H. K. HOLSMAN.

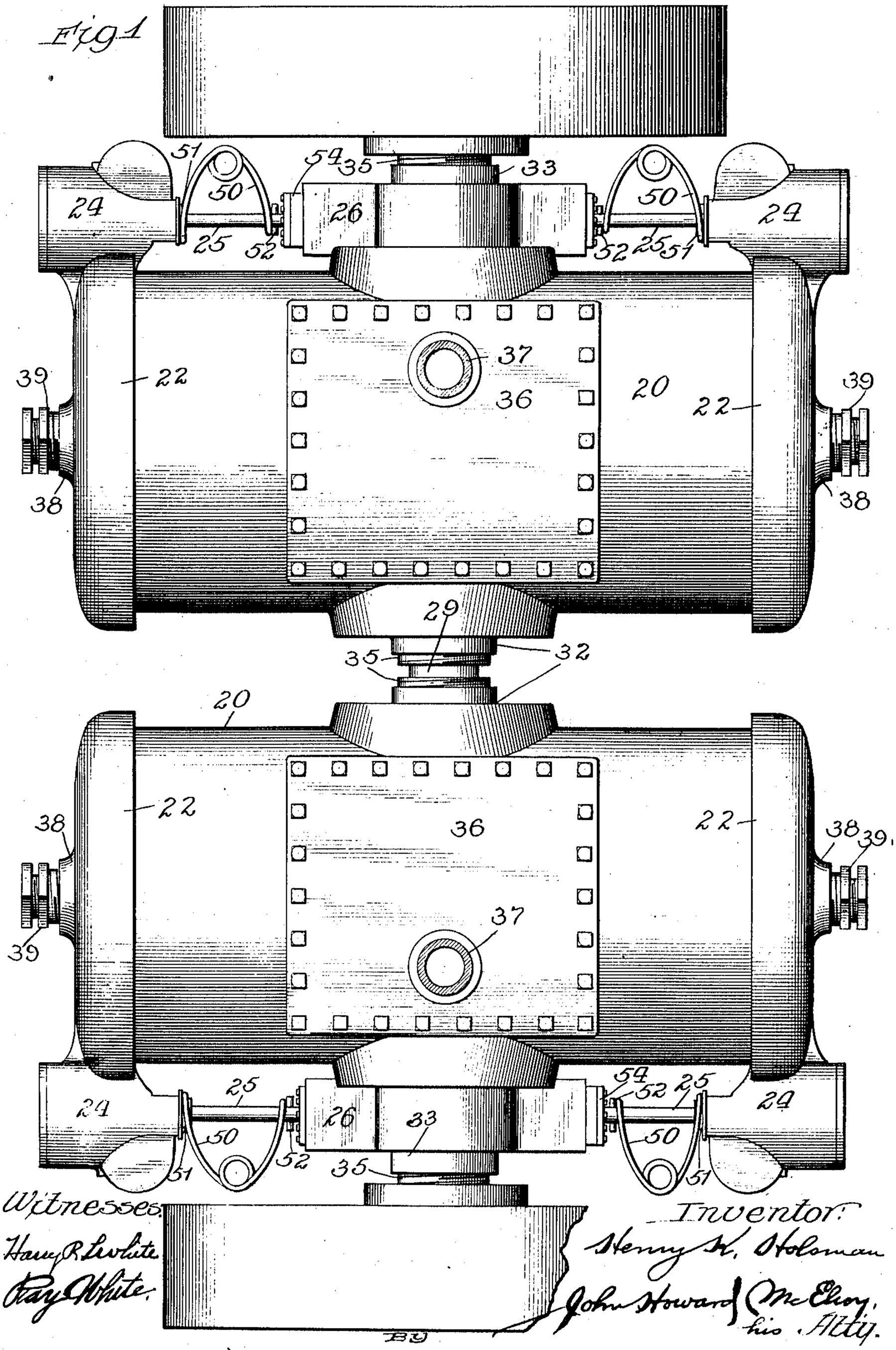
GAS ENGINE.

APPLICATION FILED FEB. 23, 1907. RENEWED APR. 19, 1909.

980,263. **Patented Jan. 3, 1911.**

5 SHEETS—SHEET 1.

Fig 1



Witnesses.

Harry R. Lovlette

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Inventor:

