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(56) Documents Cited
GB 2225056 A GB 1516809 A GB 0358802 A
US 5410996 A US 5249553 A US 4944261 A

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(54) Abstract Title
Rotary valve shaft for i.c. engines

(57) A rotary valve shaft 1 which runs in guideways 12 across the top of the cylinders of an internal combustion engine of the reciprocating piston type and which has cut-away regions 2 which allow fluid flow to occur between the engine cylinders 11 and the manifold chambers 6 at such times as rotation of the shaft orients the cut-away regions to form communicating passages between engine cylinders and manifold chambers. The shaft 1 rotates at one quarter of the speed of the crankshaft. Sealing inserts 5 may be provided in recesses 14 in the engine, oilways 9 along the length of the sealing inserts 5 being provided for lubrication of the shafts. Two shafts may be used, one for inlet, the other for exhaust gases. One of the shafts 1 may be driven by a chain or belt from the crankshaft and carrying a helically splined gear (18, fig.4) which meshes with a similar gear (19) on the other shaft. Gear (19) may be slidable along a straight-splined shaft (21) by a servo (22) to provide variable valve timing.

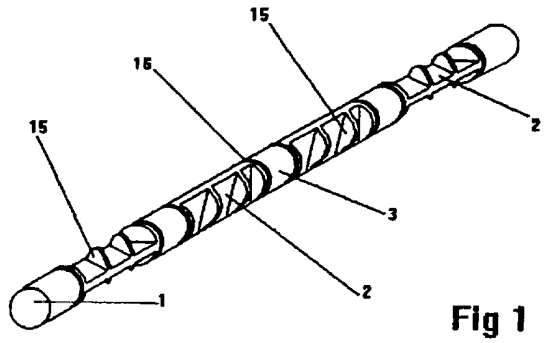

Fig 1

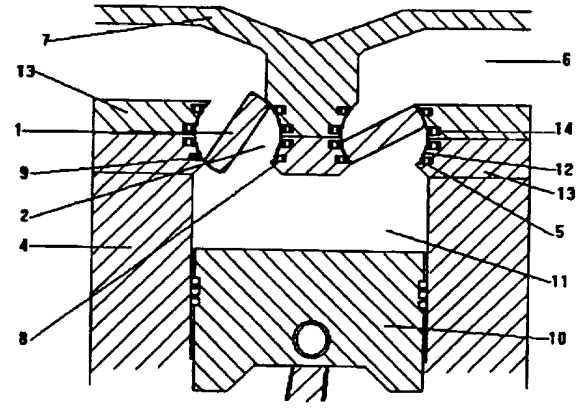

Fig 2

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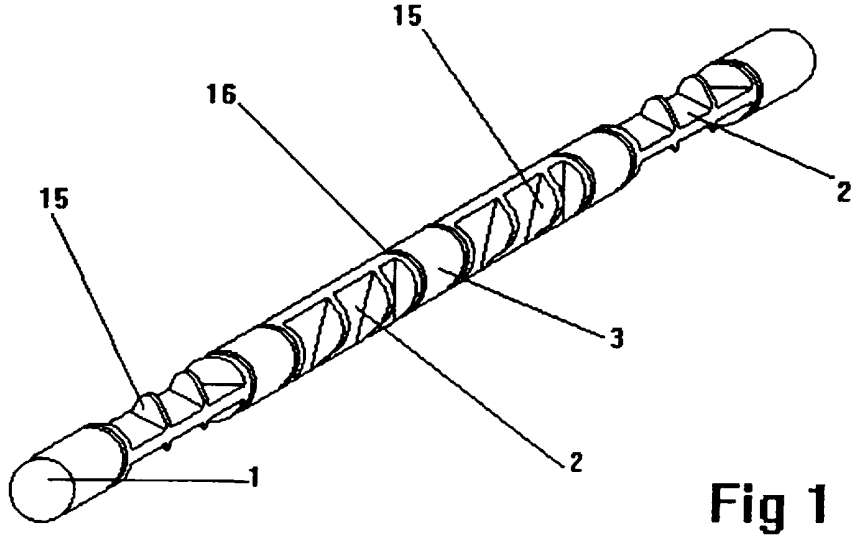

