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(54) **Camshaft with variable profile, to actuate the valves in the internal combustion chamber of the engines**

(57) This invention refers to the camshaft (1) profile in which valve actuation is performed positively for closure by means of the rocker arm(4). Opening, however, is allowed by the cut or chamfer (A-B) and the valve opening is varied by moving the camshafts sideways. In this way, the opening varies according to the several profiles that the chamfer (A-B) allows, It can thus be better adapt-

ed to the opening volumes of the valves and the respective opening and closure angles in relation to the crankshaft for the inlet and exhaust valves, taking into account the different load and rotation parameters that can be applied to the engines.

This invention can be applied in every type of internal combustion engines with two or four stroke cycles, and/or in engines in which valves are used for gas transfer.

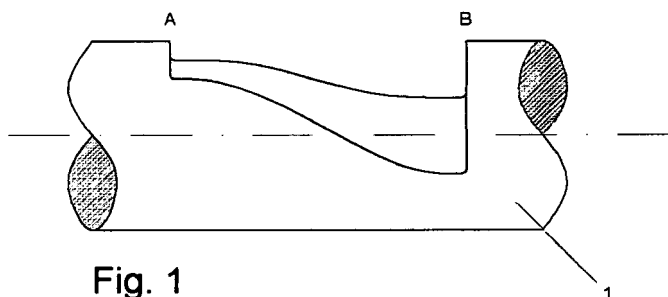


Fig. 1

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Description

[0001] The present systems of four stroke engines are based on positive actuation for valve opening, while closure is generally done by returning the valve to its original position either by using the effect of compressed spring expansion or through positive actuation of the closure in desmodromic systems.

[0002] In closure using springs, "valves fluctuation" may occur, through vibration or resonance, when the engine runs at high revolutions. This phenomenon does not occur in engines with desmodromic control because a positive and controlled force is applied for the valves closure.

[0003] Engines built to have good torque values and low revolutions have a small working capacity and develop power at high revolutions, and vice versa: if the engine is designed for high power at high revolutions, it has a weak performance and low torque at low revolutions, requiring a high idle rotation speed to avoid irregular performance.

[0004] Rigorous engine design allows for an engine that can be adapted to the various needs during the range of running revolutions, from idle to maximum, with the exception of some systems of variable actuation in valve opening or of modification of the angle of valve opening in relation to the crankshaft. In general, only the opening stroke is modified to allow greater or smaller opening, or the angle which corresponds to more or less valve overlap.

[0005] The present systems absorb a great deal of energy, both through the force of the spring compression, such as through rubbing or friction, and through the high number of moving parts (kinetic energy).

[0006] To control valve closure, the valves must be activated positively, as in the example of the closure control of desmodromic systems.

[0007] The stroke or opening volume must be modified according to the engine rpm - smaller opening for low revolutions - and greater opening for high revolutions.

[0008] It must be possible to alter the opening and closing angle of the valve in relation to the crankshaft also according to the engine load and rpm.

[0009] Summarising these three parameters in a single system of valve activation (flexible system that allows any of these variants to be adapted to the various needs at any given time), the result is an engine capable of running at low revolutions and of developing a lot of torque, as well as achieving good performance at high revolutions and outputting a lot of power. In this way, one can have more efficient combustion with fewer pollutants and better fuel saving.

[0010] Additionally, the engine can adapt to the fuel that is inserted into it at any given time, disregarding the rigid construction in which the engine is designed and planned, in terms of the type of fuel that is going to be used.

[0011] This invention, the cylindrical profile of the cam-

shaft - fig. 1 - which is the opposite of the cam or lobe profile presently used - fig. 13 - is variable from point A to point B, thus allowing, through lateral movement, greater opening near point B and smaller valve opening near point A.

[0012] The return springs and the positive actuation mechanism for opening are eliminated, and a positive actuation mechanism is only used for closing the valves through a rocker arm.

[0013] The cylindrical camshafts 1 turn over their own shaft; they are in permanent contact with cylinder 2, which is seated on bearing 3 and turns over its own shaft 9, which is placed at one of the rocker's edges 4. This rocker arm oscillates over shaft 5, which is duly fixed to the engine head, and which, through fork 8 in contact with adjuster 7, pulls valve 6 in the closure direction, so as to contradict opening force 'F' which was used to push valve 6 open. In this way, it forces valve 6 to close at the exact moment, without allowing delays or fluctuations in the closure.

