PATENT SPECIFICATION

Application Date: March 11, 1943. No. 3949/43. **564,850**

Complete Specification Left: March 8, 1944.

Complete Specification Accepted: Oct. 16, 1944.

Imp

I, FRANI
Subject, of
mersley Roa
by declare
to be as fol
This inve
bustion eng
pressors of
ber rotatabl
complement
bearing sur
in the housi
a combined
and throu
passage is
and is al
the other
at the said tapered surface and co-operates with a port in the complementary tapered surface of the housing.

An internal combustion engine of the kind aforesaid is described in the Specification of my Patent No. 463,412 from which the present invention has been developed.

Research and development of the engine of the earlier patent aforesaid by the inventor have resulted in the appreciation of certain problems connected directly with the construction of the rotary valve member and its housing.

The present invention is concerned with the problem of pressures at the complementary tapered surfaces, and the allied problem of lubrication and gas sealing, in combination with such problems as combustion chamber form, port areas, flame control, detonation control etc.

Obviously the pressure at the said tapered surfaces is proportional to the area of that end of the rotatable valve member which is exposed to gaseous pressure within the cylinder. In the construction of engine according to the said earlier Patent No. 463,412 substantially the whole area of the end of the valve member is thus exposed. At the same time it must be remembered that such pressure not only fluctuates and in an internal combustion engine reaches a peak value during the combustion phase, but there is a complete pressure reversal dur-

ERRATA

SPECIFICATION No. 564,850.

Page 1, line 100, *for* " , " *read* " ; "
Page 2, line 111, *after* " except " *insert* " that "
Page 4, line 114, *for* " larger " *read* " cylinder "

THE PATENT OFFICE,
December 6th, 1944.

chamber and through passage one end of which passage is at the end of the valve member and is always open to the cylinder and the other end of which passage is located at the tapered surface and co-operates with a port in the complementary tapered surface of the housing is characterised in that the cylinder has an opening towards the valve member which is substantially smaller than the adjacent end of the valve member and the area of which is preferably substantially the area swept by the adjacent end of the passage in the valve member and is off-set relative to the axis of the cylinder.

According to one embodiment of the invention an internal combustion engine or the like of the kind referred to is characterised by baffle means between the valve member and the cylinder to shield the adjacent end of the valve member from a substantial part or the whole of the area of the end of the cylinder not swept by the end of the passage in the valve member, such baffle means being off-set relative to the axis of the cylinder.

According to further features of the invention the internal combustion engine or the like may be further characterised in that the direction of off-setting is towards the originating location of ignition, or in internal combustion engines or the like the construction may be further characterised in that the end of the passage in the valve member which is open towards

PATENT SPECIFICATION

Application Date: March 11, 1943. No. 3949/43.

564,850

Complete Specification Left: March 8, 1944.

Complete Specification Accepted: Oct. 16, 1944.

PROVISIONAL SPECIFICATION

Improvements in or relating to Internal Combustion Engines and the like

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 internal combustion engines and the like such as compressors of the kind having a valve member rotatably mounted in a housing, with complementary tapered gas-sealing and bearing surfaces on the valve member and in the housing, said valve member having a combined combustion or like chamber and through passage, one end of which passage is at the end of the valve member and is always open to the cylinder and the other end of which passage is located at the said tapered surface and co-operates with a port in the complementary tapered surface of the housing.

An internal combustion engine of the kind aforesaid is described in the Specification of my Patent No. 463,412 from which the present invention has been developed.

Research and development of the engine of the earlier patent aforesaid by the inventor have resulted in the appreciation of certain problems connected directly with the construction of the rotary valve member and its housing.

The present invention is concerned with the problem of pressures at the complementary tapered surfaces, and the allied problem of lubrication and gas sealing, in combination with such problems as combustion chamber form, port areas, flame control, detonation control etc.

Obviously the pressure at the said tapered surfaces is proportional to the area of that end of the rotatable valve member which is exposed to gaseous pressure within the cylinder. In the construction of engine according to the said earlier Patent No. 463,412 substantially the whole area of the end of the valve member is thus exposed. At the same time it must be remembered that such pressure not only fluctuates and in an internal combustion engine reaches a peak value during the combustion phase, but there is a complete pressure reversal during the induction phase. Such pressure variations are the greater because of the higher compression ratios which can be employed with such engines, compared with compression ratios previously considered normal. (Also combustion chamber form and flame and detonation control become correspondingly more important with the increase of combustion pressures.)