Fig 1

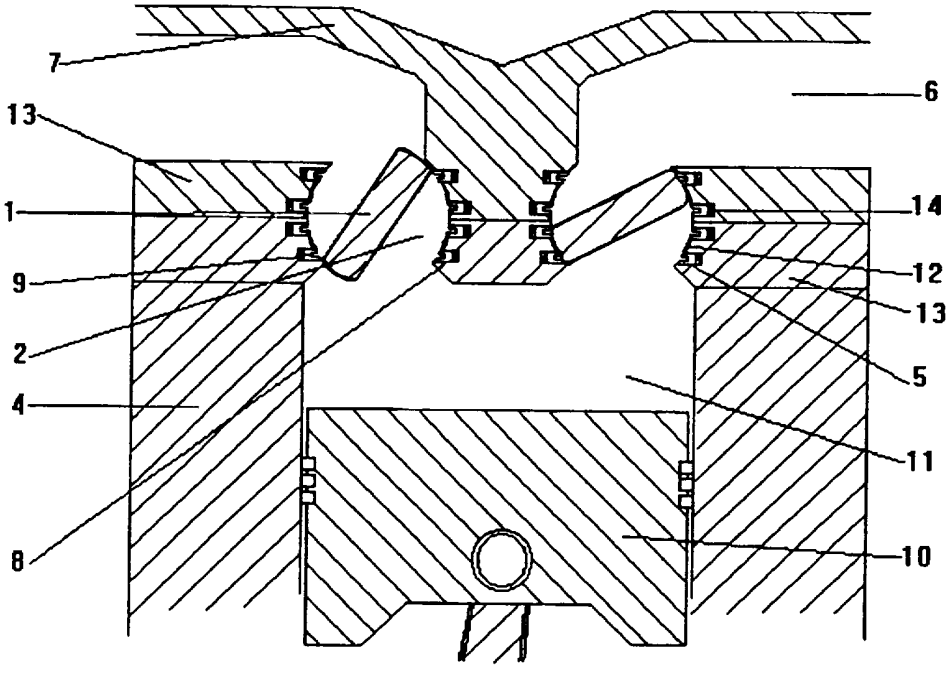

Fig 2

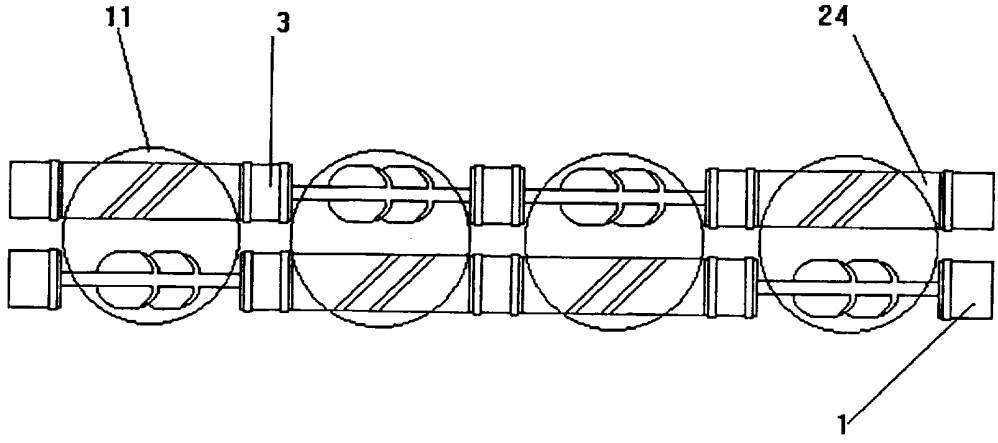

Fig 3

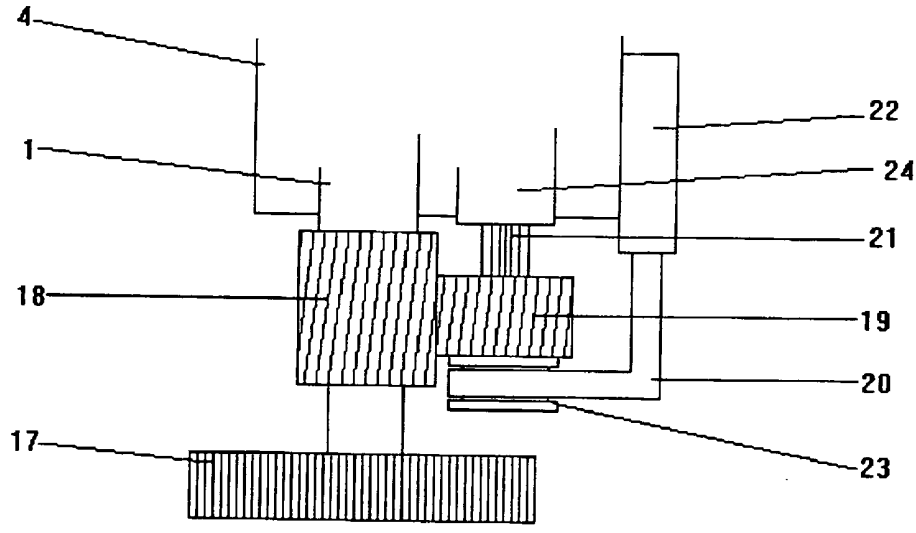

Fig 4

ROTARY VALVE SHAFT

This invention relates to a rotary valve shaft system which facilitates the flow of air or air/fuel mixture into and which allows exhaust gases to be expelled from, the cylinders of internal combustion engines of the reciprocating piston type.

Internal combustion engines require means to allow air or air/fuel mixture into, and exhaust gases out of, the cylinders. The mushroom shaped poppet type of valve operated by engine driven camshafts is commonly used in internal combustion engines of the reciprocating piston type. It is also desirable to alter the timing of inlet valve opening and closing events in response to varying combinations of engine speed and load in order to optimise engine performance over a wide range of operating conditions.

According to the present invention there is provided a rotary valve shaft comprising at least one shaft, driven by engine power and rotating at one quarter of the speed of the engine crankshaft, said shaft being generally parallel to the engine crankshaft and being located in guideways in the upper cylinder region of a reciprocating piston engine cylinder block with at least one manifold enclosing the volume of the shaft not within the cylinder block volume, the shaft, in the sections coincident with each engine cylinder, having at least two regions cut-away, each cut-away section being on opposite sides of the centre of transverse cross section of the shaft to form passages which allow fluid flow to occur between the manifold and cylinder at such intervals in the combustion cycle of the engine as the rotation of the shaft orients the passages so as to provide communication between the engine cylinder and the manifold and which rotation orients the shaft so as to prevent such fluid flow from occurring during the remainder of the engine cycle.

