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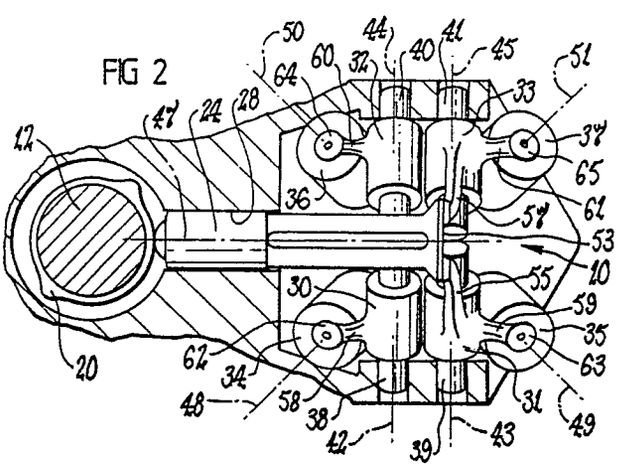
(54) An improved arrangement of radially disposed poppet valve actuation in an internal combustion engine.

(57) A valve actuating arrangement for an internal combustion engine valve train which has, for a pair of valves (34, 36 or 35, 37) a respective rocker member (31, 32, 33, 34) for each valve of the pair and a single actuating rod. Each rocker member is simultaneously movable under the action of the single actuating rod for simultaneous actuation of each valve of the pair thereof by a respective rocker member. The actuating rod may be a cam follower (22 or 24) movable longitudinally under the action of a cam profile (18 or 20) provided on a camshaft (12). Each rocker member may be mounted on a respective shaft, (38, 39, 40, 41) the shafts being inclined such that each rocker member has a shaft axis substantially perpendicular to the longitudinal movement of the cam follower and also substantially perpendicular to the axis of the respective valve. Typically, in a valve actuating system for a pair of inlet valves and a pair of outlet valves, the system comprises for each pair of valves a respective such valve actuating arrangement.

FIG 2



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AN IMPROVED ARRANGEMENT OF RADIALLY DISPOSED POPPET VALVE ACTUATION IN AN INTERNAL COMBUSTION ENGINE

This invention relates to internal combustion engine valve trains, and is applicable to all internal combustion engines.

It is the object of this invention to provide an arrangement for actuation of four radially disposed poppet valves in each combustion chamber which is substantially simpler and easier to manufacture than previous radially disposed valve actuation systems.

The present invention reduces substantially the number of moving parts required to transmit the reciprocating motion of the cam follower to valves radially disposed about the center of curvature of the combustion chamber.

According to the invention, there is provided a valve actuating arrangement in which, for a pair of valves, there is a respective rocker member for each valve and a single push rod (or cam follower) member, with each rocker member being movable under the action of the single rod for simultaneously actuating each valve of the pair thereof. In one convenient form, a respective such arrangement is provided for each of a pair of inlet valves and a pair of exhaust valves. In such form, the rod of each arrangement can be movable under the action of a cam provided on a common, or respective, camshaft.

In one embodiment of this invention, one inlet cam operates a cam follower which in turn operates two inlet rockers. Each inlet rocker is mounted on a shaft inclined at an angle enabling each rocker shaft axis to be both perpendicular to its respective valve stem axis and to the inlet cam follower axis. This enables the rocker tappet contacting the valve stem to act in line with the valve stem thus eliminating undesirable wear due to misalignment. This invention also eliminates the necessity of any type of intermediate "rockers" between the tappet and valve stem to ensure correct alignment. Similarly, an exhaust cam operates an exhaust cam follower which in turn operates two exhaust cam rockers, rotating on shafts perpendicular to both their respective exhaust valve and the exhaust cam follower. The valves are aligned on radial lines radiating from the centre of curvature of the combustion chamber which is a segment of a sphere. This produces a substantially smooth combustion chamber and the radial valve arrangement allows the radius of curvature to be quite large, eliminating the necessity of a domed piston crown or of valve reliefs in order to maintain high compression ratios without detonation or 'knock', therefore substantially improving the efficiency of the combustion process and improving fuel economy.

In a preferred form of an arrangement according to the invention, each rocker member is reversably rotatable about an axis which is substantially perpendicular to a centre line of action or movement of its valve. Additionally, or alternatively, that axis preferably is substantially perpendicular to the line of action or movement of the single rod. However, the axis of each rocker member of the pair thereof preferably are mutually inclined.