According to the invention an internal combustion engine or the like having a valve member rotatably mounted in a housing with complementary tapered gas-sealing and bearing surfaces on the valve member and in the housing, said valve member having a combined combustion chamber and through passage one end of which passage is at the end of the valve member and is always open to the cylinder and the other end of which passage is located at the tapered surface and co-operates with a port in the complementary tapered surface of the housing is characterised in that the cylinder has an opening towards the valve member which is substantially smaller than the adjacent end of the valve member and the area of which is preferably substantially the area swept by the adjacent end of the passage in the valve member and is off-set relative to the axis of the cylinder.

According to one embodiment of the invention an internal combustion engine or the like of the kind referred to is characterised by baffle means between the valve member and the cylinder to shield the adjacent end of the valve member from a substantial part or the whole of the area of the end of the cylinder not swept by the end of the passage in the valve member, such baffle means being off-set relative to the axis of the cylinder.

According to further features of the invention the internal combustion engine or the like may be further characterised in that the direction of off-setting is towards the originating location of ignition, or in internal combustion engines or the like the construction may be further characterised in that the end of the passage in the valve member which is open towards

the cylinder is concentric with the axis of rotation of the valve member; in that the cylinder opening towards the valve member is the same size as and concentric with the adjacent end of the passage in the valve member; in that the cylinder has an end wall in which is located the opening towards the valve member; in that the said end wall is formed in a part which is separable from the cylinder; in that the said end wall of the cylinder is provided with cooling means, which may be an internal cooling space and into which a cooling fluid, gaseous or liquid, may be admitted preferably with a directional factor towards the cylinder for increased contact with the heat-conducting wall of the said passage; in that the separable part, or at least that portion of it forming the end wall of the cylinder is made of metal of high heat conductivity; and in that a sealing ring is provided close to the opening in the valve member so as to perform the dual function of restricting the spread of gaseous pressure to the surrounding area of the end of the valve member and of checking loss of lubricant from such surrounding area.

The accompanying drawing is a sectional elevation of part of an internal combustion engine constructed according to one example of the invention.

As shown in the drawing the upper end only of the cylinder a is shown and has a liquid cooling space a^1. On the end of the cylinder is a separable cylinder head part b having its own internal cooling fluid space b^1 such part being located concentrically on the cylinder by an annular flange b^2. Adjacent such flange b^2 the cylinder head part has a bore which is concentric with the cylinder bore. At its opposite face there is an outlet c which is off-set so that in the diameter on which the section is taken lie the axis of the cylinder bore and of such outlet c. The larger bore is extended into the part so as to leave an inclined cylinder end wall which viewed from within the cylinder will be crescent shaped. At the widest point of such inclined end wall of the cylinder the fluid cooling space is brought in to provide extra cooling area at d whilst directed immediately on to such area d is a jet d^1 by which the cooling fluid is introduced to the space b^1 so as to give extra effective cooling at such area. Around the outlet c is an upstanding flange e concentric with the outlet and grooved to hold a sealing ring f.

Against the cylinder head part b is the housing g for the rotary conical valve member h. The housing has internal liquid cooling spaces g^1 and on the section shown is adapted to receive a sparking plug g^2. The inlet conduit g^3 is also seen where it passes through the cooling fluid space g^1 from the inlet port opening at the conical bearing surface.

The rotary valve h has an internal cooling space h^1 into which cooling fluid, liquid or gaseous, may be introduced to impinge against the wall of a passage k leading from the conical wall of the valve to the end of the valve where its opening is concentric with the axis of the conical surface of the valve. The underside of the valve is formed with a recess, complementary to the flange e and engaged by the sealing ring f. Clearance space is provided to permit the valve to move downward axially away from its seating to compensate for expansion differences and because slight axial movement is desirable to help maintain the film of lubricant at the conical bearing and gas sealing surfaces.

The piston m, of which the upper end only is shown has an inclined top, part of which, when the piston is at the top of its stroke, as shown, is complementary to the inclined end wall of the cylinder leaving only a thin space which is of considerable importance in controlling detonation.

