PATENT SPECIFICATION

Application Date: Oct. 1, 1942. No. 13762/42. **562,549**

" " March 11, 1943. No. 3950/43.

[Patent of Addition to No. 535,856 dated Sept. 23, 1939.]

One Complete Specification left (under Section 16 of the Patents and Designs Acts, 1907 to 1942): Oct. 30, 1943.

Specification Accepted: July 6, 1944.

PROVISIONAL SPECIFICATION
No. 13762 A.D. 1942.

Improvements in or relating to Rotary Valve Assemblies 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 valve assemblies for engines and is an improvement in or development of the invention formng the subject of my prior Patent No. 535,856.

According to one feature of the invention an internal combustion engine having a rotary valve provided with an internal cooling space as claimed in the said earlier Patent, is characterised by means for producing a flow of cooling gaseous fluid into and out of said cooling space.

In one embodiment of the invention said means comprises a scoop adapted to be placed in an available current of flow of air and air conduits therefor.

In another embodiment of the invention said means comprises a fan or blower which may be mounted on or driven by the rotor of the valve.

In yet another embodiment of the invention said means includes an extractor, preferably of the venturi or injector type, associated with the exhaust system of the engine. Alternatively the engine induction may provide said means.

According to a further feature of the invention, a cooling liquid in the form of a spray or gaseous suspension is used in combination with the gaseous cooling fluid, and such cooling liquid may be sprayed directed into the cooling space of the rotary valve, and means may be provided for condensation and recovery of said liquid.

The invention further comprises a cooling system for the rotary valve of an internal combustion engine including means for wetting a surface of the part to be cooled with a vapourisable fluid and means for inducing a flow of cooling gas to accelerate vapourisation, with or without means for condensation and recovery of the vapourisable liquid.

In one example of the invention, a rotary valve assembly for an internal combustion engine made according to my prior Patent No. 535,856, has the cooling space of the valve cooled by a flow of air obtained by a scoop or funnel located in an air current or flow of air. Such an arrangement may be employed in aircraft using part of the slip stream of the propellor. Preferably an air filter is incorporated in the scoop or in the air conduits connecting the same to the internal space of the valve. Where heated air is required to assist carburation or for any other purpose the heated cooling air may be used for such purpose.

In another example of the invention a fan or blower is mounted on or coupled to the valve rotor so that the air flow and therefore the cooling is proportional to the engine speed.

In another example of the invention the flow of cooling air is obtained from the engine exhaust or induction, in the former case by an extractor of the venturi or injector type and in the former case by direct connection to the engine induction system. In either case the flow of cooling air will be proportional to the engine load because the engine induction and exhaust are directly proportional to load. This arrangement may give automatic heat balance.

In another example of the invention, in combination with gaseous fluid cooling there is provided a cooling liquid in the form of a spray or gaseous suspension, and such cooling liquid may be sprayed directly into the cooling space of the rotary valve. An extractor pipe or other means may be provided to limit the volume of liquid in the cooling space so that there will always be space for the gaseous fluid and so that the spray effect, if operating within such space, may obtain. This

example employs the system of wetting a surface of the part to be cooled and of accelerating the cooling by using the flow of gaseous fluid to accelerate vapourisation. The construction may include means for condensation and recovery of the vapourisable liquid from the gaseous fluid.

The invention obviously includes possible combinations of the arrangements of the examples above described.

Dated this 16th day of September, 1942.
For the Applicant,
WILSON, GUNN & ELLIS,
Chartered Patent Agents,
54/56, Market Street, Manchester, 1.

PROVISIONAL SPECIFICATION

No. 3950 A.D. 1943.

Improvements in or relating to Rotary Valve Assemblies 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 valve assemblies for internal combustion engines and is an improvement in or development of the invention claimed in my prior Patent No. 535,856.

This invention is a development of the invention described in my co-pending Application for Patent No. 13762/42.

