A. M. WOLF.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED JUNE 13, 1910.

1,067,090.

Patented July 8, 1913.

3 SHEETS—SHEET 1.

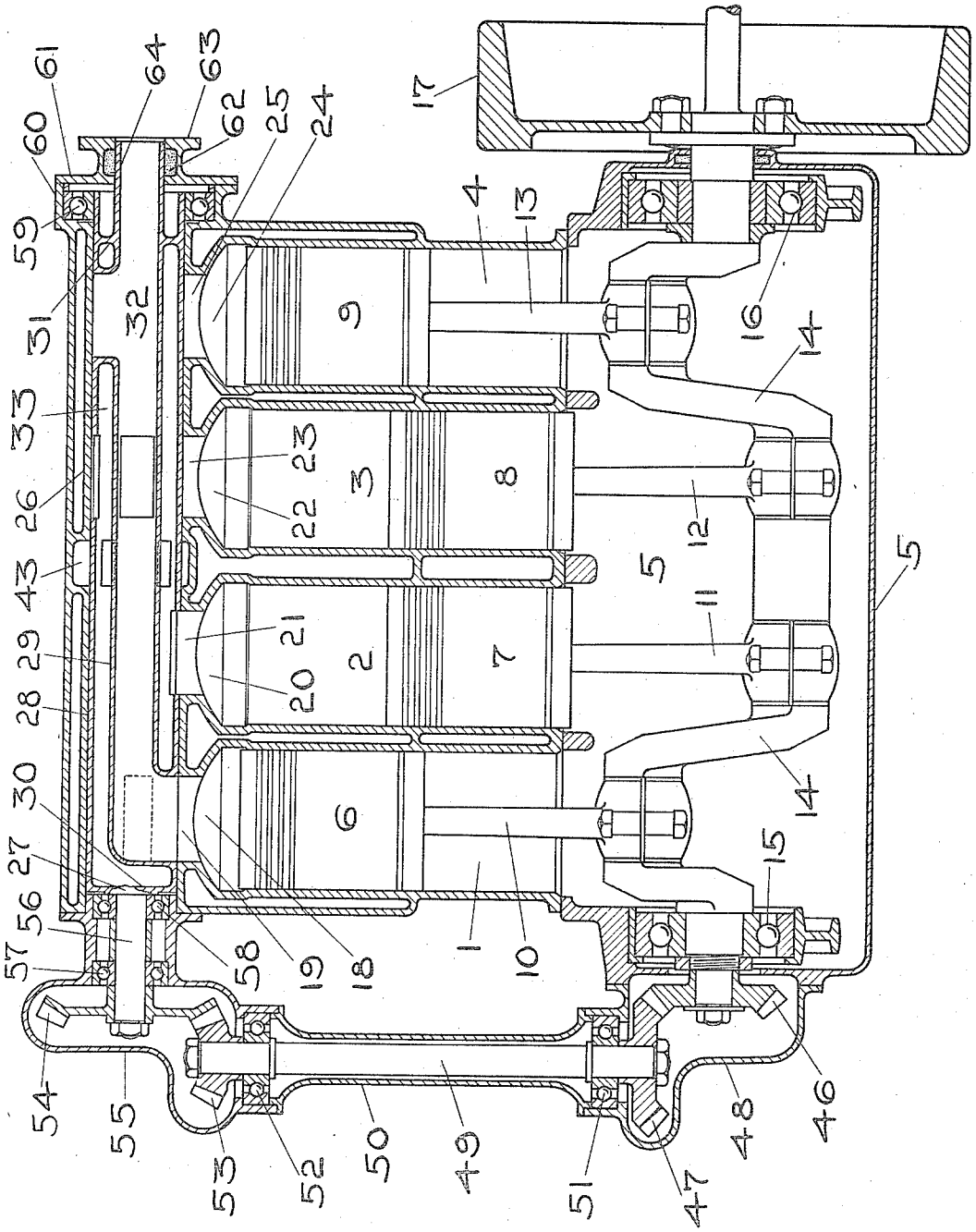


Fig. 1.