Each rocker member may comprise a body portion and a first and second arm extending outwardly from the body portion; with the first arm of each being engageable by the single rod and each second arm being engageable with the respective valve. The body portion may be of annular or cylindrical form concentric with respect to the axis of its rocker member, with the rocker member being either rotatable on, or with, a shaft extending axially through its body portion.

The invention will now be described by way of example and with reference to the accompanying drawings of preferred through not unique embodiments in which:

Figure I is a part sectional view of the cylinder head showing an axial engine camshaft arrangement;

Figure 2 is a plan part sectional view of the arrangement of Figure 1;

Figure 3 is a view similar to Fig. 1 but showing an in-line engine valve train for one cylinder; and

Figure 4 is a view similar to Fig. 2 but showing the in-line engine valve train of Figure 3.

Except for the elements directly involved in performing the valve actuation discussed above, the engine to which the invention is applied may be conventional, and therefore no attempt will be made here to describe any details of the engine not directly relevant to the invention. Sufficient to say that this invention may equally be applied to any type of four stroke cycle internal combustion engine, either of spark or compression ignition, or of fixed or variable stroke or of axial or crankshaft type.

Figures 1 and 2 show enough detail of an engine to illustrate clearly the application of the invention. As indicated in those Figures, the arrangement 10 has a camshaft 12, driven by some form of drive which is not relevant here, and is supported by bearings at 14 and 16. Camshaft 12

has formed thereon an inlet cam profile 18 and an exhaust cam profile 20; although cams 18,20 can be on respective shafts, as in Figure 3, rather than on a single camshaft.

Cams 18,20 are rotated by shaft 12 at a predetermined ratio of engine speed. As cams 18,20 rotate, they cause respective inlet cam follower 22 and exhaust cam follower 24 to reciprocate in respective follower bores 26,28.

Adjacent the end of inlet cam follower 22 remote from shaft 12, there is a pair of inlet rockers 30,32, each for controlling the opening and closing of a respective one of inlet valves 34,36. Rockers 30,32 are rotatably mounted on respective rocker shafts 38,40; each of shafts 38,40 having a respective axis 42,44 which is offset from, and perpendicular to the axis 46 of bore 26 and each offset from and perpendicular to the axis 48,50 of the respective valve 34,36.

Inlet cam follower 22 has a surface 52 which contacts a respective offset arm 54,56 of each of rockers 30,32. Also, each of rockers 30,32 has a tappet arm 58,60 each of which holds a respective tappet 62,64 of either fixed or hydraulic lash adjusting type. Each of tappets 62,64 actuate the associated one of inlet valves 34,36; with the latter being radially aligned to the centre of curvature 66 of the combustion chamber 68 of piston 70.

Similarly, the end of exhaust cam follower 24 remote from shaft 12 has a surface 53 which contacts offset arms 55,57 of exhaust rockers 31,33. Also, rockers 31,33 are rotatably mounted on rocker shafts 39,41, the axes 43,45 of which are oriented so that they are offset from, and perpendicular to the axis 47 of bore 28 and each offset from, and perpendicular to, the axes 49,51 of the respective exhaust valves 35,37. Tappet arms 59,61 formed on rockers 31,33 hold tappets 63,65. Again tappets 63,65 are of fixed or hydraulic lash adjusting type, and they actuate spring loaded exhaust valves 35,37 which are radially aligned to centre of curvature 66 of chamber 68.

In the arrangement of Figures 1 and 2 which, as indicated, shows an axial engine crankshaft arrangement, shaft 12 extends parallel to the one piston 70. Figures 3 and 4 show one cylinder of an in-line engine, with the camshafts thereof extending along the line and, in this instance, offset to one side of the pistons.

The arrangement shown in Figures 3 and 4 readily will be understood from the foregoing description of Figures 1 and 2; corresponding parts having the same reference numeral plus 100. However, in this instance, arrangement 100 has twin camshafts 112,112', each carrying a respective cam 118,120 for reciprocating cam followers 122,124.

In each of arrangements 10,110, each of the inlet valves is actuated simultaneously by a respective rocker, but under the action of a single cam follower; while the same applies to the pair of outlet valves.

Also in each arrangement, either splash or pressure type of lubrication can be employed. Passages formed in the cylinder head and/or in the rocker shafts can provide oil under pressure to the rockers, and passages formed in the tappet arms can provide oil supply to the hydraulic lash adjusters or to adjustable tappets.

Moreover, in each of arrangements 10,110, a specific valve is designated as an inlet valve, with the other one being an outlet valve. However, it will be appreciated that the respective valve functions can be the reverse of that designated.

Finally, it is to be understood that various alterations, modifications and/or additions may be introduced into the constructions and arrangements of parts previously described without departing from the spirit or ambit of the invention.

