(No Model.) 6 Sheets—Sheet 1.

J. C. BECKFELD.

GAS ENGINE.

No. 396,022. Patented Jan. 8, 1889.

FIG. 1.

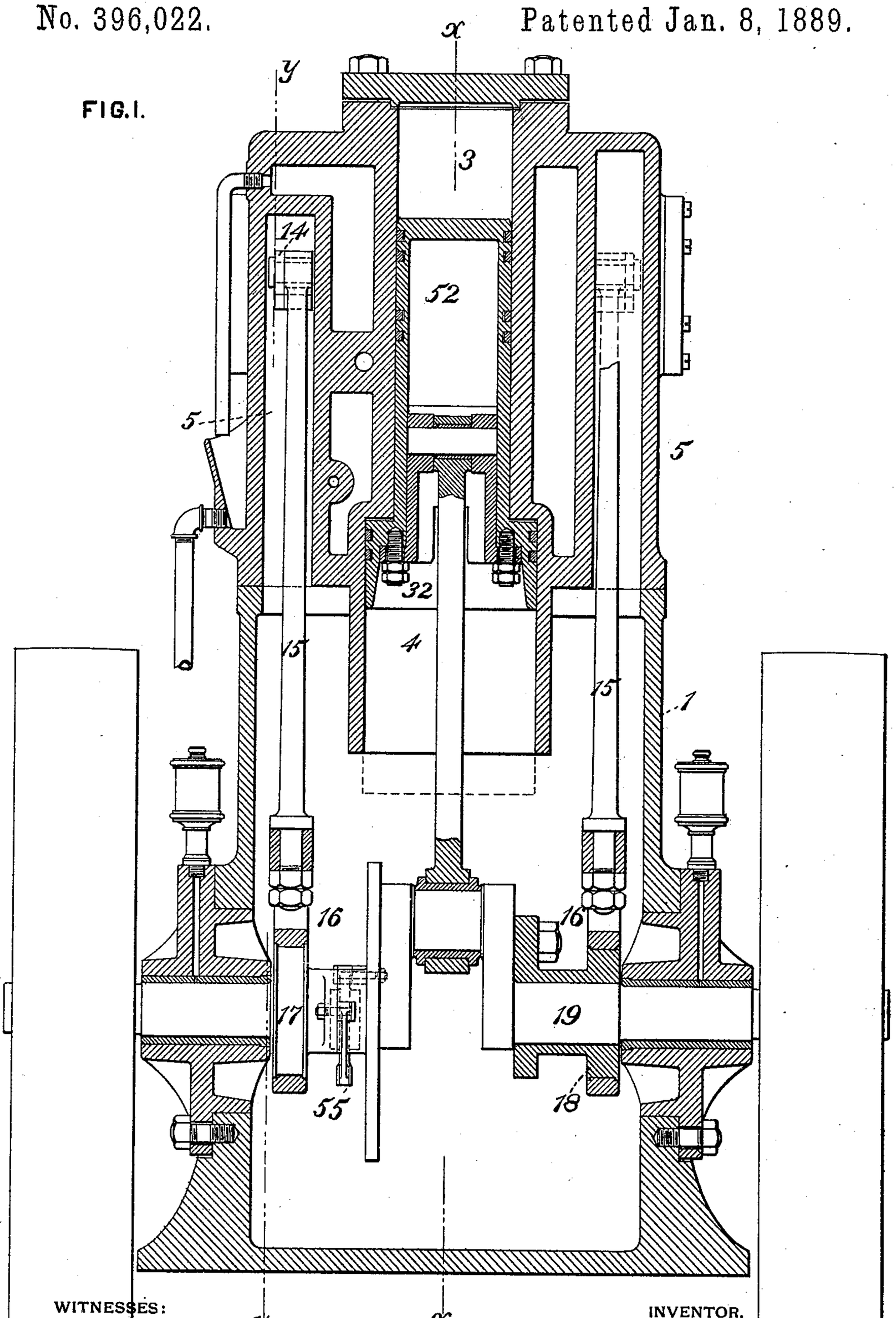

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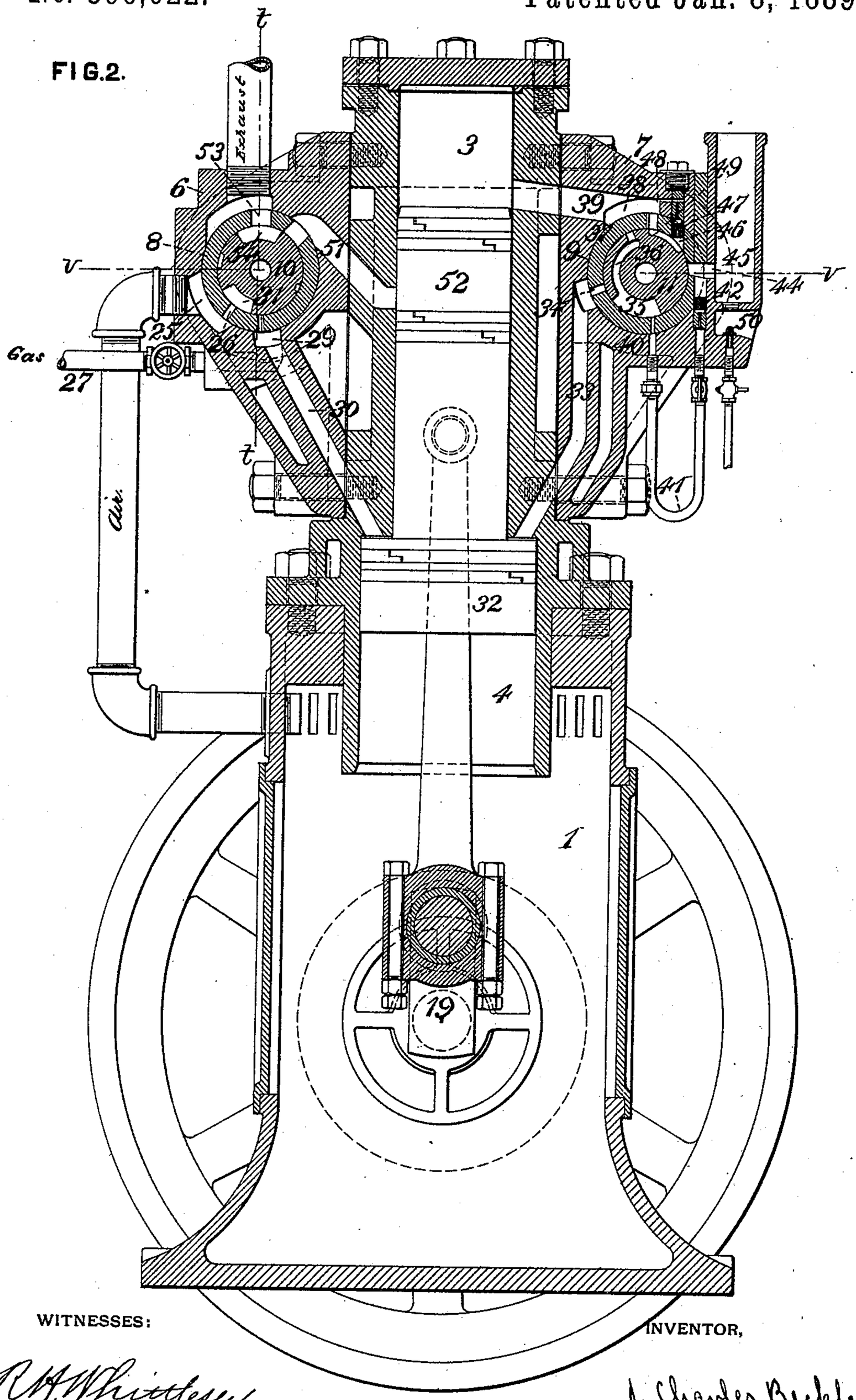