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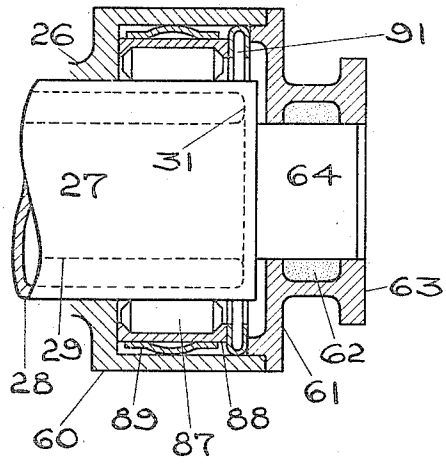


FIG. 17.

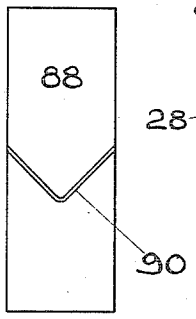


FIG. 18.

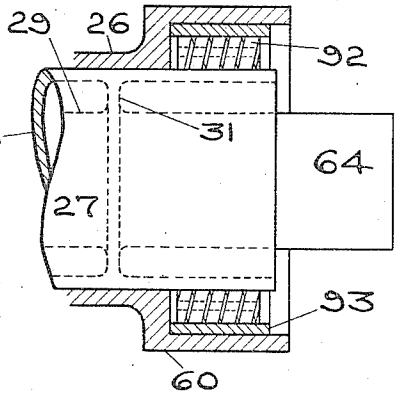


FIG. 19.

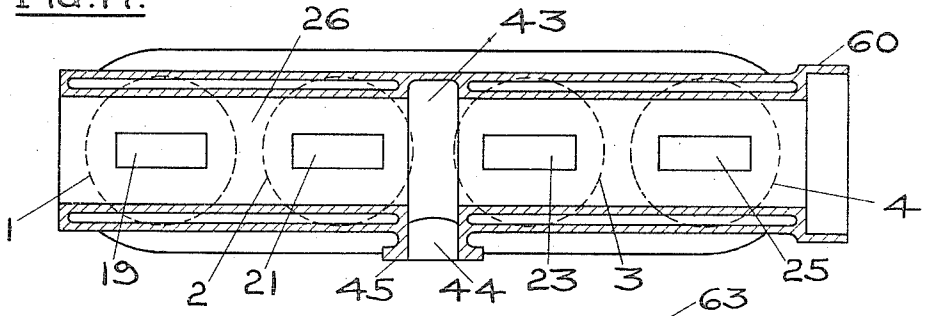


FIG. 20.

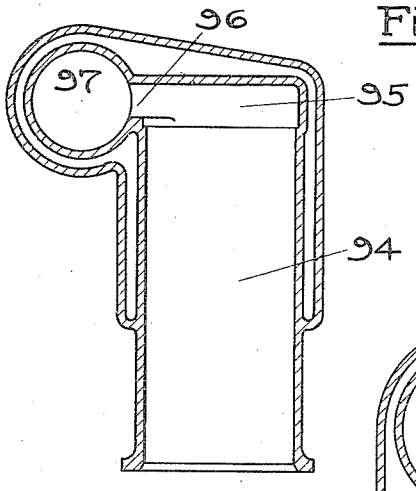


FIG. 2.

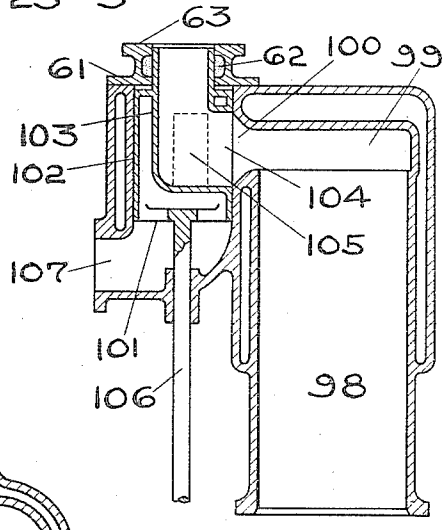


FIG. 3.

