

(No Model.)

5 Sheets—Sheet 1,

C. JACOBSON.
GAS ENGINE.

No. 586,312.

Patented July 13, 1897.

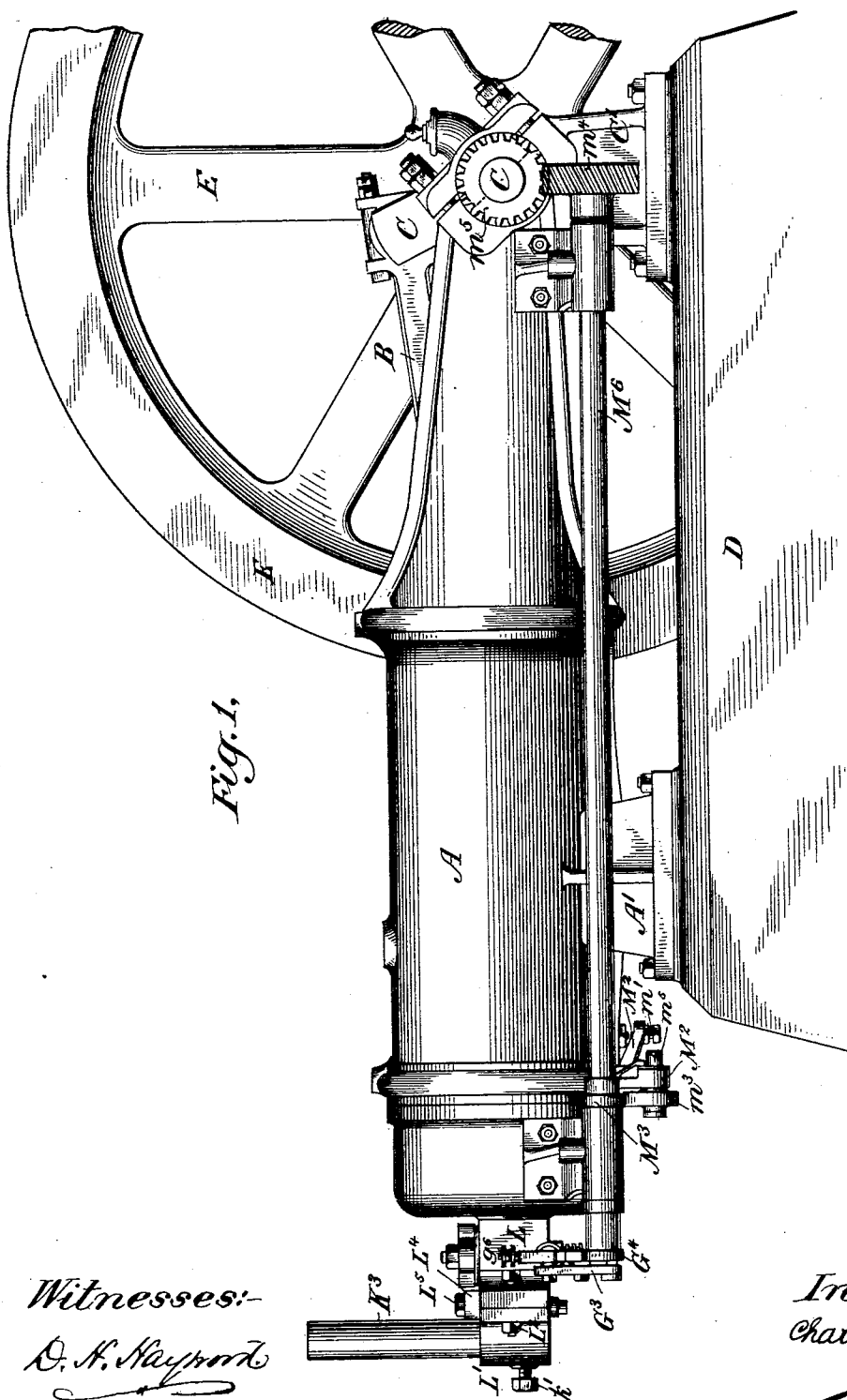


Fig. 1.

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D. A. Davis.

