M. L. WILLIAMS.

GAS ENGINE.

APPLICATION FILED JAN. 2, 1913. RENEWED JUNE 11, 1917.

1,298,132.

Patented Mar. 25, 1919.

5 SHEETS—SHEET 1.

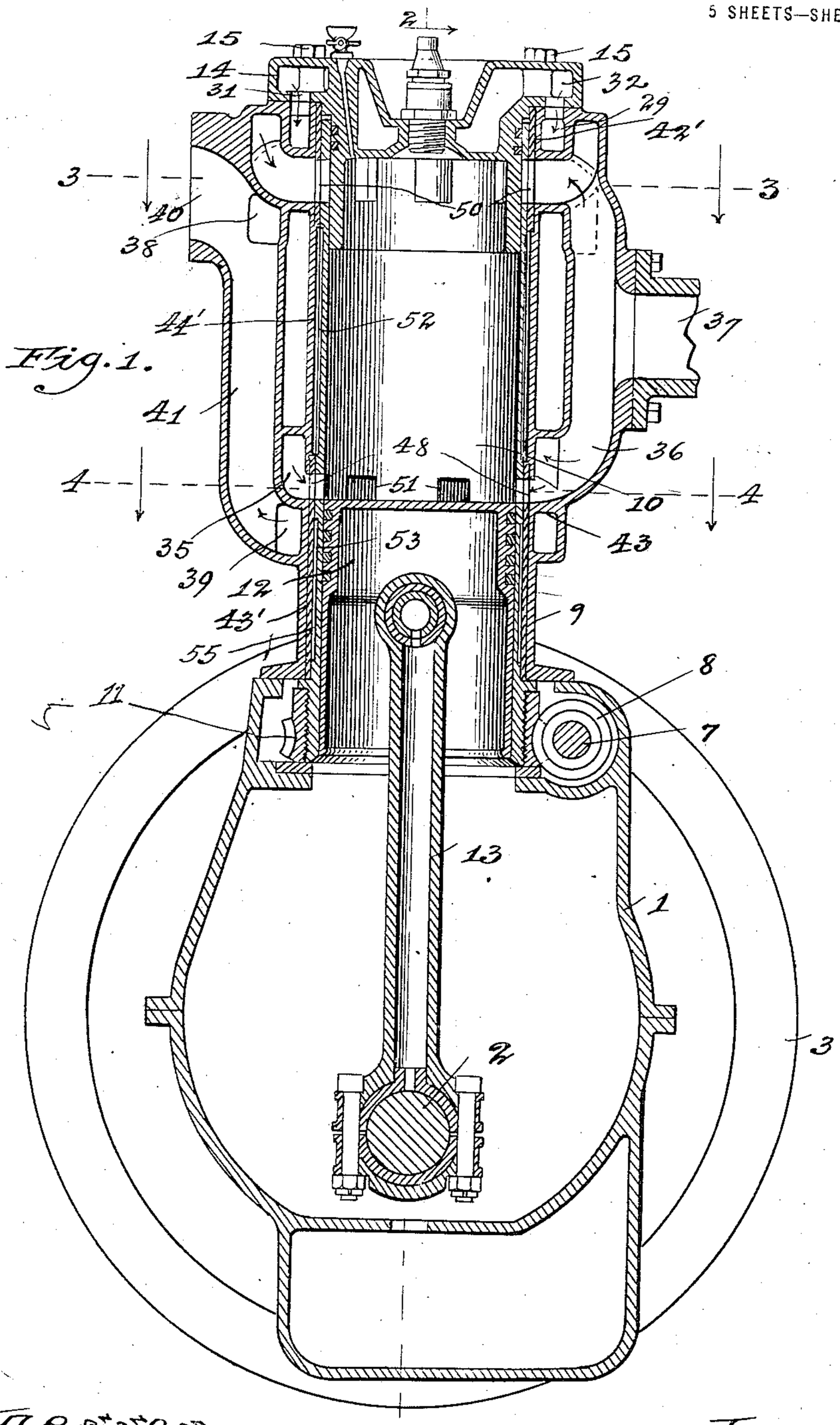

Fig. 1.

