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References cited:
EP-A- 0 063 385
FR-A- 580 537
FR-A- 2 466 611
GB-A- 2 134 977
GB-A- 2 166 799
US-A- 2 710 602

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Description

From one aspect, the present invention relates to an internal combustion reciprocating piston engine. The invention also relates to a cylinder head for use in such an engine.

In my published United Kingdom Patent Application GB 2 134 977A, there is described an internal combustion reciprocating piston engine comprising a cylinder head defining a plurality of valve ports which communicate with a combustion chamber defined between the cylinder head and a piston, a plurality of poppet valves, one for each port, and an overhead camshaft for operating the valves, wherein stems of the valves are so arranged that respective centrelines of the valve stems intersect an axis of rotation of the camshaft and, as viewed in a direction along the camshaft, one valve stem diverges from an adjacent valve stem in a direction away from the camshaft.

In EP-A 0 063 385, there is disclosed an engine having five valve ports per cylinder. These valves are arranged in three rows, with the lengths of the rows being parallel to one another. The valves associated with the two ports which constitute a first of these rows are operated by a first camshaft and are parallel to each other. The two valves associated with the ports of a second row are operated by a second camshaft and are also parallel to each other. The first camshaft is parallel to the second camshaft and parallel to the lengths of the rows of ports. The third row comprises only a single port and the associated valve is operated by the second camshaft. Accordingly, the valve of the third row is inclined to the valves of the second row, as viewed in a direction along the camshaft.

GB-A 2 134 977 and EP-A 0 063 385 show springs for closing the valves and tapets for transmitting force from the camshaft to each valve to open the valve. In FR-A 580 537, there is disclosed desmodromic valve gear where a valve is attached to a follower and the follower is reciprocated positively in valve closing and valve opening directions by a camshaft.

According to the present invention, there is provided a cylinder head in or for an internal combustion engine, the cylinder head having a working face which, in use, is presented towards a combustion chamber and in which head there are formed at least three valve ports, the cylinder head having guide means for guiding at least three valves, one for each port, for movement along respective rectilinear paths, wherein the guide means defines a longitudinal centreline of each path, said centrelines converge towards a reference axis which is spaced from said working face in a direction which, in use of the cylinder head, is away from the combustion chamber, and said centrelines intersect said reference axis substantially at right angles, characterised in that said centrelines, as viewed in a direction along the reference axis, radiate in at least three different directions and in that, as viewed in a direction along the reference axis, the angle of inclination between respective centrelines of first and second of said paths differs from the angle of incli-

nation between respective centrelines of the first and a third of the paths.

There is also provided in accordance with the invention an internal combustion engine embodying a cylinder head in accordance with the invention, together with a camshaft mounted in the cylinder head with its axis of rotation coinciding with said reference axis, a combustion chamber defined between the cylinder head and a piston of the engine and a respective poppet valve in each of said paths, the poppet valves being mounted in the cylinder head for operation by the camshaft for opening the valve ports.

An axis defined by the combustion chamber and extending in the direction of movement of the piston preferably intersects the axis of rotation of the camshaft.

The piston may be circular. Alternatively, the piston may be elongated, as viewed in the direction of its movement. In the latter case, the longest dimension of the piston is preferably parallel to the camshaft axis.

Respective centres of heads of the valves may be so positioned that, when all of the valves are viewed in a direction transverse to the length of the camshaft and transverse to the length of the valve stems, the centres of the heads of these valves are spaced apart in the direction of the length of the camshaft.

The cylinder head of an engine in accordance with the invention may define at least four valve ports which communicate with the combustion chamber. In this case, there are four valves arranged for closing respective ones of the ports, respective stems of first and second of these valves are mutually inclined, as viewed along the camshaft, at a first angle, respective stems of third and fourth of the valves are mutually inclined, as viewed along the camshaft, at a second angle and respective angles included between the first and second valve stems and between the third and fourth valve stems are bisected by a plane containing a longitudinal axis of the camshaft.

