No. 666,260. Patented Jan. 22, 1901.

L. F. BURGER.

GAS ENGINE.

(Application filed July 1, 1899.)

(No Model.) 3 Sheets—Sheet 1.

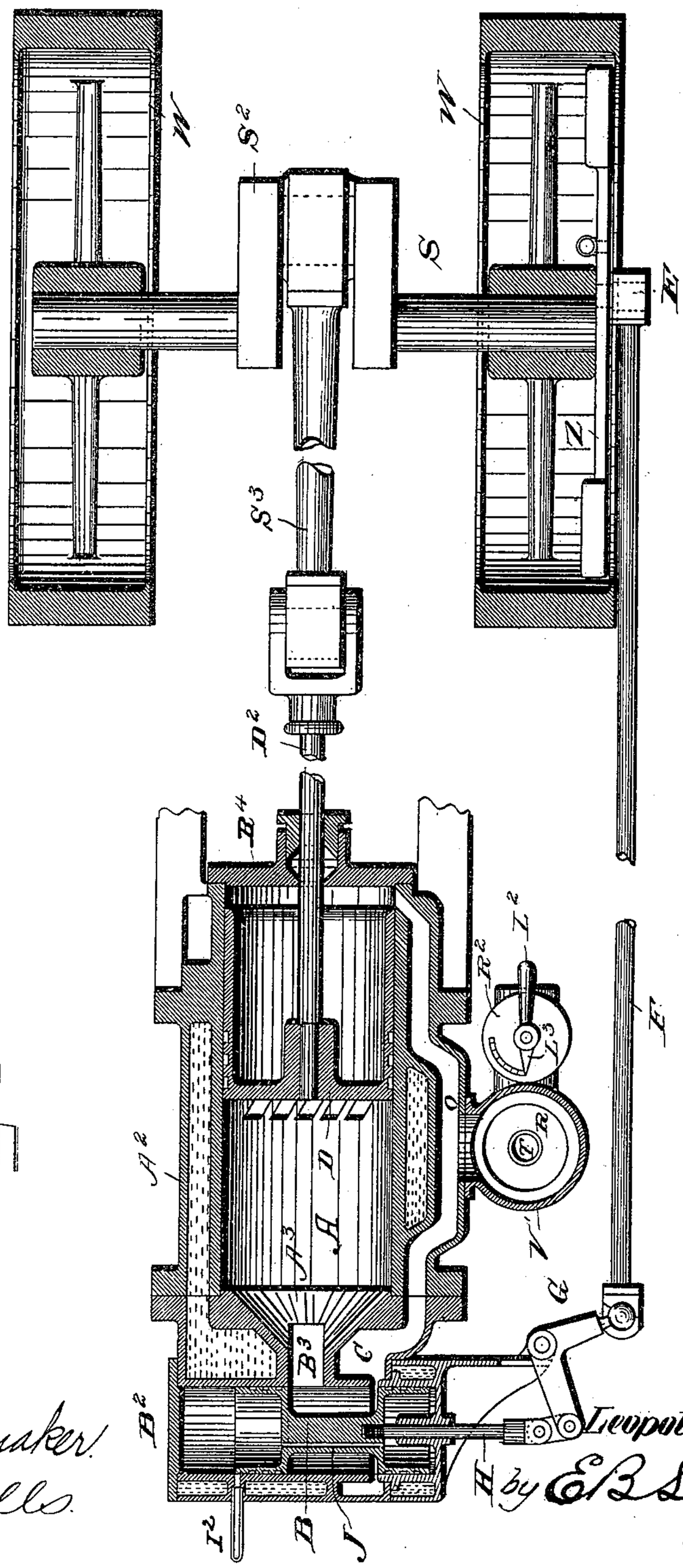

Fig. 1.

Witnesses,
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L. C. Hills.

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3 Sheets—Sheet 2.

