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(54) Internal combustion engine with rotary valves

(57) The invention is directed to an Internal combustion engine (1) with rotary valves (2, 3) in axial bores (4, 5) to control opening and closing of transfer ports (6, 7) in a cylinder head or cylinder block (8) for fluid communication between the ports (6, 7) and a combustion chamber (23) of the engine (1). A valve drive shaft (9) is arranged perpendicular to the rotary valves (2, 3), the shaft (9) being provided with helical slots (10) to cooperate with gears (11) fixed to the free ends of the rotary valves (2, 3) for driving the rotary valves (2, 3) in accordance with the operating cycle of the engine (1).

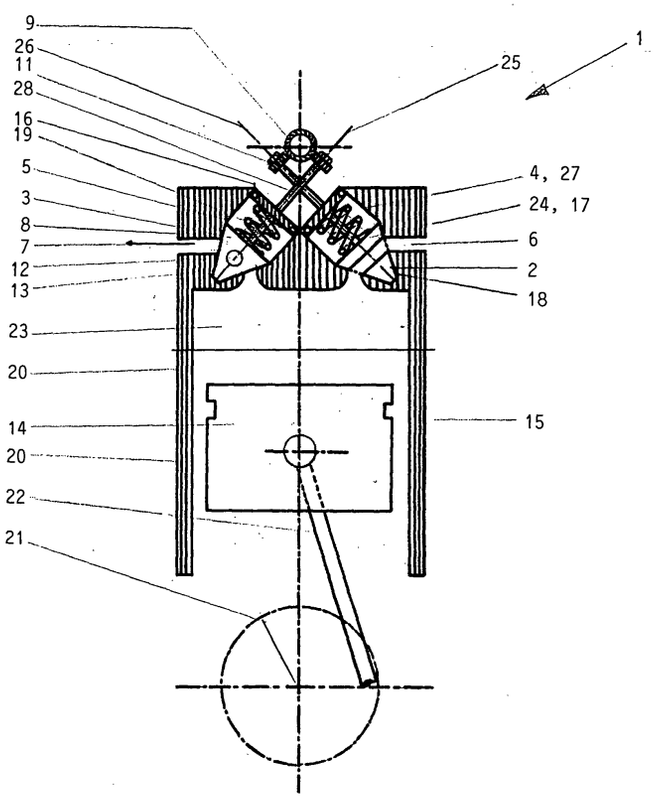

Fig. 1

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Description

[0001] The present invention relates to an internal combustion engine with rotary valves.

[0002] Internal combustion engines with rotary valves have been known since 1910 with the conception of the Burt McCollum engine. There has been influence on this concept from Minerva, Panhard and Levassor and Mercedes producing this combustion engine - patented by Knight - till 1939. Due to sealing problems the concept of the Burt McCollum engine had to be abandoned. Conventional cylinder heads with oscillating valves have the well known disadvantages of offering restricted performance and discontinuous supply of fuel-mixture. Major drawbacks result from the valves, the ignition and the sealings, that need constant surveillance and maintenance with the involved costs.

[0003] The present invention is aiming at internal combustion engines with rotary valves overcoming the above mentionned disadvantages while offering advantages for the construction and the efficiency of the engine.

[0004] The present invention proposes internal combustion engines with rotary valves with the features of claim 1. Preferred embodiments of the present invention are outlined in the subclaims.

[0005] According to the present invention is provided an internal combustion engine with rotary valves in axial bores to control opening and closing of transfer ports in a cylinder head or cylinder block for fluid communication between the ports and a combustion chamber of the engine, and a valve drive shaft arranged perpendicular to the rotary valves, the shaft being provided with helical gaps to cooperate with gears fixed to the free ends of the rotary valves for driving the rotary valves in accordance with the operating cycle of the engine with each rotary valve being provided with a passage duct in the valve head opening into the ports. The internal combustion engine with rotary valves according to the present invention is less consumptive while emitting less exhaust gases and presenting a higher perfomance due to the continuous and constant supplie of fuel mixture. The rotary valves according to the present invention may be implemented onto an existing engine with a cylinder head replacing conventional oscillating valves after changes in the cylinder head, i. e. replacing the conventional cam shaft(s) with the valve drive shaft arranged perpendicular to the rotary valves and altering the cylinder head to accomodate the rotary valves.

[0006] According to a preferred embodiment of the present invention the valve drive shaft is driven by the crankshaft of the engine or by a separat electro motor allowing better electronic control.

[0007] According to another preferred embodiment of the present invention the cylinder block is an integral unit comprising intake and exhaust channels, comprising the bores for the rotary valves and comprising the side walls till the casing of the crankshaft of the engine. A cylinder head sealing is obsolete with this new concept of an internal combustion engine with rotary valves.