The accompanying drawing is a part-sectional diagrammatic view of the upper end of an internal combustion engine according to one example of the present invention and embodying the construction of rotary valve claimed in my prior Patent No. 535,856.

As shown in the drawing the main upper structure of the engine comprises a piston 10, cylinder 11, cylinder head part 12 and rotary valve housing 13 of which the cylinder, cylinder head part and valve housing have air cooling fins. In the housing is a conical rotary valve member 14 having a combined combustion space and passage 14 and an internal cooling space 15 into which depends a stationary tube 16 the upper end of which is secured in a socket communicating with an air duct 17 formed in a cover 18 secured to the upper end of the housing 13. The cover 18 is also shaped to form a fan housing for an impellor 19 which is screwed into the end of the valve so as to rotate therewith. Also located on the upper end of the valve is a ring 20 which co-operates with a depending flange 21 so as to close the underside of the fan casing. From the fan casing is an outlet 22, also formed in the cover 18. The exhaust system includes an ejector chamber 23 into which projects a nozzle 24, whilst the outlet 22 is connected to the ejector chamber 23.

In operation, the valve 14 rotates at half engine speed for a 4 cycle engine, and the impellor 19 operates to extract air from the cooling space 15 of the rotary valve, thus causing air to be drawn from the air duct 17 down the tube 16 into the space 15 where it is directed against the wall of the combined combustion space and passage 14^1 therein, thus providing intensive cooling of such wall. The volume of cooling air drawn through the cooling space 15 is thus a function of the speed of rotation of the valve. This relation between cooling and speed of rotation is advantageous because speed of rotation is obviously one factor of the frictional heat generated at the complementary conical bearing surfaces of the valve member. On the other hand the ejector action obtained from the nozzle 24 is obviously a function of the volume of the engine exhaust. This ejector action assists the action of the impellor so that the volume of cooling air is also functionally dependent upon the volume of engine exhaust gases. This relation between the volume of cooling air and the volume of exhaust gases thus ensures variation of cooling air volume as a function of the engine load.

Obviously, as stated in my earlier Specification No. 13762/42 the cooling system, instead of being a combination of impellor fan and exhaust ejector, either of these may be used alone.

Dated this 22nd 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 Rotary Valve Assemblies 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 valve assemblies for engines and is an improvement in or development of the invention described and claimed in the Specification of my Patent No. 535,856.

The object of the invention is to improve the efficiency of the engine.

According to the invention a rotary valve assembly for an internal combustion engine having the rotary valve as claimed in the Specification of my Patent No. 535,856, and in which the rotary valve member has a hollow stem, a tube depending into the space for the cooling fluid, and a supply duct connected to said tube and is characterised by an outlet duct for the cooling fluid connected to the said hollow stem for conveying the fluid away from the valve.

The invention further comprises a cooling system for the rotary valve of an internal combustion engine including means for wetting a surface of the part to be cooled with a vapourisable fluid and means for inducing a flow of cooling gas to accelerate vapourisation, with or without means for condensation and recovery of the vapourisable liquid.

In the drawing filed with the Provisional Specification No. 3950/43 is shown one example of the invention.

In the accompanying drawing

Fig. 2 is a diagrammatic illustration of another example of the invention.

Fig. 3 shows a modification applicable to the arrangement of Fig. 2.

Figs. 4 and 5 show further examples of the invention.

As shown in the drawing filed with Provisional Specification No. 3950/43, the main upper structure of the engine comprises a piston 10, cylinder 11, cylinder head part 12 and rotary valve housing 13 of which the cylinder, cylinder head part and valve housing have air cooling fins. In the housing 13 is a conical rotary valve member 14 having a combined combustion space and passage 14^1 and an internal cooling space 15 into which depends a stationary tube 16 the upper end of which is secured in a socket communicating with an air duct 17 formed in a cover 18 secured to the upper end of the housing 13. The cover 18 is also shaped to form part of an outlet connection to the valve stem and a fan housing for an impellor 19 which is screwed into the end of the valve so as to rotate therewith. Also located on the upper end of the valve 14 is a ring 20 which co-operates with a depending flange 21 on the cover 18, so as to close the underside of the fan casing. From the fan casing is an outlet 22, also formed in the cover 18. The exhaust system includes an ejector chamber 23 into which projects a nozzle 24, whilst the outlet 22 is connected to the ejector chamber 23.

