F. FLEMING.

ROTARY COMBUSTION ENGINE.

APPLICATION FILED APR. 30, 1908.

941,567. Patented Nov. 30, 1909.

2 SHEETS—SHEET 1.

Fig. 1.

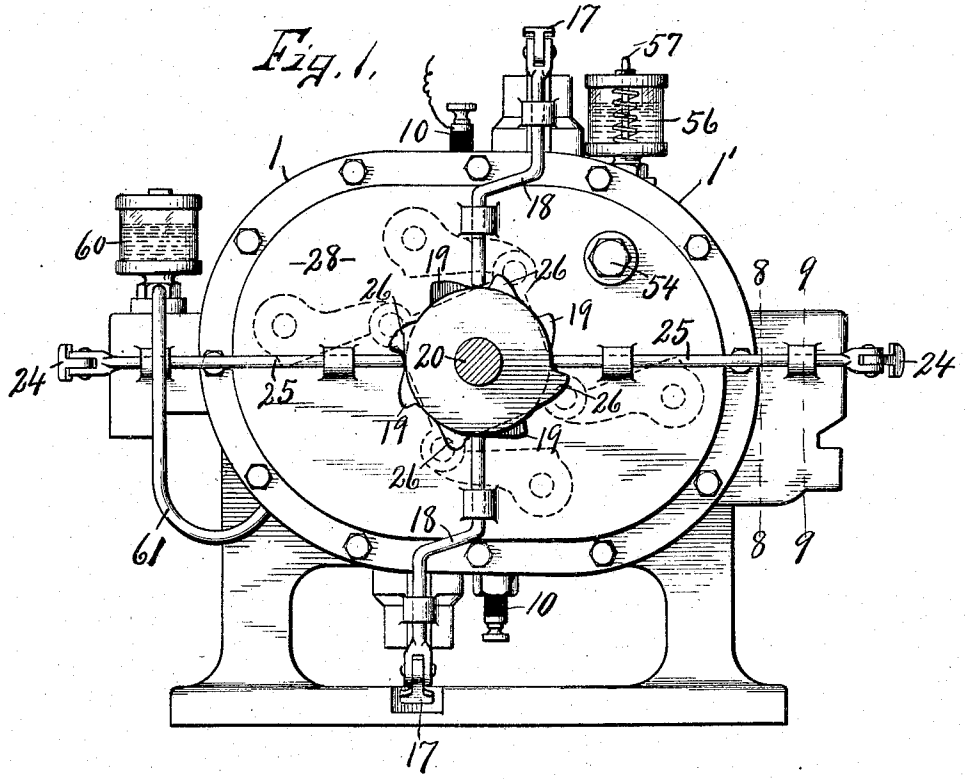


Fig. 2.

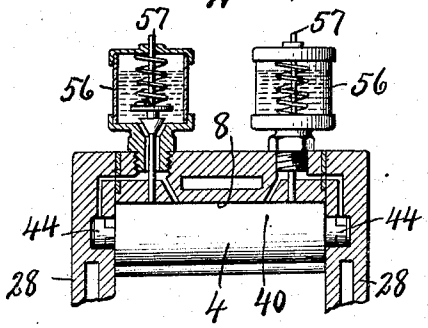


Fig. 3.

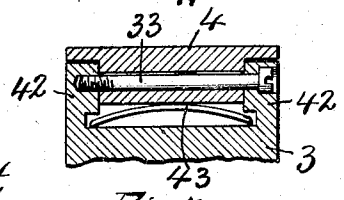


Fig. 4.

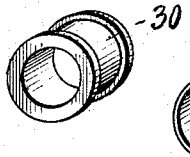
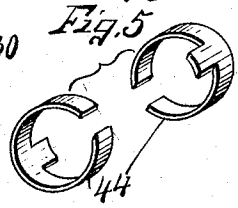


Fig. 5.



Witnesses.

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2 SHEETS—SHEET 2.

