May 10, 1927.

J. A. LEHNERT

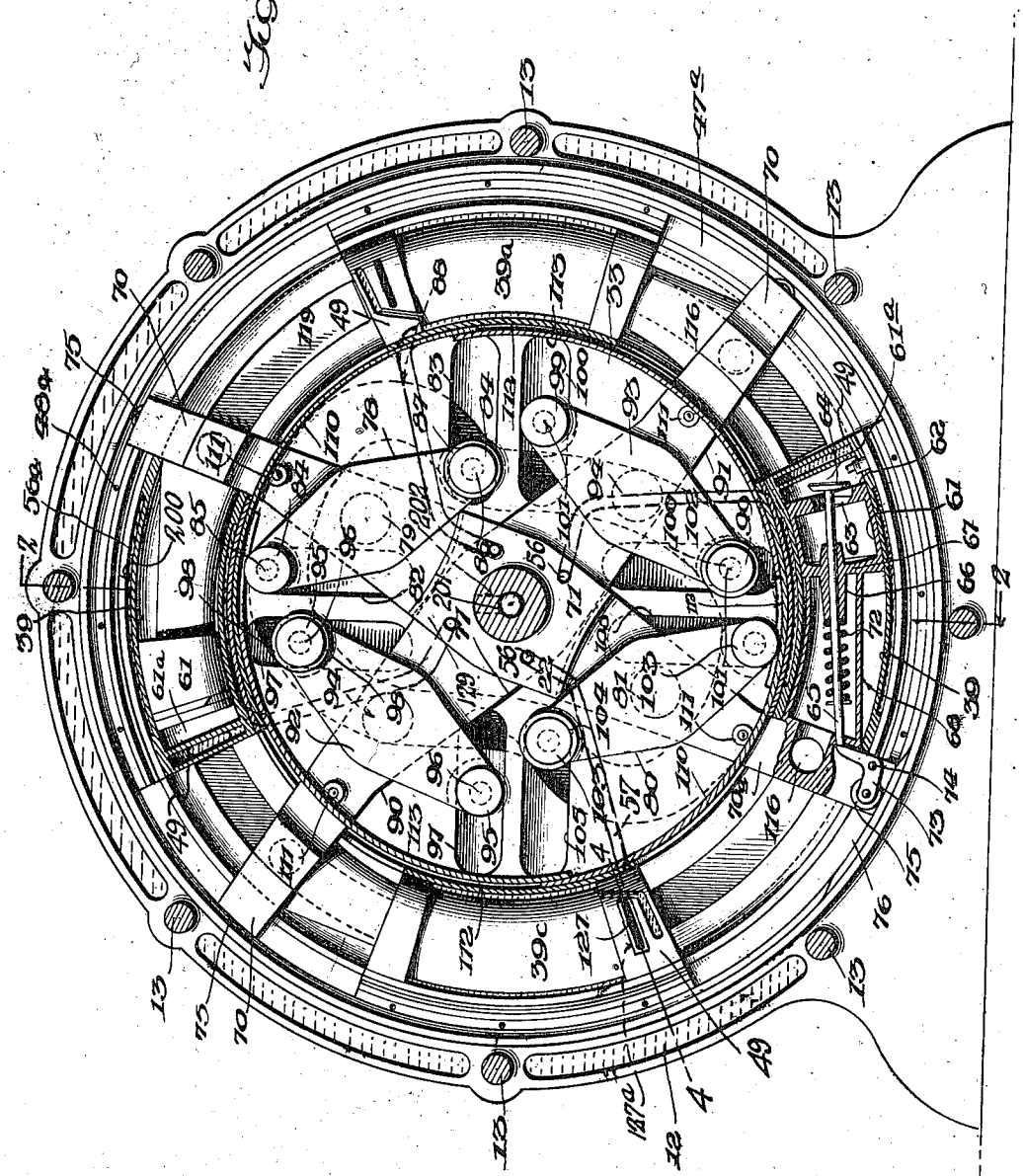
1,628,162

ROTARY ENGINE

Filed March 26, 1925

3 Sheets-Sheet 1

Fig. 1.