FIG. 2.



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GAS ENGINE.

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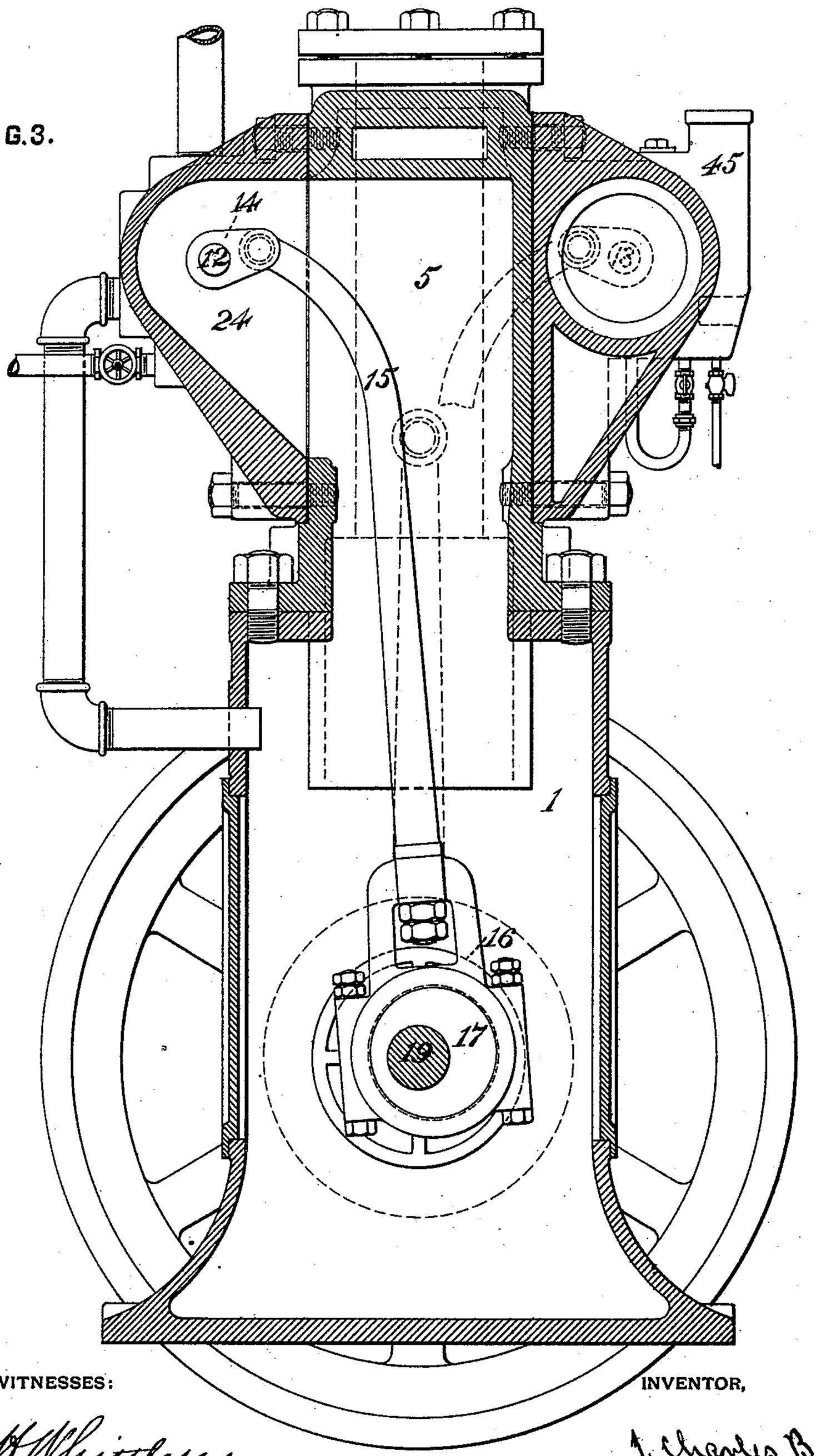
FIG. 3.



