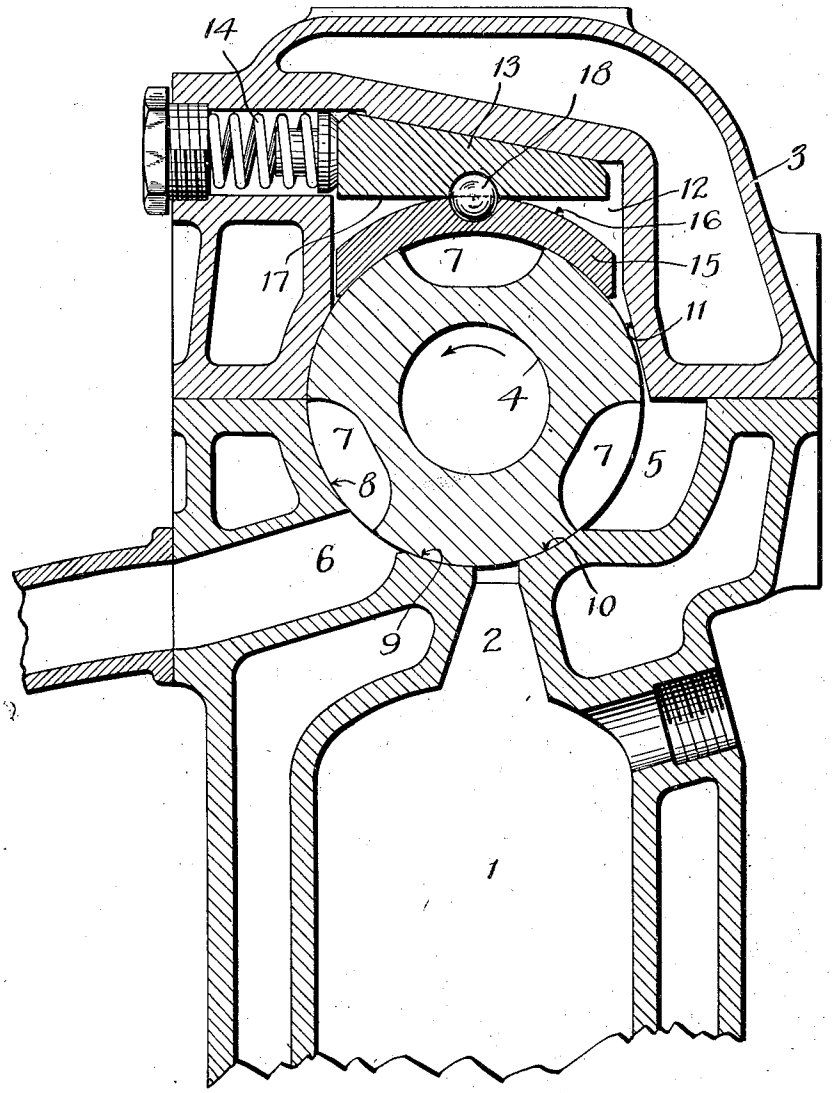
March 9, 1926. 1,576,082

E. M. BOURNONVILLE

ROTARY VALVE

Filed May 31, 1923 2 Sheets-Sheet 1

Fig. 1.