WITNESSES

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ROTARY ENGINE

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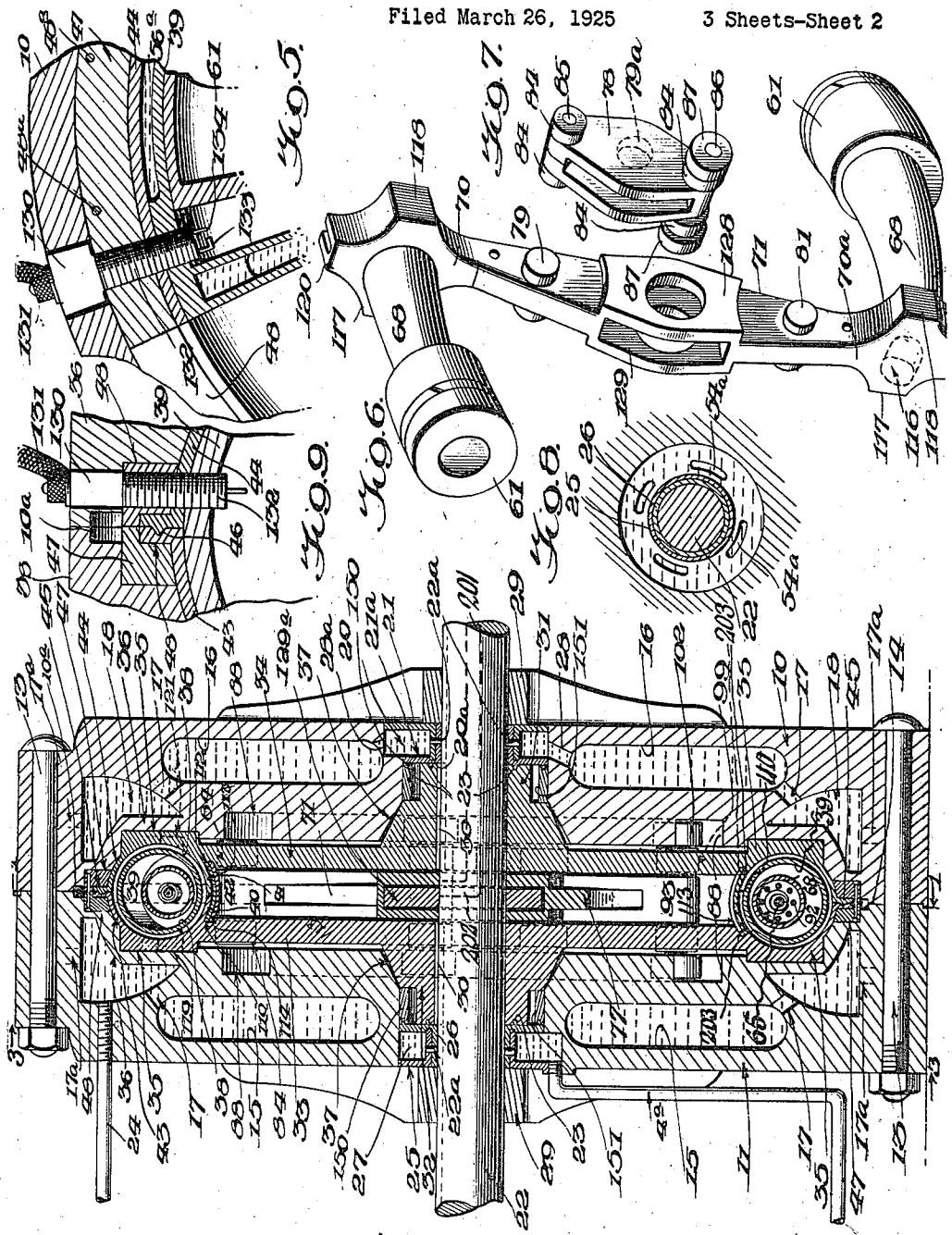


Fig. 2.

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3 Sheets-Sheet 3

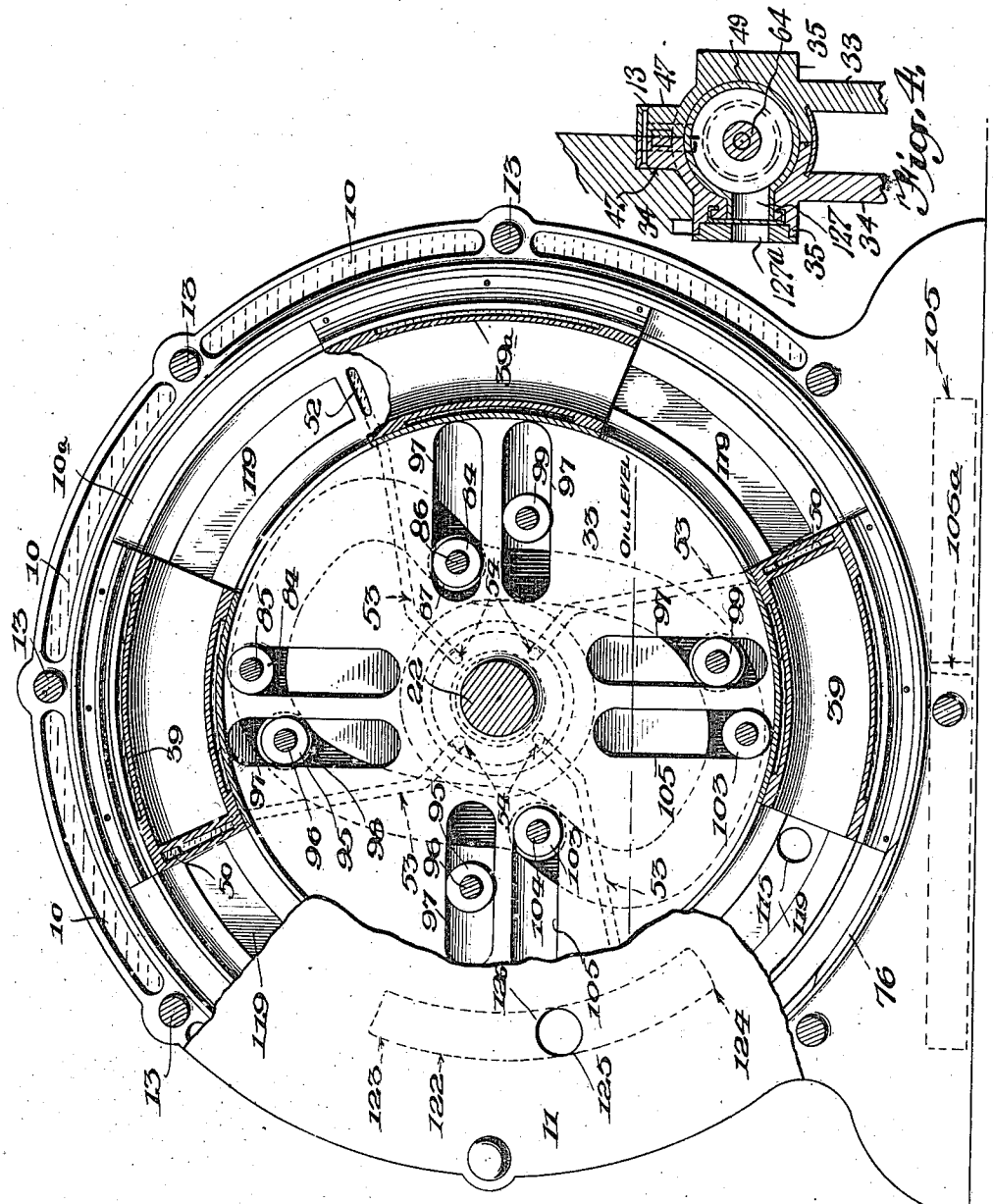


Fig. 3.

Fig. 4.

WITNESSES

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Patented May 10, 1927. 1,628,162

UNITED STATES PATENT OFFICE.

