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(54) **Rotary valve for internal combustion engines**

(57) A rotary cylindrical valve 16 with inlet and exhaust ports 32 and 34 in its circumference which communicate alternately with a cylinder port 56 is mounted in a housing 14 having water cooling passages 62. Valve ports 36 and 36 communicate with inlet and exhaust passages 50 and 44. Valve 16 is keyed to a shaft 18 supported in bearings 20 and a spring-biased seal member 55 engages the valve at the port 56. Lubrication is provided by felt pads 72 fed with oil through a hollow rotating shaft 70.

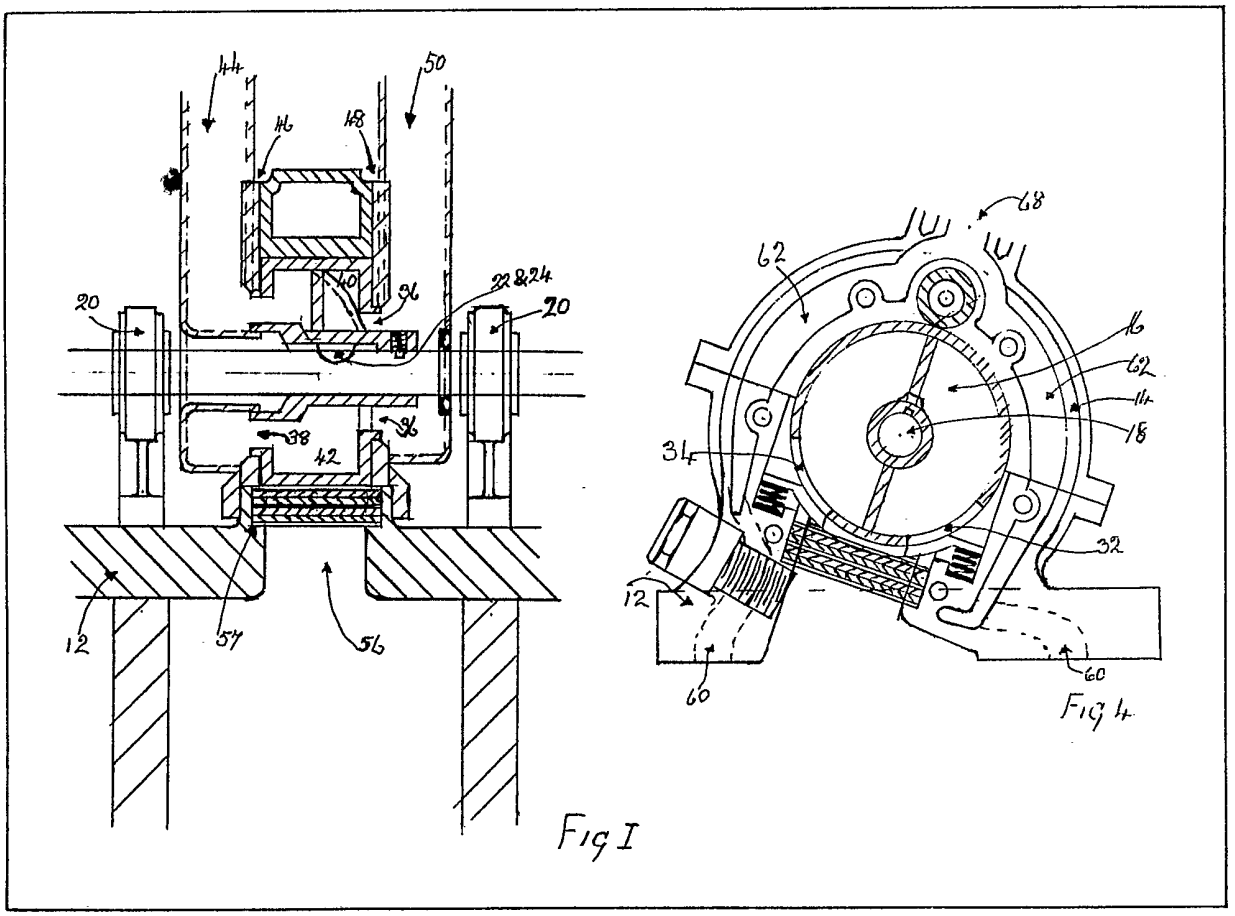

Fig I

Fig 4

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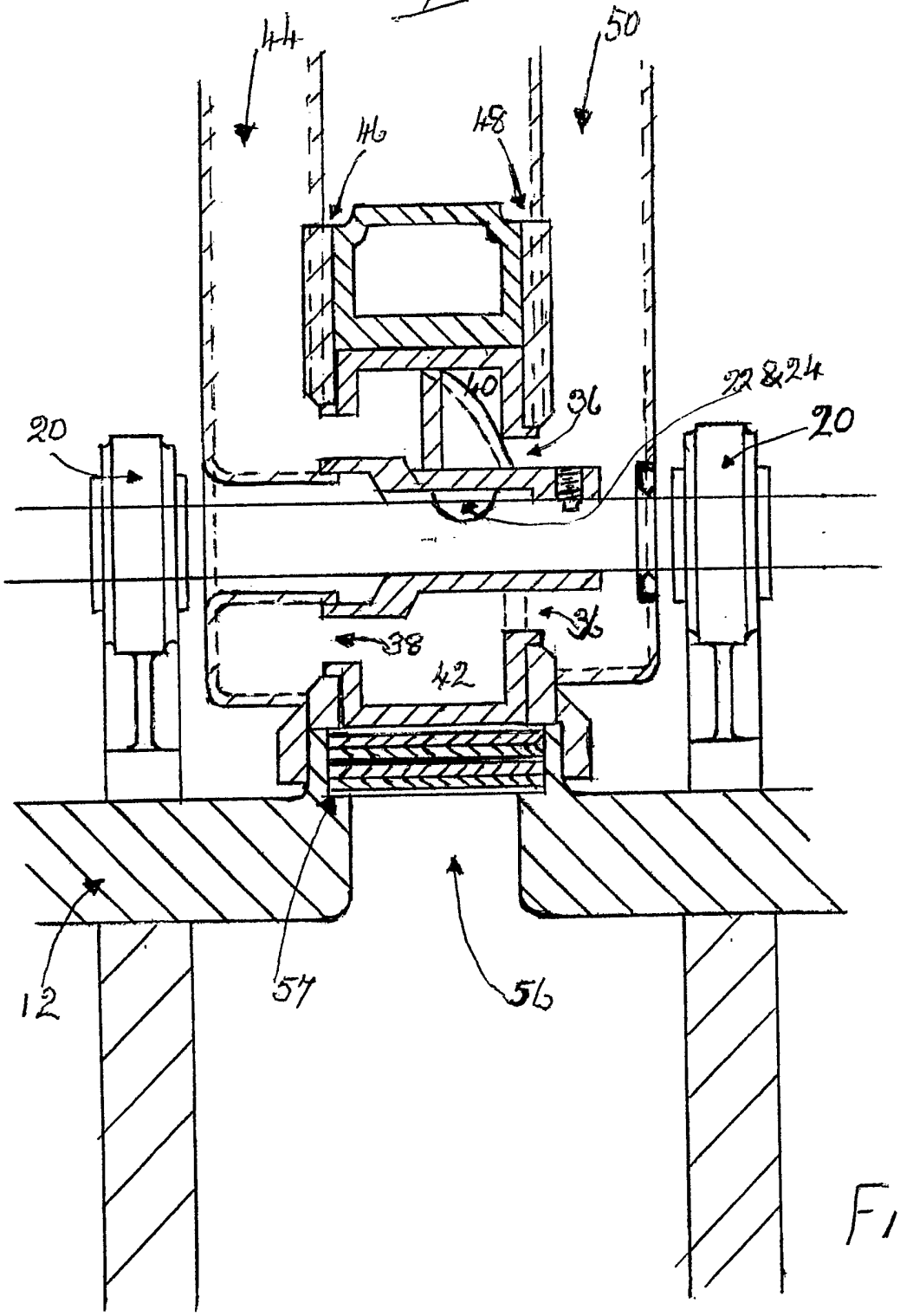