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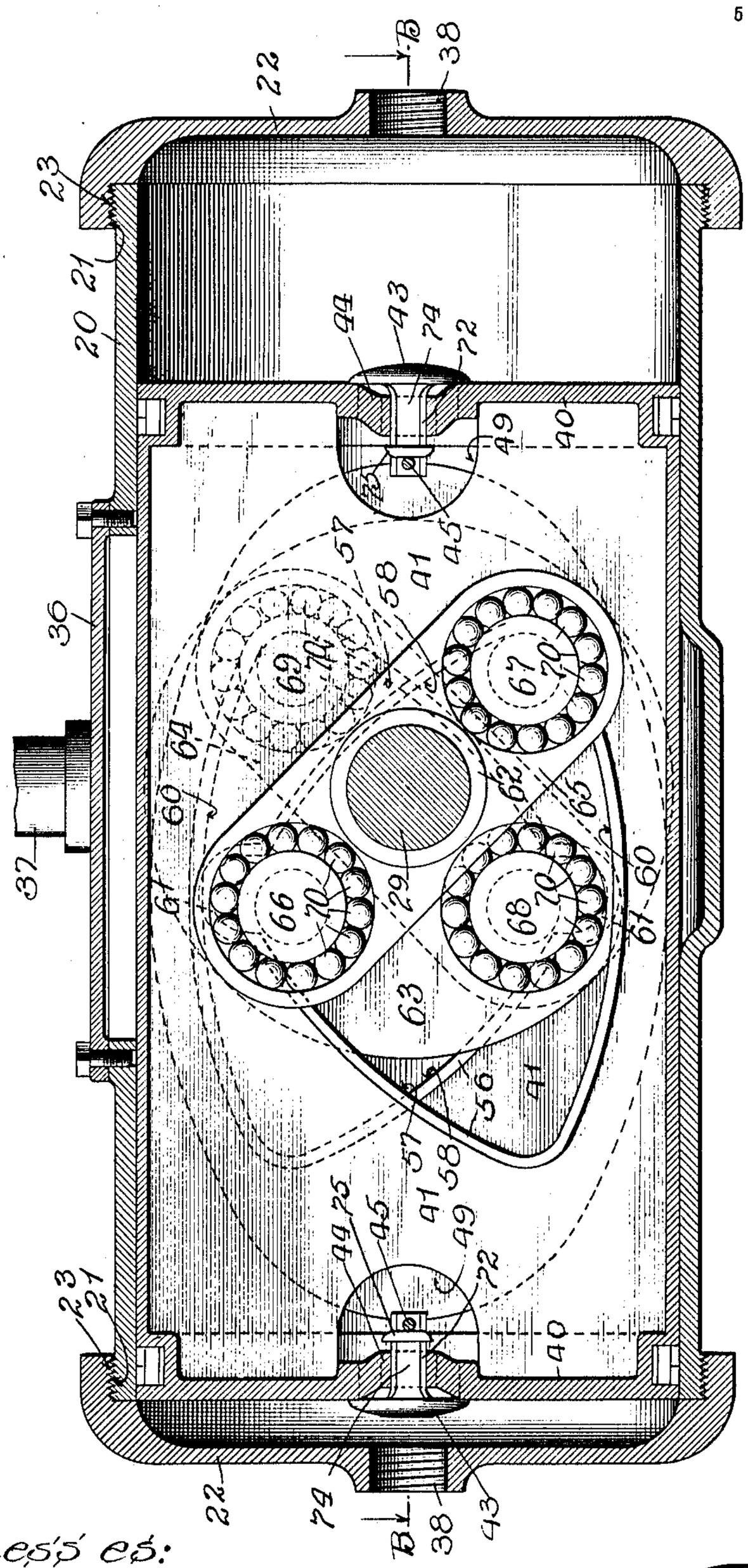
5 SHEETS—SHEET 2.

Fig 2



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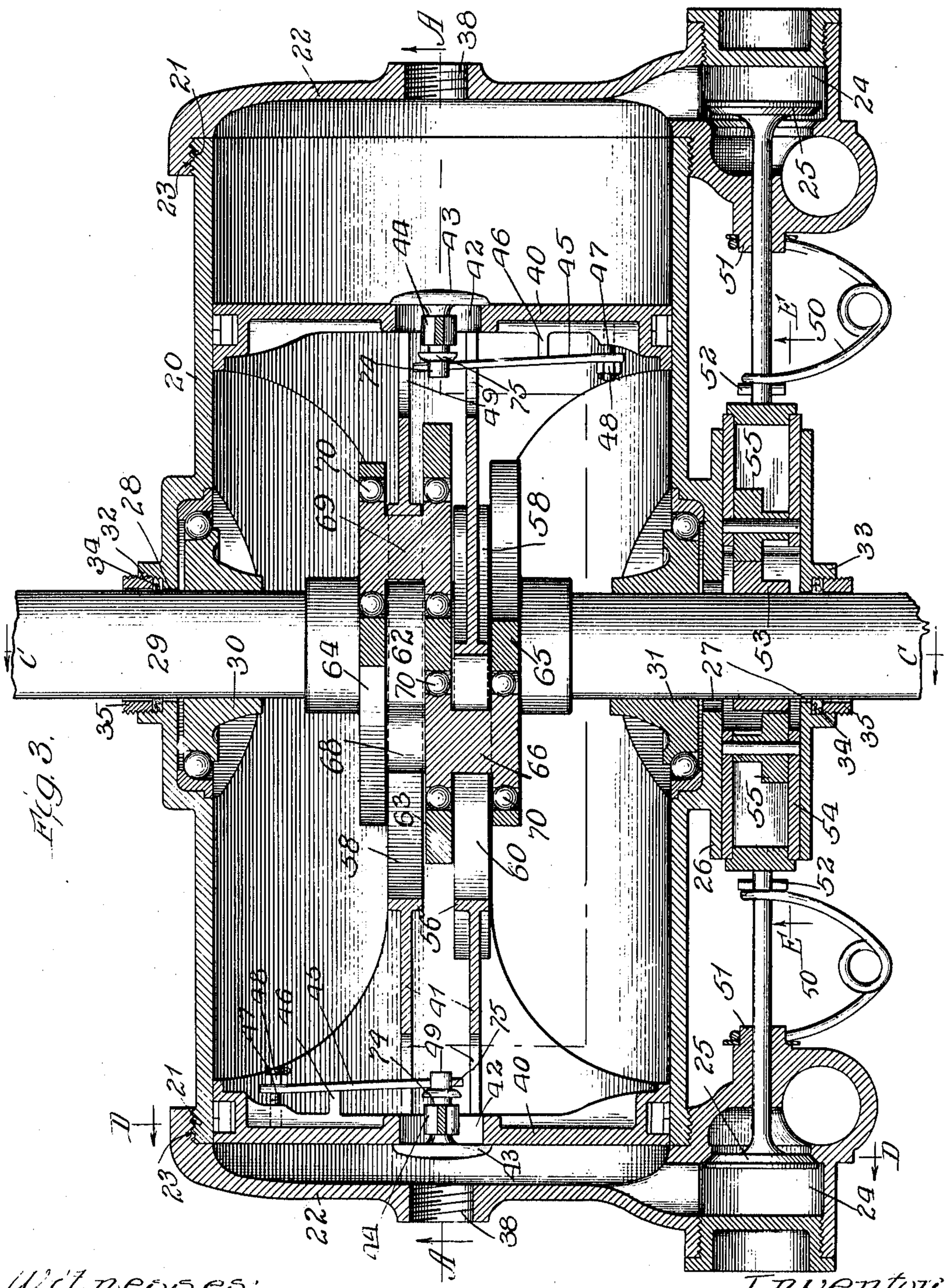

Fig. 3.

