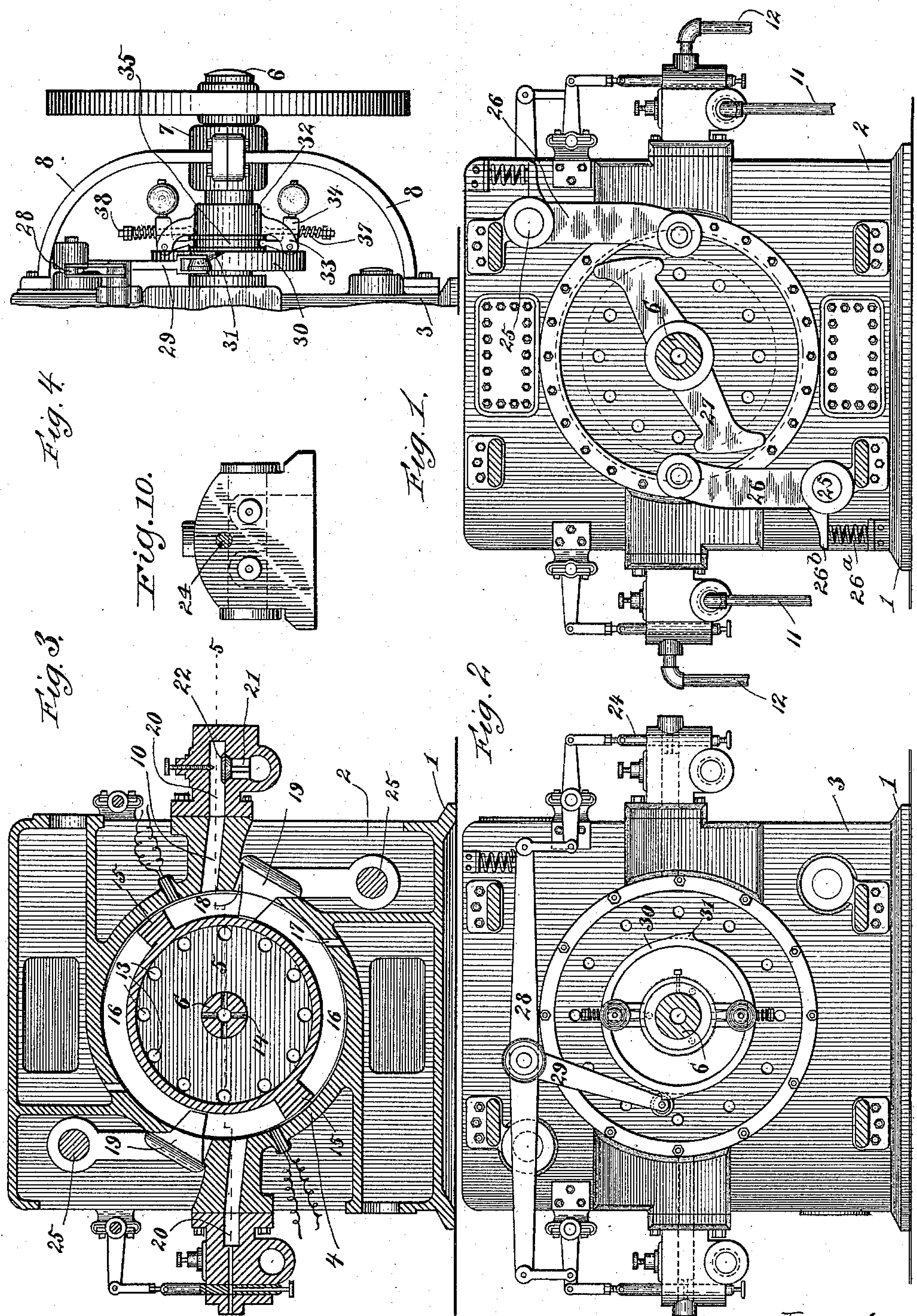
(No Model.) 2 Sheets—Sheet 1.