In operation, the part b with its off-set opening smaller than the end of the valve member and of the same area and concentric with the lower end of the passage in the valve member, provides a baffle effect which reduces the area of the valve exposed to the cylinder pressures. At high speeds the thin clearance area between the end of the flange c and the valve will offer sufficient resistance to the access of gaseous pressure so that only an average pressure and not peak pressures can obtain in such clearance space. The gas sealing ring f limits the spread of any gas pressures which reach the clearance space. Thus, for all practical purposes, all the end of the valve member except including the end of the passage therein, is shielded from the cylinder pressures. As the end of the passage in the valve member is concentric with the axis of rotation of the valve, the area of the opening is also the area swept by such end of the passage. The sealing ring f also operates to prevent reverse or induction reduced pressures from drawing lubricant from the area surrounding the end of the valve outside such ring which ring therefore performs a dual function.

The off-setting of the outlet c towards the ignition means increases the length of the detonation zone between the end of the piston and the complementary shape of the end wall of the cylinder and intensive cooling is provided therefor by the

cooling wall *d* and the cooling jet *d*[1] directed thereon.

This construction provides considerable possibilities of variation of shape for the piston head and cylinder end wall for obtaining optimum flame and detonation control according to requirements of any particular engine.

By introducing the separate part *b* between the end of the cylinder and the valve housing, such part may easily be made of a metal of high conductivity providing still better temperature control, which is a main factor in detonation control.

By shielding a substantial portion of the end of the valve from gaseous pressures in the cylinder not only are the bearing loads reduced but also the valve member may be made larger in diameter with certain obvious advantages and without the disadvantage of proportional increase of axial pressures on the valve.

In addition to the advantages already explained such as reducing bearing pressures at the conical surface of the valve; enabling larger valves to be used; extending the detonation zone at the end of the flame travel due to off-setting and intensive temperature control at such detonation zone the construction provides for example that a cross drive for the rotors may be brought nearer to the centre line of the cylinders. Also when the cylinders are spaced in pairs the off-setting of the valve members of the cylinders of a pair viewed endwise may be other than at right angles to the line of the cylinders and either parallel, convergent, or divergent with each other so as to reduce overall dimensions.

Obviously the invention is not limited to all the details of the constructions above described, many of which may be modified without departing from the nature of the invention. For example the end opening of the passage in the end of the valve member may be eccentric instead of concentric with the conical surface of the valve, in which case the opening from the cylinder whilst still being concentric may be larger so as to include the whole area swept by the end opening of the passage in the valve. Also, such opening in the end of the valve and in the baffle part whilst preferably circular may be of other shape. Again the engine cylinder and/or cylinder head part may be externally air-cooled instead of internally cooled as above described. Also, the cylinder head part may be integral with the cylinder though the separate construction has obvious advantages and possibilities.

Dated this 25th day of February, 1943.
For the Applicant,
WILSON, GUNN & ELLIS,
Chartered Patent Agents,
54/56, Market Street, Manchester, 1.

COMPLETE SPECIFICATION

Improvements in or relating to Internal Combustion Engines and the like

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 valve assemblies for internal combustion engines and the like such as compressors of the kind having a valve member rotatably mounted in a housing, with complementary tapered gas-sealing and bearing surfaces on the valve member and in the housing, said valve member having a combined combustion chamber and through passage, one end of which passage is at the end of the valve member and is always open to the cylinder and the other end of which passage is located at the said tapered surface and co-operates with a port in the complementary tapered surface of the housing.

An internal combustion engine of the kind aforesaid is described in the Specification of my Patent No. 463,412 from which the present invention has been developed.

Research and development of the engine of the earlier patent aforesaid by the inventor have resulted in the appreciation of certain problems connected directly with the construction of the rotary valve member and its housing and in particular the problem of bearing surface pressures.

The present invention is concerned with the problem of pressures at the complementary tapered surfaces, and the allied problem of lubrication and gas sealing, in combination with such problems as combustion chamber form, port areas, flame control, detonation control etc.

Obviously the pressure at the said tapered surfaces is proportional to the area of that end of the rotatable valve

member which is exposed to gaseous pressure within the cylinder. In the construction of engine according to the said earlier Patent No. 463,412 substantially the whole area of the end of the valve member is thus exposed. At the same time it must be remembered that such pressure not only fluctuates and in an internal combustion engine reaches a peak value during the combustion phase, but there is a complete pressure reversal during the induction phase. Such pressure variations are the greater because of the higher compression ratios which can be employed with such engines, compared with compression ratios previously considered normal. Also combustion chamber form and flame and detonation control become correspondingly more important with the increase of combustion pressures.