Inventor:
Charles Jacobson
by his atty
Edwin H. Brown

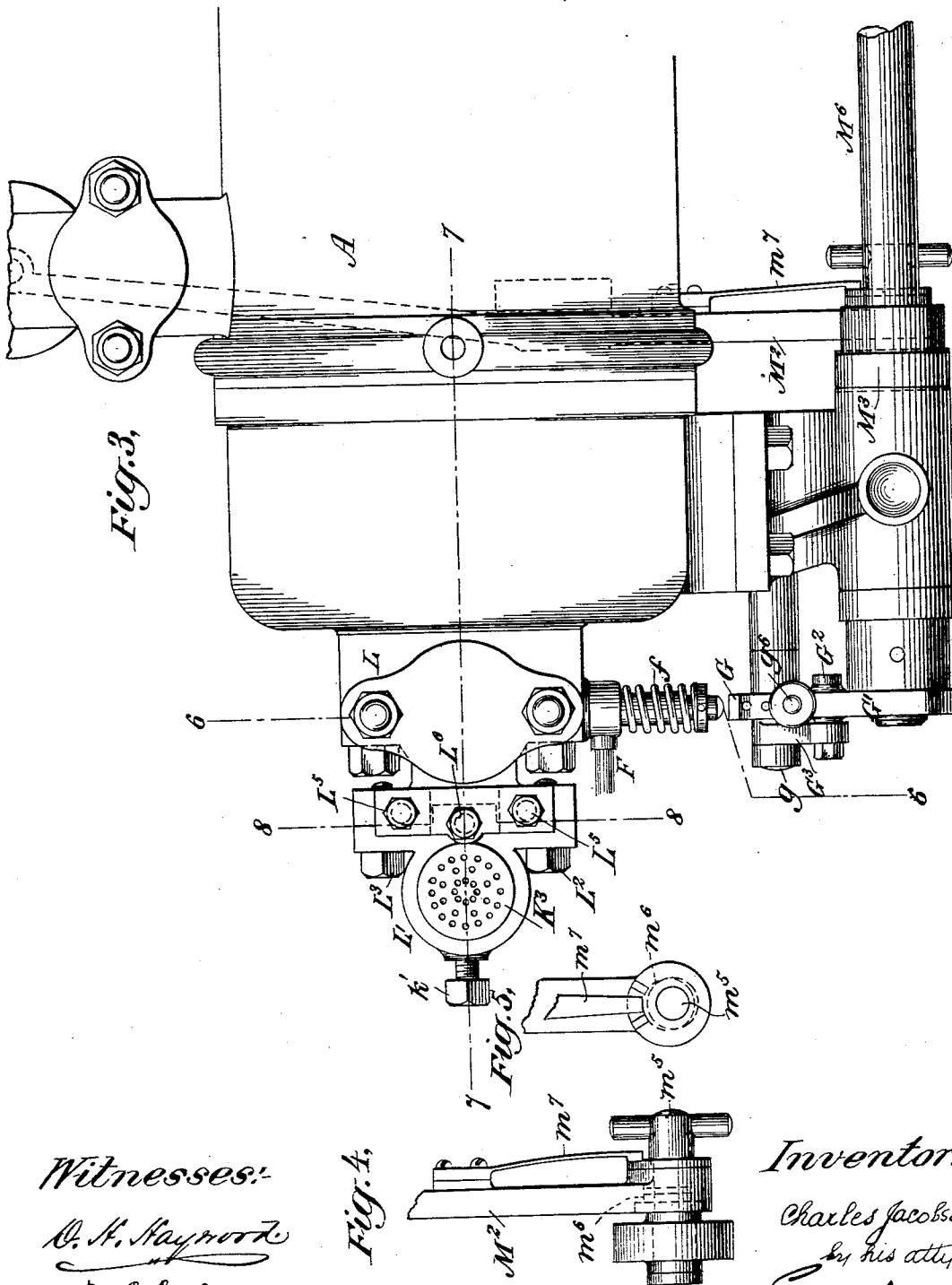
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C. JACOBSON.
GAS ENGINE.

No. 586,312.

Patented July 13, 1897.



