A. R. GARDNER & P. WASHBURN.

ROTARY INTERNAL COMBUSTION ENGINE.

APPLICATION FILED OCT. 30, 1915.

1,255,403.

Patented Feb. 5, 1918.

3 SHEETS—SHEET 1.

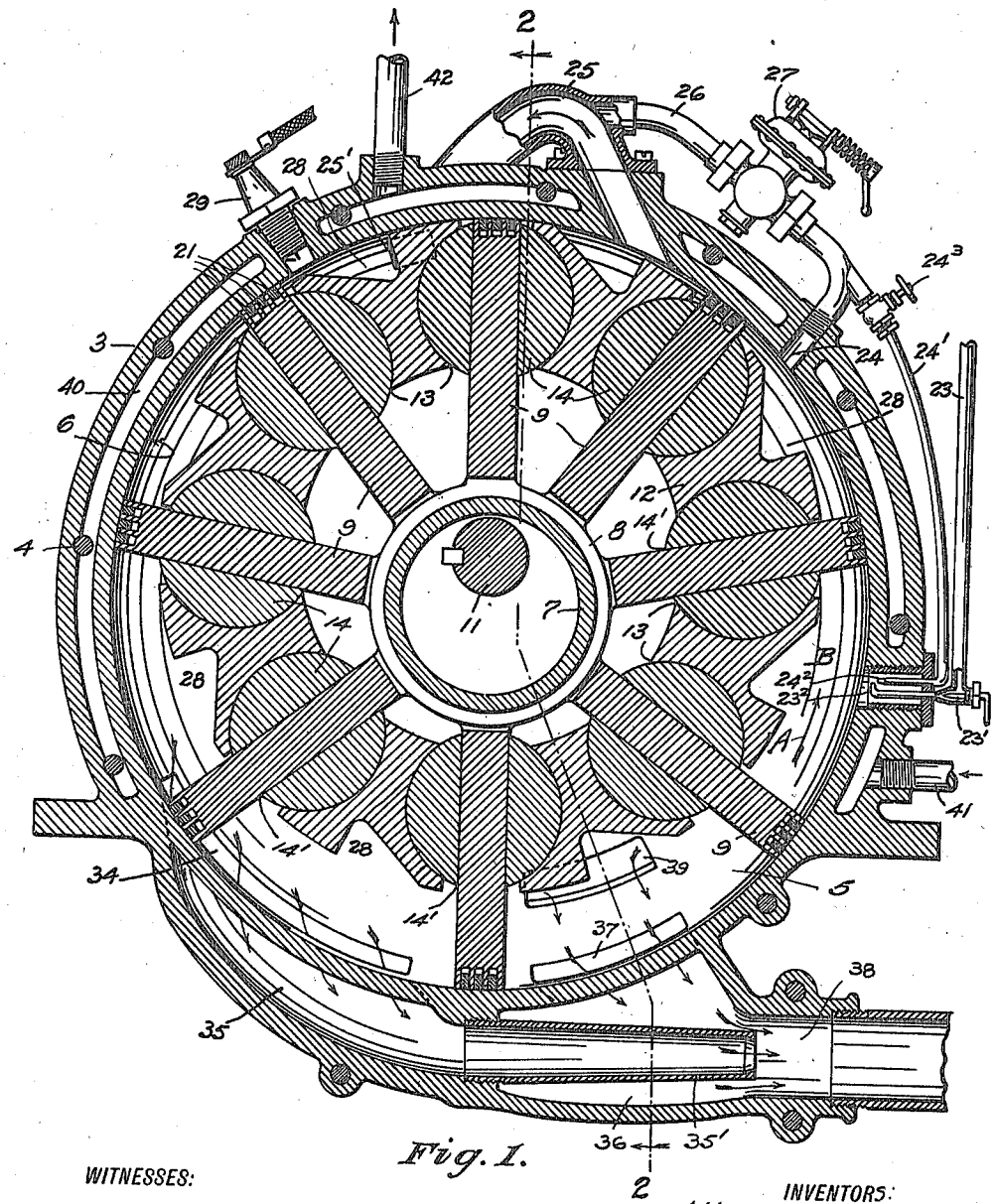


Fig. 1.

