(12) UK Patent Application (19) GB (11) 2 393 216 (13) A

(43) Date of A Publication 24.03.2004

(21) Application No: 0221777.6

(22) Date of Filing: 19.09.2002

(71) Applicant(s):
Takis Sozou
62 Natal Road, LONDON, N11 2HY,
United Kingdom

(72) Inventor(s):
Takis Sozou

(74) Agent and/or Address for Service:
Takis Sozou
62 Natal Road, LONDON, N11 2HY,
United Kingdom

(51) INT CL[7]:
F01L 7/10

(52) UK CL (Edition W):
F1B B2Q5D

(56) Documents Cited:
GB 0672954 A
EP 0423444 A
WO 1997/042403 A
US 5109814 A
US 4010727 A
GB 0429983 A
WO 2002/020979 A
US 5711265 A
US 4821692 A
US 3945364 A

(58) Field of Search:
UK CL (Edition V) **F1B**
INT CL[7] **F01L**
Other: **online: EPODOC, JAPIO, WPI**

(54) Abstract Title: **I.c. engine with rotary, eg part-spherical, valves**

(57) The engine has an engine block defining one or more cylinders 1 each with an inlet 6 and an outlet able to be opened and closed selectively by rotatable valve means to allow fluid into and out of each cylinder at pre-determined times during each operating cycle of the engine. The valve means may take the form of a rotatable shaft 14 having pan-spherical portions 15 formed along its length so as to be positioned in respective inlets and outlets of each cylinder 1. The shaft 14 may extend though both the inlet and outlet ducts. The shaft 14 may be driven from the crankshaft at a rate of rotation equal to one-quarter or one-half of that of the crankshaft. The cylinder head 5 may be of two-part construction to facilitate assembly of the valve arrangement.

FIG 2

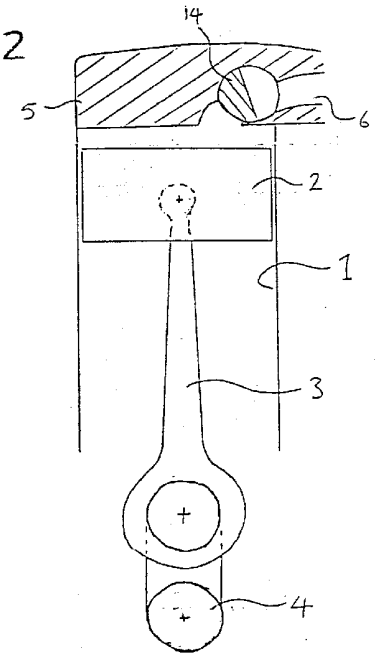
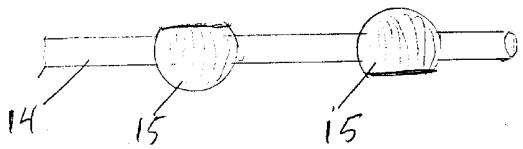