Claims

1. A valve actuating arrangement in which, for a pair of valves, there is a respective rocker member for each valve of said pair thereof and a single actuating rod, with each rocker member being simultaneously movable under the action of the single actuating rod for simultaneous actuation of each valve of the pair thereof by a respective rocker member.

2. A valve actuating arrangement according to claim 1, wherein said actuating rod is a cam follower movable longitudinally under the action of a cam profile provided on a camshaft.

3. A valve actuating arrangement according to claim 2, wherein each rocker member is mounted on a respective shaft, the shafts being inclined such that each rocker member has a shaft axis substantially perpendicular to the longitudinal movement of the cam follower and also substantially perpendicular to the axis of the respective valve.

4. A valve actuating arrangement according to claim 3, wherein each rocker member has a body portion through which its shaft axis extends and, extending outwardly from the body portion laterally of said axis, a tappet arm having a tappet for actuating the respective valve and a second arm offset from the tappet arm, each rocker member being movable simultaneously by engagement of each second arm by said cam follower.

5. A valve actuating system for a pair of inlet valves and a pair of outlet valves, said system comprising for each pair of valves a respective

valve actuating arrangement according to any one of claims 1 to 4, the respective single actuating rods being movable alternately.

6. A valve actuating system according to claim 5, wherein each said actuating rod is a cam follower movable under the action of a respective cam profile provided on a common camshaft.

7. A valve actuating system according to claim 5, wherein each said actuating rod is a cam follower movable under the action of a respective cam profile each provided on a respective camshaft.

8. A valve actuating system according to any one of claims 5 to 7, wherein said system is mounted in relation to a cylinder of an engine provided with a pair of inlet valves and a pair of exhaust valves, said valves being mutually inclined such that the axis of each is on a respective radial line passing through a centre of curvature for a part spherical combustion chamber for the cylinder.

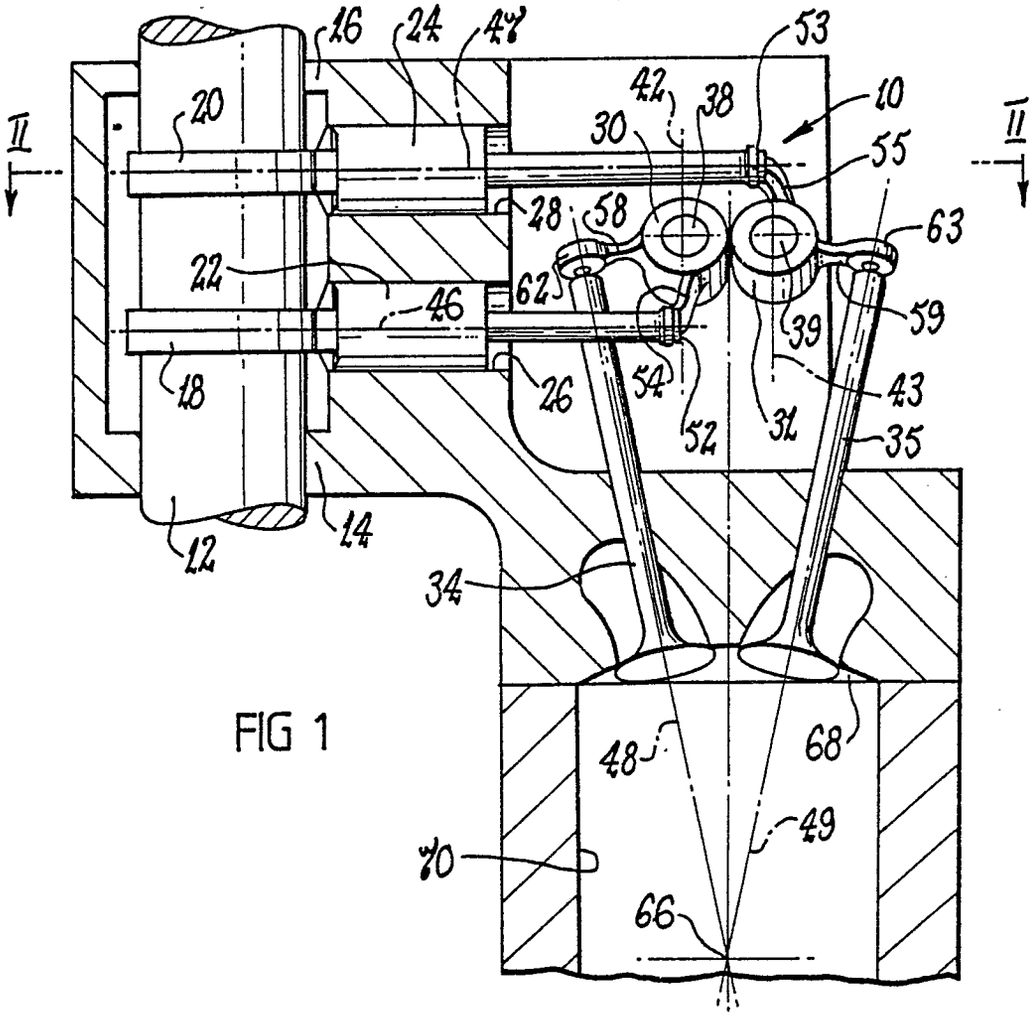
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FIG 1