Fig I

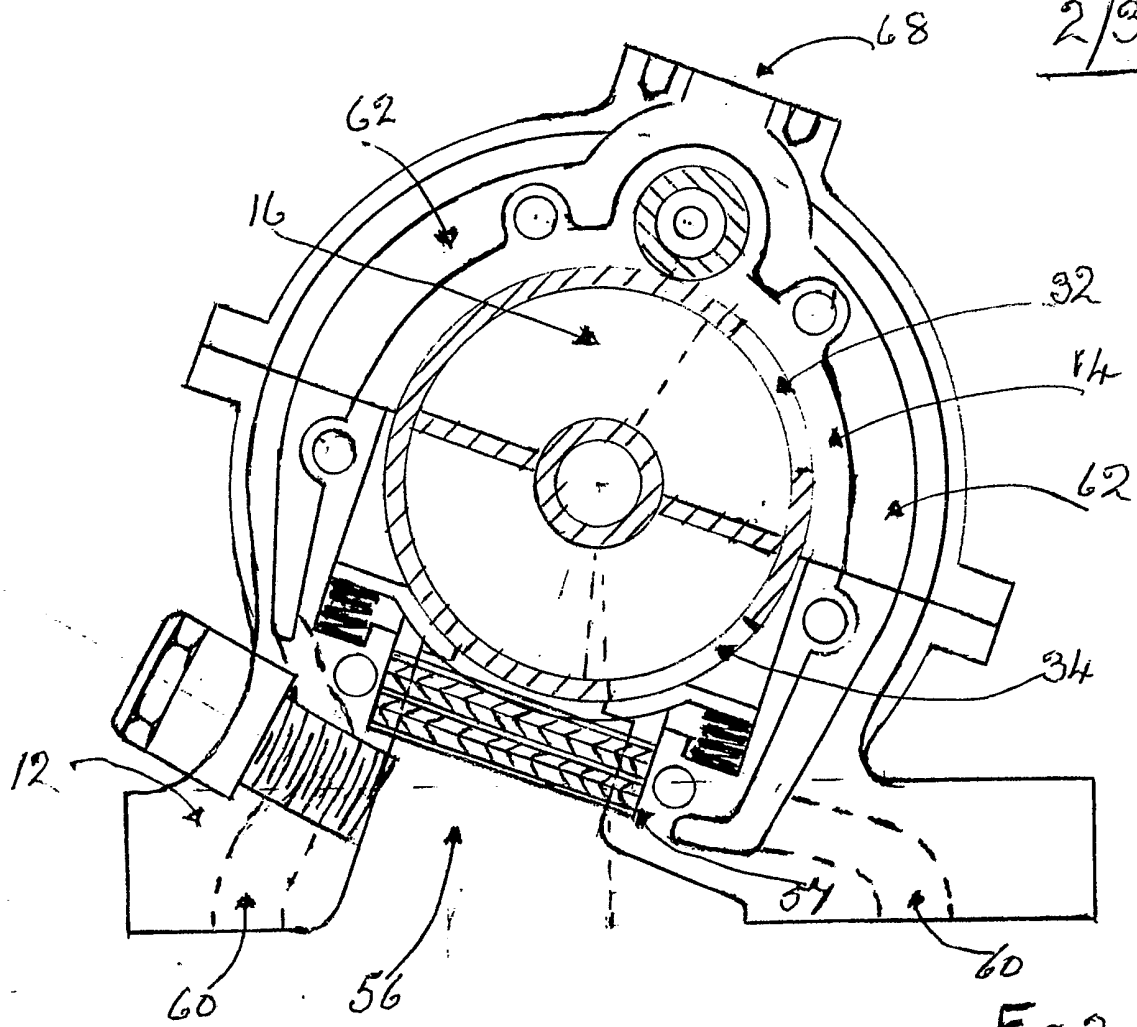

Fig 2

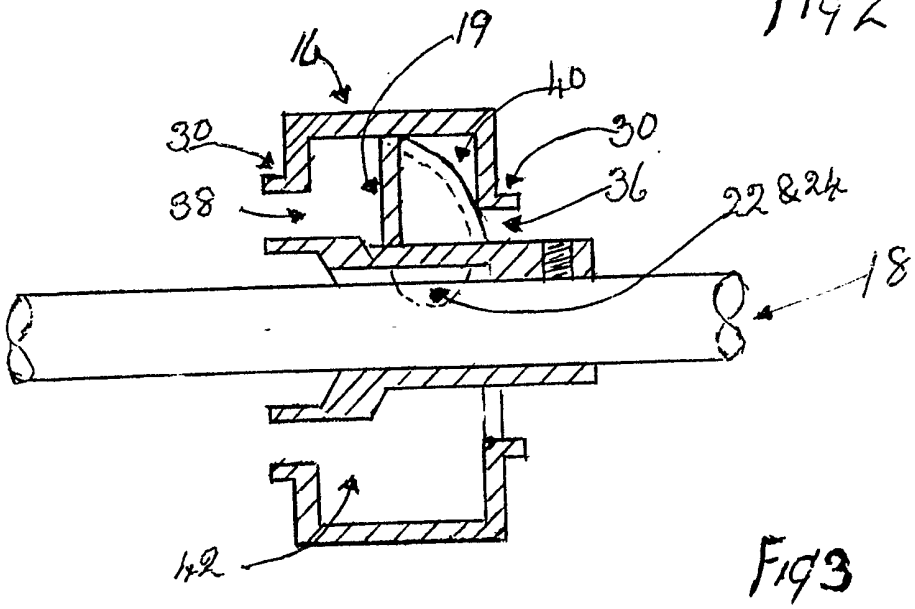

Fig 3

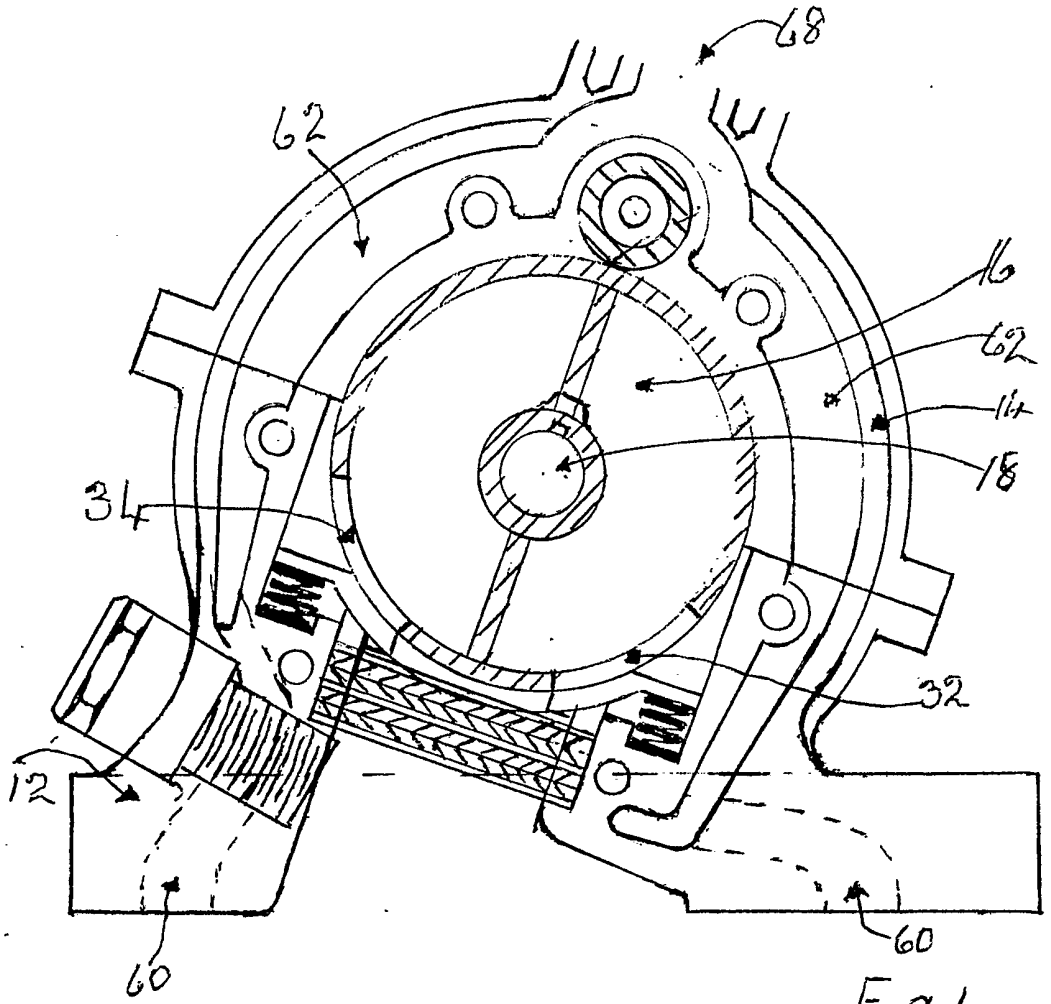

Fig 4

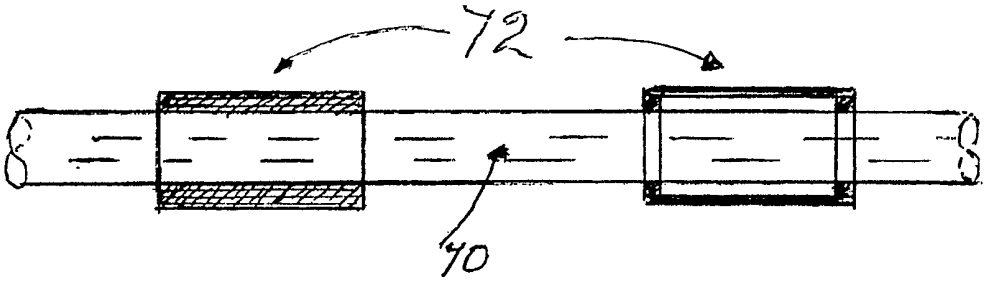

Fig 5

SPECIFICATION

Improvements in rotary valves

This invention relates to rotary valves for internal combustion engines.

The objects of this invention are to provide a rotary valve which is suitable for in-line engines and which overcomes the lubrication and sealing problems of a rotary valve by virtue of its construction.

In accordance with this invention there is provided a rotary valve for an internal combustion engine comprising a valve housing and two side covers, one for communication with an exhaust manifold of the engine, and one for communication with an intake manifold of the engine and one cylinder port for communication with a cylinder of the engine, and a rotary valve body which is accommodated within said housing and is divided into two sections therewithin connecting with passages at the side of the valve body and having two ports on the circumference of the valve, one timed for inlet gasses and one timed for exhaust gasses. The valve body being carried on a shaft which is rotatably journalled at each side in the bearings of two supports and being rotatable in the housing to connect said outlet port to said cylinder port, and said inlet port to said cylinder port, respectively, by way of said ports in the valve body.