FIG 3



GB 2 393 216 A

FIG 1

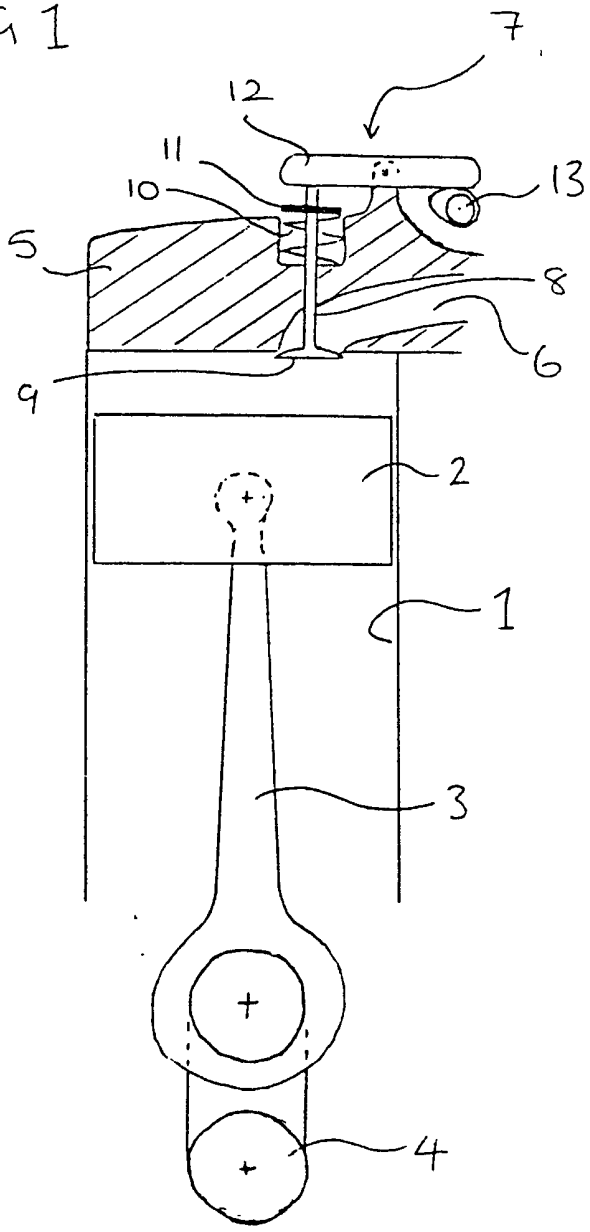


FIG 2

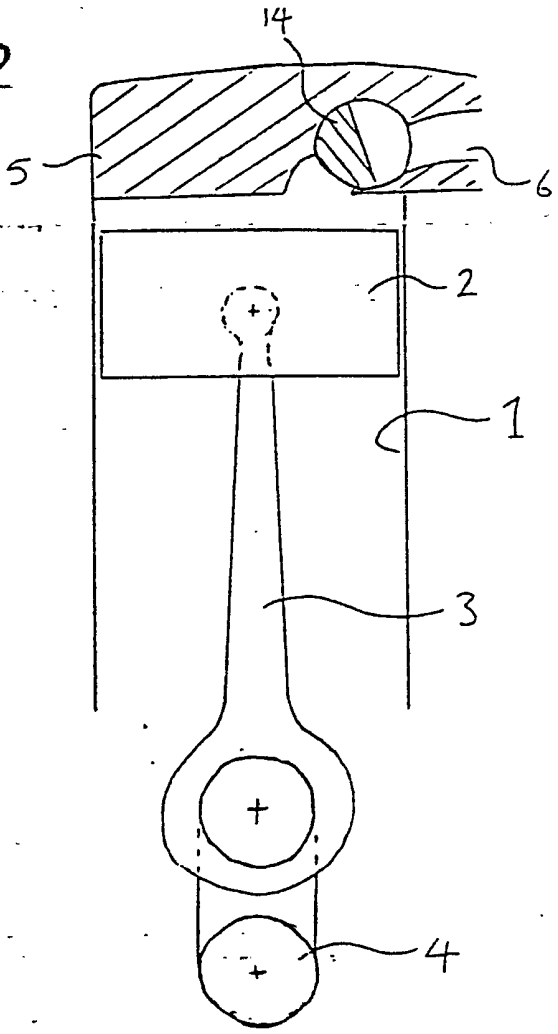


FIG 3

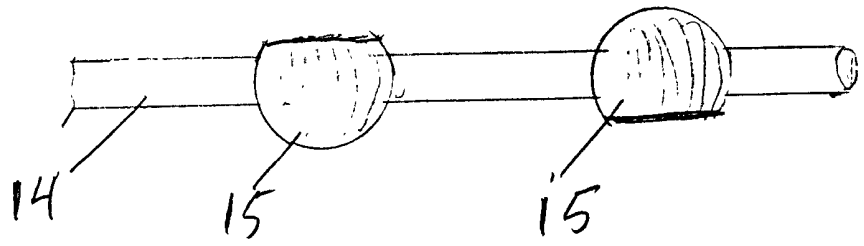


FIG 4

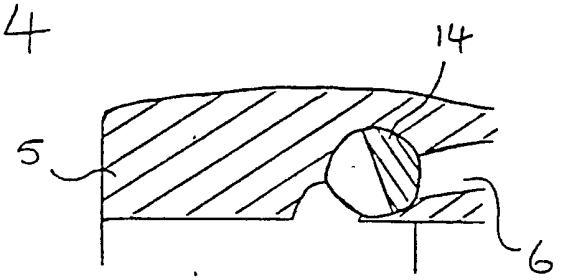


FIG 5

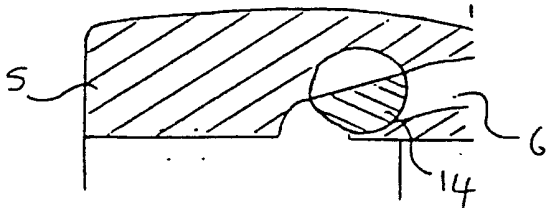
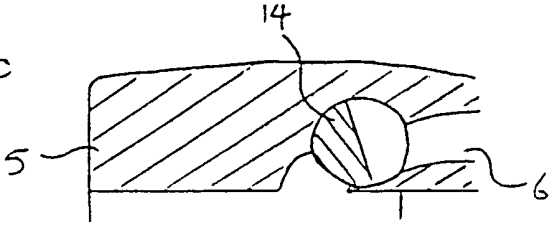


FIG 6



PATENTS ACT 1977

2393216

DESCRIPTION OF INVENTION

T S VALVE ARRANGEMENT
Improvements in or relating to an engine .

THE PRESENT INVENTION relates to an engine and more particularly to an internal combustion engine for use in a motor vehicle, in marine or industrial applications.

A conventional internal combustion engine has an engine block which defines one or more cylinders, a piston being received in each cylinder, each piston is connected by way of a connecting rod to a crankshaft which converts the linear motion of each piston into rotary motion which is subsequently transmitted to a member or members to be driven by the engine

The upper end of each cylinder is closed off by the cylinder head which defines an inlet to and an outlet from the cylinder. In conventional engines the inlet and outlet of each cylinder are each provided with a reciprocating valve which is biased to close the inlet or outlet . In operation of the engine the valves are opened at predetermined times against the bias to permit controlled flow of a combustion mixture into and out of the engine.

Each time a valve is opened it must be accelerated from it's momentary stationary condition against the closing bias and then decelerated to a momentary standstill at the open position . The force required to open the valves is derived from the engine itself and thus a certain amount of engine power is required simply to operate the valves. The force associated with valve operation also results in considerable stress being placed on other engine components.

A further problem associated with reciprocating valves occurs when the engine is run at high speeds. When operating at high speeds the valves may not be able to follow the movement imparted to them and a phenomenon known as valve bounce or flutter occurs. If the engine speed corresponds approximately with the natural frequency of the reciprocating valve system then the valve will tend to move independently of the movement imparted to it and the cylinder inlet and outlet will not be opened at the correct times in the operating cycle of the engine and the power output from the engine will fall

Thus engines incorporating conventional reciprocating valve arrangements suffer from various disadvantages and the present invention seeks to provide an improved engine in which the shortcomings associated with conventional valves are overcome.

According to one aspect of the present invention there is provided an engine comprising of an engine block defining one or more cylinders, the or each cylinder having an inlet and an outlet. There being valve means which are rotatable so as to selectively open and close the inlet and outlet of each cylinder to allow combustion mixture into and out of each cylinder at predetermined times during the operating cycle of the engine.

