(No Model.) 4 Sheets—Sheet 1.

E. D. DEBOUTTEVILLE & L. P. C. MALANDIN.

MOTIVE POWER ENGINE.

No. 400,754. Patented Apr. 2, 1889.

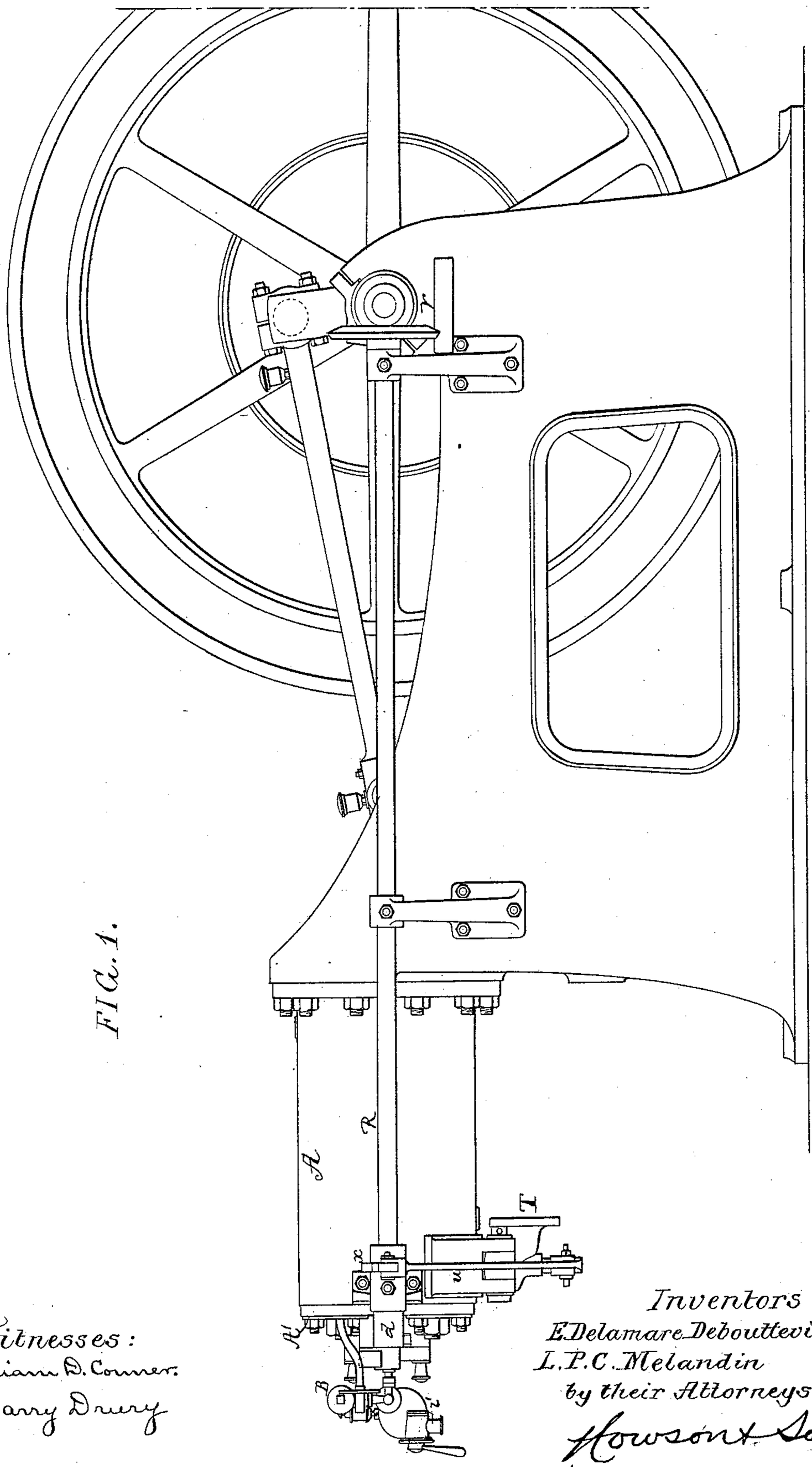

FIG. 1.