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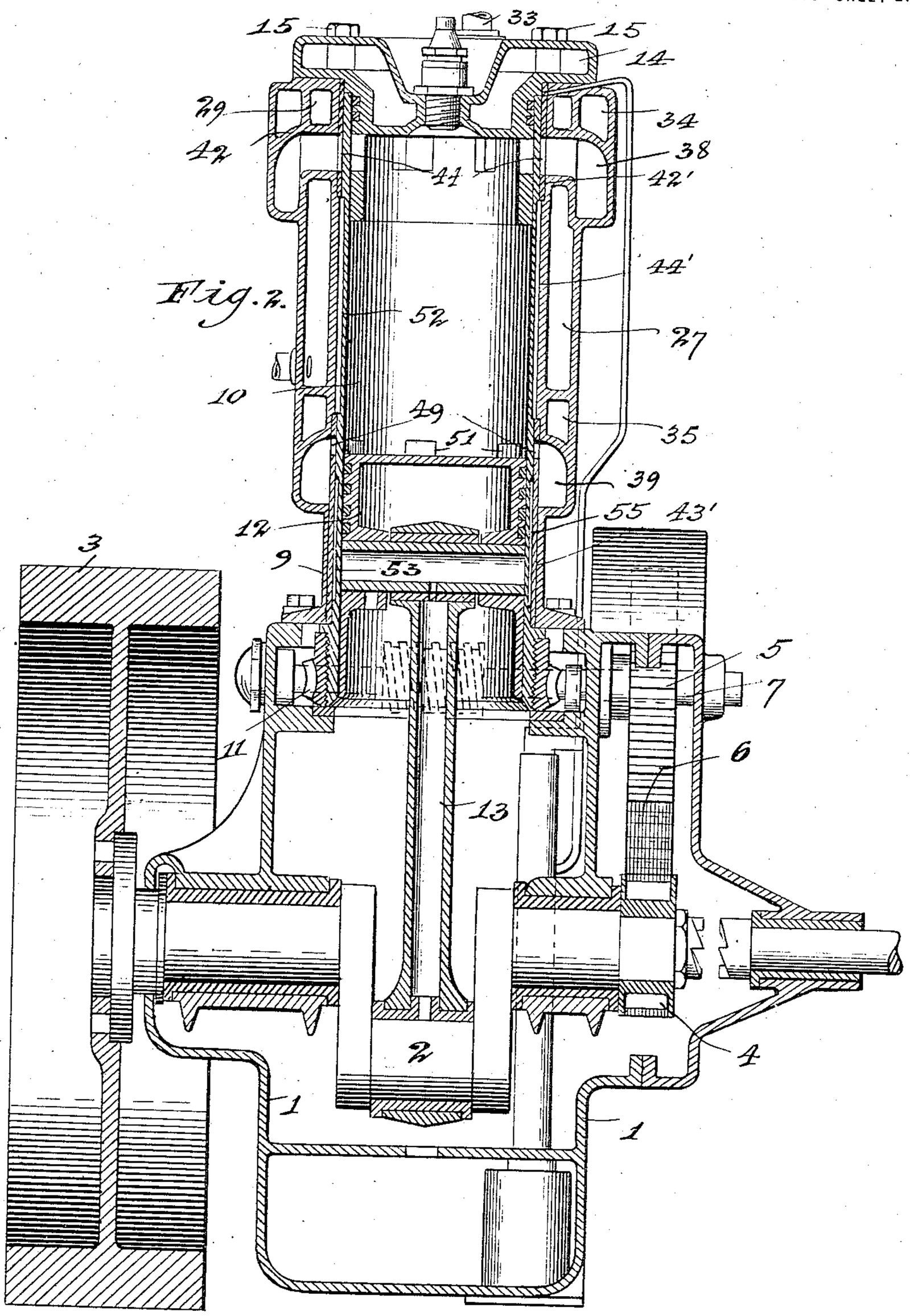

Fig. 2.