[0008] According to another preferred embodiment of the present invention each rotary valve is being held in position in the cylinder head or cylinder block by a ball bearing remote from the ports and conically shaped slide bearings above and below the ports. With the inventive arrangement of bearings there is substantially no leakage around the rotary valve, being smoothly spinning at low resistance levels.

[0009] According to another preferred embodiment of the present invention each rotary valve is provided with spring means abutting against the ball bearing and the conically shaped valve head in the bores. The spring is biasing the rotary valve into the conically shaped valve seat in the cylinder head or cylinder block thus providing for improved sealing at reduced length of the stem of the rotary valve allowing thus reduced height of the cylinder head or cylinder block and thus less encumbrance for the entire new internal combustion engine with rotary valves. The spring is abutting against the central member of the ball bearing rotating with the rotary valve and is thus free from sheer forces.

[0010] According to another preferred embodiment of the present invention each rotary valve is provided with a central passage duct in the conically shaped valve head opening into the ports in accordance with the operating cycles of the engine.

[0011] Additional features of the invention will become apparent and a fuller understanding obtained by reading the following detailed description made in connection with the accompanying drawings.

Fig. 1 shows a transversal section through an internal combustion engine with rotary valves according to the present invention,

Fig. 2 shows a schematic perspective view of a possible configuration of a rotary valve and a valve drive shaft for engine manufacturers according to the present invention, and

Fig. 3 shows a rotary valve according to the present invention.

[0012] Fig. 1, 2: An internal combustion engine 1 has rotary valves 2, 3 in axial bores 4, 5. Transfer ports, i. e. an intake port 6 and an exhaust port 7 in a cylinder block 8 allow fluid, i. e. fuel mixture, to communicate between the ports 6, 7 and a combustion chamber 23 of the engine 1. A piston 14 is connected to a crankshaft 21 via a rod 22.

[0013] The cylinder block 8 is an integral unit or is equipped with a cylinder head gasket (not shown), according to the engine manufacturers wishes, comprising the intake and exhaust ports 6, 7, comprising the bores 4, 5 for the rotary valves 2, 3 and comprising the side walls 20, 15 till the casing of the crankshaft 21 of the

engine 1.

[0014] Each axial bore 4, 5 consists of a first section with a cylindrical shaped body 27 and a second section 24 with a bevel shaped body occupying the transfer ports 6, 7.

[0015] Each rotary valve 2, 3 is being held in position in the axial bores 4, 5 of the cylinder block 8 by a circumferential member of a ball bearing 16 remote from the ports 6, 7.

[0016] Conical shaped slide bearings 17, 18 are arranged above and below the ports 6, 7. A helical spring 19 is abutting against the central member of the ball bearing 16. Helical spring 19 is biasing the conically shaped valve head 13 into the second section 24 of the bores 4, 5.

[0017] The respective axis of rotation 25, 26 of the rotary valves 2, 3 are perpendicular to each other.

[0018] A valve drive shaft 9 is arranged perpendicular to the rotary valves 2, 3. The shaft 9 is provided with helical slots 10 around its entire surface to cooperate with gear wheels 11 fixed to the respective free ends of the rotary valves 2, 3. Each rotary valve has a central passage duct 12 in the valve head 13.

[0019] The valve drive shaft 9 is driven by the crankshaft of the engine or by a separat electro motor (not shown).

[0020] Fig. 3: Each gear wheel 11 is fixed by a screw 27 to a threaded free end of the rotary valves 2, 3. A ball bearing 16 is mounted with its central member to a stem 28 of each rotary valve 2, 3. Each rotary valve has a central passage duct 12 in the bevelled valve head 13.

[0021] Operation of the internal combustion engine 1 with rotary valves 2, 3

[0022] In the following the rotary valves will be described in the context of their use with reciprocating type internal combustion engines. However neither some of the known nor the rotary valve embodiments in accordance with the present invention are limited to such applications.

[0023] Step 1: During the intake stroke the rotary valve 2 in intake port 6 is rotated by the helical slots 10 of valve drive shaft 9 in an angular position to open intake port 6 via its central passage duct 12. Exhaust port 7 remains closed by rotary valve 3.

[0024] Step 2: During the compression stroke the rotary valves 2, 3 in transfer ports 6, 7 are rotated by the helical slots 10 of valve drive shaft 9 in angular positions to close intake port 6 and exhaust port 7.

[0025] Step 3: During the ignition and expansion stroke the rotary valves 2, 3 in transfer ports 6, 7 are rotated by the helical slots 10 of valve drive shaft 9 in angular positions to keep closed intake port 6 and exhaust port 7.