[0014] For better engine efficiency, performance and economy with this invention applied, we can design four different parameters in one single area of the camshaft for one rocker arm actuation, small volume or opening stroke A-A1 of figure 15; high volume or opening stroke B-B1 of figure 16; small opening angle A2- A3 of figure 17; and high opening angle B2-B3 of figure 18.

[0015] This simple method consists of enabling valve opening and opening time to vary and of performing the closure at the exact moment in relation to the crankshaft, ensuring that the valves do not collide with the pistons, and adapting the best parameters to the different load and performance situations required by the engine. It thus offers better fuel efficiency with the consequent reduction in contaminating waste.

[0016] The profile of chamber A-B on the camshaft - fig. 1 - is valid both for the intake camshaft and for the exhaust camshaft considering the simplest engine configuration system: mono-cylinder, two valves and two overhead camshafts (DOHC), or one overhead camshaft (OHC), or with camshafts placed in the crankcase of the engine. This can also be conveyed to multi-cylinder engines, which if parallel to the camshafts, shall have a configuration similar to that represented in figure 12.

[0017] Figures 2, 3, 4, 5, 6, 7, 8, 9, 10, and 11 are several representative configurations of how this invention can be arranged in construction, where the necessary opening force is indicated as 'F', and can be performed in several ways: through spring action, hydraulic fluid, pressurised gas, clutch magnet, etc.

[0018] The rotation movement of the camshafts over their own shaft is controlled or transmitted by the crankshaft and can be performed in several ways: by chain, by cog belt, by gear cascade, by vertical axis with gear bevel edges, by fluid or electrical engine, as long as this movement is synchronised with the crankshaft.

[0019] The axial or lateral oscillatory movement of the camshafts can be done in several ways depending on

the type of engine that is required: electrical servomotor, hydraulic fluids, centrifugal weights, etc.

[0020] In the particular case of figure 10, the opening force is guaranteed by the difference of air pressure or gases in duly sealed or pressure proof chambers, where pistons 11 and 12, which are secured by the valve stem, move and where chamber P- has a pressure inferior to chamber P+, and which, through passage valve 10 in only one direction, assures the pressure differences to replace the necessary force that makes the valve open and that roller 2 never loses contact with camshaft 1 so that the system does not become inefficient.

[0021] When valve 6 goes down in the opening movement, piston 11 pushes the gas or air through the duct where passage valve 10 is located, in only one direction to the upper chamber P+, creating positive pressure. When valve 6 goes up or closes through the action of camshaft 1 through movement of rocker arm 4, pistons 11 and 12 go up and create positive pressure above piston 12 and negative below piston 11, maintaining the necessary pressure difference so that valve 6 goes down or opens, and eliminating the delays that might occur if a spring, hydraulic fluid or clutch magnet were used.

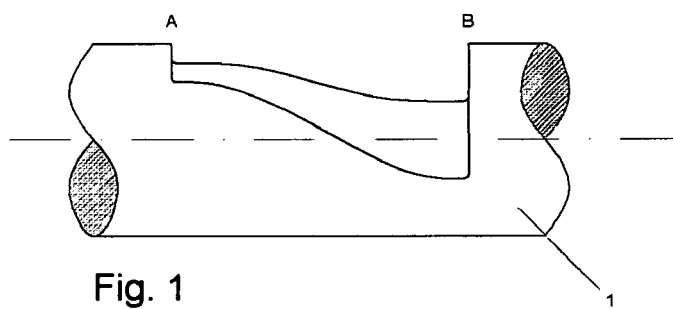
[0022] Valve 6 adjustment for the correct sealing of the internal explosion engine combustion chamber, for which this invention is intended, can be done by means of a conical or concentric spring, hydraulic retention system, or gas, memory compressible and flexible material (i.e. rubber) which is located between the upper section 8 of rocker 4 and the retention system 7 of valve 6, making the whole assembly more efficient and with less maintenance service. For the adjustment, an articulated rocker between the edges and its own oscillatory shaft 5 may also be considered.