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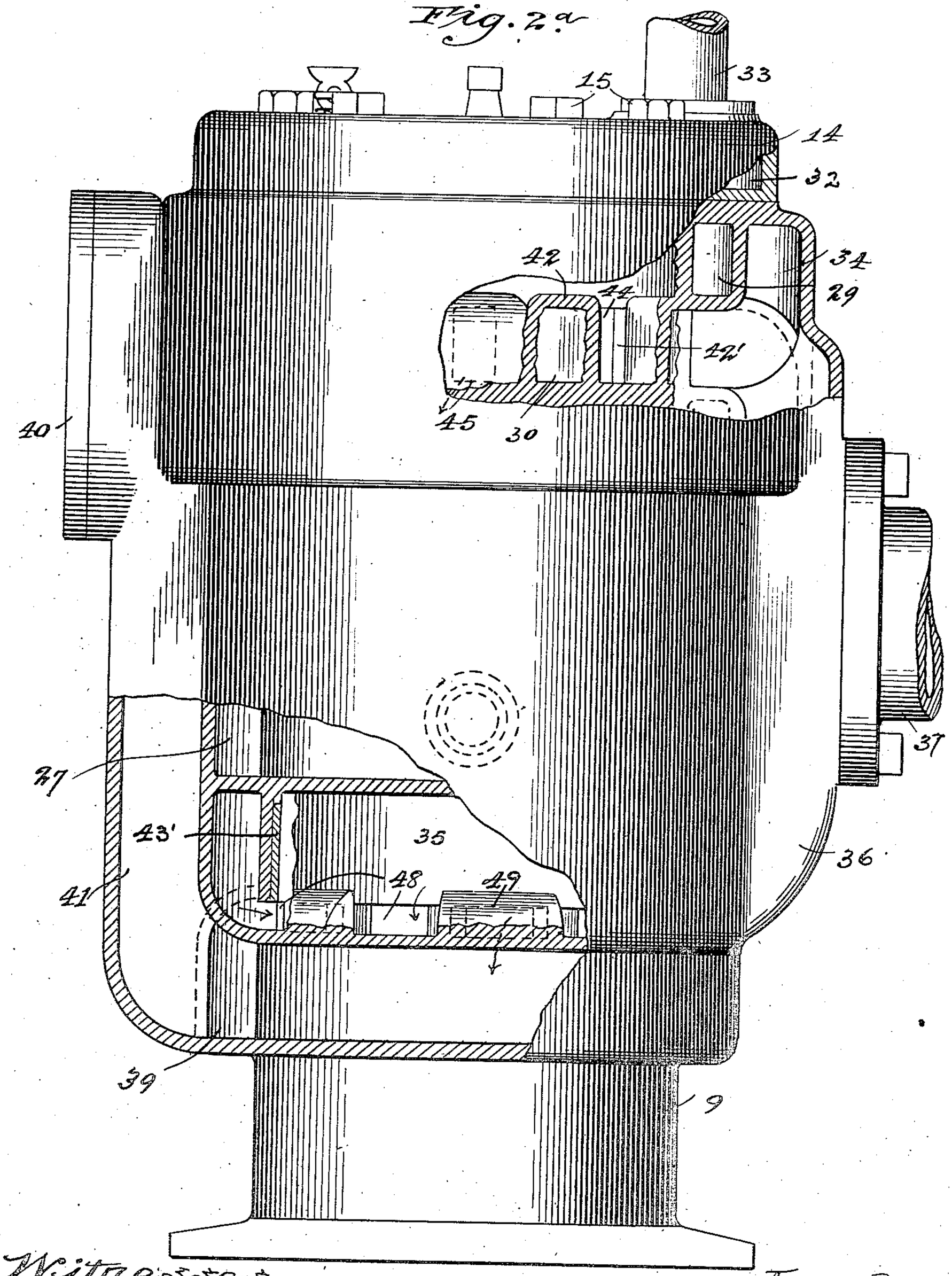
5 SHEETS—SHEET 3.

Fig. 2a



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5 SHEETS—SHEET 4.

Fig. 3.