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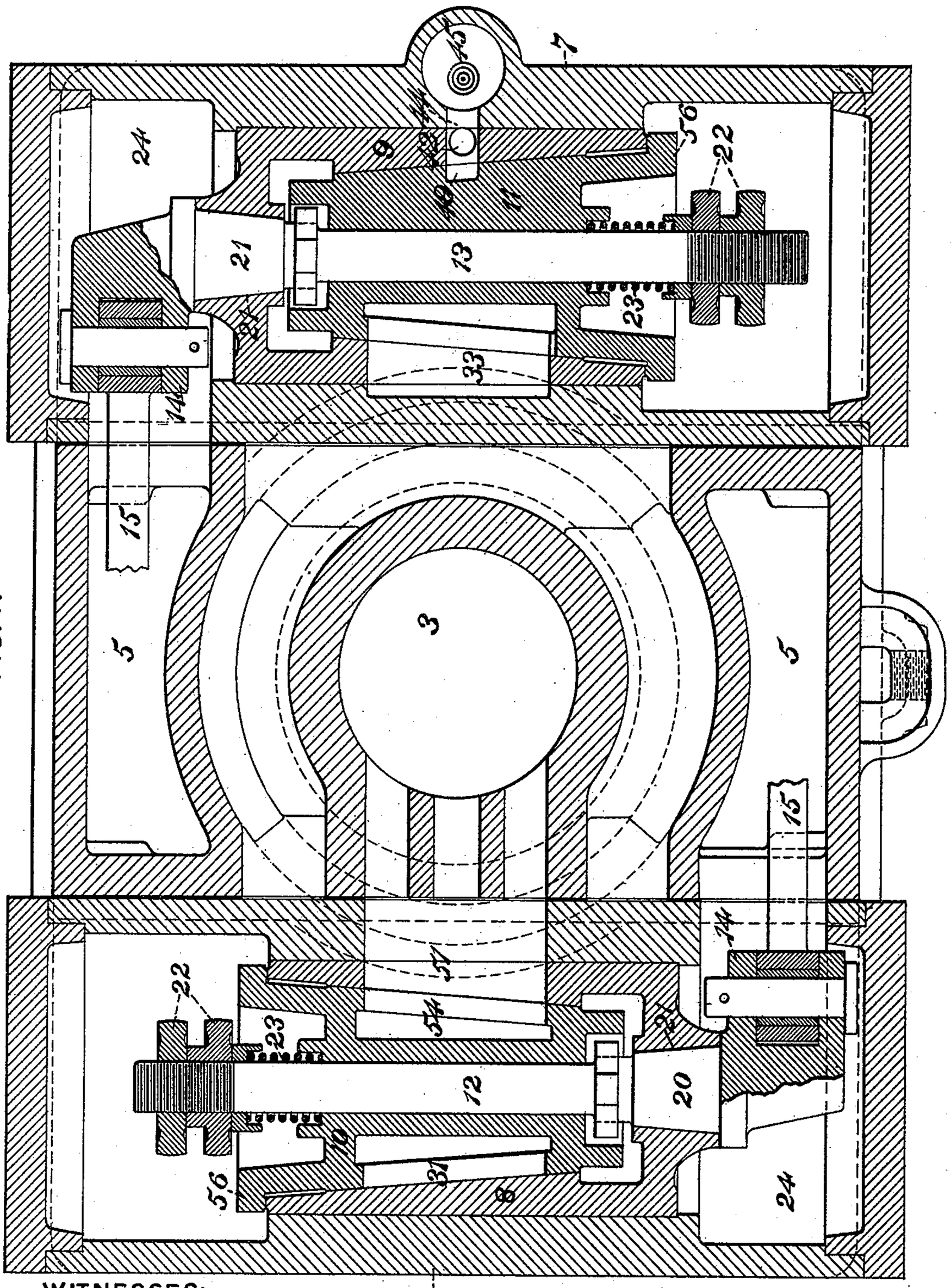

FIG. 4.