L. GATHMANN.

ROTARY GAS ENGINE.

No. 570,470. Patented Nov. 3, 1896.



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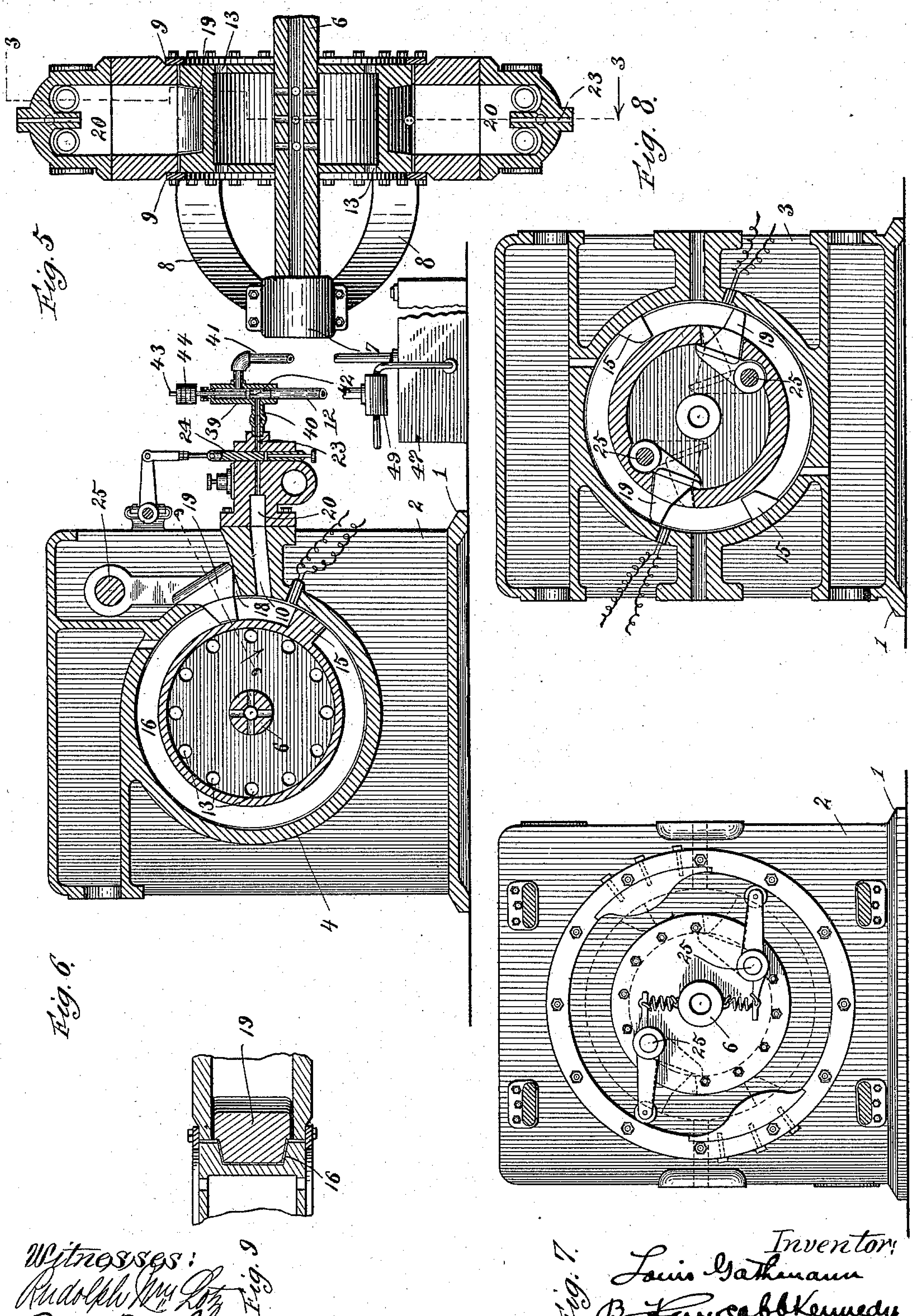

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UNITED STATES PATENT OFFICE.