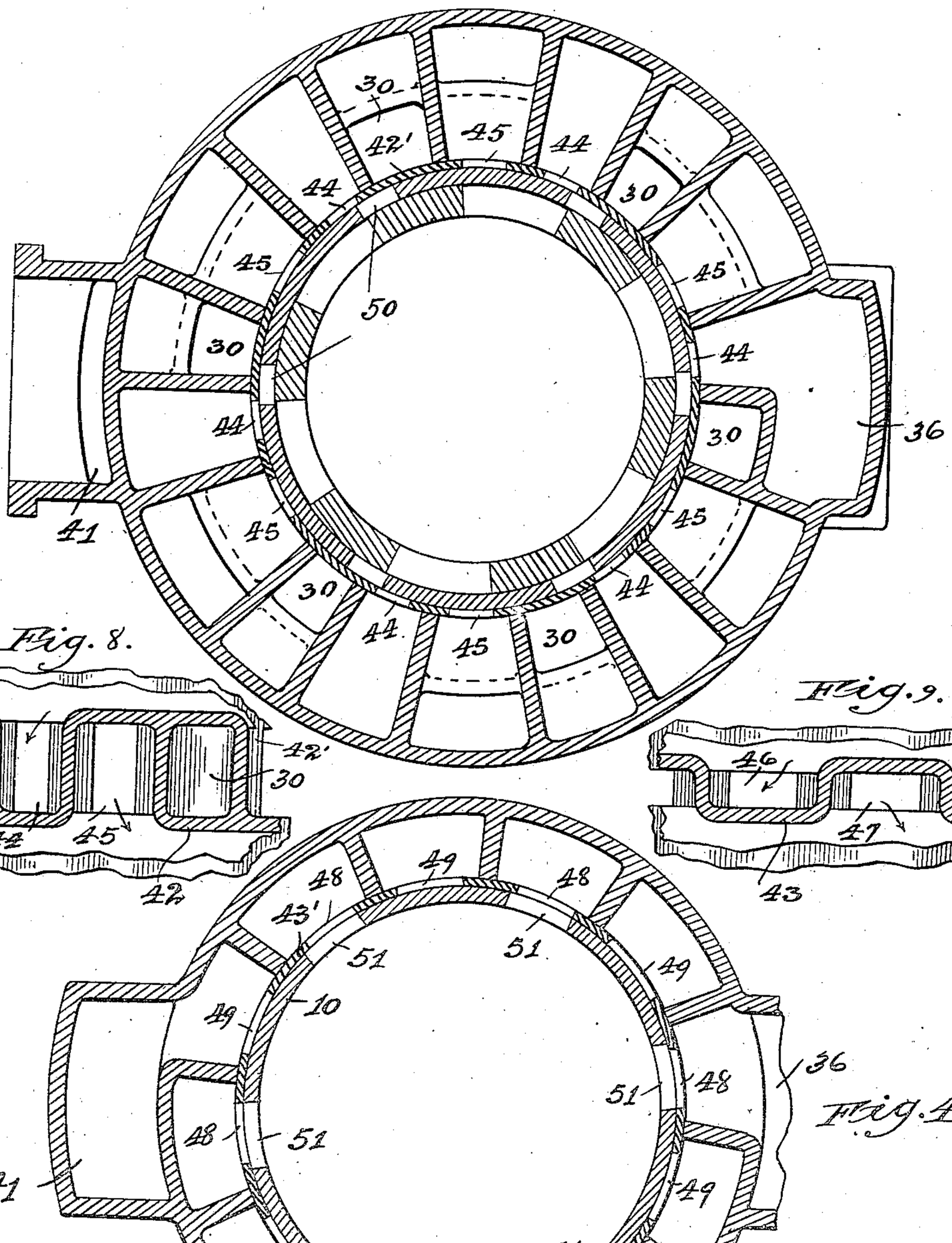

Fig. 8.

Fig. 9.

Fig. 4.

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5 SHEETS—SHEET 5.