By means of the shaft being rotatably journalled at both sides of the valve, the problem of the valve body being lifted off the cylinder port during maximum engine compression is therefore reduced to a minimum and increasing sealing efficiency and decreasing frictional forces between the valve body and the housing now effectively nullified. Furthermore, with a plurality of valve bodies rotatably received within their own housings an arrangement made possible by the short inclination of the passages with respect to the housing in a rotary valve in accordance with this invention, each valve body is supported by the two bearings, one on each side of each housing, consequently loads imposed on one valve body during its rotation even under maximum engine compression does not effect the other valve bodies, and therefore each valve is able to work independently of each other and each valve has its own independent sealing arrangement.

The invention is further described hereinafter by way of example only, with reference to the accompanying diagrammatic drawings in which:—

Fig. 1 is a sectional side view of a single-cylinder of an in-line internal combustion engine incorporating a rotary valve in accordance with this invention;

Fig. 2 is a sectional drawing of a valve body forming a rotary valve in accordance with this invention;

The valve housing 14 in which the rotary body 16 of the rotary valve is accommodated. The valve body 16 is received on a shaft 18 Fig. 3 which is rotatably journalled in bearings 20 in the bearing housings supporting the said bearings on the base 12. A groove 22 is formed in the shaft 18 which is arranged to receive a key 24 (see Fig. 1) The key 24 fits in a corresponding groove formed in the surface of a bore of the valve body 16, such that the latter is rotatably fixed with respect to the shaft 18 and therefore rotates in synchronism with it. In this manner the timing of the opening and closing of the valve ports on the cylinder port 56 can be accurately set without the need to subsequently adjust the timing.

In Fig. 3 a typical valve body 16 is illustrated. The body comprises a hollow cylinder having sides with short sleeves 30, Fig. 3. Cut into the cylinder are two ports 32, 34, Fig. 2 which are central and on the circumference of said cylinder. Each side port 36, 38 is in communication with a respective central port 32, 34 and separated by an internal division member, so that two passages in the cylinder are formed, each passage being isolated from the other by a division 19 Fig. 3 in the interior of the valve body 16.

The two passages 40 and 42 are respectively designed to guide a fuel charge to and exhaust gasses from the associated engine cylinder. During operation of the engine the valve body 16 is rotated by the shaft 18 which is itself driven by the crankshaft of the engine via a chain and gear. This transmission is geared so that the valve body 16 rotates at half the speed of the crankshaft, and therefore makes one complete revolution per cycle of the 4-stroke engine.

The central ports 32 and 34 are, on rotation of the valve body, arranged to communicate alternately with a central port 56 in the head 12, a port 56 being provided to serve each cylinder of the engine.

The mode of operation of a single rotary valve is described hereinafter in respect of a single cycle of the engine.

At the end of a firing or ignition stroke with the piston at bottom dead centre, the cylinder is filled with exhaust gases which have to be ejected at the next up-stroke of the piston. Thus at this point the exhaust port should open and this condition is illustrated in Fig. 2. Here the port 34 begins to register with port 56.

In Fig. 2 is a section through the valve immediately prior to the communication of the port 34 with the port 56, the direction of rotation of the valve being indicated by the arrow. As the ports 34 and 56 come into register, the port 38 being an open port in the side of the valve body, the exhaust gasses can get out direct into the exhaust passage 44 which is made with the side of valve housing 46 Fig. 1 and which leads to the exhaust manifold of the engine. The angular orientation of the port 38 and exhaust passage 44 with respect to the port 56 is not important but is shown in Fig. 1 so as to show action of valve as it would probably be in most engines but side cover can be set to suit exhaust manifold of any engine.

Thus, with reference to Fig. 2, as the piston rises on the exhaust stroke the crankshaft rotates through 180° and the valve body 16 through 90°. During this

time exhaust gases are pushed from the cylinder through the ports 56 and 34 through the passage 42, through the port 38 and out through the passage 44 to the manifold. At the end of this 90° rotation the ports 32 and 56 would be isolated from one another (Fig. 2).