In operation, the valve 14 rotates at half engine speed for a 4 cycle engine, and the impellor 19 operates to extract air from the cooling space 15 of the rotary valve member, thus causing air to be drawn from the air duct 17 down the tube 16 into the space 15 where it is directed against the wall of the combined combustion space and passage 14^1 therein, thus providing intensive cooling of such wall. The volume of cooling air drawn through the cooling space 15 is thus a function of the speed of rotation of the valve. This relation between cooling and speed of rotation is advantageous because speed of rotation is obviously one factor of the frictional heat generated at the complementary conical bearing surfaces of the rotary valve member. On the other hand the ejector action obtained from the nozzle 24 is obviously a function of the volume of the engine exhaust. This ejector action assists the action of the impeller 19 so that the volume of cooling air is also functionally dependent upon the volume of engine exhaust gases. This relation between the volume of cooling air and the volume of exhaust gases thus ensures variation of cooling air volume as a function of the engine load.

Obviously, instead of being a combination of impeller fan and exhaust ejector, either of these may be used alone.

The details of construction of driving gear for the rotary valve member form no part of the present invention but may be of any suitable construction and are therefore purposely omitted from this specification and drawing.

In the example of the invention shown in Fig. 2, an internal combustion engine

made according to my prior Patents and Patent Applications aforesaid has the cooling space 25 of the rotary valve member 26 cooled by a flow of air obtained by a scoop 28 and funnel 27 located in an air current or flow of air indicated by the arrow 29. Such an arrangement may be employed in aircraft using part of the slip stream of the propellor. Preferably an air filter 30 is incorporated in the scoop or in the air conduits connecting the same to the internal space of the valve. Where heated air is required to assist carburation or for any other purpose the heated cooling air, after passing through the cooling space of the valve may be used for such purpose. Either the scoop or the funnel may be omitted, if desired. The cover 18, as in Fig. 1, forms part of an outlet connection to the stem of the valve.

As shown in Fig. 3, as a modification of the arrangement shown in Fig. 2 a venturi tube 32 may be employed having an induction tube 33 adapted to be connected to the cooling space 25 and the operative flow of air in the venturi tube may be supplied by any suitable means including the use of the engine exhaust gases. Alternatively the cooling space 25 could be directly connected by a pipe to the induction manifold of the engine and with such an arrangement the cooling would be proportional to the pressure fluctuations in the induction system according to the engine speeds and loads obtaining.

In another example of the invention as shown in Fig. 4, as a modification of the construction of the drawing filed with Provisional Specification No. 3950/43, in combination with gaseous fluid cooling supplied by the air duct 17 there is provided a cooling liquid in the form of a spray injected through a jet 34 directly into the tube 16, or as shown in Fig. 5 the cooling liquid may be sprayed directly into the cooling space of the rotary valve by means of a jet 36 depending into such space through the tube 16. An extractor pipe or other means may be provided to limit the volume of liquid in the cooling space so that there will always be space for the gaseous fluid and so that the spray effect, if operating within such space, may obtain. This example employs the system of wetting, with a vapourisable liquid, the surface of the part to be cooled and of accelerating the cooling by using a flow of a gaseous fluid to accelerate vapourisation of such liquid from such surface. The construction may include means for condensation and recovery of the vapourisable liquid from the gaseous fluid. In an alternative arrangement the cooling vapourisable liquid is introduced by spraying or as a gaseous suspension into the gaseous cooling fluid for example in, or before it reaches the duct 17 of the drawing filed with Provisional Specification No. 3950/43. It is to be assumed that in the arrangements of Figs. 4 and 5, the cover 18 forms part of an outlet connection to the stem of the valve.