Eugene M. Bournonville INVENTOR

BY

ATTORNEY

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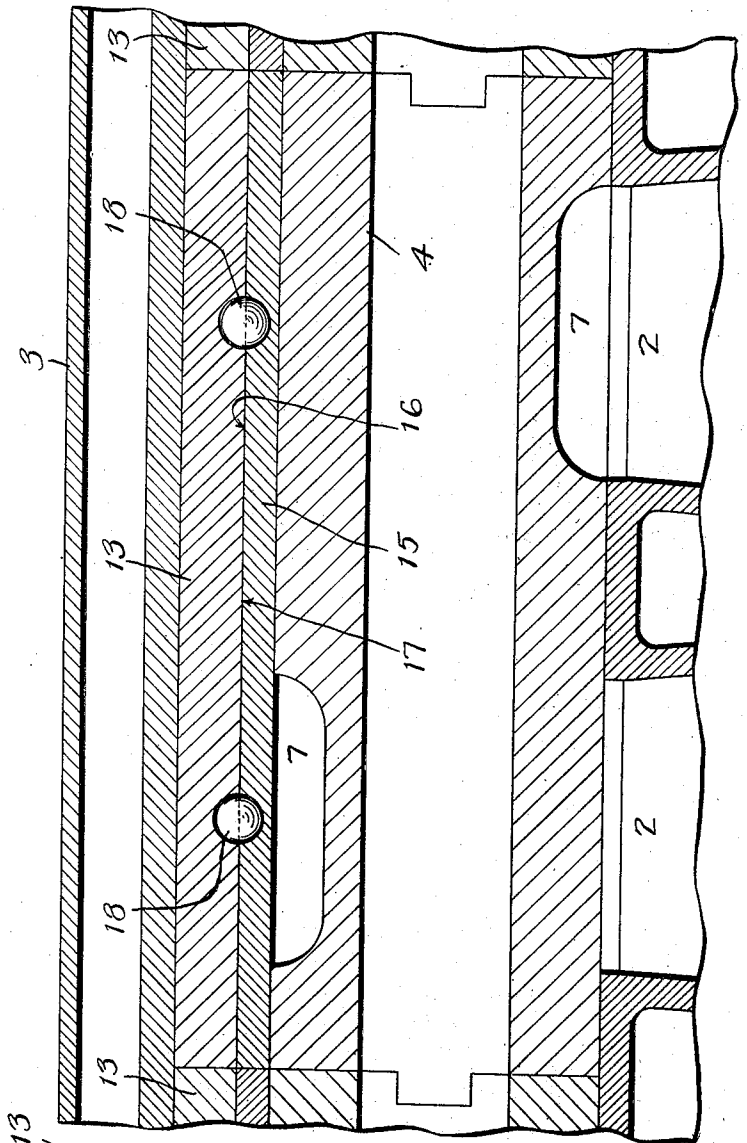

Fig. 2.

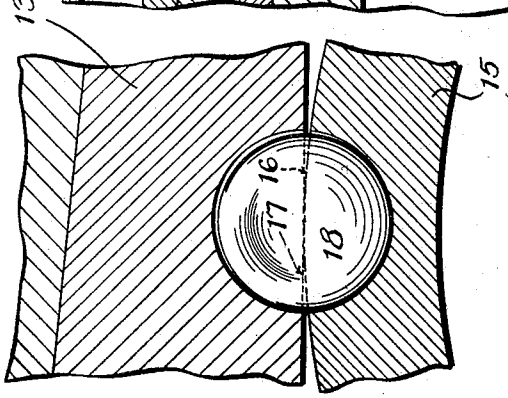

Fig. 3.

INVENTOR

Eugene M. Bournonville

BY

ATTORNEY

Patented Mar. 9, 1926. 1,576,082

UNITED STATES PATENT OFFICE.

EUGENE M. BOURNONVILLE, OF JERSEY CITY, NEW JERSEY.

ROTARY VALVE.

Application filed May 31, 1923. Serial No. 642,510.

To all whom it may concern:

Be it known that I, EUGENE M. BOURNONVILLE, a citizen of the United States, and a resident of Jersey City, in the county of Hudson and State of New Jersey, have invented a new and useful Rotary Valve, of which the following is a specification.

The invention relates to rotary valves for internal combustion engines, and is more particularly an improvement upon and within the Smith Patent 1,442,705 of January 16, 1923.

A special object of the present invention is to provide a simple and improved construction of the compensating device, whereby, particularly, the point of rocking support of the circumferentially movable shoe on the transversely movable wedge or backing member remains substantially stationary, as with reference to a center line, irrespective of the reciprocal movement of the shoe and wedge. This is accomplished in the present invention by providing the shoe with a substantially concentric curved back surface which bears and rocks rollingly upon the fact of the wedge or backing member, the members being connected for their reciprocal movement by a key or other suitable means accommodated to this action.