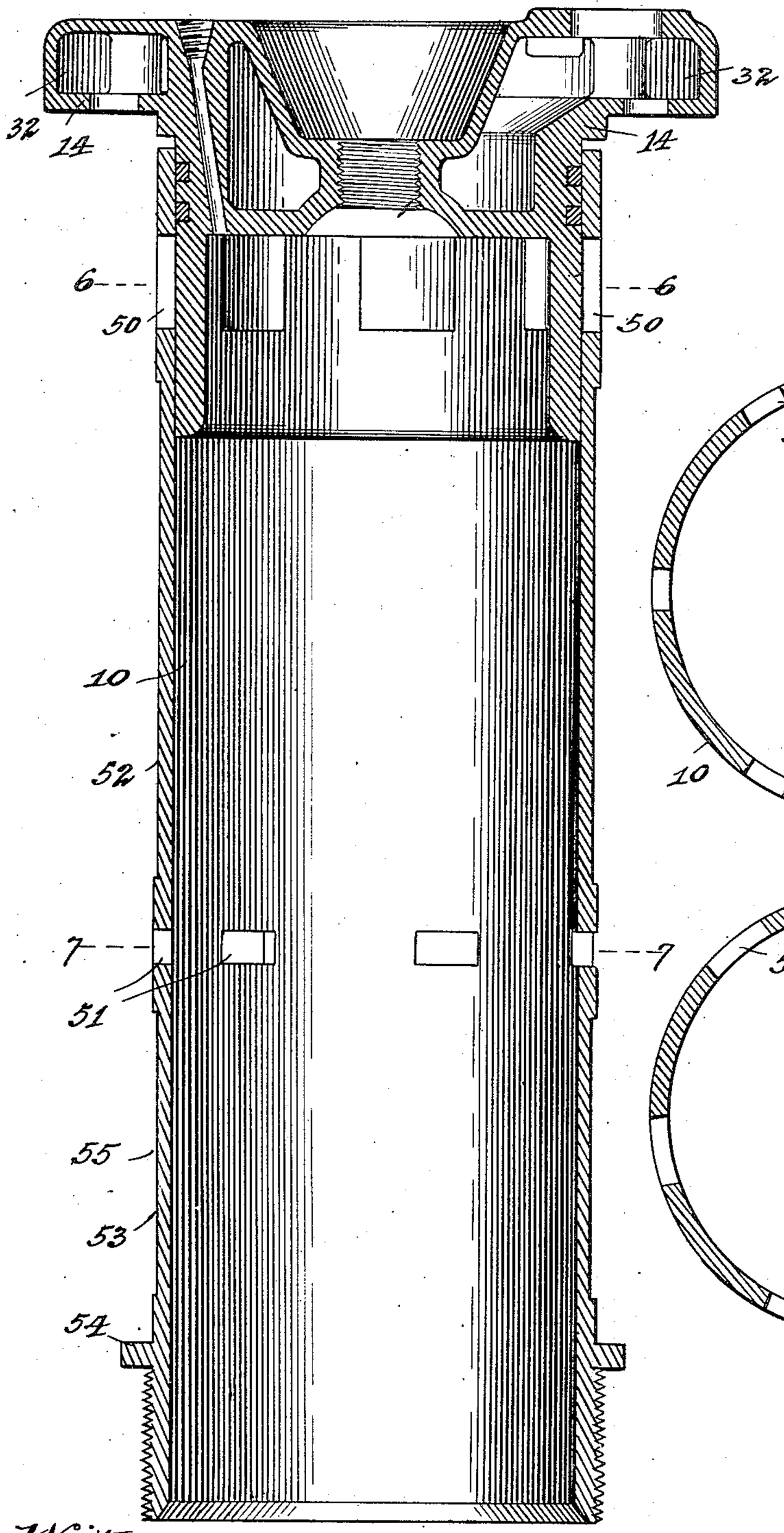
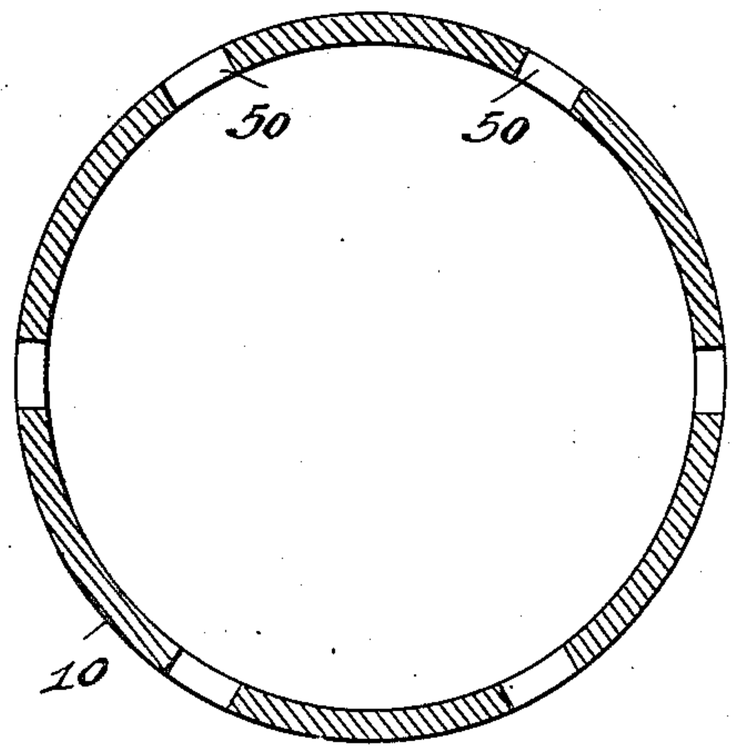


Fig. 5

Fig. 6.



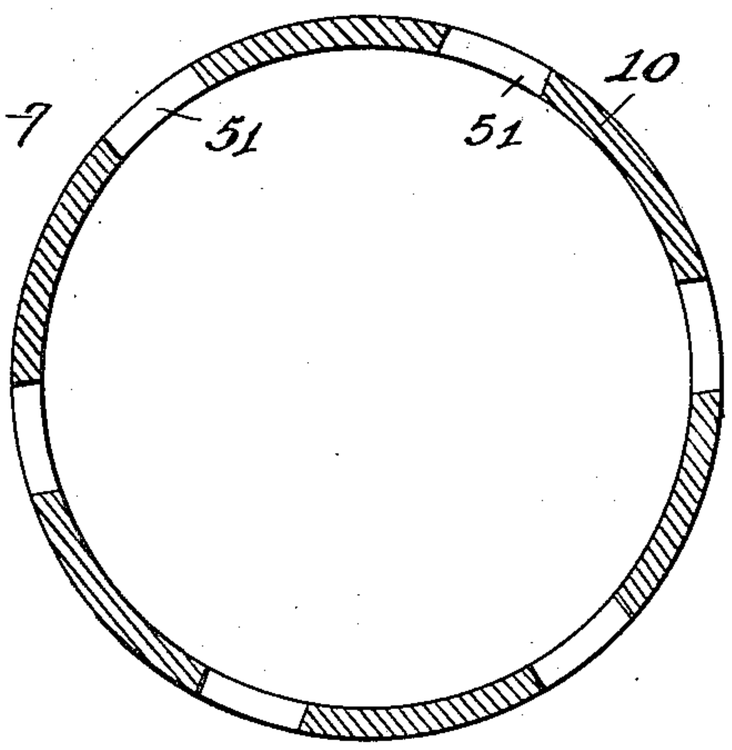


Fig. 7.