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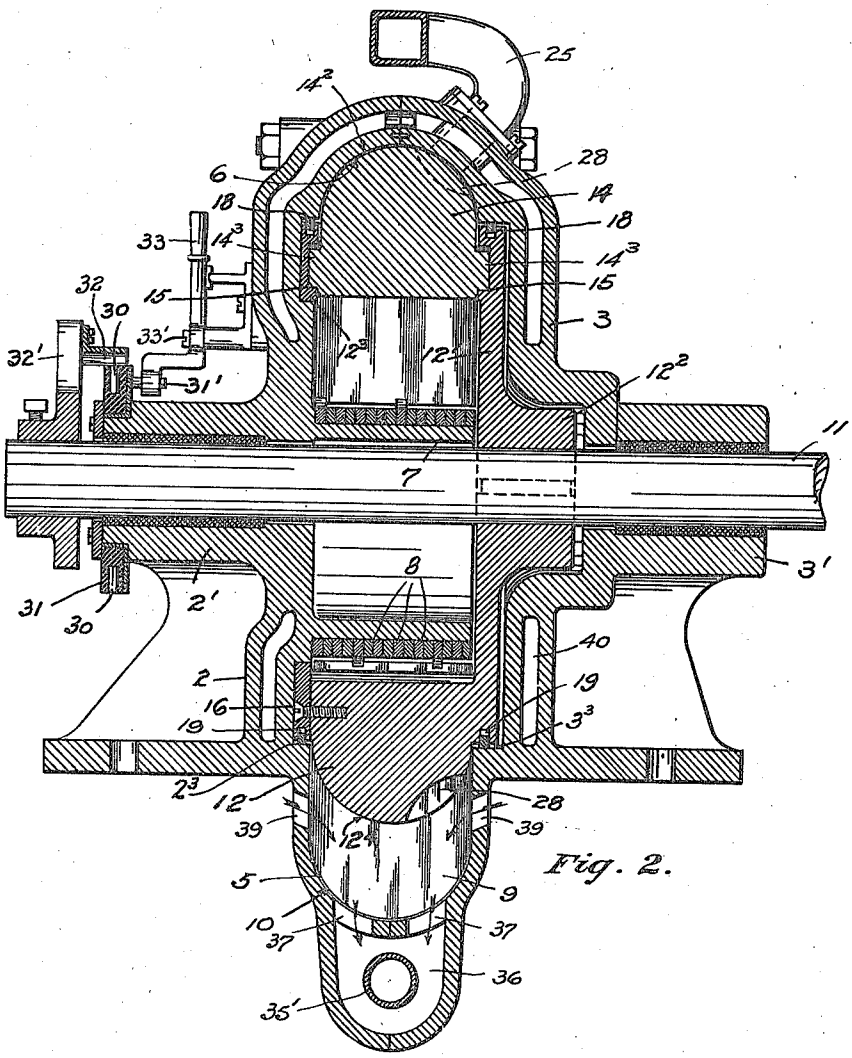


Fig. 2.

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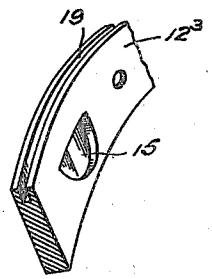


Fig. 6.

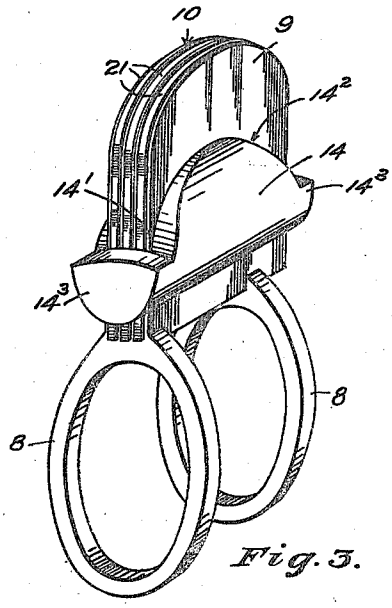


Fig. 3.

