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**GB-A- 242 919
GB-A- 687 528
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Description

The present invention relates to a four-cycle internal combustion engine. In order to improve the output performance of a four-cycle internal combustion engine at its high speed running range, it is a current practice to increase the number of intake valves and the number of exhaust valves for each cylinder of the internal combustion engine (GB—A—687528; US—A—1484376).

This is partly because the sum of the areas to be occupied in a combustion chamber by the intake and exhaust valves, i.e., the so-called "valve area" is increased to improve the charge and discharge efficiencies in accordance with the increases in the intake and exhaust valves and partly because the respective valves themselves can have their sizes and weights reduced so that their followabilities at a high speed can be improved.

However, there exist restrictions in that the area of the combustion chamber to be faced by the respective valves is limited and that the plural valves have to be arranged within that limited area without any interference among the plural valves.

In case the number of the valves is increased, there arises another problem in providing a suitable system for driving said valves.

Specifically, in the structure having its valves driven by the cam shafts which are located just above them, a valve or valves may occasionally fail to be aligned with the corresponding cam shaft if the valve number is too large.

In this case, connecting means for connecting the misaligned valve or valves and its or their cam shaft is newly required for driving it or them, thus raising another problem that the construction of the valve driving system is complicated.

From the reasons thus far discussed, the respective numbers of the intake and exhaust valves are two and are not in general increased further.

The invention as claimed has been conceived in order to remedy these drawbacks and solves the problem to provide a four-cycle engine which is enabled to have at least three intake valves without detrimental interferences in a combustion chamber and to drive the valves without rendering their driving system too complicated.

One way of carrying out the invention is described in detail below with reference to drawings which illustrate merely one specific embodiment, in which:—

Figure 1 is a longitudinal section showing the engine according to the present invention; Figure 2 is a section taken along line II—II of Figure 1; Figure 3 is a section taken along line III—III of Figure 1; and Figure 4 is a section taken along line IV—IV of Figure 2.

These drawings illustrate one cylinder of a four-cycle engine, in which reference letters a and b indicate a cylinder and a cylinder head, respectively, and reference numerals 1 and 2 indicate an

intake passage and an exhaust passage, respectively.

Numerals 3 indicates a combustion chamber which is formed below the afore-mentioned cylinder head b and into which the intake and exhaust passages 1 and 2 are opened.

Numerals 4 indicates a threaded hole for mounting an ignition plug, which is opened at the center position of the upper side of the afore-mentioned combustion chamber 3.

Numerals 5 indicates intake valves for opening and closing the afore-mentioned intake passage 1, and numeral 6 indicates exhaust valves for opening and closing the exhaust passage 2.

Said intake and exhaust valves 5 and 6 have their respective lower ends facing the combustion chamber 3 to close the open ends of the intake passage 1 and the exhaust passage 2, respectively. Their respective intermediate portions are slidably supported in the wall of the cylinder head b through guides 5a and 6a.

Numerals 7 and 8 indicate lifters which are formed to extend from the upper ends of both the afore-mentioned valves 5 and 6 and through which both the valves 5 and 6 are connected to corresponding cam shafts 9 and 10 just thereabove so that they are driven by said shafts 9 and 10.

Numerals 11 and 12 indicate springs which are made operative to bias the intake and exhaust valves 5 and 6 in their closing directions.

Furthermore, the afore-mentioned cam shafts 9 and 10 are rotatably supported above the cylinder head b through a cam carrier 13 and cam caps 14 and 15.

Numerals 16 indicates a cover which covers the afore-mentioned cam shafts 9 and 10 and the cam caps 14 and 15 and which is formed to extend from the upper end of the cam carrier 13.

The four-cycle engine thus constructed is equipped, so as to improve its output performance, with a plurality of intake valves 5 and a plurality of exhaust valves 6 for each cylinder, of which at least the intake valves 5 are three in number.

Incidentally, it is quite natural that the numbers of the intake passage 1 and the exhaust passage 2 be increased in accordance with the respective numbers of the valves 5 and 6.

The afore-mentioned three intake valves 5 are arranged and constructed such that the intermediate one 5' faces the combustion chamber 3 at a smaller angle of inclination with respect to the axis I_1 of the cylinder than that of the remaining two outer intake valves 5, 5.