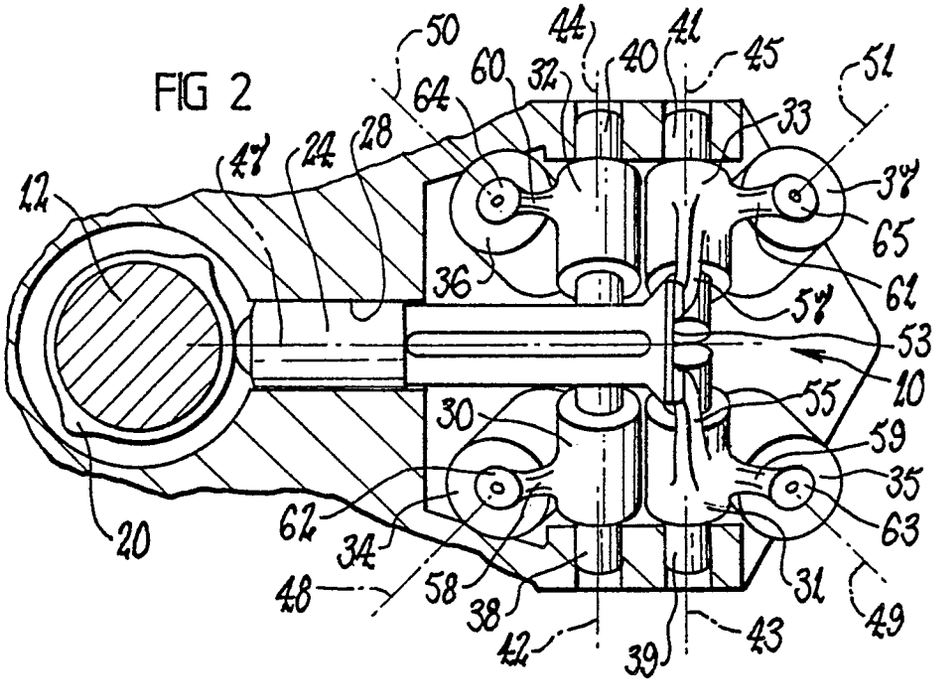
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FIG 2