The invention obviously includes possible combinations of the arrangements of the examples above described.

The construction of rotary valve forming the subject of my earlier Patent No. 535,856 whilst comprising a tapered rotary valve having a combustion chamber therein offset from the axis of rotation and formed with a hollow space for a cooling fluid to be supplied through the hollow valve stem by a depending tube, embodied no outlet duct connection to the valve stem.

In the Specification of Patent No. 11660 of 1914 there is described and illustrated a conical rotary valve for an internal combustion engine, the said valve having an axially extending groove in its periphery, which groove forms part of a combustion chamber, and the valve is hollowed for the passage therethrough of the explosive mixture on its way to the cylinder so that the said mixture assists in the cooling of the valve. This valve, however, has grooves for the intake or outlet of the gases and is not formed with a combustion chamber therein off-set from the axis of rotation as is the rotary valve member of my Patent No. 535,856 and as is the case with the present invention. In the Specification of Patent No. 493,482 is described and illustrated a valve assembly for an internal combustion engine in which the valve is formed as a cylindrical tubular member with an axial passage for the explosive mixture to a number of ports in the valve corresponding to the number of cylinders in the engine, and is also formed with a circulating space for cooling water. This arrangement is not, however, of the kind to which the present invention refers, inasmuch as the valve is not of conical form having an offset combustion chamber therein formed and a hollow stem.

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 having the rotary valve as claimed in the Specification of my Patent No. 535,856, and in which the rotary valve member has a hollow stem, a tube depending into the space for the cooling fluid, and a supply duct connected to said tube, characterised by an outlet duct for the cooling fluid connected

to the said hollow stem for conveying the fluid away from the valve.

2. A rotary valve assembly according to Claim 1 further characterised by means for admitting a vapourisable liquid in atomised form to such cooling space together with the cooling air.

3. A rotary valve assembly according to Claim 2 further characterised in that the said atomised liquid is directed onto a surface to be cooled so as to wet the same and accelerate cooling thereof by subsequent vapourisation into the gaseous fluid.

4. A rotary valve assembly according to any of the preceding Claims further characterised by means for producing a flow of cooling gaseous fluid into and out of the said internal cooling space.

5. A rotary valve assembly according to Claim 4 further characterised in that the means for producing flow of the cooling gaseous fluid comprises an impeller mounted on the stem of the rotary valve member so as to rotate therewith and a complementary impeller housing therefor.

6. A rotary valve assembly according to Claim 4 or 5, further characterised in that the means for producing flow of the cooling gaseous fluid comprises or includes ejection or induction means associated with the outlet duct of the assembly.

7. A rotary valve assembly according to Claim 1 and constructed substantially as herein described with reference to and as illustrated in any of the several figures of the drawings.