Specifically, if the angle of inclination of the intermediate intake valve 5' is designated at α_1 , whereas the angle of inclination of the two outer intake valves 5 is indicated at α_2 , then a relation of $\alpha_1 < \alpha_2$ exists.

On the other hand, the afore-mentioned intake valves 5 are further arranged and constructed such that all their respective axes I_2 extend through the center O_1 of the cam shaft 9.

Thus, the afore-mentioned intake valves 5 are

arranged, as shown in Figure 2, such that the intermediate one 5' is more offset to the outside with respect to the center line l_3 , which divides the combustion chamber 3 into intake and exhaust portions, than the two intake valves 5, 5 at both sides, whereby the entirety of intake valves 5 does not interfere with one another.

Moreover, since the respective intake valves 5 have their axes l_2 extending through the center O_1 of the cam shaft 9, nothing is newly required except the lifters 7 acting as means for connecting the intake valves 5 with said shaft 9.

On the contrary, the exhaust valves 6 provided are two in number and are arranged in the combustion chamber 3 on a plane l_4 which is parallel to the afore-mentioned center line l_3 . Moreover, the exhaust valves 6 are arranged to have their respective axes l_5 extending through the center O_2 of the cam shaft 10 and are set with an equal angle of inclination α_3 with respect to the axis l_1 of the cylinder a.

Thus, since the afore-mentioned exhaust valves provided are two in number, they are prevented from interfering with each other, even if they are in the combustion chamber 3 on the straight line, and nothing is newly required except the lifters 8 acting as means for connecting the exhaust valves 6 with the cam shaft 10.

Incidentally, although the intake valves 5 provided in the embodiment thus far described are three in number, three exhaust valves 6 may be provided if they adopt the arrangement and construction similar to those of the intake valves 5.

As has been described hereinbefore, according to the present invention, the intermediate intake valve 5' is arranged to face the combustion chamber at a smaller angle α_1 of inclination with respect to the axis l_1 of the cylinder than that of the remaining two intake valves 5 when the three intake valves are to be provided. As a result, the intermediate intake valve 5' is more offset to the outside than the intake valves at both sides so that said three intake valves can be arranged in the combustion chamber without any interference among them.

Moreover, said three intake valves are so arranged that their respective axes extend through the center O_1 of their cam shaft 9. The position relationship between the respective valves and their cam shaft is not changed from that of the prior art, and no new one is required as the means for connecting the respective valves with their cam shaft so that the valve during the system is not necessarily made complicated.

Claim

A four-cycle internal combustion engine of the type having for each of its cylinders (a) a plurality of intake valves (5) and a plurality of exhaust valves (6), both types of valves being driven by a respective cam shaft (9, 10) which are provided just above said intake and exhaust valves respectively; at least three of said intake valves (5) are

provided such that the intermediate intake valve (5') is offset further towards the outside with respect to a center line (l_3), which divides the combustion chamber (3) into intake and exhaust portions than the two intake valves (5, 5) which are arranged at both sides of said intermediate intake valve (5'), characterised in that said intermediate intake valve is arranged to face the combustion chamber (3) at a smaller angle (α_1) of inclination with respect to the axis (l_1) of said cylinder (a) than the angle (α_2) of inclination of the two remaining intake valves (5) at both sides of said intermediate intake valve; and that the entirety of intake valves (5, 5', 5) have their respective axes (l_2) extending to intersect the axis (O_1) of the cam shaft (9) driving said intake valves (5).

Patentanspruch

Viertakt-Brennkraftmaschine des Typs, der für jeden seiner Zylinder (a) eine Vielzahl von Einlaßventilen (5) und eine Vielzahl von Auslaßventilen (6) aufweist, wobei beide Ventiltypen mittels einer jeweiligen Nockenwelle (9, 10) angetrieben sind, welche dicht oberhalb der jeweiligen Einlaß- bzw. Auslaßventile angeordnet sind; wobei wenigstens drei Einlaßventile (5) derart angeordnet sind, daß das intermediäre Einlaßventil (5') weiter nach außen in Bezug auf eine Mittellinie (l_3) versetzt ist, welche die Brennkammer (3) in Einlaß- bzw. Auslaßabschnitte unterteilt, als die beiden Einlaßventile (5, 5'), welche zu beiden Seiten des intermediären Einlaßventils (5') angeordnet sind, dadurch gekennzeichnet, daß das intermediäre Einlaßventil unter einem kleineren Neigungswinkel (α_1) gegenüber der Achse (l_1) des Zylinders (a) in Bezug auf die Brennkammer (3) angeordnet ist, als der Neigungswinkel (α_2) der beiden übrigen Einlaßventil (5) zu beiden Seiten des intermediären Einlaßventils; und daß die Gesamtheit der Einlaßventile (5, 5', 5) so angeordnet sind, daß sich ihre jeweiligen Achsen (l_2) so erstrecken, daß sie die Achse (O_1) der die Einlaßventile (5) triebenden Nockenwelle (9) schneiden.