Fig. 6.

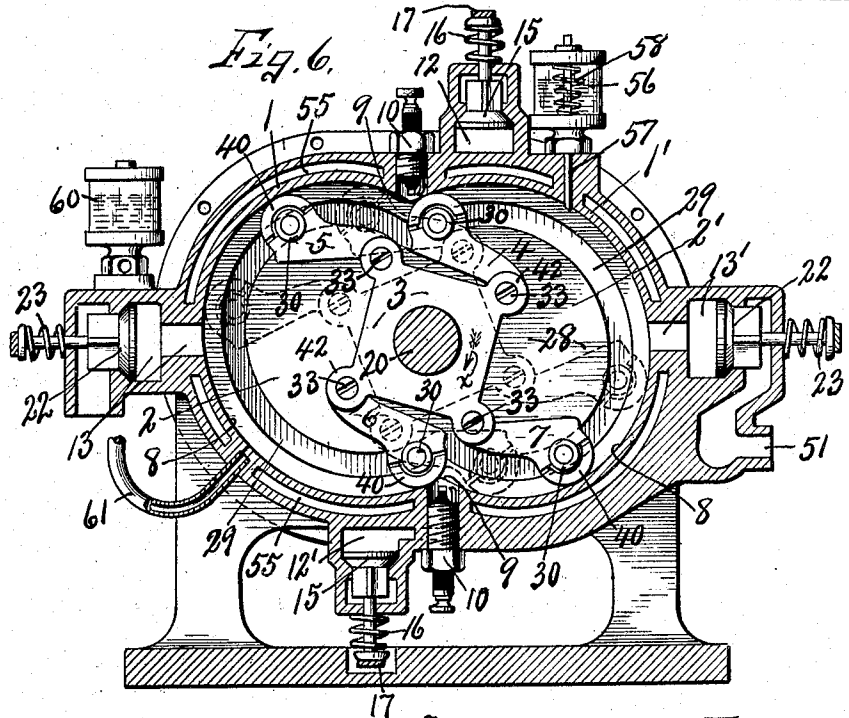


Fig. 7.

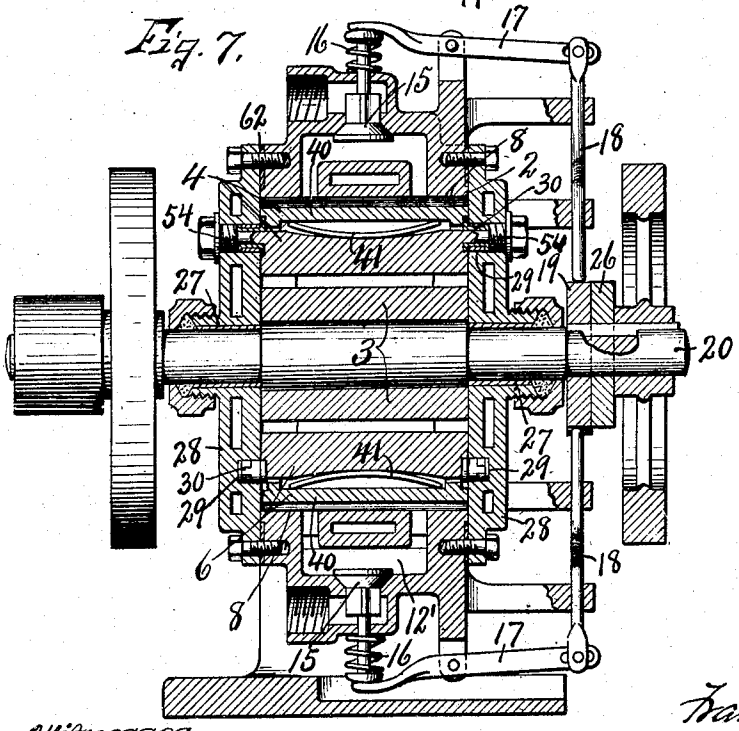


Fig. 8.