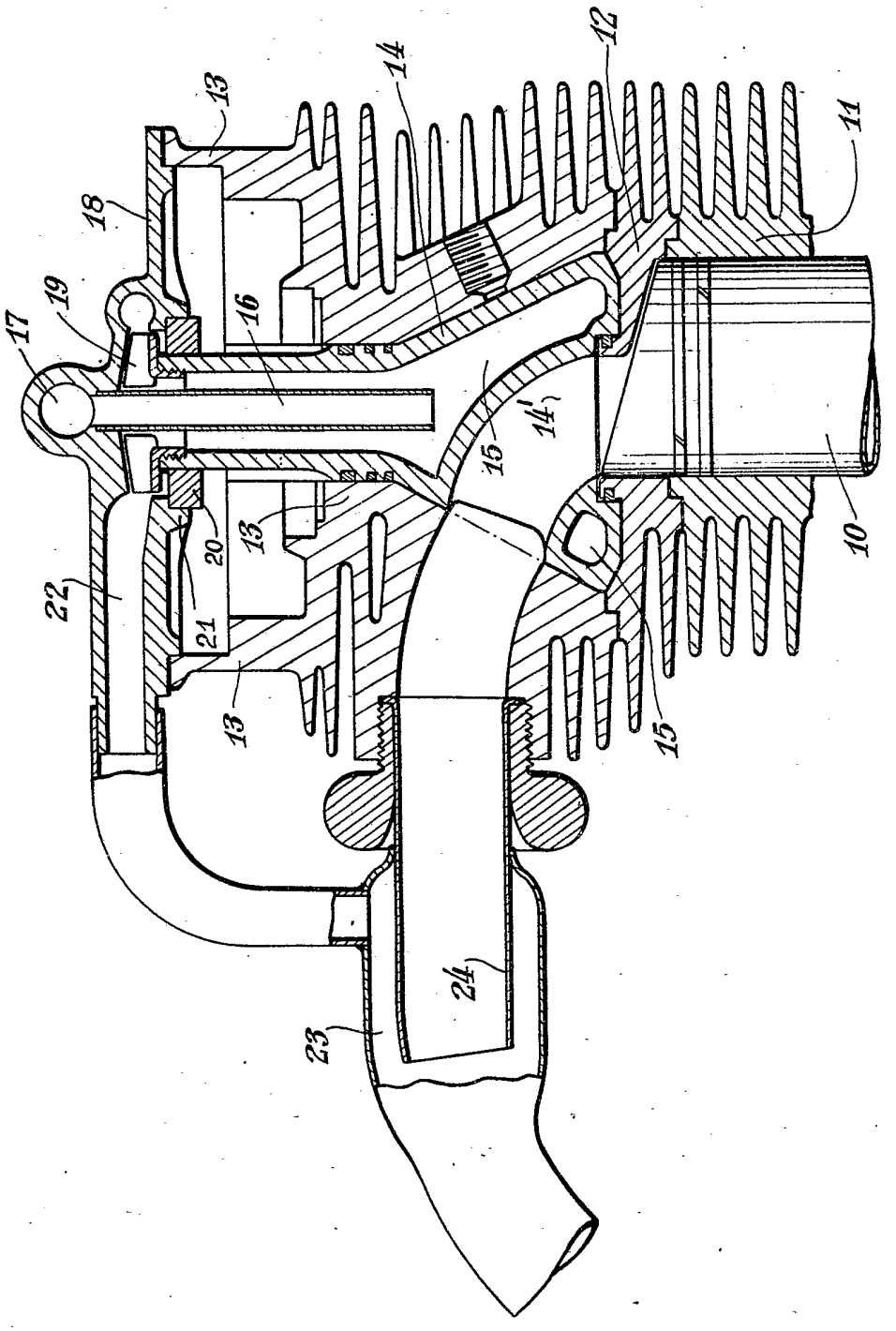
8. An internal combustion engine having a rotary valve assembly according to any of the preceding Claims.

Dated this 9th day of September, 1943.

For the Applicant,
WILSON, GUNN & ELLIS,
Chartered Patent Agents,
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.]