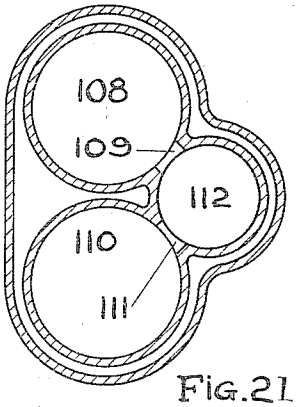


FIG. 21.

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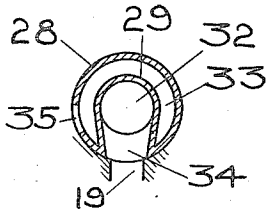


FIG. 5.

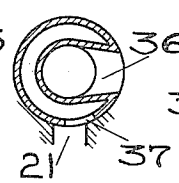


FIG. 6.

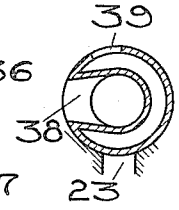


FIG. 7.

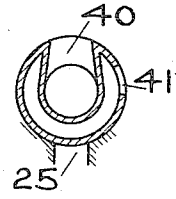


FIG. 8.

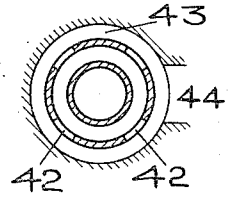


FIG. 9.

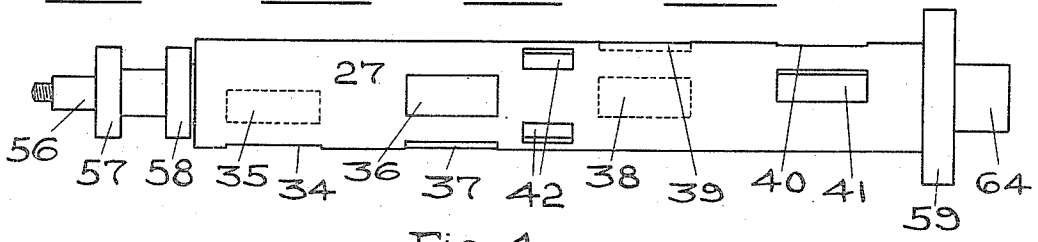


FIG. 4.

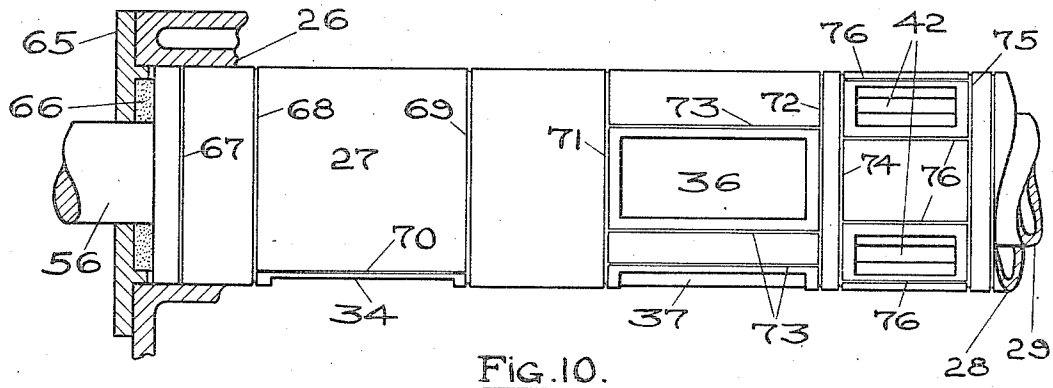


FIG. 10.

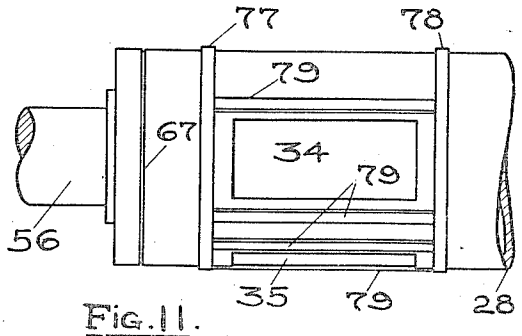


FIG. 11.

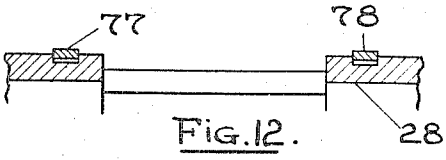


FIG. 12.