Claims

1. st Camshaft to actuate the valves in the internal combustion chamber of the engines, **characterized by** having a variable profile, opposite to normal, in which the lobe or cam X-Y-Z is replaced by the chamfer X1-Y1-Z1, which corresponds to the opening allowed in the valve(s).
2. nd The camshaft, according to the 1st claim, is **characterized by** the fact that it only acts positively in valve closure by means of a rocker arm(4).
3. rd The camshaft, according to the 1st and 2nd claims, is **characterized by** the fact that it also has lateral or axial movement, in addition to the rotational movement over its own shaft.
4. th The camshaft, according to the above claims, is **characterized by** the fact that the profile from A to B (1), commonly chamfer, corresponds to the opening and opening time allowed in the valve (6), ac-

cording to cut sections A-A1, A2-A3, B-B1, B2-B3, so that in this way, through the rotational movement over its own shaft and, at the same time, axial and lateral movement, valve (6) opening volume and opening time may be varied.

5. th The camshaft, according to the above claims, is **characterized by** the fact that the opening and closure angle and time allowed in inlet valves is variable in relation to the exhaust valves and vice-versa, in engines with more than one camshaft.
6. th The camshaft, according to the above claims, is **characterized by** valve actuation that can change the opening and closure angle and time, in relation to the engine crankshaft.
7. th The camshaft, according to the above claims, is **characterized by** the fact that in the performance allowed for the valve opening, a force exterior to the mechanism has to be performed (F), so that the valve is pushed to the opening allowed by the camshaft chamfer. This force can be performed by means of a spring, fluid, clutch magnet, pressurised gas, vacuum or mechanical device.
8. th The camshaft, according to the above claims, is **characterized by** the rotational movement over its own shaft being synchronised with the engine crankshaft, and can be transmitted by mechanical, electrical or hydraulic means.
9. th The camshaft, according to the 3rd claim, is **characterized by** the lateral movement that can be performed by mechanical, electrical or hydraulic means.



