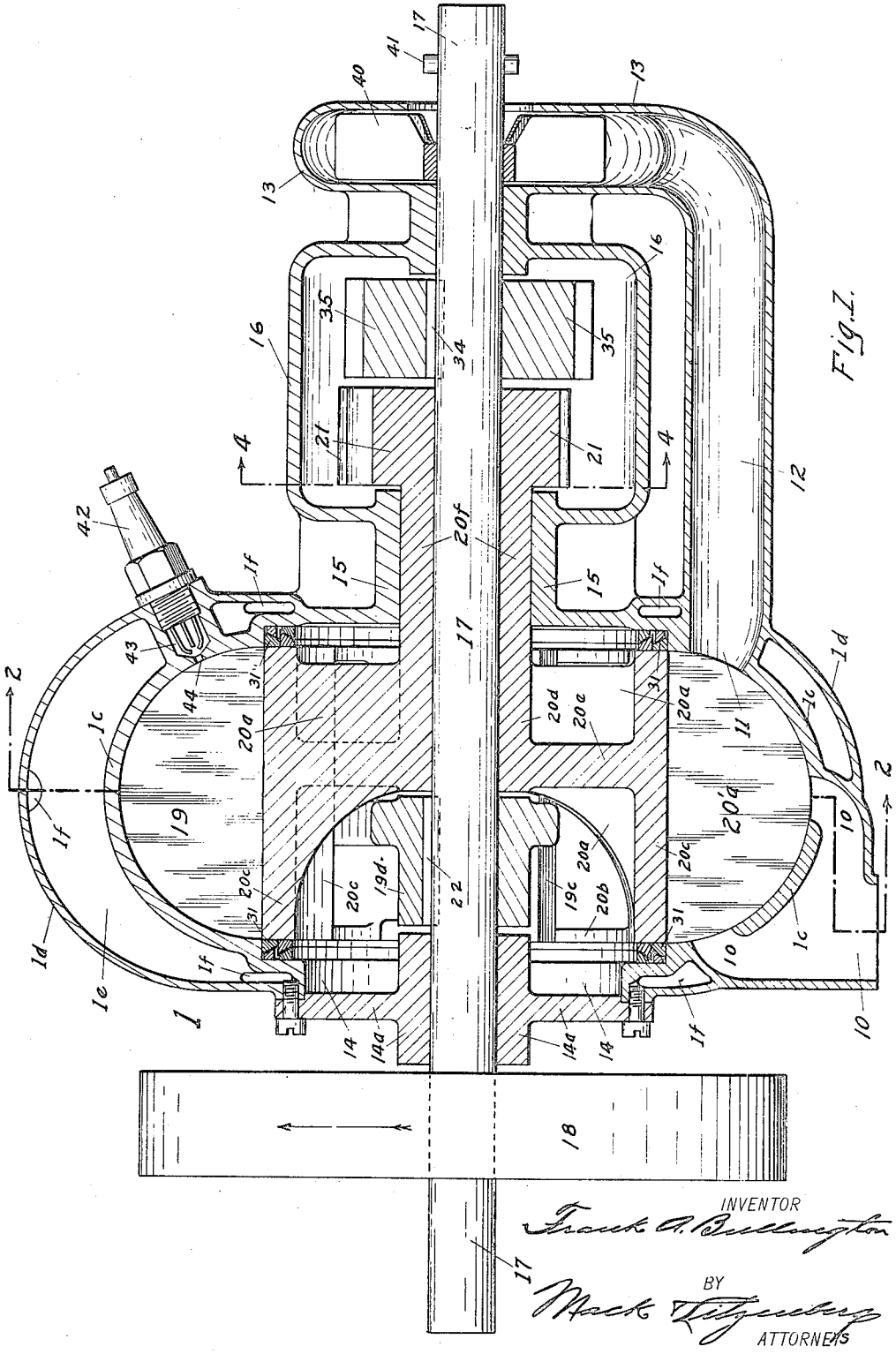
Feb. 5, 1924. 1,482,628

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ROTARY ENGINE

Filed Feb. 24, 1919 4 Sheets-Sheet 1



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ROTARY ENGINE

Filed Feb. 24, 1919 4 Sheets-Sheet 2

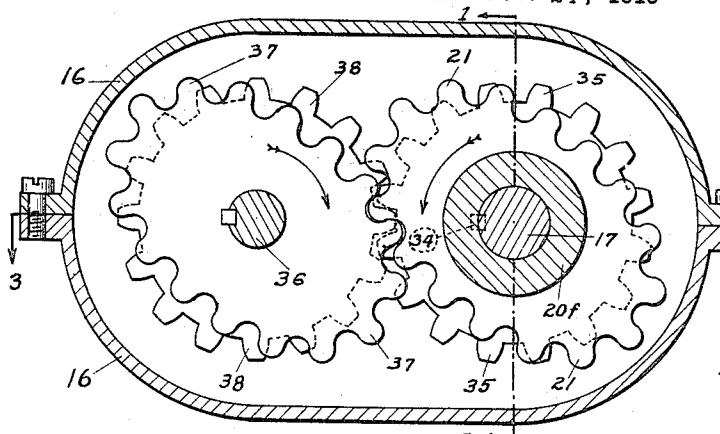


Fig. 4.

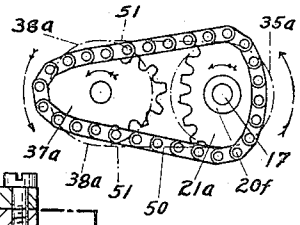


Fig. 8A.