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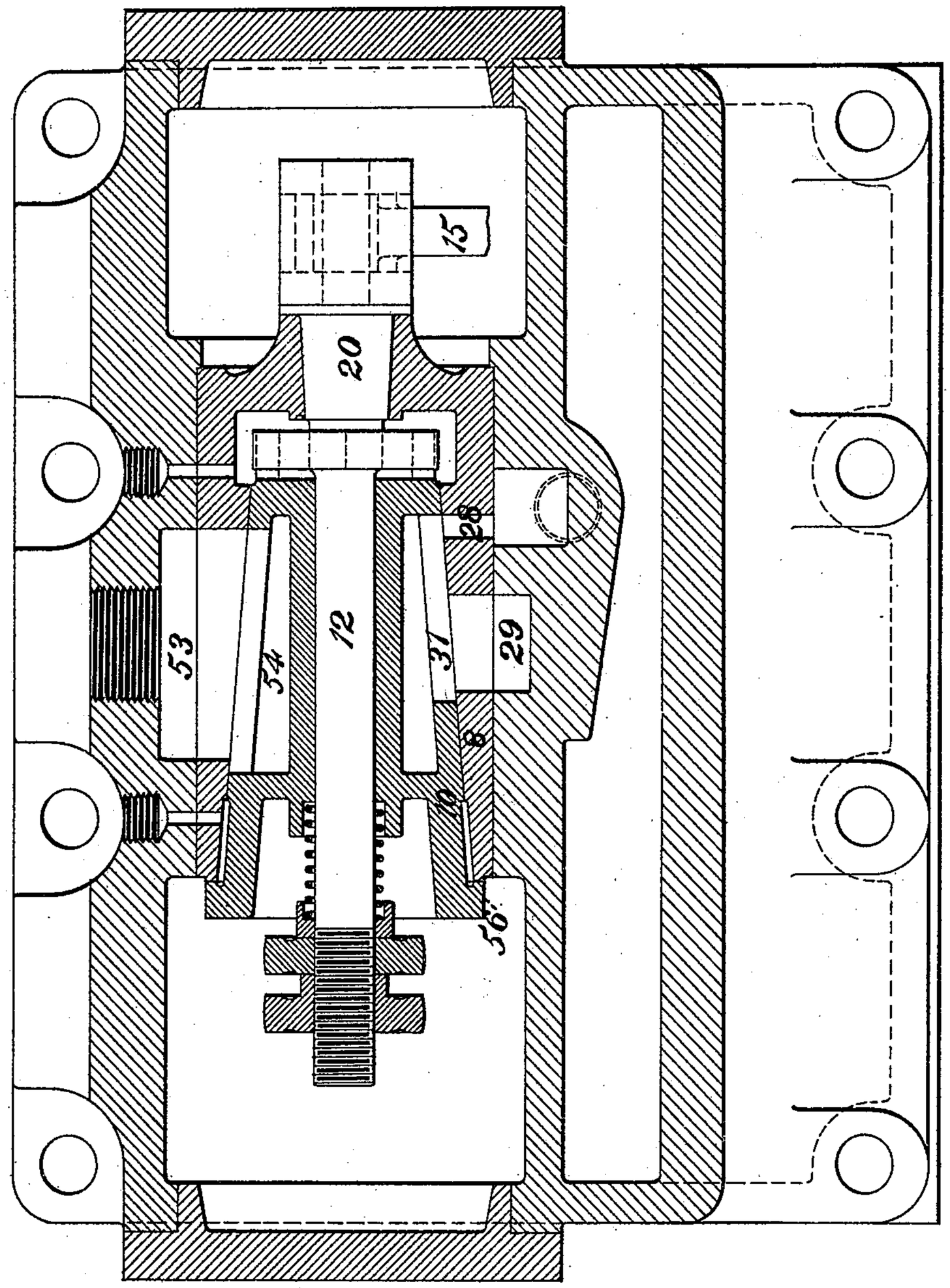
GAS ENGINE.

No. 396,022. Patented Jan. 8, 1889.

FIG. 5.



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GAS ENGINE.

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FIG. 8.

