PATENT SPECIFICATION

Application Date: June 26, 1942. No. 8774/42. **560,086**

Complete Specification Left: June 24, 1943.

Complete Specification Accepted: March 20, 1944.

PROVISIONAL SPECIFICATION

Improvements in or relating to Thrust Bearings for Rotary Valves

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

This invention relates to thrust bearings for rotary valves for example for the rotary valves of internal combustion engines of the kind described in my prior Patent No. 463,412, though the invention is not limited to such use and would apply for example to rotary valves of pumps and compressors having an axial thrust.

It has been found that further developments of the engine described in the aforesaid earlier Patent make desirable an increase in the strength of the thrust bearings. In addition to the problem of increasing the size of ball or roller type bearings as described in the aforesaid Patent or in my later Patent No. 511,208 owing to space limitations, there is the question of cost which, even in the original forms above referred to, is considerable.

The object of the present invention is therefore twofold, namely to provide a stronger thrust bearing in the limited space available and to do so at a minimum cost or even at a reduction in the present cost of production of the valve construction.

According to the invention a hydraulic thrust cushion is provided for the stem of the valve.

In one example of the invention the improved construction of the valve is provided with a stem or attachment thereto having an end of suitable area rotatably mounted in a stationary cup rigidly mounted over the end of the valve. One or more annular lubrication grooves are provided in the peripheral wall of the cup to lubricate the peripheral wall of the end of the valve stem or its attachment located therein. The cup is so proportioned and positioned relative to the end of the valve that a cushion space which may be of thin flat disc-like shape is normally provided, and lubricating oil is supplied thereto through a non-return valve either from the pressure lubrication system of the engine or from the general lubrication of the valve gear, as by gravity feed from a cup in which lubricating oil may collect. A small bleed-hole with a spring-loaded check valve is provided whereby air may be released from the cushion space should any enter or be released therein from the oil, such valve being loaded so as to open for that purpose, but to close to prevent exit of the cushioning oil when the cushion is operating to resist axial thrust on the valve.

In operation, the cushion space is normally full of lubricating oil. During the induction stroke of the piston a negative pressure on the valve tends to produce a small axial movement of the valve away from its bearings. At the same time the cushion space fills up. Such axial movement will, of course, only be very small and probably of the order of tenths of thousandths of an inch. On the compression stroke, and during the high momentary thrust pressures resulting from combustion within the cylinder, such thrust is taken partly by the conical bearing surface of the valve and by any ball or roller thrust bearing which may be provided, and by the hydraulic thrust cushion provided in accordance with this invention, it being appreciated that all bearings have some yield from the resilience of its parts as every substance has resilience, and resilience, as such, is purely relative. By suitable proportioning, therefore, of the area of the hydraulic cushion relative to the conical bearing surface of the valve, the need for taper-roller bearings or other such expensive type of bearings may be eliminated, or by suitable proportioning relative to the conical bearing surface of the valve and to the taper-roller or other such thrust bearings as may be provided, the hydraulic thrust cushion may be arranged to take such proportion of the momentary thrust of combustion as may be desired. The hydraulic cushion is self-adjusting for that purpose as the

volume of oil therein will adjust itself to the normal position of the valve.

Dated this 25th day of June, 1942.
For the Applicant,
WILSON, GUNN & ELLIS,
Chartered Patent Agents,
54/56, Market Street, Manchester, 1.

COMPLETE SPECIFICATION

Improvements in or relating to Thrust Bearings for Rotary Valves

I, FRANK METCALF ASPIN, a British subject, of 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 thrust bearings for rotary valves of the type having a tapered bearing and gas-sealing surface and subject to gaseous axial thrust in a direction to load such surface, for example for the rotary valves of internal combustion engines of the kind described in my prior Patent No. 463,412 though the invention is not limited to such use and would apply for example to rotary valves of pumps and compressors having a tapered bearing and gas sealing surface subject to axial thrust.

It has been found that further developments of the engine described in the aforesaid earlier Patent make desirable an increase in the strength of the thrust bearings. In addition to the problem of increasing the size of ball or roller type bearings, as described in the aforesaid Patent or in my later Patent No. 511,208 owing to space limitations, there is the question of cost which, even in the original forms above referred to, is considerable.

The object of the present invention is therefore twofold, namely to provide a stronger thrust bearing in the limited space available and to do so at a minimum cost or even at a reduction in the present cost of production of the valve construction.

According to the invention a hydraulic thrust cushion is provided for the stem of the valve adapted to take part of the axial thrust loads. Preferably such cushion comprises a piston slidably mounted in a hydraulically locked cylinder and having end bearing contact with a surface, relative to which there is rotational movement coaxial with the said piston.

In the accompanying drawings:—

Fig. 1 is a part sectional elevation of one example of a thrust bearing according to this invention applied to a rotary valve of an internal combustion engine.

Fig. 2 is a part sectional elevation of another example of thrust bearing according to this invention, also shown applied to a rotary valve of an internal combustion engine.