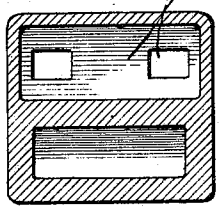
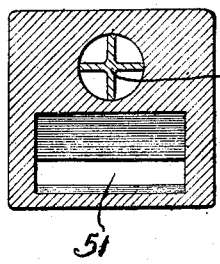


Fig. 9.



Witnesses.
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UNITED STATES PATENT OFFICE.

FRANK FLEMING, OF ROME, NEW YORK.

ROTARY COMBUSTION-ENGINE.

941,567. Specification of Letters Patent. Patented Nov. 30, 1909.

Application filed April 30, 1908. Serial No. 430,123.

To all whom it may concern:

Be it known that I, FRANK FLEMING, of Rome, in the county of Oneida, in the State of New York, have invented new and useful Improvements in Rotary Combustion-Engines, of which the following, taken in connection with the accompanying drawings, is a full, clear, and exact description.

This invention relates to certain improvements in rotary combustion engines in which liquid hydro carbon and air or any equivalent thereof is used as the explosive mixture.

My main object is to produce a rotary gas engine in which the explosive mixture or gas may be effectively compressed just prior to ignition by providing a rotary piston with a plurality of trailer wings hinged thereto and foldable toward and from each other and toward and from the piston and operating in pairs in such manner as to receive the fresh charge of live gases when at their maximum position of opening or separation and to gradually fold the wings of each pair toward each other to compress the intervening charge to the maximum degree when brought into position for ignition.

Another object is to provide for the simultaneous admission, ignition and compression of a plurality of charges of the explosive mixture at diametrically opposite sides of the piston thereby rotating the piston with a very much increased power and less vibration.

Another object is to provide for the recurrence of these simultaneous explosions several times during each rotation of the piston so as to impart a steadier rotary action to the piston.

Another object is to provide for the automatic opening and closing of the inlet and exhaust valves at regular predetermined intervals of rotation of the piston and its trailer wings.

Other objects and uses relating to specific structural elements of the engine will be brought out in the following description.

In the drawings—Figure 1 is an end elevation of a rotary engine embodying the various features of my invention. Fig. 2 is a sectional view of a portion of a cylinder showing an end view of one of the wings and oiling means therefor, and also showing the end bearings and groove by which the trailing ends of the wings are held against the inner side of the cylinder. Fig. 3 is a sectional view through one of the hinge connections between one of the wings and piston showing the spring take up for the wing. Fig. 4 is a perspective view of one of the roller bearings at the outer end of the wing. Fig. 5 is a perspective view of the detached packing rings adapted to encircle the collar shown in Fig. 4. Fig. 6 is a transverse vertical sectional view of the engine showing the piston and folding wings in elevation. Fig. 7 is a longitudinal vertical sectional view through the center of the engine parallel with the shaft. Figs. 8 and 9 are detail sectional views taken respectively on lines 8—8 and 9—9, Fig. 1.

In carrying out the objects stated, a hollow shell of cast metal or other suitable material is constructed to form two similar merging cylinders —1— and —1′— having intercommunicating chambers —2— and —2′— in which is movable a piston —3— having a series of in this instance four trailer wings, —4, —5, —6— and —7—.

The cylinders —1— and —1′— are provided with inner curved bearing faces —8— which although circular throughout nearly their entire length are eccentrically disposed with reference to and at opposite sides of the axis of the piston —3— and intersect each other above and beneath said axis thus contracting the central portion of the shell and forming what may be termed compression points —9— at diametrically opposite sides of and equi-distant from the axis of the piston —3— at which compression points are located suitable spark plugs 10. These compression points —9— and spark plugs —10— are located at opposite sides of a vertical line drawn through the axis of the piston —3— to cause the simultaneous compression and ignition of the compressed gases immediately upon being exposed to ignition by the spark plug. These cylinders —1— and —1′— are provided with opposite fuel inlet ports —12— and —12′— and opposite exhaust ports —13— and —13′— the fuel inlet ports being located in close proximity to but at one side of their corresponding spark plugs —10— in the direction of rotation of the piston indicated by arrow —*x*—, Fig. 6.