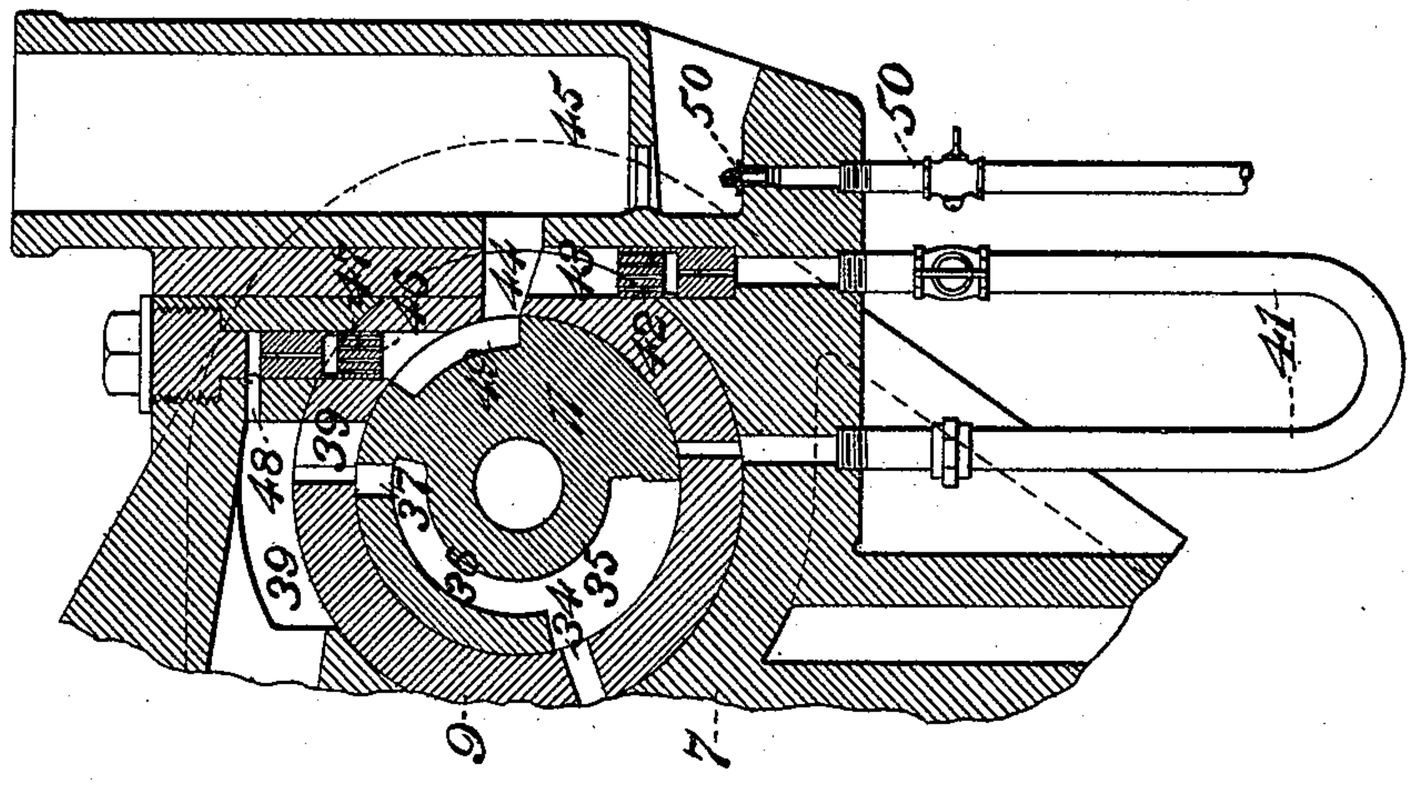


FIG. 7.