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FIG. 2.

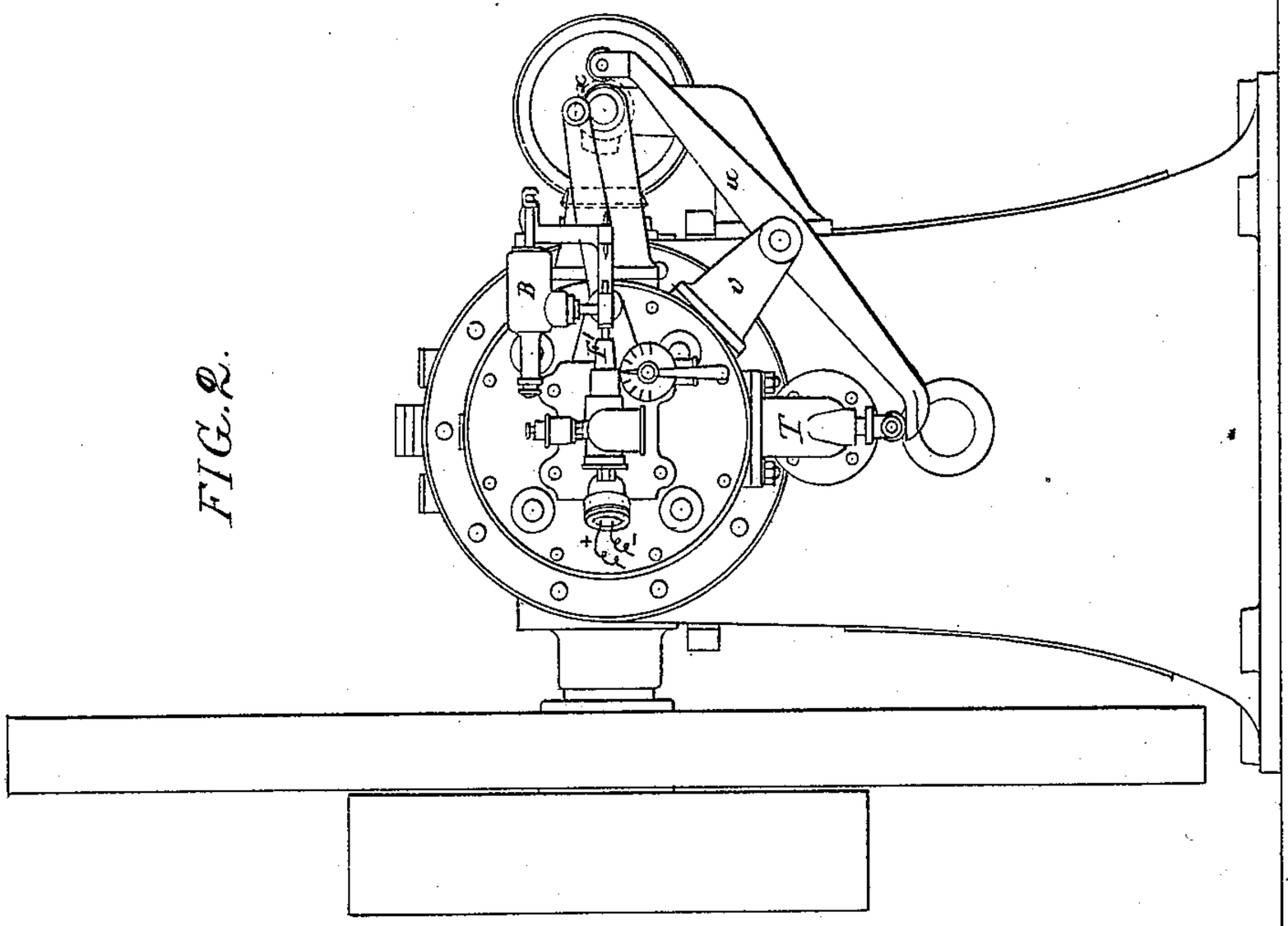
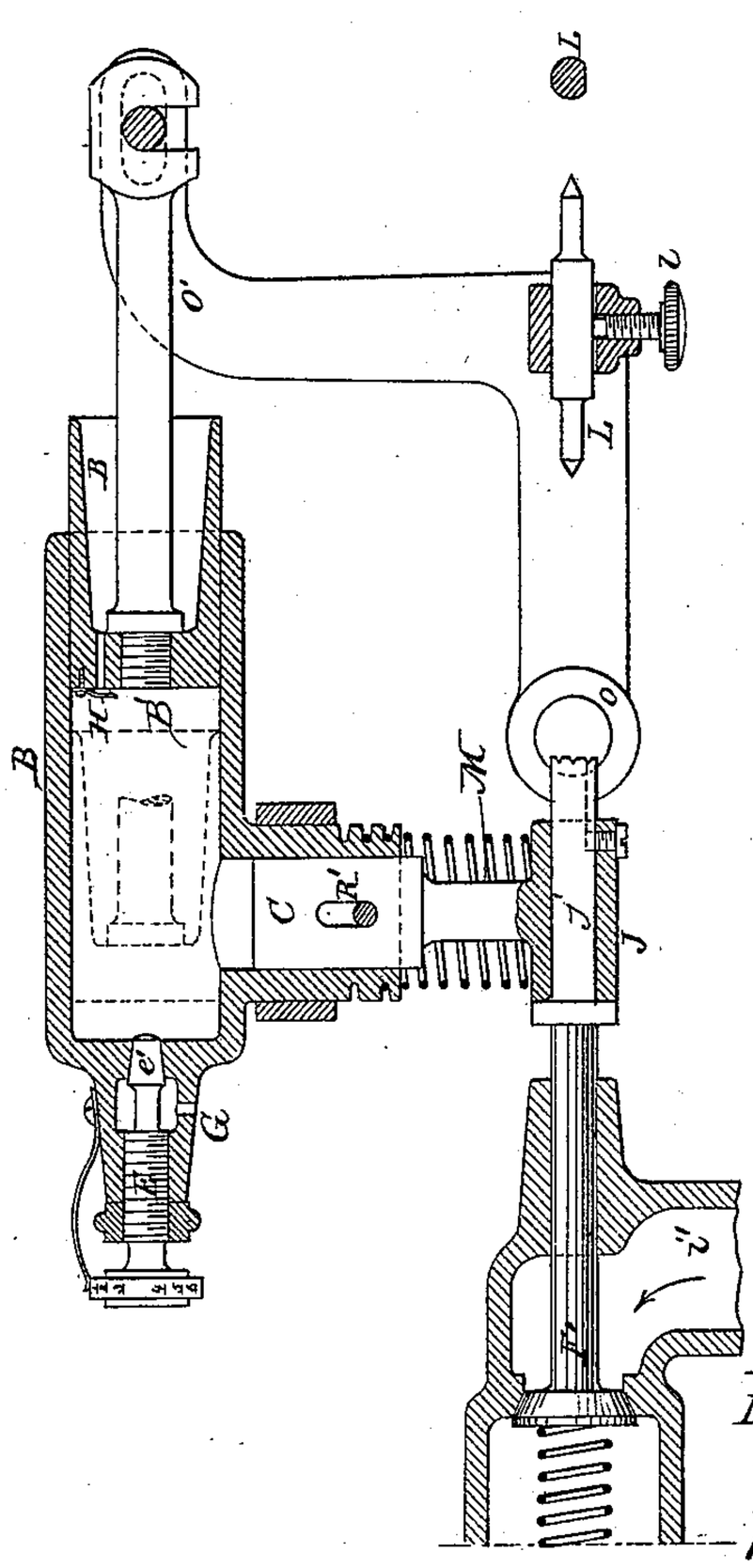