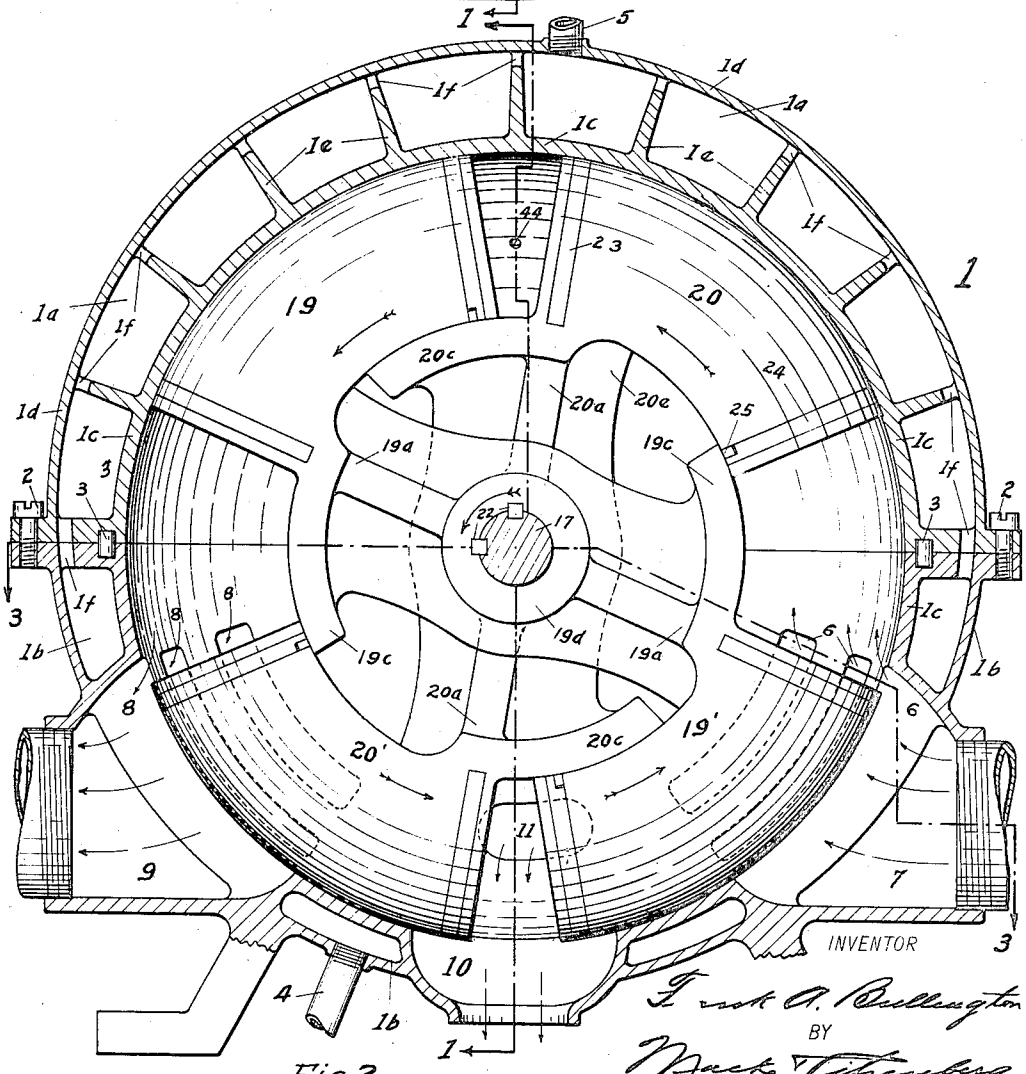


Fig. 2.