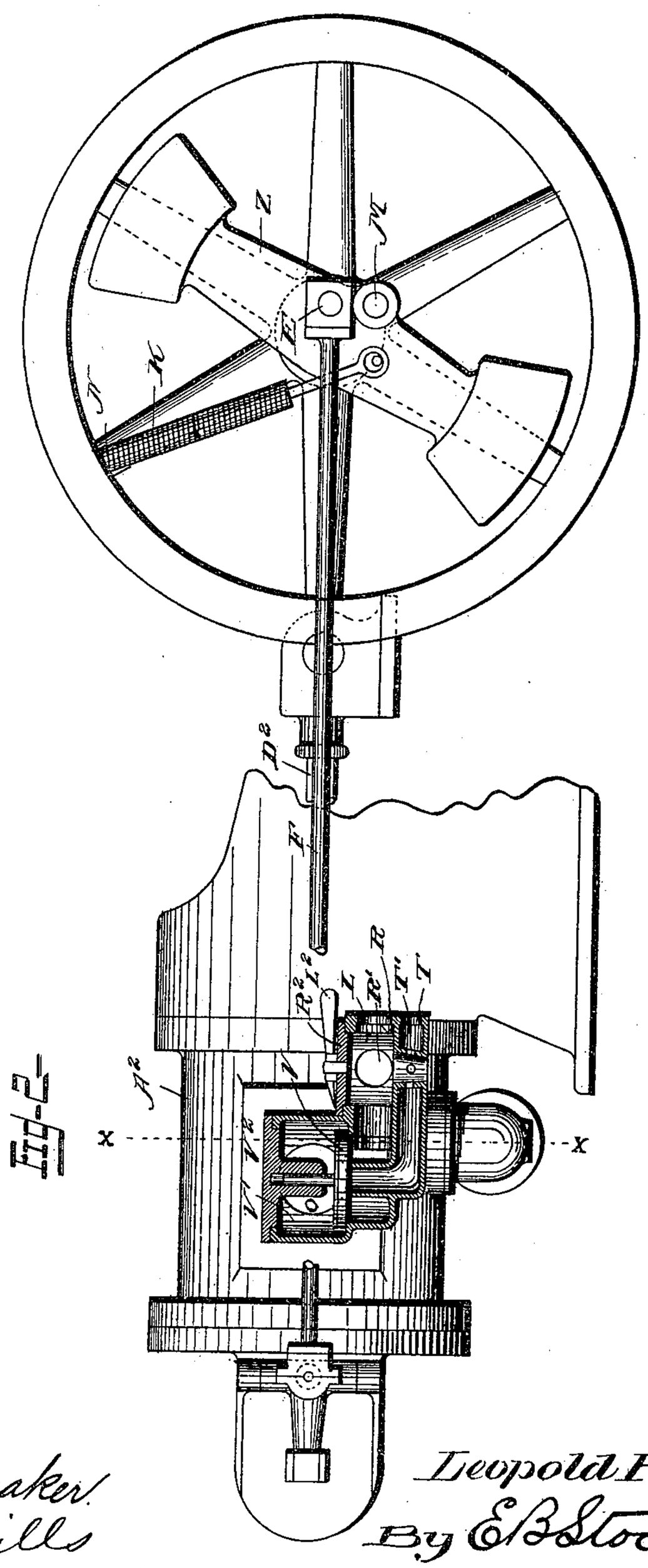

Fig. 2.

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Fig. 4.