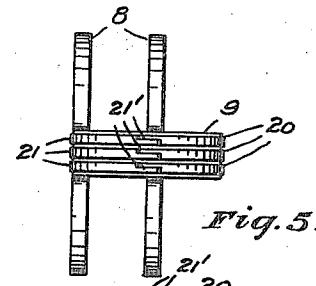


Fig. 5.

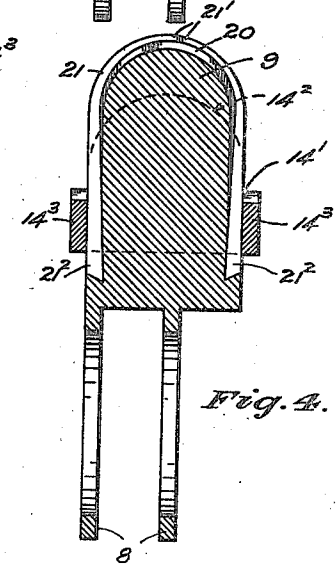


Fig. 4.

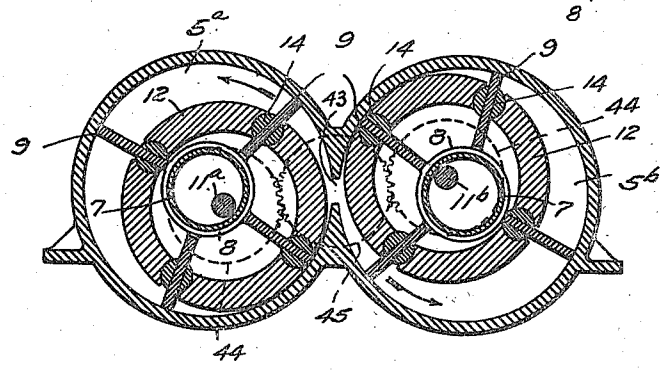


Fig. 7.

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UNITED STATES PATENT OFFICE.

ALBERT R. GARDNER AND PAUL WASHBURN, OF SEATTLE, WASHINGTON.

ROTARY INTERNAL-COMBUSTION ENGINE.

1,255,403. Specification of Letters Patent. Patented Feb. 5, 1918.

Application filed October 30, 1915. Serial No. 58,777.

To all whom it may concern:

Be it known that we, ALBERT R. GARDNER and PAUL WASHBURN, citizens of the United States, residing at Seattle, in the county of King and State of Washington, have invented certain new and useful Improvements in Rotary Internal-Combustion Engines, of which the following is a specification.

This invention relates to rotary internal combustion engines; and its object is the perfecting of engines of this type to enable them to be operated with a smaller consumption of the power medium, and at a higher efficiency.

To which ends, we provide devices which will perform within the engine cylinder and in a single revolution, the following functions: supplying a hydro-carbon in a suitable proportion with air, compressing an admixture of these components into an effective explosive condition, and transferring the same at a predetermined pressure and in a succession of charges from the compressing to the firing positions, igniting the charges, and discharging the combustion products so that subsequent supplies of the power medium will be unimpaired.

The invention further consists in the novel construction, location and combination of parts, as will be hereinafter described and claimed.

An embodiment of our invention is illustrated in the accompanying drawings, wherein Figure 1 is a transverse vertical section. Fig. 2 is a longitudinal vertical section taken substantially through 2—2 of Fig. 1. Fig. 3 is a perspective view of a piston and the rocker bearing therefor. Fig. 4 is a transverse vertical section of Fig. 3. Fig. 5 is a top plan view of Figs. 3 and 4 with the oscillator omitted. Fig. 6 is a fragmentary perspective view of the wheel ring. Fig. 7 is a transverse vertical sectional view, shown somewhat diagrammatically, of a modified form of the invention.

In carrying out our invention we employ a circular casing comprised of two substantially similar parts 2 and 3 which are secured together by bolts 4. The outer or circumferential surface of the chamber 5 within said casing is of a semi-circular form, as at 6, in transverse section.

Extending from the casing part 2 axially into the chamber 5 is a cylindrical wall 7 whose outer peripheral surface serves as a journal bearing for hub elements 8 of radially arranged pistons 9 having semi-circular extremities 10.