LOUIS GATHMANN, OF CHICAGO, ILLINOIS, ASSIGNOR TO DANIEL Y. McMULLEN, OF SAME PLACE, JAMES B. McMULLEN, OF NEW YORK, N. Y., GEORGE W. McMULLEN, OF PICTON, CANADA, AND DAVID S. McMULLEN AND ROGER B. McMULLEN, OF EVANSTON, ILLINOIS.

ROTARY GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 570,470, dated November 3, 1896.

Application filed June 1, 1895. Serial No. 551,427. (No model.)

To all whom it may concern:

Be it known that I, LOUIS GATHMANN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Rotary Gas-Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to a novel construction in a rotary gas-engine of that class employing an explosive charge as the source of power and propelling medium, as distinguished from engines wherein compressed air, steam, and analogous gases are employed as the propelling medium, namely, such gases exerting power by expansion due to the release of pressure thereon.

The object of my invention is to provide an engine of the kind above pointed out which combines certain features which simplify the construction and produce an effective engine.

The invention consists in the features of construction and combinations of parts hereinafter fully described and specifically claimed.

In the accompanying drawings, illustrating my invention, Figure 1 is a side elevation of an engine constructed in accordance with my invention, with certain parts omitted for convenience of illustration. Fig. 2 is a side elevation taken from the opposite side, with certain parts omitted for convenience of illustration. Fig. 3 is a vertical longitudinal section taken on the line 3 3 of Fig. 5. Fig. 4 is an elevation, on an enlarged scale, of the governor for controlling the supply of oil or gas. Fig. 5 is a horizontal transverse section taken on the indirect line 5 5 of Fig. 3. Fig. 6 is a vertical longitudinal section of a modified construction embodying my invention and illustrating the engine constructed with a single valve. Fig. 7 is a side elevation of another modified construction embodying my invention wherein the valves are carried by the rotating piston. Fig. 8 is a vertical longitudinal section of the same. Fig. 9 is a fragmentary section of the valve and valve-seat, taken on the line 9 9 of Fig. 6. Fig. 10 is a detail top plan view of the projecting block at the left of Fig. 3, in which the air and oil supply passages are situated.

As before stated, it is the object of my invention to simplify the construction of a rotary gas-engine and at the same time to provide for obtaining the maximum of energy from the propelling medium.

The invention relates and is confined, as above pointed out, to rotary engines in which an explosive charge is employed as the source of power, and is operated by a continuous series of explosions, and is therefore distinctly of a different class from engines which employ air, steam, or gas acting by expansion after pressure is relieved, for my engine acts upon a different principle, and the same conditions do not apply to both classes of engines. By certain novel features of construction in a rotary gas-engine acting under this principle, namely, a series of explosions, I am enabled to combine in a small compass an effective and powerful engine. To attain this result, I have provided a cylinder and a revoluble piston situated within the same, and between which the chamber or channel wherein the explosive force of the gas exerts itself is situated.

The piston is supported by a shaft mounted in bearings outside of the cylinder and does not come in contact with the cylinder. The said piston is set within the cylinder and fits nicely therein with a small space intervening between the relatively movable parts to avoid friction, while the bearings for the piston-shaft are arranged in the curved side arms, hereinafter described. The curvature of said side arms provides for sufficient elasticity to compensate for the expansion of the working parts of the engine caused by the variations in temperature therein. I also provide a construction whereby the explosion of the gas is made as effective as possible, that is to say, I provide for the cleansing of the chamber or channel between the cylinder and piston after each explosion to remove all spent and inert gases entirely before a new explosive charge is admitted, so that in each explosion the full force of the explosive medium is obtained. By combining in a rotary gas-engine these and other features, all of which are specifically described hereinafter, I am enabled to provide a simple and powerful device.