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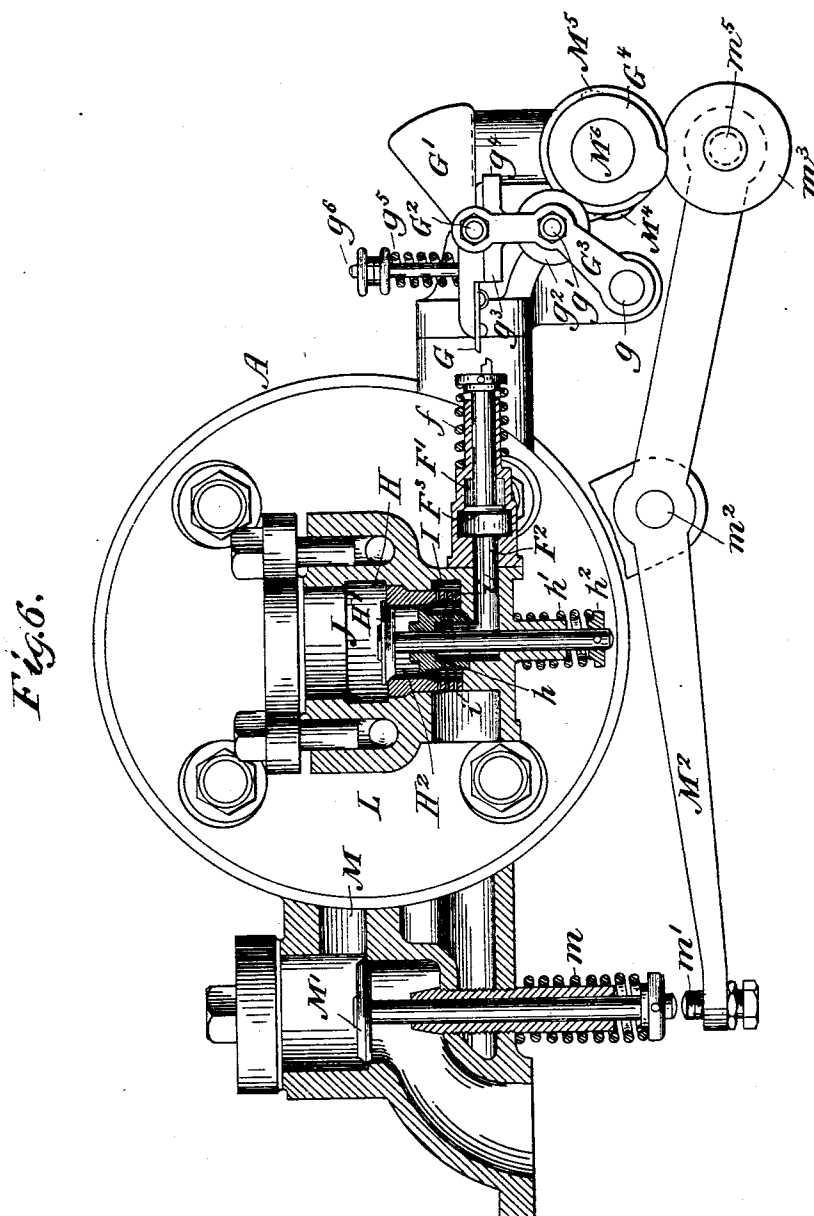
(No Model.)

5 Sheets—Sheet 4.

C. JACOBSON.
GAS ENGINE.

No. 586,312.

Patented July 13, 1897.



Witnesses:-

Ernest Hopkinson

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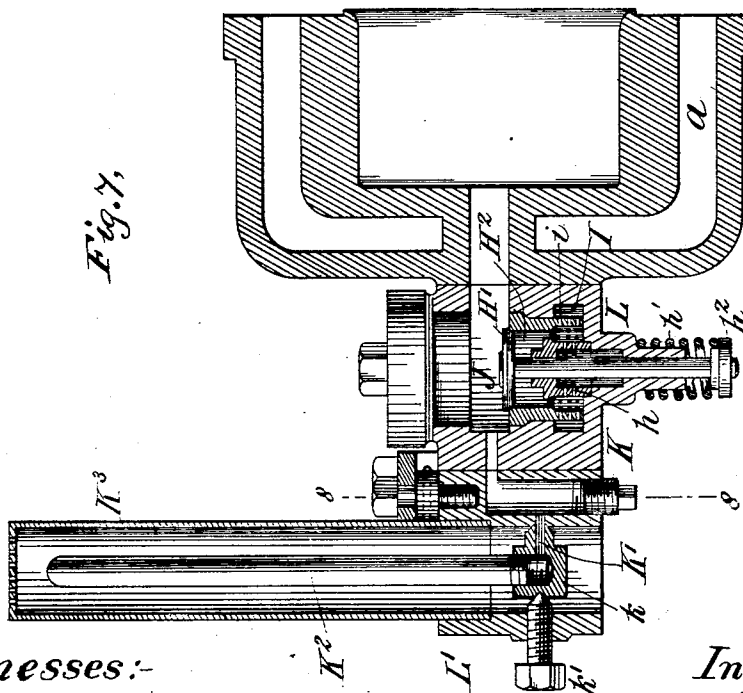
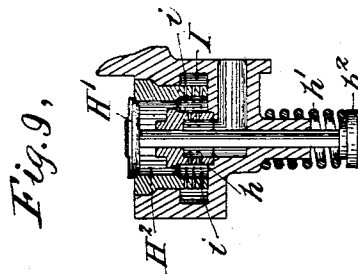
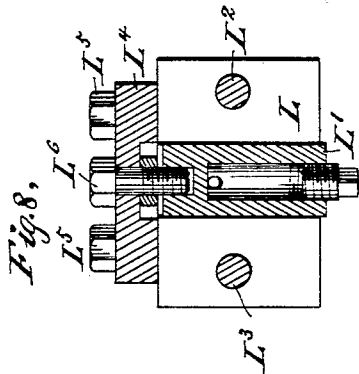
(No Model.)

