C. T. RAULE.

ROTARY GAS ENGINE.

APPLICATION FILED DEC. 10, 1912.

1,100,618.

Patented June 16, 1914.

2 SHEETS—SHEET 1.

Fig. 2.

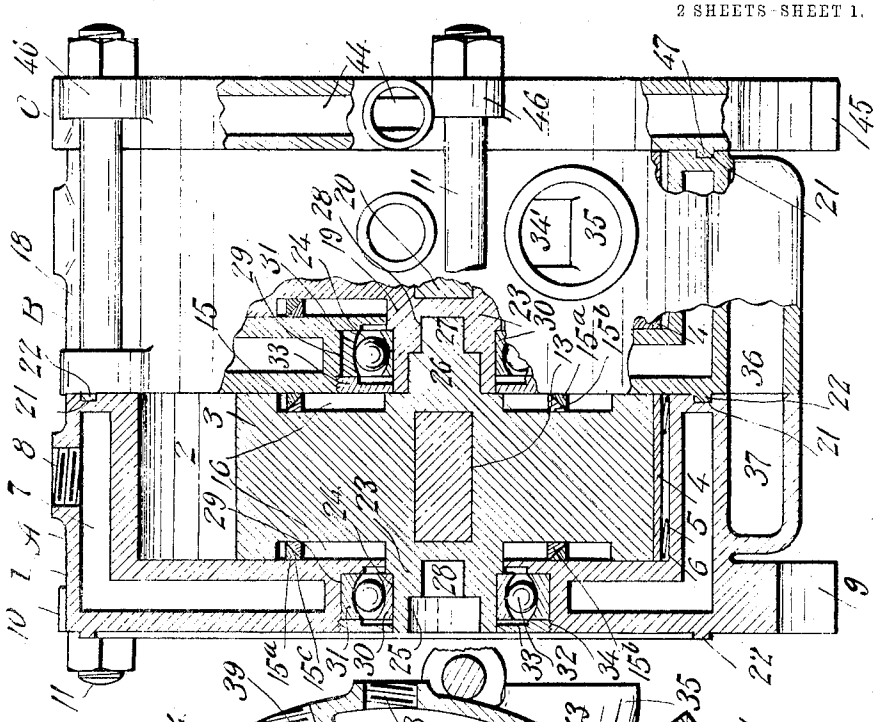
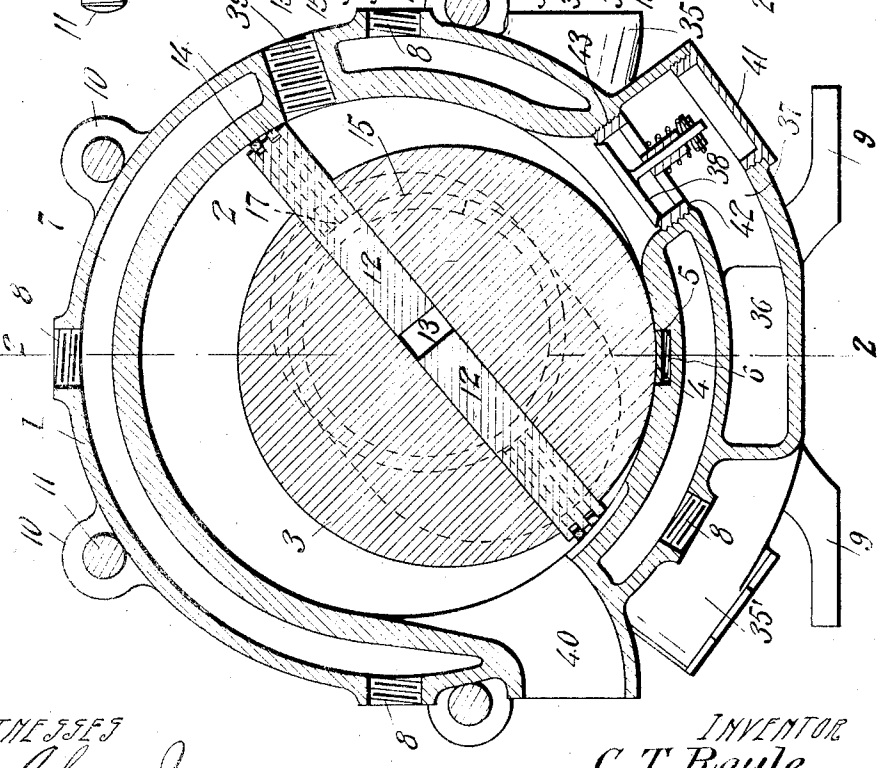


Fig. 1.