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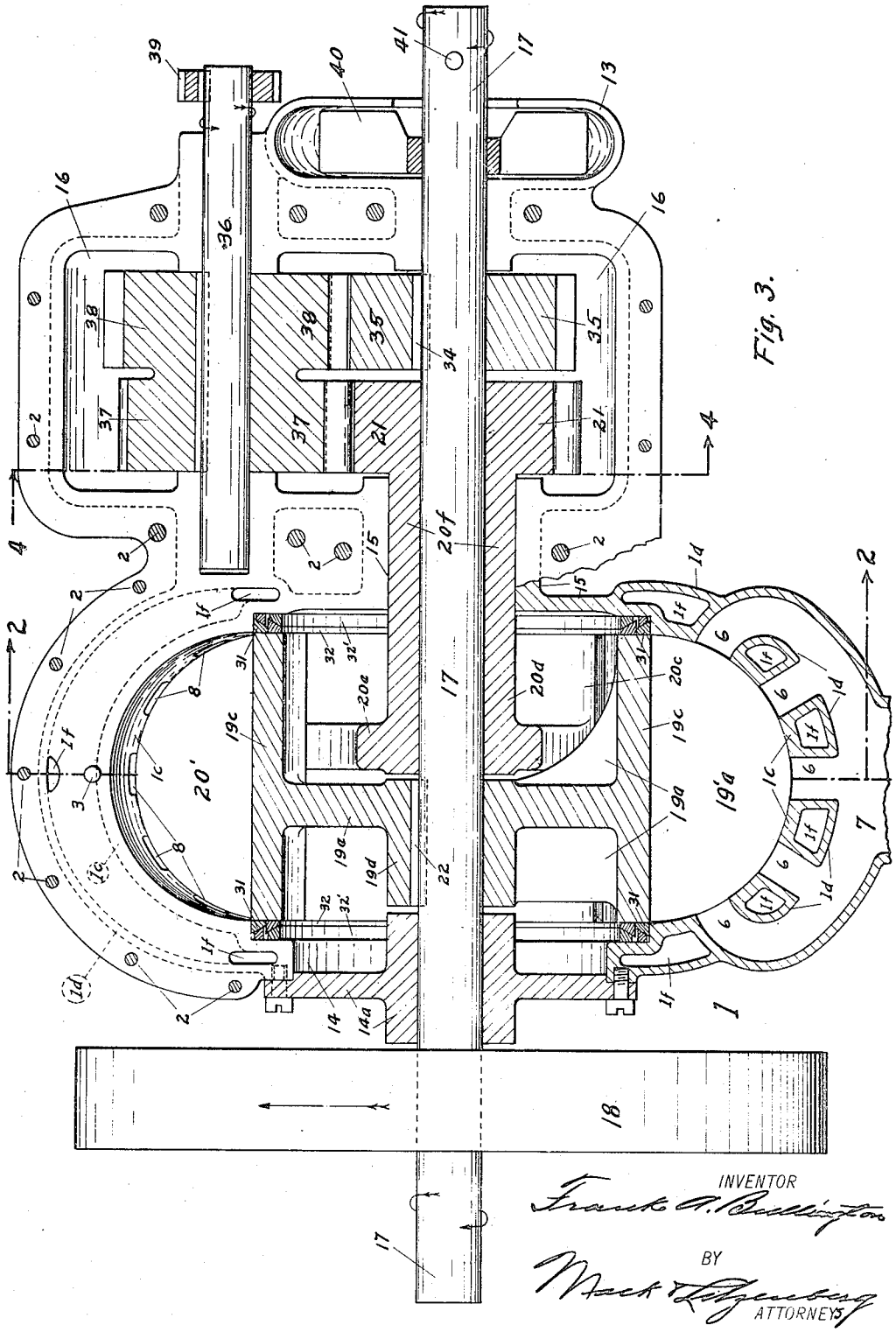