5 Sheets—Sheet 5.

C. JACOBSON.
GAS ENGINE.

No. 586,312.

Patented July 13, 1897.



Witnesses:-
 Ernest Hopkinson
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Inventor:-
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UNITED STATES PATENT OFFICE.

CHARLES JACOBSON, OF BROOKLYN, NEW YORK, ASSIGNOR TO THE CLIMAX GAS ENGINE COMPANY, OF SAME PLACE.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 586,312, dated July 13, 1897.

Application filed September 24, 1895. Serial No. 563,569. (No model.)

To all whom it may concern:

Be it known that I, CHARLES JACOBSON, of Brooklyn, in the county of Kings and State of New York, have invented a certain new and useful Improvement in Gas-Engines, of which the following is a specification.

I will describe a gas-engine embodying my improvement and then point out the novel features in the claims.

In the accompanying drawings, Figure 1 is a side elevation of an engine embodying my improvement, a portion of its fly-wheel being broken away. Fig. 2 is a rear end view of the engine. Fig. 3 is a plan of the rear end portion. Fig. 4 is a plan of certain parts also comprised in Fig. 3. Fig. 5 is a front view of some of the parts shown in Fig. 4. Fig. 6 is a vertical section taken as indicated by the dotted lines 6 6, Fig. 3. Fig. 7 is a longitudinal vertical section taken as indicated by the dotted line 7 7, Fig. 3. Fig. 8 is a vertical transverse section taken as indicated by the dotted lines 8 8 in Figs. 3 and 7. Fig. 9 is a longitudinal section through the mixing-chamber, showing the gas and air passages.

Similar letters of reference designate corresponding parts in all the figures.

A designates a cylinder supported by a standard A'. It may be of ordinary or any other suitable form. It is to be fitted with a suitable piston which is connected by a rod B with a crank-shaft C that is journaled in suitable standards C'. The standards A' C' are shown as fastened to a base D. To the crank-shaft C is affixed a fly-wheel E. The cylinder may have a water-jacket *a*, as usual. It may be understood by reference to Fig. 7, where it is shown in connection with the head of the cylinder.

F designates a pipe or conduit through which gas is supplied. It communicates with a chamber F', which between the point where the supply-pipe F communicates with it and a conduit F², that extends toward the engine-cylinder, is fitted with a valve F³. This valve F³ is normally held to its seat by means of a spring *f*, surrounding an extension of the chamber F' and bearing at one end against the said chamber F' and at the other end against a collar fastened to the valve-stem. In order to open the valve, the valve must be

moved inward by a push-piece G, acting upon the valve-stem. The details and appurtenances of this push-piece will presently be described.

The gas-conduit F² extends on toward the rear end of the engine-cylinder and is bent upward at right angles, ending in an enlarged circular chamber, the outer walls of which form the inner walls of substantially the lower half of a mixing-chamber H². The lower half of this mixing-chamber is of annular shape and surrounds the gas-chamber, and in the annular wall of said gas-chamber there is a series of small radial gas-openings *h*, through which the gas passes in finely-divided radial jets into the lower or annular part of the mixing-chamber.

