(No Model.)

2 Sheets—Sheet 1.

W. S. BEEMAN.

ENGINE.

No. 603,601. Patented May 3, 1898.

Fig. 1.

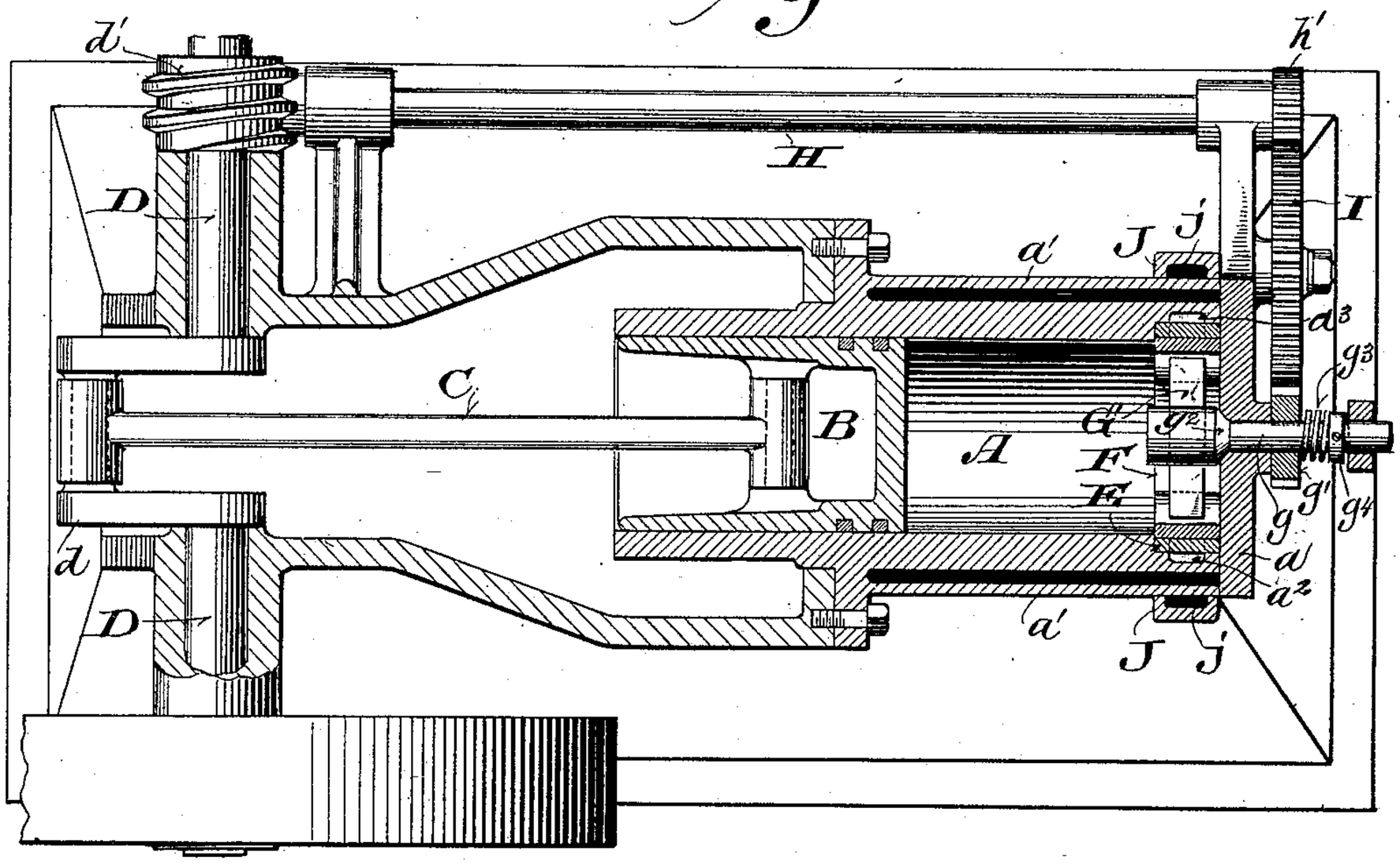
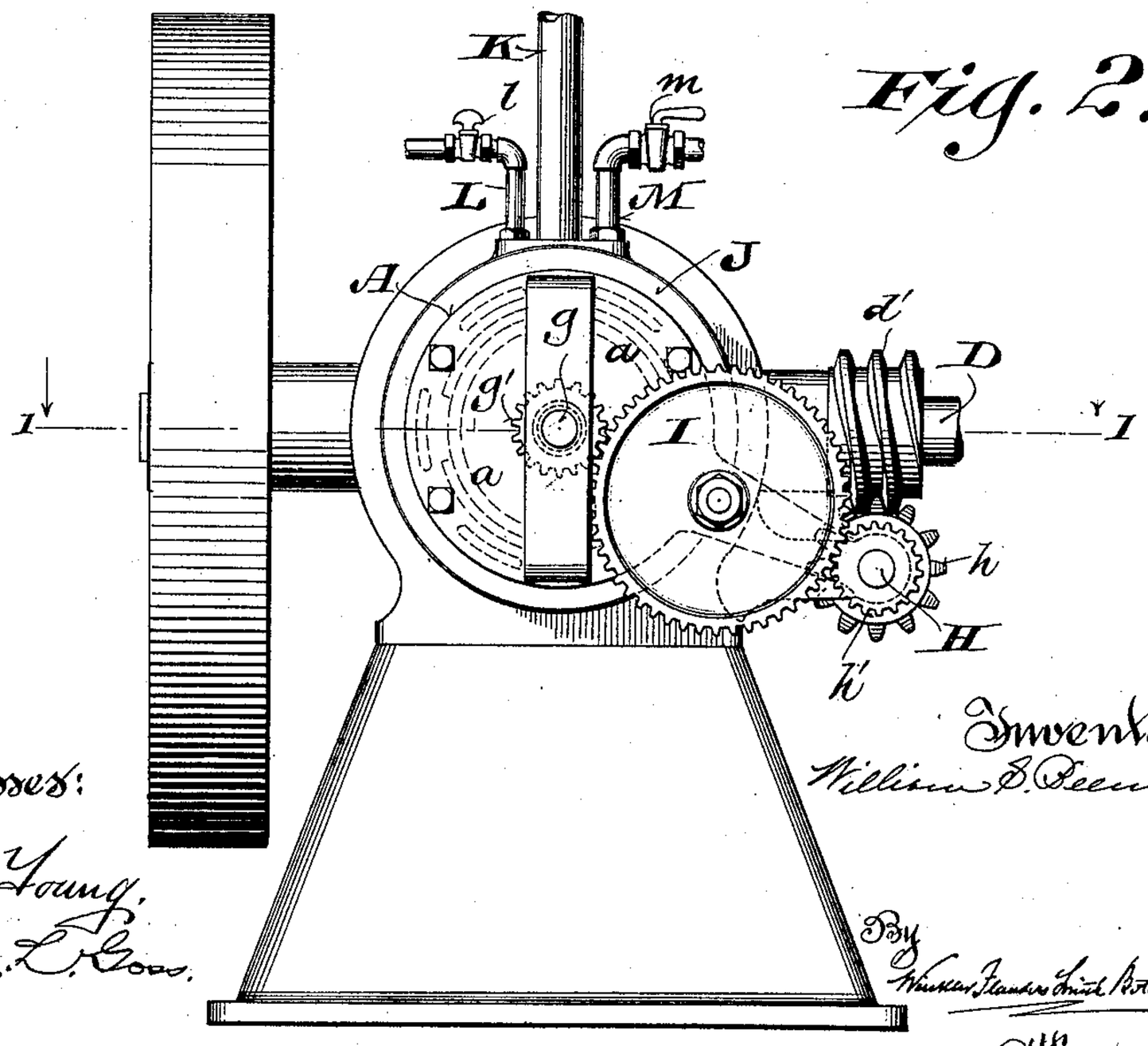