Another object is to secure a better and tighter seating of the valve member in the casing, with reference to the port portions. This involves a relation whereby the pressure created in the cylinder acts upon the valve member at one side of a center line passing through the center of the valve member and the point of rocking support of the shoe on the wedge, as will be hereinafter described.

In the accompanying drawings, forming part hereof:

Fig. 1 is a vertical section taken transversely of the valve and longitudinally of one of the cylinders of the engine;

Fig. 2 is a vertical longitudinal section through a portion of the valve of a multi-cylinder engine, of which the ports leading to two cylinders appear; and

Fig. 3 is a fragmentary section in the plane of Fig. 1, on an enlarged scale.

The invention is applicable to engines having any number of cylinders. One of the cylinders is marked 1 in Fig. 1, and its port 2. Two of these ports, indicating two cylinders, are seen in Fig. 2.

The water-cooled valve casing 3 extends longitudinally preferably over the tops of the row of cylinders and contains an incomplete cylindrical bore in which the valve member 4 turns always in the one direction indicated by the arrow.

On the one hand of each cylinder port is an intake port or manifold 5, connected with the carbureter; on the other hand is an exhaust port and passage 6; and the valve member is formed with pockets or ports 7 which connect the cylinder port with the exhaust port and then with the intake port, all as is familiar in rotary valves of this kind.

The interior of the casing is made with curved seat surfaces 8, 9, 10, forming parts of a circular bore, and located above the exhaust port, between the exhaust port and the cylinder port, and between the cylinder port and the intake port, respectively. Above the last the interior of the casing may be relieved as indicated at 11.

At the top, that is to say, in general at the opposite side from the cylinder port, the casing has a chamber 12 to accommodate a compensating device such as disclosed in the Smith patent aforesaid, and as improved herein. The top, or back, of this chamber is made as a wedge-way, sloping transversely of the valve, and slidable on this surface is a wedge or movable backing member 13, which is pressed contrary to the direction of rotation of the valve member by a spring or springs 14, the effect of which is transmitted to a circumferentially movable, rockable shoe 15, connected with the wedge. The cylindrical curved inner face of the shoe, which constitutes in effect a movable part of the casing, coacts with a considerable circumferential extent of the surface of the valve member, and is subject to the frictional drag thereof. As explained in the Smith patent, the action of the springs is such as to press the shoe against the valve member, and the latter to its seat in the valve chamber. As wear occurs, or in the event of a change in thermal conditions during running tending to make the valve member smaller or the casing larger, the wedge or slide moves to the right and the shoe moves with it in the sense of shifting circumferentially on the valve member thus taking up excess clearance. When the valve member heats up and expands, or the casing contracts, the increased drag of the valve member on the shoe moves the latter circumferentially to

the left, moving the wedge also to the left, against the action of the springs, thereby in effect increasing the diameter of the bearing in the casing and preventing binding. Thus, a balance of forces is maintained at all times, insuring a substantially constant best working clearance, avoiding leakage on the one hand and sticking on the other. Radial pressure on the valve member, from compression or explosion in the cylinder, is resisted solidly by the shoe, wedge and wedge-way, the angular relation being such that the springs always act to force the shoe inwardly toward the center of the valve, but are not called upon to withstand the direct radial counterpressure of the valve member, relief in case of tendency to bind being secured by virtue of the drag. The shoe is always free to rock on the backing member so as to accommodate itself truly to the governing valve member.