Preferably the inlet and outlet of each cylinder is in the form of a respective bore duct and the valve means comprise an elongate circular section shaft extending through at least one of the inlet bore duct and the outlet bore duct the shaft been spherical in shape were it passes through the inlet duct and the outlet duct the shaft being configured such that upon rotation the or each duct through which it extends will be selectively opened and closed by the spherical section of the shaft so as to permit or prevent the flow of mixture into and out of each cylinder at said predetermined times

Conveniently a single shaft extends through both the inlet duct and the outlet duct of each cylinder of the engine but two or more shafts can be employed for an engine configured with four or more cylinders in a V configuration

Advantageously the shaft extends transversely to the general direction of the ducts the spherical part of the shaft extending into the ducts the spherical part of the shaft defining openings extending transversely of the shaft at intervals along it's length at those spherical points of the shaft which are received within the ducts, the shaft being rotatable to align said openings with the duct to permit the flow of air and fluid into and out of each cylinder

The openings may each be in the form of a bore extending diametrically through the spherical part of the shaft

In this case the shaft is connected to the crankshaft of the engine so as to be rotatably driven by the crankshaft at a rate of rotation equal to one quarter of the rate of rotation of the crankshaft

Alternatively the openings may each be in the form of a notch of recess cut into the spherical section of the shaft from the outer surface thereof, each notch extending transversely to the longitudinal axis of the shaft

In this alternative the shaft is connected to he crankshaft of the engine so as to be rotatably driven by the crankshaft at the rate of rotation equal to half the rate of rotation of the crankshaft

Preferably the inlet and outlet for each cylinder are formed in the cylinder head of the engine, the cylinder head being of two part construction to facilitate assembly of the rotatable valve means in the engine.

According to a second aspect of this invention there is provided a motor vehicle incorporating an engine as described above.

In order that the present invention may be more readily understood and so that further features thereof may be appreciated, the invention will now be described by way of example with reference the accompanying drawings in which.

FIGURE1 is a partly sectioned side view of one cylinder of an engine illustrating a conventional valve arrangement

FIGURE 2 is a partly sectioned side view of one cylinder of an engine in accordance with the present invention incorporating a modified valve arrangement

FIGURE 3 is a perspective view of part of one component of the valve arrangement shown in Figure 2

FIGURES 4 TO 6 illustrate the valve arrangement of Figure 2 in various operating positions.

Figure 1 of the drawings shows a cylinder 1 of an internal combustion engine. A piston 2 is received within the cylinder 1 and is connected by way of a connecting rod 3 to a crankshaft 4. The cylinder is closed at it's upper end by a cylinder head 5 [shown in section] which is received upon the main body of the engine block which defines the cylinders. The cylinder head 5 defines an inlet duct 6 and outlet duct [not visible in the drawings] which lead into the interior of the cylinder 1. In some engines a pair of inlet ducts and a pair of outlet ducts may be provided.

A valve arrangement 7 is provided to open and close the inlet and outlet ducts. A conventional valve arrangement 7 comprises a valve 8 mounted in the cylinder head 5. The valve 8 has a head 9 designed to block the end of the duct 6. The valve is biased to the closed position [i. e. the position in which the end of the duct is blocked] by a spring 10 which acts an a spring retainer 11 secured to the valve stem. The valve may be opened against the bias of a spring 10 by a rocker arm 12 which centrally, pivotally mounted of the cylinder 5. One end of the rocker arm 12 engages the upper end of the valve stem whilst the underside of the other end of the rocker arm is in contact with a camshaft 13. The camshaft 13 is rotatably driven by the crankshaft 4 . when a cam on the camshaft raises the right and of the rocker arm the valve 8 is depressed by the left hand end of the rocker arm and the inlet duct 6 is opened so that a combustible mixture may enter the cylinder 1.

As mentioned above this type of valve arrangement can suffer from valve flutter and requires a certain amount of engine power to actually open the valve against the spring bias. This type of valve arrangement also requires regular maintenance to ensure opening of the valves at the correct time in the operating cycle of the engine, as well as to ensure opening of the valves for the correct duration of time. Valves of this type also suffer from the disadvantage that the head 9 of the valve presents an obstruction to the flow of mixture into the cylinder 1 from the duct 6 when the valve is open. The mixture is forced to flow around the head 9.