WITNESSES

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2 SHEETS—SHEET 2.

Fig. 4.

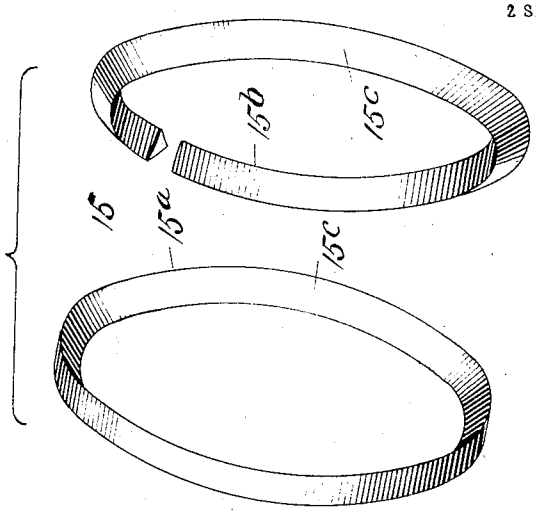
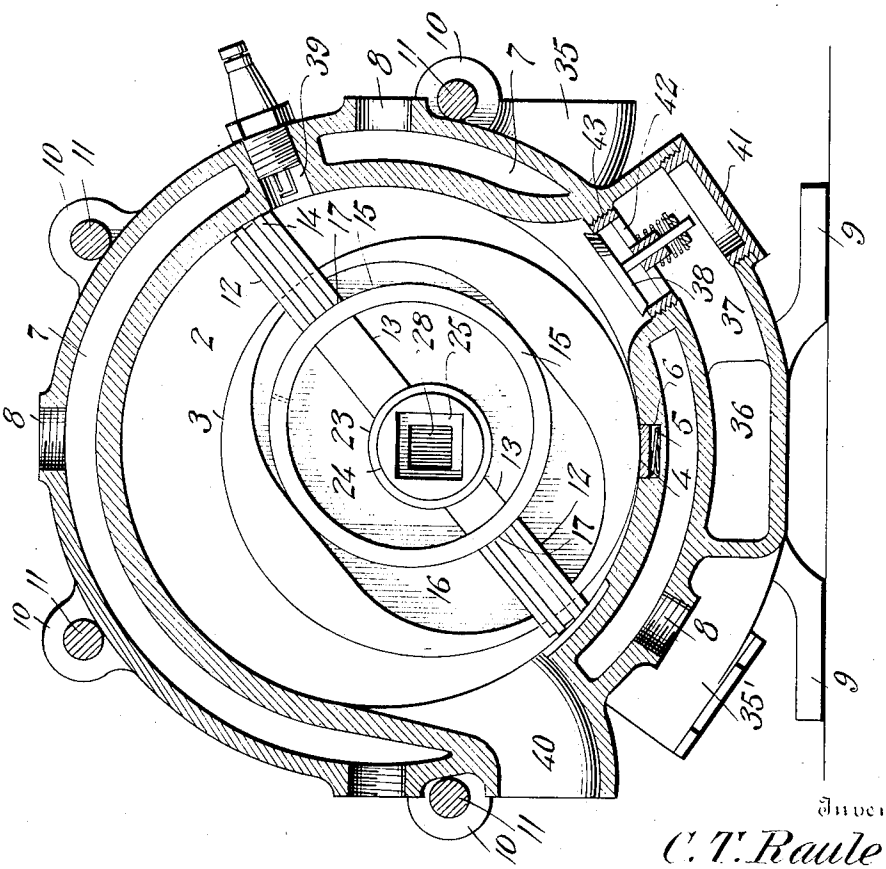



Fig. 3.