Fig. 3.

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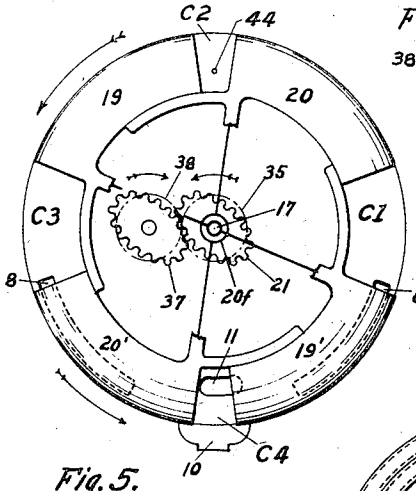


Fig. 5.

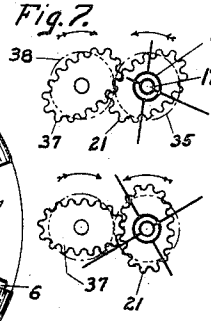


Fig. 8.

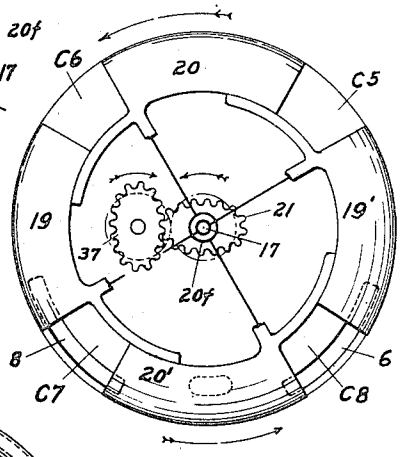


Fig. 6.

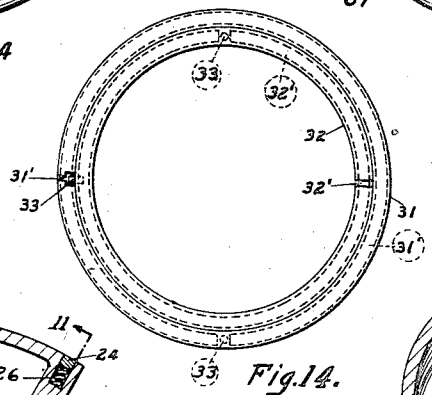


Fig. 14.