The engine shaft 11 extends through the space within the casing wall 7 and is journaled in suitable boxes, such as 2^1 and 3^1, provided on or formed integral with the respective casing parts. The shaft 11 is disposed eccentrically with respect to the casing and, as shown in Figs. 1 and 2, it has its axis above and in a vertical plane with the axis of the chamber 5, although it is obvious that the referred to axes may be positioned in any other plane.

12 represents the rim of a wheel having at one end a web 12^1 whereby it is joined with a hub 12^2 which is keyed or otherwise secured to said shaft. The wheel rim 12 at its outer peripheral surface 12^4 is of a semi-cylindrical shape in transverse section to fit into the correspondingly shaped peripheral surface 6 of the casing chamber at the top of the latter.

Disposed symmetrically in the wheel rim 12 are bores 13 into which are rotatably fitted rocker bearings 14, one for each piston, said bearings being severally provided with slots 14^1 for the respective pistons to extend diametrically therethrough.

These rocker bearings are each primarily formed of a cylindrical shape and after being inserted within the wheel bores 13 are machined to have their outer sides with respect to their axis of revolution, finished to a curvature 14^2 corresponding to the outer surface 6 of the chamber 5 and fit therewith at the top of the latter.

Beyond the outer ends of a slot 14^1 a bearing 14 has its extremities 14^3 formed of substantially sector shapes to extend into cavities 15 provided respectively in the wheel web 12^1 and a ring 12^3 which is secured, as by screws 16, to the opposite end of the wheel rim from said web. This ring, in effect, is a part of the wheel and is made detachable to enable the bores 13 to be conveniently made. The ring 12^3 and web 12^1 protrude, as shown in Fig. 2, from the curved portion of the wheel rim 12 and are respectively accommodated in recesses 2^3 and 3^3 of the casing parts. Said recesses are of cir-

cular configuration and provide at their outer peripheries shoulders to coact with packing rings 18 provided in grooves 19 in the wheel at each side of the casing chamber proper.

Provided in each of the pistons 9 is one or more grooves 20 to accommodate wicket-shaped spring-metal packing devices 21, each comprised of two parts and having overlapping ends 21^1.

The outer portion of a packing device part is relatively thin so as to improve its resiliency and enable it to yieldingly bear against the chamber surface 6, while the inner portion 21^2 of such part is held in its piston groove by the adjacent end 14^3 of the associated rocker bearing.

Because of the eccentric mounting of the wheel in the chamber 5, the bearings 14 are successively moved outwardly upon the pistons 9 as the latter ascend in their revoluble travel in the direction indicated by arrow A in Fig. 1, so that in passing over their axis of revolution at the top of the chamber, the pistons are sheathed by the bearings. In the further travel of the pistons the latter are progressively protruded from such bearings until they pass under the chamber axis.

Thus we provide intermediate the pistons on one side hereinafter designated as the "back", expanding compartments, and on the other side which we term the "front", contracting compartments. At or about the mid-height of such front we introduce into the chamber 5 hydrocarbon oil through a supply pipe 23 provided with a needle valve 23^1 to regulate the oil supply.

The oil, as will be presently explained, is delivered in the form of a spray into the chamber to mix with air confined in a space, as B, between two pistons.

As the pistons advance, the capacity of the space between such pistons diminishes with a consequent increase in pressure until the forward of the referred to pistons passes a relief opening 24 in the casing, whereat a quantity of the gas mixture is discharged into a pipe 24^1 leading back to and into the casing chamber in proximity to the outlet end of the oil supply pipe 23. These two pipes are respectively provided with nozzles 32^2 and 24^2 adapted to deliver the gas discharge from the pipe 24 across the outlet of nozzle of the other pipe 23 to produce the spray above alluded to.

24^3 indicates a valve for regulating the quantity of gas passing through the pipe 24^1.

The travel of the pistons beyond the relief opening 24 further compresses the explosive mixture and facilitates its flow into a receiving pipe 25 which is connected to a by-pass pipe 26 leading back to the aforesaid relief opening 24 and also to the pipe 24^1.