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# UNITED STATES PATENT OFFICE.

CLIFFORD T. RAULE, OF PHILADELPHIA, PENNSYLVANIA.

## ROTARY GAS-ENGINE.

1,100,618. Specification of Letters Patent. Patented June 16, 1914.

Application filed December 10, 1912. Serial No. 735,993.

*To all whom it may concern:*

Be it known that I, CLIFFORD T. RAULE, a citizen of the United States, residing at Germantown, Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented new and useful Improvements in Rotary Gas-Engines, of which the following is a specification.

This invention relates to rotary gas engines, the object of the invention being to produce a reliable and efficient internal combustion motor, embodying, in connection with a suitable casing, a rotor having movable wings or blades against which the expanding gas acts to impart a continuous rotary motion to the rotor and the shaft, the gas being furnished to the expansion chamber under compression, and the compression being developed by the engine itself in a separate compression chamber, from whence the compressed gas is led into the expansion chamber and exploded by a suitable igniter properly timed with relation to the position of the rotor and its wings or blades.

A further object of the invention is to provide an engine of the class described, made up of and embodying any desired number of units, so combined and related to each other that units may be added to or taken from the motor, in accordance with the power desired.

With the above and other objects in view, the invention consists in the construction, combination and arrangement of parts, as will be hereinafter more fully described, illustrated in the accompanying drawings, and pointed out in the claims hereunto appended.

In the drawings Figure 1 is a vertical longitudinal section through a rotary internal combustion motor, embodying the present invention. Fig. 2 is an end elevation partly in section on the line 2—2 of Fig. 1, and showing the combination of the power unit and the compressing unit. Fig. 3 is a section similar to Fig. 1, but illustrating the rotor and wings in elevation. Fig. 4 is a detail perspective view of one of the combination packing rings.

The engine contemplated in this invention in its simplest form embodies two units A and B, and a head C, A designating the power unit, and B the adjacently located compressing unit. Each power unit comprises a cylindrical casing 1, inclosing an expansion chamber 2, within which is mounted a rotor or cylindrical piston 3, the same being eccentrically mounted in the casing, as clearly shown in Fig. 1, and operating in contact at one point, preferably at the bottom of the casing, with a packing or contact plate 4 which divides the expansion space from the exhaust space of the casing, as will hereinafter appear. This packing or contact plate is arranged in a recess 5 in the inner wall of the casing, and is backed up by a spring 6 which holds said plate in contact with the periphery of the rotor 3.

The casing is water-jacketed, as shown at 7, and any desired number of threaded ports 8 lead into the water jacket space, a number of such ports being shown, so as to allow the water inlet and outlet pipes to be connected with the water jacket at any desired points, in accordance with the position of the motor, which is provided with attaching lugs 9, by means of which the motor as a whole may be fastened to a horizontal bed, or to a side wall or other form of support. The ports 8 are so arranged that the inlet and outlet pipes may be connected, respectively, to the bottom and top of the casing, which is particularly desirable where a thermo-syphon system of water cooling is adopted. The casing is further provided with outwardly extending lugs 10 adapted to receive tie bolts 11, by means of which the several units of the engine may be firmly secured together, in the manner illustrated in Fig. 2.

The rotor 3 is provided with telescoping wings or blades 12, which slide back and forth in radial openings 13 in the rotor, as illustrated in Figs. 1 and 2, and said wings are provided at their outer edges with packing strips 14 which work in contact with the inner periphery of the cylindrical casing 1, so as to preserve a practically gas-tight joint between the wings and the casing. As the rotor revolves, the wings 12 move outwardly and inwardly, and said wings are held in contact with the casing by means of expansion packing rings 15 arranged in recesses 16 in the opposite sides of the rotor 3, as shown in full lines in Figs. 2 and 3, and by dotted lines in Fig. 1. Each of the recesses 16 is elliptical in shape, so as to allow the packing ring 15 to float or move back and forth along the longitudinal axis of said recess 16, said ring 15 bearing at diametrically opposite points against shoulders 17 projecting laterally from the wings 12, the ring 15 being slightly compressed, so that it will al-