FIG. 3.



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MOTIVE POWER ENGINE.

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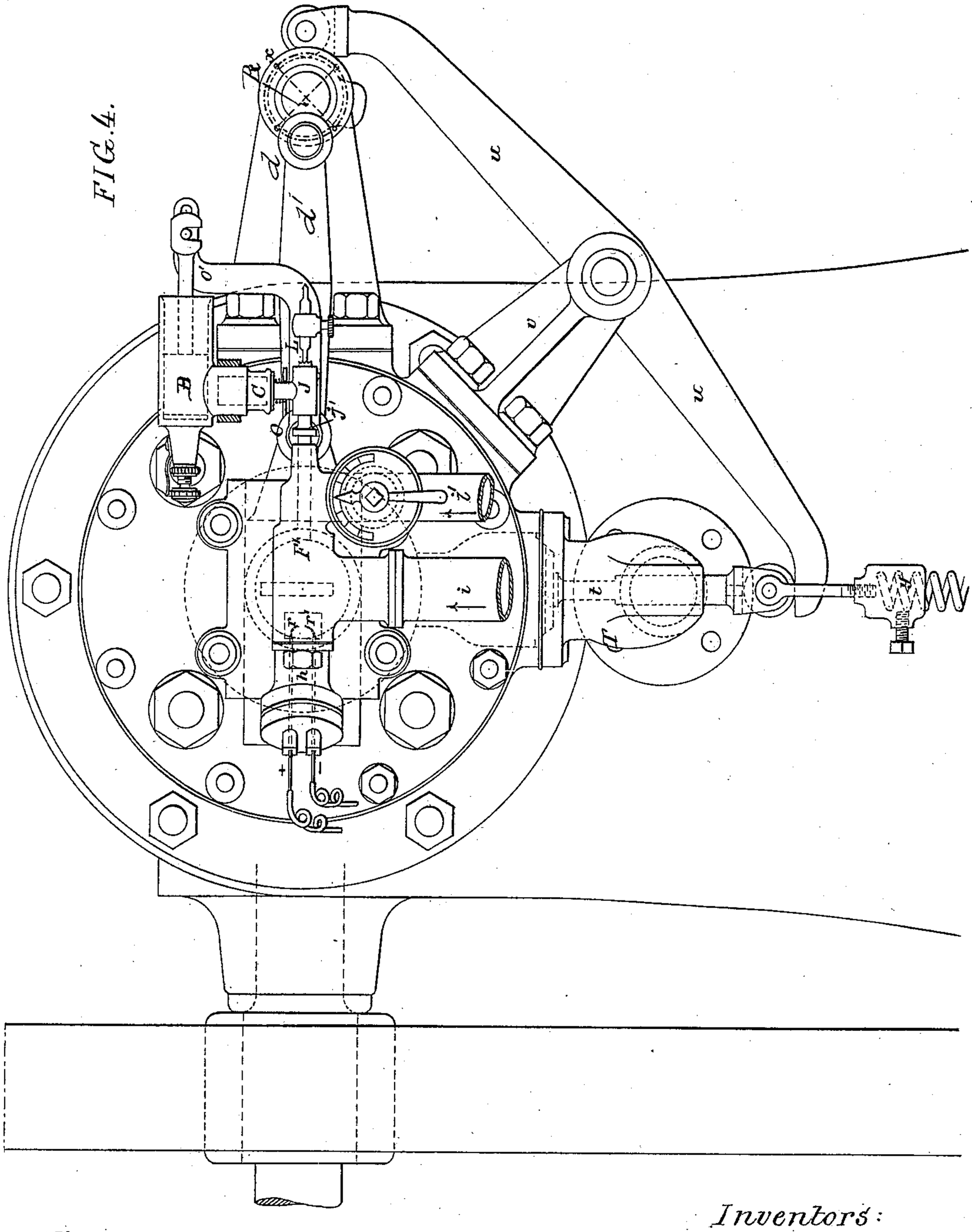
FIG. 4.



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MOTIVE POWER ENGINE.

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FIG. 5.