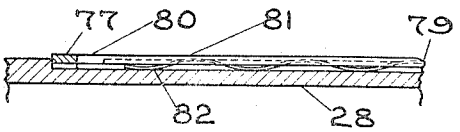


FIG. 13.

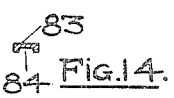


FIG. 14.

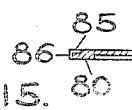


FIG. 15.

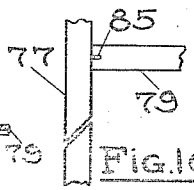


FIG. 16.

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UNITED STATES PATENT OFFICE.

AUSTIN M. WOLF, OF NEW YORK, N. Y.

INTERNAL-COMBUSTION ENGINE.

1,067,090. Specification of Letters Patent. Patented July 8, 1913.

Application filed June 13, 1910. Serial No. 566,597.

To all whom it may concern:

Be it known that I, AUSTIN M. WOLF, a citizen of the United States, residing at New York, in the borough of Manhattan, county of New York, and State of New York, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

My invention relates to internal combustion engines employing rotary valves, and its object is to produce an engine having a simple and efficient valve mechanism, of economical construction, compact, and noiseless in operation. These and other features of my invention will be more fully set forth with reference to the accompanying drawings forming a part of this specification, in which—

Figure 1 is a vertical section of my improved engine. Figs. 2 and 3 show alternative locations of the rotary valve. Fig. 4 is an elevattion of the rotary valve; Figs. 5, 6, 7, 8 and 9 are sections through the ports of the valve; Figs. 10, 11, 12, 13, 14, 15 and 16 are views showing means for packing the valve and preventing leakage; Figs. 17, 18 and 19 show means for mounting the rotary valve; Fig. 20 is a horizontal section through the valve casing; and Fig. 21 shows a modified form of construction.

In Fig. 1, it will be seen that the cylinders 1, 2, 3 and 4 are secured to the crank case 5. The pistons 6, 7, 8 and 9 reciprocate within the above mentioned cylinders and are attached to the crank shaft 14 by means of the connecting rods 10, 11, 12 and 13. Crank shaft 14 turns in bearings 15 and 16; to its rear extremity is secured the flywheel 17. In cylinder 1, above the combustion chamber 18, lies the cylinder port 19. In cylinder 2, the port 21, is located above the combustion chamber 20. In cylinders 3 and 4, the combustion chamber 22 communicates with the port 23 and the combustion chamber 24 connects with port 25. Within the casing 26 lies the rotary valve 27. The latter consists essentially of two passageways traveling the length of the valve. This is accomplished by means of an outer wall 28 surrounding an inner wall 29. Thus the passageways 32 and 33 are formed. A wall 30 closes the forward end of passageway 33, while a wall 31 closes the rear end of the passageway. Not only does the valve contain the passageways but it also acts as a distributing valve, as will be explained later. It is to be understood that the valve location need not be confined to that shown in Fig. 1; namely, directly over a cylinder or with its axis in a horizontal position. Fig. 2 shows how the valve casing can be offset from the center of the cylinder and Fig. 3 shows the valve in a vertical position.

As in Fig. 4, on the outer wall 28 of the rotary valve 27, are to be seen openings or ports. There are two ports for each cylinder, one appearing after the other as the valve rotates. These openings register in succession with the cylinder ports. One of the openings communicates with the inner passageway and one with the outer passageway. Thus in Fig. 5, a section through the valve ports for cylinder 1 is shown. The wall 29 incloses the passageway 32 and the latter communicates with the port 34 at the surface of the valve. The port 35, in wall 28, opens into the passageway 33. The cylinder port 19 is indicated below the valve. The valve ports for cylinder 2 are shown in Fig. 6. Ports 36 and 37 register with cylinder port 21 as the valve rotates. In Fig. 7, the valve ports 38 and 39 register with cylinder port 23; similarly in Fig. 8, valve ports 40 and 41 register with the cylinder port 25.