In neither figure of the drawings are shown the ports in the rotary valve member and housing, as these are not features of the invention and their inclusion would merely complicate the drawings. However, it may be assumed for convenience, that any such ports will preferably be in accordance with my first named earlier Patent No. 463,412.

Where the parts are the same in the two figures, the same reference letters are used.

In the example of the invention shown in Fig. 1 the rotary valve member 10 has a stem 11 which is provided with a renewable thrust stud 12 having an end of suitable area engaging a piston 13 rotatably mounted in a stationary cup 14 formed in a bridge or cover 15 detachably and rigidly mounted over the end of the valve. One or more annular lubrication grooves are provided in the peripheral wall of the cup 14, or on the piston 13, to allow lubrication oil to flow to and lubricate the peripheral wall of the piston and the contact surface of the stud 12 in end of the valve stem where relative rotation may occur. The cup is so proportioned and positioned, relative to the end of the valve, that a cushion space is normally provided, and lubricating oil is supplied thereto through a non-return valve 16 either from the pressure lubrication system of the engine or from the general lubrication of the valve gear, as by gravity feed from a cup in which lubricating oil may collect. The oil reaches the cushion spaces through a passage 17, annular groove 18 in the cover 15 and passage 19 in the piston 13. A spring 13*a* holds the piston normally against the stud 12. A small bleed-hole with a spring-loaded check valve may be provided whereby air may be released from the cushion space should any enter or be

released therein from the oil, such valve being loaded so as to open for that purpose, but to close to prevent exit of the cushioning oil when the cushion is operating to resist axial thrust on the valve.

As shown in Fig. 2 the rotary valve 10 with its stem 11 is fitted with an extension 20 forming a cylinder for a piston 21 adapted to engage a thrust facing 22 on the cover 23. Lubricating oil reaches a cushion space below the said cylinder from a passage 24, annular groove 25, passage 26, space 27 in the end of the valve, and passage 28 in a seating 29 for a non-return valve 30. A spring 21*a* holds the piston 21 normally against the facing 22.

In operation, considering equally both figures of the drawing, the cushion space is normally full of lubricating oil. During the induction stroke of the piston a negative pressure on the valve tends to produce a small axial movement of the valve 10 away from its bearings. At the same time the cushion space fills up. Such axial movement will, of course only be very small and probably of the order of tenths of thousandths of an inch. On the compression stroke, and during the high momentary thrust pressure resulting from combustion within the cylinder, such thrust is taken partly by the conical bearing surface of the rotary valve member and any ball or roller thrust bearing which may be provided for that purpose, and partly by the hydraulic thrust cushion provided in accordance with this invention by the piston 13 or 21, it being appreciated that all bearings have some yield from the resilience of their parts as every substance has resilience, and resilience, as such, is purely relative. By suitable proportioning, therefore, of the area of the hydraulic cushion relative to the conical bearing surface of the valve, the need for taper-roller bearings or other such expensive type of bearings may be eliminated, or by suitable proportioning relative to the conical bearing surface of the valve and to the taper roller or other such thrust bearings as may be provided, the hydraulic thrust cushion may be arranged to take such proportion of the momentary thrust of combustion as may be desired. The hydraulic cushion is self-adjusting for that purpose as the volume of oil therein will adjust itself to the normal position of the valve.

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 thrust bearing for a rotary valve of the type referred to comprising a hydraulic cushion adapted to take part of the axial thrust loads.

2. A thrust bearing for a rotary valve member of the type referred to characterised by a hydraulic thrust cushion comprising a piston slidably mounted in a hydraulically locked cylinder and having end bearing contact with a surface, relative to which there is rotational movement coaxial with the said piston.

3. A thrust bearing according to Claim 1 or 2 characterised in that the fluid content of the hydraulic thrust cushion is maintained from the lubrication system for the rotary valve member.

4. A thrust bearing according to Claim 1 2, or 3 characterised in that the hydraulic cushion is incorporated in the end of the rotary valve member or in an extension thereof and rotates therewith.

5. A thrust bearing according to Claim 1, 2 or 3 characterised in that the hydraulic cushion is mounted in a stationary part with its piston coaxial with and adapted to engage with the end of the rotary valve member or with an attachment thereto.

6. A thrust bearing according to any of the preceding Claims characterised in that the relatively rotating surfaces including the end of the piston are lubricated by the hydraulic fluid.

7. A thrust bearing for a rotary valve member constructed and arranged substantially as herein described with reference to and as illustrated in either figure of the accompanying drawings.

8. A rotary valve assembly comprising a housing and a rotary valve member mounted therein having complementary tapered bearing and gas-sealing surfaces, subject to gaseous axial thrust in a direction to load such surfaces, means for lubricating the said surfaces, a bridge or cover secured to the housing over the rotary valve member, and a hydraulic thrust cushion located between the bridge or cover and the rotary valve member adapted to take part of the axial thrust loads.

9. A rotary valve assembly according to Claim 8 wherein the hydraulic thrust cushion is characterised according to any of the preceding Claims 2 to 7 inclusive.