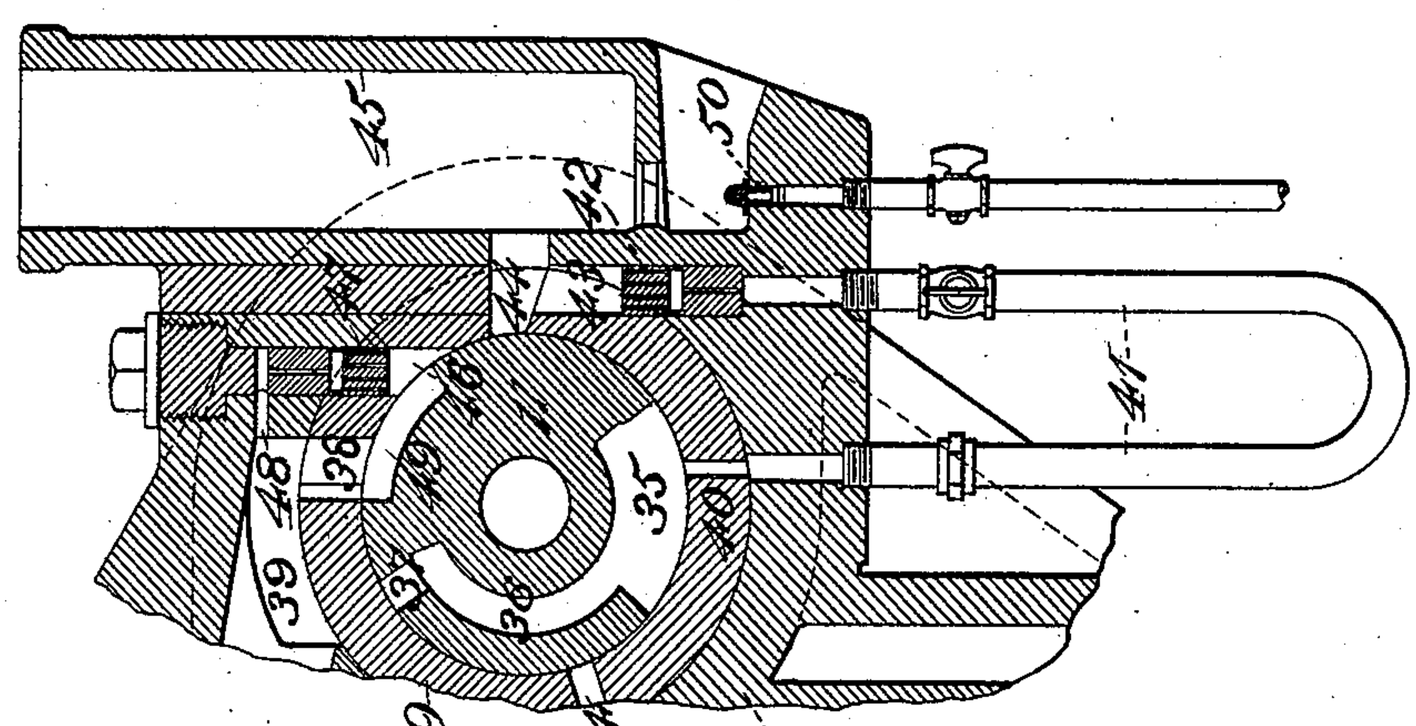
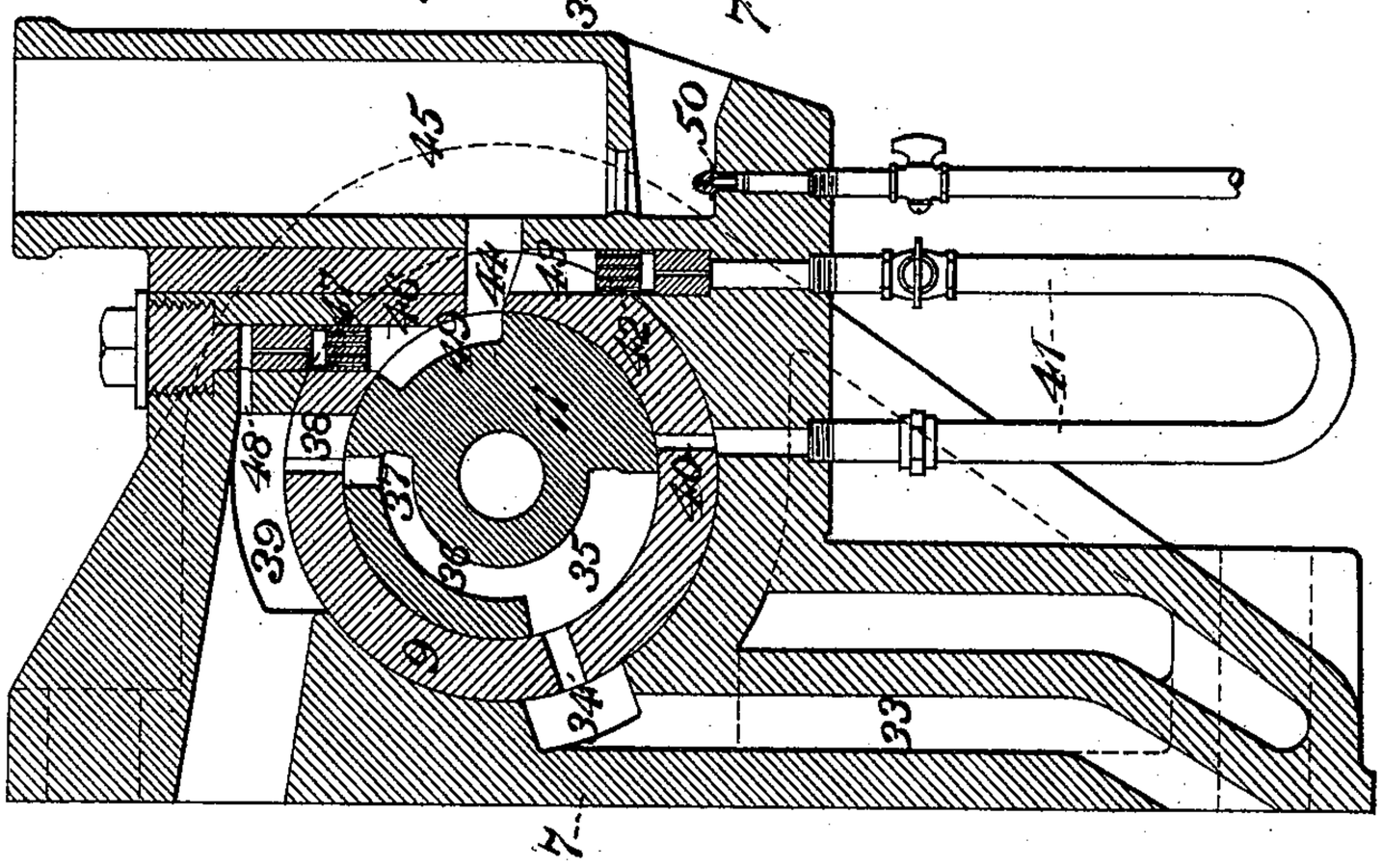


FIG. 6.



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UNITED STATES PATENT OFFICE.

