[Second Edition.]

# PATENT SPECIFICATION

Application Date: Feb. 2, 1931. No. 3221/31. **373,660**

Complete Left: Sept. 7, 1931.

Complete Accepted: June 2, 1932.

PROVISIONAL SPECIFICATION.

## Improvements in the Sealing and Lubricating of Valves for Internal Combustion or other Engines and Pumps.

I, ROLAND CLAUDE CROSS, of 17, Old Warminster Road, Odd Down, Bath, in the county of Somerset, a British subject, do hereby declare the nature of this invention to be as follows:—

In the use of Rotary, Sleeve, Slide and other valves of the type in which the wall of the valve is used to control the opening and closing of a port or ports in the cylinder or cylinder head of internal combustion or other engines or pumps, it has been found that two difficulties have presented themselves. The first of these difficulties has been to make the valve sufficiently gas tight to reduce the leakage to proportions that are not material, and the second of the said difficulties has been to provide the valve with an adequate supply of lubricant without the extravagant wastage of same.

My invention aims at providing a satisfactory solution of both the said difficulties by one and the same means.

I provide a thin bush, which is pressed or otherwise fastened into the valve housing, and in which the valve rotates, slides or otherwise moves to perform its work of opening and closing the said port in the cylinder or cylinder head. This bush will, of course, have a hole in its wall to register with the port in the cylinder head and the said bush, at that part of it which forms the periphery of the said hole and for some distance all round it, will be shaped so as to press slightly inwards towards the wall of the valve, so that the edge of the said hole is resiliently pressed against the wall of the said valve. By so pressing the bush towards the valve adjacent to the edge of the said port, a slight gap is produced between the said bush and the valve housing at that part. This permits of the gas pressure in the said cylinder to get underneath the said bush for a short distance adjacent to the edge of the said port, thereby further tending to press the said edge of the bush against the said valve. This means that the valve is enabled to have a good working clearance in the bush, and that whatever position the valve is in the clearance of the bush, the said edge of the bush will resiliently follow the surface of the said valve, thereby making it sufficiently gas tight for all practical purposes.

In a similar manner, an oil hole or oil holes are cut in the surface of the bush, such oil holes communicating with the oil supply, the edges of the said oil holes being pressed inwards, so as resiliently to press against the surface of the valve. This allows the oil to be wiped on to the valve in a thin film, but at the same time does not allow the oil to escape so freely into the clearance between the said valve and the said bush as to be wasteful The said oil holes would for preference be elongated in shape.

Dated this 31st day of January, 1931.

ROLAND C. CROSS.

COMPLETE SPECIFICATION.

## Improvements in the Sealing and Lubricating of Valves for Internal Combustion or other Engines and Pumps.

I, ROLAND CLAUDE CROSS, a British subject, of 17, Midford Road (late Old Warminster Road), Odd Down, Bath, Somerset, 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 valve assemblies for internal combustion and other engines and pumps (e.g. rotary, piston, reciprocal, and sleeve valves) of the type wherein a valve element slides on a bearing surface in rotary and/or reciprocal manner and is used to control the opening and closing of a port or ports in

the bearing element. An important application of the invention is to rotary valves disposed at the cylinder head of an internal combustion engine or pump.

The said invention has for its object to enable such valves to be used efficiently by removing the chief disadvantages which exist in such types, viz: (a) pressure leakage between the valve and its bearing, (b) poor lubrication or extravagant wastage of lubricant. By the present invention the leakage is reduced to negligible proportions notwithstanding that the usual necessary clearance between the relatively sliding parts is maintained, and adequate lubrication may be employed without risk of wasteful flooding.

Cylindrical valve members constructed to fit resiliently in rigid bearings have been proposed, and it is known conversely to form the valve bearing with a degree of resiliency around its port or ports. For example, the metal of an unlined cylindrical bearing of a rotary valve has been split about the port so as to form a series of resilient tongues; it has also been proposed to construct a flat seating or bearing plate for a disc valve with a continuous flexible flange extending around a port in said bearing plate and adapted to be pressed against the plate valve by fluid pressure.