The engine is of the four cycle type. It is the duty of the rotary valve 27 to supply each of the cylinders with combustible gas on the suction stroke, to seal the cylinders on compression and explosion strokes, and finally to rid the cylinders of the spent gases after they have expended their energy in driving the pistons. It is the passageway 32 into which the exhaust gases pass from the cylinders. Thus the ports 34, 36, 38 and 40 are the exhaust ports of the rotary valve. These ports are seen as openings on the surface of the valve; they communicate with the inner passageway by means of four inclosing walls surrounding the port opening. The passageway 33 contains the combustible fuel which is drawn into the cylinders on the suction stroke through the inlet ports 35, 37, 39 and 41. These inlet ports, it will be seen, are merely openings in the wall 28. As the suction stroke follows the explosion stroke, the valve (in Figs. 5, 6, 7 and 8) will rotate counterclockwise. In this way each exhaust port registers with its cylinder port; after which the inlet port registers with the cylinder port. After this the wall 28 extends for almost 250° without interruption. During

this interval the compression and explosion strokes take place. During one revolution of the rotary valve, each cylinder can exhaust the exploded gas, and draw in a new charge. Then come the compression and explosion strokes. As this takes two revolutions of the crank shaft, the rotary valve must be driven at half the crank shaft speed. The outer passageway 33 could be made the exhaust passageway if desired and the inner passageway 32 the fuel supply passageway. In either case, there being a single separating wall between them, the incoming gas passing through the fuel supply passageway will cool the exhaust passageway, while the latter will warm the passing fuel. In case of the use of a carbureter for supplying the fuel, the warming of the incoming charge will aid in the complete vaporization of the liquid hydro-carbon particles in the mixture, forming a homogeneous and well carbureted gas. By placing the fuel supply or inlet passageway outside of the exhaust passageway, the former insulates the latter from the valve casing 26, which would not be the case if the exhaust gases traveled in the outer passageway and the latter was in contact with the casing 26. By inclosing the exhaust gases within one circular wall, the minimum area of surface is presented and this wall is not in contact with the valve casing 26.

In Fig. 9, which is a section through the fuel supply ports 42 of Fig. 4, is shown the supply passageway 44 which communicates with the annular passageway 43. Fig. 1 shows passageway 43 midway between cylinders 2 and 3. The ports 42, distributed about the circumference of the valve, allow the outer passageway 33 to be in continual communication with the source of supply. The flange 45 (Figs. 1 and 3) allows the attachment of a supply pipe, be it from a suction producer, carbureter or other supply. Assuming that the succession of firing in the four cylinders is in the order 1, 3, 4, 2, and as each of these strokes are 180° apart on the crankshaft circle, then each exhaust port, and similarly each inlet port, must be 90° apart on the circumference of the valve and in the above named order of firing. So in Figs. 5 and 7, representing the valve ports for cylinders 1 and 3, the exhaust ports are 90° apart and so placed that, as the valve rotates counter-clockwise, the exhaust port 34 registers with the cylinder port 19 before the ports 38 and 23 register. Similarly the ports of cylinder 4 are 90° beyond those of cylinder 3. And those of cylinder 2 are 90° beyond the ports of cylinder 4. In Fig. 1 the exhaust stroke of cylinder 1 has been completed and cylinder 2 has drawn in a new charge of fuel.

The means for driving the rotary valve at half the crank shaft speed, can be one of numerous ways. Bevel gears, worm gears, chain and sprockets or other transmitting mechanism could be utilized. Fig. 1 illustrates the use of bevel gears. On the forward end of the crank shaft is secured the bevel gear 46. The latter meshes with the bevel gear 47 which is on the lower end of the vertical shaft 49. The shaft 49 is inclosed within the tubular member 50 and rotates in bearings 51 and 52. The case 48 incloses the gears 46 and 47 and a similar case 55, at the upper end of the tubular member 50, houses gears 53 and 54. The former is secured to the upper end of shaft 49 and the latter is secured to the shaft 56, which is an extension of the rotary valve 27. The drawing shows the two to one reduction by means of gears 53 and 54. Shaft 56 is supported by bearings 57 and 58, while the rear end of the rotary valve is supported by bearing 59. The latter is located within the housing 60. The inner wall 29 of the valve extends rearwardly beyond the outer wall 28, forming the extension 64. Surrounding the latter is the member 61—62—63. The flange 61 is secured to the housing 60 and it also holds the bearing 59 in place. The flange 63 allows an exhaust pipe, muffler, or similar apparatus to be attached to the engine to convey the exhaust gases off. The extension 64 is exhausting the spent gases as it rotates and the engine operates. This constitutes a rotating exhaust member discharging into a stationary receiving member. The packing 63 is capable of standing a high degree of heat and prevents the spent gas from leaking back around the extension 64 through the stationary receiving member.