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5 SHEETS—SHEET 4.

Fig. 4

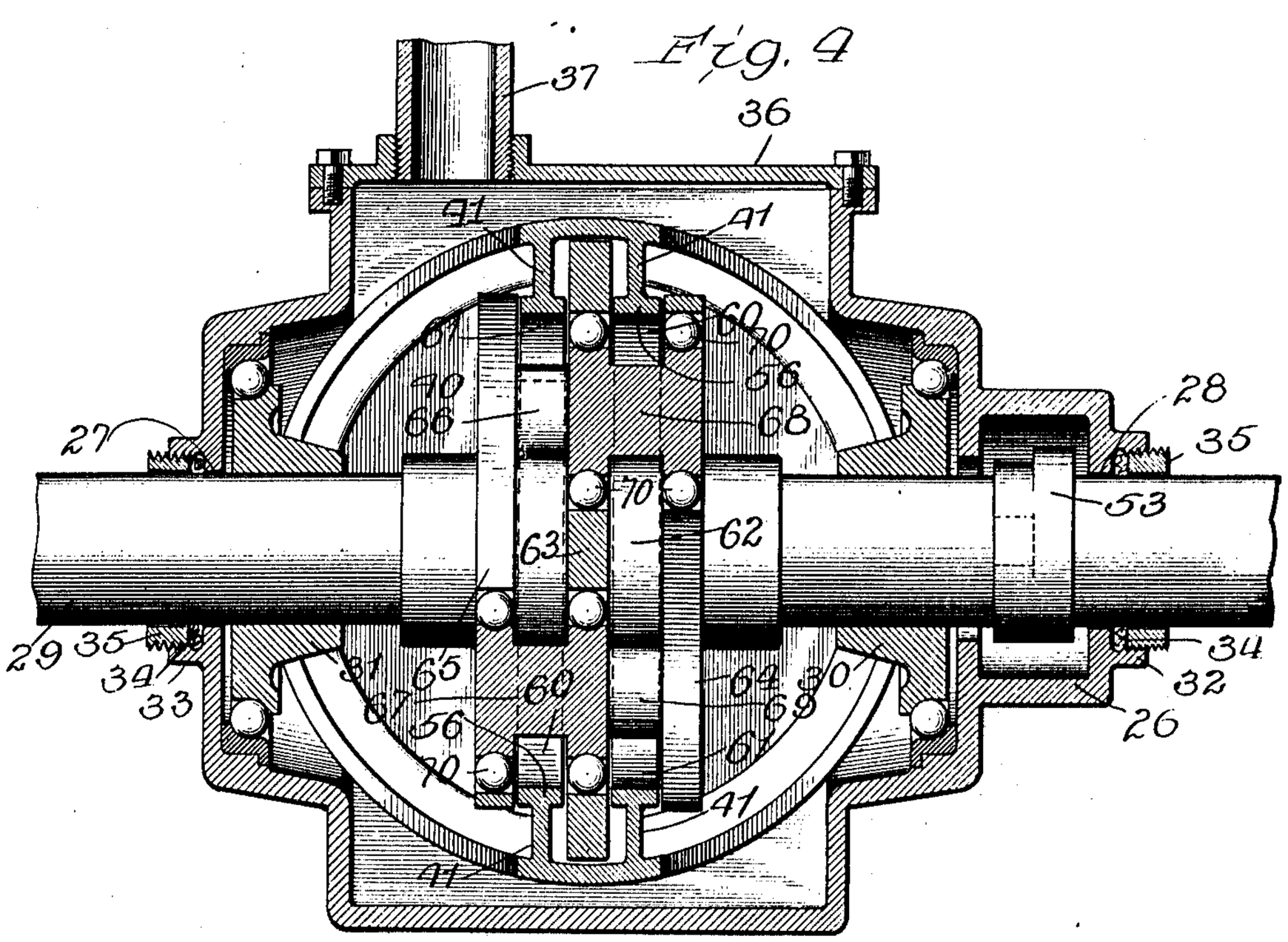
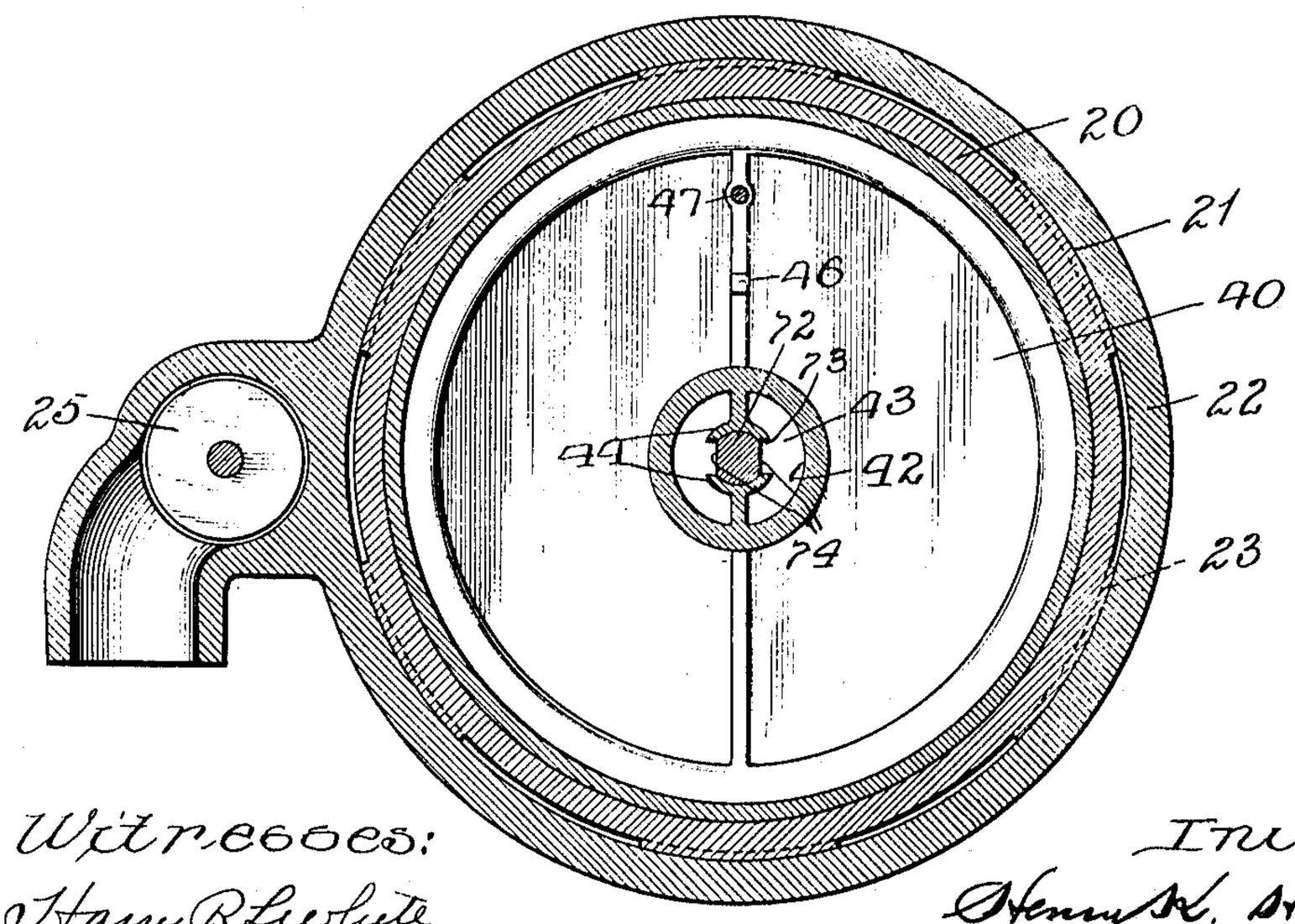