According to the present invention, a valve assembly of the type set forth is characterised by the provision of a bearing liner fixed in or to the valve housing and surrounded by or surrounding the valve mounted therein, a port (which registers with the port in the valve housing) being provided in the said liner, said port being formed at the surface of said liner with which the valve coacts, by a resilient lip pressed up from said liner and having an unbroken or continuous edge. The said lip tends to project into the space occupied by the valve, and thus, when the complete valve components are assembled, the lip is normally pressed back by the valve to form a fluid-tight seal. The lip pressure then follows and takes up any play of or resulting from bad alignment of the valve in any direction. In the case of cylindrical valves (to which the invention is particularly applicable) the method of forming the lip by pressing the same up from the liner enables a lip having a continuous edge readily to be formed on a cylindrical surface. The thickness of the resilient lip may vary across the width thereof (being thinnest at the edge) so as to increase the flexibility or resiliency of the lip.

While suitable materials for use as a liner in the present invention are cobalt chrome steel (white metal lined) and hard drawn bronze tube, any metal or alloy which has properties such that it can be used as a bearing surface and at the same time has sufficient elasticity to allow of the resilient lip being pressed up with a continuous edge can be used for the purposes of the present invention.

In an example of the invention, a rotary valve according to the invention may be formed with inlet and outlet ports coacting with a port or ports in the valve chamber, the latter being provided with a fixed cylindrical liner constituting the bearing element, said liner being formed with a port or ports in register with the valve chamber ports, the ports in the liner having resilient margins pressing on to the rotary valve element. The thickness of the resilient lip may vary as previously mentioned to increase the resiliency.

It will be readily understood that although the bearing liner from the point of view of the working of the valve assembly is to be regarded as fixed immovably on or to the valve housing the said bearing liner is nevertheless capable of being removed from such housing for the purposes of repair or replacement.

In order that the invention may be more clearly understood reference is directed to the following description of some particular embodiments, which are given by way of example only, and are illustrated by the accompanying drawings, in which:—

Figure 1 is a vertical section of an internal combustion engine fitted with a rotary valve controlling the inlet and exhaust of the cylinder according to the invention;

Figure 2 is a vertical section of a similar arrangement according to a modification;

Figure 3 is a transverse section of a water-cooled example of an internal combustion engine, according to a further modification;

Figure 4 shows the invention, in one of its forms applied to a reciprocal slide valve;

Figures 5—9 are details, to a larger scale, of sealing lips hereinafter referred to, all shown on a flat plane for convenience.

In Figures 1 to 3, there is provided a thin bearing liner or bush 1, which is pressed or otherwise fastened into the valve housing 2, and in which the valve 3 rotates to perform its work of opening and closing the port 4 in the cylinder or cylinder head 5. This liner or bush 1 has a hole 6 in its wall to register with the port 4, and the said bush, at that part of it which forms the periphery of the said hole, and for some distance all round it

is shaped with a lip 8 so as to press slightly inwards towards the working face of the valve 3, so that the edge of the said hole is resiliently pressed against the wall of the said valve. By so pressing the liner or bush 1 inwards toward the valve 3 adjacent to the edge of the said port 4, a slight gap 7 is produced between the said liner 1 and the valve housing 2. This permits of the gas pressure in the said cylinder to get underneath the said liner for a short distance adjacent to the port, thereby further tending to press the said edge of the liner against the said valve. This means that the valve is enabled to have a good working clearance in the liner, and that whatever position the valve assumes in the clearance of the liner, the said edge or lip 8 of the liner will resiliently follow the surface of the said valve, thereby making it sufficiently gas tight for all practical purposes.

The clearance between the valve 3 and the liner 1 is necessarily greatly exaggerated in Figures 1—3 to show the deflected lip 8, but obviously for all practical purposes the lip may be regarded as having been pressed substantially back to the plane of the working surface of the liner or bush when in assembled position.