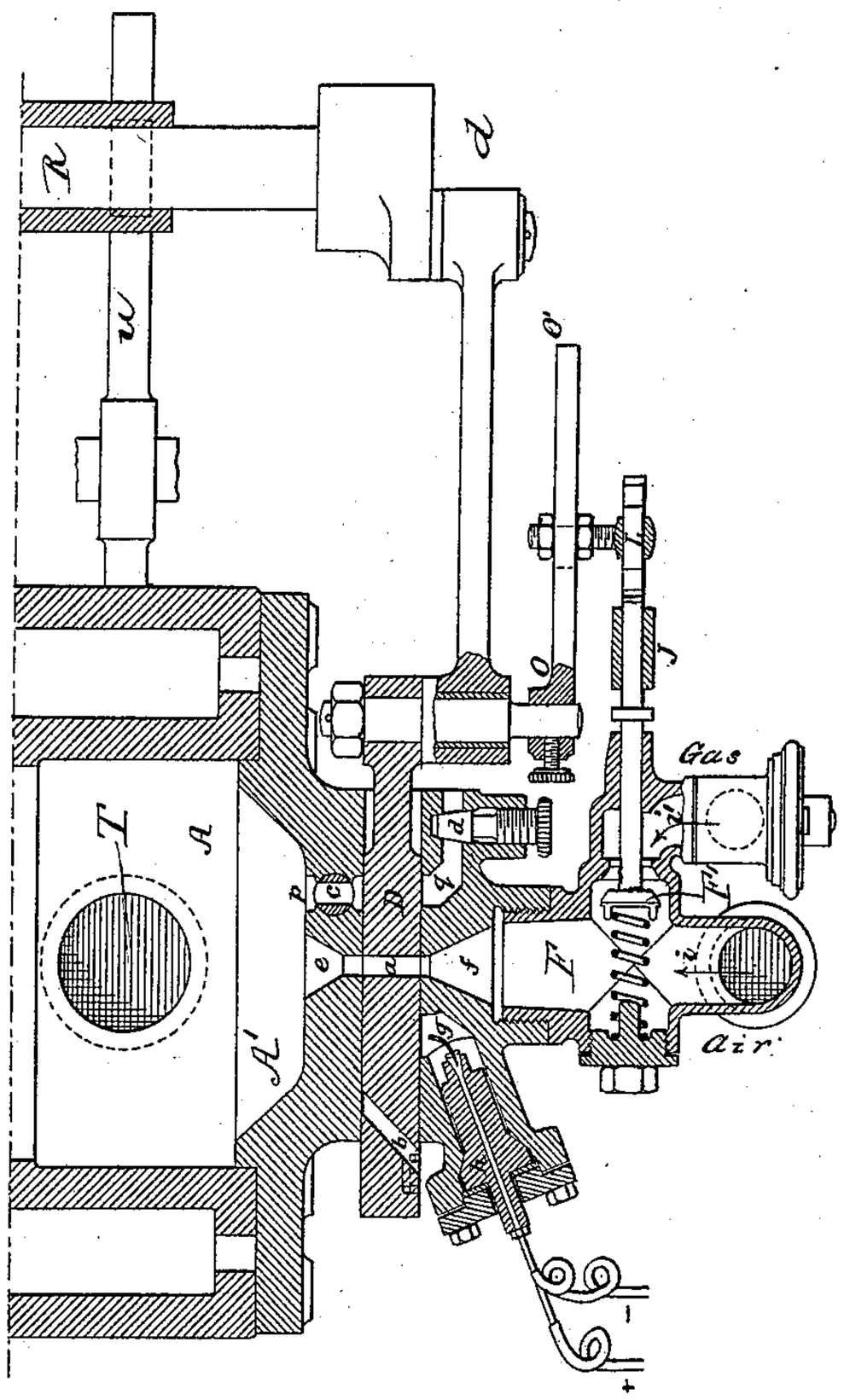


FIG. 5 bis.

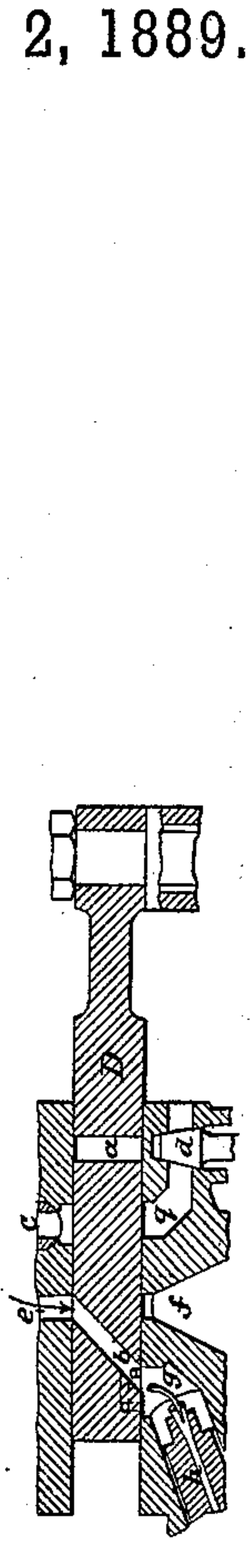


FIG. 6.