Fig. 2.



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(No Model.)

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ENGINE.

2 Sheets—Sheet 2.

No. 603,601. Patented May 3, 1898.

Fig. 3.

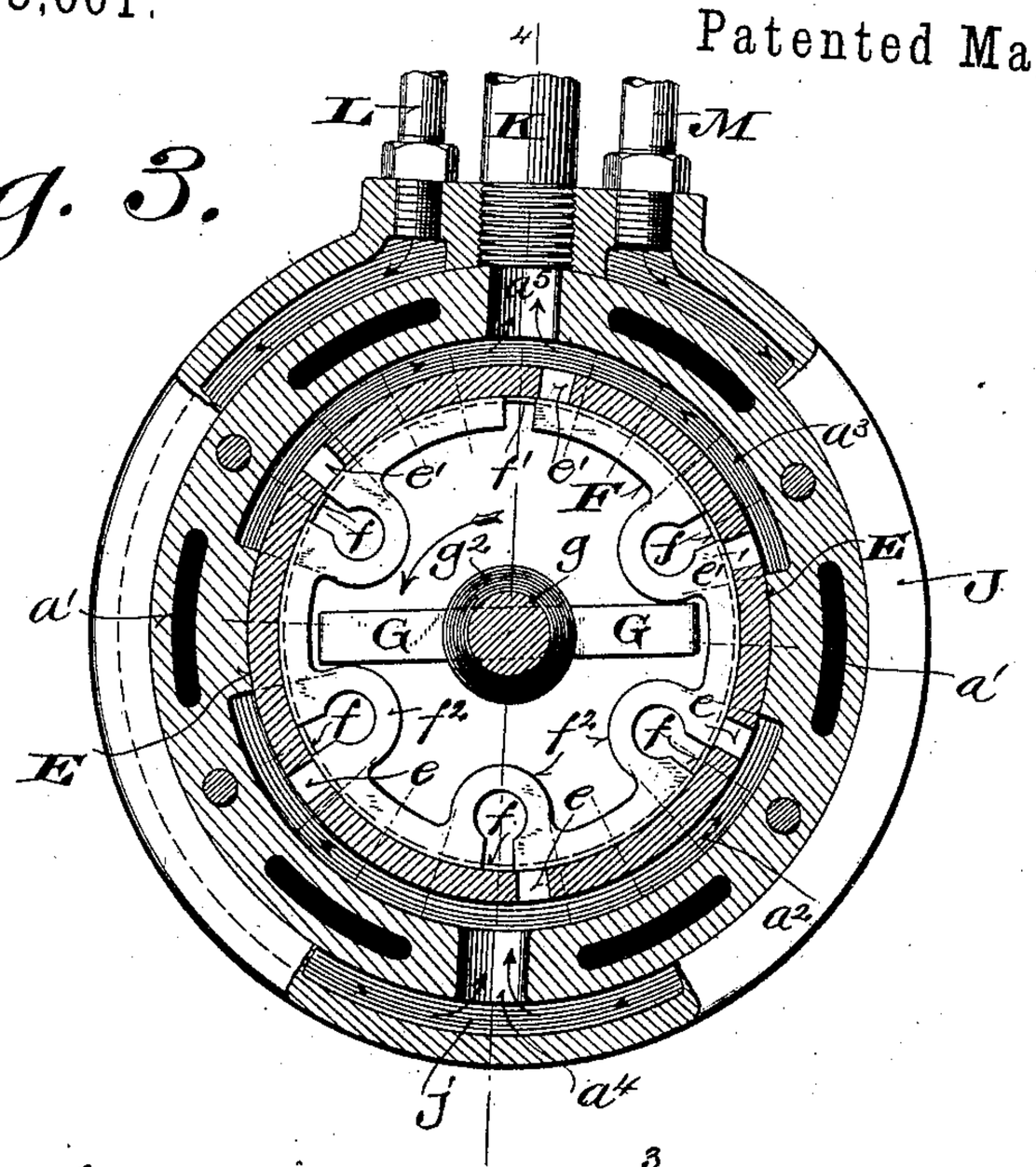
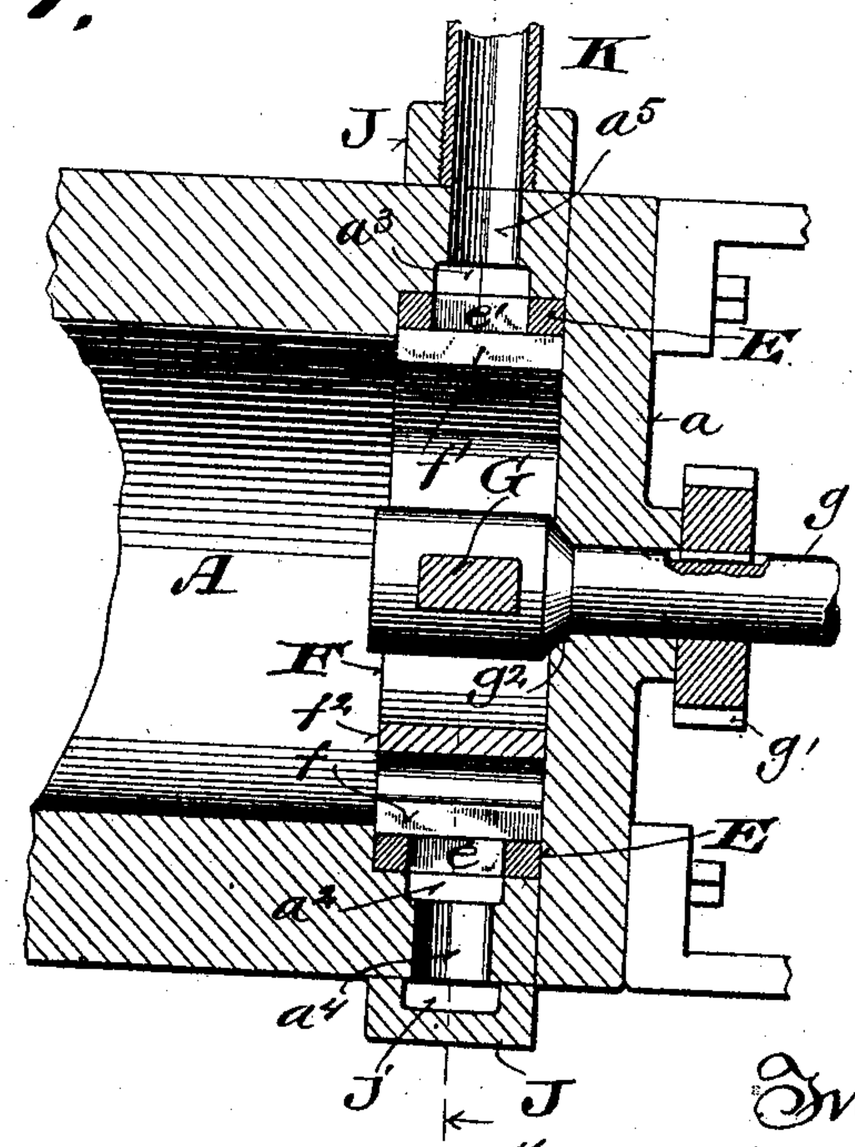