[0026] Step 4: During the exhaustion stroke the rotary valves 2, 3 in transfer ports 6, 7 are rotated by the helical slots 10 of valve drive shaft 9 in angular positions to keep closed the intake port 6 but to open exhaust port 7 via the central passage duct 12 of rotary valve 3.

[0027] With the next stroke the operating cycle starts again with step 1.

Claims

1. Internal combustion engine (1) with
rotary valves (2, 3) in axial bores (4, 5) to control opening and closing of transfer ports (6, 7) in a cylinder head or cylinder block (8) for fluid communication between the ports (6, 7) and a combustion chamber (23) of the engine (1), and
a valve drive shaft (9) arranged perpendicular to the rotary valves (2, 3), the shaft (9) being provided with helical slots (10) to cooperate with gears (11) fixed to the free ends of the rotary valves (2, 3) for driving the rotary valves (2, 3) in accordance with the operating cycle of the engine (1).

2. Internal combustion engine (1) according to claim 1, **characterized in that** the valve drive shaft (9) is driven by the crankshaft (21) of the engine (1).

3. Internal combustion engine (1) according to claim 1, **characterized in that** the valve drive shaft (9) is driven by an electro motor or by timing-belt, chain or gear.

4. Internal combustion engine (1) according to claim 1, **characterized in that** the cylinder block (8) is an integral unit comprising intake and exhaust ports (6, 7), comprising the bores (4, 5) for the rotary valves (2, 3) and comprising the side walls (20, 15) till the casing of the crankshaft of the engine (1).

5. Internal combustion engine (1) according to claim 1, **characterized in that** each rotary valve (2, 3) being held in position in the cylinder head or cylinder block (8) by a ball bearing (16) remote from the ports (6, 7) and conically shaped slide bearings (17, 18) above and below the ports (6, 7).

6. Internal combustion engine (1) according to claim 1, **characterized in that** each rotary valve (2, 3) is provided with resilient means (19) abutting against the ball bearing (16) and the conically shaped valve head (13) in the bores (4, 5).

7. Internal combustion engine (1) according to claim 1, **characterized in that** each rotary valve (2, 3) is provided with a central passage duct (12) in the conically shaped valve head opening in the ports (6, 7).