Referring now to said drawings, 1 indicates the base-plate, and 2 and 3 upright side plates extending upwardly from said base-plate and which support the cylinder 4 of the engine. Within said cylinder a piston 5 is situated, and is carried by a shaft 6, that extends on both sides and is mounted in bearings 7. These bearings 7 are supported by curved arms 8, rigidly secured to the side plates 2 and 3 and to said bearings 7. The piston 5 is about the same width as the cylinder, and its diameter is slightly less than the cylinder, so that it can revolve freely therein, that is to say, the adjacent faces of the piston and cylinder do not come in contact with each other, and, therefore, when the engine is working, the friction ordinarily generated between these two principal working parts is obviated entirely, and it is obvious that there is less loss of power in the engine. The piston is guided laterally by two rings or gaskets 9, secured to the cylinder and overlapping the outer edge of the piston. It will be understood, of course, that in an engine of this kind heat is generated; also that the temperature varies, and, consequently, the size of the parts varies slightly. In view of this fact, and to preserve strictly the position of the piston within the cylinder, that is to say, to prevent the piston from binding and causing friction, I employ the curved arms 8 for carrying the bearings 7. These arms are of equal length and size and are sufficiently elastic to compensate for the expansion and contraction of the working parts of the engine, and thus under all circumstances to maintain the bearings in their proper position concentric with the cylinder.

The cylinder is, of course, provided with induction and exhaust ports, described hereinafter, and between the cylinder and piston a chamber or channel is formed wherein the exploded gas is confined. This chamber can be formed by making a groove in the face of either cylinder or piston and mounting the valves on either of these parts, as shown. Across the groove extend the abutments for forming these power-chambers, while the side walls of the grooves are inclined or beveled, as shown in Fig. 5, to receive the beveled valve, all as described hereinafter.

Referring now to Figs. 1 to 5 of the drawings, the said cylinder 4 is provided at diametrically opposite points with induction-ports 10, to admit the propelling medium to the cylinder. The said ports 10 communicate with a suitable source of supply, which in the instance illustrated consists of air-pipes 11 and gas or oil pipes 12, and the admixture of gas and air is adapted to enter the cylinder and to be there exploded by any suitable means of ignition coming from a suitable ignition-recess. A constant supply of air under constant pressure is admitted to the air-pipes 11, and this supply of air should be in excess of the theoretical requirements of the engine, and it can be attained by the employment of a double-acting air-pump or from any other efficient source of supply. The said piston 5 and shaft 6 are hollow, and in the sides of said piston are a series of perforations 13, while the hollow shaft within the piston has a series of perforations 14, so that a cooling medium can be forced through the shaft and piston to cool the former. As before stated, the said piston fits within the cylinder and is held in place by the rings 9 and the shafts and bearings, and I have provided on the face of said piston a valve seat or groove having inclined or beveled walls converging toward the center of the piston, and at diametrically opposite points I arrange transverse abutments 15, which divide this valve-seat into two chambers 16.

I make the transverse abutments 15 wider than the induction-ports 10. In this way, while the abutments are passing the induction-ports the said ports will be closed for a moment and the mixture is confined to the mixing-chamber. The admixture will thereby be more complete, the area of possible leakage much reduced, while at the same time the pressure within the mixing-chamber is momentarily increased, so that when the charge is admitted to the explosion-chamber after the passage of the abutments the desired pressure and resulting force of the explosion will be more uniformly and economically maintained.

Although in this description I refer to two diametrically oppositely located induction-ports, abutments, valves, and eduction-ports, yet it will be understood that the number can vary, as found most efficient.

In the rear of the induction-ports 10 are the eduction or exhaust ports 17. Located between the ports 10 and 17 are the valve-openings 18, formed in the cylinder, and through which the valves 19 extend and enter the valve-seat or chambers 16 in the face of the piston 9. The end portions of said valves entering said valve-seat or chambers 16 are beveled on their sides to conform to the contour of the inclined sides of said valve-seat. It will be noted, also, that said valves do not come in contact with the valve-seats, but that a slight space intervenes that prevents friction between these parts, as between the cylinder and the piston above described. By thus arranging the principal parts so that they work without friction I am enabled to save a great amount of power usually lost, due to this cause, and therefore make the engine more effective.