Fig. 4.



Witnesses:
Geo. W. Young.
Chas. L. Goss.

Inventor:
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By Wintter, Flanders, Smith, Bolton & Vila
Attorneys.

UNITED STATES PATENT OFFICE.

WILLIAM S. BEEMAN, OF ASHLAND, WISCONSIN, ASSIGNOR OF ONE-HALF TO GEORGE B. RINEHART, OF SAME PLACE.

ENGINE.

SPECIFICATION forming part of Letters Patent No. 603,601, dated May 3, 1898.

Application filed February 18, 1897. Serial No. 624,074. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM S. BEEMAN, of Ashland, in the county of Ashland and State of Wisconsin, have invented certain new and useful Improvements in Engines; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

The main object of my invention is to provide a combined admission and exhaust valve for engines that will be reliable and noiseless in operation, that will afford ample area of port-opening both for admission and exhaust, that will not wear and become leaky, and that will require little lubrication.

It consists of certain novel features in the construction of the valve mechanism and valve-actuating gear, as hereinafter particularly described, and pointed out in the claims.

In the accompanying drawings like letters designate the same parts in the several figures.

Figure 1 is a horizontal longitudinal section of an engine to which my improvements are applied. Fig. 2 is an end elevation of the engine as viewed from the right with reference to Fig. 1. Fig. 3 is a cross-section, on an enlarged scale, of the valve-seat and of the supply and exhaust connections of the engine on the line 3 3, Fig. 4, the valve being shown in end elevation; and Fig. 4 is a longitudinal section on the line 4 4, Fig. 3.