With the piston at top dead centre, the intake stroke commences. With reference to Fig. 4 which is a section of a valve and housing in Fig. 1 showing the valve in central position between exhaust and inlet, it can be seen that with 90° rotation from the position illustrated in Fig. 2 the piston would rise to top dead centre and the port 32 would rotate to its position at the commencement of the intake stroke. Fig. 4, that is the port 32, would be in a position to commence register with an intake port 56 and passage 50 which is also set in the side cover 48 Fig. 1 and then leads to the carburettor. Again, the angular orientation of the passage 50 is not important but it is in this embodiment, arranged on the side of the housing opposite to that of the exhaust port.

In Fig. 4 when the piston is at top dead centre at the beginning of an intake stroke, the port 34 is shown rotated out of register with the port 56, while the port 32 is commencing register with the port 56 while the port 32 is commencing register with the port 56 so that a fuel charge from the carburettor can enter the cylinder during the downstroke of the piston via the inlet manifold 50, the port 36, the passage 40 and the ports 32 and 56.

At the end of the intake stroke the piston again reaches bottom dead centre and the inlet closes. Subsequently, the crankshaft undergoes 360° rotation during the compression and ignition strokes. The valve body only undergoes 180° rotation however and during this period neither ports 32 or 34 are in register with the port 56.

The exact dimensions of the ports 32, 34, 56 and passages 44 and 50 are arbitrary, but in one advantageous arrangement the leading and lagging edges of the ports 32, 34, are arranged to subtend an angle at the centre of the shaft 18 of 62° while the edges of the port 56 subtend an angle of 28° at the centre. Thus the ports are open for substantially 90° of rotation of the valve body. Modifications to this arrangement are envisaged for various types of engine, wherein it may be advantageous for a given port to open, or close, before, or after, bottom, or top, dead centre of the piston's travel.

Coolant, normally water, enters the jacket 12 by way of the normal water channels which exist in the engine block, e.g. passages 60 in Figs. 2 and 4. If, however, the existing cylinder head is normally supplied with coolant then a point of entry can readily be incorporated directly into the housing 14. By way of passages 60 the water is fed to passages 62 which extend around and about the valve housings 14. The passages 60 and 62 connect with the passages 68 from whence the water is returned to the radiator and re-circulated around the engine.

The problem of lubrication of the valve bodies may be solved in this invention by the fact that the valve bodies being supported by two bearings 20 in two pillars at each side of the valve housing covers prevents the valves being lifted off their seats during maximum compression and is rotated on a fixed rotational axis. As the valves rotate they wipe against an oiled felt pad on the shaft 70 which is supported by hearings in the side covers, and is rotated by a gear at side of the housing of the valve.

This design lends itself to the easy lubrication of the valve bodies, and by using special felt pads 72 which are held against the valve bodies by means of a hollow rotating shaft with spaced hollow sleeves wrapped by a special felt sleeve to absorb the oil which is fed through the hollow shaft Fig. 5 by means of oil pipe from the oil pump of the engine, and thereby retaining an oil film on the surface of the valve which will prevent any seizure. The supply of oil being controlled by a ball valve in the feed line to give the required feed. The side covers 46 and 48 are bored to accept the short sleeves of the valve so that the valve can rotate freely at all times and when the covers are secured to the valve body there is no requirement for any other seal for the valve. The only frictional area is the 3mm surface around the port 56 of the shell 55 in the lower half of the housing which is maintained in contact with the valve by springs supporting the curved shell to seal the valve against leaks, and also has a spigot 57 on the under side of the shell to fit in the port bore of the combustion chamber and carried 2 piston rings in a single groove to make a seal around the spigot with a third ring in another groove above said rings to assist the sealing from combustion pressure.

