PATENT SPECIFICATION

Application Date: Sept. 23, 1939. No. 26487/39. 535,856
" " Dec. 7, 1939. No. 31694/39.
One Complete Specification Left: Sept. 25, 1940.
(Under Section 16 of the Patents and Designs Acts, 1907 to 1939.)
Specification Accepted: April 24, 1941.

PROVISIONAL SPECIFICATION
No. 26487 A.D. 1939.

Improvements in or relating to Rotary Valves for Internal Combustion Engines

I, FRANK METCALF ASPIN, a British subject, of Walmer Place, 149, Walmersley Road, Bury, Lancashire, do hereby declare the nature of this invention to be as follows:—

This invention relates to rotary valves for internal combustion engines of the kind forming the subject of my Patent No. 463,412.

The Patentee has realised that the rotary valve of such earlier Patent has possibilities for improvement as regards its construction for simplification and for improved results. For example, for high speed work in large engines, the factor of balance requires more attention, for aero engine work a reduction of weight is desirable, whilst for combustion efficiency, internal cooling of the valve preferably controlled is sometimes desirable. Economic factors such as cost of manufacture also require consideration.

The object of the invention is an improved construction of rotary valve of the kind referred to with improvements in the direction above indicated.

According to the invention the improved rotary valve of the kind described comprises a hollow shell having a shaped partition secured therein and forming with the lower part of the shell, the eccentric combustion chamber.

According to a further feature of the invention cooling means is provided operating on the upper surface of the said partition.

According to another feature of the invention means is provided for controlling temperature distribution as by directing the flow of the coolant.

In one example of the invention, the improved rotary valve comprises a hollow shell of iron, preferably of one of the special bearing irons now available which are porous and capable of holding lubricant. This shell is conical in shape, except for a stem part in which are provided grooves for one or more piston rings. Such ring or rings serve to eliminate any slight " blow by " up the stem and also assist in retaining the lubricant and maintaining effective lubrication of the bearing surface of the shell. As the special bearing irons are not generally suitable for receiving a key way, a plug of steel is fitted and secured in the stem of the shell, where it may be secured by screwing, brazing, welding or other suitable means. Passages for a coolant are provided in such plug, which may consist of a central inlet passage fitted with a tube, the lower end of which may be directed to distribute the coolant as hereinafter explained. The outlet passage or passages may be concentric with or parallel to and spaced around the inlet passage and may either pass up through the end of the plug or have a bend or inclination so as to pass outward through the side of the plug and/or be taken through the stem of the shell.

Secured within the conical part of the shell is a plate, which may conveniently be a casting of bronze, steel, iron or other suitable material, the underside of such plate being shaped to form the underside of the valve including the greater part of the wall of the combustion chamber. The only part of the wall of the combustion chamber which is not formed by the plate consists of the port aperture in the conical shell.

The above construction is obviously extremely simple and cheap to produce and provides the advantage of being able to use the most suitable bearing material for the conical shell port, that is to say, material most suitable to co-operate with another bearing material forming the cylinder head; in being able to use high strength material for the driving shaft or stem and in being able to use material of a high thermal conductivity for the plate. Also the construction may be accurately balanced by suitable thickening of the plate or by attachment of balance weights

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before or during assembly and by cutting away excess material after assembly. At the same time the structure provides strength with lightness.

In use, the valve may be cooled by circulating through it lubricating oil or other suitable coolant and the velocity and distribution thereof can be controlled so that the temperature of the plate can be effectively controlled, whereby in accordance with the latest knowledge and experience in the art, detonation control and general control of combustion is obtainable. Both balance and detonation control are of great importance for large high speed high efficiency engines as required for aircraft.

The construction above described is obviously capable of modification without departing from the nature of the invention, for instance, as regards the materials to be used. Instead of using a bearing iron the shell could be made of steel or other suitable material not being a suitable bearing material, to which is applied a surface of a suitable bearing material, such as tin, and of suitable thickness, which surface may only be very thin. In this way, i.e., by an applied coating of bearing material any suitable combination of bearing materials for the valve and its seating can be employed as there are many known ways in which one material can be applied as a surface for another so as to be intimately united thereto.

Dated this 11th day of September, 1939.
For the Applicant,
WILSON, GUNN & ELLIS,
Chartered Patent Agents,
54—56, Market Street, Manchester, 1.

PROVISIONAL SPECIFICATION
No. 31694 A.D. 1939.

Improvements in or relating to Rotary Valves for Internal Combustion Engines

I, FRANK METCALF ASPIN, a British subject, of Walmer Place, 149, Walmersley Road, Bury, Lancashire, do hereby declare the nature of this invention to be as follows:—

This invention relates to rotary valves for internal combustion engines of the kind described in Patent Specification No. 463,412.

