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GB 2225056 A GB 2166493 A GB 0206196 A
GB 0136334 A GB 0106712 A US 5249553 A

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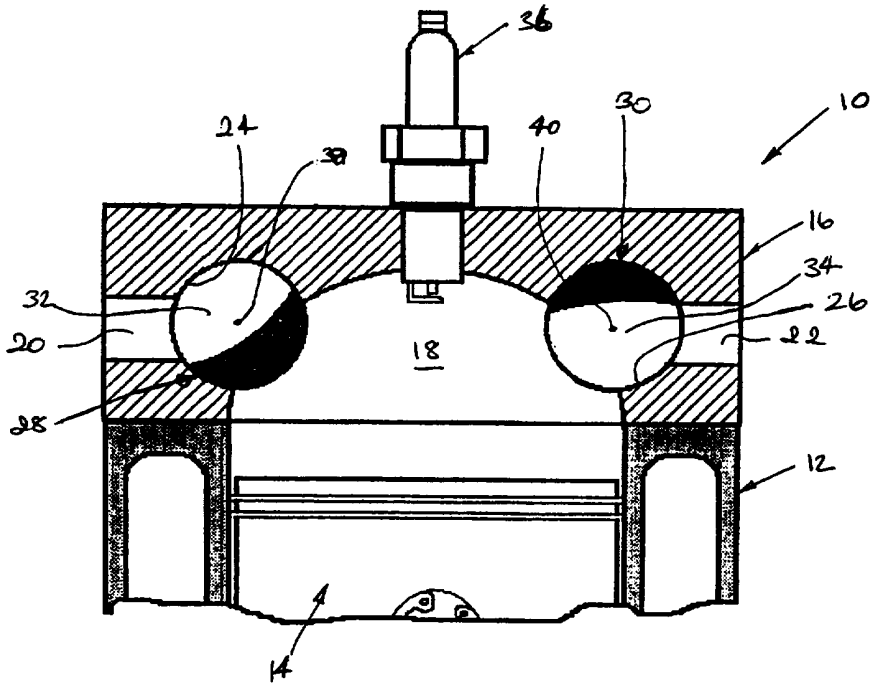
(54) Engine or compressor rotary valve arrangement

(57) Synchronously driven valve shafts 28 and 30 have respective passages 32, 34 for flow into and exhaust from the working chamber 18.



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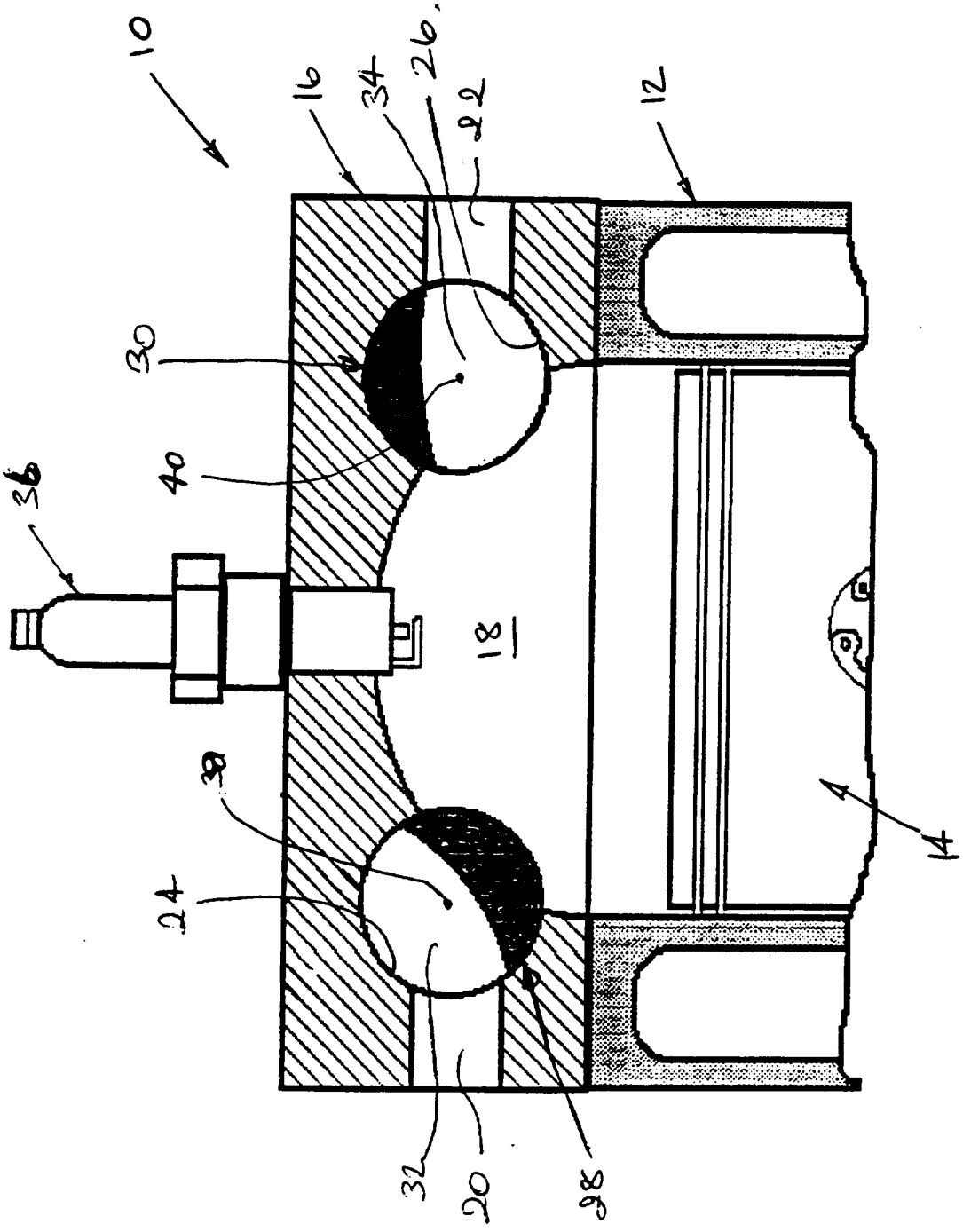
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VALVE ARRANGEMENT FOR AN INTERNAL COMBUSTION ENGINE OR COMPRESSOR

