July 2, 1929. J. GOOD 1,719,508

INTERNAL COMBUSTION ENGINE VALVE

Filed July 27, 1923

Fig. 1,

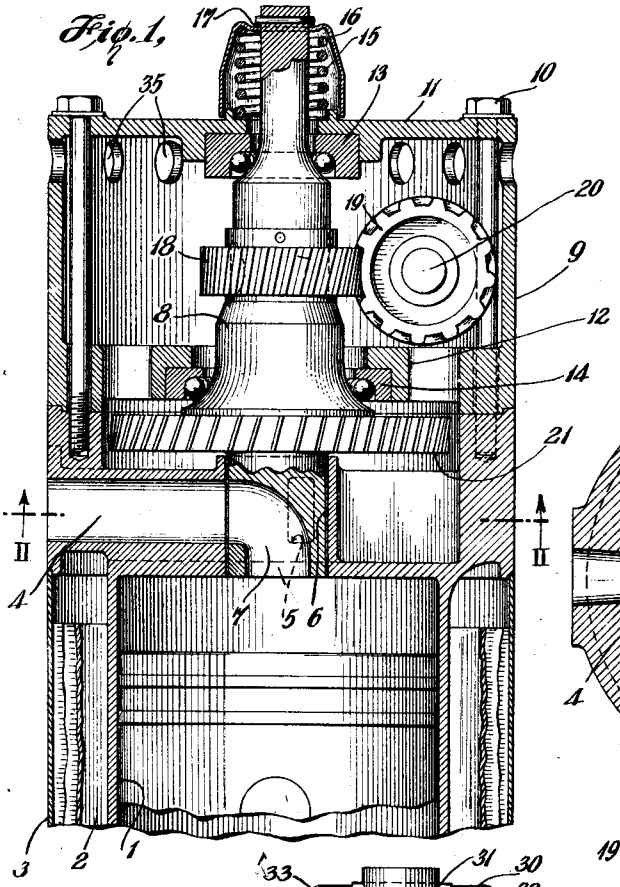


Fig. 2,

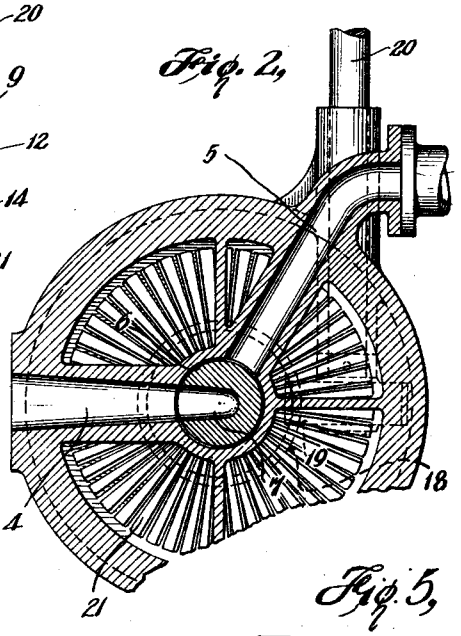


Fig. 5,

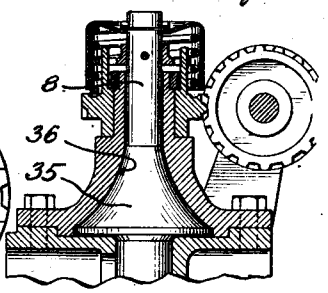


Fig. 3,

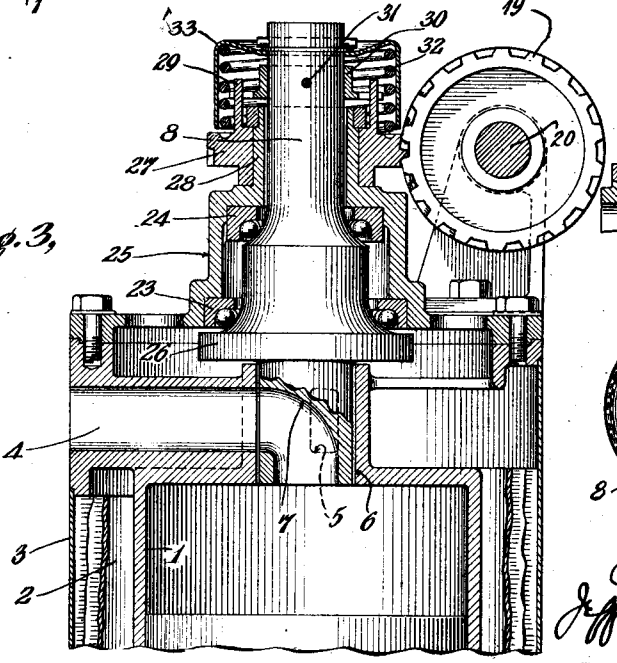
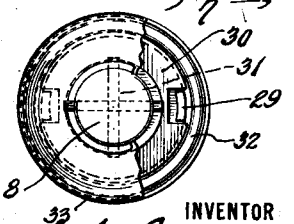