Around the outer wall of the annular part of the mixing-chamber is an annular air-chamber I, on substantially the same vertical plane as the gas-chamber, and in the outer wall of the annular part of the mixing-chamber, which also constitutes the inner wall of the annular air-chamber I, are small radial air-openings *i*, through which the air passes into the annular part of the mixing-chamber H², so that the gas from the openings *h* and the air from the openings *i* meet in the form of fine jets moving radially toward each other, so as to evenly and uniformly intermix with each other, and after being so intermixed pass upward through the constricted annular passage, forming the upper end of the annular or lower part of the mixing-chamber, into the upper part of the mixing-chamber H². The upper end of this mixing-chamber consists of a check-valve H', which closes the passage J to the engine-cylinder, the stem of this valve passing down through the upper part of the mixing-chamber H² and through the center of the circular gas-chamber, formed upon the end of the gas-conduit F², and out below the frame, where it is provided with a collar *h*² and a spiral spring *h*¹, which acts upon said collar to close the valve H' down upon its seat, so that said valve operates as a check-valve and prevents any of the intermixed air and gas which has passed out of the upper portion of the mixing-chamber H² from returning thereto.

The intermixed air and gas is sucked from

the mixing-chamber H^2 through the passage J by the forward movement of the engine-piston, the valve H' being raised during this time by means of a cam-actuated lever M^2 , acting on the lower end of the stem thereof, as hereinafter described.

By the rearward movement of the engine-piston the motive agent will be forced back through the passage J and will be compressed. Owing to its being forced backwardly it will be caused to pass from the passage J into the passage K and thence through a passage K' into a tube K^2 , which is closed at all points except where it communicates with the passage K' . The tube K^2 is inclosed in a chamber K^3 , that is open at both ends, it being here shown as entirely open at the bottom and perforated at the top. It may of course be closed by a perforated diaphragm at the bottom. Any suitable means for supporting the tube K^2 may be used. As here shown it is screwed into a block k , that is tapered at one side to fit a seat in the material comprising the passage K, and at the other side is sustained by a screw k' .

The tube K^2 is kept hot in the ordinary or any suitable manner—as, for instance, by means of a blowpipe—and the motive agent, which is forced into it in the manner described, is ignited, whereupon it develops energy which acts through the passages K J against the engine-piston, forcing the latter forward. Obviously any known equivalent of the igniting-tube K^2 —as, for instance, an electric igniter—may be used.

The mixing-chamber and part of the passage K, as well as part of the passage J, are formed in a block L, which is attached to the end of the engine-cylinder. The other part of the passage K is formed in a block L' . The blocks L L' are adjustably secured together, as may best be understood by reference to Figs. 3, 7, and 8. I may conveniently secure the blocks L L' together by means of screws L^2 L^3 , passing through portions of one block and engaging with tapped holes in the other in conjunction with a plate L^4 and screws L^5 L^6 . The screws L^5 pass through the plate L^4 and engage with tapped holes in the block L, but the screw L^6 passes through the plate and engages with a tapped hole in the block L' . By loosening the screws L^2 L^3 and turning the screw L^6 the block L' and its appurtenances may be raised or lower relatively to the block L, so as to adjust the meeting ends of the two sections of the passage K into line or more or less out of line. Thus the capacity of this passage may be varied to secure ignition at the proper time.

Before the completion of the forward movement of the engine-piston an exhaust is opened. M is an exhaust-passage communicating with the engine-cylinder and closed during the actuation of the piston by means of a valve M' . The closing of the valve is effected by a spring m bearing at one end against the collar affixed to the valve-stem

and at the other end against an opposite part. The valve is opened by means of a lever M^2 , coacting with the outer end of the valve-stem. For purposes of adjustment the end of the lever M^2 may be fitted with an adjustable pin or screw m' . The lever M^2 is fulcrumed on a pin m^2 , and at the outer end is provided with a roller m^3 . A cam M^3 , having two toes or projections M^4 M^5 , coacts with a roller m^3 to oscillate the lever M^2 , and consequently control the exhaust-valve M' . The toe M^4 of the cam is the one which opens the exhaust-valve during the normal operation of the engine, and the toe M^5 of the cam is only used during starting. How this is accomplished I will presently explain.