Although there is a slight space between the cylinder and piston and between the valve and piston in Figs. 1 to 6, and between valves and cylinder in Figs. 7 and 8, or, stated broadly, between the valves and the part between which and the valve there is relative rotation, yet the space is so small that there is no appreciable escape of the products of the explosion, or such as to diminish the effective force of the explosion, as has been demonstrated.

I employ a mechanism, of course, for moving the valves out of the path of the abutments as the latter approach the valves and to move said valves inwardly after said abutments pass by, and the said valves 19 are located and arranged so that the back pressure of the propelling medium comes against the end of the valve and the strain or pressure thereon is not against the piston but upon the pivot of the valve itself, and in the instance shown this is accomplished by arranging the valve approximately tangential to the piston, so that the pressure is received by the pivot, and in this manner the piston is relieved of pressure. I thus avoid the friction that usually takes place between the valves or movable abutments and cylinder or piston. Consequently, by obviating this friction I am enabled to save a large amount of power, as well as prolong the life of the parts of the engine.

I do not claim in this application the construction of the valves and piston, nor the means for operating said valves, as this is claimed in another application for patent filed by me in the United States Patent Office December 31, 1894, and Serial No. 533,544.

Communicating with the induction-ports 10 are the passages 20, for admitting the propelling medium. These passages 20 communicate with the air-supply pipe 11 through openings 21, controlled by check-valves 22, while the oil or gas supply pipe 12 communicates with the passage 20 through an opening 23, controlled by a valve 24, operated at intervals by the engine.

The valves 19 are hung on pivots 25, extending between the upright plates of the engine, and these pivots 25 extend through the side plate 2 and are provided with arms or levers 26, whose free ends are located in the path of projections or arms 27, fastened to the piston, as shown in Fig. 1. The valves are normally held at the inward limit of their movement and resting in their seats 16, and the projections 27 are so located with reference to the abutments 15 that they engage the levers 26 to move the valves outwardly when the abutments approach the same and to allow them to reseat after the abutments pass by.

It will be seen that the ends of arms 27 strike the ends of arms 26 and turn the pivots 25 to move the valve outwardly, and that the valves are returned to their normal position by springs 26^a, that press against feet 26^b, secured to the arms 26.

The supply of air is controlled automatically in accordance with the relative pressure on opposite sides of the check-valves 22, but the supply of oil is regulated by the movement of the piston and controlled by a governor carried thereby, as will now be described.

The valves 24 are connected, through the intermediacy of links, with a vibrating lever 28, mounted upon plate 3 of the engine, and an arm 29 is fastened to said lever and projects downwardly in the path of a cam-disk 30 carried by the piston. The cam-disk 30 has two projections 31 so located that they strike arm 29 at the moment it is desired to open the valves 24, while the cam-disk 30 is movable upon the hub 32 of the piston and upon which it is mounted. The cam projections 31 are beveled on their inner sides, so that while the disk stands at the inner limit of its movement the arm 29 will be moved to the full extent of the projection; yet when the disk is moved outwardly by the governor the extent of movement of the arm 29 decreases proportionately to the inclination or bevel of the cam projections 31, and thus opens the valves 24 to a less extent. The said governor is mounted upon the hub 32 and consists of projections 33, upon which are pivoted bell-crank levers 34, weighted at one end and at their other ends engaging a groove in 35 in a hub projection 36 of the cam-disk. Springs 37 are held by pins 38, mounted upon hub 32, and serve to hold the bell-crank levers 34 at the inner limit of their movement. In this way it will be seen that the supply of oil can be regulated and is controlled automatically, and that if the speed of the engine becomes excessive the governor will serve to open the valves to a less extent and regain their former position as the speed approaches normal.