Examples of engines embodying the present invention will now be described, with reference to the accompanying drawings, wherein:

FIGURE 1 shows diagrammatically a cross-section through a part of an engine, in a plane which contains an axis of a cylinder and is perpendicular to an axis of rotation of a camshaft;

FIGURE 2 shows the underside of a part of a cylinder head of the engine of Figure 1;

FIGURE 3 is a view similar to Figure 2 showing a part of the cylinder head of a further engine;

FIGURE 4 is a diagrammatic representation of components of an alternative cam follower;

FIGURE 5 illustrates the alternative cam follower in association with a part of a cylinder head; and

FIGURE 6 shows diagrammatically a cam structure for use with the follower of Figure 5.

The engine illustrated in Figure 1 is a reciprocating piston, internal combustion engine which may comprise a single cylinder or a plurality of cylin-

ders, although only a single cylinder and parts associated therewith are illustrated. The engine comprises a cylinder block 10 defining a cylindrical bore 11 containing a piston 12 connected with a crankshaft (not shown) in the usual way. On the block 10, there is mounted a cylinder head 13 defining four valve ports communicating with a combustion chamber 14 defined between the cylinder head and the piston. The piston presents a cavity to the combustion chamber. Alternatively, the piston could present a flat face to the combustion chamber.

The cylinder head 13 further defines three inlet ducts, one of which is shown at 15, and three exhaust ducts, one of which is shown at 16. There are mounted in the cylinder head three inlet valves 17, 18 and 19 and three exhaust valves 20, 21 and 22. The inlet valves control respective ports at which the inlet ducts terminate and the exhaust valves control respective ports at which the exhaust ducts terminate. All of these ports communicate with the combustion chamber 14.

For each valve, there is provided in the cylinder head 13 a respective valve guide. The valve guides for the valves 18 and 21 are shown at 23 and 24 respectively. The valve guides define respective longitudinal centrelines which coincide with the longitudinal centrelines of the stems of the valves. These centrelines intersect at respective positions an axis 25 of a camshaft 26 supported in the cylinder head 13 and arranged to be driven from the crankshaft in a known manner.

For the purpose of illustration, the valves 18 and 21 are shown in Figure 1 as having their respective centrelines lying in the same plane. In fact, these centrelines lie in respective planes which are spaced apart in a direction along the camshaft axis 25.

The angle at which the valves, as viewed in a direction along the camshaft axis 25, converge is within the range 10° to 30°, preferably in the region of 15° to 20°. Accordingly, the cylinder head has a mild form of "inverse pentroof" presented to the combustion chamber 14.

As shown in Figure 2, the head of the valve 18 is somewhat larger than are the heads of the valves 17, 19, 20 and 22. In the particular example illustrated, the head of the valve 18 is larger than the head of the valve 21. The head of the valve 18 lies generally between the heads of the valves 17 and 19. The head of the valve 21 lies generally between the heads of the valves 20 and 22.

The heads of the valves 18 and 21 lie on opposite sides of a plane 27 which contains a central axis 28 of the bore 11 and also contains the camshaft axis 25. The heads of valves 17 and 20 also lie on opposite sides of the plane 27 but are somewhat closer to that plane than are the heads of the valves 18 and 21. Similarly, the heads of the valves 19 and 22 lie on opposite sides of the plane 27 and are somewhat closer to that plane than are the heads of the valves 18 and 21.

The longitudinal axes of the stems of valves 17 and 20 are each inclined to the plane 27 at the same angle, which is a smaller angle than the angle of inclination to the plane 27 of the longitudinal axis of the

centreline of the stem of each of the valves 18 and 21. The head of valve 17 is somewhat larger than is the head of valve 20, so that the head of valve 17 lies nearer to the plane 27 than does the head of valve 20. Similarly, the longitudinal centrelines of the stems of valves 19 and 22 are each inclined to the plane 27 at the same angle as are the longitudinal centrelines of the stems of valves 17 and 20. The head of valve 19 is somewhat larger than is the head of valve 22 so that the latter is spaced further from the plane 27 than is the head of valve 19.