Fig. 5.



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5 SHEETS—SHEET 5.

Fig. 6

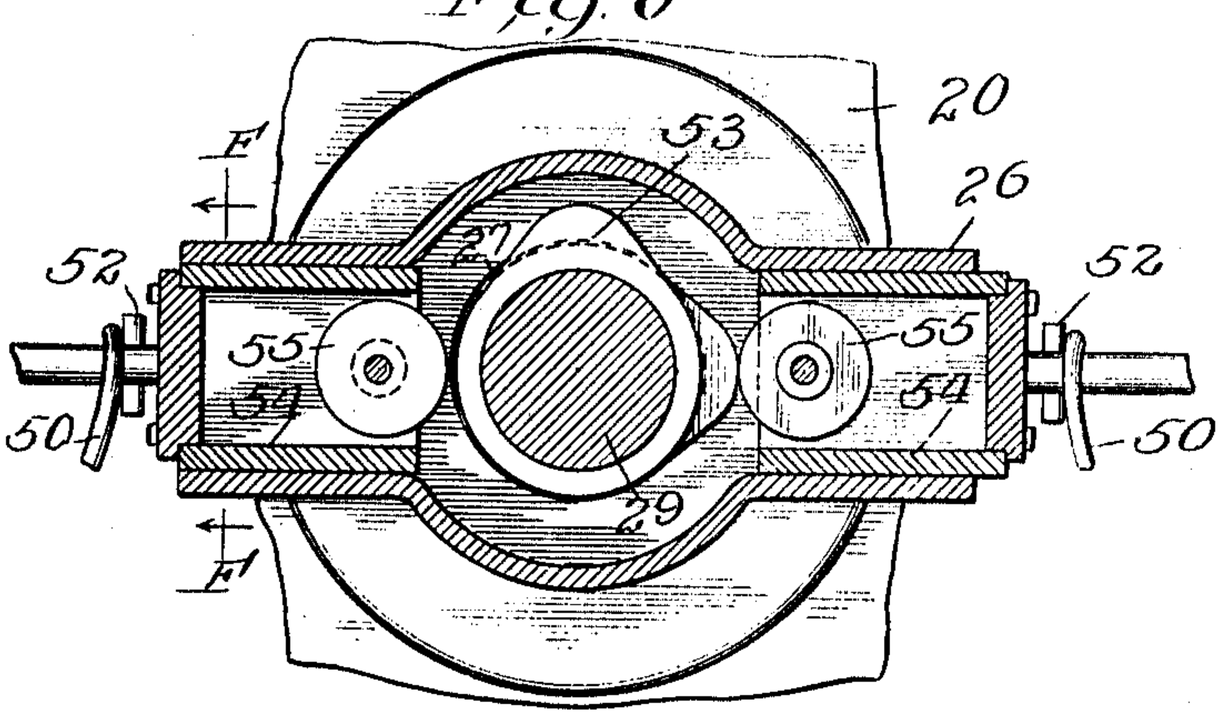


Fig. 7.