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ROTARY ENGINE.

Application filed March 26, 1925. Serial No. 18,603.

This invention relates to rotary engines and has for its object the provision of a device which includes a plurality of arcuately shaped cylinders contained in the rotor which are operated through oscillating arms, the arms in turn being controlled by oscillating levers carrying rollers that move in cam tracks.

A further object of the invention is the provision of a rotary motor in which the rotor is driven by pistons mounted in arcuately shaped cylinders with the reciprocation of the pistons being controlled by the cam arrangement actuated cooperatively through cam tracks carried by both the stator and the rotor.

This invention will be best understood from a consideration of the following detailed description, in view of the accompanying drawing forming a part of the specification; nevertheless it is to be understood that the invention is not confined to the disclosure, being susceptible of such changes and modifications which shall define no material departure from the salient features of the invention as expressed in the appended claims.

In the drawings:

Figure 1 is a longitudinal vertical section of the rotary engine taken along the line 1—1 of Figure 2.

Figure 2 is a transverse vertical section taken along the line 2—2 of Figure 1.

Figure 3 is a longitudinal vertical section taken along the line 3—3 of Figure 2.

Figure 4 is a section taken along the line 4—4 of Figure 1.

Figure 5 is a vertical section showing the detail of the cylinder and piston, and the arrangement of the spark plug.

Figure 6 is a view in perspective of a rocker bar and the associated pistons.

Figure 7 is a view in perspective of oscillating guide arms pivoted on the rocker bars.

Figure 8 is a transverse vertical section through the chamber which supplies cooling water.

Figure 9 is an enlarged detail section taken at right angles to the section shown in Figure 5 and disclosing a spark plug of each cylinder.

Referring more particularly to the drawings, 10 and 11 designate the two sections of the housing of the motor and which comprises a stator. These sections are provided adjacent their peripheries with spaced alining chambers 12 of water jackets and the sections are secured together by means of bolts 13. The inner abutting edges of the housing, as shown at 14, have a tongue and groove formation in order that the sections may be fitted water-tight and gaskets may be applied to the interfitting edges as is well known. Each section of the shell has incorporated therein a chamber 15 or 16 which encircles the section of the housing and which is in communication, by means of passages 17, with an annular chamber 18. The chamber 18 is in communication with the chambers 12 through passages 17^a while the chamber 16 is in communication with an annular chamber 20 in a pair of complementary interfitting rings 21 and 21^a. The rings are L-shaped in cross section and ring 21^a is provided with a groove 20^a into which is received the periphery of one of the circular flanges of ring 21. The portion of the hub 31 adjacent the ring 21^a is provided with a socket adapted to receive pins 23 formed on the ring 21^a for locking said ring to the hub. Pins 22^a are passed through perforations in the cooperating rings 21 and 21^a for locking said rings together whereby the rings will be revolved with said hub and shaft 22.

The upper portion of the chamber 18 is connected with a pipe 24 which in turn is in communication with a radiator (not shown). The complementary formed rings 25 and 26 form an annular chamber 27 which is in communication with an intake pipe 24^a, leading from a source of water under pressure such as a pump (not shown) and driven by the engine. These ring sections are similar to the ring sections 21 and 21^a and are secured together and to a hub section 32 by the respective pins 22^a and 23.

The shaft 22 is mounted in bearings 29 carried by the sections 10 and 11 of the housing. Keyed to the shaft 22 as shown at 30 are the pair of spaced hubs 31 and 32. The hub 32 is formed integrally with a plate 33 of the rotor while hub 31 is formed integrally with a plate 34. The plates are so spaced from each other at the center of the rotor that a chamber is provided for a purpose which will be presently explained. Each plate 33 or 34 at its periphery is formed with a lateral annular rib 35 adapted to be seated within a correspondingly formed annular groove in the portions 36

of the housings 10 and 11, the portions 36 being located within the chamber 18 of the cooling system.

It will also be noted that the portion of the sections 10 and 11 of the housing is cut away as shown at 37 complementary to the outer curved wall of the bosses 31 and 32 so that the bosses will be neatly received by such sections 10 and 11 of the housing. The ribs 35 of the plates 33 and 34 are provided with semi-cylindrical and arcuately shaped passages 38 in which are fitted at spaced intervals arcuately shaped cylinders 39. The bottom of the passage 38 is formed by inward extensions 40 and 41, from the respective plates 33 and 34 the meeting edges of such extensions having a tongue and groove formation as shown at 42 to seal the bottom of the passage. The upper portion of the groove is likewise formed by inturned arcuately shaped extensions 43 and 44 provided with annular ribs 45 having a tongue and groove formation as shown at 46 for sealing the plates 33 and 34 adjacent their peripheries. The ribs are received within a groove 47^a in the sections of a split ring 47 which is riveted or bolted together as shown. The split ring 47 is received within annular cooperating grooves 48 formed in the portions 36 of the sections 10 and 11 of the housing and extend entirely around the housing and revolve in said tracl or groove 48. The portions of the ring 47 between the cylinder is provided with a slot 148. An annular track 10^a formed in the housing or cooperating sections 10 and 11 of said housing is located outwardly from groove 48 and is for a purpose to be presently described.

When the rotor is revolved the ribs 35 and the ring 47 will ride in their respective grooves in which they are incorporated in the sections of the housing.

Each of the cylinders 39, 39^a, 39^b and 39^c is provided with a head 49 in which is included a water jacket 50 having an opening 51 adapted to register with a port as shown at 52 in Figure 3. This port is connected with a substantially radial passage 53 formed in the plate 33 of the rotor and which connects with a passage 54 shown in dotted lines in Figures 2 and 3 located within the hub 32. This passage is alined with an elongated arcuately shaped slot 54^a formed in the ring 26 as shown in Figure 8. It will be noted that four of these slots are provided which connect with the four substantially radial passages in the plate 33 which lead to the four cylinder heads of the rotor.