In such Specification a method of manufacture was described for drilling and plugging the valve body for balancing purposes.

The object of the present invention is an improved construction embodying in combination means for cooling and balancing the valve.

According to the invention, the rotary valve member is formed hollow to provide space for a cooling fluid and so that the remaining metal, forming the peripheral wall of the valve member and the wall of the eccentric combustion chamber therein shall jointly with the cooling fluid substantially balance the valve about its axis of rotation.

According to a further feature of the invention, circulation and distribution of the cooling fluid through and in the cooling space is assisted by centrifugal action from rotation of the valve member.

According to a preferred embodiment of the invention the rotary valve member is formed with a hollow stem and a stationary tube is arranged depending into said stem to supply lubricating oil to the cooling space adjacent to the wall of the off-set combustion chamber in the valve.

In one example of the invention, the rotary valve member is formed hollow, with a hollow stem and a cooling space, the latter being proportioned so as to leave a peripheral wall and the wall of the off-set combustion space of substantially equal thickness. The combustion space wall is, however, designed with a thickened part where it merges into or springs from the peripheral wall, the design embodying smooth curves to avoid sharp corners. The thickened portions thus formed at each side of the off-set combustion chamber are so proportioned as to provide balance masses to compensate for the space formed by such chamber, and to balance out also with the eccentric mass of the cooling fluid which will be located in the valve member.

The cooling fluid, which in this case comprises lubricating oil, is supplied to the cooling space in the valve member by a stationary oil tube depending from a suitable support and with its lower end just short of the wall of the combustion space, such tube being centrally disposed within the hollow stem of the valve member.

In use, oil is supplied at low pressure by a suitable circulating pump and passes down the tube into the cooling space in the valve member. The coolest oil is thereby directed against the wall of the combustion chamber and thus provides

temperature control where it is most important, that is to say, in the region bounding the final zone of combustion, ignition in this case being provided by a sparking plug located in the periphery of the housing for the rotary valve member so that flame propagation spreads inwardly to the back wall of the combustion space.

The oil is permitted to overflow from the upper end of the stem of the rotary valve member between such upper end and a conical shoulder formed on the depending oil tube. This shoulder may be formed on an adjustable collar so that the flow space may be adjusted. This feature of adjustment may be useful for multi-cylinder engines for temperature equalisation.

The oil, due to rotation of the valve member, is forced by centrifugal force to the lower end of the cooling space so that air or vapour pockets cannot accumulate therein, and the sum of centrifugal pressure thus created assists in the expulsion of the oil at the upper end of the valve stem. The interior walls of the cooling space may be formed with ribs of spiral, radiating or other shape for controlling distribution of circulation of the cooling fluid. The oil, after passing through the cooling space overflows into the driving gearing, etc., above the valve member and provides cooling and lubrication therefor.

Dated this 4th day of December, 1939.

For the Applicant,
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COMPLETE SPECIFICATION

Improvements in or relating to Rotary Valves for Internal Combustion Engines

I, FRANK METCALF ASPIN, a British subject, of Walmer Place, 149, Walmersley Road, Bury, Lancashire, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to rotary valves for internal combustion engines of the kind forming the subject of my earlier Specification No. 463,412.

The Patentee has realised that the rotary valve of the inventions covered by such earlier Application for Patent has possibilities for improvement as regards its construction for simplification and for improved results. For example, for high speed work in large engines, the factor of balance requires more attention, for aero engine work a reduction of weight is desirable, whilst for combustion efficiency, internal cooling of the valve, preferably controlled, is sometimes desirable. Economic factors such as cost of manufacture also require consideration.

In the Specification of such earlier Application for Patent a method of manufacture was described for drilling and plugging the valve body for balancing purposes.

The object of the invention is an improved construction of rotary valve of the kind referred to with improvements in the direction above indicated.

According to one feature of the invention, the rotary valve member having a combustion chamber therein offset from the axis of rotation is formed hollow to provide a space for a cooling fluid. According to a preferred embodiment of the invention the hollow space is so formed that the mass of the remaining metal, forming the peripheral wall of the valve member and the wall of the off-set or eccentric combustion chamber therein, jointly with the mass of the cooling fluid filling the same substantially balances the valve member about its axis of rotation.

According to a further feature of the invention means are provided for admitting the cooling fluid to the cooling space constructed and arranged so that the circulation and distribution of the cooling fluid through and in the cooling space is assisted by rotation of the valve member.