Communication between the source of fuel supply and interior of the cylinders —1— and —1′— through the fuel inlets —12— and —12′— is controlled by suitable valves

—15— which are rendered self-closing by external springs —16— and are opened against the action of said springs by suitable mechanism as levers —17—, plunger rods —18— and cams —19— best seen in Figs. 1 and 7, said cams being secured to a shaft —20— upon which the piston —3— is mounted, the gases being under pressure at the inlets.

The exhaust ports —13— and —13'— are located in substantially the same horizontal plane as and at diametrically opposite sides of the axis of the piston —3— and communication through these ports between the interior of the cylinders and atmosphere is controlled by suitable valves —22— which are rendered self-closing by external springs —23— and are adapted to be opened at regular predetermined intervals by levers —24—, plunger rods —25— and cams —26— the latter being secured to the shaft —20— in close proximity to the cams —19—.

The piston —3— which is substantially square or rectangular in cross section is located centrally within the shell or casing at the junction of the cylinders —1— and —1'— and is rigidly secured to the shaft —20— which in turn is journaled in suitable bearings —27— in the opposite ends or heads —28— of the main shell or casing, said heads being removable to permit access to the interior of the cylinder and enables the curved bearings —8— to be accurately milled. These heads are formed on their inner faces with grooves —29— which are parallel with the bearing faces —8— and merge with each other at the junction of the cylinders and serve to receive suitable rollers —30— projecting laterally from opposite faces of the wings —4—, —5—, —6— and —7— to hold the extreme outer ends of said wings in contact with the bearing faces —8—.

The distance between the compression points —9— above and beneath the piston —3— is considerably less than the horizontal distance between opposite sides of the bearings —8— and therefore by making the grooves —29— parallel with the bearings —8— and engaging the rollers —30— of the wings in said grooves, it is evident that said wings will be folded toward and from adjacent sides of the piston as the latter is rotated.

As previously stated, I provide a series of in this instance four wings, —4—, —5—, —6— and —7— corresponding to the number of sides of the piston —3— each wing being hinged at —33— to one corner of the piston while its remaining portion is free to move toward and from the adjacent side of the piston. Each side of the piston is therefore, provided with a folding wing hinged thereto and coacting therewith to receive and compress the live gases preparatory to ignition, each folding wing coacting with the next succeeding wing to effect the same result as the piston with the wings thereon is rotated.

The outer or trailing end of each wing is provided with a bearing section —40— which is spring-pressed outwardly into engagement with the bearings —8— by flat springs —41— which are interposed between the bearing sections —40— and adjacent face of the main body of the wing and are preferably let into suitable recesses in the inner faces of the bearing sections —40— to protect them from excessive heat and products of combustion as best seen in Fig. 7.

The hinged ends of the wings and portions of the piston to which they are attached are recessed into each other in the manner shown in Fig. 3 so that a portion of the wing is interposed between opposed ears —42— on the ends of the piston while other portions of the wings overhang the outer faces of the ears —42— to guard as far as practicable against leakages of the live gases at the joints, the ears —42— serving to receive the hinge pins —33— which are passed through suitable apertures in the intervening portion of the wings, the hinge joint being made additionally tight by the use of flat springs —43— which are arranged in suitable recesses in the adjacent portion of the piston and exert a spring pressure against the inner faces of the hinged ends of the wings.

The rollers —30— which are mounted upon suitable studs or bearings on opposite sides of the trailing ends of the wings and ride in the grooves —29— are provided with split packing rings —44— as shown in Fig. 5, said packing rings encircling the intermediate portion of the rollers —30— and are formed of spring metal tensioned to open and thereby maintain a practically tight joint between the rollers and grooves in which they ride to prevent undue escape of the gases at such joints.