J. CHARLES BECKFELD, OF ALLEGHENY, PENNSYLVANIA, ASSIGNOR OF ONE-HALF TO ALBERT SCHMID, OF SAME PLACE.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 396,022, dated January 8, 1889.

Application filed November 23, 1887. Serial No. 255,979. (No model.)

To all whom it may concern:

Be it known that I, J. CHARLES BECKFELD, a citizen of the United States, residing at Allegheny, in the county of Allegheny and State of Pennsylvania, have invented or discovered certain new and useful Improvements in Gas-Engines, of which improvement the following is a specification.

The invention herein relates to certain improvements in that class or kind of engine in which motion is imparted by a series of explosions of inflammable gases in the cylinder of the engine.

In general terms, the invention consists in the construction and combination of devices or mechanism, all as more fully hereinafter described and claimed.

In the accompanying drawings, forming a part of this specification, Figure 1 is a sectional elevation of my improved engine, the section being taken on a plane passing through the axis of the crank-shaft. Figs. 2 and 3 are similar views, the sections being taken on the lines *x x* and *y y*, Fig. 1, respectively. Fig. 4 is a sectional plan on an enlarged scale, the section being taken on the line *v v*, Fig. 2. Fig. 5 is a vertical section of the valve mechanism on the line *t t*, Fig. 2. Figs. 6, 7, and 8 are transverse sectional views of the valve controlling the flow of gas to the explosion-chamber and the ignition thereof.

On the crank-case 1 is secured the casting, in which is formed the power-cylinder 3, compression-cylinder 4, and pockets 5, in which the valve-rods work, as will be more fully hereinafter set forth. On opposite sides of the cylinder-casting are secured the valve-chests 6 and 7, having horizontal valve-chambers formed therein, as shown in Figs. 2, 4, and 5, by shells 8 and 9, having a cylindrical exterior and a conical interior. Within these chambers 8 and 9 are arranged the conical valves 10 and 11. Through these valves are passed the stems 12 and 13, each provided at one end with a crank-arm, 14, said crank-arms being pivotally connected to valve-rods 15, attached at their lower ends to straps 16, surrounding eccentrics 17 and 18 on the crank-shaft 19, which is mounted in suitable bearings in the ends of the crank-case 1. (See Fig. 1.) On the valve-stems 12 and 13, adjacent to the crank-arms 14, (see Fig. 4,) are formed conical enlargements 20, fitting within correspondingly-shaped openings 21, formed in one of the ends of each of the shells 8 and 9, and on the opposite threaded ends of the stems 12 and 13 are screwed nuts 22, which bear against springs 23, interposed between said nuts and the large ends of the valves 10 and 11, thereby holding said valves yieldingly against their seats. It will be observed that as the conical valves 10 and 11 and the conical enlargements 20 on the valve-stems are oppositely arranged—*i. e.*, with their small ends adjacent — the springs 23 will serve to hold both parts in position. It will also be observed that the valves are oppositely arranged, thereby bringing the crank-arms 14 in line with the pockets 5 for the valve-rods, said pockets being connected with openings 24 in the ends of the valve-chests. (See Fig. 4.)

In the wall of the valve-chest 6 is formed an opening, 25, for the admission of air, said opening communicating by a port, 26, with the interior of the valve-chamber 8. Gas is introduced into the chamber 8 by the pipe 27 and port 28, and the combined gas and air escape by the port 29 and passage 30 from said chamber into the compressing-cylinder 4. The ports 28 and 29 are arranged in line with each other, so that both ports will be simultaneously opened and closed by the movement of the valve 10, in which is formed a groove or recess, 31, of such a width as to form a passage connecting in one position of the valve the air-port 26 with the port 29, the latter being simultaneously connected with the gas-inlet port 28, which, as above stated, is opened and closed simultaneously with the port 29.

Gas and air are admitted into the compressing-cylinder 4 in the manner above described during the downward movement of the piston 32. As soon as or before the piston reaches the lower limit of its movement, the valve 10 is shifted so as to close the ports 28 and 29. During the upward movement of the piston 32 the gas and air are forced through the passage 33 and port 34 into the chamber or recess 35 of the valve 11, which has previously been shifted so as to bring said chamber into communication with the port 34. The cham-

ber 35, as shown in Figs, 2, 6, 7, and 8, extends around the valve 11 about half its circumference, a portion being open and a portion, as 36, within the body of the valve, said portion 36 being provided with an exit-port, 37, which at one point in the movement of the valve registers with the port 38, connected with the explosion-chamber by the passage 39. The combined gas and air escape by the above-described ports and passages from the compression-cylinder to the explosion-chamber. In the wall of the valve-chest 9 is formed a port, 40, so located with reference to the port 34 and the circumferential opening or recess 35 in the valve 11 as to be in communication with the port 34 for a short period on the opening of said port by the movement of the valve to permit of the escape of the combined gas and air from the compression-cylinder, thereby permitting of the escape of a small portion of the gas and air through the port 40, and then by the pipe 41 to the burner 42. This burner 42, which is located in a recess, 43, in the valve-chest 7, consists of a metal block having a number of small perforations therethrough. This recess 43 is connected by a passage, 44, with the chimney 45, attached to the chest 7, and also intermittent with a recess, 46, in which is located the burner 47, similar in construction to the burner 41, gas and air being supplied thereto by a passage, 48, extending from the passage 39, and of such a diameter as to permit of the flow of gas, but not the passage of flame.