The rotary valve can rotate within the casing 26 and the latter can serve as a bearing for the former. Or the valve can be made independent of the containing casing by the use of bearings which will keep the valve out of contact with the casing. The amount of clearance will be very small; a film of lubricating oil between the two will constitute a sealing member between them. Lubricant can be supplied to the rotary valve by means of oil leads from a lubricator, grease cups, or otherwise to the inside of the valve casing (not shown). As a means for providing efficient lubrication, especially if the containing casing is to act as a bearing for the valve, the grooves on the circumference of the valve as shown in Fig. 10, will aid in the distribution of lubricant and maintain a supply within themselves. The end cap 65 closes the bore of the valve casing 26. A washer 66 lies between the cap 65 and the valve 27. The circumferential groove 67 prevents the lubricant from escaping beyond the end of the valve. On each side of the ports for cylinder 1, are the grooves 68 and 69 while a groove 70, paral-

lel with the axis of the valve, extends between the grooves 68 and 69 on each side of each valve port. The exhaust port 34 is to be seen at the bottom. To each side of the second row of ports 36 and 37 are the grooves 71 and 72; while the horizontal grooves 73 lie to each side of each port. To each side of the supply ports 42 are the circumferential grooves 74 and 75. As there is an annular recess around the valve at these ports, the grooves 74 and 75 are located on the valve where it bears on or lies within the valve casing just away from the annular passageway 43. The grooves 76 lie between the grooves 74 and 75. With an uninterrupted annular passageway 43, there is no need for extending these grooves across from one circumferential groove to the other but just so far beyond the grooves as there extends the surface of the casing 26. The annular passageway could have a few narrow ribs (not shown), parallel with the axis of the valve, spaced at intervals around the circumference of and forming a continuation of the surface of the casing. In this case the grooves would extend across between the circumferential grooves. It is important to prevent leaking from an exhaust port to an inlet port, or vice versa. This becomes unnecessary with the ports 42 and therefore the number of oil grooves 76 extending all the way across needs not exceed the requirements of proper lubrication.

In Fig. 11, packing rings 77 and 78 and packing strips 79 are used to prevent leakage. The end retaining oil groove 67 is also used. When packing rings and strips are used, there is no need for packing strips between the fuel supply ports 42. Oil grooves are sufficient. The rings 77 and 78 (Fig. 12) have a set which tends to expand them. The packing strip 79 shown in Fig. 13 butts against a ring at each end and fits into a slot cut in the wall 28 parallel to the axis of the valve. The end 80 is solid, the inner or central portion 81 being recessed on the under side so as to accommodate the spring 82.

Fig. 14 shows the channel shaped section of the packing strip, where it houses the spring 82. The recess is represented at 84. The surface 83 is the bearing surface which comes in contact with the valve casing 26. A film of oil is likely to seal the joint formed by the packing ring and strip if the members of the joint are in close proximity. To insure the existence of a film of lubricant acting as a seal, in Figs. 15 and 16 a horizontal groove or cut 85 is provided. In Fig. 15, a vertical groove 86 is cut on the end of the packing strip 79, which is in communication with groove 85. These grooves are very small in size; their purpose is to collect and maintain a small quantity of lubricant at the surfaces where the packing ring and strip butt together. Thus a film of oil is kept at the joint and seals the same.