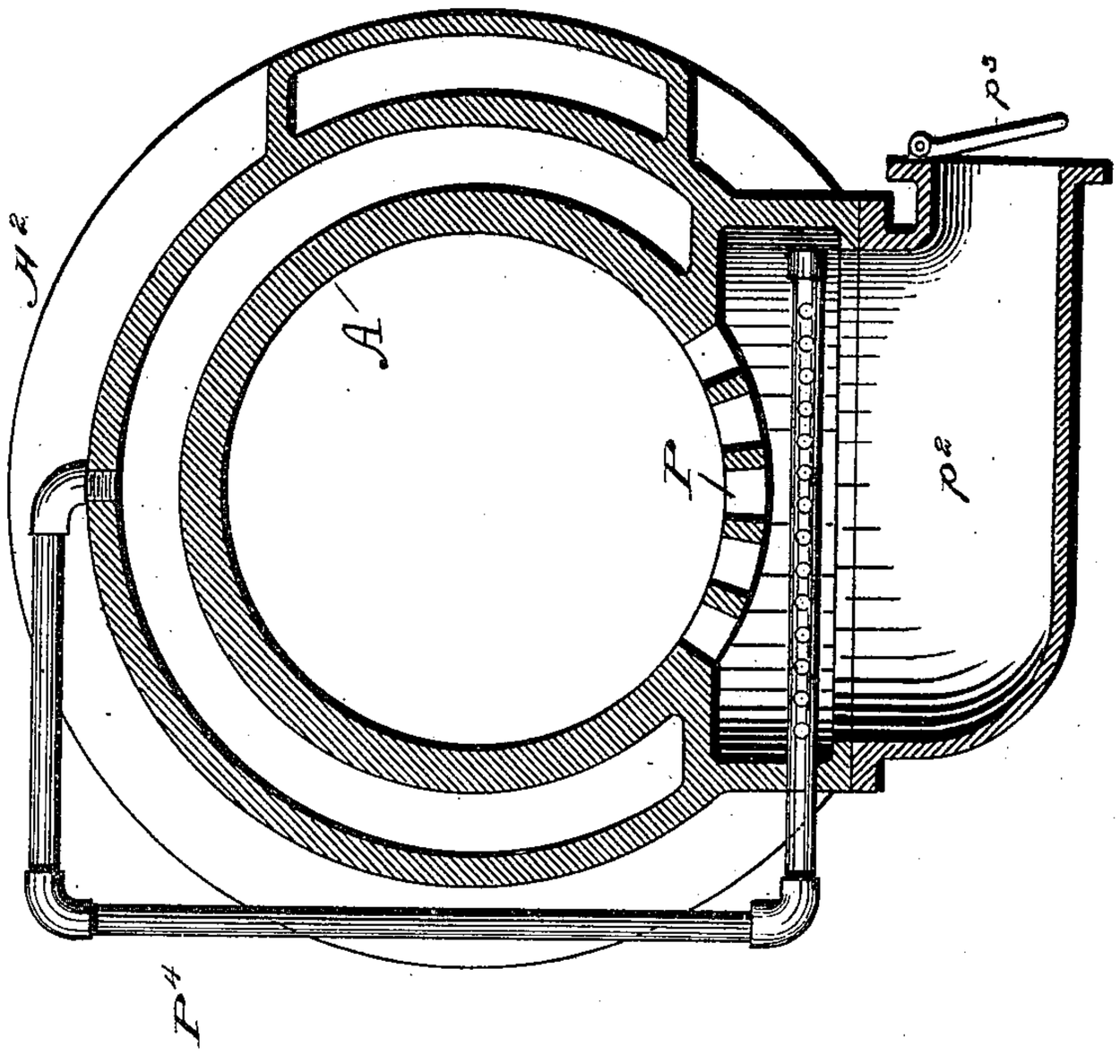
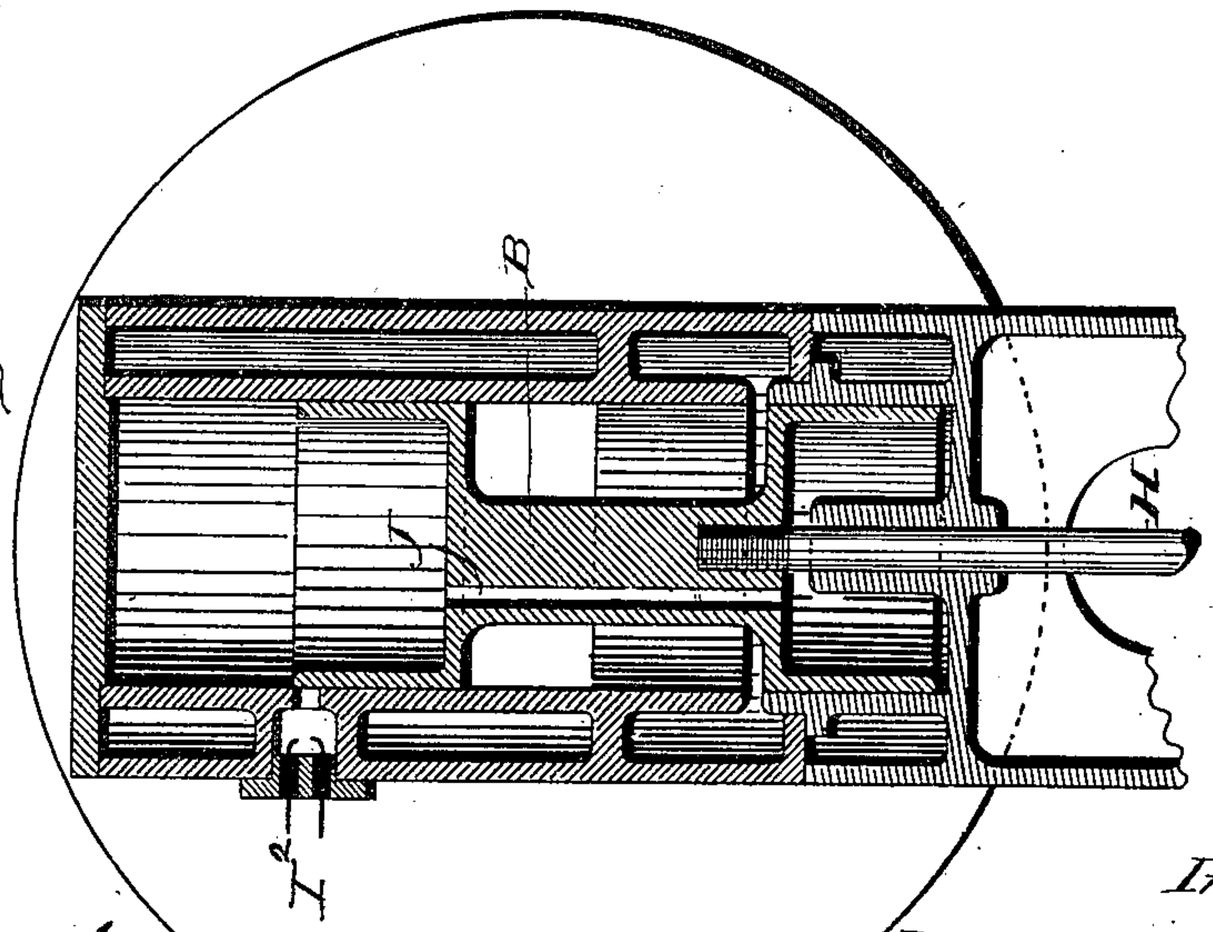


