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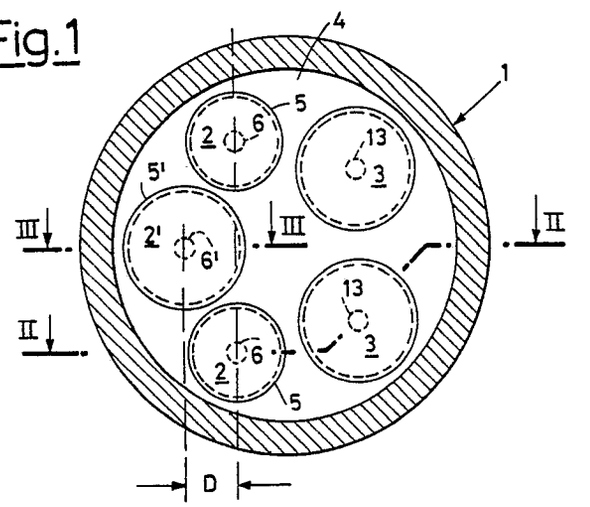
(54) System of valves and related operating devices for internal combustion engines having high specific horsepower.

(57) Each cylinder (1) of the internal combustion engine comprises a group of intake valves (2, 2′) and a group of exhaust valves (3). At least one (2, 2′) of said groups is formed by three circumferentially spaced out valves (2, 2′) operated by a single camshaft (9). Of said three valves the two lateral ones (2) are of smaller diameter with respect to the central one (2′) and have stems (6) which are parallel to one another and inclined with respect to that (6′) of the central valve (2′). At least one of said stems (6, 6′) has its axis displaced laterally with respect to the axis of rotation (10) of the camshaft (9). Means (18, 18′) are provided for offsetting the lateral displacement of the above axis.

Fig.1



EP 0 340 834 A2

System of valves and related operating devices for internal combustion engines having high specific horsepower

The present invention relates to a system of valves and related operating devices for internal combustion engines having high specific horsepower.

It is known that to obtain internal combustion engines having high specific horsepower it is necessary to increase as much as possible the cross-section of the valve passage, in particular for the intake ones. This need, on the other hand, clashes with the limitation of the diameter of the cylinder in which the valves must be housed and with the need of accomplishing valves which are as light as possible in order to limit inertias and thus attain high rates of engine rotation.

The search for possible solutions to the above mentioned problems has led to the adoption of a larger number of valves for each cylinder so that smaller, and thus lighter, valves may be accomplished, at the same attaining a better ratio between the diameter of the cylinder and the overall cross-section of the valve passage.

In engines having a certain level of specific horsepower it is now common practice to adopt the construction solution of two intake valves and two exhaust valves, thus accomplishing engines having four valves per cylinder which represent a good compromise between the different needs mentioned above.

The construction of engines having a number of valves per cylinder higher than four would certainly lead to a further reduction in weight and/or to an increase in the overall cross-section of the valve passage, and it would thus be desirable in order to further increase the engine's specific horsepower.

This construction, however, clashes with the problem of the arrangement of the valves and with the accomplishment of their control device. Indeed, in the case of engines having four valves per cylinder the operation of the valves, grouped in two for intake and two for exhaust, may be accomplished simply by means of two camshafts which, each, drive two homologous valves (the intake ones and the exhaust ones, respectively) arranged with the stems parallel to one another, the latter condition leading to the possibility of accomplishing an internal combustion chamber having an optimum shape for the performance of the engine.

In the case, however, of the accomplishment of an engine having a higher number of valves, for example three for intake and two for exhaust, if it is desired to maintain the simplicity of construction and the reliability of use of a single camshaft for performing the drive of the homologous valves, the three intake valves would have to be arranged with at least one of them having the stem not parallel to those of the other two so that the extremities of all the stems may be brought onto the same axis and thus permit their operation by a single camshaft, as it is not possible, for reasons of space and also of the design of the combustion chamber, to arrange the three valves in line. A similar problem arises if it is required to accomplish an engine having three exhaust valves. An internal combustion engine having three intake valves with inclined stems converging onto a single camshaft is described, for example, in European patent No. 0063385.

It appears evident that the greater the angle of inclination required for the valve stems, the greater are the construction problems which the designer must tackle and the lower is the output of the combustion chamber with respect to that which is theoretically possible.

A possible solution to this problem is that described in the Italian patent application No. 22394 A/87 dated October 23, 1987 in the name of the same Applicant, consisting in the arrangement of all the homologous valves with parallel stems and in the use of a finger rocker arm to reach with only one camshaft the stem of the valve or valves which are not aligned with said camshaft.

This solution simplifies the construction of the combustion chamber, but evidently requires the use of an additional organ (the finger rocker arm) to permit the only camshaft to reach the non-aligned valve stem as well.