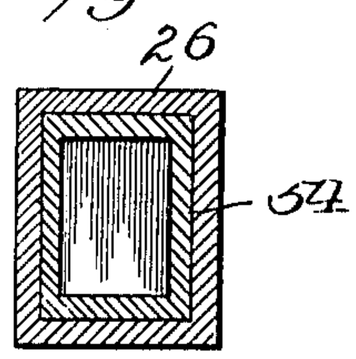


Fig. 8

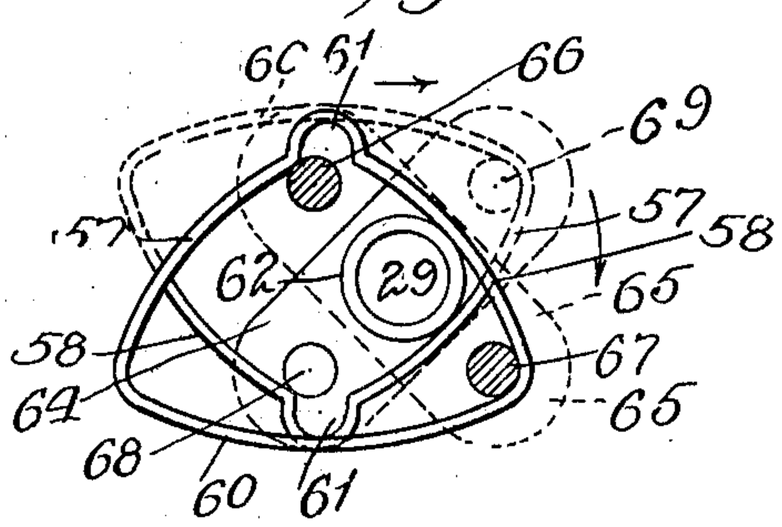


Fig. 9.

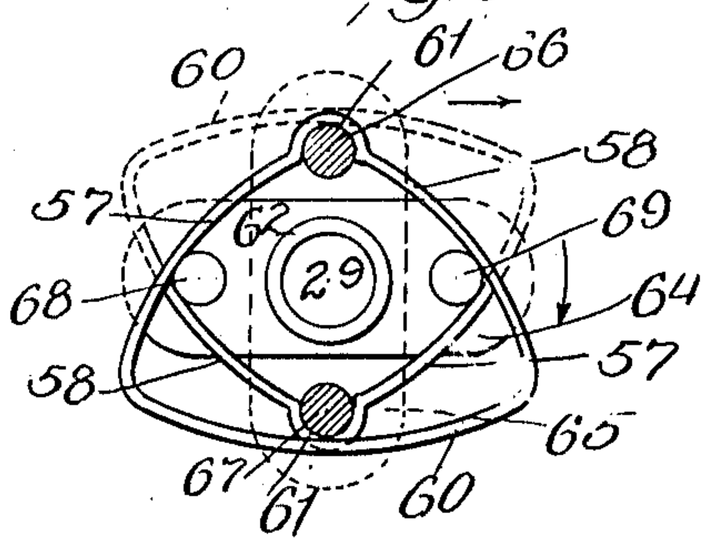


Fig. 10

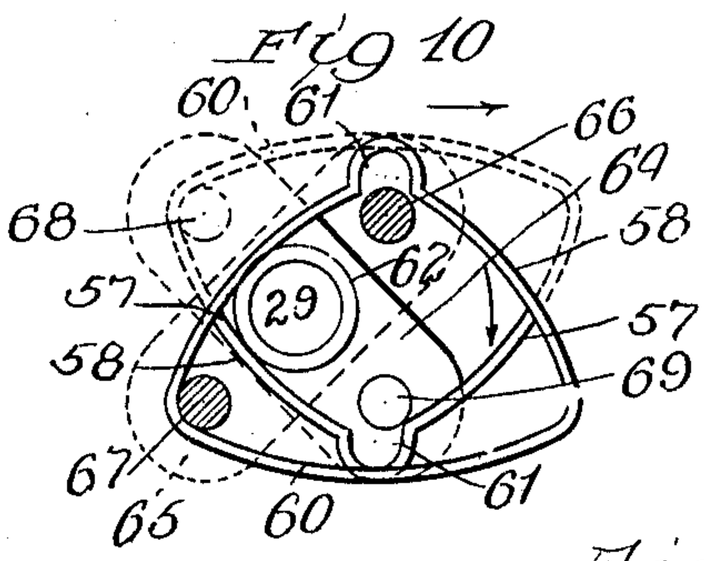


Fig. 11.

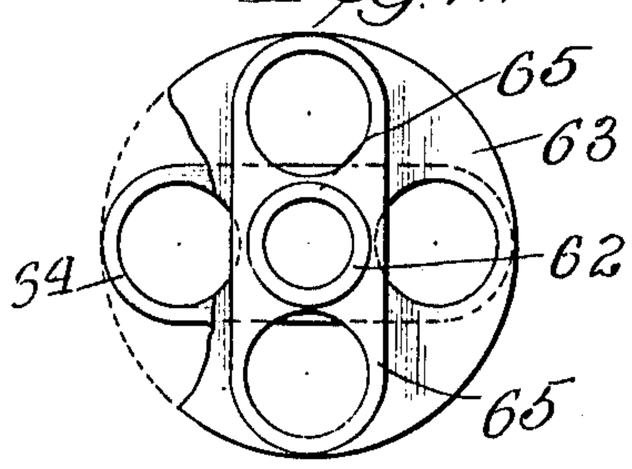
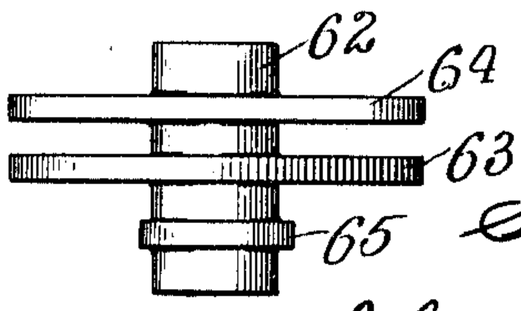


Fig. 12



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UNITED STATES PATENT OFFICE.