Included in said by-pass pipe is a pressure-relief valve 27 of any well-known or suitable type, said valve being regulated to maintain the fluid pressure within said receiving pipe at or below a predetermined amount.

The office of the receiving pipe 25 is that of a reservoir, besides serving to transfer the explosive mixture from the rear to the front of the engine, whereat it terminates in a port 25^1.

Explosive charges are admitted into the casing chamber through the medium of pockets 28 provided in the wheel rim 12 as they successively revolve by the port. By such devices it is evident that as each pocket passes the port there is but a momentary communication established for the delivery of an explosive charge from the reservoir pipe 25 into the front of the engine. Subsequent to the closure of said port the previously admitted charge is ignited through the agency of a spark plug 29, resulting in an explosion which is effective against the portions of the pistons which protrude from the bearings 14 in advance, and to the rear thereof in the space in which the explosion occurs to drive the wheel in the direction denoted by arrow A.

As illustrated, the sparking plug is located in front of and in proximity to the tangential contact between the chamber 5 and the wheel in order that an explosion may be made at or about the time that the piston to the rear of a charge is passing the vertical axis of the chamber or, where the fit of the wheel at the port is not tight, after the referred to piston has passed the port to obviate firing of the mixture within the reservoir pipe.

The spark plug 29 is in a normally incomplete circuit which includes an electric battery and a series of insulated wire terminals, such as 30 (Fig. 2), disposed about a collar 31 which is rotatably mounted on the bearing box 2^1 at one end of the casing.

Said terminals are successively contacted by a brush 32 carried by a holder 32^1 secured to and rotatable with the engine shaft. 33 represents a lever pivoted at 33^1 and engaging with a stud 31^1 on said collar to adjustably move the same to present the series of terminals 30 ahead or in a reverse direction to vary the relative position in which the explosive charges are to be ignited.

When a charge is ignited, the force derived from the explosion acts until its power is nearly spent at or about the time that a piston influenced thereby arrives at an opening 34 provided near the bottom of the front side of the casing whence the greater part of the burnt gases are discharged into a receptacle 35. Such discharge into the latter is attained principally by centrifugal force due to the revolution of the pistons.

The receptacle 35 is in the nature of a conduit arranged tangentially with respect to the chamber 5 and has an outlet in the form

of a tubular nozzle 35^1 which extends into a compartment 36. This compartment communicates by openings 37 with the bottom of the chamber 5 at the back of the engine and has an exhaust opening 38 of somewhat greater diameter than the mouth of the nozzle 35^1 and in axial alinement therewith.

By such an association of the nozzle and the outlet 38 we provide an ejector which serves to induce an outflow of any gaseous combustion products which may remain in said chamber in advance of a piston in passing neutral axis of the engine or from the front to the back thereof.

The gaseous products withdrawn from the chamber, as above explained, through openings 37 are accompanied by atmospheric air admitted from opposite directions into the chamber through inlets 39 disposed above the openings 37. The openings 39 and 37 serve as ventilators for the chamber and the air currents which pass through the same act as a scavengering agent, so to speak, to thoroughly clean the chamber. A quantity of air will, however, remain in the chamber to be conveyed by the onward travel of the impelling piston into position whereat oil is added in the form of a spray to afford an explosive mixture.

From the foregoing description it is apparent that the various operations or cycles, as conventionally termed, necessary to the operation of an internal combustion engine, are performed by the present invention in a single rotation of the engine shaft.

While we have in the foregoing description described the operation with relation to a pair of pistons, it is to be understood that any suitable number of pistons may be employed and that they will all be influenced by the explosions of the charges as they successively revolve into positions which they will occupy at the times the charges are ignited.

The passage of air into and out of the casing chamber through ventilating openings 39 and 37, respectively furnishes a means to cool the engine and, to further reduce the temperature, the casing is provided with compartment 40 having inlet and outlet pipe connections 41 and 42 for the flow or circulation of the cooling water.

In Fig. 7 we illustrate an adaptation of the before described engine for use by employing two of such engines to act in a unitary manner, and possessing certain advantages. In this view, only such parts are shown as are deemed necessary to an understanding of the same.