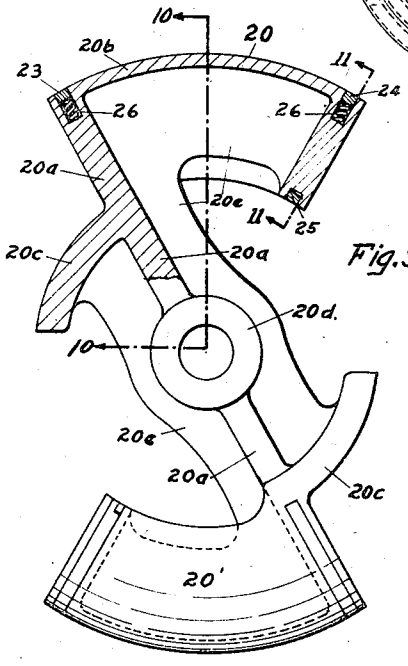


Fig. 9.

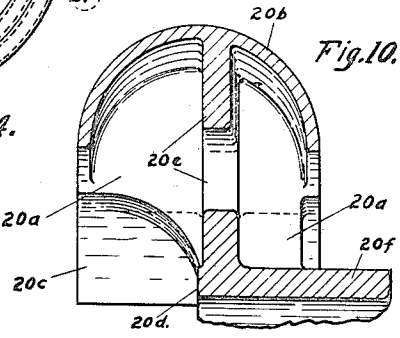


Fig. 10.

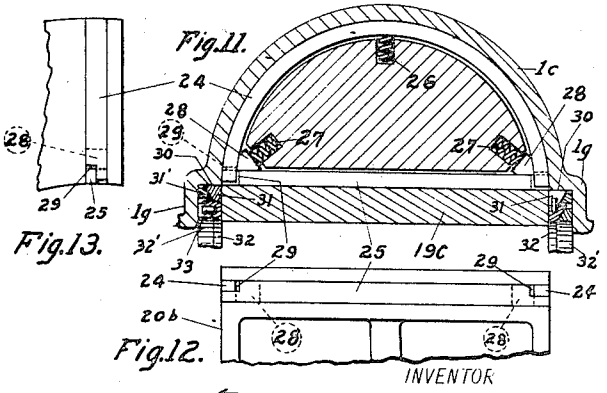


Fig. 11.

Fig. 13.

Fig. 12.

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Patented Feb. 5, 1924. 1,482,628

UNITED STATES PATENT OFFICE.

FRANK A. BULLINGTON, OF PORTLAND, OREGON.

ROTARY ENGINE.

Application filed February 24, 1919. Serial No. 278,880.

To all whom it may concern:

Be it known that I, FRANK A. BULLINGTON, a citizen of the United States, residing in the city of Portland, county of Multnomah, and State of Oregon, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification.

My invention relates to rotary engines of the general type shown and described in my pending application, filed June 17, 1918, Serial Number 240,443. The present invention has as its principal object to improve and simplify the engine casing, the form of piston, the operating connections between the pistons, the ignition means, and the pressure sealing means. In my improved engine as disclosed in my former application, above referred to, and also in this application, the pistons have a continuous rotary motion within the piston casing, as distinguished from engines in which the pistons have an intermittent stopping functon just preceding or simultaneously with the explosions.

In order to more clearly explain my invention, I have shown one form thereof on the accompanying sheets of drawings, which I will now describe:

Figure 1 is a vertical longitudinal sectional view through an engine embodying my improvements, taken on line 1—1 of Figs. 2 and 4;

Figure 2 is a vertical sectional view through the piston casing, taken on line 2—2 of Fig. 1, with pistons shown in side elevation;

Figure 3 is a horizontal longitudinal sectional view taken on line 3—3 of Figs. 2 and 4;

Figure 4 is a vertical sectional view taken on line 4—4 of Figs. 1 and 3;

Figure 5 is a diagrammatic view showing the pistons in the positions indicated in Fig. 2 and also showing the relative positions of the operative connecting gears, shown in Fig. 4;

Figure 6 is a similar view showing the pistons and the operating connecting gears in an advanced position;