HENRY K. HOLSMAN, OF CHICAGO, ILLINOIS.

GAS-ENGINE.

980,263. Specification of Letters Patent. Patented Jan. 3, 1911.

Application filed February 23, 1907, Serial No. 358,818. Renewed April 19, 1909. Serial No. 490,964.

To all whom it may concern:

Be it known that I, HENRY K. HOLSMAN, a citizen of the United States, and a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Gas-Engines, of which the following is a full, clear, and exact specification.

My invention is concerned with a novel gas or similar engine in which mechanism is employed therein for converting every two complete reciprocations of the piston or pistons into one revolution of the engine shaft or vice versa.

In the following disclosure of my invention, I will first describe in detail what I now consider to be the best form in which it is to be employed, and finally, in the claims, point out the elements and combinations of elements which I consider to be novel.

To illustrate my invention, I annex hereto five sheets of drawings, in which the same reference characters are used to designate identical parts in all the figures, of which,—

Figure 1 is a top plan view of a four-cylinder engine containing my invention; Fig. 2 is a longitudinal vertical section thereof, on the line A—A of Fig. 3; Fig. 3 is a horizontal section through one half of the complete engine illustrated in Fig. 1, in section on the line B—B of Fig. 2; Fig. 4 is a vertical transverse section on the line C—C of Fig. 3; Fig. 5 is a similar view, in section on the line D—D of Fig. 3; Fig. 6 is a detail in section on the line E—E of Fig. 3; Fig. 7 is a detail in section on the line F—F of Fig. 6; Figs. 8, 9 and 10 are somewhat diagrammatic views showing the relationship of the operating connections in three different positions; and Fig. 11 is a side elevation, and Fig. 12 a top plan view. of the member secured to the driving shaft and carrying the eccentric pins.

As indicated in Fig. 1, I preferably employ my invention in connection with an engine of the four-cylinder opposed type, but it will be obvious that it could be employed, although perhaps less advantageously, in connection with a fewer number of cylinders. The pair of opposed cylinders are preferably constructed of a single sleeve 20, which, as best shown in Fig. 5, has the interrupted threads 21 formed on the outer surfaces of its ends, so that by forming the similar interrupted threads 23 on the interior of the heads 22, the heads can be quickly and accurately brought into position so that the chambers 24 for the exhaust valve 25 can be readily and accurately brought opposite to the bearings 26 formed in or secured to the cylinder 20 in assembling the parts. The cylinder has the recess 27 on one side and 28 on the other side for the passage of the shaft 29, which is journaled in suitable bearings 30 and 31, respectively, associated with said apertures. The shaft is provided with one or more fly wheels at its ends, as seen in Fig. 1, to operate the pistons by its momentum on other than the explosion strokes, as is customary in gas engines. The cylinder is preferably provided with the interiorly-threaded bosses 32 and 33, so that the packing 34 can be confined by the nuts 35, so as to make the cylinder substantially air-tight. The tops are closed by the plates 36, which have the inlet pipes 37 let into them. The ends are provided with the perforated bosses 38, in which the spark plugs 39 are placed when the parts are assembled. Each cylinder is preferably provided with the opposed pistons 40, which are connected by one or more webs 41, and are provided with inlet apertures 42, which are normally closed by inlet valves 43, which are shown as of the mushroom variety, and have their stems sliding in the bearing sleeve 44 suitably supported across the aperture 42. The valve is held normally closed by means of a spring 45, which passes through an aperture in the stem of the valve, across the abutment 46 projecting from the interior of the piston head and to the bolt 47 secured in the piston, which passes through an aperture in the spring, so that by adjusting the nut 48 thereon, the tension of the valve 43 can be regulated so as to open at the proper degree of exhaustion. The web or webs 41 are provided with the recess 49 therein to permit the entrance of the spring and the operation of the valve. The exhaust valve 25 is held normally closed by the spring 50, one end of which coöperates with the abutment 51 on the exhaust valve-casing 24, while the other end coöperates with the pin or abutment 52 associated with the end of the valve stem. The valve is opened against the tension of the spring at the proper interval by means of the cam 53 secured on the shaft 29 cooperating with the slide 54 reciprocating in the bearing 26, and having its end contacting

with the end of the valve stem. I preferably provide the anti-friction roller 55 in the end of the slide 54 adjacent the cam, and as the slides are in the same plane, the cams are preferably offset, as shown, and the rollers correspondingly arranged. As seen in Fig. 6, the cams 53 for one cylinder are set at an angular distance of ninety degrees apart, and the cams for the other cylinder will be correspondingly set at one hundred and eighty degrees from these cams and at ninety degrees from each other, so that the engine will be given four impulses, one for each direction of movement of the pistons at each complete rotation of the shaft 29.

I will next explain the novel mechanism which I have devised for the specific purpose of transforming the two complete reciprocations of the piston or pistons of my engine into one complete rotation of the shaft, or vice versa, although it will be understood that the movement might be employed in other places where such a transformation is desired. As is best shown in Figs. 2, 3, and 8 to 12, the webs 41 are each provided with the bearing surfaces or tracks 56 which are preferably formed by flanges projecting on either side of the two webs, although it will be understood that a single web might be employed with the flanges, one projecting from each side thereof. These surfaces 56 are of the somewhat peculiar shape shown, being substantially that of an isosceles triangle with the equal sides 57 and 58, and with the longer third side 60, all three sides being curved, and the apex being formed by the short substantially semicircular recess 61, which is in fact a portion of a transverse groove, as the mechanism for transforming the motions in fact consist substantially of a combined cam and transverse groove member coöperating with eccentric pins or members carried by the shaft 29. The bearing surfaces 56 on the two webs 41 are on the opposite sides of the single web, if one should be employed, and set at an angle of one hundred and eighty degrees from each other, and the shaft 29 has secured thereon the pin bearing element, which, as shown in Figs. 11 and 12, preferably consists of the sleeve 62 having the central disk 63, which extends between the webs 41 and the arms 64 and 65, which are set at right angles to each other, and which extend on the outside of the webs 41. The ends of the arms 65 are connected with the disk 63 by the pins 66 and 67, and the ends of the arms 64 are connected with the disks 63 by the pins 68 and 69, all these pins preferably taking the form of anti-friction rollers which are mounted in their supporting arm and disk by means of the ball-bearings 70, as best shown in Fig. 3.