In view of this state of the art, object of the present invention has been that of accomplishing a system of valves and related operating devices for internal combustion engines having high specific horsepower, to permit the use of a single camshaft for the operation of homologous valves, limiting the construction difficulties of the combustion chamber and at the same time avoiding the necessity of additional organs such as the finger rocker arm mentioned above.

According to the invention such object has been attained with a system of valves and related operating devices, comprising for each cylinder a group of intake valves and a group of exhaust valves, wherein at least one of said groups is formed by three circumferentially spaced out valves operated by a single camshaft, characterized in that said three valves consist of a central valve and of two lateral valves having a smaller diameter with respect to the central one.

In addition, still according to the present invention, said lateral valves are provided with stems parallel to one another and inclined with respect to

that of the central valve and at least one of the stems of said lateral and central valves has its own axis displaced laterally with respect to the axis of rotation of said camshaft, there being provided means for offsetting the lateral displacement of said axis.

The above means may be constituted, for example, by a guide cup placed on the summit of the stem having a displaced axis and in its turn displaced laterally with respect to it in the opposite direction and in an amount equal to the lateral displacement of said stem.

As an alternative, with all the cups along the same axis with their respective stems, it is possibile to provide cups larger than necessary such as to absorb the lateral displacement of the camshaft with respect to the stem or stems having a displaced axis.

It appears evident that the reduced diameter of the two lateral valves with respect to the central one permits the heads of the valves to be closer together with consequent less need of reciprocal inclination of the stems.

There thus results an evident construction advantage, especially if the above reduced diameter of the lateral valves is combined with an inclination of the valve stems such that at least one of them has its own stem displaced laterally with respect to the camshaft's axis of rotation.

It is clear that a small displacement at the summit, easily offset with the above means, does not prejudice the correct operation of the valves and at the same time permits to further reduce the reciprocal inclination of the valve stems to the advantage of the simplicity of construction and of the combustion chamber's efficiency.

The features of the present invention shall be made more clearly evident from the following detailed description of its possible embodiments illustrated, as a non-limiting example, in the enclosed drawings, wherein:

Fig. 1 is a schematic plan view from below of a combustion chamber provided with a system of valves according to a first embodiment of the present invention;

Fig. 2 shows said combustion chamber in a vertical cross-section taken along the line II-II of Fig. 1;

Fig. 3 shows said combustion chamber in a vertical cross-section taken along the line III-III of Fig. 1;

Fig. 4 is a cross-sectional view as the Fig. 2, which shows a system of valves according to a second embodiment of the present invention;

Fig. 5 is a cross-sectional view as the Fig. 3, related to the system of valves of Fig. 4.

There is illustrated in the drawings a head of a cylinder 1 of an internal combustion engine, which by way of an example is provided with three intake valves 2, 2′ and with two exhaust valves 3. To obtain a good combustion chamber and good discharge coefficients, connected with the filling, the five valves are arranged on the head 4 of the cylinder in a circumferentially spaced out position which is also approximately symmetrical with respect to the cylinder's central axis.

As can be seen from Fig. 1, the lateral valves 2 of the three intake valves 2, 2′ have heads 5 having a reduced diameter with respect to the head 5′ of the central valve 2′ and define with the latter a lower distance between centres equal to D.

As shown on the other hand in Fig.s 2 and 3, the lateral intake valves 2 operate in respective intake ports 7 and have stems 6 having axes parallel to one another and inclined with respect to the axis of the stem 6′ of the central intake valve 2′ - (operating in an intake port 7′), thus defining an upper distance between centres d less than the lower one D. The exhaust valves 3 in turn operate in exhaust ports 8 and have stems 13 having axes parallel to one another.

The operation of the intake valves 2 and 2′ is provided by a first camshaft 9 having axis of rotation 10, while the operation of the exhaust valves 3 is provided by a second camshaft 11 having axis of rotation 12.

As shown in Fig. 2, the stems 13 of the exhaust valves 3 have axes which pass through the axis of rotation 12 of the camshaft 11 and are operated by the latter's cams 14 by means of guide cups 15 slidably housed in respective seats 16 of the head 4.

The stems 6, 6′ of the intake valves 2, 2′ are on the other hand displaced laterally in opposite directions with respect to the axis of rotation 10 of the camshaft 9, which operates them with cams 17, 17′ by means of guide cups 18, 18′ slidably housed in respective seats 19, 19′ of the head 4.

The cups 18 of the lateral valves 2 (Fig. 2) are displaced laterally with respect to the axes of the stems 6, in a direction and in an amount such as to offset the lateral displacement of the above axes with respect to the axis of rotation of the camshaft 9. A similar displacement takes place, in the opposite direction, in the case of the cup 18′ of the central valve 2′ (Fig. 3).