ways exert an outward pressure against the shoulder 17, and thereby hold the outer edges of the wings in contact with the inner peripheral wall of the casing. Each of the rings 15 comprises an endless section $15^a$, and a split section $15^b$, the two sections being provided with beveled or inclined meeting faces $15^c$ which work in contact with each other, and the split section $15^b$ having a normal tendency to expand beyond the diameter illustrated, so that in tending to expand, it will act against the endless section $15^a$ to force said endless section outwardly in contact with the adjacent side wall of the casing, and at the same time the split section $15^b$ will be forced into close contact with the adjacent side of the rotor 3 within the recess 16 thereof. This provides for a close contact between the rotor and the casing, and in addition thereto, it provides at the same time for distributing the oil or other lubricant over the inside face of the casing, on account of the ring 15 as a whole floating or moving lengthwise of the elliptical recess 16 in the rotor, it being apparent in Fig. 1 that as the rotor revolves, the wings 12 move outwardly and inwardly about equally, and carry the packing ring 15 with them, said ring moving back and forth in the recess 16 and in contact with the adjacent side wall of the expansion chamber.

The compressing unit B is similar in all respects to the power unit A, said compressing unit embodying the cylindrical water-jacketed casing 18, rotor 19, and wings or blades 20. One of the sections, as for example, the section A, is provided with an annular groove 21, while the adjoining section B is provided with an annular tongue or rib 22 which enables the units A and B to be brought together in proper concentric relation to each other, preparatory to inserting the tie bolts 11 through the lugs 10, in order to fasten the sections or units together. The tongue and groove connection referred to also provides for a break joint between the units, thereby avoiding any leakage of gas from the motor at the meeting points of the units. Each rotor is also provided with a hub 23 having a reduced journal portion 24, and also formed in the end thereof with a recess 25 to receive a corresponding cylindrical reduction 26 of the adjacent rotor, as clearly shown in Fig. 2. The hub of each rotor is also provided with a squared extension 27, which fits into a squared socket 28 in the adjoining section or unit, whereby the rotors are interlocked with one another, so that they are caused to rotate always in unison. The connection referred to between the rotors is made so that said rotors may be separated from each other and reassembled. The construction referred to enables any desired number of rotors and casings to be combined, as both the casing and the rotor have an interlocked engagement with each other. Each unit is also provided in one wall thereof with an enlarged circular recess 29 adapted to receive a radial ball bearing, comprising an inner cup 30, an outer cup or ball race 31, and an interposed circular series of anti-friction balls 32, as shown in Fig. 2. The bearing referred to as a whole is held in place by a retainer 33, preferably in the form of a disk having the outer edge thereof threaded, as shown at 34, and screwed into the recess 29 which is also threaded to receive the retainer 33. This retainer 33 forms a flush section of the side wall of the casing, so that said side wall, which is shown as the outside wall in Fig. 2, may be utilized as the adjacent inside wall of the expansion chamber or compressing chamber, as the case may be, when the units are combined in the manner shown in Fig. 2. Inclosing the outer end of the last unit, I employ a head C which is water-jacketed, as shown at 44, and provided with attaching or supporting feet 45, and also with lugs 46 to receive the tie bolts 11 above referred to. This head C is also provided with a tongue 47 which fits into the adjacent annular recess or groove 21 in the adjoining unit.

The explosive mixture is admitted to the compression chamber 34′ through a suitable inlet or nozzle 35, and is then carried around by the following wing of the rotor, and compressed within the casing 18. The compressed mixture of gas is then delivered into a chamber 35′ which communicates by means of a connecting passage 36 with a receiving chamber 37 in the casing of the power unit A. From the chamber 37, the compressed gas passes by a spring seated intake valve 38 into the expansion chamber 2, where it is ignited by a plug or other igniter inserted in an opening 39 arranged at a suitable point in the casing 1. The burnt gases are forced by the wings 12 outwardly through an exhaust nozzle 40 arranged opposite the inlet passage 35.