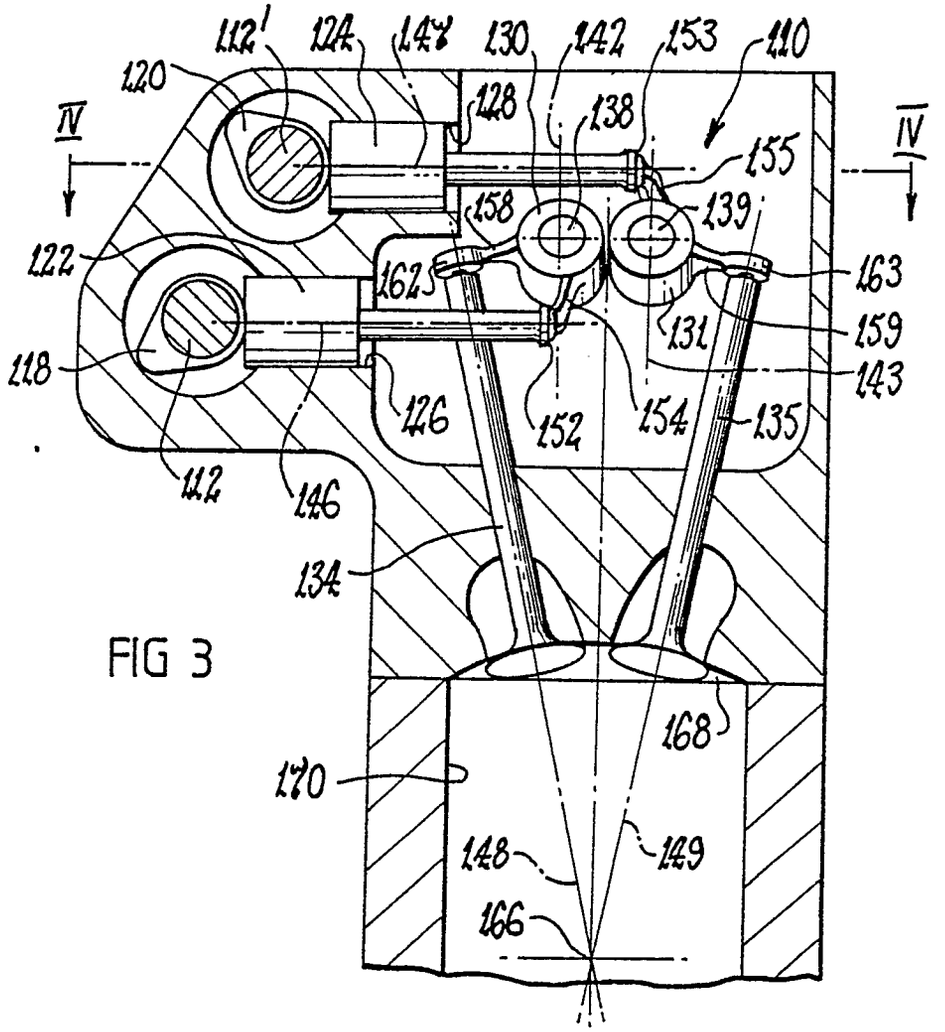
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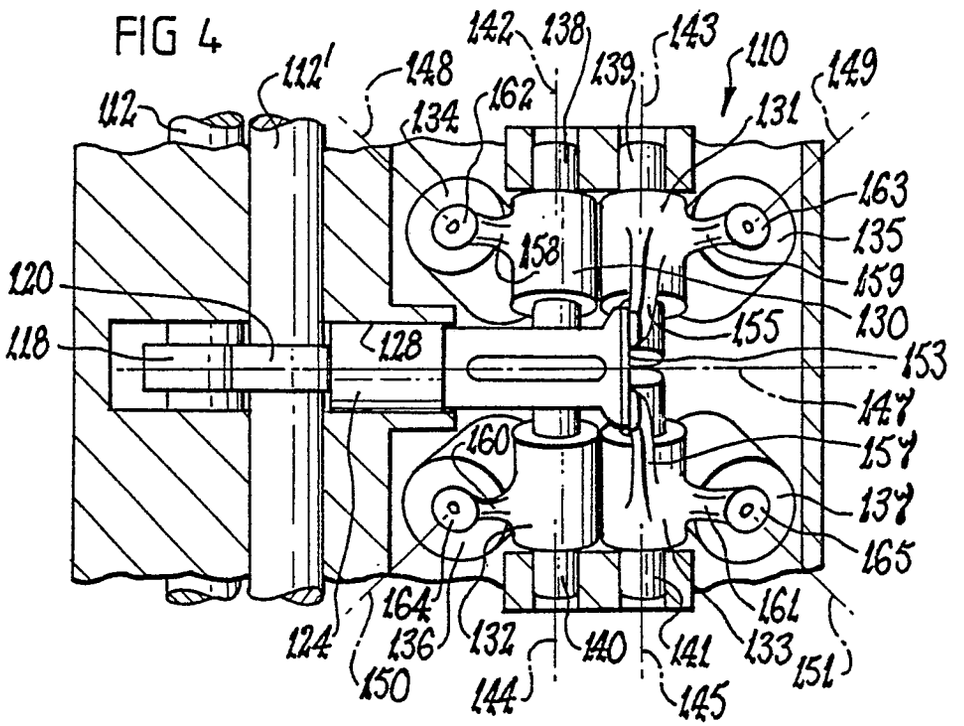
FIG 3

FIG 4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EUROPEAN SEARCH REPORT

Application number

EP 87 30 2628

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	GB-A- 206 898 (RUDGE-WHITWORTH LTD) * Page 3, lines 17-73,90-115; figures 1-6 *	1-7	F 01 L 1/26
Y		8	

X	GB-A- 403 666 (GIANNOTTI) * Page 3, lines 34-42,56-77,74-110; page 4, lines 19-40,79-109; figures 1-6 *	1-7	
Y		8	

Y	DE-B-1 300 578 (BMW) * Column 2, lines 20-34; figure 2 *	8	
	-----		TECHNICAL FIELDS SEARCHED (Int. Cl.4) F 01 L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	13-07-1987	LEFEBVRE L.J.F.

CATEGORY OF CITED DOCUMENTS

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