The lip 8 may be simply a resilient deflection of the margin of the port orifice 6, as in Figures 1 and 5, or may be thinned by slitting or V-cutting as in Figures 2 and 6, or by chamfering as in Figures 3 and 7. The last mentioned form is shown also as the example in Figure 4 where the invention is applied to a reciprocal slide valve 9 working between bearing faces 10 which are the equivalent of the bearing liner or bush 1.

Figures 8 and 9 show examples wherein the lip is set back from the margin of the port, but surrounding or circumscribing the port boundary as in the other illustrated cases.

In a similar manner (see Figure 3, an oil hole or oil holes or ports 11 may be cut in the surface of the liner 1, such oil holes communicating with the oil supply, the edges of the said oil holes being pressed inwards as lips 8* so as resiliently to press against the surface of the valve. This allows the oil to be wiped on to the valve in a thick film, but at the same time, does not allow the oil to escape so freely into the clearance between the valves and the liner 1 as to be wasteful. The said oil holes would, for preference, be elongated in shape.

The liner 1 or 10 may be a composite member to ensure a good bearing metal at one side and a more elastic metal at the other. For example a liner or a bush of high tensile steel could be formed with a thin bearing face of white metal.

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 valve assembly for internal combustion or other engines and pumps of the type set forth, characterised by a bearing liner fixed in or to the valve housing, a port or ports being provided in the said liner, such port or ports being formed or surrounded, at the surface of said liner with which the valve co-acts, by a resilient lip pressed up from said liner and having an unbroken or continuous edge, said lip tending to project into the space occupied by the valve and being normally pressed back by the valve to form a fluid-tight seal.

2. A cylindrical valve assembly according to Claim 1 wherein the bearing liner is cylindrical and embraces or is embraced by a cylindrical valve, the port or ports in said liner being formed or surrounded on the cylindrical surface by a pressed up continuous integral lip tending to project into the valveway, and normally pressed back by the valve to form a fluid-tight seal.

3. A valve assembly according to Claim 1 or 2 characterised in that lubricant is introduced through the port in the liner to the valve surface passing said port, a regulated film only of said lubricant being carried into the space between valve and liner by reason of the leak-proof resilient lip of the liner port which tends to project into the valveway and is normally pressed back by the valve.

4. A valve assembly as claimed in any of the preceding Claims characterised in that the thickness of the leak proof resilient lip varies across the width thereof being thinnest at the free continuous edge so as to increase the flexibility of the lip.

5. For use with valve assemblies according to the preceding Claims, a liner for securing in the valve housing to provide a valve bearing, said liner having a port or ports formed with an integral resilient lip having an unbroken or continuous edge pressed up from the valve-bearing surface into the valveway.

6. A cylindrical rotary valve assembly for internal combustion engines constructed substantially as herein described with reference to Figures 1, 2 and 5 to 9 of the accompanying drawings.

7. A reciprocal sliding valve assembly for internal combustion or other engines and pumps constructed substantially as herein described with reference to Figures

3, 4 and 5 to 9 of the accompanying drawings.

Dated this 7th day of September, 1931.

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Agent for the Applicant.

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[Wt. 37A.—50/3/1934.]

FIG. 1.