The present invention relates to internal combustion and compressors and particularly to a valve arrangement for the inlet and exhaust functions of such devices.

Presently, internal combustion engines and compressors generally have the inlet and exhaust functions controlled by reciprocating valves such as the well known "poppet" valve. These valves are generally opened directly by a driven cam or by an intervening pushrod and/or rocker actuated by a cam. Return of the valve to its closed position is generally effected by resilient spring means. These known systems are complex; involving many moving parts and are inherently expensive to manufacture.

Other sophisticated methods of valve actuation are known including hydraulic, pneumatic, electro-pneumatic for example. However. such sophisticated actuation systems only add to the complexity and cost of manufacture.

In addition to the complexity and cost of manufacture, significant losses in engine or compressor efficiency are incurred due to friction and inertia for example.

Rotary valves have been proposed in the past for dealing with inlet and exhaust functions. Examples of such rotary valve systems are described in GB 2203797, where the inlet function is

provided by gas channels formed in the surface of a tubular valve member and the exhaust function is provided by a central, axially disposed exhaust passage having access ports formed through the tube wall. US 4019488 describes a similar system. US 3945364 describes a rotary type valve arrangement where a common inlet and exhaust passage is formed in the outer surface of an otherwise solid cylindrical or spherical valve shaft or member. GB 2223800 describes a valve arrangement where both reciprocating poppet-type valves and a rotary valve are used in conjunction.

However, all the above valve systems employ only one rotary valve member or valve shaft which deals with both inlet and exhaust functions. Thus, the flexibility of these prior art arrangements are limited by the need to introduce compromises between valve timing and overlap, volumetric flow and combustion chamber design and size.

According to the present invention there is provided a valve arrangement for the exhaust and inlet functions of an internal combustion engine or a compressor, the valve arrangement comprising a generally cylindrical inlet valve shaft having gas passage means formed in the surface thereof for admitting inlet charge gases into an associated combustion chamber; a generally cylindrical exhaust valve shaft having gas passage means formed in the surface thereof for allowing escape of exhaust gases from said associated combustion chamber; said inlet valve member and said exhaust valve member being in simultaneous, substantially sealing engagement with said associated combustion chamber during

at least a major proportion of a compression and combustion event in said associated combustion chamber; and said inlet valve shaft and said exhaust valve shaft being driven in mutual synchronism by valve shaft drive means.

In this specification the terms "inlet charge", "exhaust gases", "combustion chamber" and other such terms are also intended to apply to the comparable functions of a compressor where no actual combustion takes place, the compressor apparatus being driven by external drive means to supply compressed gas, generally air. Similarly, the term "engine" used hereafter is also intended to include both internal combustion engines and compressors, where appropriate.

The term "combustion chamber" is used to denote the volume in which combustion takes place and is not to be taken as being limited only to the volume defined within an engine cylinder head and may, for example, include or be substituted by part or all of the volume of the associated engine cylinder in which a piston reciprocates.

In one embodiment of the present invention, the valve shafts may be located in a cylinder head separate from the engine cylinder block. Alternatively, the valve shafts may be located in the engine cylinder block, gas flow ports being formed to communicate with the cylinders either directly or through an associated cylinder head.

In one embodiment of the present invention, the engine is a four-stroke engine having either spark-ignition or compression ignition.

The engine may have conventional carburettor fuel induction or be fuel injected or be supercharged as by, for example, a turbocharger.

The valve arrangement of the present invention may relate to a single cylinder engine or to a multi-cylinder engine.

The valve shafts may be formed from metal or from ceramic materials and the gas flow passages may be formed in the surface of the valve shafts by any known means appropriate to the material from which they are made.

An advantage of the valve arrangement of the present invention is that a greater gas flow area may be provided by both the inlet and exhaust valve shafts compared with that available by poppet valves. Thus, the volumetric efficiency of the engine may be improved by ability to induce increased fuel charges by normal atmospheric aspiration means.