Figures 7 and 8 show the operating connecting gears in different positions when the different pistons of the group occupy the same positions as shown in Figs. 5 and 6, respectively;

Figure 8ª is a detail view showing a modified construction of mechanism illustrated in Fig. 4;

Figure 9 is a detail view of one pair of pistons, one piston being shown in section, and the other in side elevation;

Figure 10 is a detail section through one piston on line 10—10 of Fig. 9;

Figure 11 is a detail sectional view through one of the pistons on line 11—11 of Fig. 9, showing my improved sealing means in position;

Figure 12 is a fragmentary bottom plan view of the piston shown in Fig. 11;

Figure 13 is a fragmentary side elevation of the end of the piston shown in Fig. 11; and

Figure 14 is a side elevation of my improved sealing means between the casing and the sides of the piston lips.

Referring now in detail to the drawings, my invention as here shown for purposes of description, comprises a piston casing 1, shown in two parts, designated 1ª and 1ᵇ, the parts of which are connected by means of suitable bolts 2, and interlocking pins 3, thus constituting an interlocked joint horizontally through said casing. In transverse section my improved piston casing is of semicircular form as to that part in which the pistons move, as will be clearly understood from Fig. 1, in which 1ᶜ designates the piston casing wall and 1ᵈ designates an outer wall, between which are crescent-shaped reenforcement ribs 1ᵉ. The spaces between said ribs constitute cooling chambers communicating with each other through the ports or passageways 1ᶠ. Any suitable cooling fluid can be supplied through a pipe 4, with an outlet pipe at 5. Said piston casing is provided with a plurality of intake ports 6, communicating with a main inlet 7. Said piston casing is also provided with similar exhaust ports 8, communicating with a main exhaust 9. Said casing is also provided with auxiliary ports 10, cooperating with an air supply port 11, with which communicates an air supply pipe 12, connected at its other end with a blower casing 13, from which air is supplied under pressure.

Said piston casing 1 is open at the side, as at 14, with a combination closure and bearing plate or member 14ª. At its opposite side said casing has a bearing 15. Con-

nected with said piston casing 1 is a gear casing 16, with which latter is also connected a blower casing 13, above referred to. Mounted through said casings is a main shaft 17, provided with a fly wheel 18. Mounted on said main shaft 17, within the piston casing 1, are two sets of pistons designated, respectively, 19, 19′ and 20, 20′. Referring particularly to Figs. 9 and 10, in which pistons 20, 20′ are shown in detail, it will be seen that each piston comprises a piston vane 20^a, a piston body 20^b at one side thereof, and a piston lip 20^c projecting in the opposite direction from the other side thereof. Pistons 20 and 20′ have their vanes secured to a hub 20^d, reenforced with webs 20^e which extend into the piston bodies to reenforce the same. The hub 20^d of the pistons 20 and 20′ is extended into a sleeve 20^f, provided at its outer end with an elliptical gear 21. The pistons 19 and 19′ are the same in structure as pistons 20 and 20′ with the exception that they have no sleeve extension of their hub 19^d. Pistons 19 and 19′ are secured to the shaft 17 by means of keys 22. Referring to Figs. 1, 2 and 3, it will be seen that the piston vanes are arranged in crossed, overlapping or interlocking relationship to each other at their hub portions. It will also be noted by reference to Fig. 2 that one piston body overlaps the piston lip of the next adjacent piston, whereby said piston lip forms the inner wall of a chamber between the end of the piston body, or the piston head, and the opposite end or vane of the next adjacent piston. Said pistons are provided at their piston vane ends with sealing members 23 and at their head ends with sealing members 24 and 25. Sealing members 23 and 24 are similar as to their curved or ring portions, as indicated in Fig. 11, and comprise ring-like members held yieldingly against the casing wall 1^c by means of springs 26 and 27. Springs 26, as shown in Figs. 9 and 11, are simply straight pressure springs. Referring to Fig. 11, sealing member 24 has an overlapping or interfitting connection with the straight sealing member 25, the overlapping joint being clearly indicated in Figs. 11, 12 and 13. This straight sealing member 25 is provided for sealing the joint between the piston body and the piston lip of an adjacent piston, as will be understood from Fig. 2 in connection with piston 20 and piston lip 19^c. Springs 27, Fig. 11, bear against wedge blocks 28, which fit into the angle between the ends of the sealing members 24 and 25, in such a way as to press both of said members outwardly against their bearing surfaces, and also to seal the openings 29 in the interfitting joints between the ends of said members 24 and 25.