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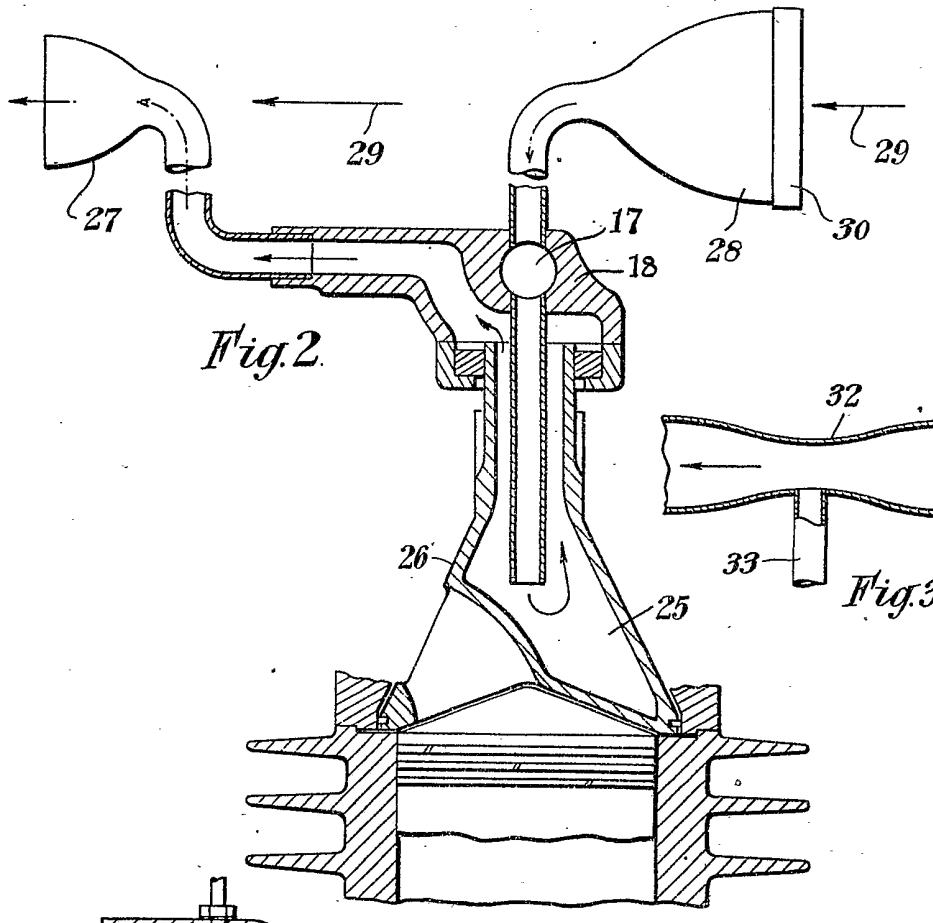

Fig. 2.

Fig. 3.

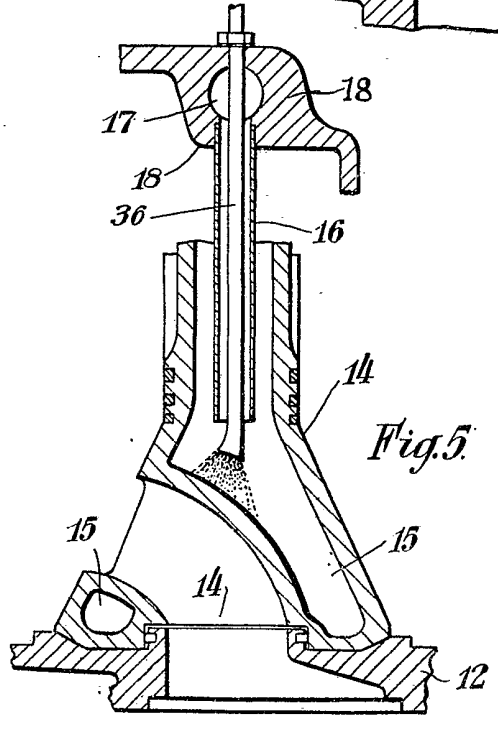

Fig. 5.

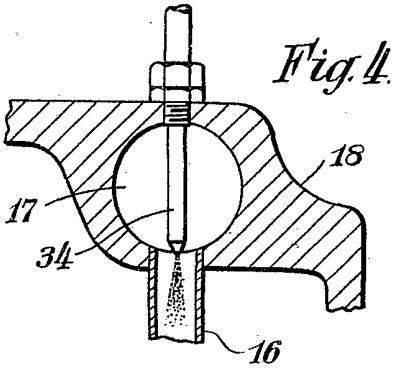

Fig. 4.

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