10. The method of mounting a rotary valve member of the kind located in a housing and having complementary tapered gas-sealing and lubricated bearing surfaces and subject to gaseous axial thrust in a direction to load such surfaces, wherein a hydraulic thrust cushion is provided to take a part of the thrust loads.

Dated this 22nd day of June, 1943.

For the Applicant,
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560,086. COMPLETE SPECIFICATION

[This Drawing is a reproduction of the Original on a reduced scale.]

Fig.1.

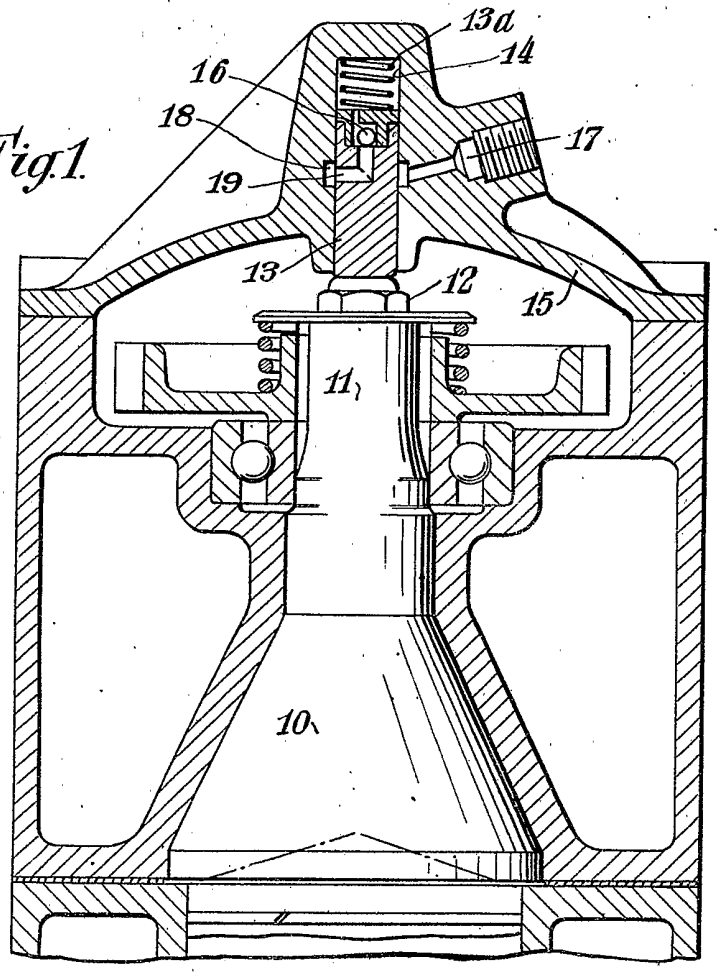
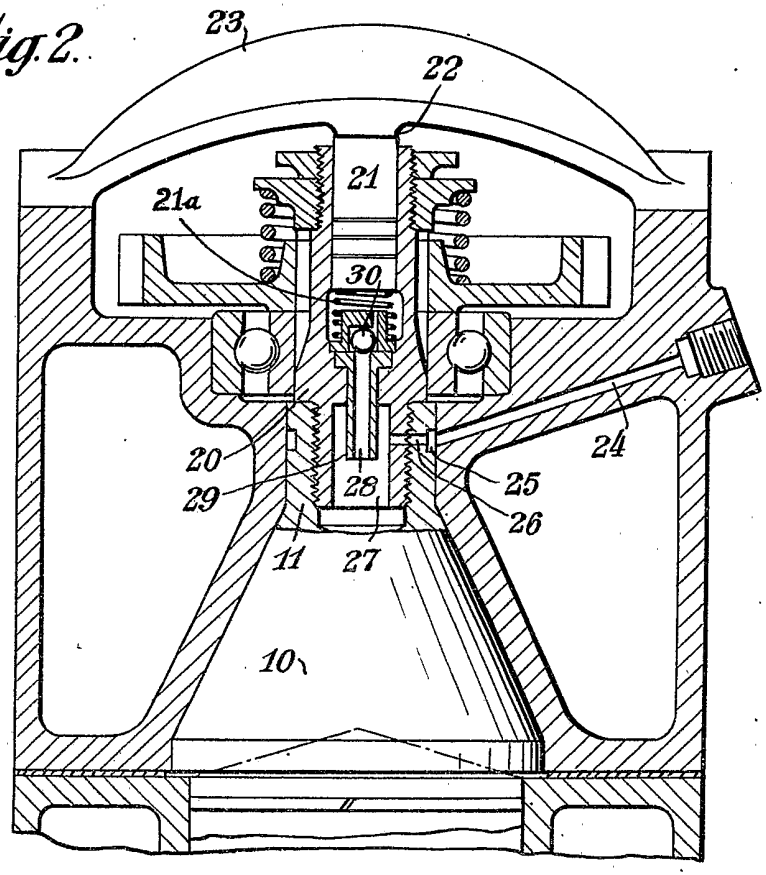


Fig.2.



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