The particular improvement in the compensating device itself has to do with the manner of rockingly supporting the shoe on the backing member and connecting it therewith for their reciprocal, right and left, movement. In accordance with this improvement the back surface 16 of the shoe is curved concentrically with its face that bears upon the valve member, and this surface bears directly upon the flat under face 17 of the wedge. The shoe will thus rock by a rolling movement on the wedge. If it be considered that the wedge moves back and forth transversely of the valve and that the shoe is guided on the cylindrical valve member so as to oscillate about its axis, it will be seen that while different points on the back of the shoe bear at different times upon the wedge, the point, or longitudinal line, of contact does not shift in space. It results that in Fig. 1 there is a fixed center or radial line from the center of the valve to the point of rocking support of the shoe against the wedge, and a fixed angle between such line, or its perpendicular, and the sliding surface between the wedge and the wedge-way in the casing. This is advantageous, because a good working angle having been selected it will be preserved throughout the operation of the valve. In the Smith valve the point of support of the shoe against the wedge or slide shifts back and forth with the movement of the parts, the angle referred to consequently changing. In consequence, in that valve, as the parts shift in the direction of taking up wear or shrinkage of the valve member, it becomes more and more difficult for the drag of the valve member to slide the wedge back when necessary, and there will be a critical point or angle, which may be attained as the result of wear, beyond which the valve can not move the slide and the parts will lock. On the other hand, when the valve pushes back the wedge to compensate for expansion, the effect of the drag against the springs becomes greater the farther the parts move. In my valve what I may term the working angle of the drag of the valve transmitted through the shoe to the slide remains constant.

It is true that the actual range of movement in these compensating devices is very narrow, and the Smith valve if properly made, and until wear proceeds too far, is entirely operative. The present improvement, however, by virtue of the fixed working angle, insures the best operative condition at all times, and irrespective of the extent of wear, and is much less exacting to manufacture.

The connection between the shoe and wedge, so that the spring will cause them to move to the right, while increased frictional drag of the valve member on the shoe will cause them to move to the left, is effected by means of a key, or some equivalent device, whereby transverse effort to produce sliding is transmitted from one part to the other and vice-versa, the key, however, not taking the radial pressure. This may be accomplished in the very simple and desirable manner illustrated, in which there are complementary hemispherical recesses in the opposed, meeting portions of the shoe and wedge, receiving a loose ball 18, the latter, as more clearly seen in Fig. 3, being too small to take the radial thrust, which is always transmitted directly from the curved back 16 of the shoe to the face 17 of the wedge, whereon the shoe can rock without restraint by the key.

As shown in Fig. 2, there are preferably two, or more, of these keys, spaced longitudinally of the shoe and wedge. All movements are actually very slight, and it will be understood that the curvature 16 of the back of the shoe need be only a short arc, though it is simple to form the whole back of the shoe on the same curvature. It will also be apparent that the key need not be loose with respect to both members, and indeed I contemplate any equivalent arrangement whereby the shoe and wedge are operatively connected for reciprocal movement while bearing one upon the other in the manner set forth.

There may be one shoe and one wedge, or the shoes and wedges may be divided into any desirable number of sections lengthwise of the valve.

The other part of the invention relates to relations whereby the pressure from the cylinder acts upon the valve member at one side, or more at one side than the other, of the center line passing through the center of the valve and the point of support of the shoe against the wedge or backing. The side of this line at which the pressure acts is the side of the intake port, and this is ac-

complished in a simple manner by disposing the cylinder port 2 off center as shown in Fig. 1. The result of the upward and slightly lateral pressure of the gases on the valve member and the pressure downward of the compensating device is to tend to force the valve member downward and slightly toward the exhaust side. In this way a sufficient pressure of the valve member on its seat is exerted at the seat regions between the cylinder port 2 and the exhaust port 6 and at both sides of the latter, so that tendency of leakage from the exhaust to the cylinder direct, or to the cylinder by way of the chamber 12, is overcome. At the same time, sufficient tightness is secured between the cylinder port and the intake port 5. The rotation of the valve member in the direction shown by the arrow, together with the action of the compensating device, seems in itself to have a tendency to shift the valve member slightly to the right on its seat in the lower part of the valve casing, and this tendency is overcome by the offset action of the cylinder pressure. Experience has taught that where the ports at different sides of the valve casing are so arranged that the cylinder pressure acts centrally, or worse, is displaced toward the side of the exhaust, the valve swings toward the intake side of the casing. This not only permits leakage of the kind mentioned, which seriously impairs the operation of the invention, but causes the valve to bear upon diagonally opposite corners, namely the lower corner or edge of the intake port and the diagonally opposite corner edge of the chamber 12, with the result that cutting is produced at the latter corner. Furthermore, in such case, the valve member does not, as wear takes place, wear down in the casing so as to maintain either a good rotating journal bearing or a good seal, but the action of the valve is generally faulty. These conditions are rectified by shifting the cylinder port toward the intake port side, with reference to the center line through the center line of the valve and the point of rocking support of the shoe 15 on the backing member 13. Manifestly the same relation would be produced by shifting the compensating device toward the side of the intake port.