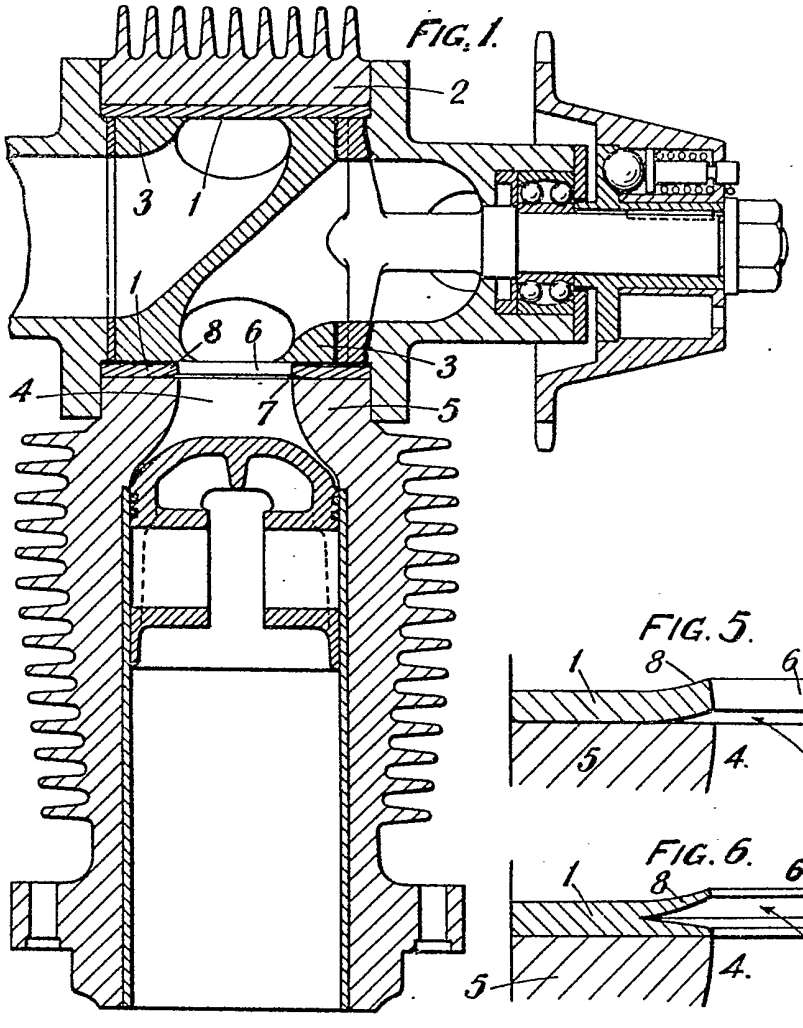


FIG. 5.




FIG. 6.




FIG. 2.

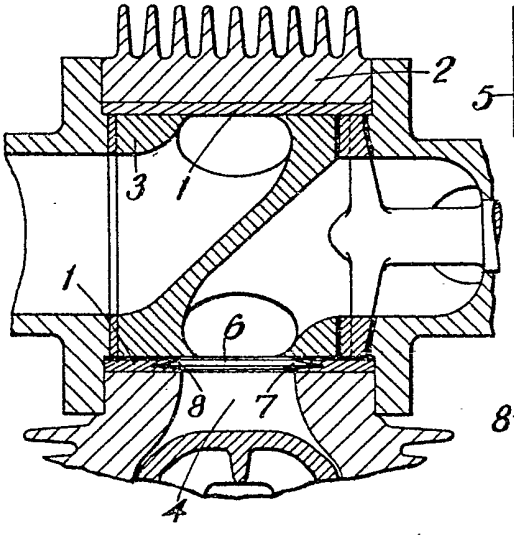


FIG. 7.

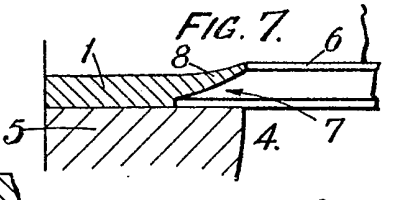


FIG. 8.

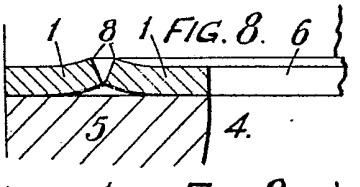


FIG. 9.

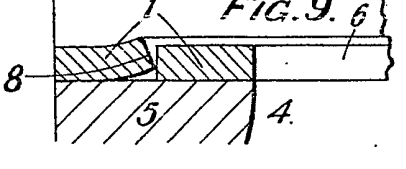

FIG. 4.