CLAIMS

1. A rotary valve and housing for an internal combustion engine and having a port in the housing for communication with a cylinder of the engine, the rotary valve being rotatably mounted on a shaft in said housing and the shaft supported and rotatable in bearings on supports separate of the said housing. The rotary valve having ports set in the outer circumference of the said rotary valve for communication alternatively with the cylinder port of the engine as valve rotates. A rotary valve having said ports separated by a division member to divide the rotary valve into two parts, inlet side and an exhaust side, the rotary valve being cast or so made to form a single piece unit.

2. A housing in two parts, a top part and a bottom part having a port for communication to a cylinder of the engine.

3. A housing in two parts jointed together on horizontal centre line by bolts or screws and having a cooling jacket cast integral with housing.

4. A rotary valve as claimed in claim 1 wherein the rotary valve has a drive shaft fitted through the bore and fixed by a key or other means to locate the rotary valve to the drive shaft.

5. A rotary valve as claimed in claim 1 wherein a rotary valve has two ports set in the circumference of valve one for inlet side and one for exhaust side.

6. A rotary valve as claimed in claim 5 wherein one port is separated from the other port by a division from inlet side to exhaust side and to said bore.

7. A rotary valve as claimed in claim 6 wherein the said division is continued along exhaust side of

inlet port and then as segment of worm thread diagonally across interior of valve to inlet side of valve and blanking off inlet side of exhaust port so dividing valve into two parts.

8. A rotary valve as claimed in claim 1 and 7 wherein a short sleeve is set on inlet side of valve.

9. A rotary valve as claimed in claim 1 and 5-8 wherein a rotary valve has a sleeve on the exhaust side of the valve.

10. A rotary valve as claimed in claim 1 wherein the housing is fitted with an inner half shell in the lower half of the housing.

11. A rotary valve as claimed in claim 10 wherein the lower housing has a sealing member supported by springs under the side lugs of the sealer to maintain contact with the valve surface for sealing and a spigot on the under side of the sealer fitting into a counter bore of the combustion chamber port and having grooves for piston rings to make seal against compression pressures.

12. A rotary valve as claimed in claim 1 wherein the exhaust from the valve is guided by a side cover to the exhaust manifold and is bored so the valve sleeve has ample freedom for rotation.

13. A rotary valve as claimed in claim 1 wherein the inlet side has a cover bored to accept the inlet side sleeve and give free rotary movement of said sleeve and guides inlet mixtures from inlet manifold of engine.

14. A rotary valve for internal combustion engines hereinbefore described with reference to the drawings accompanying the provision specification.

15. A lubrication system, whereby oil is fed through a hollow shaft to a felt pad which wipes surface of valve leaving a thin film of oil on surface of valve and supported by split bushes in side covers of the valve.

16. A hollow shaft as claimed in claim 15 whereby oil flows through the shaft to passages in the shaft to surface of the shaft.

17. A shaft having two rings as claimed in claim 15 whereby they are secured to the shaft and have a perforated sleeve over the rings.

18. A shaft as claimed in claim 17 whereby the said rings and perforated sleeves are covered by a special felt sleeve which is secured to said perforated sleeve to rotate felt sleeve against surface of valve.

19. A lubrication system for a rotary valve as hereinbefore described with reference to drawings accompanying the provisional specification.

New claims or amendments to calims filed on 13/12/82.

New or amended claims:—

15. A lubrication system, whereby oil is fed through a hollow shaft to a felt pad or bush which wipes surface of valve leaving a thin film of oil on surface of valve and supported by split bushes in the side covers of the valve.

17. A shaft having a special bronze bush fitted or two rings as claimed in claim 15 whereby they are secured to the shaft and have a perforated sleeve over the rings.

18. A shaft as claimed in claim 17 whereby the said bronze bushes or rings and perforated sleeves covered by a special felt sleeve is secured to said shaft to rotate felt sleeve against surface of valve.

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