The ports 56 at the end of passages 57 in the plate 34 of the rotor and shown in dotted lines in Figure 1 is adapted to provide a discharge for the water which passes through the heads and surrounds the engine cylinders, providing a water jacket as shown at 56^a. It will be noted that the cylinder at this point is provided with an annular groove 200 for spacing the cylinder wall from the walls of the ribs 35 to form the jacket in order that the portions of the cylinder which are subjected to the heat of combustion may be properly cooled. The passages 57 which are four in number, extend towards the center of the plate adjacent the shaft 22 and through passages in the rings 21^a connect with chamber 20 in rings 21 and 21^a. Passages 28 and 28^a connect the chamber 20 with the annular cooling chamber 16. The warm water is discharged through pipe 24. The construction of the rings 21 and 21^a and the passages 57 and the ports 56 in the ring 21^a is similar in all respects to the ring and port construction at the opposite side of the stator of the engine.

Mounted for reciprocation in each cylinder is a piston 61 having a head 62 in which is mounted a port and valve seat 63 for a reciprocating valve 64. The valve 64 is carried by a stem 65 mounted in a guide 66, which is carried by a spider 67 formed integrally with the piston 61. The piston 61 is provided with the usual piston rings and is arcuately shaped to conform to the curvature of the engine cylinder. The piston is provided with a hollow connecting rod 68 which is secured to the spider 67 and has its outer end rigidly connected to one end 70 of an oscillating bar 71. A spring 72 embracing the stem 65 is secured to said stem at one end and has its other end in engagement with the bearing 66 in order to maintain the valve 64 on its seat 63 in the head 62 except when the valve is forced upwardly by means of a dog 73 pivotally mounted at 74 in the bifurcated end of the oscillating bar 71 which carries a roller 75 adapted to engage a cam portion 76 carried by the section of the housing of the stator.

The oscillating bar 71 is loosely mounted on the shaft 72 as is a bar 77. The arm 70 of the oscillating bar 71 is provided with a pair of rock levers 78 pivoted on pins 79 formed on opposite sides of the bar. The arm 70^a of the oscillating bar is likewise provided with a pair of rock levers 80 pivoted on pins 81 formed on opposite sides of said arm. Recesses 79^a are provided in said levers to receive the pins. A pair of slots 82 and 83 disposed at right angles to each other and formed in each of the rotor plates 33 and 34 are adapted to receive rollers 84 carried by the ends of the said rock levers. These rollers are mounted on pins 85 and 86 carried by rock levers 78. A pair of rollers 87 mounted on the outer ends of the pins 86 are adapted to be received by cam guides generally designated by the numeral 88. These guides are formed within the sections 10 and 11 of the housing of the engine. The

arms 90 and 91 of the oscillating bar 77 has at either end a pair of rock levers 92 or 93 pivoted as shown at 94 upon the opposite sides of said arms. The rock levers 92 are provided with a pair of rollers 95 mounted upon a pin 96 carried by one end of the lever 92 and adapted to be received within elongated slots or guides 97 formed in the side plates 33 and 34 of the rotor.

The one end of the levers 92 are also provided with a pair of rollers 98 mounted for rotation on a pin 96 and received within the cam groove 88. The rock levers 93 have rollers 99 riding in their respective slots 100. These slots are disposed at right angles to the slots 97 and are likewise formed in the plates 33 and 34. The pins 101 on which a pair of the rollers 99 are mounted are sufficiently extended and provided with rollers 102 which are received within the continuous cam slot 88 formed in the sections of the housing. The lever 80 is provided with similarly positioned rollers 103 and 104 for riding in the respective slots 105 with the larger rollers 104 riding in the groove 88.

The interior of the rotor is supplied with a definite quantity of lubricating oil which is splashed by the revolution of the rotor and which finds its way in all the movable parts of the engine and which maintains the same properly lubricated. The oil is forced into the central chamber by a pump (not shown) and is returned to a chamber 105 through a passage 105^a.

In order to limit the quantity of lubricating oil carried by the cylinders 39, 39^a, 39^b and 39^c I provide a shield for each cylinder and in which a shield 110 is connected as shown at 111 to the arm 70 or 70^a of the oscillating bar 71 and rides in an arcuately shaped track as shown at 112. As the arm 70 oscillates back and forth said shield is reciprocated and is adapted to substantially maintain the space between the cylinders 39 and 39^a closed. The cylinders 39^a and 39^c are each provided with a shield 113 which rides in a groove 114 which has a shorter radius than groove 112. One of these shields is likewise pivotally mounted as at 111 to either arm 90 or 91 of the oscillating bar 77. The shields 113 are reciprocated in close contact with either of the shields 110 during rocking of the respective arms. It will be noted that the side edges of the respective shields are each mounted in grooves 203 as has been described, the grooves being formed in both of the rotor plates 33 and 34. the shields being curved to conform to the curvature of the members 40 and 41 of the respective plates 33 and 34 as shown in Figure 2.

The cylinders are supplied with a combustible mixture through an opening 115 formed in the section 11 of the housing adjacent the lower end of the rotor. This opening or port is adapted to be connected to a conduit that is extended to the usual carbureter and upon the intake stroke of a piston 61 the gases are drawn into the hollow connecting rod 68 past the spider 67 through the port 63 and into the combustion chamber 61^a of each of the cylinders when they pass said opening.

A passage 116 in each end of an arm of the bars 71 and 77 which is in communication with the hollow connecting rod 68 is adapted to aline with the port 115 in the housing. The passage 116 is formed in a lateral extension 117 provided upon the outer end of both of the arms 70 and 70^a of the oscillating bar 71. A diametrically disposed extension 118 is located opposite the extension 117 and these extensions are adapted to ride in grooves formed in the ribs 35 of the plates 33 and 34, the extension 117 riding in the groove 119 in the plate 33 while the extension 118 rides in a groove 121 in plate 34. The outer end of said arms, as shown at 120, is adapted to ride in the groove 10^a located between the sections of the housings 10 and 11 and at those points between the sections of the rings 47 where said rings are cut away to form slots 47^a between adjacent cylinders. The groove 119 in the plate 33 is deeper than the groove 121 in the plate 34 and extends substantially through the rib 35 at this point while the groove 121 is located entirely within the rib 35 of the plate 34.