For the purpose of illustration I have shown and will describe my improvements as applied to a gas-engine in which the valve is designed to make one revolution to each twelve revolutions of the crank-shaft, and an explosion takes place not oftener than at each second revolution of the crank-shaft; but with suitable modifications, which will be readily understood by those familiar with the subject to which my invention pertains, my improved valve mechanism and gear may be adapted to different types of gas, oil, and other engines.

Referring to the drawings, A designates the engine-cylinder, which is open at the end toward the crank and closed at the opposite end by a suitable head *a*. B is the piston, connected by a rod C with the crank *d* of the crank-shaft D in the usual or any suitable manner. The cylinder is shown as provided with a water-jacket *a'*, commonly employed in this class of engines to prevent overheating. In the present case the valve mechanism is contained in the cylinder, one end of which constitutes the valve-case and is formed with an internal annular recess in which is fitted the annular valve-seat E. This seat is formed radially with admission-ports *e e*, arranged equidistant from each other and communicating on the outer side of the ring with a common supply-passage a^2, formed in the cylinder. It is also formed with correspondingly-spaced equidistant exhaust-ports *e' e'*, which communicate on the outer side of the ring E with a common exhaust-passage a^3, formed in the cylinder. In the present case, in which the valve-actuating gear is constructed and arranged to produce one revolution of the valve to every twelve revolutions of the crank-shaft, the valve-seat is provided with three admission-ports and three exhaust-ports, and the admission-ports are arranged nearer to the exhaust-ports on one side than on the other, so that all the exhaust-ports *e'* in the valve-seat will register with ports in the valve on every fourth stroke of the piston, all the admission-ports *e* will register with valve-ports on the next succeeding stroke of the piston, and both exhaust and admission ports will be closed during two intervening strokes of the piston.

F is a rotary annular valve fitted inside of the valve-seat E and formed in its periphery with six ports *f f* and *f'*, equidistant from each other and spaced to correspond with the spacing of the admission-ports *e* and the exhaust-ports *e'* of the valve-seat. The ports *f f'* extend transversely through the face of the valve and open at its sides. On one side the valve is completely severed by the port *f'*, but is connected around the remaining ports by inwardly-extending bridge-pieces f^2. In this way it is made contractible and expansible, so as to fit snugly at its face within the seat E, unaffected by the varying tem-

perature to which it is subjected and the consequent expansion and contraction of the metal of which it and its seat are composed. In the construction of the valve it is made normally slightly larger than the opening in the ring E, and is sprung into place therein by slightly contracting the port f', so as to produce and maintain by its expansive tendency a constantly snug fit between its working face and its seat in the ring E and to compensate for the slight wear that results from its continued operation. The valve may be guided and held in place between the cylinder-head a and the side of the recess in which the ring E is inserted. It is turned in the direction indicated by the arrow in Fig. 3 by the loose engagement therewith of a cross-bar G on the inner end of a spindle g, which projects outwardly through a central opening in the head a, and is provided on its outer end with a gear g'. The stem g has a conical enlargement g^2, which fits into a corresponding recess in the inner side of the cylinder-head a and is held snugly in said recess by a spring g^3, interposed between a collar g^4 on its outer end and the gear g', which is free to move endwise upon said stem, but is held from turning thereon by a key or feather. (Shown in Fig. 4.) By this means leakage around the stem from the cylinder is prevented and at the same time the stem is allowed to turn freely. The cross-arm G, being made a little shorter than the internal diameter of the ring F and engaging loosely at its ends with the inwardly-projecting bridge-pieces f^2, permits the valve to freely conform in position to the valve-seat, and thus preserve a close fit between the working faces of the valve and its seat.

H is a lay-shaft supported in suitable bearings at one side of and parallel with the cylinder. It is provided at one end with a worm-gear h, which engages with a worm d' on the crank-shaft, as shown in Fig. 2. It is provided at the other end with a gear h', meshing with a gear I, which in turn meshes with the gear g'. These several gears, including the worm and worm-gear, are so constructed and proportioned that twelve revolutions of the crank-shaft will produce one revolution of the valve, as hereinbefore stated.

J is an internally-recessed ring shrunk upon the cylinder and forming therewith an annular passage j, through which gas or vapor and air are supplied to the cylinder, said passage communicating with the passage a^2 through an opening a^4 in the under side of the cylinder.