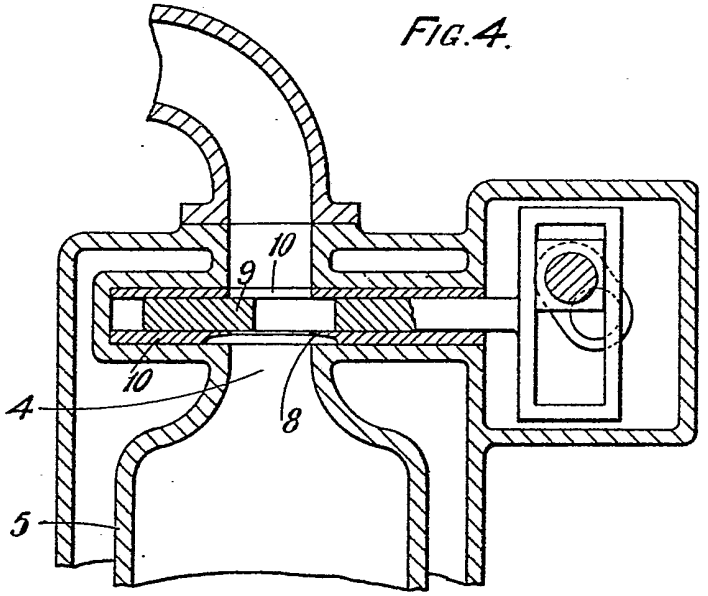


FIG. 3.

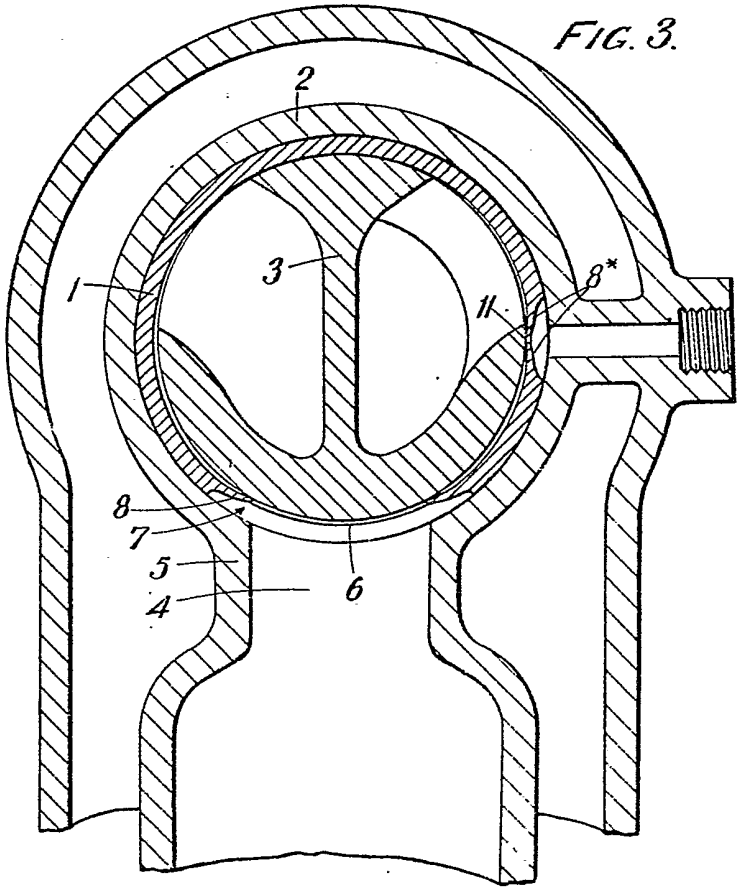


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FIG. 1.