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UNITED STATES PATENT OFFICE.

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GAS-ENGINE.

1,298,132. Specification of Letters Patent. Patented Mar. 25, 1919.

Application filed January 2, 1913, Serial No. 739,682. Renewed June 11, 1917. Serial No. 174,165.

To all whom it may concern:

Be it known that I, MARTIN L. WILLIAMS, a citizen of the United States, residing in the city of South Bend, county of St. Joseph, and State of Indiana, have invented certain new and useful Improvements in Gas-Engines, of which the following is a specification.

This invention relates to improvements in gas engines and refers more particularly to a four cycle gas engine of the single sleeve rotary valve type. The present invention is an improvement of the invention shown, described and claimed in my application, Serial No. 723,851, filed October 4th, 1912.

In the present invention the cylinders are provided at both their upper and lower ends with inlet and exhaust ports which are controlled by a single rotary valve sleeve provided at either end with ports, common to the inlet and exhaust ports at the respective ends of the cylinders. The arrangement is such as to provide a maximum port area at both ends of the cylinder without unduly weakening either the cylinders or the sleeve walls, and in which the sleeve is driven in timed relation with the operation of the cylinder piston.

Among the salient objects of the invention are to provide an improved construction of cylinder which insures absolute accuracy in the position of the cylinder ports, whereby they will also register in properly timed relation with the ports of the rotary sleeve; to provide a construction in which the cylinder, cast in the ordinary way, is counterbored to receive at either end a flat port ring, the ports of which were previously milled out to accurately register with the ports of the rotary valve sleeve; to provide a construction which reduces the friction between the sleeve and cylinder wall to a minimum, and at the same time affords ample lubricating space for the working parts; to provide a construction in which the wearing parts can be readily removed and replaced at nominal cost without affecting the main construction of the cylinder; to provide a construction which is particularly characterized by the accuracy of alinement of the working parts and in general to provide a simple and improved construction of the character referred to.

The invention consists in the matters hereinafter described and more particularly pointed out in the appended claims.

In the drawings—

Figure 1 is a vertical sectional view of my improved gas engine showing one cylinder thereof;

Fig. 2 is a vertical sectional view taken on lines 2—2 of Fig. 1 and looking in the direction of the arrows;

Fig. 2^A, is a side elevation with parts broken away and shown in section;

Fig. 3, is a horizontal sectional view taken on lines 3—3 of Fig. 1 and looking in the direction of the arrows, but on an enlarged scale;

Fig. 4 is a horizontal sectional view taken on lines 4—4 of Fig. 1 and looking in the direction of the arrows on the same scale as Fig. 3;

Fig. 5 is a vertical sectional view of the valve sleeve and cylinder head;

Fig. 6 is a horizontal sectional view of the sleeve showing the ports in the upper end;

Fig. 7 is a similar view showing the ports at the lower end;

Fig. 8 is a fragmentary detail view showing the partition wall at the upper end of the cylinder laid out flat;

Fig. 9 is a similar view of the partition at the lower end of the cylinder which divides the inlet and exhaust chambers.

In the drawings shown in Figs. 1 and 2, the piston is shown at the end of the intake stroke, and in the remaining figures the parts are shown in the same relation.

Referring to the drawings—

1 designates the crank case, 2 the crank shaft, 3 the balance wheel. On the crank shaft 2 is mounted a spur gear 4 connected to another spur gear 5 by a chain drive 6. The gear 5 is mounted on a rotary shaft 7 journaled in suitable bearings in the crank case, and to this shaft 7 is secured a worm gear, and at the upper end of the crank case is secured a piston cylinder 9. Within the cylinder is mounted a rotary valve sleeve 10 on the lower end of which is secured a worm gear 11. A piston 12 slides within the rotary sleeve 10 and is secured to the crank shaft by means of a pitman 13 in the usual manner.

Within the upper end of the cylinder is a detachable cylinder head 14, the lower end of which fits within the sleeve 10. The cyl-

inder head is rigidly secured to the cylinder by bolts 15. The cylinder wall is surrounded by a water jacket chamber 27, water entering through a supply pipe connection in the lower end of the jacket, passing around the cylinder wall and into an annular chamber 29. The water passes from the water jacket to the inner chamber 29 by means of a series of conduits 30 formed in the cylinder. From the chamber 29 the water passes through ports 31 into a second water chamber 32 formed in the cylinder head. A delivery or discharge pipe 33 is connected to the second water jacket 32.