The cam M^3 is affixed to a shaft M^6 , which is journaled in suitable bearings and provided at the forward end with a spiral gear m^4 , that engages with a spiral gear m^5 , affixed to the crank-shaft of the engine. These gears m^4 m^5 are intended to be so proportioned with respect to their number of teeth that the shaft M^6 , and consequently the cam M^3 , will make a single rotation for each two rotations of the crank-shaft. It will of course be understood that in starting this engine the fly-wheel will necessarily be turned by hand one or more times. If the toe M^4 on the cam M^3 were during this operation of compressing the motive agent solely relied upon for operating the exhaust-valve, the labor of turning the fly-wheel would be very great. To reduce this, I provide temporarily for bringing into action at this time the toe M^5 of the cam M^3 . I provide for doing this by lowering or raising the roller m^3 upon the lever M^2 . The roller m^3 is loosely mounted upon a pin m^5 , which is provided with an eccentric disk or collar m^6 , that is incapable of independent movement. The outer end of the pin m^5 is provided with a handle, by which it may be readily turned. Obviously by rotating the pin in one direction or the other the pin m^5 may be bodily raised relatively to the lever M^2 , and consequently the roller m^3 may be correspondingly adjusted. For retaining the roller m^3 in any position into which it may be adjusted I combine with the eccentric disk or collar a spring-detent m^7 , which is fastened to the lever M^2 and is capable of engaging in either of two notches with which the disk or collar is provided. For starting the engine the detent is disengaged from the eccentric disk or collar, the pin m^5 turned, and the detent afterward re-engaged. The roller m^3 will then be in such a position as to be subject to the action of the toe M^5 of the cam M^3 . Afterward the position of the roller m^3 may be changed relatively to the lever M^2 , so that only the toe M^4 of the cam M^3 will act upon it. The toe M^5 of the cam M^3 eases the labor of turning the fly-wheel E by hand, because it allows of a small escape of the compressed motive agent at just about the time that the compression becomes most intense.

I will now describe the push-piece G and its appurtenances. The push-piece is shown as being made in the form of a plate, with a beveled end to coact with a notch at the end of the stem of the gas-supply valve F³. The push-piece is fastened to one end of a lever G', which is fulcrumed between its ends on a pin G². The pin G² is connected to a lever G³, that is fulcrumed on a pin g, supported by an appurtenance of the engine-cylinder. Between its ends the lever G³ is provided with a pin g', upon which is mounted a roller g², which bears against a cam G⁴, mounted on the shaft M⁶. This cam G⁴ has a single toe, which once in each rotation of the shaft M⁶, and consequently once in each two rotations of the fly-wheel E, oscillates the lever G³ suitably to cause the push-piece G to coact with the stem of the gas-supply valve F³. It will be seen that the upper portion of the lever G³ is provided with shelves g³ g⁴. Normally the forward portion of the lever G', carrying the push-piece G, rests upon the shelf g³, it being held there by means of a spring g⁵, bearing at one end against said lever G' and at the other end against a collar fastened to a rod g⁶, that extends upwardly from the shelf g³ and loosely through the lever G'. The rear portion of the lever G' is above the shelf g⁴, but normally out of contact with the shelf. During normal conditions the forward oscillation of the lever G³ will cause the push-piece to open the supply-valve F³. Should the speed of the engine become too high to make further supply of gas desirable, the outer end of the lever G', which is quite heavily weighted, will by gravity cause the oscillation of the lever until it contacts with the shelf g⁴. This movement will be sufficient to shift the push-piece G out of line with the stem of the gas-supply valve F³, so as to prevent the opening of the said valve.

An essential feature of this invention is the thorough and intimate intermixture of the gas and air, accomplished in the mixing-chamber by projecting them therein in the form of a number of fine jets. This method of mingling the air and gas permits each particle of the gas to be brought in immediate association with a mass of air necessary for its combustion. When, therefore, ignition takes place, thorough and complete combustion occurs in a manner best suited to the attainment of economical results and the maximum development of power.

It is of the utmost importance that the openings delivering the air and the gas into the mixing-chamber should be each of very small size. The smaller, within reasonable limits, the better. I have found that one-eighth of an inch for the diameter of the openings gives satisfactory results. Openings of a less dimension than this also prove satisfactory in results obtained. I do not wish to be limited to openings of the size named, stating this

merely as illustrative of what I mean when I say "very small openings."