According to another feature of the invention the improved rotary valve of the kind described comprises a hollow shell having a shaped partition secured therein and forming with the lower part of the shell, the off-set or eccentric combustion chamber.

According to yet another feature of the invention cooling means is provided operating on the upper surface of the said partition.

According to a still further feature of the invention means is provided for controlling temperature distribution as by directing the flow of the coolant

According to a preferred embodiment of the invention the rotary valve member is formed with a hollow stem and a stationary tube is arranged depending into said stem to supply lubricating oil to the cooling space adjacent to the wall of the

off-set combustion chamber in the valve.

In the accompanying drawings,

Fig. 1 is a sectional elevation of one example of a rotary valve member made in accordance with the invention.

Fig. 2 is a section on line 2—2 of Fig. 1.

Fig. 3 is a sectional elevation of a modified form of construction of the rotary member.

Fig. 4 shows a further modification.

In the example of the invention illustrated in Fig. 1, the rotary valve member 10 is formed with a hollow stem 11 and a cooling space 12 within the body of the valve, the latter space being proportioned so as to leave a peripheral wall 13 a little thinner than the wall 14 of the off-set combustion space and the wall 15 above the piston of substantially equal thickness to the wall 14. The wall 15 is, however, designed with a thickened part 16 (see Fig. 2) where it merges into or springs from the peripheral wall, the design embodying smooth curves to avoid sharp corners. The thickened portions 16 thus formed at each side of the off-set combustion chamber are so proportioned as to provide balance masses to compensate for the space formed by such chamber, and to balance out also with the eccentric mass of the cooling fluid which will be located in the valve member.

The rotary valve member 10 is mounted in a housing 17 adapted to be bolted to the upper end of the engine-cylinder, not shown, and in addition to the oil lubricated conical plan bearing surface which it provides coacting with the conical outer periphery of the valve body, it carries a conical roller thrust bearing 18 secured by a cap 19 in which latter is supported a combined thrust and radial duty ball bearing 20, the inner race of which is a sliding fit on the stem of the rotary valve member. On the upper end of the rotary valve member is fixed a driving gear wheel 21 whilst a spring 22 is arranged between such gear and the inner race of the bearing 20. Adjustment of the load distribution between the conical roller thrust bearing 18 and the plain lubricated conical surfaces is initially provided by selection of a spacing ring 23 of suitable thickness. During assembly a standard thickness washer and a graded selection of washers of slightly greater and less thickness are made available for trial and error assembly until the correct load distribution is obtained as explained in the Specification of my co-pending Application for Patent No. 511,208.

Between the conical part of the valve and its stem 11 there is a cylindrical portion 24 in which are provided oil retaining piston rings 25.

The cooling fluid, which in this case comprises lubricating oil, is supplied to the cooling space 12 in the valve member by a stationary oil tube 26 depending from a suitable support such as an overhead pins line 26*a* and with its lower end 26*b* just short of the wall 14 of the combustion space, each tube being centrally disposed within the hollow stem 11 of the valve member 10 and its outlet being on the axis of rotation.

In use, oil is supplied at low pressure by a suitable circulating pump not shown and passes down the tube 26 into the cooling space 12 in the valve member. The coolest oil is thereby directed against the wall 14 of the combustion chamber and the greater part flows down over the wall 15 and thus provides temperature control where it is most important, that is to say, at the lower part of the wall 14 and on the wall 15 in the region bounding the final zone of combustion, ignition in this case being provided by a sparking plug 27 located in the periphery of the housing 17 for the rotary valve member so that flame propagation spreads inwardly to the back wall of the combustion space and finally along the wall 15 over the piston.

The oil passes up the hollow stem 11 around the tube 26 and is permitted to overflow from the upper end of the stem 11 of the rotary valve member between such upper end and a conical shoulder 28 formed on the depending socket in which the oil tube is secured. This shoulder 28 may, as shown in Fig. 4, be formed on an adjustable collar 28*a* so that the flow space may be adjusted. This feature of adjustment may be useful for multi-cylinder engines for temperature equalisation. The outlet for the oil relative to the outlet from the tube 26 within the rotary valve member is thus spaced away from the axis of rotation, and rotation of the fluid caused by rotation of the valve causes centrifugal pressures which assist its flow.

The oil, due to rotation which it will acquire from rotation of the valve member, is forced by centrifugal force to the lower end of the cooling space 12 so that air or vapour pockets cannot accumulate therein, and the sum of centrifugal pressure thus created assists in the expulsion of the oil at the upper end of the valve stem. The interior walls of the cooling space may be formed with ribs of spiral, radiating or other shape for controlling distribution of circulation of the cooling fluid and, as shown in Fig. 4 a spiral vane 29 may be secured to the tube 26 to assist turbulence and flow. The oil, after passing through the cooling space overflows into the driving gearing etc. above the

valve member and provides cooling and lubrication therefor.

