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(54) **An internal combustion engine.**

(57) An internal combustion engine which has a piston (2) running in a cylinder (1) has a combustion chamber (6) which communicates with an auxiliary chamber (7). A valve (10) is operable to open or close communication between the combustion chamber (6) and the auxiliary chamber (7) so that the chambers can be in communication during a compression stroke, but can be closed off from one another during combustion so that the compression ratio of the engine is changed without altering the expansion coefficient.

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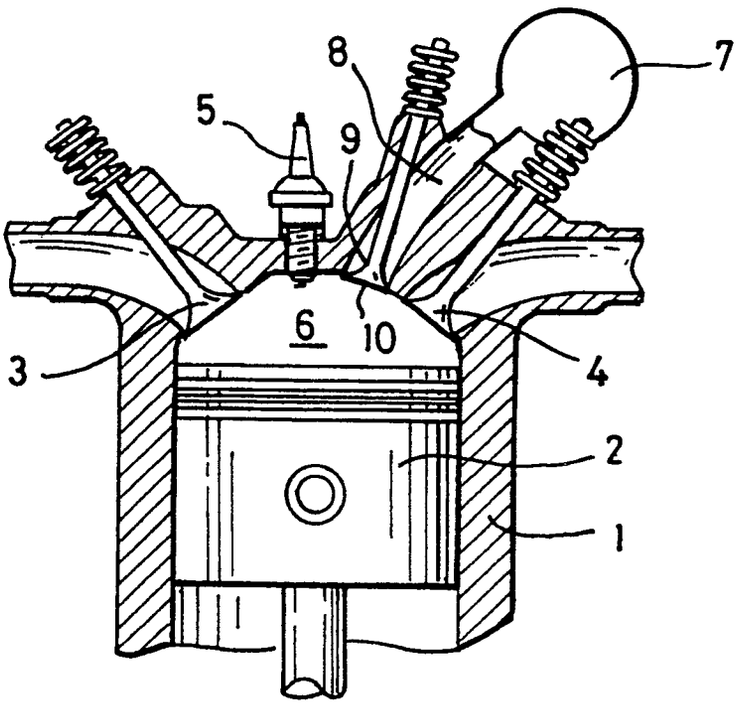

Fig. 1

AN INTERNAL COMBUSTION ENGINE

This invention relates to an internal combustion engine with a variable compression ratio. In particular the invention allows the varying of the compression ratio of a cylinder of the engine.

It is known that varying the compression ratio of an internal combustion engine can increase the efficiency of the engine.

It is known to increase and decrease the volume of the combustion chamber in each cylinder to change the compression ratio of the engine.

Actual known constructions embodying this principle include the insertion of an auxiliary piston into a tubular body which is provided with an opening in the combustion chamber. The volume of the combustion chamber is then increased or decreased by moving the auxiliary piston in one direction or the other.

Another known scheme for varying the compression ratio is to use a connecting rod which is connected to the piston pin position, thus changing the upper dead point position by raising or lowering the position of the piston, in order to change the volume of the combustion chamber.

In the prior art methods, a decrease in the compression ratio was produced in order to prevent knocking and to obtain an effective engine design. A decrease in compression ratio is generally associated with an increase in combustion chamber volume, and the use of a large combustion chamber in order to prevent knocking resulted in a low expansion coefficient obtained from the explosion of the fuel in the chamber, and also a lower output.

Because of the consumed fuel in the amount of the intake, the actual fuel consumption was poor.

On the other hand, when the expansion coefficient is increased by reducing the size of the combustion chamber and increasing the compression ratio, the output increases but knocking can easily occur. This is why, in order to prevent knocking, the compression ratio is decreased in accordance with the rotational speed of the engine. When the compression ratio is decreased the result is that at the same time the expansion coefficient is lowered, which also exerts an adverse influence on the output and on the fuel consumption.

It is an object of the present invention to make it possible to produce a substantial change of the compression ratio, while at the same time maintaining the expansion coefficient.

According to the invention, there is provided an internal combustion engine having a combustion chamber, an auxiliary chamber which communicates with the combustion chamber and a valve which is operable to open and close communication between the combustion chamber and the auxiliary chamber, to vary the compression ratio of the engine.

The auxiliary chamber is preferably mounted so as to communicate with a cylinder combustion chamber, and when the valve between the combustion chamber and the auxiliary chamber is open during the compression stroke, compressed air/fuel mixture will flow into the auxiliary chamber.

Consequently, the amount of air/fuel mixture inside the combustion chamber decreases only to the amount of the inflow, and when the valve is closed during an explosion, the actual compression ratio will be reduced in inverse proportion to the amount that has passed into the auxiliary chamber.

To give an example, if the compression ratio is 10 :1 when an auxiliary chamber that has the same internal volume as the combustion chamber is in communication with the combustion chamber, then it is possible to change the compression ratio from 5 :1 to 10 :1 by closing the valve to decrease the amount that has passed into the auxiliary chamber.

On the other hand, since the valve will be closed during the combustion, the volume of the combustion chamber will not change which is why there will be no alteration to the expansion coefficient as a result of the invention, and as a result there will be no change in the output.

The air/fuel mixture contained in the auxiliary chamber may be either returned to the mixture intake passage, or may be returned to the combustion chamber when the valve is next opened during the induction stroke so that this mixture can be used again.