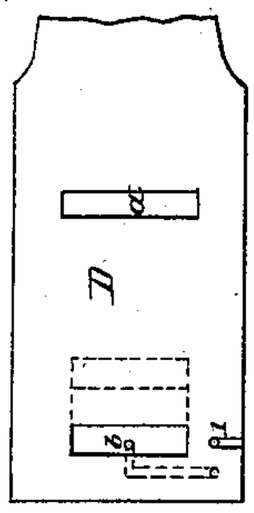


FIG. 7.

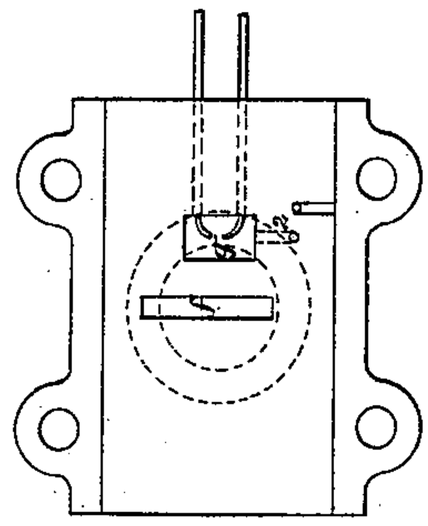
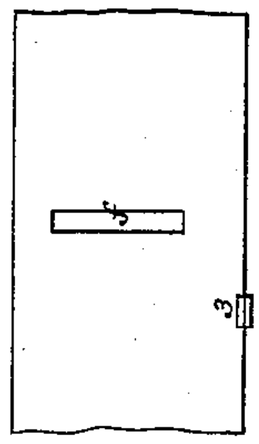


FIG. 8.



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UNITED STATES PATENT OFFICE.

EDOUARD DELAMARE DEBOUTTEVILLE AND LEON PAUL CHARLES MALANDIN, OF FONTAINE-LE-BOURG, FRANCE.

MOTIVE-POWER ENGINE.

SPECIFICATION forming part of Letters Patent No. 400,754, dated April 2, 1889.

Application filed October 12, 1886. Serial No. 216,012. (No model.) Patented in Germany May 4, 1884, No. 33,915, and May 2, 1886, No. 37,420; in France February 4, 1885, No. 160,267; in England January 1, 1886, No. 11; in Belgium May 4, 1886, No. 72,974; in Italy June 10, 1887, No. 21,842, and in Spain July 13, 1887, No. 11,124.

To all whom it may concern:

Be it known that we, EDOUARD DELAMARE DEBOUTTEVILLE and LEON PAUL CHARLES MALANDIN, both of Fontaine-le-Bourg, (Seine-Inférieure,) France, have invented certain Improvements in Gas-Engines, (for which patents have been obtained in France, No. 160,267, dated February 4, 1885; Great Britain, No. 11, dated January 1, 1886; Belgium, No. 72,974, dated May 4, 1886; Italy, No. 21,842, dated June 10, 1887; Spain, No. 11,124, dated July 13, 1887, and Germany, No. 33,915, dated May 4, 1884, and No. 37,420, dated May 2, 1886,) of which the following is a specification.

Our invention consists of certain improvements in the construction of gas-engines, our present improvements being designed more particularly with reference to the construction of gas-engines for which we have obtained Letters Patent of the United States, dated January 5, 1886, and reissued July 31, 1888, under No. 10,951.