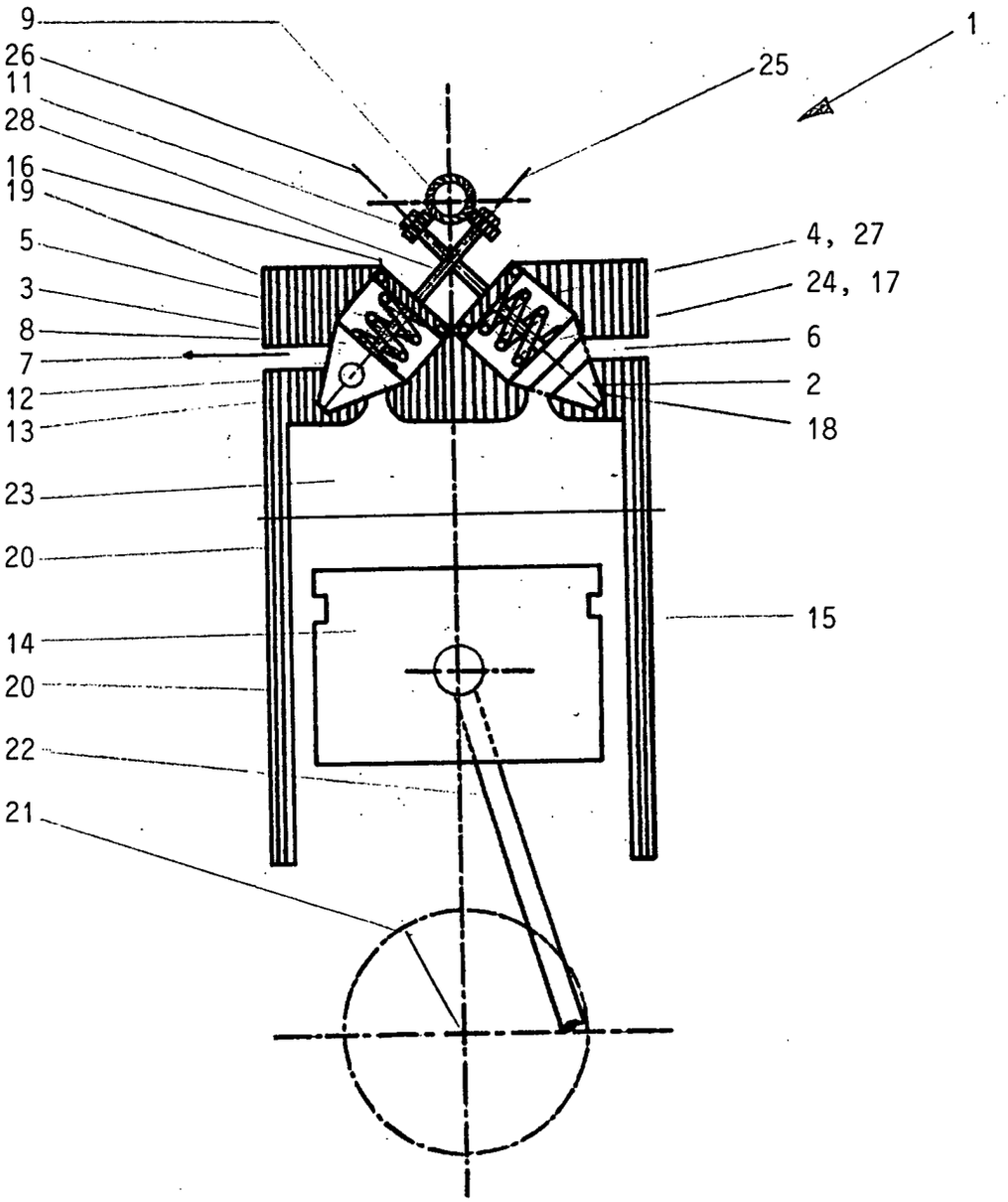

Fig. 1

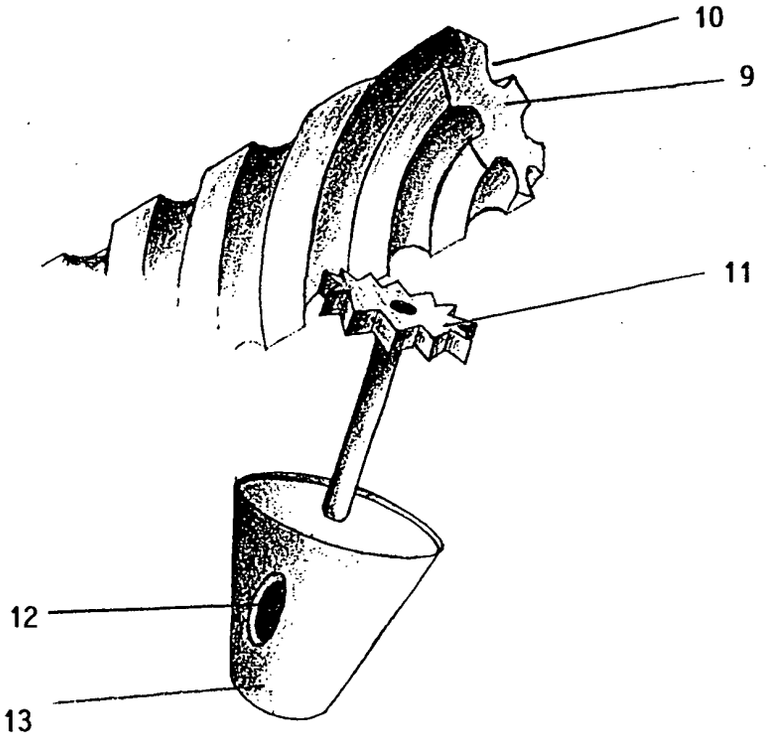

Fig. 2

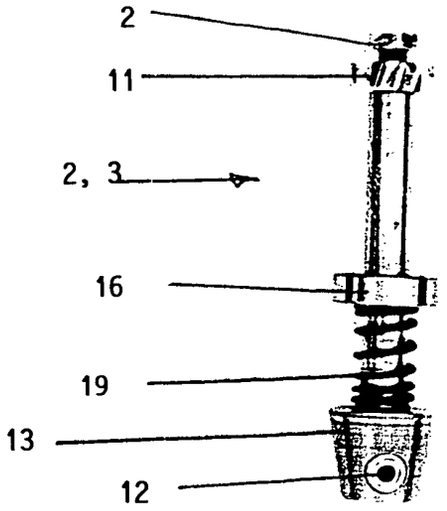

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 01 12 4825

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.7)
X	GB 396 641 A (JEAN MARIE DUFOUR;HENRI ALBARET) 10 August 1933 (1933-08-10) * figures 1-5 *	1-3,5-7	F01L7/08
X	GB 511 208 A (ASPIN FRANK METCALFE) 15 August 1939 (1939-08-15) * figures 1,2 *	1-3,5,7	
X	US 2 245 743 A (METCALF ASPIN FRANK) 17 June 1941 (1941-06-17) * figures 1,3 *	1-3,5	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

F01L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	25 January 2002	Paulson, B

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 01 12 4825

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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25-01-2002

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 396641 A	10-08-1933	NONE	
GB 511208 A	15-08-1939	NONE	
US 2245743 A	17-06-1941	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82