Around the cylinder wall is formed a pair of annular inlet chambers 34 and 35, at the upper and lower ends of the cylinder respectively. Gas is delivered to these chambers by means of an inlet manifold 36 which connects with a main inlet pipe 37. Around the cylinder is also formed a pair of annular exhaust chambers 38 and 39 respectively. These chambers are arranged immediately beneath the inlet chambers 34 and 35. The exhaust gases from these chambers 38 and 39 pass to a main exhaust passage 40 by means of a manifold 41. The upper inlet and exhaust passages 34 and 38 are divided by staggered partition wall 42. This partition wall is staggered or provided with alternately offset portions in order to cause the exhaust and inlet conduits hereinafter described to register with the respective inlet and exhaust chambers. It is to be noted that the passages 30 between the water jacket and water chamber 29 pass through this bridge wall 42. The lower inlet chamber 35 and exhaust 39 is similarly divided by a staggered partition wall 43. This partition wall 43 does not however, have any water passage ways through it as does the upper bridge wall 42. The exhaust and inlet passages are so arranged that they are open at their inner sides except for the port rings hereinafter described.

Describing these port rings, the upper end of the cylinder is slightly counterbored to permit the insertion of a ring 42′ which fits tightly within the counterbored portion of the cylinder referred to. This port ring 42′ is provided with a series of circumferentially extending equi-spaced inlet ports 44 alternately arranged relative to similar exhaust ports 45. In the present instance there are six of these inlet ports and six exhaust ports at the upper end of the cylinder. The inlet ports 44 are narrower than the exhaust ports 45 for a purpose hereinafter described, and it is to be noted that both these inlet and exhaust ports are longer vertically than horizontally. The lower end of the cylinder is similarly counter bored to receive a second port or guide ring 43′, which forms a tight fit with the cylinder wall. This port ring 43′ is likewise provided with six inlet ports 48 and six exhaust ports 49 alternately disposed as in the upper ring 42′. The ports in the lower ring, in contra-distinction to the ports previously described, are longer horizontally than vertically, and the exhaust ports 49 are slightly larger than the inlet ports 48. These rings 42′ and 43′ are so arranged as to close the inner sides of their respective inlet and exhaust chambers except for the ports in the rings just described.

The internal diameter of the cylinder is slightly in excess of the internal diameter of the port rings 42′ and 43′ so as to leave a slight clearance space between the outer wall of the rotary valve sleeve and the cylinder wall as shown at 44′, for a purpose hereinafter described.

Describing now the ports in the rotary valve sleeve, at the upper end of the sleeve are six circumferentially extending ports 50, 50 which ports are spaced equi-distant apart as shown in Fig. 6. These ports 50 are of the same height and width as the exhaust ports 45 in the ring 42′ in the upper end of the cylinder. The lower end of the sleeve is provided with the same number of circumferentially extending ports 51 which are of the same height and width as the exhaust ports in the port ring 43′. It is to be noted that the ports 50 at the upper end of the sleeve are offset, or in other words, do not lie in the same vertical plane as the ports in the lower end of the sleeve.

The arrangement of these ports is such that all of the ports 50 in the upper end of the sleeve simultaneously register with all of the inlet ports in the upper port ring 42′ and the same is true with reference to the exhaust ports in the port ring 42′. In exactly the same manner the ports 51 in the sleeve simultaneously register with either the inlet or exhaust ports in the lower port ring 43′. The sleeve is geared to the crank shaft by a one to twelve reduction so that the sleeve will rotate, for example, one hundred times while the crank shaft makes twelve hundred rotations. Accordingly, the sleeve makes one twenty-fourth of a revolution while the piston travels from the bottom to the top of the cylinder or vice versa.

As is seen more clearly in Fig. 5, that portion of the sleeve between the upper and lower ports 50 and 51, is provided exteriorally with an annular recess 52, which together with the cylinder wall forms the annular space 44′ heretofore referred to. This clearance space 44′ not only materally reduces the friction or bearing surface between the sleeve and cylinder but also serves as an excess lubricating pocket. To further reduce the bearing surface between the sleeve and the cylinder, the former is provided with a second annular recess 53 between the lower ports 51 and the annular shoulder 54

as shown more clearly in Fig. 5. The space between the annular recess 53 and lower bearing ring 43′, forms a second excess lubricating pocket 55.

One of the main advantages of the port rings 42′ and 43′, is that these rings are formed independent of the cylinder proper, and accordingly the ports in these rings can be milled out much more accurately than would be possible if they were cast with the cylinder. Furthermore, these bearing rings can be readily removed and replaced without in any way disturbing or affecting the cylinder proper, and it is these bearing rings which are subjected to substantially all the wearing friction. The lubricating pockets referred to provide ample lubricating space thereby further insuring against wearing. It may also be stated that by the use of these separate bearing rings, the main body of the cylinder, by reason of having the bearing strains removed, can be made of much lighter material than has heretofore been possible.