In another example of the invention as illustrated in Fig. 3, the improved rotary valve comprises a hollow shell 30 of iron, preferably of one of the special bearing irons now available which are porous and capable of holding lubricant. This shell 30 is conical in shape, except for a stem part 31 in which are provided grooves for two piston rings 32. Such rings serve to eliminate any slight " blow by " up the stem and also assist in retaining the lubricant and maintaining effective lubrication of the bearing surface of the shell. As the special bearing irons are not generally suitable for receiving a key way, a plug of steel 33 is fitted and secured in the stem of the shell, where it may be secured by screwing, brazing, welding or other suitable means. Passages for a coolant are provided in such plug, which consist of a central inlet passage fitted with a tube 34, the lower end of which may be directed to distribute the coolant as hereinafter explained. Two outlet passages 35 are provided which at their lower ends are parallel to and spaced around the inlet passage and bend so as to pass outward through the side of the plug. Alternatively the outlet passage or passages may be provided concentric to the inlet passage and passing out through the upper end thereof.

Secured within the conical shell part 30 of the valve by brazing, welding or other suitable method according to the materials used, is a plate or partition 36 which may conveniently be a casting of bronze, steel, iron or other suitable material, the underside of such plate being shaped to form the underside of the valve including the greater part of the wall of the combustion chamber 37. The only part of the wall of the combustion chamber which is not formed by the plate consists of the part formed by the edge of the conical shell 30 at the port aperture 38, the line of junction between the plate and the shell at such point not being shown for the reason that such line would be invisible after machine finishing.

The partition or plate may be made of metal unsuitable for the shell of the valve and of higher heat conductivity to provide a higher cooling rate for the walls which are exposed to the heat of combustion.

The above construction is obviously extremely simple and cheap to produce and provides the advantage of being able to use the most suitable bearing material for the conical shell part, that is to say, material most suitable to co-operate with another bearing material forming the cylinder head; in being able to use high strength material for the driving shaft or stem and in being able to use material of a high thermal conductivity for the plate. Also the construction may be accurately balanced by suitable thickening of the plate or by attachment of balance weights before or during assembly and by cutting away excess material after assembly. At the same time the structure provides strength with lightness.

In use, the valve may be cooled by circulating through it lubricating oil or other suitable coolant and the velocity and distribution thereof can be controlled so that the temperature of the plate can be effectively controlled, whereby in accordance with the latest knowledge and experience in the art, detonation control and general control of combustion is obtainable. Both balance and detonation control are of great importance for large high speed high efficiency engines as required for aircraft.

The construction above described is obviously capable of modification without departing from the nature of the invention, for instance, as regards the materials to be used.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A rotary valve for internal combustion engines having a combustion chamber therein off-set from the axis of rotation and formed hollow to provide a space for a cooling fluid.

2. A rotary valve for internal combustion engines having a combustion chamber therein off-set from the axis of rotation and formed hollow to provide a space for a cooling fluid, the said hollow space being so formed that the mass of the remaining metal forming the peripheral wall of the valve member and the wall of the off-set combustion chamber therein jointly with the mass of the cooling fluid filling the same, substantially balances the valve member about its axis of rotation.

3. A rotary valve for internal combustion engines having a combustion chamber therein off-set from the axis of rotation and formed hollow to provide a space for a cooling fluid, the hollow space being formed so that the remaining metal wall where the combustion chamber wall merges into the peripheral wall of the valve member is of greater thickness than the rest of the wall so that the mass of the metallic portion of the valve member jointly with the mass of the cooling fluid in the cooling space substantially balances the valve member about its axis of rotation.

4. A rotary valve member according to any of the preceding Claims, characterised by means for admitting cooling fluid to the cooling space, constructed and arranged so that the circulation and distribution of the cooling fluid through and in the cooling space is assisted by rotation of the valve member.

5. A rotary valve member according to Claims 1 to 3 characterised by means for admitting cooling fluid to the cooling space comprising an inlet tube with its outlet arranged within the cooling space and substantially on the axis of rotation and an outlet for the fluid relatively off-set from such axis so that the circulation and distribution of the cooling fluid through and in the cooling space is assisted by rotation of the valve member.

6. A rotary valve member according to any of the preceding Claims 1 to 3 characterised by means for admitting cooling fluid to and releasing it from the said cooling space and flow inducing and directing formations within the said cooling space.