In the wall of the valve 11 is formed a groove or recess, 49, of such dimensions as to connect at one point in its movement the port 38 and recess 46, containing the burner 47, (see Fig. 7,) and also at a certain other point in its movement to connect the recess 46 and the passage 44. (See Figs. 6 and 8.) An ordinary gas-burner, 50, is located in the chimney 45 below the passage 44, and in such proximity thereto that any gas escaping from said passage will be ignited by the flame of the burner 50.

The operation of the above-described parts is as follows: The combined gas and air escape by the passage 33 and port 34 into the recess 35 and 36 of the valve 11, a small portion escaping thence by the port 40 and pipe 41 to the burner 42. The gas escaping through the burner (the passage 44) to the chimney is ignited by the flame from the burner 50. From the recess 35 36 the combined gas and air (the port 40 being closed) escape by the ports 37 and 38 and the passage 39 into the explosion-chamber. By a further rotation of the valve 11 to the right the recess 46 and passage 44 are connected by the groove or recess 49 in the valve, whereupon the gas escaping from the burner 47 is ignited by the flame from the burner 42. As soon as the gas from the burner 47 is ignited, as above described, the movement of the valve 11 is reversed, and the recess 46 and port 38 are connected by the groove 49, whereupon the flame from the burner 47 ignites the gas in the explosion-chamber. The travel of the valve 11 when rotating to the left is such that the port 40 is uncovered, thereby permitting the combined gas and air in the recess 35 36 to escape and burn at the burner 42. In high-speed engines it is necessary to employ a very hot flame in order to ignite the gas in the explosion-chamber at every stroke, and this is especially the case where natural gas is employed; hence I employ a flame produced by a proper mixture of gas and air, the burner 50 being employed solely in starting the engine (see Figs. 6 and 7) and until its movements have become so rapid that a practically constant flow of gas is maintained through the pipe 41, which is sufficiently large to supply the burner 43 between each stroke of the valve 11. After the engine has obtained a sufficient speed, as above stated, the supply of gas to burner 50 is turned off.

The exhaust-port 51 is located at a point approximately midway between the extreme limits of movement of the power-piston 52. This port or passage 51, connecting the power-cylinder and the valve-chamber 8, is placed in communication with the outlet-port 53 at certain intervals, dependent on the speed of the engine, by the groove or recess 54, formed in the valve 10. Their eccentric 17, operating the valve 10, is made adjustable transversely of or around the power-shaft, and is connected to a suitable governing mechanism, 55, whereby the amount or intervals of movement of the valve 10 are regulated, and hence as the valve 10 governs or controls the flow of gas and air to the power-cylinder, and also the exhaust of dead gases therefrom, as will be readily understood, the speed of the engine is regulated either by the admission of more or less gas and air into the power-cylinder, it being understood that the valve 11 is constructed to permit of the passage of all the gas and air from the compression-cylinder, and also by retaining more or less the dead gases in the power-cylinder, and thereby deteriorating the quality of the explosive mixture to that extent.

On the valves 10 and 11 are formed shoulders 56, constructed to bear against the ends of the valve-chests or shells 8 and 9 for the purpose of preventing the valves 10 and 11 from being wedged in the shells by the pressure of the springs. These shoulders are constructed to permit of the valves fitting snugly but without binding upon their seats in the shells, and as said shoulders are gradually worn away the valves will bear a little harder upon their seats, whereupon the wearing-section will be transferred from the shoulders to the faces of the valves until the pressure is again transferred to the shoulders. In this way we are enabled to maintain a tight but non-binding contact between the valves and their seats.

I claim herein as my invention—

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

valve mechanism controlling the flow of gas and air from the compression-cylinder to the power-cylinder and the passage of flame from the igniter to the power-cylinder, a burner having a supply connection with the power-cylinder, and a burner connected to and receiving its supply of gas and air through the valve mechanism, substantially as set forth.

2. In a gas-engine, the combination of a valve mechanism controlling the flow of gas and air from the compression-cylinder to the power-cylinder and the passage of flame from the igniter to the power-cylinder, a burner having a supply-connection with the power-cylinder, a burner connected to and receiving its supply of gas and air through the valve mechanism, and a burner having an independent source of supply, substantially as set forth.

3. In a gas-engine, the combination of a valve mechanism for controlling the passage of flame from the igniter to the power-cylinder, a burner having a supply-connection with the power-cylinder, and a burner receiving its supply of gas and air from the compression-cylinder, substantially as set forth.

4. In a gas-engine, the combination of a compression-cylinder and a power-cylinder suitably connected for the passage of gas and air, a burner receiving its supply of gas and air from the compression-cylinder, and a valve mechanism for controlling the passage of flame from the burner to the power-cylinder and preventing the extinction of the flame by the explosion, substantially as set forth.

In testimony whereof I have hereunto set my hand.

J. CHARLES BECKFELD.

Witnesses:

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DARWIN S. WOLCOTT.