In Fig. 6 I have shown the opposite pairs of wings in position for effecting a maximum compression of the live gases between them, the space between each pair of wings being exposed to the spark plug ready for ignition of the compressed gases, the ignition of the compressed gases between both pairs of wings being simultaneous and effected by any well known mechanism for producing simultaneous sparks at the plugs.

When the piston and wings are in the position shown in full lines in Fig. 6, the fuel inlets and exhaust valves are closed in which position the compressed gases are ignited and the expansive force of the exploded gases exerts a lifting power upon the wings —4— and —6— thereby gradually unfolding or opening the wings which lie close to the ad-

jacent sides of the piston, and this power operating to unfold or open the wings —4— and —6— causes the bearing sections —40— to ride against the eccentric bearings —8— while the rollers —30— riding in the grooves —29— keep the free ends of the wings in contact with the bearing faces —8—. This opening of the wings —4— and —6— against the bearings —8— effects a forward rotary movement of the piston in the direction of opening of the wings, the spaces between the wings —4— and —5— and also between the wings —6— and —7— gradually increasing until the advance wings are open to their maximum degree, the enlargement of the intervening space permitting the gases to exhaust at a comparatively low pressure. As the piston —3— continues to rotate through practically a quarter revolution or at about the same time that the contact sections —40— of the wings —4— and —6— reach or just begin to uncover the exhaust ports —13— and —13'—, the exhaust valves —22— are opened by the cams —26— through the medium of the rods —25— and levers —24—, said valves being immediately closed by the springs —23— as soon as the contact sections —40— of the wings pass the exhaust ports to the position shown by dotted lines in Fig. 6. In this position, the wings —4— and —5— and —6— and —7— between which the gas was previously compressed are separated to their maximum degree and the intervening spaces are registered with the fuel inlet openings at which time and during a further partial revolution of the piston the fuel inlet valves —15— are opened by the cams —19— through the medium of the rods —18— and levers —17—, thus allowing fresh charges of the explosive mixture to enter between the advancing wings —4— and —5— and also between the wings —6— and —7— when in the position shown by dotted lines in Figs. 1 and 6.

The cams —19— are so constructed and timed as to hold the fuel inlet valves open while the wings —4— and —6— are passing from the position shown by dotted lines to the positions previously occupied by the wings —5— and —7— shown by full lines in Fig. 6 during which time the explosive mixture is introduced through the open inlets under pressure by any suitable pressure device not shown, after which the fuel inlet valves —15— are closed by their springs —16—, the exhaust valves being also closed. During this partial rotation of the piston and wings carried thereby from the position shown by full lines to the position shown by dotted lines, the wings —4— and —7— and also the wings —5— and —6— are coacting in pairs to compress the live gases previously introduced between them and as soon as they approach their maximum compressing position they will be in the same position as those shown by full lines ready to ignite the intervening compressed charges of the explosive mixture, so that each wing coacts with the one succeeding it to compress the gases and at the same time coacts with the one preceding it to form a larger chamber for the reception of the live gases so that four double explosions occur during each revolution of the piston or in other words two simultaneous explosions occur as each side of the piston with the compressed wings thereon is brought into alinement with the spark plug.

The axial length of the piston and wings is substantially equal to the distance between the inner faces of the opposite heads —2— of the cylinder to form a running fit therewith.

The distance between the compression points —9— at the junction of the cylinders —1— and —1'— is substantially equal to the combined diametrical width of the piston and opposite wings when the latter are folded against the adjacent side of the piston but the distance horizontally through the axis of the piston between the opposite bearing faces —8— where the exhaust ports —13— and —13'— are located is substantially equal to the combined diametrical width of the piston and transverse length of the wings when unfolded so that as the piston is rotated the wings will be folded against its opposite sides when riding past the compression points —9— and will be unfolded or extended to their maximum opening when passing the exhaust ports, the contact sections —40— of the wings being held against the eccentric bearing faces —8— during such rotation of the piston by the grooves —29— and rollers —30— riding therein.