Describing now the operation of the engine, as the piston starts down on the first intake stroke, the ports in the upper end of the cylinder register with the inlet ports in the port ring and a relatively small charge of gas rushes into the cylinder. At this time the exhaust ports in the upper port ring are closed; the ports in the lower ring being of course closed by the piston and as the piston descends on the intake stroke it creates a vacuum drawing in gas through the upper inlet port. These upper inlet ports are, however, not sufficiently large to let in a full charge of gas; accordingly, as the piston reaches the end of its intake stroke it uncovers the inlet ports in the lower ring and the main charge of gas rushes into the cylinder by reason of the vacuum created on the intake stroke of the piston. The rotation of the sleeve is so timed relative to the crank shaft that the ports in the lower end of the sleeve register with the inlet ports in the lower ring and of course close the exhaust ports in the lower bearing ring. As the piston starts up on its compression stroke it covers all of the ports in the lower end of the cylinder. At this time the sleeve is rotated sufficiently to cover both the inlet and exhaust ports in the upper port ring. The sleeve is so arranged that these ports will remain closed, not only during the compression stroke, but during the power stroke. As the piston approaches the end of the power stroke the sleeve is rotated so that the ports at its lower end register with the exhaust ports in the lower port ring while the inlet ports in this lower port ring are closed. At the same time the upper exhaust ports are open and remain open until the piston finishes its scavenging stroke. During the scavenging stroke the inlet ports at the upper bearing ring are of course closed. On the next stroke or intake of the piston the upper inlet ports are uncovered, the upper exhausts closed and the cycle takes place as before.

The invention is not limited to the details of construction shown except as set forth in the appended claims.

I claim as my invention:

1. In a four cycle gas engine, the combination with a cylinder, of a port ring in either end of said cylinder, the internal diameter of said cylinder between said rings being slightly less than the diameter of said rings, a valve sleeve rotating in said cylinder and provided with ports at its upper and lower end adapted to register with the ports of said rings, a piston reciprocating in said sleeve and means for actuating said sleeve and piston in timed relation.

2. In a four cycle gas engine, the combination with a cylinder structure having inlet and exhaust ports at its upper and lower ends respectively, the internal diameter of said cylinder structure being less at an intermediate portion of said cylinder structure than at the ends thereof, a valve sleeve rotating in said cylinder structure and having ports registering with the inlet and exhaust ports of said cylinder structure, a piston reciprocating in said sleeve and means for actuating said sleeve and piston in timed relation.

3. In a four cycle gas engine, the combination with a cylinder structure having inlet and exhaust ports, of a valve sleeve rotating in said cylinder and having a plurality of inlet and exhaust ports, the opposed walls of said cylinder and sleeve being recessed to form an intermediate annular lubricating pocket, a piston reciprocating in said sleeve and means for actuating said piston and sleeve in timed relation.

4. In a four cycle gas engine, the combination with a cylinder provided with inlet and exhaust passages, a rotary valve sleeve having inlet and exhaust ports coöperating with the inlet and exhaust passages of said cylinder, an annular ported bearing member interposed between said sleeve and said cylinder, a piston reciprocating in said sleeve and means for actuating said piston and sleeve in timed relation.

5. In a four cycle gas engine, the combination with a cylinder provided with inlet and exhaust passages at either end, a rotary valve sleeve having inlet and exhaust ports coöperating with the inlet and exhaust passages of said cylinder, annular ported bearing members interposed between either end of said sleeve and said cylinder, and means for actuating said piston, and means for rotating said sleeve at a reduced speed relative to the speed of said piston.

6. In a four cycle gas engine, the combina-

tion with a cylinder having inlet and exhaust passages, a rotary ported valve sleeve rotating in said cylinder, annular bearing members interposed between said cylinder at the upper and lower end of the latter and sleeve, a piston reciprocating in said sleeve and means for actuating said sleeve and piston in timed relation.

7. In a four cycle gas engine, the combination with a cylinder having inlet and exhaust passages at either end, an annular bearing ring at either end of said cylinder having ports communicating with the respective inlet and exhaust passages, a sleeve rotating in said cylinder and having ports adapted to register with the ports of said bearing rings, a piston reciprocating in said sleeve, that portion of the cylinder wall between said bearing rings forming with said sleeve an annular lubricating space and means for actuating said piston and rotating said sleeve in timed relation.

8. In a four cycle gas engine, the combination with a member having inlet and exhaust ports, of a second member moving therein, and having a plurality of circumferentially distributed inlet and exhaust ports, bearing members interposed between said first mentioned members, a piston reciprocating in said members and means for actuating said piston and said movable member in timed relation.

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