A specific embodiment of the invention will now be described by way of example with reference to the accompanying drawing in which:-

Figure 1 shows the rotary valve shaft.

Figure 2 shows a cross section of the engine cylinder, manifold and valve shafts.

Figure 3 shows the arrangement of one inlet valve shaft and one exhaust valve shaft in relation to the engine cylinders.

Figure 4 shows a plan view of the drive system for the shafts with the mechanism for varying inlet opening and closing timings.

Referring to the drawing the valve shaft mechanism comprises two shafts, 1 and 24 as shown in Fig 3 of which one is illustrated in Fig 1. One shaft handles inlet gases and the other, exhaust gases, the shafts have cut-away regions 2 and regions with bearing surfaces 3. As shown in Fig 2 the shafts are located in the upper region of the engine cylinder 11 within guideways 12 in the cylinder block 4 and the manifold 7. The shafts are driven to provide rotation synchronous with the induction, compression, combustion and exhaust strokes of piston 10 so as to provide fluid flow between the engine cylinder 11 and the manifold 7 through cut-away regions 2 during pre-determined phases of the engine cycle.

The rotation of the shafts alternately permits and prevents the occurrence of fluid flow between the manifold chamber 6 and the cylinder 11 through cut-away regions 2.

Sealing of the shafts against fluid flow between the shafts and the guideways is by means of sealing inserts 5 housed in recesses 14 located in the cylinder block and the manifold. The sealing inserts are held in contact with the shafts by spring inserts 8. Segments 15 within the cut-away regions of the shafts provide contact between the shafts and the sealing inserts at such times as the cut-away regions of the shafts coincide with the sealing inserts, said segments may be angled so as to induce swirl within the gases as they flow across the shaft.