The openings for both the air and for the gas must be very small, that a preliminary atomization, as it were, or minute subdivision may be obtained, essential to the subsequent intimate commingling or mutual absorption, forming an essential feature of my invention. Very small openings for one and large openings for the other will not produce the results I obtain. Both the air and the gas must enter the mixing-chamber in very small jets, of small cross-sectional area, and not *en masse*, either actually or relatively, one to the other.

Experiment has proved that totally dissimilar results are obtained when either the air or gas, or both, enter *en masse* into the mixing-chamber through relatively large openings as compared with the results obtained by having both enter the chamber in fine streams. In point of economy in gas consumption the first method is not to be compared with the latter.

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

1. In a gas-engine, the combination of a mixing-chamber, a gas-chamber communicating with a gas-supply conduit and having a series of small gas-outlet openings therefrom into said mixing-chamber, an annular air-chamber separated from said mixing-chamber by a wall having a series of air-inlet openings into said mixing-chamber in direct opposition to said gas-inlet openings, whereby the gas and air enter said mixing-chamber in minute jets impinging upon each other from opposite directions, so as to intimately intermix them, substantially as set forth.

2. In a gas-engine the combination of a gas-chamber communicating with a gas-conduit and having a series of small radial outlet-openings in the periphery thereof, a mixing-chamber, a portion of which annularly surrounds said gas-chamber, an air-chamber surrounding the annular portion of the mixing-chamber and separated therefrom by an annular shell having a series of small radial air-inlet openings therethrough, substantially as and for the purpose set forth.

3. In a gas-engine the combination of a cylindrical gas-chamber communicating with a gas-conduit and having a series of small radial gas-outlet openings in the periphery thereof, a mixing-chamber, a portion of which is above the gas-chamber, and a portion of which annularly surrounds said gas-chamber and communicates with the upper portion thereof by means of a narrow passage, an annular chamber surrounding the annular portion of the mixing-chamber and separated therefrom by an annular shell having a series of small radial air-inlet openings therethrough, substantially as and for the purpose set forth.

4. In a gas-engine, the combination, of a

vertical cylindrical gas-chamber communicating with a gas-conduit and having a series of small radial gas-outlet openings in the periphery thereof, a mixing-chamber, a portion
 5 of which is above the gas-chamber and a portion of which is on the same horizontal plane with and surrounds said gas-chamber and communicates with the upper portion thereof by means of a constricted annular passage,
 10 an air-chamber surrounding the annular portion of the mixing-chamber and on the same horizontal plane therewith and separated therefrom by an annular shell having a series of small radial air-inlet openings there-
 15 through, whereby the gas-outlet openings and the air-inlet openings are on the same plane and diametrically opposite each other, whereby the incoming jets of air and gas impinge upon each other in substantially direct lines,
 20 substantially as and for the purpose set forth.

5. In a gas-engine, the combination of an engine-cylinder, an igniter, and a passage intermediate the engine-cylinder and igniter and made in two sections capable of being
 25 adjusted eccentrically, substantially as specified.

6. In a gas-engine, the combination of an engine-cylinder, an igniter, blocks L, L', adjustably connected with each other and hav-
 30 ing formed in them two sections of a passage K, leading from the cylinder to the igniter, substantially as specified.

7. In a gas-engine, the combination of an

engine-cylinder, an igniter, blocks L, L', adjustably connected with each other and hav-
 ing formed in them two sections of a passage K, and means comprising an adjusting-screw
 L⁶, for securing the blocks L, L', together, substantially as specified.

8. In a gas-engine, the combination of a gas-
 supply valve, a lever G³ pivoted to a fixture of the engine, a lever G' pivoted to the lever G³, a push-piece G affixed to the lever G', a cam for oscillating the lever G³, a spring and weight for controlling the movements of the
 45 lever G', and stops or shelves g³, g⁴, for limiting the motion of the latter lever, substantially as specified.

9. In a gas-engine, the combination of an exhaust-valve, a cam for operating said valve
 provided with two toes, a lever intermediate the cam and the valve, a roller upon the lever adapted to normally coöperate with one of
 said toes, an eccentric fitted to said lever, supporting said roller, and adjustable to a
 55 position to cause the coöperation of both toes with the roller, and means for holding the eccentric in a position to which it may be adjusted, substantially as specified.

In testimony whereof I have signed my
 name to this specification in the presence of two subscribing witnesses.

CHARLES JACOBSON.

Witnesses:

W. LAIRD GOLDSBOROUGH,
 WALTER A. PAULING.