Thanks also to the smaller diameter of the valve heads 5 with respect to the valve head 5′, the reciprocal inclination of the stems of the intake valves 2, 2′ is thus contained within acceptable limits while still maintaining the possibility of using a single camshaft 9 and without having to recourse to auxiliary components such as rocker arms or such.

As an alternative, the cups 18, 18′ could be

aligned along the same axis as the stems 6, 6′ and the offset of the lateral displacements of the axes of the stems 6, 6′ could be obtained by having cups of an appropriately larger size. This solution is shown in Fig.s 4 and 5.

In addition, the axes of the stems 6 could pass through the axis of rotation 10 of the camshaft 9 and only the axis of the stem 6′ be laterally displaced with respect to the above axis of rotation, and vice versa.

Claims

1. System of valves and related operating devices for internal combustion engines having high specific horsepower, comprising for each cylinder a group of intake valves and a group of exhaust valves, wherein at least one of said groups is formed by three circumferentially spaced out valves operated by a single camshaft, characterized in that said three valves consist of a central valve (2′) and of two lateral valves (2) having a smaller diameter with respect to the central one (2′).

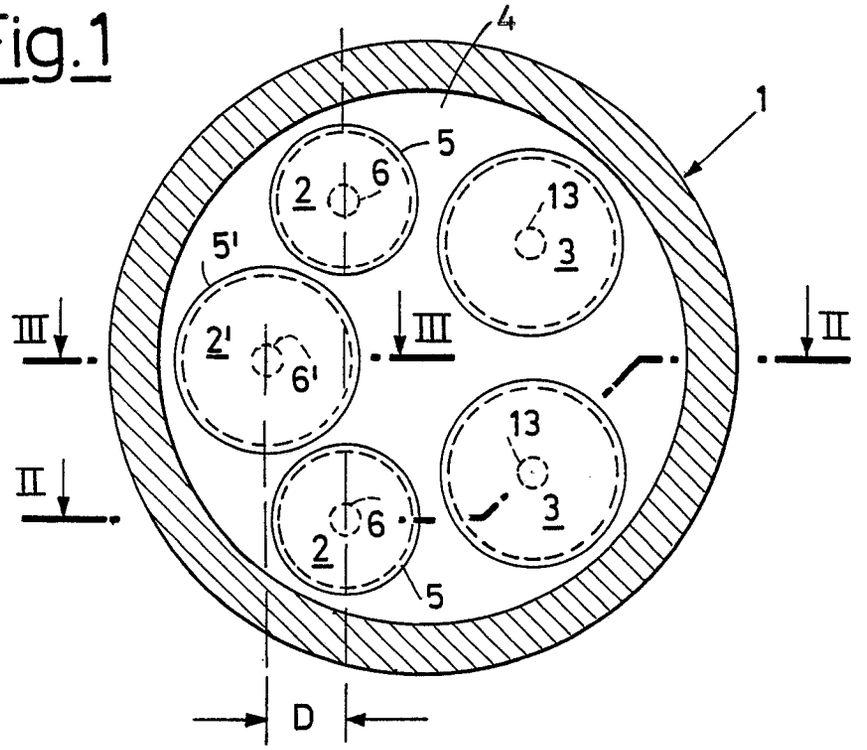
2. System of valves according to claim 1, characterized in that said lateral valves (2) are provided with stems (6) which are parallel to one another and inclined with respect to that (6′) of the central valve (2′), at least one of said stems (6, 6′) having its own axis displaced laterally with respect to the axis of rotation (10) of the camshaft (9) and there being provided means (18, 18′) for offsetting the lateral displacement of said axis.

3. System of valves according to claim 2, characterized in that the stems (6) of said lateral valves (2) and the stem (6′) of said central valve (2′) are displaced laterally on opposite sides with respect to the axis of rotation (10) of the camshaft (9).

4. System of valves according to claim 2, characterized in that said means (18, 18′) are constituted by a guide cup (18, 18′) placed on the summit of said stem having a displaced axis and in its turn displaced laterally with respect to it in the opposite direction and in an amount equal to the lateral displacement of said stem.

5. System of valves according to claim 2, characterized in that said means are constituted by a guide cup (18, 18′) placed on the summit of said stem having a displaced axis and a size larger than needed so as to offset the lateral displacement of said stem with respect to the camshaft (9).