In Fig. 1, the rear end of the rotary valve is shown supported in the bearing 59. In case of an overheating of the valve, the outer wall 28 is liable to expand slightly and unless an allowance is made therefor, the bearing might stick. In Fig. 17, the valve 27 rotates in a special bearing located within the housing 60. The rollers 87 roll within the ring 88, which is split as shown in Fig. 18 by means of the slit 90. This will allow the ring to expand slightly and to still retain a circular raceway for the rollers 87. The ring 88 is mounted in the housing 60 by means of the flexible member 89. It consists essentially of a ring having a centrally arched portion, to each side of which are flat portions which support the ring 88. The highest portion of the arch, or that portion of the member 89 having the greatest diameter, is supported by the housing 60. The flexible member 89 is capable, at the proper pressure, of flattening out slightly when the ring 88 expands. The expansion of the latter occurs when it becomes heated; this expansion will be aided by the expansion of the outer wall 28 which is transmitted to the ring 88 by the rollers 87.

In Fig. 19, rollers 92 are mounted in a solid ring 93. But here the rollers constitute the flexible element. They consist of coiled strips of square section. The flexible bearings described are so made that they will not yield to a slight pressure exerted by the wall 28. Otherwise the pressure at each cylinder port during the compression and explosion strokes would tend to raise the valve upward. Only when a great pressure, due to the expansion of the various members of the bearing, occurs, then only will the bearing yield slightly. The stationary receiving member 61—62—63 is retained. If desired the forward end of the valve can be similarly supported. In Fig. 17 the retaining ring 91 holds the ring 88 in place. It is of U section and the spring action inherent in its design keeps the ring 88 constantly in place.

Fig. 20 shows the valve casing 26 and the rear housing 60. Cylinders 1, 2, 3 and 4 are shown in dotted lines. The fuel supply passageway 44, flange 45 and the annular passageway 43 are shown. The cylinder ports 19, 21, 23 and 25 bring the combustion chambers of the cylinders into communication with the casing 26.

Referring to Fig. 2 in detail, the cylinder 94 has the combustion chamber 95, which communicates through the port 96 with the casing 97. The position of the latter corresponds to the valve pocket in the L port type of engines having puppet valves.

This arrangement allows the rotary valve to be placed in a lower position and allows the inlet and exhaust manifolds to be placed lower.

Fig. 3 shows a cylinder 98 in which the combustion chamber 99 is kept in communication with a valve casing by means of port 100. A vertical rotary valve is employed. Passageway 107 is connected with the source of fuel supply. The inner wall 103 of the valve forms the exhaust passageway, while the outer wall 102 forms the inlet passageway, into which the fuel travels from passageway 107 through the open end 101. The vertical shaft 106 causes the valve to rotate. This vertical placing of the rotary valve allows two cylinders to be connected at the same time to the valve casing.

In Fig. 21, cylinders 108 and 110 communicate with the valve casing 112 through the ports 109 and 111. The latter are placed 98° apart with reference to the circumference of the rotary valve. This allows 180° difference between the cranks of the two cylinders.

It will be seen that parts and details of construction may be added, omitted, modified or substituted without departing from the spirit and scope of the invention.

What I claim is:

1. A rotary valve having an inner wall, an outer wall, inner, and outer passageways formed thereby, a bearing supporting said outer wall, and said inner wall extending unsupported beyond said outer wall.

2. A rotary valve having an inner wall, an outer wall, inner, and outer passageways formed thereby, said inner wall extending beyond said outer wall, said extension rotating within a stationary receiving member, and a packing between said extension and receiving member.

3. A rotary valve having a circumferential packing ring, a packing strip whose end abuts against said packing ring, and means for holding lubricant at the joint thus formed.

4. A rotary valve having a circumferential packing ring, a packing strip whose end abuts against said packing ring, and a groove for holding lubricant at the joint thus formed.

5. A rotary valve having a packing strip, a bearing surface on said strip, said strip having an end, and a groove on said bearing surface extending inwardly from said end.

6. A rotary valve having a packing strip, a packing ring, said strip having an end abutting against said packing ring, and a groove on said end for holding lubricant.

7. A rotary valve having an inner wall, an outer wall, a restricted bearing surface on said outer wall, and a space between said inner and outer walls at said bearing.

8. A rotary valve subject to heat, a valve casing for said valve, and a yieldable bearing for supporting said valve in said valve casing.

Whereunto I affix my signature in the presence of two subscribing witnesses.

AUSTIN M. WOLF.

Witnesses:

HENRY WOLF,

HAMILTON ACHILLE WOLF.