7. A rotary valve member according to any of the preceding Claims characterised in that the valve member comprises a hollow shell having a shaped partition secured therein and forming, with the lower part of the shell, the said off-set combustion chamber.

8. A rotary valve member according to Claim 7 characterised in that a shaped partition forms the under-side of the valve including the greater part of the wall of the combustion chamber.

9. A rotary valve member according to Claim 7 or 8 characterised in that the partition is of metal of high heat conductivity.

10. A rotary valve member according to any of the preceding Claims 7, 8 or 9 characterised in that it is balanced relative to the joint masses of itself and the fluid within its cooling space by thickening the partition where required.

11. A rotary valve member according to any of the preceding Claims, characterised in that the valve comprises a tubular shell, a driving plug secured in the upper end and a shaped partition secured in the lower end forming, with the lower part of the shell the said off-set combustion chamber.

12. A rotary valve member according to any of the preceding Claims characterised in that the body part is conical.

13. A rotary valve member according to any of the preceding Claims characterised in that an upper portion of the valve is cylindrical and is provided with oil retaining rings.

14. A rotary valve member for internal combustion engines constructed and arranged substantially as herein described with reference to and as illustrated in Figures 1 and 2, or as modified in Figure 3 or Figure 4 of the accompanying drawings.

Dated this 10th day of September, 1940.
For the Applicant,
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Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1941.

FIG. 2.

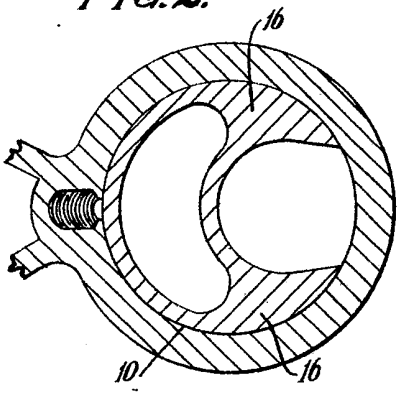


FIG. 3.

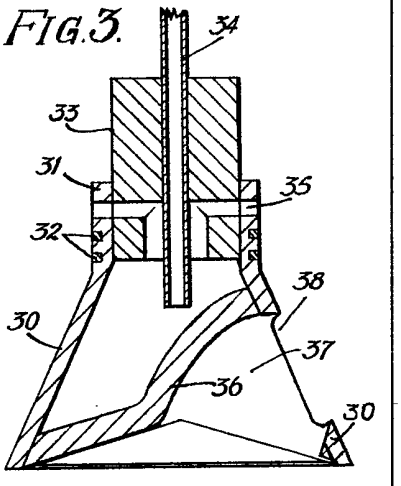


FIG. 1.

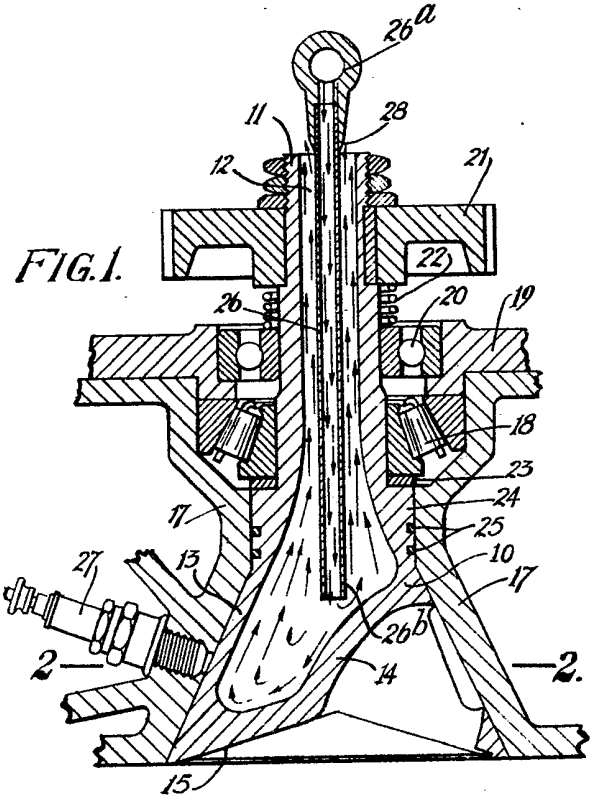
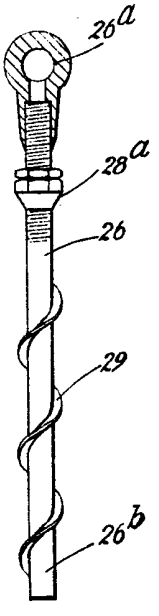


FIG. 4.



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