Revendication

Moteur à combustion interne à quatre temps, du type comportant pour chacun de ses cylindres (a), plusieurs soupapes d'admission (5) et plusieurs soupapes d'échappement (6), ces deux types de soupapes étant commandés par des arbres à cames respectifs (9, 10) qui sont prévus respectivement juste au-dessus desdites soupapes d'admission et d'échappement; au moins trois soupapes d'admission (5) étant disposées de telle sorte que la soupape intermédiaire d'admission (5') est plus décalée en direction de l'extérieur, par rapport à un axe central (l_3) qui subdivise la chambre de combustion (3) en des parties d'admission et d'échappement, que les deux soupapes d'admission (5, 5) qui sont disposées des deux

côtés de ladite soupape intermédiaire d'admission (5'), caractérisé en ce que ladite soupape intermédiaire d'admission est disposée face à la chambre de combustion (3) en étant inclinée d'un angle (α_1) par rapport à l'axe (l_1) dudit cylindre (a), plus faible que l'angle (α_2) d'inclinaison des deux autres soupapes

d'admission (5) des deux côtés de ladite soupape intermédiaire d'admission; et que les axes respectifs (l_2) de l'ensemble des soupapes d'admission (5, 5', 5) s'étendent de manière à intersecter l'axe (O_1) de l'arbre à cames (9) entraînant lesdites soupapes d'admission (5).

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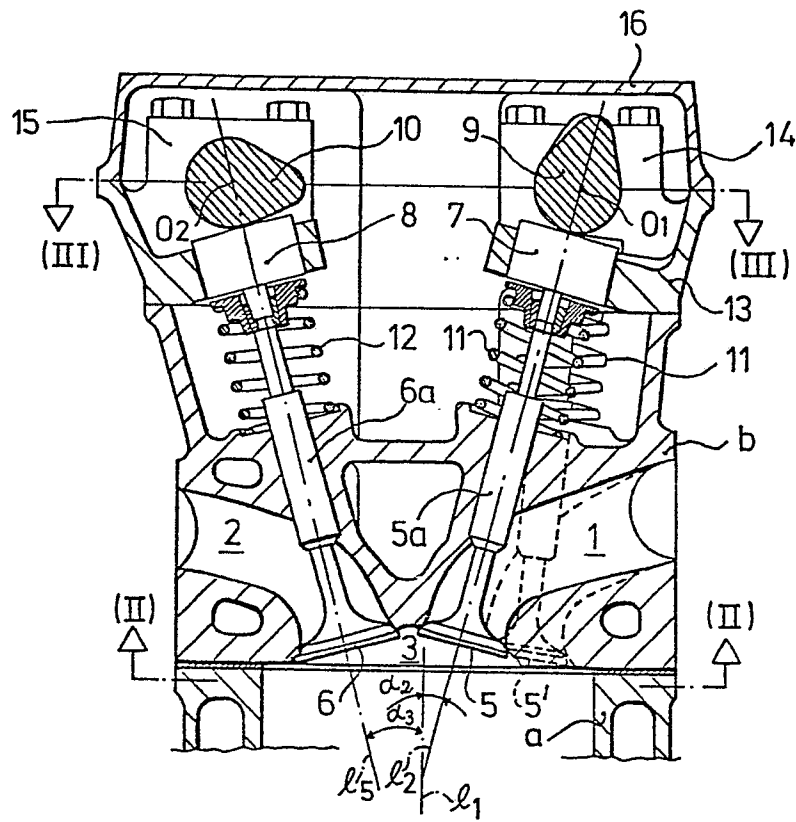