Fig. 4,



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Patented July 2, 1929. 1,719,508

UNITED STATES PATENT OFFICE.

JOHN GOOD, OF GARDEN CITY, NEW YORK, ASSIGNOR TO GOOD INVENTIONS CO., OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

INTERNAL-COMBUSTION-ENGINE VALVE.

Application filed July 27, 1923. Serial No. 654,100.

This invention concerns the design and organization of rotary, combustion-engine valves of the type shown in my prior Patents No. 1,230,291, June 19, 1917 and No. 1,329,521, Feb. 5, 1920 wherein the rotary valve member functions to seal the port passage in a dry or unlubricated condition and without friction-producing or pressure contact upon the corresponding part of the valve casing, and this invention more particularly consists in improvements in the means of applying and using such valves for controlling the inlet passage to the engine as well as for controlling, by a single valve member, both the inlet and the exhaust passages. In the use of this type of valve for the control of the engine inlet, difficulty has been experienced from the formation on the valve of a gummy material which tends to fill up the crevice between the valve member and its casing, frequently sticking the valve to the casing so that it is impossible to turn it. I have ascertained that this material is deposited out of the liquid fuel or gasolene of the mixture sucked in from the carburetor and that its formation and deposit on the valve are a function of the temperature of the valve and that, in consequence, it can be eliminated by a proper adjustment and control of such temperature and my invention consists broadly in means to this end. It also consists in the means and manner of supporting the rotary valve member in its said dry-running relation, especially when it is organized in the engine so as to be subject to thrust in an endwise or axial direction by the cylinder pressure, the object of this independent part of my invention being to avoid the tendency for this type of valve, to develop a greater amount of heat from engagement of its seating or journal surfaces than can be practically disposed of, or a greater extent of wear displacement than is considered practical, and my invention therefore involves the provision of the valve supporting means as a structure separate from the cylinder or cylinder head and applied thereto so that it may contain a journal-seat or seats of extended diameter or area, and always of wider diameter than the port-sealing part of the valve member, thereby effectually eliminating the danger of any disturbance of the dry-running relationship of the valve member and casing during the life of the valve. My invention further consists in various other collateral features of construction hereinafter disclosed, such as the provision of means for guarding against the entrance of lubricating oil into the port-sealing crevice and the utilization of the valve motion for promoting the flow of the cooling medium, as well as the general organization and relative disposition of dry-running valves in relation to the engine cylinder and other matters as will hereinafter more fully appear.

In the accompanying drawings:—

Fig. 1, represents a longitudinal section, with parts in elevation, of one form of construction embodying the invention,

Fig. 2, being a section thereof on the line II—II in the direction of the arrows.

Fig. 3, is a cross section of a modified and preferred form,

Fig. 4, is a detail of the valve drive for this form, and

Fig. 5 is another form.

Both forms illustrate the invention as applied to an air-cooled engine, to which the invention has especial relation although many of the features of the invention are equally applicable to water-cooled engines. In the case in hand the engine cylinder wall 1 is provided with heat-radiating fins 2 and with an exterior casing 3 so arranged that air may flow through the spaces between the fins, according to well-known design. The head wall of the cylinder, in the present case, is formed integral with the walls of the cylinder proper and contains the inlet passage 4 and the exhaust passage 5, both of which are radially disposed with reference to a single central valve chamber 6. This chamber is cylindrical or circular in cross section, and its axis is parallel to the axis of the engine cylinder and preferably coincident therewith. The intersections of the inlet and exhaust passages with its wall surface represent or form the valve ports, and these are alternately opened and closed by the rotary member of the valve. This member has two portions or parts which serve different functions, although they may be, and preferably are, constituted of a single piece of metal. One part, herein called the ported part and marked 7, is contained within the valve chamber 6 being formed with an elbow-shaped passage adapted to register successively with the