According to the invention a rotary valve assembly for an internal combustion engine or the like comprises a valve housing located at the end of the engine cylinder and a rotary valve member mounted in the said housing, the said rotary valve member and housing having complementary tapered gas-sealing and bearing surfaces, said rotary valve member also having a through passage, one end of which passage is at the end of the valve member and is always open to the cylinder and the other end of which passage is located at the said tapered surface and co-operates with a port in the complementary tapered surface of the housing, the engine cylinder having an end wall with an opening towards the rotary valve member which is smaller than the adjacent end of the said rotary valve member and the area of which opening is substantially the area swept by the end of the passage in the said rotary valve member and is off-set relative to the axis of the cylinder.

According to one embodiment of the invention an internal combustion engine or the like of the kind referred to is characterised by a baffle member located between the valve member and the cylinder to shield the adjacent end of the valve member from a substantial part or the whole of the area of the end of the cylinder not swept by the end of the passage in the valve member, such baffle means being off-set relative to the axis of the cylinder.

According to further features of the invention the internal combustion engine or the like may be further characterised in that the direction of off-setting is towards the originating location of ignition, or in internal combustion engines or the like the construction may be further characterised in that the end of the passage in the valve member which is open towards the cylinder is concentric with the axis of rotation of the valve member; in that the cylinder opening towards the valve member is the same size as and concentric with the adjacent end of the passage in the valve member; in that the cylinder has an end wall in which is located the opening towards the valve member; in that the said end wall is formed in a part which is separable from the cylinder; in that the said end wall of the cylinder is provided with cooling means, which may be an internal cooling space and into which a cooling fluid, gaseous or liquid, may be admitted preferably with a directional factor towards the cylinder for increased contact with the heat-conducting wall of the said passage; in that the separable part, or at least that portion of it forming the end wall of the cylinder is made of metal of high heat conductivity; and in that a sealing ring is provided close to the opening in the valve member so as to perform the dual function of restricting the spread of gaseous pressure to the surrounding area of the end of the valve member and of checking loss of lubricant from such surrounding area.

The drawing filed with the Provisional Specification is a sectional elevation of part of an internal combustion engine constructed according to one example of the invention.

As shown in the drawing the upper end only of the cylinder a is shown and has a liquid cooling space a^1. On the end of the cylinder is a separable cylinder head part b having its own internal cooling fluid space b^1 such part being located concentrically on the cylinder by an annular flange b^2. Adjacent such flange b^2 the cylinder head part has a bore which is concentric with the cylinder bore. At its opposite face there is an outlet c which is off-set so that in the diameter on which the section is taken lie the axis of the cylinder bore and of such outlet c. The larger bore is extended into the part so as to leave an inclined cylinder end wall which viewed from within the cylinder will be crescent shaped. At the widest point of such inclined end wall of the cylinder the fluid cooling space is brought in to provide extra cooling area at d whilst directed immediately on to such area d is a jet d^1 by which the cooling fluid is introduced to the space b^1 so as to give extra effective cooling at such area. Around the outlet c is an upstanding flange e concentric with the outlet and grooved to hold a sealing ring f.

Against the cylinder head part b is the housing g for the rotary conical valve member h. The housing has internal

liquid cooling spaces g^1 and on the section shown is adapted to receive a sparking plug g^2. The inlet conduit g^3 is also seen where it passes through the cooling fluid space g^1 from the inlet port opening at the conical bearing surface. For convenience the conduit g^3 is shown in section and diametrically opposite to the sparking plug, which is obviously not its true relative position.

The rotary valve h has an internal cooling space h^1 into which cooling fluid, liquid or gaseous, may be introduced to impinge against the wall of a passage k leading from the conical wall of the valve to the end of the valve where its opening is concentric with the axis of the conical surface of the valve. The underside of the valve is formed with a recess, complementary to the flange e and engaged by the sealing ring f. Clearance space is provided to permit the valve to move downward axially away from its seating to compensate for expansion differences and because slight axial movement is desirable to help maintain the film of lubricant at the conical bearing and gas sealing surfaces.

The piston m, of which the upper end only is shown has an inclined top, part of which, when the piston is at the top of its stroke, as shown, is complementary to the inclined end wall of the cylinder leaving only a thin space which is of considerable importance in controlling detonation.