It will be understood that there is a constant supply of air controlled by the pressure on check-valves 22, and that although the oil is under pressure also, yet it is controlled by the piston and is admitted while the air is on, and I put the oil under greater pressure than the air that a small quantity can be quickly injected at the proper moment.

The operation of the engine is as follows: In Fig. 3 the parts are shown in about the position they occupy just after an explosion has taken place and the abutments 15 are traveling from the induction-port 10 to the exhaust-port 17, that is to say, the valves controlling the air and oil supplies have opened and closed, the oil-valve 24 being closed by the mechanism heretofore described and the air-valves 22 being closed by the excess of pressure between the cylinder and said valves. When the abutments 15 reach the exhaust-ports 17, the active and useful force from the exploded gases has about ceased, and it will be noted that when the abutments pass the exhaust-ports the pressure within the cylinder decreases considerably, owing to the opening of this port, and therefore the pressure within the air-pipe 11 being maintained will overcome the pressure within the cylinder, and therefore open the air-valve 22 and permit a charge of fresh air, or what I term a "scavenger charge," to enter the cylinder and remove the inert and spent gases. This supply of fresh air continues until the next explosion takes place, and therefore in the meantime it will be seen that when the swinging valve 19 opens to permit the passage of the abutment any of the spent or inert gases remaining will be blown out through the valve-opening 18, but as soon as the abutment passes by the valve and the valve closes the fresh air is then retained within the cylinder; and as soon as the abutment passes the induction-port 10 the supply of oil or gas is admitted and the admixture becomes ignited from the ignition-recess, and thus supplies another propelling charge to the cylinder, and so on.

It will be seen from the foregoing description that by expelling from the cylinder all the inert and spent gases and cleaning the cylinder, so to speak, the next charge has greater force and power than if these spent gases remained and were admixed with the fresh charge, and therefore I am enabled to obtain a given force and power from the engine in a more economical manner than has heretofore been accomplished. Another advantage I obtain from allowing this fresh charge of air to pass through the cylinder after each explosion is that the piston and cylinder is cooled off to a certain extent, that is to say, the excessive heat usually present is reduced and equalized to a certain extent by this charge of fresh air passing through the heated parts and the premature explosion of the mixed gas and air effectually prevented.

In Fig. 6 I have shown a modified construction embodying my invention, which consists in making the cylinder with one induction-port, one exhaust-port, and one valve, and in making the piston with only one abutment. The construction and operation of the former will be obvious. I have also shown in said Fig. 6 a safety or relief valve for maintaining the supply of oil at an even pressure, which consists of a valve-chamber 39, situated between the pipe 12 and the valve 24, while a passage 40 leads from said valve-chamber 39 to the oil-passage 23. Above the passage 40 a relief-passage 41 leads from said valve-chamber 39, and within the valve-chamber 39 a valve 42 is situated and carries a stem 43 passing out through the upper end of the valve-chamber and provided with weights 44, which can be increased or diminished in accordance with the pressure to be maintained. The normal pressure upon the oil is sufficient to lift the valve 42 above the passage 40, and thus permit the oil to flow to the oil-passage 23, but it will be seen that under an abnormal pressure within the pipe 12 the valve 42 will be raised still higher and above the relief-passage 41, and thus relieve the pressure by permitting the excess of oil to flow through passage 41 back to the oil-tank. When the pressure again becomes normal, the valve 42 recovers its former position, as will be seen. In this way it is apparent that a regular pressure can be maintained to feed the oil in the desired quantity.

In connection with Fig. 6 is illustrated a form of oil-tank that could be employed, and consisting of a tank 47, communicating by means of passage 12 with the engine. In this passage 12 is arranged a pump 49, for forcing the oil, and the relief-passage also flows into this tank, as shown.