Figure 2 shows part of an engine in accordance with the present invention. For ease of description parts which are common to the engine of the present invention and to the prior art engine described above carry the same reference numerals. Thus, the cylinder 1, piston 2, connecting rod 3 and crankshaft 4 are identical in design and operation to those of the conventional engine described above. The engine of the present invention also has a cylinder head 5 received upon the upper end of the main body of the engine block, the cylinder head 5 defining an inlet duct 6 and an outlet duct for each cylinder.

The engine of the present invention has a valve arrangement 7 which comprises an elongated ,circular section shaft 14 which is rotatably mounted in the cylinder head 5 the shaft 14 extends transversely to the general direction of the inlet duct 6 and the outlet duct [which would be located behind the inlet duct 6 as seen in Figure 2]. Part of the shaft 14 extends into the inlet duct to and the outlet duct, whilst the remainder of the shaft is received in a channel formed in the body of the cylinder head 5.

The shaft 14 is illustrated more clearly in Figure 3 where it can be seen that at intervals along its length corresponding to the positions of the inlet and outlet ducts in the engine cylinders the shaft forms spheres defining openings in the form of recesses 15 which extend transversely to the longitudinal
axis of the shaft and which are bored into the shaft from the outer surface thereof

In order to assemble the valve arrangement 7 it is envisaged that the cylinder head will be formed in two halves having a substantially horizontal joint. Each half will define a co-operating semi-circular channel spherical were the inlet and outlet ducts are located such that the shaft 14 may be received within the channel in the lower half of the cylinder before the upper half is secured thereto. seals are provided on the spheres along the length of the shaft and at 90 degrees in the form of piston rings on the grooves cut on the spheres seals are also provided on the shaft 14 between the spheres, in the form of sealing bearings .

The shaft 14 is connected by any appropriate means such as a chain and sprockets or a toothed belt and sprockets to the crankshaft 4 in a four stroke engine the connection is such that the shaft 14 will be driven by the crankshaft 4 at a speed which is half the speed of the crankshaft.

When the engine is running ,rotation of the crankshaft 4 will therefore rotate the shaft 14 when a recess 15 is received in the duct 6 as shown in Figure 2 the duct will be open. One clockwise revolution of the shaft 14 will move the shaft through the positions illustrated in Figures 4 to 6 and back to the position shown in Figure 2. The duct will be closed between the positions illustrated in Figure 4 and Figure 6 . thus the duct will be selectively opened and closed at predetermined times during the operating cycle of the engine . the configuration of and the offsetting of the various recesses 15 around the shaft 14 is such that the inlet and outlet ducts of all the engine cylinders are opened and closed in the correct sequence, at the correct time and for the correct duration of time.

Clearly the two to one speed ratio between the crankshaft 4 and the shaft 14 ensures that the inlet duct and the outlet duct are open only once for each two upward strokes of the piston 2 as is necessary in the operation of a four stroke engine.

It will be appreciated that the above described valve arrangement has several advantages over prior valve arrangements. In particular, a rotary movement is much smoother than a reciprocating movement and thus overall engine vibration is reduced which results in less stress on the engine components. In addition there is no spring bias to overcome in order to open the valve and therefore less engine power is required to operate the proposed valve arrangement. The proposed arrangement also overcomes the above-described problems of valve bounce and of the valve head obstructing the flow of combustion mixture. Also the engine will sustain no damage if the drive fails from the crankshaft 4 to the shaft 14. The overall construction proposed is relatively simple and therefore easier and cheaper to produced than a conventional valve arrangements.