In order to permit the packing rings —44— to be conveniently removed and replaced when worn, I provide the heads —2— with suitable openings which are normally closed by plugs —54—, the openings in which the plugs are located being in circumferential alinement with the travel of the packing rings and, therefore, in alinement with the grooves —29—.

Each of the cams —19— and —26— is provided with two diametrically opposite sets or pairs of cam teeth, those of each pair being arranged at substantially right angles to those of the other pair so as to open the fuel inlet valves and exhaust valves as each side of the piston with the wings thereon is presented at a given point in the rotation of the piston. For example, all of the valves are closed at the time of ignition of the compressed charge which takes place immediately after each of the wings passes the spark plugs or compression points —9— and the exhaust valves are opened while each wing is passing its exhaust port and the

fuel inlet valves are open through a short arc of revolution of each wing after it leaves the exhaust port, but close before such wing reaches the compression point —9— or spark plug.

The entire shell inclosing the piston and its trailer wings is provided with a suitable water jacket —55— and the interior bearings for the wings are lubricated from suitable oil cups —56— having valve stems —57— which project through suitable apertures in the shell into the path of the contact sections —40— of the wings, each contact section acting upon the valve stem —57— to open the oil valve which is self-closing by a suitable spring —58— shown by dotted lines in Figs. 1 and 6, the other oil cup as —60— shown at the left of Figs. 1 and 6 communicating with the interior of said shell through a suitable conduit —61—.

In order to make the shell practically gas tight, suitable packings —62— of copper are placed between the heads —2— and adjacent faces of the shell.

What I claim is:

1. In a rotary internal combustion engine, a rotary piston, trailer wings hinged to the piston, a cylinder having merging piston chambers eccentric to the piston and each having an inlet port and an exhaust port, self closing valves for said ports, means to open said valves, igniting devices, and curved bearings also eccentric to the piston for engaging and moving the wings to and from said piston.

2. In a rotary internal combustion engine, a rotary piston, a cylinder having merging piston chambers and curved inner bearing faces eccentric to the piston, each chamber having an inlet port and an exhaust port, self closing valves for said ports, means for opening said valves, spark plugs in opposite sides of the cylinder, trailer wings hinged to the piston, and means for holding said wings in contact with said bearing faces as the piston is rotated and for rocking the wings toward the piston as they approach the spark plug.

3. In a rotary internal combustion engine, a rotary piston, trailer wings hinged to the piston, a cylinder having merging piston chambers and curved inner bearing faces eccentric to the piston, each chamber having an inlet port and an exhaust port, self closing valves for said ports, means for opening said valves at regular intervals, means for holding the trailing ends of the wings in contact with said bearings and for moving them toward and from the piston as the latter is rotated, and igniting devices in the cylinder located where the chambers merge.

4. In a rotary internal combustion engine, a rotary piston, trailer wings hinged to the piston, a cylinder having merging piston chambers and curved bearings eccentric to the piston, each chamber having an inlet port and an exhaust port, the piston being located at the junction of said chambers, separate self-closing valves for said ports, means to hold the wings against said bearings as the piston is rotated, whereby the wings are rocked to and from the piston, means for opening each pair of inlet valves and each pair of exhaust valves at regular but at different intervals during the rotation of the piston, and separate igniting devices in opposite sides of the cylinder.

5. In a rotary internal combustion engine, a rotary piston, trailer wings hinged one in advance of the other to and around said piston, a cylinder having merging piston chambers eccentric to the piston and in which the piston and wings rotate, each cylinder having an inlet port and an exhaust port, self closing valves for said ports, opposite spark plugs at the junction of the chambers, means for successively moving the wings toward the piston as they approach the spark plugs, means for opening the exhaust valves while each wing is passing the exhaust port and means for opening the inlet valves just after each wing has passed the exhaust port.