While the preferred embodiment of the invention has been described in detail, I wish it to be understood that I do not limit myself to the precise construction, since various changes in form and arrangement and various substitutions of equivalents may be made without departing from essentials. Terms of orientation employed in the specification are relative.

What I claim is:

1. A rotary valve of the kind described, having a casing and a rotary valve member, and a circumferentially movable shoe and a wedge or movable backing member, together constituting a compensating device acted on in one direction by the drag of the valve member and in the opposite direction by means opposing such drag characterized by the shoe having a back surface curved substantially concentrically with the face that bears on the valve member, so as to bear and rock in a rolling manner on the face of the backing member, there being means to connect the wedge and shoe in respect to their reciprocal movement.

2. In a rotary valve particularly for internal combustion engines, a compensating device of the kind described comprising a shoe member movable circumferentially of the rotary valve member, and a slidable backing member, the shoe having a back surface curved substantially concentrically with its inner face in order to bear rockingly upon the face of the backing member, together with a key connects the shoe and backing member for their reciprocal movement and which is free of the radial thrust.

3. In a rotary valve particularly for internal combustion engines, a compensating device of the kind described comprising a shoe member movable circumferentially of the rotary valve member, and a slidable backing member, the shoe having a back surface curved substantially concentrically with its inner face in order to rock in a rolling manner upon the face of the backing member, said backing member and shoe having complementary recesses, and a loose connector or key lying in said recesses.

4. In a rotary valve particularly for internal combustion engines, a compensating device of the kind described comprising a shoe member movable circumferentially of the rotary valve member, and a slidable backing member, the shoe having a back surface curved substantially concentrically with its inner face in order to rock in a rolling manner upon the face of the backing member, said backing member and shoe having complementary recesses, and a loose ball lying in said recesses.

5. In a rotary valve particularly for internal combustion engines, a compensating device of the kind described comprising a shoe member movable circumferentially of the rotary valve member, and a slidable backing member, the shoe having a back surface curved substantially concentrically with its inner face in order to rock in a rolling manner upon the face of the backing member, said backing member and shoe having complementary recesses, and a loose connector or key lying in said recesses, there being two or more of said loose keys spaced longitudinally of the members.

6. A rotary valve particularly for internal combustion engines comprising a casing having a cylinder port and intake and

exhaust ports on opposite hands, a rotary valve member disposed to turn in the casing, and a compensating device bearing upon the valve member at the opposite side from the cylinder port, characterized by the cylinder port being offset toward the intake port from the center line through the valve axis and the point of support against the compensating device.

7. In an internal combustion engine having a power cylinder, a rotary valve comprising a casing having a cylinder port and intake and exhaust ports on opposite hands, and a wedge-way at the opposite side from the cylinder port, a rotary valve member disposed to turn in the casing, a spring-pressed wedge movable on said wedge-way transversely with respect to the valve member, and a circumferentially movable shoe rockingly supported against the wedge and having connection therewith for reciprocal movement, the relations being such that pressure created in the cylinder acts upon the valve member at one side, namely the side of the intake port, of the center line passing through the center of the valve member and the point of support of the shoe on the wedge.

8. In a rotary valve, a compensating device of the kind described comprising a movable shoe and a movable spring-pressed wedge or backing member adapted to have reciprocal movement under the opposed forces of the spring pressure and the drag of the valve member, characterized by the shoe having a smooth back surface curved substantially concentrically with its inner face and bearing rockingly upon the flat face of the wedge.

9. In a rotary valve, a compensating device of the kind described comprising a movable shoe and a movable spring-pressed wedge or backing member connected to have reciprocal movement under the opposed forces of the spring pressure and the drag of the valve member, said shoe having its front and back faces curved on wide arcs, the front face to bear slidingly upon the valve member and the curved back face to bear rockingly upon the backing member.

EUGENE M. BOURNONVILLE.