Fig. 3.



Witnesses:
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L. C. Hills.

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UNITED STATES PATENT OFFICE.

LEOPOLD F. BURGER, OF ANDERSON, INDIANA, ASSIGNOR TO THE WOOLLEY FOUNDRY AND MACHINE WORKS, OF SAME PLACE.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 666,260, dated January 22, 1901.

Application filed July 1, 1899. Serial No. 722,571. (No model.)

To all whom it may concern:

Be it known that I, LEOPOLD F. BURGER, a citizen of the United States, residing at Anderson, in the county of Madison, State of Indiana, have invented certain new and useful Improvements in Gas-Engines, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to a gas or similar motive power engine, and particularly to the type of engine embodying a cylinder closed at both ends and having therein a piston, one end of which forms a pump and the opposite end a compressing device for the fuel or elements of combustion. Much difficulty has heretofore been experienced in regulating and maintaining an engine of the above-mentioned construction at a uniform speed and also preventing the large amount of loss or waste of the motive fluid. Furthermore, owing to imperfections of the mixing and compressing devices, the motive fluid has a tendency to separate into strata of different specific gravities, which results in a frequent failure to ignite and in other cases a premature explosion.

The invention has for one object to obviate these disadvantages by admitting the explosive mixture in the center of the rear cylinder-head, thus allowing the first charge to uniformly distribute throughout the combustion-chamber and to mix more intimately before compression and ignition take place.

A further object of the invention is to provide means whereby the operation of the engine can be more effectually controlled, whether working under constant and invariable loads or under variable loads.

A further improvement consists in a particular construction of exhaust-chamber whereby the products of combustion are withdrawn by a vacuum from the cylinder and the noise of exhaust more effectually muffled.

A further object is to perfect the structure of the stop-cocks for admitting air and gas, so that a single stop-cock having therein independent passages for air or gas can be used, and thus maintaining a constant relation in the quantity of air and gas admitted to the engine.

A further improvement consists in the mechanism for ignition by the movement of the valves which will cover or uncover the ignition-hole, thus permitting the spark or ignition-tube to be completely cut off when not desired for use.

Other objects and advantages of the invention will hereinafter appear in the following description, and the novel features thereof will be particularly pointed out in the appended claims.

In the drawings, Figure 1 is a horizontal section of the engine with the bed or foundation removed. Fig. 2 is a side elevation. Fig. 3 is an enlarged vertical section of the cylinder-head and ignition-valve, and Fig. 4 is a cross-section on the line 4 4 of Fig. 2.