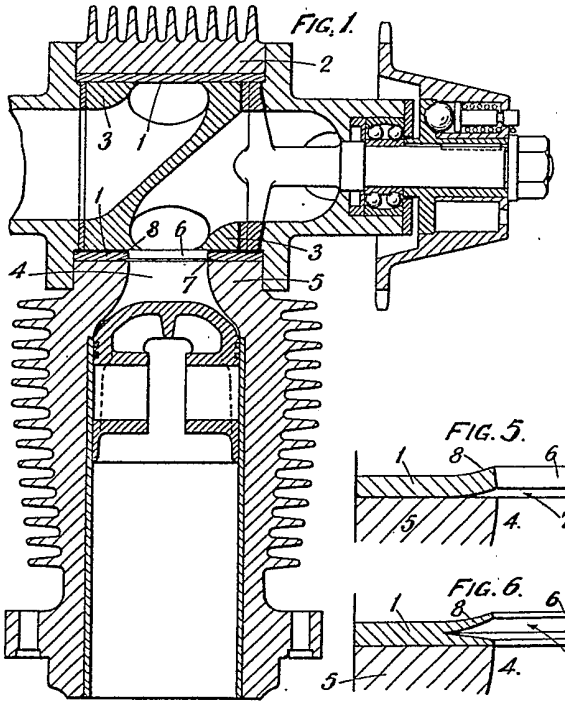



FIG. 2.

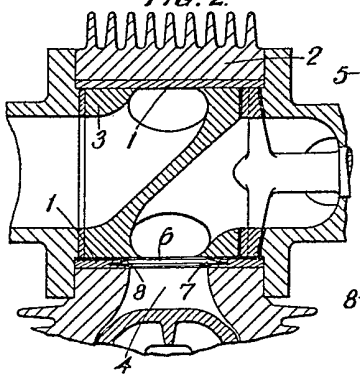



FIG. 5.




FIG. 6.




FIG. 7.

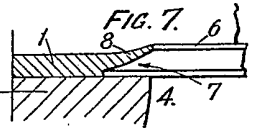



FIG. 8.

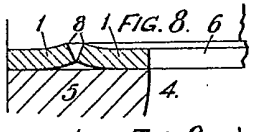



FIG. 9.

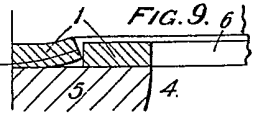



FIG. 4.

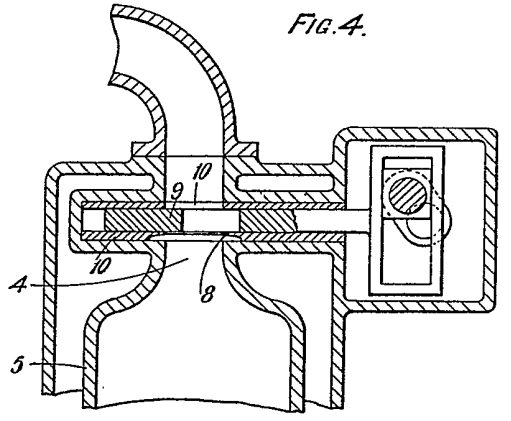
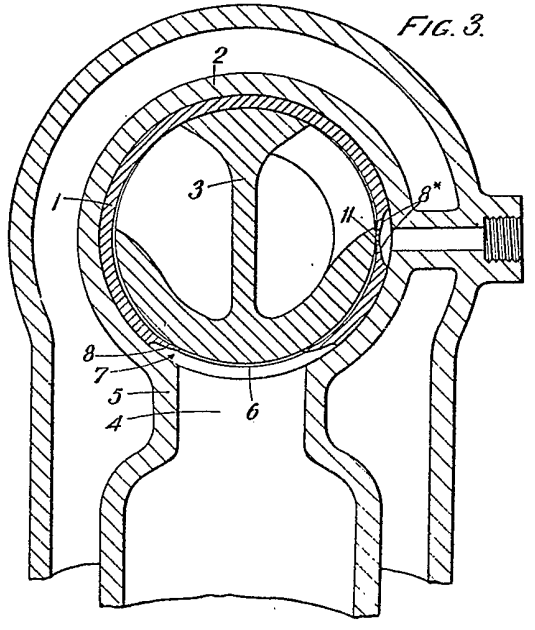



FIG. 3.

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