In operation, the part b with its off-set opening smaller than the end of the valve member and of the same area and concentric with the lower end of the passage in the valve member, provides a baffle effect which reduces the area of the valve exposed to the cylinder pressures. At high speeds the thin clearance area between the end of the flange c and the valve will offer sufficient resistance to the access of gaseous pressure so that only an average pressure and not peak pressures can obtain in such clearance space. The gas sealing ring f limits the spread of any gas pressures which reach the clearance space. Thus, for all practical purposes, all the end of the valve member except that including the end of the passage therein, is shielded from the cylinder pressures. As the end of the passage in the valve member is concentric with the axis of rotation of the valve, the area of the opening is also the area swept by such end of the passage. The sealing ring f also operates to prevent reverse or induction reduced pressures from drawing lubricant from the area surrounding the end of the valve outside such ring which ring therefore performs a dual function.

The off-setting of the outlet c towards the ignition means increases the length of the detonation zone between the end of the piston and the complementary shape of the end wall of the cylinder and intensive cooling is provided therefor by the cooling wall d and the cooling jet d^1 directed thereon.

This construction provides considerable possibilities of variation of shape for the piston head and cylinder end wall for obtaining optimum flame and detonation control according to requirements of any particular engine, as known in the art.

By introducing the separate part b between the end of the cylinder and the valve housing, such part may easily be made of a metal of high conductivity providing still better temperature control, which is a main factor in detonation control.

By shielding a substantial portion of the end of the valve from gaseous pressures in the cylinder not only are the bearing loads reduced but also the valve member may be made larger in diameter with certain obvious advantages such as larger ports and without the disadvantage of proportional increase of axial pressures on the valve.

In addition to the advantages already explained such as reducing bearing pressures at the conical surface of the valve; enabling larger valves to be used; extending the detonation zone at the end of the flame travel due to off-setting and intensive temperature control at such detonation zone the construction provides for example that a cross drive for the rotors may be brought nearer to the centre line of the cylinders. Also when the cylinders are spaced in pairs the off-setting of the valve members of the cylinders of a pair viewed endwise may be other than at right angles to the line of the cylinders and either parallel, convergent, or divergent with each other so as to reduce overall dimensions.

Obviously the invention is not limited to all the details of the constructions above described, many of which may be modified without departing from the nature of the invention. For example the end opening of the passage in the end of the valve member may be eccentric instead of concentric with the conical surface of the valve, in which case the opening from the cylinder whilst still being concentric with the axis of the rotary valve member may be larger so as to include the whole area swept by the end opening of the passage in the valve. Also, such opening in the end of the valve and in the baffle part whilst preferably circular may be of other shape. Again the engine cylinder and/or cylinder head

part may be externally air-cooled instead of internally cooled as above described. Also, the cylinder head part may be integral with the cylinder though the separate construction above described has obvious advantages and possibilities.

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 assembly for an internal combustion engine or the like comprising a valve housing located at the end of the engine cylinder and a rotary valve member mounted in the said housing, the said rotary valve member and housing having complementary tapered gas-sealing and bearing surfaces, said rotary valve member also having a through passage, one end of which passage is at the end of the valve member and is always open to the cylinder and the other end of which passage is located at the said tapered surface and co-operates with a port in the complementary tapered surface of the housing, the engine cylinder having an end wall with an opening towards the rotary valve member which is smaller than the adjacent end of the said rotary valve member and the area of which opening is substantially the area swept by the end of the passage in the said rotary valve member and is off-set relative to the axis of the cylinder.

2. A rotary valve assembly according to Claim 1 characterised by a baffle member adapted to be secured to the cylinder and forming the end wall of the cylinder and embodying the said opening towards the rotary valve member.

3. A rotary valve assembly according to Claim 1 or 2 characterised by means for originating ignition located in the housing and adapted to be uncovered by the through passage in the rotary valve member, the off-setting of the opening in the end of the cylinder being towards said means for originating ignition.

4. A rotary valve assembly according to Claim 1, 2 or 3 characterised in that the end of the passage in the valve member which is open towards the cylinder is circular and concentric with the axis of rotation of the valve member.

5. A rotary valve assembly according to Claim 4 further characterised in that the cylinder opening towards the rotary valve member is circular and the same size as and concentric with the adjacent end of the passage in the said valve member.

6. A rotary valve assembly according to any of the preceding Claims characterised in that the end wall of the cylinder is provided with direct cooling means.

7. A rotary valve assembly according to any of the preceding Claims characterised in that the end wall of the cylinder is formed with an internal cooling space.