Like letters of reference indicate like parts throughout the several figures of the drawings.

The letter A designates a suitable engine-cylinder, which is jacketed, as at A^2, and provided with the usual means for circulating the water or other cooling agent through said jacket. The cylinder has at its lower portion a series of exhaust-ports, which may be of any desired shape, but in the present illustration are composed of segmental slots which lead to the exhaust-chamber P^2, and said chamber is arranged at its outlet or communication with the atmosphere with an outwardly-opening valve—such, for instance, as the pivoted door P^3. The gas-inlet end of the cylinder is formed cone-shaped, as at A^3, and is provided with a port B^3, communicating with the ignition-chamber. The opposite end of the cylinder is closed by a suitable head B^4, through which a piston-rod D^2 passes and carries upon its inner end a piston D. From the jacket A^2 a conducting-pipe P^4 extends to the exhaust-chamber P^2 and is there provided with suitable perforations to project water from the jacket longitudinally outward from the pipe. The effect of this water upon the heated gases of combustion from the cylinder is to condense the same and create a vacuum, which effectually withdraws all of the gas from the cylinder and also causes the swinging door P^3 to automatically close. This vacuum further prevents the sharp and disagreeable noise produced by the exhaust.

When the exhaust-port is uncovered by the piston D, the same has traveled to the extreme outward end of its stroke, and in its return movement this piston draws in a charge of air and gas through the valve-box V′, which is provided with a suitable central gas-passage T, communicating with any desired source of supply and with the circumferential passage R, both of said passages being controlled by a single check-valve V, adjacent to the cylinder, and a stop-cock L, provided with an air-passage R′ and a gas-passage T′, respectively. It will be observed that the stop-cock L has the portions R′ and T′ in the air and gas passages R and T, respectively, and this cock may be held in position by any suitable means—for instance, a cap-plate R^2. As one method of adjusting or operating the valve or stop-cock I have illustrated a handle L^2 and an index-finger L^3, traveling over a suitable graduated scale on the cover R^2, and thus indicating the positions of the valve-passages relatively to the passages for the air and gas.

The valve-box V′ is provided with a suitable cap or cover V^2, having a depending hollow stem, within which the stem of the check-valve V reciprocates. Both the air and gas passages lead into this valve-chamber and are controlled by the single check-valve, so that when an inward suction is exerted upon the valve-box through its communication with the cylinder the valve will be raised and a charge of air and gas admitted to the passage O. When this charge is placed under pressure, the pressure effectually closes the valve V. It will be seen that by the means just described the operation of the engine or motor may readily be controlled by hand, but as performing a more satisfactory work I will proceed to describe an automatic device for controlling the engine. This automatic control is effected by means of a weighted governor Z and a suitable valve (for instance, a balanced piston-valve) B, operating in a valve-box B^2, as shown in Figs. 1 and 3. This valve-box is in communication with the passage O, which leads from the front end of the cylinder and communicates through said valve-box with the admission-port B^3. In Fig. 1 the valve B is shown at the extreme limit of its movement in one direction, and the air and gas from the front end of the cylinder communicates through passages O and C with the space between the two heads of the balanced piston-valve and thence to the port B^3, leading to the combustion-chamber of the cylinder. To equalize the pressure upon the opposite ends of the balanced valve B, there is a passage J through the neck thereof, which connects the opposite heads of the valve. The valve-stem H extends through a suitable packing-box and is connected to a crank-arm G, suitably pivoted upon a fixed part. From the opposite arm of this crank a governor-rod F extends to a wrist-pin E upon the weighted governor Z, which pin is eccentric to the axle of the shaft S, upon which the fly-wheels W and W′ are carried. The governor Z is pivoted upon a pin or lug M and is pivotally connected to a spring K, carried by the balance or fly wheel at the point N. As the result of this connection the rotation of the engine has a tendency to cause the governor to be retarded in its movement or hang back, and the faster the shaft S rotates the more pronounced this effect upon the governor will be, whereby the wrist-pin E is brought near the center of the shaft S, thereby reducing the stroke of the valve, and thus limiting the extent to which the port C is uncovered and admitting a minimum quantity of air and gas into the combustion-chamber. When the engine is working under a load or under a high speed, then the momentum which the governor has attained forces it ahead of the fly or balance wheel, thereby forcing the piston-valve wide open and admitting a larger quantity of fuel into the combustion-chamber. It will be obvious that any suitable valve may be substituted for the piston-valve shown, which is given merely as a form adapted to accomplish the operation. The piston D may be connected to the shaft S in any suitable manner—for instance, by the piston-rod D^2, pivotally connected to the connecting-rod S^3, which in turn is pivoted to the crank S^2, carried by the shaft S. When the parts are in the position shown in Fig. 1, the passage O is in communication with both ends of the cylinder and the air and gas pass through the ports C and B^3 into the combustion-chamber, thus forcing all the products of combustion outward through the exhaust-port P. This clearing of the cylinder is accomplished by the vacuum in the exhaust-chamber and by the greater specific gravity of the products of combustion than that of the first charge, making it very easy to draw out all burned gases. As the piston D begins its movement toward the inlet end of the cylinder it first closes the exhaust-ports P and at the same time the piston-valve B closes the port C, thus confining the charge in the combustion-chamber of the cylinder. The continued movement of the piston creates a suction which draws into the passage O and forward end of the cylinder a fresh charge of fuel through the inlet-valve V. The movement of the piston, in connection with that of the piston-valve, compresses the charge, and the continued movement of the valve uncovers the igniting device I^2, thus exploding or expanding the charge and forcing the piston D outward to the position shown in Fig. 1. This movement of the piston from the inlet end of the chamber compresses the charge in the passage O (the port C being still closed) and finally opens the exhaust-ports and the port C to permit the exhaust of the products of combustion and the recharging of the combustion-chamber, when the parts are in the position to repeat the foregoing operation at each reciprocation thereof.