K is the exhaust-pipe, which in the present instance is threaded in the upper part of the ring J and communicates with the passage a^3 through an opening a^5 in the upper side of the cylinder. On opposite sides of the exhaust-pipe K pipes L and M are secured in said ring, communicating with opposite ends of the passage j. One of these pipes is arranged to supply gas, vapor, or oil and the other air to the passage j, and they are provided with suitable cocks or valves l and m, as shown in Fig. 2.

My improved valve mechanism operates as follows: Assuming the valve to be in the position in which it is shown in Fig. 3 and the piston at the end of its stroke toward the cylinder-head, during the next forward stroke of the piston toward the crank-shaft the valve will be turned one twenty-fourth of a revolution. (Represented by one of the divisions into which the valve and its seat are divided by dotted lines in Fig. 3.) During this movement of the valve three of the ports $f\,f$ will be carried over and past the admission-ports $e\,e$ in the valve-seat and a charge of gas or vapor and air will be drawn into the cylinder, the exhaust-ports remaining closed. During the next return stroke of the piston the admission as well as the exhaust ports will be closed and the charge of gas or vapor and air contained in the cylinder will be compressed. At the beginning of the next advance stroke of the piston the compressed charge will be ignited by any suitable device, such as is ordinarily employed in engines of this kind for the purpose and not necessary to be shown or specifically described. The piston is thus propelled forward by the impact and expansive force of the exploded charge, the admission and exhaust ports still remaining closed. As the piston begins its next return stroke the three exhaust-ports e' will be simultaneously opened by three of the ports in the valve being brought into register therewith. The spent charge will then be expelled from the cylinder by the return movement of the piston. At the beginning of the next advance movement of the piston the admission-ports will be again opened to admit a fresh charge of gas or vapor and air into the cylinder and the operation as above explained will be repeated, the exhaust-ports being opened at every fourth stroke of the piston and the admission-ports the next succeeding stroke.

The several ports $f\,f'$ in the valve being equidistant from each other, both admission and exhaust ports e and e' would be opened at the same time if the exhaust-ports e' were the same distance from the admission-ports that they were from each other; but while the several admission-ports e and the several exhaust-ports e' are spaced with reference to each other like the valve-ports $f\,f'$, so that all admission or all exhaust ports will be simultaneously opened, the admission-ports e are nearer on one side than on the other to the exhaust-ports e', so that when the admission-ports e are opened the exhaust-ports e' will be closed, and vice versa. The valve being turned continuously in one direction and making one revolution to a number of revolutions of the crank-shaft equal to twice the number of ports in the valve, all the exhaust-ports e' will be opened at every fourth stroke of the piston, all the admission-ports e will

be opened on the stroke next succeeding the opening of the exhaust-ports, and both admission and exhaust ports *e* and *e'* will be closed during the intervening two strokes.

When oil and air are employed as the actuating agents, they are supplied to the cylinder through a passage encircling the cylinder, as shown, and thus become heated, the oil being vaporized and the air expanded in its sinuous circuit in contact with the heated walls of the cylinder. By the employment of a worm on the crank-shaft and a slowly-turning rotary valve the valve-gear is rendered noiseless in operation, and the wear on the valve face and seat is made very slight.

I do not wish to be understood as limiting myself to the exact details of construction shown and described, as they may be variously modified within the spirit and intended scope of my invention. The number of ports may be varied without affecting the principle of the valve mechanism. For instance, the valve may be provided with eight ports and its seat with four admission and four exhaust ports, the valve-gear in such case being arranged to turn the valve one revolution to sixteen revolutions of the crank-shaft, or the valve may be made with four ports and the valve-seat with two admission and two exhaust ports, the actuating-gear being arranged to turn the valve in this case once to every eight revolutions of the crank-shaft.

I claim—

1. The combination of a valve-chamber having a seat with a number of equidistant admission-ports and a number of equidistant exhaust-ports arranged in circular series, the exhaust-ports being nearer to the admission-ports on one side than on the other, and a rotary valve having a number of equidistant ports arranged and spaced to correspond with the admission and exhaust ports in the valve-seat, said valve consisting of an expansible ring severed on one side through one of its ports, substantially as and for the purposes set forth.