In the accompanying drawings, Figure 1 is a side elevation of a gas-engine embodying our improvements. Fig. 2 is an end view. Fig. 3 is a sectional view, drawn to an enlarged scale, of the governing devices. Fig. 4 is an end view of the gas-engine cylinder, drawn to an enlarged scale from that shown in Fig. 2. Fig. 5 is a sectional plan view of the end of the cylinder with the valves, ports, and igniting devices. Fig. 5^{bis} is a sectional view showing the valve in a different position from that shown in Fig. 5. Fig. 6 is a rear view of the valve detached. Fig. 7 is an inside face view of the cover-plate of the valve. Fig. 8 is a face view of the end of the cylinder with the valve and cover-plate removed.

A is the working-cylinder of the gas-engine, which may be inclosed in a water-jacket, as described in our previous patent, and in this cylinder works the piston, which is connected through the usual rod to the crank-shaft, and the latter is provided with the usual fly-wheel and belt-pulleys. The outer end of the working-cylinder A is closed by the head A′, to which is adapted the transverse slide D, and this in turn is inclosed by the cover E, as shown in Figs. 1, 2, 4, and 5. This slide D is controlled by a crank, *d*, on the outer end of a longitudinal rod, R, through the medium of the connecting-rod *d′*. This shaft R receives a continuous rotary motion from the main crank-shaft through the medium of suitable bevel-gearing, *r*, Fig. 1.

The construction of the sliding valve D is illustrated more fully in Figs. 5 and 6, from which it will be seen that it has a central aperture, *a*, for the passage of the supply of air and gas from the mixing-chamber F through the tapering passage *f* and the opening *e* in the end of the cylinder into the cylinder, Fig. 5. In the machine of our former patent the electric igniting-points were carried by the slide itself; but in our present invention they are mounted in the inclosing-cover E. The conducting-wires, Figs. 4 and 5, are insulated in a porcelain plug, *h*, and terminate in two platinum points in a cavity, *g*, in the cover. In the reciprocating movement of the slide the cavity *g*, containing the sparking-points, is placed in communication at the proper moment with the orifice *e* in the end of the cylinder through the medium of an inclined passage, *b*, Fig. 5, in the slide. The explosive mixture in the cylinder is then ignited, and the force developed causes the movement of the piston.

In order to purge or clear the cavity *g* of the burned gases with which it is filled after the explosion, orifices 1 and 2 are provided, as follows: At the moment when the passage *b* in the slide communicates with the orifice *e* in the end of the cylinder the mixture compressed by the piston rushes into the passage *b* and the cavity *g*, so that a small quantity of gas in trying to escape through the orifices 1 and 2 and through the opening 3, Fig. 8, forces before it the burned gases contained in the passage *b* and cavity *g*, so that the latter are thoroughly purged. The small passage 1 is of the rectangular form in-

dicated in Fig. 5, and communicates with the small passage 2. The third passage, 3, is a relief-passage made in the cover to enable the gases to be discharged from 1 and 2. The movement of the slide being rapid, these small passages only permit of the escape of a quantity of gas just sufficient to clear the burned gases out of the cavity. These passages 1, 2, and 3 perform the same functions as the passages *m* of the machine shown in our former patent. The spark passing between the igniting-points in the cavity *g* may be produced by two batteries connected with an accumulator and with an induction-coil in the sparking-circuit. We prefer to make the production of the spark continuous and to control the ignition by means of the distributing-slide D, for this dispenses with a commutator. If preferred, however, the spark may be produced intermittently by a commutator or by a key which at the proper moment closes the circuit communicating with the two platinum points. A platinum wire or a piece of spongy platinum to be heated to incandescence by the electric current may be substituted for the two platinum points. When a dynamo-electric machine is employed in combination with an induction-coil, an electrical accumulator should be provided, in order to produce the sparks required for starting the engine.

For introducing the gaseous mixture we employ the arrangement shown in Figs. 3, 4, and 5. Air enters from the passage *i* into the mixing-chamber F, and gas enters the same mixing-chamber from the passage *i* upon the opening of the valve F′. The gases are intimately mixed in the chamber F, and thence passed through the orifices *f a e* into the cylinder.

The valve *t* for the exhaust T, Figs. 4 and 5, is operated by a lever, *u*, pivoted to a bracket, *v*, on a fixed part of the engine, and this lever is vibrated by means of a cam, *x*, upon the shaft R. A spring, *y*, closes the valve *t* when the lever *u* is released from the action of the cam.