8. A rotary valve assembly according to Claim 7 further characterised by means for admitting a cooling fluid gaseous or liquid, with a directional factor towards the back face of the end wall proper.

9. A rotary valve assembly according to any of the preceding Claims characterised in that the end wall of the cylinder is made of a metal of high heat conductivity.

10. A rotary valve assembly according to Claim 2 and any Claim appendant thereto characterised in that the baffle member is made of a metal of high heat conductivity.

11. A rotary valve assembly according to any of the preceding Claims characterised in that the end wall of the cylinder and the end of the rotary valve member are formed with complementary upstanding flange and recess to act as a gas seal.

12. A rotary valve assembly according to Claim 11 characterised by a sealing ring, located on the said flange and engaging the recess in the rotary valve member so as to perform the dual function of restricting the spread of gaseous pressure to the surrounding area of the end of the rotary valve member and of checking loss of lubricant from such surrounding area.

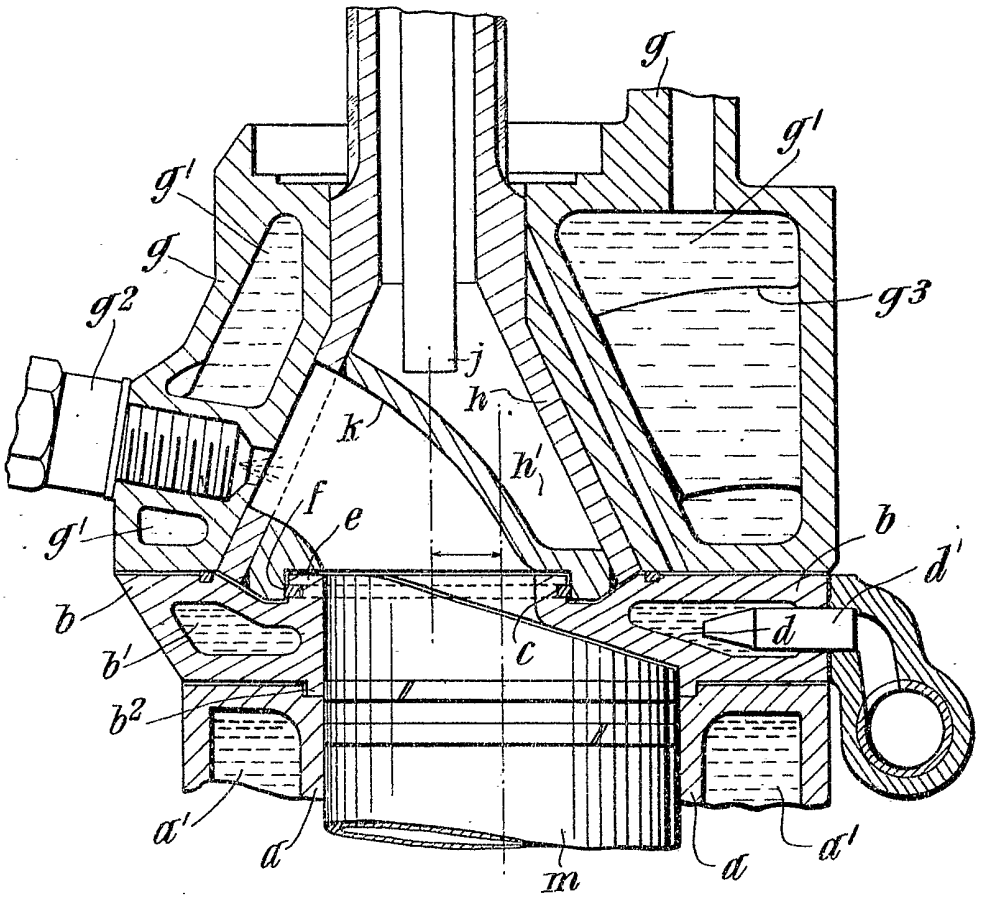
13. A rotary valve assembly constructed and arranged substantially as herein described with reference to and as illustrated in the drawing filed with the Provisional Specification.

14. An internal combustion engine or the like having a rotary valve assembly according to any of the preceding Claims.

Dated this 29th day of February, 1944.
For the Applicant,
WILSON, GUNN & ELLIS,
54/56, Market Street, Manchester, 1.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1944.

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



Malby & Sons, Photo-Lith.