An alternative embodiment of the present invention in which the shaft 14 of the valve arrangement forms spheres over the inlet duct and the outlet duct as above , in this alternative the sphere is provided with a bore 16 which extend diametrically through the shaft 14 rather than being provided with recesses15. The arrangement operates in the same manner as described above but it will be appreciated that duct 6 is opened upon every half revolution of the shaft 14. It is therefore necessary to connect the shaft 14 to the crankshaft 4 such that the shaft 14 is driven at a speed which is one quarter of the speed of the crankshaft 4 if the arrangement is incorporated in a four stroke engine

Various modifications and alterations may be made to the above-described embodiments of the present invention without departing from the scope thereof. Thus the size of the inlet and outlet ducts may be varied with corresponding alteration being made to the size of the shaft and sphere 14 and the recesses or bores provided therein. It would be possible to use the valve arrangement in an engine provided with two inlet ducts and two outlet ducts for each cylinder simply by providing two shafts 14. It may also be desirable to provide separate shafts for the inlet duct and outlet duct depending upon the positioning of the ducts relative to one another.

CLAIMS

1. An engine comprising an engine block defining one or more cylinders , the or each cylinder having an inlet and an outlet there being valve means which are rotatable so as to selectively open and close the inlet and outlet of each cylinder to allow fluid into and out of each cylinder at predetermined times during the operating cycle of the engine.

2. An engine according to Claim 1 wherein the inlet and outlet of each cylinder is in the form of a respective duct and the valve means comprise an elongate, circular section shaft, the shaft extending through at least one of the inlet duct and the outlet duct, the shaft being configured such that upon rotation the or each duct through which it extends will be selectively opened and closed by the shaft so as to permit or prevent the flow of fluid into and out of each cylinder at said predetermined times.

3. An engine according to Claim 2 wherein a single shaft extends through both the inlet duct and the outlet duct of each cylinder of the engine.

4. An engine according to Claim 3 wherein the shaft extends transversely to the general direction of the ducts, part of the shaft extending into the ducts, the shaft defining openings extending transversely of the shaft at intervals along its length at those points of the shaft which are received within the ducts, the shaft being rotatable to align said openings with the duct to permit the flow of fluid into or out of each cylinder.

5. An engine according to Claim 4 wherein the openings are each in the form of a bore extending diametrically through the shaft.

6. An engine according to Claim 5 wherein the shaft is connected to the crankshaft of the engine so as to be rotatably driven by the crankshaft at a rate of rotation equal to one quarter of the rate of rotation of the crankshaft.

7. An engine according to Claim 4 wherein the openings are each in the form of a notch of recess cut into the shaft from the outer surface thereof, each notch or recess extending transversely to the longitudinal axis of the shaft.

8. An engine according to Claim 7 wherein the shaft is connected to the crankshaft of the engine so as to be rotatably driven by the crankshaft at a rate of rotation equal to half the rate of rotation of the crankshaft.

9. An engine according to any one of the preceding claims wherein the inlet and outlet for each cylinder are formed in the cylinder head of the engine, the cylinder head being of two part construction to facilitate assembly of the rotatably valve means in the engine.

10. A motor vehicle incorporating an engine in accordance with any one of the preceding claims.

11. An engine substantially as herein described with reference to and as shown in Figures 2 to 6 of the accompanying drawings.

12. An engine substantially as herein described with reference to and as shown in Figures 7 and 8 of the accompanying drawings.

13. Any novel feature of combination of features disclosed herein.

Application No:	GB 0221777.6	**Examiner:**	John Twin
Claims searched:	1 to 12	**Date of search:**	11 February 2003

Patents Act 1977 : Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance	
X	1,2 at least	GB 672954	(Genet)
X	1,2,6 at least	GB 429983	(Chaudé)
X	1,2 at least	EP 0423444 A	(Coates)
X	1,2 at least	WO 2002/20979 A1	(Coates)
X	1,2 at least	WO 97/42403 A1	(Munoz)
X	1,2 at least	US 5711265	(Duve)
X	1,2 at least	US 5109814	(Coates)
X	1,2 at least	US 4821692	(Browne)
X	1,2 at least	US 4010727	(Coles & Cross) - see eg figure 17
X	1,2 at least	US 3945364	(Cook)

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC[V]:

F1B

Worldwide search of patent documents classified in the following areas of the IPC[7]:

F01L

The following online and other databases have been used in the preparation of this search report:

online: EPODOC, JAPIO, WPI