Fig.1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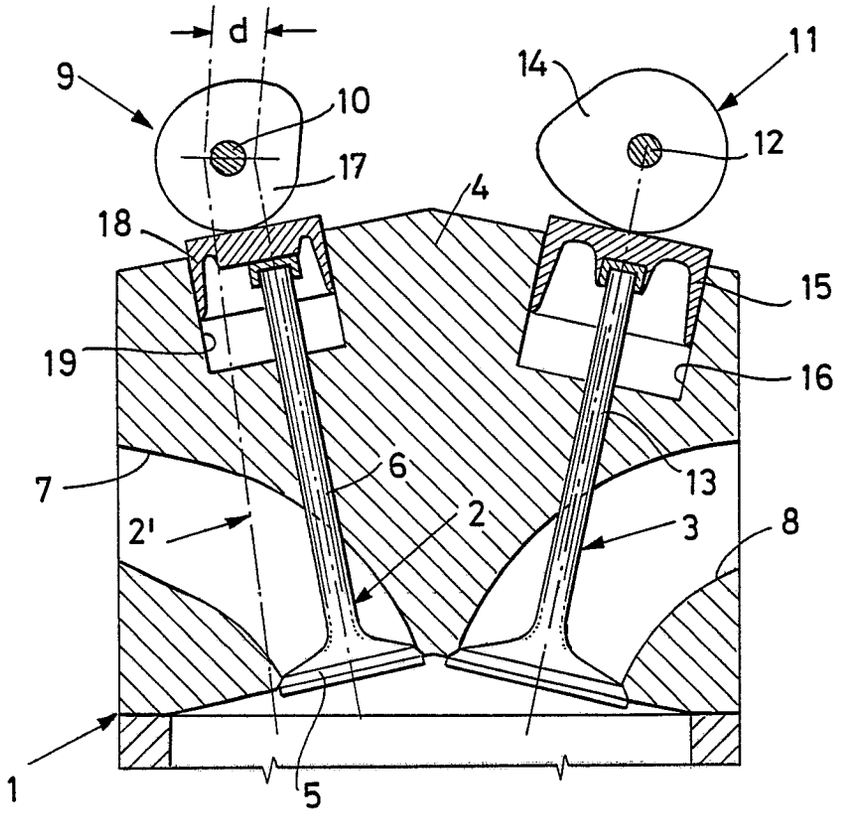
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Fig.2

Fig.3

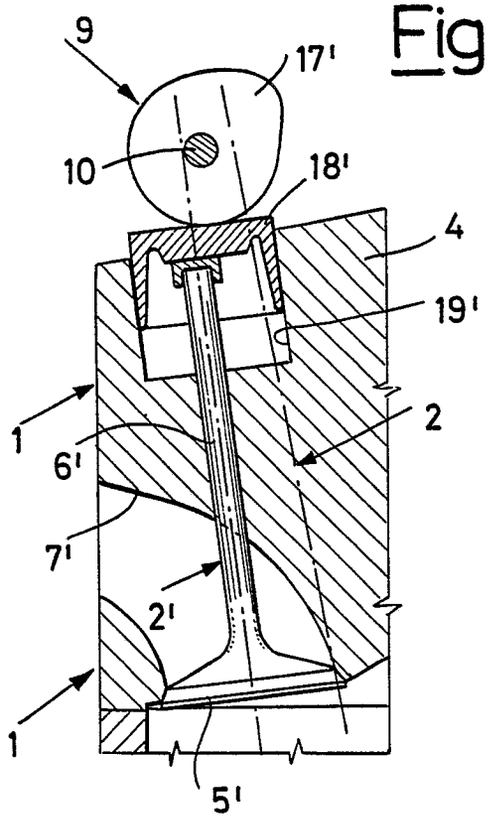

Fig.5

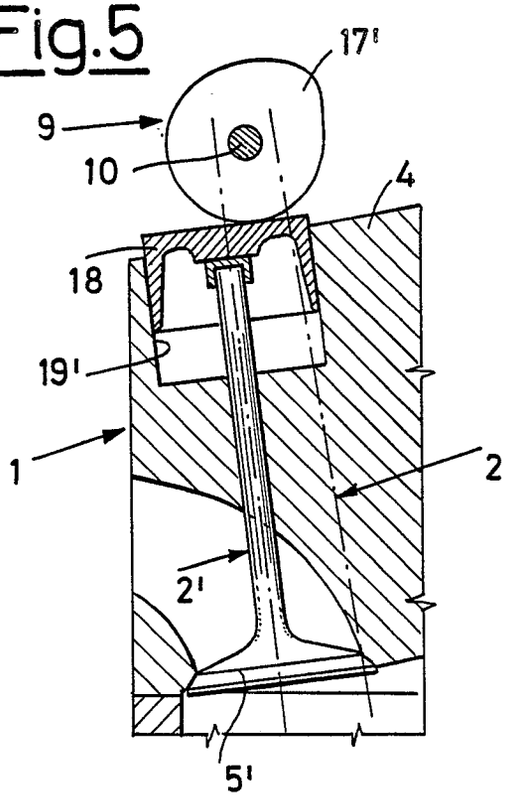

Fig.4