view, of an engine embodying our invention. Fig. 4 is a sectional view through slides; Fig. 5, a section of cross-head at wrist-pin; Figs. 6 and 7, enlarged views of valves; Figs. 8 and 9, enlarged views of levers, &c., for operating valves.

A A′ are the cylinders, cast together, attached to bed-plate B. The pistons of these cylinders are joined together by piston-rods C C′ to cross-head D. The cross-head is formed of two parts, one of which is attached to each piston-rod, and is cast in one piece with the piston, for convenience of manufacture. The two halves of cross-head are secured together by bolts *b b′ b²*. The connecting-rod E is formed with a half-bearing on each end, joined together by bars *e e e*, for lightness; or an open web may be substituted for the middle bar. The cross-head D has projections *d d d d* cast on it, forming bearings for wrist-pin D′. Between these projections are the caps *e′ e′ e′*, which are bolted to the connecting-rod by bolts *e² e² e²*. The half-bearing at crank has also a cap, *e³*, bolted on by bolts *e⁴ e⁴ e⁴*.

G is the crank-shaft with fly-wheel H.

The cylinders are each provided at the back end with an explosion-chamber, I I′. To these are bolted the valve-chambers K K′, each containing two valves, *k′ k²*, *k³ k⁴*, which are actuated by eccentrics L L′ by means of rods *l l′*, levers *l² l³*, and levers *l⁴ l⁵*.

l′ is a stand attached to explosion-chambers I I′, holding stud *l⁶*, on which levers *l²*, *l³*, *l⁴*, and *l⁵* are rocked.

The eccentrics L L′ are on the longitudinal shaft M, driven from crank-shaft G by gears N N′, which are so proportioned that the shaft M makes one-half a revolution for each turn of the crank-shaft.

Having described the construction and relative arrangement of the several parts of our improved gas-engine, we will now describe its operation.

The pistons, being joined together at the cross-head, move in unison. When an explosion takes place in cylinder A, the pistons advance, and the inlet-valve *k⁴* being opened by eccentric L′, rod *l′*, and levers *l² l³*, the piston in cylinder A′ draws in a charge of gas and air through opening *k⁵*. On the backward movement the piston in A clears the cylinder of the products of the explosion through exhaust-valve *k′*, and that in A′ compresses the charge of gas and air in explosion-chamber I′. On the second outstroke an explosion takes place in A′ and a charge is drawn through valve *k²* into A, and on the second return the charge is compressed into the explosion-chamber I and the products cleared out of A′ through exhaust-valve *k³*. Thus an explosion takes place at every forward movement of the pistons. The valves for admitting the charges of gas and air and the valves for exhausting are arranged in pairs opposite each other, so that the same lever may operate each alternately. The shaft M revolving once to two revolutions of the crank-shaft, the action of the eccentrics would be to hold each of their respective valves open

for one-half the time, whereas they are each required to be held open only during one-quarter of the revolution of the shaft M, or during the time their respective cylinders are drawing in their charges or exhausting the products of their explosions. To remedy this difficulty, the arrangement shown in Figs. 8 and 9 is used, whereby the motion from the eccentric is communicated to each of the valves during a quarter-revolution only. The lever l^4, operated by eccentric L by means of rod l, has on one side a V-shaped lug. The lever l^5, rocking on same stud, l^6, has the upper part extended and divided into a V-shaped opening, as shown, Fig. 9. Into this opening the lug on lever l^4 extends. The relation between the lug and opening is such that the lever l^4 is permitted to rock a certain distance without moving the lever l^5. When the lug strikes one side of the opening, the lever is moved the remainder of the distance of the throw of the eccentric. A like operation takes place at the other end of the stroke. Thus the lever l^3 operates the inlet-valves k^2 k^4 alternately during outstrokes of the pistons, and lever l^5 operates valves k' k^3 during alternate instrokes of the piston.

We prefer to have the motive cylinders placed horizontally; but they may be placed vertically with equal effect. We also prefer to use single-acting cylinders, but can readily make the arrangement double-acting with ordinary pistons, as usually made in a steam-engine. By the latter method the engine would receive an impulse twice in each revolution.

We have described our improvements as most conveniently applied; but they may be somewhat modified in form or construction without materially lessening their efficiency. We do not therefore strictly confine ourselves to the exact construction above mentioned, as it is evident that this may to some extent be altered without departing from the spirit of our invention.

There is no governor shown, as any style of regulating apparatus ordinarily used on gas-engines may be used in connection with our invention. We prefer to use electrical igniters of the form described in Patent No. 287,855; but any form of igniter may easily be adapted for use.

Having thus fully described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In a gas-engine, the combination, with the two cylinders having their pistons connected at a common cross-head, the connecting-bars *e*, and the crank-shaft, of the levers and their rods, the eccentrics, and the shaft M, constructed and arranged substantially as shown and described.

2. In a double gas-engine, the cylinders A A', provided with explosion-chambers I I', in combination with valve-chambers K K', placed with the valve-stems facing each other in pairs, substantially as described.

3. In a double gas-engine, the valve-chambers K K', placed with valve-stems facing each other in pairs, in combination with levers l^2, l^3, l^4, and l^5, rods l l', and eccentrics L L', substantially as described.

4. In a double gas-engine, the combination, with valve-chambers having the valve-stems placed facing each other in pairs, of levers adapted to move each valve-stem during only a quarter of the revolution of the eccentrics, substantially as described.

5. In a double gas-engine, the levers l^3 l^5, having V-shaped openings in their upper members, in combination with levers l^2 l^4, having projections working in the V-shaped openings, whereby the levers l^3 l^5 remain stationary during a portion of the throw of the levers l^2 l^4, substantially as shown and described.

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