In the diagrammatic views constituting Figs. 8, 9 and 10, in order to render the operation of the parts a little more apparent, I have considered the arms 65 nearest the observer as removed, but have indicated its position by dotted lines, but its associated pins 66 and 67 are in position. In Fig. 8, the reciprocating member is shown as at its extreme left-hand position, and ready to move to the right. In this position, the pin 66 has not yet come in engagement with its cooperating wall of the transverse groove 61, but the pin 68 is just being engaged by the cam surface of the side 58 coöperating therewith, so that as the reciprocating member is moved to the right, the pin 68 will be cammed or wedged up so as to cause the shaft to rotate in the direction of the arrow. After it has moved upward a little farther, and notably to the position shown in Fig. 9, the pin 66 is engaged by its groove 61, and the movement for substantially the next forty-five degrees is effected by this action, as well as the cam action of the side 58 on the pin 68. This brings us to the position of Fig. 10, where the reciprocating part has reached the limit of its movement to the right, and is ready to return to the left, and in this position of the parts, the pin 66 is just ready to be engaged by the side 58 associated therewith, to cam or drive it through an angle of ninety degrees, and during the latter portion of which movement, this action is supplemented by the pin 69 being engaged by the groove 61. The movement through this second quadrant is effected in the same manner as through the first quadrant, but by different parts, and so on, throughout the entire rotation of the shaft, which is effected by two complete reciprocations of the piston heads. The came action, of course, will occur if the shaft 29 be driven, as the action of the pins 66, 67, 68 and 69 upon the surfaces 57 and 58 and the ends of the grooves 61 will serve to drive the reciprocating element back and forth, and the same general action will, of course occur if the shaft 29 be held from movement, and the reciprocations of the pistons cause the cylinders to be rotated about the shaft as a center, and it will be understood that I desire to cover the structure in whatever way it be operated.

By the novel movement which I have herein shown, it will be perfectly apparent that I have produced a simple mechanism for transforming the two complete reciprocations of the piston heads into one single rotation of the engine shaft, thus enabling me to mount the cams 53 directly on the shaft, dispensing with the gearing. This construction also gives me the further advantage of taking up much less room along the length of the pistons than is the case with the ordinary crank and pin connection.

It will be noted that the exhaust valve seat and casing is carried directly by the head of

the cylinder, and also that the inlet valve is carried directly by the piston head. In the case of the latter, in order to conveniently assemble the parts, I form the bearing 44 for the valve stem 72 with the recess 73 cut in one or both sides so that by flattening the stem 72 at 74, I can conveniently insert the valve in place even if the flange 75 thereon is integral with the valve stem, and once it is inserted, the spring 45 passing through the stem holds the valve in place. It will be understood that the design and exact location of the spring might be changed. It will also be understood that the curved end of the transverse groove 61, and the portion 60 of the track 56, have practically no action in the conversion of the motion, and might as well, except for appearance and design, be omitted.

It will be noted that the mixture inlet pipes 37 admit the vapor into the crank-case portion of the engine which connects the cylinder portions proper, and that while the crank case has the two sides thereof formed by the pistons movable, yet the pistons move so that the volume of the crank case is always uniform. This is an important feature because it is essential that there should be no change in the volume of the crank case, as the charge is drawn therefrom by suction through the valves 43 into the cylinders proper, and the uniform volume of the crank case is essential to the success of this mode of operation. It also offers an advantage in that the lubricating oil may be mixed with the gasolene and deposited on the interior of the cylinder, thoroughly lubricating it without the necessity of employing any force-feed lubricator.

While I have shown and described a novel mechanical movement, cylinder construction and valve piston, in connection with my improved transmission mechanism for an explosion engine, I do not herein claim the same, but reserve the subject-matter for divisional applications.

While I have herein shown and described a novel construction in which a plurality of cylinders is employed, together with a crank case connecting the cylinders, and pistons reciprocating in said cylinders and forming movable sides of the crank case, the pistons moving so that the volume of the crank case is always uniform, together with inlet valves in the pistons and means for admitting fuel to the crank chamber, I do not herein claim said novel combination, as it is made a part of my application No. 470,376, filed January 2, 1909.

While I have shown and described my invention as embodied in the form which I at present consider best adapted to carry out its purposes, it will be understood that it is capable of modifications, and that I do not desire to be limited in the interpretation of the following claims, except as may be necessitated by the state of the prior art.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In an engine, the combination with a cylinder, of the piston therein adapted to be moved in one direction by an explosion, of means for moving the piston in the other direction, a shaft extending transversely of the piston, and connections between the piston and the shaft for rotating the latter once for each two reciprocations of the former, consisting of the combined cam and transverse groove members carried by the piston, and the eccentric members carried by the shaft.

2. In an engine, the combination with a cylinder, of the piston therein adapted to be moved in one direction by an explosion, of means for moving the piston in the other direction, a shaft extending transversely of the piston and connections between the piston and the shaft for rotating the latter once for each two reciprocations of the former, consisting of the pair of combined cam and transverse groove members carried by the piston and arranged at an angle of one hundred and eighty degrees to each other, and the four eccentric members carried by the shaft and arranged at angular distances of ninety degrees from each other.