Fig. 1

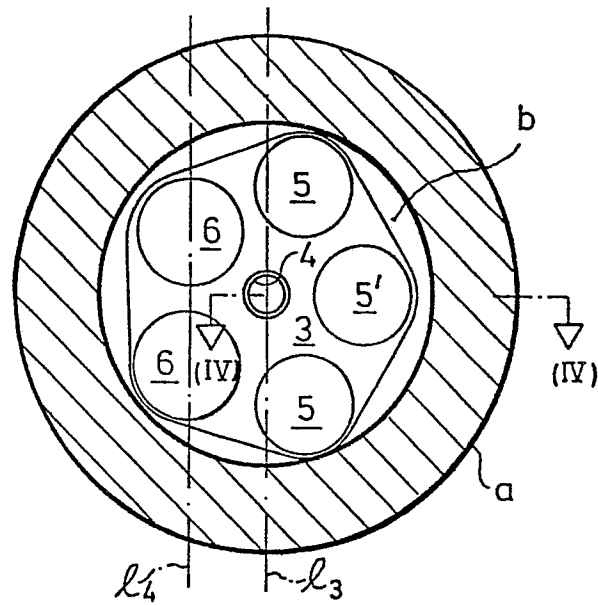


Fig. 2

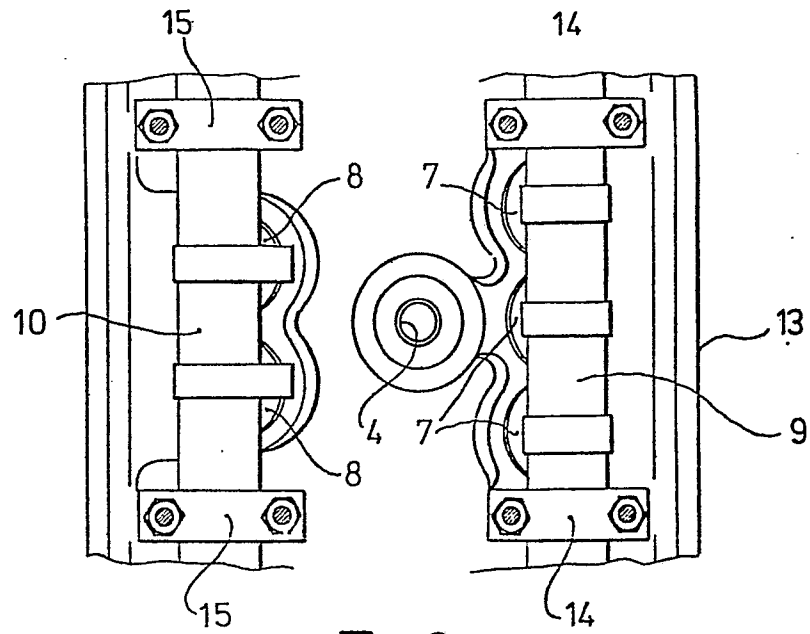


Fig. 3

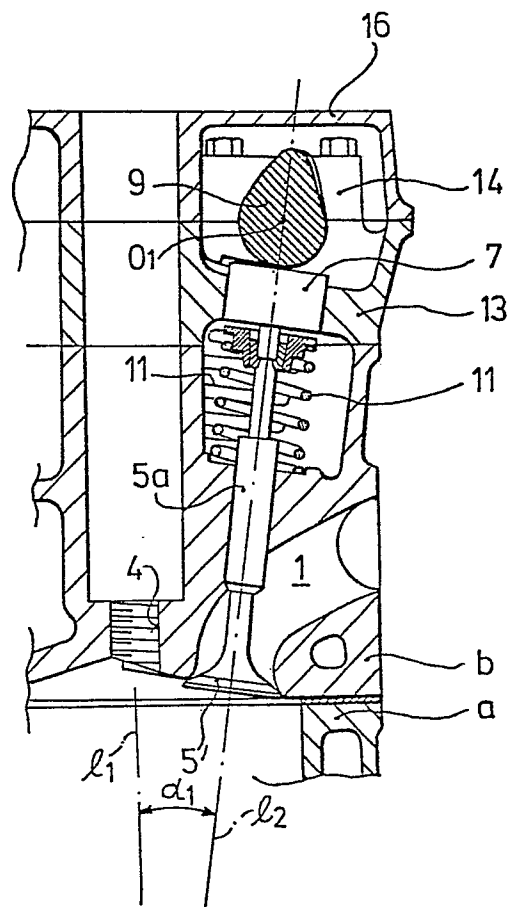


Fig. 4