valve chamber ports, just referred to. The other part, herein called the journaled part and marked 8, is outside of the valve chamber and seated in a valve-supporting fixture so that it holds the ported part of the member securely and permanently in its centralized position in the valve chamber. As above mentioned the ported part within the valve chamber, is designed to fit that chamber snugly but without friction-producing engagement with the wall surface thereof, as set forth in my prior patents, and so that the microscopic crevice between the opposing surfaces is competent to form the seal against the flow of gas through the valve when the ports thereof are not in registry. The absence of any substantial pressure between said surfaces enables this part of the valve member to rotate in the chamber without producing heat by friction and hence without the need of maintaining a film of lubricant between the said surfaces, the fact being that lubricant in the port-sealing crevice is not only unnecessary, but is a disadvantage in that it would be scraped up by the edges of the ports and become baked therein so as to build up an obstruction to the gas flow. The journaled part 8 of the rotary valve member is supported by and mounted in a supporting structure 9 which may be variously designed and which is accurately fitted to the engine cylinder or cylinder head, as the case may be, and secured thereto in any proper manner, as by means of the series of bolts indicated at 10. In the present case this structure 9 is formed as a single casting with a surrounding apertured casing and two cross walls or spiders, 11 and 12, respectively designed to carry the race-rings 13 and 14 for the ball or roller bearing of the valve, which style of bearing is preferred. The balls of the bearing 14 directly engage with a taper-curved or coned portion of the journaled part of the valve member, adjacent to the valve chamber 6 and of considerably greater diameter. The balls of the other bearing engage a correspondingly tapered or coned surface on the valve member which may be of less diameter. Both these bearings, it will be observed, are arranged to sustain thrust in an endwise, upward, direction and are self-centering so that when the valve-supporting structure 9 has once been accurately fitted to the cylinder they permanently maintain the ported part 7 of the valve member in its accurately centralized, crevice-forming and dry-running position. The cylinder pressure is exerted against the end of the ported part 7 and thrusting endwise on the valve member, tends to set the latter firmly against the balls. In the event of wear on the bearings, the displacement of the valve member is entirely in an axial direction, without tending to tip the ported part so as to distort its port-sealing function. It is important that the journal means adjacent the valve chamber be larger than said chamber, whether constituted of balls or some other type of bearing. It is desirable also to keep the valve member constantly engaged with this self-centering journal means which is done by means of a spring 15 thrusting against the top of the spider 11 and against the underside of a skirted washer 16 pinned to the end of the valve stem, a washer 17 being provided to allow the rotation of the valve without rotating the spring. The valve member is rotated in the present case by a spiral gear 18 fixed to its journaled part 8 between the bearings and driven by a gear 19 carried on a shaft 20 journaled in the valve-supporting structure 9, or elsewhere, as desired. In the case of multicylinder engines the said shaft 20 is common to the valves of all the cylinders of the block or row, and it will be understood that in the case where one valve controls both inlet and exhaust, it will be rotated a complete turn for each cycle, being properly connected to the crank shaft through the valve shaft 20 for that purpose. Although ball bearings are preferred and found to be entirely practicable, it will of course be evident that they may be substituted by ordinary journal bearings in which event the extended seat area, made available by the large diameter of the journaled part of the valve member, will provide the same advantage. In order to prevent the entrance of lubricant into the port-sealing crevice, the valve member is provided with an enlargement between its bearings and the valve chamber. In the form of Figs. 1 and 2 this is a radial enlargement or flange formed in the shape of radial blades 21 which sling the oil away from the valve chamber. These blades may also operate to produce or assist the flow of air into the valve-support 9 thereby assisting in the general cooling of the engine but the use of the blades for this purpose is optional, depending upon the kind of valve and the temperature characteristics of the engine to which it is applied.