3. In an engine, the combination with a cylinder, of the piston therein adapted to be moved in one direction by an explosion, of means for moving the piston in the other direction, a shaft extending transversely of the piston, and connections between the piston and the shaft for rotating the latter once for each two reciprocations of the former, consisting of the web carried by the piston containing the bearing surfaces having the general outline of isosceles triangles with the short transverse grooves at their apexes, and the member carried by the shaft having the four eccentric members, two for each bearing surface, diametrically opposite each other and at an angle of ninety degrees to the pins coöperating with the opposed surface.

4. In an engine, the combination with a cylinder, of the piston therein adapted to be moved in one direction by an explosion, of means for moving the piston in the other direction, a shaft extending transversely of the piston, and connections between the piston and the shaft for rotating the latter once for each two reciprocations of the former, consisting of a pair of webs carried by the piston and each containing the bearing surface having the general outline of an isosceles triangle with the short transverse groove at its apex, and the members carried by the shaft having a plate between the webs, the crossed arms outside of the webs, and the pins connecting the plate and

the ends of the arms and coöperating with the bearing surfaces.

5. In an engine, the combination with the cylinder having ignition means at each end, of the two pistons adapted to reciprocate therein, a web between the piston heads, a shaft extending through the web transversely of the piston, and connections between the piston and the shaft for rotating the latter once for each two reciprocations of the former, consisting of the combined cam and transverse groove members carried by the web, and the eccentric members carried by the shaft.

6. In an engine, the combination with the cylinder having ignition means at each end, of the two pistons adapted to reciprocate therein, a web between the piston heads, a shaft extending through the web transversely of the piston, and connections between the piston and the shaft for rotating the latter once for each two reciprocations of the former, consisting of the pair of combined cam and transverse groove members arranged at an angle of one hundred and eighty degrees to each other upon the web, and the four eccentric members carried by the shaft and arranged at an angular distance of ninety degrees from each other.

7. In an engine, the combination with the cylinder having ignition means at each end, of the two pistons adapted to reciprocate therein, a web between the piston heads, a shaft extending through the web transversely of the piston, and connections between the piston and the shaft for rotating the latter once for each two reciprocations of the former, consisting of the pair of bearing surfaces carried by the web and each having the general outline of an isosceles triangle with the short transverse groove at its apex, and the shaft having the member carrying the four eccentric pins, two for each bearing surface diametrically opposite each other and at an angle of ninety degrees to the pins coöperating with the opposed surface.

8. In an engine, the combination with the cylinder having the ignition means at each end, of the double piston to reciprocate therein, a pair of webs between the piston heads, a shaft extending through the webs transversely of the pistons, and connections between the pistons and the shaft for rotating the latter once for each two reciprocations of the former, consisting of the two combined cam and groove members, one carried by each web and having the bearing surface of the general outline of an isosceles triangle with the short transverse groove at its apex, and the eccentric pin-carrying member carried by the shaft, having the plate between the webs and the crossed arms outside of the webs, and the pins connecting the plate and the ends of the arms.

9. In an engine, the combination with a pair of parallel cylinders, each provided with the ignition means at each end, of the two pistons adapted to reciprocate in each cylinder, a web between each pair of pistons, a shaft extending through the webs transversely of the pistons, valves for each of said cylinders, cam mechanism carried by the shaft for actuating the valves so as to secure an explosion at each quarter revolution of the shaft, and connections between the piston and the shaft for rotating the latter once for each two reciprocations of the former, consisting of the combined cam and transverse groove members carried by the piston, and eccentric members carried by the shaft.

10. In an engine, the combination with a pair of parallel cylinders each provided with the ignition means at each end, of the two pistons adapted to reciprocate in each cylinder, a web between each pair of pistons, a shaft extending through the webs transversely of the pistons, valves for each of said cylinders, cam mechanism carried by the shaft for actuating the valves so as to secure an explosion at each quarter revolution of the shaft, and connections between the piston and the shaft for rotating the latter once for each two reciprocations of the former, consisting of the two pairs of combined cam and transverse groove members arranged at an angle of one hundred and eighty degrees to each other and carried by the piston, and the eight eccentric members carried by the shaft and adapted to cooperate with the cam and groove members, substantially as and for the purpose described.

11. In an engine, the combination with a pair of parallel cylinders each provided with the ignition means at each end, of the two pistons adapted to reciprocate in each cylinder, a web between each pair of pistons, a shaft extending through the webs transversely of the pistons, valves for each of said cylinders, cam mechanism carried by the shaft for actuating the valves so as to secure an explosion at each quarter revolution of the shaft, and connections between the piston and the shaft for rotating the latter once for each two reciprocations of the former, consisting of a web connecting each pair of pistons and containing the bearing surfaces having the general outline of an isosceles triangle with the short transverse groove at its apex, and the member carried by the shaft having the four eccentric pins for each cylinder, two for each bearing surface diametrically opposite to each other and at an angle of ninety degrees to the pins coöperating with the opposed surface.

12. In an engine, the combination with a pair of parallel cylinders each provided with the ignition means at each end, of the

two pistons adapted to reciprocate in each cylinder, a web between each pair of pistons, a shaft extending through the webs transversely of the pistons, valves for each of said cylinders, cam mechanism carried by the shaft for actuating the valves so as to secure an explosion at each quarter revolution of the shaft, and connections between the piston and the shaft for rotating the latter once for each two reciprocations of the former, consisting of the pair of webs connecting each pair of pistons and containing the bearing surfaces, each having the general outline of an isosceles triangle with the short transverse groove at its apex, and the shaft having the pair of plates between the webs, the two pairs of crossed arms outside of the webs, and the eight pins connecting the ends of the arms with their associated plates.

In witness whereof, I have hereunto set my hand and affixed my seal, this 20th day of February, A. D. 1907.

HENRY K. HOLSMAN. [L. S.]

Witnesses:
JOHN H. MCELROY,
M. G. REEDER.