Referring to Fig. 11, the piston casing is provided at its opposite sides with annular extensions or enlargements 1^g, for the purpose of providing annular recesses 30 between the sides of the piston lips and the piston casing, in which recesses are placed specially formed, split sealing rings 31 and 32, each of said rings comprising two parts, a bearing ring 31 and 32, and a pressure ring 31′ and 32′. Bearing ring 31 bears against the side of the piston lip 19^c and also against the wall of the piston casing. The pressure ring 31′ bears against the side wall of the piston casing and against the beveled side of the bearing ring 31 in such manner as to force said bearing ring inwardly and outwardly. Bearing ring 32 also bears against the side of the piston lip 19^c and against the inner surface of bearing ring 31, reenforcing said ring 31. Ring 32′ bears against the beveled side of the ring 32 and against the side of the piston casing. The four parts of said rings are connected together by means of pins 33, for the purpose of interlocking them so that they will turn together, said members together constituting in effect a floating sealing ring turning with the piston lips but at a reduced speed because of their bearing against the sides of the piston casing. It will thus be seen that the piston heads are semi-circular in cross section, and that the sealing means is therefore more efficient than it could be if the pistons were square or rectangular in cross section, requiring four angular joints instead of two, as here shown.

Referring now to Figs. 1, 3 and 4, I will describe the operating connections between the pistons. Secured to the main shaft 17, by means of a key 34, is a circular gear 35. This gear is adjacent the elliptical gear 21, on the sleeve 20^f, on said shaft 17. Mounted in the gear casing 16 is a counter shaft 36, having keyed thereto elliptical and circular gears 37 and 38. The elliptical gear 37 meshes with the elliptical gear 21 on the sleeve, and the circular gear 38 meshes with the circular gear 35, on the shaft. Thus a connection is made between the pistons 19, 19′ on the shaft and the pistons 20, 20′ on the sleeve. The rotation of the main shaft 17 and the rotation of the counter shaft 36 are uniform in opposite directions by reason of the circular gears 35 and 38, connecting the same, while the rotation of the sleeve 20^f and the counter shaft 36 are variable to each other by reason of the action of the elliptical gears 21 and 37. This provides for the variable movement of the pistons carried by the shaft and the pistons carried by the sleeve with relation to each other. By reason of the inertia of the balance wheel 18, carried by the main shaft 17, the rotation of said shaft 17, and its pistons is made uniform.

Mounted on the outer end of the counter shaft 36 is a driving gear 39 for driving auxiliary mechanism, as desired. Mounted

in the fan or blower casing 13, on the main shaft 17, is a vane or blower 40, for forcing air through the air conduit 12, leading to the piston casing 1, for forcing air through said casing and across the path of the pistons, for the purpose of scavenging the chambers formed between the pistons. Said main shaft 17 is also provided at its outer end with a pin 41, for hand starting crank, not shown. The opposite end of said main shaft is extended for any desired driving connections.

Referring to Fig. 1, a spark plug 42 is set in an ignition chamber 43, formed in the piston casing, and communicating with the interior of the piston casing through a relatively small port 44. The reason for connecting such an ignition chamber with the piston casing by means of a small port is to minimize the undersirable effect of the pressure resulting from combustion and exerted upon the sealing means of the pistons when passing the ignition chamber.