Another advantage of the present invention is that conventional operations such as valve clearance adjustment is no longer required. Similarly, inertia problems concerned with rate of opening and valve-bounce with conventional reciprocating valves do not occur with the valve arrangement of the present invention.

In order that the present invention may be more fully understood, an example will now be described by way of illustration only with reference to the accompanying drawing which shows a schematic cross section through a cylinder head of an internal combustion engine having a valve arrangement according to the present invention.

Referring now to the drawing which shows a schematic cross section through a cylinder of a spark-ignition internal combustion engine designated generally at 10. The engine 10 includes a cylinder block 12 having a reciprocating piston 14 therein and a cylinder head 16. A combustion chamber 18 is formed within the cylinder head and an inlet passage 20 and exhaust passage 22 lead from the outer faces of the head to the combustion chamber 18. Cylindrical valve shaft passages 24, 26 are formed in the cylinder head 16 which partially extend into the combustion chamber 18. An inlet valve shaft 28 and an exhaust valve shaft 30 are situated in the passages 24, 26, respectively. The valve shafts 28, 30 have gas flow passages 32, 34 formed in the surfaces thereof. The portions of the valve shafts 28, 30 which traverse the combustion chamber 18 are in substantially sealing engagement with the valve shaft passages 24, 26 under the combustion conditions in which they operate in practice when the gas flow passages are not exposed to the combustion chamber in the major portion of the compression and combustion phases of the operating cycle. The valve shafts 28, 30 are driven in synchronism with each other by shaft drive means (not shown) such as a toothed belt, chains and/or gears, for example. A spark plug

36 is also provided for the combustion chamber 18.

In operation, the valve shafts 28, 30 are rotated about their axes 38, 40, respectively by the drive means (not shown) such that as the piston 14 is descending in the cylinder the gas flow passage 32 is opening and an air charge may be induced into the combustion chamber and cylinder. At the bottom of the piston stroke, the gas flow passage 32 is closing and the gas flow passage 34 of the exhaust valve shaft, although rotating, remains closed as the piston 14 rises in the cylinder to compress the fuel/air mixture. Adjacent the top of the piston stroke, the spark plug fires and the mixture is ignited forcing the piston down the cylinder on the power stroke. When the piston again begins to rise in the cylinder, the gas flow passage 34 is beginning to open and continues to do so as the piston 14 drives the exhaust gases out of the cylinder, the gas passage 32 remaining closed. At the top of the stroke, the exhaust gas flow passage 34 closes and the passage 32 begins to open to repeat the cycle.

The above description of the combustion cycle merely describes it in principle. However, the person skilled in the art will appreciate that there are many subtleties such as valve gas flow passage overlap, for example, which may be employed to achieve such objectives as scavenging of the exhaust gases by the incoming fuel/air mixture whereby the exhaust passage is still slightly open as the inlet passage begins to open as the piston begins to descend.

The inlet and exhaust timing of any engine may be controlled by the arc of rotation over which the gas flow passages 32, 34 open and close. Similarly, the area available for gas flow may be controlled by the extent in the axial direction (i.e. perpendicular to the plane of the drawing) in which the gas flow passages are and limited only by the axial width of the combustion chamber 18.

The valve shafts 28, 30 may be positioned closer to the top surface of the cylinder block 12 such that they intrude slightly into the cylinder bore or bores, the piston 14 being relieved at the appropriate regions of its top periphery, above the piston rings, to accommodate them. In this way, control of the combustion chamber volume may be controlled and hence may be used to assist control of the engine compression ratio.

CLAIMS

1. A valve arrangement for the exhaust and inlet functions of an internal combustion engine or a compressor, the valve arrangement comprising a generally cylindrical inlet valve shaft having gas passage means formed in the surface thereof for admitting inlet charge gases into an associated combustion chamber; a generally cylindrical exhaust valve shaft having gas passage means formed in the surface thereof for allowing escape of exhaust gases from said associated combustion chamber; said inlet valve member and said exhaust valve member being in simultaneous, substantially sealing engagement with said associated combustion chamber during at least a major proportion of a compression and combustion event in said associated combustion chamber; and said inlet valve shaft and said exhaust valve shaft being driven in mutual synchronism by valve shaft drive means.

2. An engine or compressor having the valve arrangement of claim 1.

Patents Act 1977 **Examiner's report to the Comptroller under Section 17** **(The Search report)**	Application number GB 9418596.4
Relevant Technical Fields (i) UK Cl (Ed.M) F1B (ii) Int Cl (Ed.5) F01L 7/02	Search Examiner R J DENNIS Date of completion of Search 11 OCTOBER 1994
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii)	Documents considered relevant following a search in respect of Claims :- 1 AND 2

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 2225056 A	(LEES)	1 and 2
X	GB 2166493 A	(BRODIE)	1 and 2
X	GB 0206196	(WHITE)	1 and 2
X	GB 0136334	(MUSURUS)	1 and 2
X	GB 0106712	(EDMONDSON)	1 and 2
X	US 5249553	(GUIOD)	1 and 2

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).