Referring to Figs. 3 and 4, it will be understood that the ported part 7 of the valve member is related to the valve chamber 6 in the pressureless, dry-running position already described and is maintained in such position by its journaled part 8 of considerably larger diameter than the valve chamber. The journaled part is seated on two ball bearings 23 and 24 both carried in a separate valve-supporting structure 25 fitted to the engine cylinder as before. The oil guard in this case is formed by the radial enlargement 26 overhanging the top of the valve chamber 6 and the drive of the valve is applied at the end of its stem which pro-

jects upwardly above the valve support. The driving connections are as follows:— The shaft 20, geared to the crank shaft, drives a spiral gear 27 journaled on an upstanding boss 28 on the valve support 25, said gear 27 being provided with one or more upstanding fingers 29 loosely engaging radial slots formed in a collar 30, pinned at 31 to the valve stem. By this means the rotation of the gear 27 is transmitted to the valve stem without imparting lateral thrust thereto, such as might result after long use, in lateral wear of the ball races. This form of floating drive is recommended where the seating means of the valve support is composed of two ball bearings spaced as closely together as indicated in this figure, but there is no limitation to the use of this or any form of floating drive. A spring 32 contained within and thrusting upwards against the skirted washer 33, tends to keep the valve member in constant engagement with its seating means as in the case of Fig. 1, counteracting the gravity of the valve. In both forms above described, the only displacement of the valve member that can occur from the effect of wear is in a direction strictly conforming to the axis of the valve so that the port-sealing function is not disturbed.

In the case of dry-running valves controlling the engine inlet and especially in valves controlling both inlet and exhaust, sometimes called double-purpose valves, it is found that the ported part which is exposed to the flame transmits a large portion of the heat it absorbs therefrom to the liquid fuel particles in the incoming mixture, helping it to vaporize and correspondingly improving the combustion and that if the absorbed heat is not conserved for this purpose, the vaporization will not only not be accomplished, but the ported part of the valve member i. e. the dry-running part will become so cold by loss of its heat that the gum deposit above referred to, will appear thereon. By surrounding the journaled part of the valve member with uncooled metal, such as is present in the valve support 9 or 25, or by air, or both, but without subjecting it to active cooling by such air or any other medium, the ported part can be kept above the gum-forming temperature and also high enough to help in the vaporizing of the fuel although without danger of reaching a temperature likely to affect the member injuriously as by warping or otherwise. In ordinary cases it is found that the simple enclosure of a journaled part of the valve member which is larger than its ported part, in a casing or housing such as indicated at 25, in Fig. 3, is sufficient for the purpose and in the case of air cooled engines, that the exposure of the casing, or of the valve to the general air flow, as in Fig. 1, will not produce an undesirably low temperature. In that figure the air flow is through the air holes 35 in the surrounding wall of the valve support and through the spider 12 to the fins 2 on the engine cylinder. When the blades 21 are used as the oil guard they are mounted on the valve member in such a way as not to be the equivalent of heat transfer fins, so as thus to guard against undue cooling of the valve member, but when the valve is arranged to control only the exhaust port these same blades can be made to conduct and dissipate the heat that will then be present.

It will thus be understand that the virtue in having the journal part of larger diameter than the ported part lies first, in the attainment thereby of a correct working temperature in the ported part, avoiding the objections referred to under all conditions of use, and second, the fact that journal wear has the least effect upon the centralized position of that part, in reference to the ported chamber with which it coacts.

Fig. 5 illustrates the same general organization as above described, in the case where the valve is mounted on a plain bearing. In this form the enlarged journal part 35 of the valve seats against the correspondingly large seat surface 36 of the head structure providing a large area of bearing surface and a greater diameter than that of the port-seating part with corresponding reduction of pressure per square inch and with the other advantages above scheduled to be incident to the relative dimensions of the ported and journal parts of the valve.

I claim:—

1. In an internal combustion engine, the combination of a valve chamber formed in the wall of the combustion space, a rotary valve member having a ported part within said chamber and a journaled part of larger diameter outside thereof, said ported part and the valve chamber being respectively provided with closely opposed, dry-running surfaces in pressureless, port-sealing relation to each other, and a valve-supporting structure fitted to said wall, engaging said journaled part and thereby centralizing the ported part in the valve chamber and comprising journal means of larger diameter than the valve chamber subject to wear displacement only in the direction of the axis of the valve.

2. In an internal combustion engine, the combination of a cylinder and a rotary valve having its axis parallel with the cylinder axis and in line with the piston therein and comprising a valve chamber, a rotary valve member having a port-sealing part within said chamber subject to the cylinder pressure in an endwise direction and a journaled part of larger diameter than said chamber, the proximate surfaces of said ported part

and valve chamber being closely related in dry-running, port-sealing but pressureless contact, and seating means engaging said journaled part adapted to sustain the endwise thrust and permit wear displacement of said valve member only in the direction of its axis.