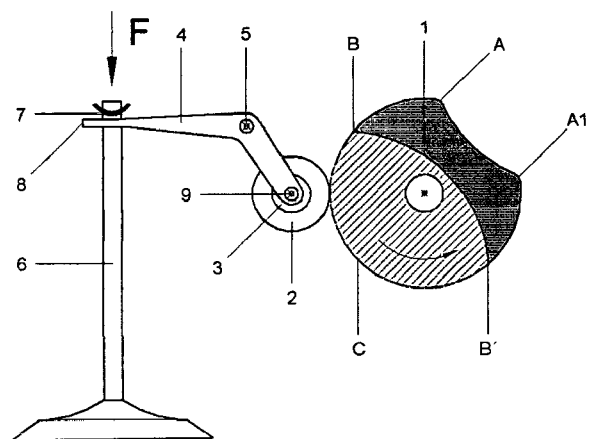


Fig. 2

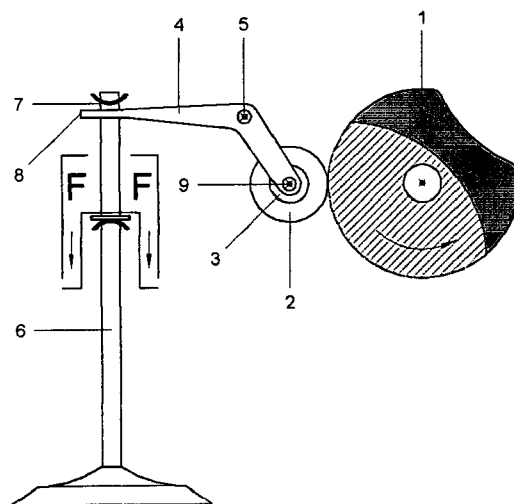


Fig. 3

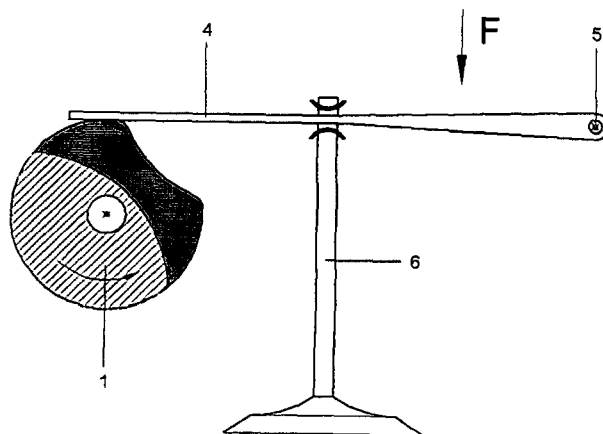


Fig. 4

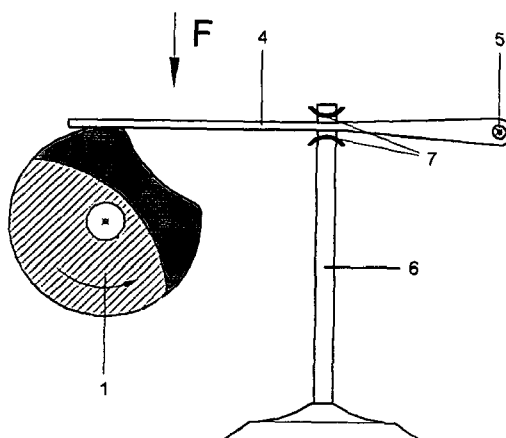


Fig. 5

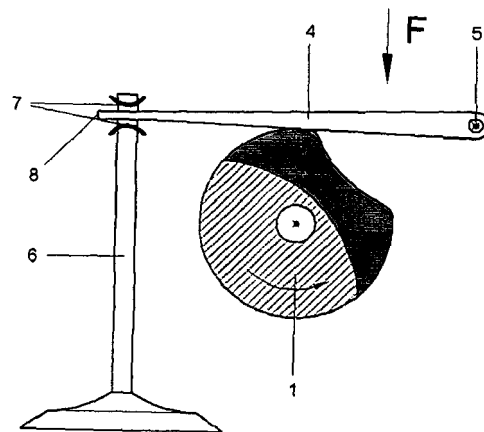


Fig. 6

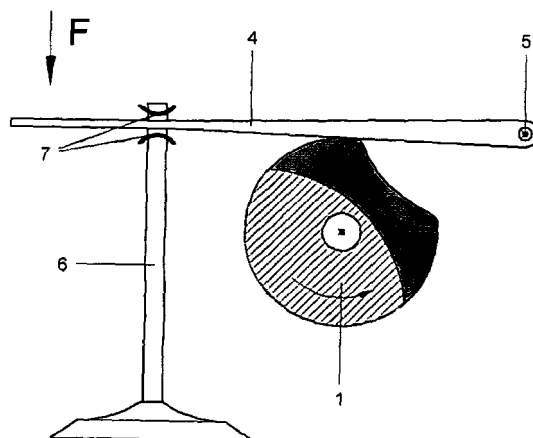


Fig. 7

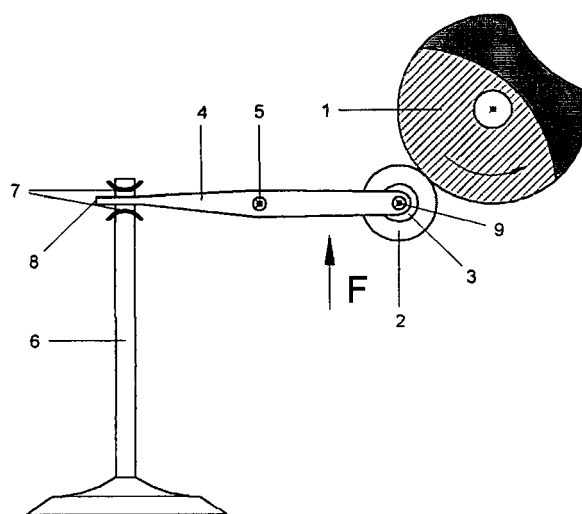


Fig. 8

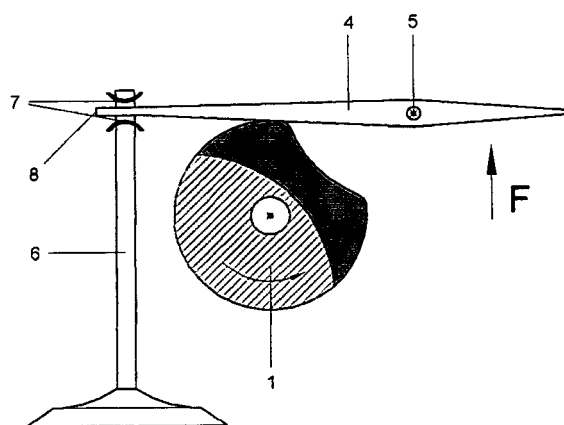


Fig. 9

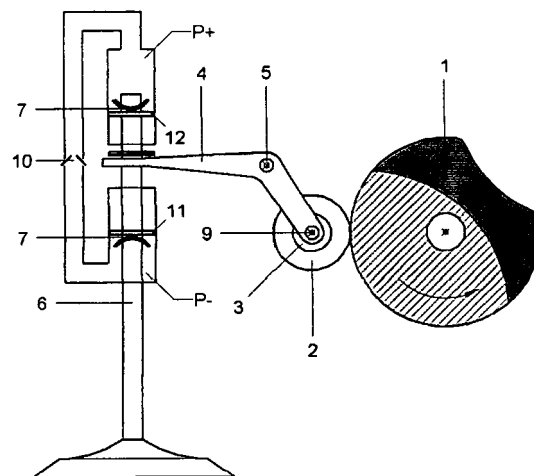


Fig. 10

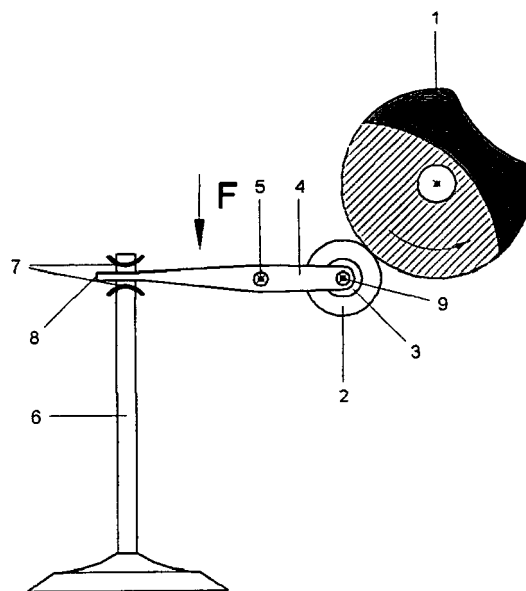


Fig. 11



Fig. 12

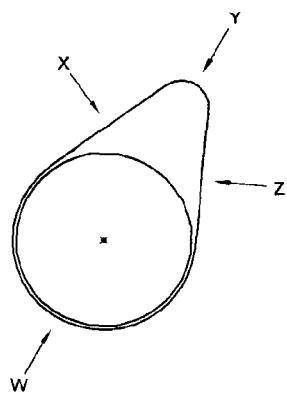


Fig. 13

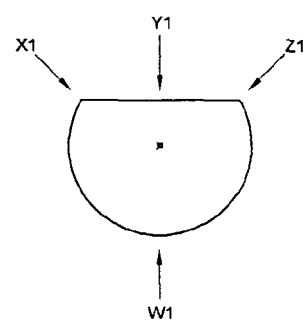


Fig. 14

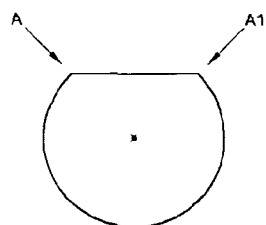


Fig. 15

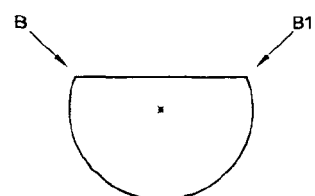


Fig. 16

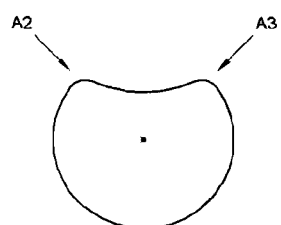


Fig. 17

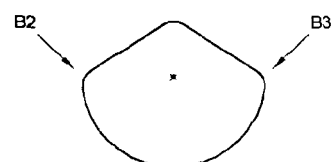


Fig. 18



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EUROPEAN SEARCH REPORT

Application Number
EP 06 39 8002

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Place of search The Hague		Date of completion of the search 11 April 2006	Examiner Paquay, J
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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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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