An elongated slot 122 is formed in the section 11 of the housing and decreases in depth from an end 123 to the end of the arc which is shown at 124, with an opening 125 intermediate the end of the slot 122 which is adapted to be connected in any approved manner with an exhaust pipe.

An opening 127^a in the plate 34 alines with the opening 127 through which the exhaust gases pass and when the opening in the plate alines with the opening 125 in the section 10 of the housing the gases are exhausted throughout the length of the arcuately shaped grooves 122.

As shown more particularly in Figure 6 the oscillating bar 71 is enlarged at its central portion, as shown at 128 having an elongated opening as shown at 129 to receive the hub 129^a of the oscillating bar 77. It will be seen that the bar 77 oscillates within the slot 129 of the oscillating bar 71.

The contact 130 is removably mounted in a passage formed in the section 10 of the housing and is connected to a wire 131 from the usual ignition system of an engine. This contact, as is shown in Figure 5, is insulated from the housing. The contact is adapted to engage the outer end of an electrode mounted in a spark plug 132. This spark plug is threaded and adapted to be screwed into threaded openings passing

through the split ring 46, the arcuately shaped member 44 of the plate 34 and through a wall of an engine cylinder 39. The electrode which passes through the spark plug and is adapted to engage at one end with the contact member 130 has an electrode 133 at its inner end projecting into the cylinder and spaced from a point 134 which is grounded on the metal of the engine.

The operation of my device is as follows: The crank shaft 22 is revolved in the usual manner either by a crank or by an electric motor for the purpose thereby causing revolution of the rotor which is included within the plates 33 and 34. The engine cylinders are carried around through a circular track by said rotor plates and the oscillating bars 71 and 77 are periodically rotated through predetermined arcs as the pistons 61 are moved or reciprocated in their respective engine cylinders.

As a cylinder 39^b reaches the position shown in Figure 1 the roller 75 carried by the arm 70^a of the oscillating bar 71 engages the cam member 76 thereby rocking the lever 73 which acts upon the stem 55 of the valve 64 against the tension of the spring 72 and moves said valve inwardly and away from its seat 63 so that the hollow connecting rod 68 places the passage 116 in the arm 70^a in communication with the combustion chamber 61 and since at this time the arm 70^a is held stationary by the position of the rock levers 80 the cylinder 39^b will be carried forwardly by the rotor plates 33 and 34 and withdraws the piston 61 from the cylinder thus creating the suction stroke and causing a combustible mixture to be drawn into the combustion chamber 61^a.

The cylinder 39^a containing a charge of combustible mixture is moving along the compression stroke when the piston within said cylinder is being forced inwardly by the rock levers 93 and compressing the combustible mixture which reaches the maximum compression at a point in the travel as shown by the position of the cylinder 39. At this point the respective spark plugs of the various cylinders engage the contact 130 and ignite the compressed fuel. At the explosion the reaction of the expanding gases tends to force the piston 61 in cylinder 39 upon a backward stroke but as shown in Figure 1 the rock levers 78 are maintained substantially stationary through the position of the various rollers at its opposite ends in their respective slots thereby holding the arm 70 stationary. Since the piston 61 cannot be reversed in its movement the rotor plates and likewise the cylinder 39 are moved forwardly until the cylinder has moved to its outward limit of stroke whence the cylinder and piston and arm 70 will simultaneously be moved forwardly in their paths. The cylinder 39^c is shown as having reached the exhaust position and is now disclosed as having partially completed such a stroke. All of the cylinders begin to exhaust at the point designated by the numeral 123 in Figure 3 and terminate such stroke at the point designated by the numeral 124. The exhaust port 125 is shown as located in the housing 11 at a point intermediate the ends of the complete exhaust stroke so that the exhaust must pass or move in a direction which is from the points designated by the numerals 123 and 124 towards the port 125. When each of the cylinders again reach the position shown by cylinder 39^b in Figure 1 the suction stroke is had as has been explained. The combustible mixture, as will be noted, enters the hollow connecting rod 68 from passage 116 in the arm 70^a and which passage extends, as shown in Figure 6, through the lateral extension 117 which rides within the groove 119 formed at intervals in the ribs 35 of the rotor 33. The section 11 of the housing also has an opening or port 115 alining with the passage 116. The exhaust passes out from the cylinders through the passages 127 formed in the cylinders and through the passages 127^a formed in the rib 35 of the plate 34 whence it enters the slot 122.

The various strokes of each of the pistons of the engine are controlled by the two rocker bars 71 and 77 and the various rock levers and their rollers which are carried by said rock levers and these oscillating bars and rock levers are in turn controlled by the movements of the various rollers in the straight grooves in the rotor plates and the cam grooves in the sections of the housing. The small rollers 84 move in the respective straight slots 82 and 83 and therefore control the rocking movement of the levers 78. The speed at which the levers are rocked is controlled by the movement of the large rollers 87 in the cam grooves 88 and the cam grooves and the straight grooves are so coordinated that they will tend to lock the oscillating arms against movement at different points in the rotation of the rotor plates 33 and 34 while permitting the rotor plates 33 and 34 to continue in their revolution, the speed of the revolution being constant. This effect is shown more clearly in Figure 1 and in which the rock levers 78 maintain the oscillating bars 71 against movement through the respective rollers carried at its opposite ends. The rollers 84 in the straight slots 82 are substantially at the upper limit of the upper ends of said slots while rollers 84 are at the inner ends of the slot 83, with the large rollers 87 at a point in the cam tracks 88 where the cam track decidedly changes its direction to form a bend in the track. The rollers 87 being engaged by the point at this bend aid in locking the

rock levers 78 against movement. The rock levers 80 are similarly held against movement to cause the suction stroke in cylinder 39[b]. Rock levers 92 and 93 are moving in their cooperative paths as directed by their rollers and compound tracks so that cylinder 39[c] is exhausting while cylinder 39[a] is compressing.