3. In an internal combustion engine, the combination of a substantially cylindrical valve chamber formed in the head wall of the cylinder, parallel with the latter and having ports connecting with the inlet and exhaust passages thereof, a single rotary valve member having a part within said chamber provided with a port adapted to connect said chamber ports to the combustion space and having a journaled part of larger diameter than said ported part, and a valve support for said journaled part comprising journal means subject to wear displacement only in the direction of the axis of the valve, said ported part and valve chamber being respectively provided with closely opposed, dry-running surfaces in pressureless, port-sealing relation to each other and adapted to be maintained in such relation by said journal means.

4. In an internal combustion engine, the combination of a substantially cylindrical valve chamber formed in the head wall of the cylinder substantially concentric to the axis of the latter, a rotary valve member having a ported part within said chamber exposed at its end to the cylinder pressure and carried by a journaled part of larger diameter than said ported part, and a valve-support for said journaled part comprising journal means arranged to center the valve member to the casing by the effect of the endwise pressure on the valve member, said ported part and valve chamber being respectively provided with closely opposed, dry-running surfaces in pressureless, port-sealing relation to each other and adapted to be maintained in such relation by said journal means.

5. In an internal combustion engine, the combination of a cylinder, a rotary valve comprising a valve chamber, a rotary valve member having a ported part within the chamber, the proximate surfaces of said ported part and chamber being closely related in unlubricated, port-sealing, pressureless contact, and also having a journaled part, means for supporting said latter part and means for preventing lubricant on said journaled part from entering the crevice between said valve member and chamber.

6. In an internal combustion engine, the combination with the cylinder of a rotary valve comprising a valve chamber, a valve member having its lower part ported and located within said chamber, the proximate surfaces of said valve part and chamber being closely related in dry-running, port-sealing but pressureless contact and having a journaled part above said valve chamber, a supporting structure for said journaled part adapted to sustain the endwise thrust thereof without lateral wear displacement, and means for preventing lubricant on said part from entering the valve chamber.

7. In an internal combustion engine, the combination of a valve chamber, a rotary valve member having a ported part within said chamber and a journaled part outside thereof, and a radial enlargement between said ported part and the journal seat, said ported part and said valve chamber being respectively provided with closely opposed, dry-running surfaces in pressureless, port-sealing relation to each other, and means for supporting the journaled part to maintain said ported part in said relation.

8. In an internal combustion engine, the combination of a valve chamber, a rotary valve member having a ported part within said chamber and a journaled part outside of it, said ported part and chamber being respectively provided with opposed, dry-running surfaces in pressureless, port-sealing relation to each other and a valve-suporting structure engaging said journaled part and comprising an endwise thrusting ball-bearing immediately adjacent to and of greater diameter than said ported part, and another bearing of less diameter spaced from said ball-bearing.

9. In an internal combustion engine, the combination of a valve chamber, a rotary valve member having a ported part within said chamber and a larger journaled part outside of it, the ported part and chamber being respectively provided with closely opposed, dry-running surfaces in port-sealing, relation to each other, a structure for supporting said journaled part and means mounted on said valve support for rotating the valve member.

10. In an internal combustion engine, the combination of a valve chamber, a rotary valve member having a ported part within said chamber and a larger journaled part outside of it, the ported part and chamber being respectively provided with closely opposed, dry-running surfaces in port-sealing relation to each other, a gear wheel surrounding the journaled part of the valve member and means for driving said gear wheel.

11. In an internal combustion engine, the combination of a valve chamber formed in the head wall of the engine cylinder opposite the engine piston, a rotary valve member having a journaled part of relatively large diameter and a ported part of relatively small diameter occupying said chamber, a valve-supporting structure bolted to the cyl-

inder, engaging and surrounding said journaled part and comprising one or more journal bearings therefor.

12. In an internal combustion engine, the combination of a valve chamber provided with inlet and exhaust ports, a rotary valve member having a ported part within said chamber coacting in dry-running relation to open and close said inlet and exhaust ports and having a part by which it is supported outside of said chamber, said latter part having a greater diameter and larger superficial area than the part within said chamber.

13. A rotary engine valve sustaining the cylinder pressure in an axial direction, a seat for receiving the thrust, said seat having a larger projected area than the area of the valve exposed to the cylinder pressure.

14. A rotary engine valve comprising a valve sealing part, and a separate seating part, said parts functioning independently of each other, the seating part having a larger projected area than the valve sealing part in order to reduce the driving load and being subject to the cylinder gas pressure in an axial direction.

In testimony whereof, I have signed this specification.

JOHN GOOD.