From the foregoing it will be seen that the charge of fuel may be admittted in proper quantities to maintain a constant speed of the engine and is properly mixed and compressed before its introduction into the combustion-chamber. The structure of governor, in connection with the valve B, provides means whereby the speed may be controlled under varying loads or conditions, while the particular construction of the exhaust-chamber assists the withdrawal of the products of combustion by creating a vacuum and also muffles the noise at that time. Furthermore, the relative proportions of air and gas to be admitted to form a charge can be definitely regulated by means of the single stop-cock and the time of ignition very accurately determined.

The provision of a valve having separated heads and an intermediate pressure-space permits the application of the explosive pressure of the charge within the valve-chamber without the damage to the valve which ordinarily occurs when the pressure is exerted against the solid face of a slide-valve. Under such circumstances the friction caused by the pressure on the valve is such as to prevent the proper movement of the same and quickly wears the bearings of the valve, causing the same to be forced from its seat. In the present invention the pressure is received equally upon the opposite heads of the valve, and the movement thereof is not affected nor is the valve forced into contact with its casing, so as to prevent the easy movement thereof.

It is obvious that changes may be made in the details of construction and configuration without departing from the spirit of the invention as defined by the appended claims.

Having described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A gas-engine comprising a cylinder, a passage communicating with the opposite ends thereof, a piston within said cylinder, a valve-casing at one end of said cylinder having at opposite sides of its center a feed-passage and an igniting device and provided with an intermediate inlet-opening communicating with said cylinder, a reciprocating valve in said casing adapted to alternately cut off the feed-passage and establish communication with the igniting device and the inlet-opening, and means for automatically controlling the operation of said valve; substantially as specified.

2. A gas-engine comprising a cylinder, a piston therein, a valve-casing having at opposite end portions a feed-passage and an igniting device and provided with an intermediate inlet-opening communicating with said cylinder, a balanced piston-valve having opposite heads and a space between the same by which alternate communication may be established with either the feed-passage or the igniting device and the inlet-opening, and means for controlling the movement of said valve; substantially as specified.

3. A gas-engine comprising a cylinder having exhaust-ports therein, a parallel longitudinal passage communicating with the opposite ends thereof and provided with an intake-opening between its ends, a piston within said cylinder, a valve-casing disposed transversely to the cylinder and provided with an inlet-opening communicating therewith and a feed-passage at one end thereof, an igniting device at the opposite side of said inlet, and an automatically-operated piston-valve in said casing having opposite heads and an intermediate chamber to establish alternate communication between either said feed-passage or igniting device and constant communication with the inlet to said cylinder and the exhaust-port thereof when open; substantially as specified.