Bushings 150 are received within the passages 151 in the sections 10 and 11 of said housing and have their inner walls spaced from the respective hubs 31 and 32 of the rotor plates 33 and 34.

The outer edges of the bushing abut the respective rings 26 and 21[a].

What I claim is:

1. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates keyed to the shaft, said plates adjacent their peripheries being provided with circular grooves, cylinders mounted in a fixed spaced relation in the grooves and adapted to move with the rotor plates, pistons mounted in each cylinder, oscillating bars loosely mounted on the shaft, and means carried by the oscillating bars for controlling movement of the oscillating bars, said pistons being connected to the ends of said bars.

2. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates keyed to the shaft, said plates adjacent their peripheries being provided with circular grooves, cylinders mounted in a fixed spaced relation in the grooves and adapted to move with the rotor plates, pistons mounted in each cylinder, oscillating bars loosely mounted on the shaft, means on the oscillating bars and means in the plates and housing and cooperating with the means on the bars for causing oscillation of the bars and pistons independently of the rotary movement of the rotor plates.

3. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates keyed to the shaft, said plates adjacent their peripheries being provided with circular grooves, cylinders mounted in a fixed spaced relation in the grooves and adapted to move with the rotor plates, pistons mounted in each cylinder, oscillating bars loosely mounted on the shaft, rock levers pivoted on the oscillating bars, and means in the plates and housing cooperating to cause oscillation of the bars and pistons.

4. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates keyed to the shaft, said plates adjacent their peripheries being provided with circular grooves, cylinders mounted in a fixed spaced relation in the grooves and adapted to move with the rotor plates, pistons mounted in each cylinder, oscillating bars loosely mounted on the shaft, rock levers pivoted on the oscillating bars, and means in the plates and housing cooperating to cause oscillation of the bars and pistons, and means included in the last mentioned means for causing the pistons and bars to remain stationary during certain periods of each revolution of the rotor plates.

5. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates keyed to the shaft, said plates adjacent their peripheries being provided with circular grooves, cylinders mounted in a fixed spaced relation in the grooves and adapted to move with the rotor plates, pistons mounted in each cylinder, oscillating bars loosely mounted on the shaft, rock levers on the oscillating bars and provided with rollers, said plates being provided with slots adapted to receive certain of the rollers, and means on the housing adapted to engage the other rollers, and cooperating with the slots and rollers for causing oscillation of said bars and reciprocation of said pistons.

6. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates keyed to the shaft, said plates adjacent their peripheries being provided with circular grooves, cylinders mounted in a fixed spaced relation in the grooves, and adapted to move with the rotor plates, pistons mounted in each cylinder, oscillating bars loosely mounted on the shaft, rock levers on the oscillating bars and provided with rollers, said plates being provided with slots adapted to receive certain of the rollers, means on the housing adapted to engage the other rollers, and cooperating with the slots and rollers for causing oscillation of said bars and reciprocation of said pistons, and means included in the last mentioned means for causing the pistons and bars to remain stationary during certain periods of each revolution of the rotor plates.

7. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates keyed to the shaft, said plates adjacent their peripheries being provided with circular grooves, cylinders mounted in a fixed spaced relation in the grooves and adapted to move with the rotor plates, pistons mounted in each cylinder, oscillating bars loosely mounted on the shaft, rock levers on the oscillating bars and provided with rollers, said plates being provided with slots adapted to receive certain of the rollers, said housing being provided with cam grooves adapted to receive the other rollers, and cooperating with the slots and rollers for causing oscillation of said bars and reciprocation of the pistons.

8. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates keyed to the shaft, said plates adjacent their peripheries being

provided with circular grooves, cylinders mounted in a fixed spaced relation in the grooves and adapted to move with the rotor plates, pistons mounted in each cylinder, oscillating bars loosely mounted on the shaft, rock levers on the oscillating bars and provided with rollers, said plates being provided with slots adapted to receive certain of the rollers, said housing being provided with cam grooves adapted to receive the other rollers and cooperating with the slots and rollers for causing oscillation of said bars and reciprocation of the pistons, said cam grooves having offset portions adapted to retain the oscillating bars and pistons at rest for periods during each revolution of said plates.

9. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates keyed to the shaft, said plates adjacent their peripheries being provided with circular grooves, cylinders mounted in a fixed spaced relation in the grooves and adapted to move with the rotor plates, pistons mounted in each cylinder, oscillating bars loosely mounted on the shaft, rock levers on the oscillating bars and provided with rollers, said plates being provided with slots adapted to receive certain of the rollers, said housing being provided with cam grooves adapted to receive the other rollers and cooperating with the slots and rollers for causing oscillation of said bars and reciprocation of the pistons, said cam grooves having offset portions adapted to retain the oscillating bars and pistons at rest for periods during each revolution of said plates, one of the bars being oscillated while the other bar remains stationary, said pistons being carried around with the plates in a continuous revolution.

10. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates keyed to the shaft, said plates adjacent their peripheries being provided with circular grooves, cylinders mounted in a fixed spaced relation in the grooves and adapted to move with the rotor plates, pistons mounted in each cylinder, oscillating bars loosely mounted on the shaft, rock levers on the oscillating bars and provided with rollers, said plates being provided with slots adapted to receive certain of the rollers, said housing being provided with cam grooves adapted to receive the other rollers and cooperating with the slots and rollers for causing oscillation of said bars and reciprocation of the pistons, said cam grooves having offset portions adapted to retain the oscillating bars and pistons at rest during the intake and expansion strokes.

11. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates keyed to the shaft, said plates adjacent their peripheries being provided with circular grooves, cylinders mounted in a fixed spaced relation in the grooves and adapted to move with the rotor plates, pistons mounted in each cylinder, oscillating bars loosely mounted on the shaft, rock levers on the oscillating bars and provided with rollers, said plates being provided with slots adapted to receive certain of the rollers, said housing being provided with cam grooves adapted to receive the other rollers and cooperating with the slots and rollers for causing oscillation of said bars and reciprocation of the pistons, said cam grooves having offset portions adapted to retain the oscillating bars and pistons at rest during the intake and expansion strokes, hollow rods connecting the pistons with the oscillating bars.

12. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates keyed to the shaft, said plates adjacent their peripheries being provided with circular grooves, cylinders mounted in a fixed spaced relation in the grooves and adapted to move with the rotor plates, pistons mounted in each cylinder, oscillating bars loosely mounted on the shaft, and means carried by the oscillating bars for controlling movement of the oscillating bars, a hollow rod connecting a piston with an end of an oscillating bar, the ends of each bar having a passage opening into the hollow rod, a passage in one of the plates adjacent each cylinder adapted to register at times with the passage in an arm and an intake passage in the housing adapted to register with the openings in the plate.

13. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates keyed to the shaft, said plates adjacent their peripheries being provided with circular grooves, cylinders mounted in a fixed spaced relation in the grooves and adapted to move with the rotor plates, pistons mounted in each cylinder, oscillating bars loosely mounted on the shaft, and means carried by the oscillating bars for controlling movement of the oscillating bars, said pistons being connected to the ends of said bars, each cylinder having an exhaust port, one of the plates having a plurality of exhaust ports, a port in the plate alining with a port in said cylinder, the housing having an exhaust port adapted to be alined with the exhaust ports in the cylinders and plate.

14. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates keyed to the shaft, said plates adjacent their peripheries being provided with circular grooves, cylinders mounted in a fixed spaced relation in the grooves and adapted to move with the rotor plates, pistons mounted in each cylinder, oscillating bars loosely mounted on the shatf,

and means carried by the oscillating bars for controlling movement of the oscillating bars, said pistons being connected to the ends of said bars, each cylinder having an exhaust port, one of the plates having a plurality of exhaust ports, a port in the plate alining with a port in said cylinder, the housing having an exhaust port adapted to be alined with the exhaust ports in the cylinders and plate, the housing being provided with a groove decreasing in depth from end to end, the exhaust port in the housing being located midway between the ends of said groove.

15. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates keyed to the shaft, said plates adjacent their peripheries being provided with circular grooves, cylinders mounted in a fixed spaced relation in the grooves and adapted to move with the rotor plates, pistons mounted in each cylinder, oscillating bars loosely mounted on the shaft, and means carried by the oscillating bars for controlling movement of the oscillating bars, said pistons being connected to the ends of said bars, the opposite sides of the bars adjacent each end being provided with lateral ribs, the rotor plates being provided with arcuately shaped grooves to receive the ribs.

16. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates keyed to the shaft, said plates adjacent their peripheries being provided with circular grooves, cylinders mounted in a fixed spaced relation in the grooves and adapted to move with the rotor plates, pistons mounted in each cylinder, oscillating bars loosely mounted on the shaft, and means carried by the oscillating bars for controlling movement of the oscillating bars, said pistons being connected to the ends of said bars, the opposite sides of the bars adjacent each end being provided with lateral ribs, the rotor plates being provided with arcuately shaped grooves to receive the ribs, said plates being provided with annular ribs adjacent the grooves in the plates, said housing being provided with grooves adapted to receive the ribs on the plates.

17. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates keyed to the shaft, said plates adjacent their peripheries being provided with circular grooves, cylinders mounted in a fixed spaced relation in the grooves and adapted to move with the rotor plates, pistons mounted in each cylinder, oscillating bars loosely mounted on the shaft, and means carried by the oscillating bars for controlling movement of the oscillating bars, said pistons being connected to the ends of said bars, an arcuately shaped shield connected to each end of the oscillating bar and oscillatable in close association with each cylinder for closing the space between each pair of the cylinders.

18. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates keyed to the shaft, said plates adjacent their peripheries being provided with circular grooves, cylinders mounted in a fixed spaced relation in the grooves and adapted to move with the rotor plates, pistons mounted in each cylinder, oscillating bars loosely mounted on the shaft, and means carried by the oscillating bars for controlling movement of the oscillating bars, said pistons being connected to the ends of said bars, an arcuately shaped shield connected to each end of the oscillating bar and oscillatable in close association with each cylinder for closing the space between each pair of the cylinders, said plates being provided with grooves to receive the edges of the shields.

19. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates keyed to the shaft, said plates adjacent their peripheries being provided with circular grooves, cylinders mounted in a fixed spaced relation in the grooves and adapted to move with the rotor plates, pistons mounted in each cylinder, oscillating bars loosely mounted on the shaft, and means carried by the oscillating bars for controlling movement of the oscillating bars, a hollow rod connecting a piston with an end of an oscillating bar, the ends of each bar having a passage opening into the hollow rod, a passage in one of the plates adjacent each cylinder adapted to register at times with the passage in an arm and an intake passage in the housing adapted to register with the openings in the plate, the piston being provided with an intake port, a valve for closing said port, and carried by a stem, means for operating the stem to open position for the valve at a predetermined point in the revolution of the rotor plates.

20. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates keyed to the shaft, said plates adjacent their peripheries being provided with circular grooves, cylinders mounted in a fixed spaced relation in the grooves and adapted to move with the rotor plates, pistons mounted in each cylinder, oscillating bars loosely mounted on the shaft, and means carried by the oscillating bars for controlling movement of the oscillating bars, a hollow rod connecting a piston with an end of an oscillating bar, the ends of each bar having a passage opening into the hollow rod, a passage in one of the plates adjacent each cylinder adapted to register at times with the passage in an arm and an intake passage in the housing adapted to register with the openings in the plate, the piston being provided with an intake port,

a valve for closing said port and carried by a stem, a bell crank lever pivoted in each end of the oscillating bars and having and arm normally in engagement with the valve stem, the housing having an annular track adapted to receive the other arm of the bell crank lever, and a cam in the track adapted to engage and rock the bell crank lever to open the valve during the intake stroke.

21. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates keyed to the shaft, said plates adjacent their peripheries being provided with circular grooves, cylinders mounted in a fixed spaced relation in the grooves and adapted to move with the rotor plates, pistons mounted in each cylinder, oscillating bars loosely mounted on the shaft, and means carried by the oscillating bars for controlling movement of the oscillating bars, said pistons being connected to the ends of said bars, said rotor plates at their peripheries being provided with cooperating flanges, a ring having a groove to receive the flanges, means for clamping the ring to said flanges, said flanges being cut away between each pair of cylinders and the ring being provided with slots at these points, the free ends of the oscillating bars being movable in the slots in the ring.

22. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates keyed to the shaft, said plates adjacent their peripheries being provided with circular grooves, cylinders mounted in a fixed spaced relation in the grooves and adapted to move with the rotor plates, pistons mounted in each cylinder oscillating bars loosely mounted on the shaft, and means carried by the oscillating bars for controlling movement of the oscillating bars, said pistons being connected to the ends of said bars, said rotor plates at their peripheries being provided with cooperating flanges, a ring having a groove to receive the flanges, means for clamping the ring to said flanges, said flanges being cut away between each pair of cylinders and the ring being provided with slots at these points, the free ends of the oscillating bars being movable in the slots in the ring, said rings being clamped to the rotor plates and revolved therewith, the oscillating bars having periodic oscillating movement in the direction of the rotation of said plates, a bell crank lever pivotally mounted in each end of the oscillating bar, an annular groove provided in the housing, the outer end of each bell crank lever being provided with a roller riding in the groove, a cam in the groove in the housing adapted to be engaged by the roller for oscillating the bell crank lever, and an intake valve carried by a piston adapted to be operated by the oscillating bell crank lever.

23. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates keyed to the shaft, said plates adjacent their peripheries being provided with circular grooves, cylinders mounted in a fixed spaced relation in the grooves and adapted to move with the rotor plates, pistons mounted in each cylinder, oscillating bars loosely mounted on the shaft, and means carried by the oscillating bars for controlling movement of the oscillating bars, said pistons being connected to the ends of said bars, one of the oscillating bars being provided with a slot through which is inserted the other bar, with said bars having relative movements with respect to each other.

24. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates keyed to the shaft, the housing being provided with annular grooves, each plate adjacent its periphery being provided with a rib movable in the groove, cylinders mounted in the plates, oscillating bars loosely mounted on the shaft, a piston in each cylinder with the pistons connected to the ends of oscillating bars, the end of each bar being provided with a lateral passage, an intake port in the housing, the passages in the ends of the oscillating bars being adapted to aline with the intake port in the housing, a conduit connecting each of the cylinders with the passages in the ends of the oscillating bars, and elongated passages in one of the rotor plates alining with the passage in the end of the bar and adapted to periodically aline with the intake port in the housing.

25. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates keyed to the shaft, the housing being provided with annular grooves, each plate adjacent its periphery being provided with a rib movable in the groove, cylinders mounted in the plates, oscillating bars loosely mounted on the shaft, a piston in each cylinder with the pistons connected to the ends of oscillating bars, the end of each bar being provided with a lateral passage, an intake port in the housing, the passages in the ends of the oscillating bars being adapted to aline with the intake port in the housing, a conduit connecting each of the cylinders with the passages in the ends of the oscillating bars, and elongated passages in one of the rotor plates alining with the passages in the end of the bar and adapted to periodically aline with the intake port in the housing, and means for controlling the flow of the combustible mixture through the conduit connecting the cylinders with a passage in the ends of the oscillating bars.

26. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced co-

operating rotor plates keyed to the shaft, said plates adjacent their peripheries being provided with circular grooves, cylinders mounted in a fixed spaced relation in the grooves and adapted to move with the rotor plates, pistons mounted in each cylinder, oscillating bars loosely mounted on the shaft, means on the oscillating bars and means in the plates and housings and cooperating with the means on the bars for causing intermittent angular rotation of the bars independently of the rotary movement of the rotor plates.

27. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates provided with hubs keyed to the shaft, cylinders mounted in fixed spaced relation in the grooves and adapted to be spaced for a portion of their length from the rotor plates to form a water jacket, passages provided in the plates and hubs, a ring on the shaft adjacent each hub providing an annular chamber, the passages in the hub and plates connecting the annular chamber in the rings with the water jacket embracing the cylinders.

28. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates provided with hubs keyed to the shaft, cylinders mounted in fixed spaced relation in the grooves and adapted to be spaced for a portion of their length from the rotor plates to form a water jacket, passages provided in the plates and hubs, a ring on the shaft adjacent each hub providing an annular chamber, the passages in the hub and plates connecting the annular chamber in the rings with the water jacket embracing the cylinders, the housing being provided with annular chambers forming water jackets connected together, one of said chambers in the housing being connected with a ring, a source of water supply connected with the other ring.

29. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates provided with hubs keyed to the shaft, cylinders mounted in fixed spaced relation in the grooves and adapted to be spaced for a portion of their length from the rotor plates to form a water jacket, passages provided in the plates and hubs, a ring on the shaft adjacent each hub providing an annular chamber, the passages in the hub and plates connecting the annular chamber in the rings with the water jacket embracing the cylinders, the head of each cylinder being provided with a chamber forming a water jacket, and passages connecting the water jacket in the head with the water jacket embracing the cylinder.

30. In a rotary internal combustion engine, a housing, a shaft, a pair of spaced cooperating rotor plates provided with hubs keyed to the shaft, cylinders mounted in fixed spaced relation in the grooves and adapted to be spaced for a portion of their length from the rotor plates to form a water jacket, passages provided in the plates and hubs, a ring on the shaft adjacent each hub providing an annular chamber, the passages in the hub and plates connecting the annular chamber in the rings with the water jacket embracing the cylinders, the housing adjacent its periphery being provided with a pair of annular chambers forming water jackets adjacent the peripheries of the rotor plates where the cylinders are mounted in said plates.

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