The use and operation of my invention may be briefly described as follows, referring especially to Figs. 5, 6, 7 and 8:

Assuming that the pistons are in the positions shown in Fig. 5, and are moving in the direction indicated by the arrow, and with the elliptical gears in the relationship to each other as shown, it will be seen that their long diameters are parallel with each other and that their engagement is on their mean diameters. In these positions they will have a momentary uniform speed. Moving from these positions to the positions shown in Fig. 6, gear 21 has its long diameter perendicular to the long diameter of gear 37 and in these positions the gear 37 is rotating at a greater rate of speed relatively than the gear 21. Moving from these positions to the positions shown in Fig. 7, where the long diameters of the gears are again parallel to each other and their mean diameters are in engagement with each other, but at a different point, their movements are again momentarily uniform. In Fig. 8 they are shown to have advanced to positions opposite those shown in Fig. 6, and the gear 21 is rotating at a greater rate of speed relatively than gear 37. As these gear connections control the movements of the pistons, it will be understood that said pistons must have a corresponding movement. These movements of the pistons cause the chambers formed therebetween to be alternately contracted and enlarged for the performance of their functions. Referring to Fig. 5, a chamber C^1 is shown as just completing an intake of explosive mixture about to be compressed. At C^2 a charge is shown compressed and in register with the ignition port 44. At C^3 an exhaust is commencing, and at C^4 the exhaust is completed and a position is reached in register with the air port 11, receiving my special scavenging blast of air under pressure, preliminary to taking in another charge of explosive mixture prior to reaching the position C^1.

In Fig. 6 the pistons are shown in different advanced positions resulting in the chambers being shown as substantially uniform in size. Chamber C^5 is shown in the act of compressing; chamber C^6 in the act of expanding under explosion; chamber C^7 in the act of exhausting the burnt charge, and chamber C^8 in the act of drawing in the fresh charge.

Thus the different chambers are enlarged and contracted as they move around their course with the continuously moving pistons, the varying relative movements of which cause such expansion and contraction of the chambers, all properly timed to bring about the proper intake, compression, expansion and exhaust actions.

Referring now to Fig. 8^a, I have shown a modified construction of mechanism for accomplishing the relative movements of the main shaft 17 and the sleeve 20^t. Instead of having the gears mesh with each other direct, as in Fig. 4, said gears are spaced apart and are connected by means of gear chains. In this figure the elliptical gears are designated 21^a and 37^a and their connecting chain is designated 50. The circular gears, indicated in broken lines, are designated 35^a and 38^a, and their connecting chain is designated 51. With these gears thus connected the counter shaft 36 and the main shaft 17, of course, rotate in the same direction. This construction provides for a more extensive distribution or application of the power impulse from the explosions to the gears by reason of the chains being at all times in connection with approximately one half the teeth of their respective gears.

I am aware that changes can be made in the embodiment of my invention as here shown for illustrative purposes without departing from the spirit thereof, and I do not, therefore, limit my invention to the form of the invention here shown, except as I may be limited by the hereto appended claims.

I claim:

1. In a rotary engine, a piston casing having a piston chamber therein of semi-circular form in cross section, and crescent-shaped reinforcing ribs projecting from the outer surface of the casing, the ribs being progressively narrower from the center toward each end whereby the maximum strength and cooling area will be effective in the middle portions of the ribs.

2. In a rotary engine, a piston casing having a piston chamber therein of semi-circular form in cross section, and rein-

forced on its outer surface with radially disposed, crescent-shaped ribs, the ribs being progressively narrower from the center toward the ends so that the widest portion is in the middle, and an outer shell over said ribs to form a cooling chamber between the ribs, the piston casing and the outer shell.

Signed at Portland, Multnomah County, Oregon, this 7th day of February, 1919.

FRANK A. BULLINGTON.

In presence of—
I. M. GRIFFIN,
W. R. LITZENBERG.