4. In a gas-engine, the combination with a cylinder and piston therein, of a feed-passage communicating with one end of the combustion-chamber, an exhaust-passage communicating with said chamber at about its mid-length and adapted to be covered and uncovered by said piston, a valve controlled by the movement of the piston and formed to constitute with its casing a pressure-chamber for receiving and exploding charges of fuel for said cylinder, and automatically-controlled igniting means for said cylinder; substantially as specified.

5. In a gas-engine, the combination with a cylinder and piston therein, a feed-passage communicating with opposite ends of said cylinder, an exhaust-chamber communicating with said cylinder, a feed-valve having a pressure-space between its heads adapted to communicate with the inlet to the cylinder and with the exhaust-port thereof through said inlet and provided with means to close the feed-passage and permit compression therein, and an igniting device communicating with said pressure-space of said valve when the feed-passage is closed; substantially as specified.

6. In a gas-engine, the combination with a cylinder and piston therein, a feed-passage communicating with opposite ends of said cylinder, an exhaust-chamber communicating with said cylinder at substantially its mid-length, a valve-casing having at its opposite end portions a feed-passage and an igniting device and provided with an intermediate inlet-opening communicating with said cylinder, a piston-valve having heads at its opposite ends adapted to cut off the feed-passage and igniting device and an intermediate space communicating through the cylinder-inlet with the cylinder exhaust-port and adapted to receive and convey a charge of fuel from the feed-passage to the inlet-opening and igniting device, and means for automatically operating said valve; substantially as specified.

7. In a gas-engine, the combination with a cylinder and piston therein, of a feed-passage, an exhaust-passage communicating with said cylinder at substantially its mid-length, a valve having separated heads controlling said feed-passage and the inlet-port of the cylinder and having an intermediate chamber communicating through the cylinder-inlet with the cylinder exhaust-port and adapted to contain a body of fuel, and means for igniting said fuel; substantially as specified.

8. In a gas-engine, the combination with a cylinder and piston therein, of a feed-passage communicating with opposite ends of the cylinder, an exhaust-port in said cylinder, a valve having separated heads controlling said feed-passage and the inlet-port of the cylinder and having an intermediate chamber and communicating through the cylinder-inlet with the cylinder exhaust-port and adapted to contain a body of fuel, and means for igniting said fuel; substantially as specified.

9. In a gas-engine, the combination with a cylinder and piston therein, of a feed-passage, an exhaust-port communicating with said cylinder, a valve having separated heads connected by an intermediate stem, whereby a pressure-space is provided between the heads to receive an explosive fuel, communicating through the cylinder-inlet with the cylinder exhaust-port and an igniting device communicating with said space; substantially as specified.

10. In a gas-engine, the combination with a cylinder and piston therein, of a compression-passage communicating with the opposite ends of said cylinder, a valve-casing provided at its opposite end portions with a feed-passage and an igniting device and having an intermediate inlet-opening communicating with said cylinder, a sliding piston-valve having opposite heads to alternately cut off the feed-passage and igniting device automatically controlled by the movement of the piston to convey a charge to said cylinder, an inlet-valve controlling air and gas supply to said compression-passages, a stop-cock located in said passages, and an igniting device automatically controlled in the movement of said sliding valve; substantially as specified.

11. In a gas-engine, the combination with a cylinder having an exhaust-port and piston therein, of a balanced piston-valve having opposite heads and a receiving-chamber communicating through the cylinder-inlet with the cylinder exhaust-port, a feed-port communicating with said casing and adapted to be cut off by a valve-head, a port extending from said casing to said cylinder, and an igniting device carried by said casing at the side of the inlet-port opposite to the feed-port and exposed to the charge in the movement of a piston-head of said valve; substantially as specified.

12. In a gas-engine, the combination with a cylinder having an exhaust-port and piston therein, of a piston-valve having opposite heads and an intermediate chamber communicating through the cylinder-inlet with the cylinder exhaust-port controlling the entrance of fuel to said cylinder and the exhaust from said valve, a rod for actuating said valve, a crank-shaft connected with said piston and carrying a balance-wheel, a weighted governor pivoted upon said balance-wheel eccentrically to the axis thereof, a spring connecting said governor with said wheel, and a pivotal connection between said rod and governor eccentrically to the pivotal connection of the governor; substantially as specified.

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

LEOPOLD F. BURGER.

Witnesses:

B. H. CAMPBELL,

H. BENEFIEL.