Sealing of the shafts against fluid flow in a direction generally parallel to the longitudinal axis of the shaft is by means of sealing washers 16.

Lubrication of the shafts is provided through oilways 9 along the length of the sealing inserts one of which may be arranged to act as an oil scraper to remove excess oil from the shafts.

The bearing surfaces of the shafts are enclosed in bearing shells attached to or machined into the cylinder block and the manifold so as to enclose the bearing surfaces when the engine is assembled.

To facilitate engine maintenance and assembly the upper region 13 of the cylinder block containing the shaft guideways may be separable from the remainder of the cylinder block.

As shown in Fig 4 shaft drive is by means of sprocket 17 which is driven from the engine crankshaft by a belt or chain causing helically splined gear 18 to rotate and drive shaft 1, which in this case is the exhaust shaft, and to drive helically splined gear 19 which is meshed with gear 18, gear 19 driving shaft 24 which is the inlet shaft, via straight splines 21 on the end of shaft 24 and which pass through a correspondingly splines orifice through the centre of gear 19 and bearing 23.

In response to inputs from engine sensing equipment servo 22, being connected to gear 19 by linkage 20 and bearing 23, slides gear 19 in a direction parallel to the axis of rotation of the gears to pre-determined positions along the straight splines, the helical splines of the gears thereby altering the rotational angle of shaft 24 relative to shaft 1 so adjusting the timing of inlet opening and closing in relation to engine crankshaft angle.

CLAIMS

1 A rotary valve shaft for internal combustion engines comprising at least one shaft, driven by engine power and rotating at one quarter of the speed of the engine crankshaft, said shaft being generally parallel to the engine crankshaft and being located in guideways in the upper cylinder region of a reciprocating piston engine cylinder block with at least one manifold enclosing the volume of the shaft not within the cylinder block volume, the shaft, in the sections coincident with each engine cylinder, having at least two regions cut-away, each cut-away section being on opposite sides of the centre of transverse cross section of the shaft to form passages which allow fluid flow to occur between the manifold and cylinder at such intervals in the combustion cycle of the engine as the rotation of the shaft orients the passages so as to provide communication between the engine cylinder and the manifold and which rotation orients the shaft so as to prevent such fluid flow from occurring during the remainder of the engine cycle.

2 A rotary valve shaft as claimed in Claim 1 wherein means are provided to seal against fluid flow between the shaft and the guideways.

3 A rotary valve shaft as claimed in Claim 1 wherein means are provided to seal against fluid flow in a direction generally parallel to the longitudinal axis of the shaft.

4 A rotary valve shaft as claimed in Claim 1 and Claim 2 wherein means are provided to maintain contact between the shaft and the sealing means at such times as the cut-away regions of the shaft coincide with the sealing inserts.

5 A rotary valve shaft as claimed in Claim 1 and Claim 2 wherein lubrication means are provided.

6 A rotary valve shaft as claimed in Claim 1 wherein means are provided to vary the timing of valve opening and closing events.

7 A rotary valve shaft substantially as described herein with reference to Figures 1, 2, 3 and 4 of the accompanying drawing.

The Patent Office

INVESTOR IN PEOPLE

Application No: GB 9805845.6 **Examiner:** John Twin
Claims searched: 1 to 7 **Date of search:** 28 April 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): F1B (B2Q5B)

Int Cl (Ed.6): F01L 7/02

Other: Online: EPODOC, JAPIO, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2225056 A	(Lees)	1 at least
X	GB 1516809	(Dana) - see eg p.3, lines 116-119	1,6 at least
X	GB 358802	(Zeeman) - see eg p.2, lines 30-35	1 at least
A	US 5410996	(Baird)	
X	US 5249553	(Guiod) - see eg column 3, lines 35-46	1-4
X	US 4944261	(Coates) - see eg column 5. lines 1-17; column 7, line 63 to column 8, line 8	1-5

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Y Document indicating lack of inventive step if combined with one or more other documents of same category.
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