In Figs. 7 and 8, I have shown still another modified construction embodying my invention wherein the chambers to receive the propelling charge are formed by making a groove in the inner face of the cylinder instead of in the outer face of the piston, as above described. In this construction the valves 19 are situated and pivoted within the hollow piston and project through valve-openings 18 therein into the groove or chambers 16 of the piston, practically the reverse of that above described. The pivots 25 of the valves project through the side wall of the piston and are provided with arms 26, that engage projections 46, fastened to the side of the cylinder to cause the valves to rock on their pivots when they approach and retire from the abutments. In other particulars the construction is similar and the engine works in the same manner.

It will be seen, therefore, that I provide a rotary gas-engine to be propelled by successive explosions wherein the rotating part or piston is entirely surrounded or inclosed by a cylinder, and between which piston and cylinder the explosion-chamber is situated, but that the piston and cylinder are not in contact with each other and rotate without friction.

I claim as my invention—

1. In a rotary gas-engine wherein explosive charges are employed as a source of power, a cylinder, and a piston of less diameter than said cylinder situated and supported within the same and capable of rotation therein without contact with the said cylinder, substantially as described.

2. In a rotary gas-engine, a passage in communication with the induction-port and with a means for supplying air under constant pressure, and with a means for intermittently supplying gas or oil at a pressure greater than that of the air, and a valve in the air-supply passage constructed and arranged to be controlled by differences of pressure in the air-supply pipe and the passage to the inlet-port, as and for the purpose set forth.

3. In a rotary gas-engine, a cylinder having induction and exhaust ports, a revoluble piston situated within said cylinder and having a chamber or valve-seat and abutments, a valve passing through an opening in said cylinder and adapted to enter said chamber or valve-seat, and situated between said exhaust and induction ports, means for opening and closing the valve before and after the passage

of an abutment, an exploding device, and means constructed and arranged to supply to the induction-port air and gas or oil before explosion and air after explosion, substantially as described.

4. In a rotary gas-engine, a cylinder having induction and exhaust ports, a revoluble piston situated within said cylinder, and having a valve-seat and abutment, a valve passing through an opening in said cylinder and entering said valve-seat, in the gas or oil supply passage, and situated between said exhaust and induction ports, means for opening and closing the valve before and after the passage of an abutment, and an air-supply, and a gas or oil supply communicating with said induction-port, a valve for controlling the admission of gas or oil to said induction-port operated by means of said piston, and a check-valve situated in the air-supply passage, substantially as described.

5. In a rotary gas-engine, a cylinder having induction and exhaust ports, a revoluble piston situated within said cylinder, and having a valve-seat and abutment, a valve passing through an opening in said cylinder and entering said valve-seat, and situated between said exhaust and induction ports, an air and gas or oil supply communicating with said induction-port, a valve for controlling the admission of gas or oil to said induction-port operated by said piston, and means for admitting air to said induction-port after the abutment passes said exhaust-port and until the explosion occurs, substantially as described.

6. In a rotary gas-engine, the combination with a cylinder having induction and exhaust ports, of a piston rotatably mounted therein, valves pivotally mounted upon one of said parts and adapted to enter valve-seats, said valve-seats being formed in the other of said parts and having inclined side walls and transverse abutments, and said valves having inclined ends adapted to enter said valve-seats, with devices for admitting the propelling charge and for operating the valves, substantially as described.

7. In a rotary gas-engine, the combination with a cylinder having induction and exhaust ports, of a piston rotatably mounted therein and having a groove or chamber and transverse abutments, said abutments being wider than said induction-ports, and valves for said groove or chamber, substantially as described.

8. In a rotary gas-engine, wherein explosive charges are employed as a source of power, a cylinder and a piston coöperating therewith, one of said parts having an explosion-chamber and the other part having a clearance extending into the explosion-chamber, and said parts rotating without frictional contact and a valve or movable abutment adapted to be projected at regular intervals into the explosion-chamber to confine the explosive force, substantially as described.

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

LOUIS GATHMANN.

Witnesses:
RUDOLPH WM. LOTZ,
HARRY COBB KENNEDY.