6. In a rotary internal combustion engine, a cylinder and a rotary piston centrally mounted therein, said cylinder having opposite merging chambers eccentric to the piston, each chamber having an inlet port and an exhaust port, self closing valves for said ports, means for opening said valves at regular intervals, wings hinged one in advance of the other to and around the piston and bearing against the interior of the cylinder, means for holding the wings in contact with said cylinder, whereby they are moved to and from the piston as the latter is rotated to receive and compress an explosive mixture, and means to ignite said mixture.

7. In a rotary internal combustion engine, a rotary piston, wings hinged to the piston one in advance of the other, a cylinder inclosing the piston and wings and having merging piston chambers and bearings for the wings, said chambers and bearings being eccentric to the piston, each chamber having an inlet port and an exhaust port, normally closed valves for said ports, igniting devices close to the inlet ports, means for holding the wings in engagement with said bearings as the piston is rotated, means for opening the exhaust valves as each wing crosses the exhaust port, and means for opening the inlet valves during the travel of the wings between the exhaust port and inlet port.

8. In a rotary internal combustion engine, a cylinder having merging piston chambers, a rotary piston at the junction of said chambers, said chambers being eccentric to the piston and each provided with an inlet port and an exhaust port, the inlet ports being

located at diametrically opposite sides of the piston and equal distances from their respective exhaust ports, self closing valves for said ports, means for opening said valves, trailing wings hinged to the piston one in advance of the other, means for moving the trailing ends of the wings toward and from the piston as the latter is rotated and igniting devices located at points in the cylinder where the wings approach nearest to the piston.

9. In a rotary internal combustion engine, a rotary piston, wings hinged to the piston, a cylinder inclosing the piston and provided with merging piston chambers eccentric to said piston, each chamber being provided with an inlet port and an exhaust port, self-closing valves for said ports, the inlet ports being located at diametrically opposite sides of the piston and equal distances from the respective exhaust ports, means for opening said valves, spark plugs located in proximity to the inlet ports, and means for moving the trailing ends of the wings toward the piston as said wings approach the spark plugs.

10. In a rotary internal combustion engine, a rotary piston, a cylinder having opposite piston chambers eccentric to the piston and each provided with an inlet port and an exhaust port, self-closing valves for said ports, trailer wings hinged to the piston, means for moving the trailing ends of the wings toward and from the piston as the latter is rotated, igniting devices located at points in the cylinder where the wings are moved nearest to the piston, means for opening the exhaust valves while the wings are passing the exhaust ports, and additional means for opening the inlet valves just after the wings have passed the exhaust ports.

11. In a rotary internal combustion engine, a rotary piston, wings hinged to the piston one in advance of the other, a cylinder inclosing the piston and wings and provided with merging piston chambers eccentric to said piston, each chamber having an inlet port and an exhaust port, self closing valves for said ports, means for opening the exhaust valves while the wings are passing the exhaust ports only, and additional means for opening the inlet valves for a short interval just after the wings have passed the exhaust ports.

12. In a rotary internal combustion engine, a rotary piston, wings hinged to the piston one in advance of the other, a cylinder inclosing the piston and wings and provided with merging piston chambers eccentric to the piston, each chamber having an inlet port and an exhaust port, spark plugs in the cylinder at diametrically opposite sides of the piston and at the junction of the merging chambers, self-closing valves for said ports, means for moving the wings toward the piston as they approach the spark plugs and also for moving the wings away from the piston as they approach the exhaust ports, and means for opening the inlet valves and exhaust valves at regular predetermined intervals.

In witness whereof I have hereunto set my hand this 23d day of April 1908.

FRANK FLEMING.

Witnesses:

H. E. CHASE,

CAROLINE MCCORMACK.