The valve F′ is opened against the action of its spring by a knife-edge, L, striking the notched end of a rod, *j*, which bears against the end of the stem of the valve, Fig. 3, and this knife-edge is reciprocated from the valve D by the means which are now described.

As will be seen on reference to Fig. 3, B is a compressing-cylinder in which works a compressing-piston, B′. During the drawing in of the gaseous mixture into the cylinder this piston B′ moves inward through the medium of the bell-crank lever O′, connected at O to the valve D, and as this piston moves inward it compresses the air in the cylinder B, with the result of forcing outward the piston C, which is connected to a socket, J, through which passes the sliding rod *j*, bearing against the end of the stem of the valve F′. When this rod is not acted upon by the tappet or edge L upon the lever O′, the valve F′ is not opened, and in consequence the admission of gas does not take place and the engine misses one explosion. The screw E is employed to regulate the escape of the compressed air. A cone, *e′*, on the end of the screw is adapted to a corresponding opening in the end of the compressing-cylinder B, so that by this means the escape of air can be nicely adjusted. The escaping air is discharged into the atmosphere through an opening, G. The speed of the engine is regulated by varying the amount of air allowed to escape past the cone *e′* on the screw E. When the cone *e′* is adjusted to a degree of opening corresponding with the regular speed at which the engine is to run, the piston C will remain stationary with reference to the cylinder B, being balanced between the pressure of its spring *m* and the pressure of the compressed air against the action of the spring. Under these conditions gas is admitted each time there is an exhaust from the working-cylinder. On the other hand, if the speed of the engine is accelerated, the air continuing to escape from the cylinder B at the same rate, the pressure in the cylinder B will increase and press upon the piston C, so as to cause the piston with the rod *j* to descend. This causes the tappet L to miss the rod *j*, bearing on the stem of the valve F′, which, not being opened, therefore does not admit any gas at the next stroke. These conditions are maintained until the motor resumes its normal speed. A pin carried by the cylinder B, and passing through a slot, R′, in the piston C, prevents the latter from being entirely withdrawn from the said cylinder. A flap-valve in the piston B′ permits the air to enter the cylinder during the back-stroke of the piston. The tappet or knife-edge L is adjusted in the socket on the arm or lever O′, and can be secured after adjustment by means of a set-screw, *l*, so as to open the valve F′ to a greater or less extent at each movement of the slide. We also prefer to provide convenient means to facilitate starting the engine, in order to overcome the difficulty usually experienced in starting compressing gas-engines, owing to the resistance of the compressed mixture. Before starting the engine a valve, *c*, in the head of the cylinder is opened and a plug, *d*, in passage *q* is unscrewed. When the fly-wheel is turned, no compression takes place, as the mixture escapes through the passages *p q*, which are then put in communication through the passage *a* and slide D. When the passage *a* has passed beyond the orifices *p q*, the spark ignites the mixture, as already described, and the piston is moved outward. The engine being thus started, its speed gradually increases, and the plug *d* can then be gradually screwed inward, so as to increase the compression of the gaseous mixture by diminishing the leakage. When the plug *d* has been finally screwed home, the valve *e* is also closed, in order to avoid useless pressure of the gases upon the slide D through the passage *q*.

We claim as our invention—

1. A gas-engine provided with a slide-valve having a small outlet from the igniting-chamber to the atmosphere when the said chamber is opened to the cylinder, in combination with an inclosing-cover for the slide, and containing said igniting-chamber, substantially as set forth.

2. The combination of the gas-valve of a gas-engine and a compressing-cylinder and piston operated by a moving part of the engine, with a tappet operated with the slide to act on the gas-valve under the control of the compressing-cylinder and piston, substantially as described.

3. The combination of the cylinder of a gas-engine and its slide having a passage, *a*, with passages *p q* in the cylinder-head and cover, and a regulating-plug for the escape of the air in starting the engine.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

EDOUARD DELAMARE DEBOUTTEVILLE.
LEON PAUL CHARLES MALANDIN.

Witnesses:
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WILLIAM J. POWELL.