The inlet and exhaust passages, and the intake valve 38 and igniter in the opening 39 are so arranged relatively to each other that when the rotor with its wings is in the position illustrated in Fig. 1, the expansion chamber behind the uppermost wing 12 is filled with compressed gas and is ignited. The gas expanded by the explosion then acts against the wing 12 just beyond the igniter and drives said wing around the upper portion of the expansion chamber, the burnt gases on the opposite side of the wing being driven outwardly through the exhaust nozzle 40. As this occurs, the mixture admitted through the inlet nozzle 35 is being compressed by one of the wings in the compressing chamber, and just after the wing 12 passes by the intake valve 38,

which has been held closed by the expanding gas, the new charge of compressed gas passing inwardly at 36 into the receiving chamber 37 is sufficient to unseat the valve 38 and fill the expansion chamber in which the pressure is now less than that of the new charge in the chamber 37. As soon as the pressure of the new charge of gas equals the compression back of the valve 38, said valve is closed by means of its spring and held closed, while the fresh charge of gas is ignited, the pressure of the explosion being in excess of the pressure on the opposite or outer side of the valve 38. In this way, continuous rotary motion is imparted to the rotor 3, to which a power transmitting shaft may be attached for delivering off the power generated by the motor.

41 designates a threaded plug or cap for giving access to the valve 38 and for enabling said valve to be placed in position and removed therefrom, the valve 38 being mounted in a suitable cage 42 which is shown as screwed into an internally threaded opening 43 in the peripheral wall of the casing 2.

What is claimed is:

1. In a rotary internal combustion motor, a motor made up of an assembled series of like units, each unit embodying a separate and independent rotor chamber, and a rotor operating therein, the rotors being separably interlocked for synchronous operation, and the rotor chambers being also separably interlocked, each unit chamber having a closed head at one side, the opposite side being open before the units are assembled, and the head of one unit acting as a closure for the open side of the adjoining unit.

2. In a rotary internal combustion motor, a plurality of units each embodying a cylindrical chamber, one for compression and the next for expansion, said expansion and compression chambers being arranged side by side, and each unit embodying one integral head only the opposite head being formed by an adjoining unit, a power rotor working in the expansion chamber, a compressing rotor working in the compression chamber, both of said rotors being eccentric with respect to the chambers in which they operate and having a common axis of movement, wings carried by both rotors and movable radially with respect to said axis, and interlocking shoulders on said rotors causing them to rotate in unison.

3. In a rotary internal combustion motor, a plurality of units each embodying a cylindrical chamber, one for compression and the next for expansion, said expansion and compression chambers being arranged side by side, and each unit embodying one integral head only the opposite head being formed by an adjoining unit, a power rotor working in the expansion chamber, a compressing rotor working in the compression chamber, both of said rotors being eccentric with respect to the chambers in which they operate and having a common axis of movement, wings carried by both rotors and movable radially with respect to said axis, interlocking shoulders on said rotors causing them to rotate in unison, the expansion and compression chambers of said units also having a separable interlocking connection with each other.

4. In a rotary internal combustion motor, cylindrical expansion and compression chambers arranged side by side, a power rotor working in the expansion chamber, a compressing rotor working in the compression chamber, both of said rotors being eccentric with respect to the chambers in which they operate and having a common axis of movement, and wings carried by both rotors and movable radially with respect to said axis, each rotor embodying a squared central stub at one side and a squared central stub receiving socket at the opposite side.

5. In a rotary internal combustion motor, cylindrical expansion and compression chambers arranged side by side, a power rotor working in the expansion chamber, a compressing rotor working in the compression chamber, both of said rotors being eccentric with respect to the chambers in which they operate and having a common axis of movement, and wings carried by both rotors and movable radially with respect to said axis, the expansion and compression chambers being separated from each other and each contained in a separate casing, said casings having a tongue and groove separable connection with each other.

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

CLIFFORD T. RAULE.

Witnesses:
JOHN H. HARTRANFT,
CHARLES G. SUPER.