More particularly, two casings are arranged in tangential relations with a communicating passage 43 between the respective chambers which are designated by 5^a and 5^b. This passage constitutes the firing compartment for both chambers.

The shafts 11^a and 11^b of the respective chambers in this instance are arranged eccentrically, but below and above a plane extending through the chambers' axes and toward a vertical plane medially of the chambers. Toothed gears 44 are secured to the respective shafts and are operatively connected by an intermediate gear 45 to compel the two shafts to be driven in the same rotary directions and also cause the wheels 12 and pistons 9 to be turned uniformly.

What we claim, is—

1. In a rotary internal combustion engine having a circular chamber, a plurality of pistons revolubly mounted in said chamber, a fuel supply pipe for the chamber, means rendered operative through the agency of a fluid compressed in one part of said chamber by the revolving pistons whereby the fuel is injected from said supply pipe into a part of said chamber whereat the fuel will be compressed with such fluid agent, and means to transfer the resultant compressed mixture into the firing portion of the chamber.

2. In an internal combustion engine, a circular chamber provided with fuel and air inlet openings, a gas exhaust opening, and inlet and outlet ventilating openings intermediate said exhaust opening and the aforesaid openings, a wheel rotatable about an axis eccentric of the chamber, a plurality of pistons revoluble about an axis concentric of said chamber, said pistons extending through the rim of said wheel, means to ignite charges of an explosive mixture of said fuel and air behind each piston successively whereby the pistons are driven to rotate said wheel, whereupon the latter coöperating with the pistons serve to discharge through said exhaust opening previously exploded charges, and means influenced by such discharges whereby a flow of air is caused to enter and leave the chamber through the respective ventilating openings.

3. In a rotary internal combustion engine, a chamber having fuel inlet and gas exhaust openings and also provided with ventilating openings, a compartment communicating with said chamber through said exhaust opening, a second compartment communicating with said chamber and provided with a discharge opening, and a nozzle extending from the first-named chamber into the second-named chamber and directed into the discharge opening of the latter whereby a current of air is induced to flow through said ventilating openings and the chamber by the power of the gas ejected from the nozzle.

4. An internal combustion engine having two tangentially arranged circular chambers, a shaft extending eccentrically through each of said chambers, gear connections be-

tween said shafts whereby they are constrained to rotate in similar rotary directions, pistons revoluble about an axis concentric of each of said chambers, operative connections between said shafts and the respective pistons, and a firing chamber common to both of the aforesaid chambers whereby an explosion occurring within the engine will serve to simultaneously propel a piston in each chamber.

5. An internal combustion engine having two tangentially arranged circular chambers with an opening therebetween, a shaft extending eccentrically through each of said chambers, a wheel secured to each of the shafts, series of pistons revoluble about the axes of the respective shafts and extending through the adjacent wheels into juxtaposition with the peripheries of said chambers, and mechanical connections whereby the two shafts and the associated wheels are constrained to rotate in similar directions in the two chambers, said pistons being influenced by explosions obtaining in the opening between the chambers and the spaces in the latter which communicate therewith to actuate the engine.

6. In a rotary internal combustion engine, a circular chamber having fuel inlet openings, an opening for the exhaust of the combustion products and inlet and outlet ventilating openings, fuel igniting means, a conduit for transferring the explosive mixture under pressure from the compressing side to the exploding side of said chamber, a plurality of revoluble pistons, and a rotary member disposed eccentrically in said cylinder and coöperating with said pistons whereby the fuel supplied to the cylinder is first compressed and subsequent to being exploded the combustion product is thereby expelled through the exhaust opening said pistons serving in coöperation with the power of the exhausting such combustion product effecting a flow of air through the respective ventilating openings to clean the chamber in proximity to said ventilating openings.

7. In an internal combustion engine, a casing, two wheels mounted for rotation in said casing, pistons therefor, shafts for the respective wheels, gear connections between said wheels whereby they are constrained to rotate in similar directions, and a firing chamber provided in said chamber intermediate said wheels to effect the rotation of the wheels through pressure obtaining by the explosion of gases in said firing chamber.

Signed at Seattle, Washington, this 20th day of October, 1915.

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PAUL WASHBURN.

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