The invention will now be further described, by way of example, with reference to the accompanying drawing which shows a cross section through the cylinder of an internal combustion engine in accordance with the invention.

In the drawing, a piston 2 travels in a cylinder 1. An air intake valve 3 closes an air intake passage leading into the combustion chamber 6, and an exhaust valve 4 closes an exhaust passage leading out of the combustion chamber. A conventional spark plug is shown at 5.

An auxiliary chamber 7 is connected to the combustion chamber 6 by a communication passage 8, and the passage 8 is closed by a valve 10 which closes onto a valve seat 9.

When the valve 10 is closed during the combustion part of the cycle, a knock sensor which produces a signal between the induction stroke and the compression stroke, or alternatively other means of control, can be used to select the optimum time period for which the valve 10 remains closed.

The valve 10 can be opened also during the exhaust stroke.

Finally, it is possible to provide an additional passage for the air/fuel mixture leading between the

auxiliary chamber 7 and the air/fuel mixture intake pipe which is closed by the valve 3. This bypass passage between the auxiliary chamber and the mixture intake may also include a valve to control flow through the passage.

As explained above, the effect of this invention is that part of the air/fuel mixture sucked into the cylinder flows into the auxiliary chamber. As a result, the compression ratio between the bottom dead centre and top dead centre positions of the piston is substantially lower than it would be without the presence of the auxiliary chamber. However since the passage 8 is closed during combustion, the volume of the combustion chamber is changed so that it is possible to obtain an actual variable compression ratio that corresponds to the amount of the inflow into the auxiliary chamber.

Furthermore, since the passage 8 is closed by the valve 10 during the period of explosion or combustion, the volume of the combustion chamber remains unchanged. Thus it is possible to maintain the same expansion coefficient as is obtained without the auxiliary chamber 7, so that there is no adverse effect on the engine output. This is possible because the usual full throttle at high rotational speed is almost eliminated, and the decrease of the explosion power by fuel reduction will not exert any influence on the output.

The air/fuel mixture that flowed into the auxiliary chamber can be returned to the cylinder during the next induction stroke to be re-used. Alternatively this volume of mixture can be returned through a bypass pipe into the engine intake. In either case, this volume of mixture can be used again during the next cylinder cycle, rather than being wasted, which makes it possible to obtain high efficiency of fuel consumption because the overall design is efficient.

Claims

1. An internal combustion engine having a combustion chamber (6), an auxiliary chamber (7) which communicates with the combustion chamber and a valve (10) which is operable to open and close communication between the combustion chamber (6) and the auxiliary chamber (7) to vary the compression ratio of the engine.

2. An internal combustion engine as claimed in Claim 1 wherein a bypass passage connects the auxiliary chamber with an engine intake passage.

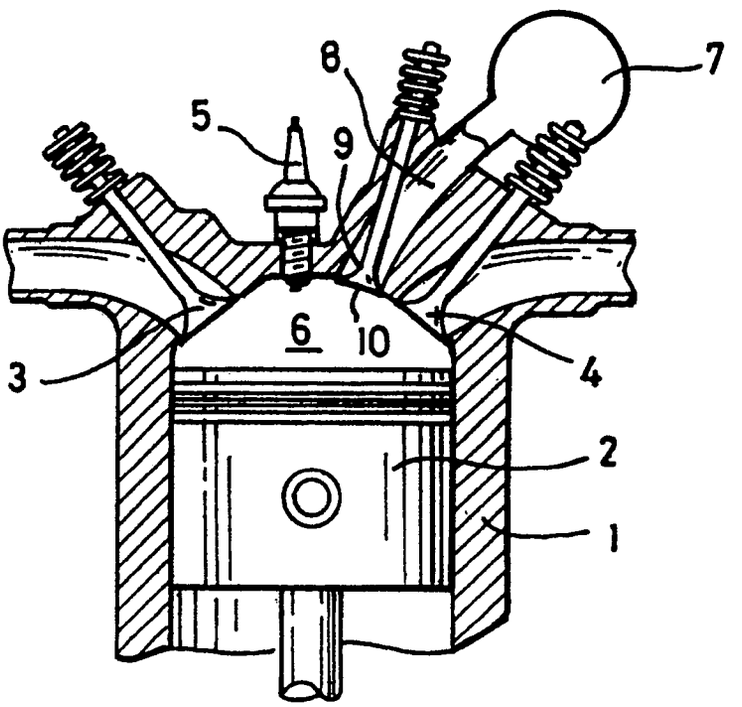

Fig. 1

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EUROPEAN SEARCH REPORT

Application Number

EP 91 30 0249

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.5)
X	EP-A-95252 (FORD) * abstract; figures 1, 2 * * page 1, line 4 - page 2, line 12 * * page 3, lines 1 - 27 * * page 5, lines 14 - 31 * * page 6, line 33 - page 7, line 10 * * page 7, lines 29 - 33 * * page 8, lines 1 - 12 * * page 9, lines 5 - 8 * ---	1, 2	F02D15/04
X	PATENT ABSTRACTS OF JAPAN vol. 6, no. 240 (M-174)(1118) 27 November 1982, & JP-A-57 137635 (FUJI JUKOGYO) 25 August 1982, * the whole document * -----	1	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			F02D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	19 MARCH 1991	JORIS J.C.

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