2. The combination of a cylindrical valve-seat having admission and exhaust ports, a rotary ring-shaped valve severed on one side and having ports in its periphery arranged to register with the ports in the valve-seat, a spindle fitted to turn in the wall of the valve-chamber through which it projects and provided with a projection which loosely engages with said valve and means for turning said spindle, substantially as and for the purposes set forth.

3. The combination of a cylindrical valve-seat having a number of admission-ports equidistant from each other and communicating with a common supply-passage, and a number of similarly-spaced exhaust-ports and a ring-shaped valve having a number of ports extending completely across its periphery and spaced to correspond with the admission and exhaust ports in said seat, one of the valve-ports severing the ring and rendering it contractible and expansible, and the parts of said ring between its other ports being connected by inwardly-projecting bridge-pieces, substantially as and for the purposes set forth.

4. The combination with an engine-cylinder, of a cylindrical valve-seat inserted therein and having a number of admission and exhaust ports communicating respectively with supply and exhaust passages encircling said seat, a rotary annular valve fitted to turn in said seat and formed in its periphery with a number of equidistant ports spaced to correspond with the spacing of the admission and exhaust ports respectively in the valve-seat, the exhaust-ports in the valve-seat being nearer the admission-ports on one side than on the other, and so arranged that all the exhaust-ports will register with ports in the valve at every fourth stroke of the piston, and all the admission-ports will register with ports in the valve on the next succeeding stroke of the piston, and means for turning said valve continuously in one direction, substantially as and for the purposes set forth.

5. The combination with an engine-cylinder provided with a cylindrical valve-seat and supply and exhaust passages encircling said seat, and each communicating with the cylinder through a number of equidistant ports in said seat, of an expansible annular valve fitted to turn in said seat and having a number of ports in its periphery arranged to register alternately with the admission and exhaust ports in said seat, means for turning said valve continuously in one direction, the exhaust-ports in the valve-seat being nearer the admission-ports on one side than on the other, and so arranged that all the exhaust-ports will register with valve-ports at every fourth stroke of the piston, all the admission-ports will register with valve-ports on the next succeeding stroke of the piston, and both exhaust and admission ports will be closed during two intervening strokes of the piston, and a passage around the cylinder communicating on one side thereof with the supply-passage to the admission-ports and having at its ends on the opposite side of the cylinder air and gas or vapor supply connections, substantially as and for the purposes set forth.

6. The combination with an engine-cylinder or valve-chamber provided with a cylindrical valve-seat and supply and exhaust passages, each communicating with said cylinder or chamber through a number of ports in said seat, of a rotary annular valve having a number of ports in its periphery arranged to register with the admission and exhaust ports alternately opening the exhaust-ports on every fourth stroke and the admission-ports on the next succeeding stroke of the piston, a spindle loosely connected with said valve and having a conical enlargement fitting a corresponding recess in the inner wall of the cylinder-head or valve-chamber, a spring tending to hold said conical enlargement snugly seated in said recess, and means

for turning said spindle, substantially as and for the purposes set forth.

7. The combination with an engine-cylinder provided with a cylindrical valve-seat and supply and exhaust passages each communicating with said cylinder through ports in said seat, a piston and a crank-shaft, of an expansible annular valve fitted to turn in said seat and having ports in its periphery arranged to register alternately with the admission and exhaust ports in said seat, said valve being severed through one of its ports, a spindle passing through the cylinder and having a self-adjusting connection with said valve, whereby the valve is turned and allowed to adapt itself to its seat by expansion or contraction, and a lay-shaft connected with said spindle by gears and with said crank-shaft by a worm and worm-gear, substantially as and for the purposes set forth.

8. The combination with an engine-cylinder, piston and crank-shaft of an annular valve-seat having a number of admission and exhaust ports, the spaces between the several admission-ports and between the several exhaust-ports being alike, while the space between the adjacent admission and exhaust ports is different, a rotary valve fitted to said seat and having a number of ports equidistant from each other and spaced to correspond with the spacing of the admission and exhaust ports in the valve-seat, and actuating connections between said valve and crank-shaft whereby a number of revolutions of the crank-shaft equal to twice the number of ports in the valve produce one revolution of the valve, substantially as and for the purposes set forth.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

WILLIAM S. BEEMAN.

Witnesses:
FLORA B. HOLT,
A. F. WRIGHT.