The heads of all of the valves are spaced from the axis 28 so that there is around the axis 28 a space in the cylinder head to accommodate a spark plug 29 (not shown in Figure 1). Thus, the electrodes of the spark plug may be positioned at the centre of the combustion chamber 14. Alternatively, the spark plug may be spaced from the centre of the combustion chamber or a plurality of spark plugs may be provided for the combustion chamber 14. The spark plug may be accommodated in a bore formed in the cylinder head 13 and lying generally above the exhaust ducts, a bore formed between adjacent ones of the inlet ducts or a bore terminating between an inlet duct and an exhaust duct.

The arrangement illustrated in Figures 1 and 2 may be modified by reducing the number of valves. For example, two inlet valves and a single exhaust valve may be provided. The number of inlet and exhaust ducts would be varied accordingly. In a case where a single exhaust valve is provided, the head of this valve would preferably lie at one side of the plane 27 whilst the heads of the inlet valves lie at the opposite side of that plane. The inlet valves would be arranged with longitudinal centrelines of respective stems inclined to the plane 27 at different angles.

One only of the six valves shown in Figure 2 may be omitted and the position of the remaining five valves may be adjusted accordingly.

For operating the valves 17 to 22 of the engine illustrated in Figure 1, there is provided desmodromic valve gear. For each valve, there is provided a respective follower. The follower of the valve 21 is indicated in Figure 1 by the reference numeral 30. The follower has a form approximating to that of an annulus and defines a central space in which a corresponding part of the camshaft 26 is received. The follower is guided by the cylinder head 13 for reciprocation along a path parallel to that defined by the valve guide 24. Such guidance may be provided partly by surfaces 32,33 of the cylinder head which lie on opposite sides of the camshaft and partly by a bore 34 defined by the cylinder head which lies below the camshaft and receives with sliding clearance a tappet portion 31 of the follower. If required, further guidance of the follower may be provided by co-operation between a housing 36 mounted on the cylinder head and an upward projection 35 on the follower disposed above the camshaft.

The tappet portion 31 of the follower is coupled with the stem of the valve 21 in a manner to enable the follower to move the valve downwardly to open the corresponding valve port and to move the valve upwardly to close the corresponding valve

port. The coupling between the tappet portion and the valve stem may be rigid. Alternatively, the coupling may provide a small amount of lost motion and incorporate a spring which is stressed as the follower reaches its uppermost position, so that the force which holds the valve on its seat is transmitted from the follower to the valve stem via the spring.

For co-operation with the follower 30, the camshaft 26 may be provided with three distinct cam tracks arranged in succession along the camshaft. In this case, the follower 30 would be provided with three internal corresponding follower tracks. The central one of these cam tracks may co-operate with a corresponding follower track to close the valve; whilst the cam tracks which are spaced apart by that one cam track may co-operate with corresponding follower tracks to open the valve. Alternatively, the pair of cam tracks may be used to close the valve whilst the central cam track is used to open the valve.

In a case where the camshaft 26 is provided with three distinct cam tracks for co-operation with the follower 30, these cam tracks may be presented by separately formed discs which are mounted adjacent to one another on the camshaft. Similarly, the follower 30 may comprise three separately formed pieces which are assembled together. The tappet portion 31 may be integral with the remainder of the follower or formed separately and attached thereto.

A typical construction of cam follower and cams, which may be used in place of the follower and cam illustrated in Figure 1, is shown diagrammatically in Figures 4, 5 and 6. The follower comprises a central component 37 having a tappet portion 38 and an upward projection 39. There is formed in the component 37 between the tappet portion and the projection an opening 40, the boundary surface of which defines a cam track which controls opening movement of the associated valve. The component 37 is secured between further components 41 and 42 which lie in face-to-face engagement with the component 37. The components 41 and 42 are formed with respective openings 43 and 44 having the same size and shape. The boundaries of these openings define cam tracks which control closing movement of the associated valve.

Each of the components 37, 41 and 42 has a pair of opposite, flat surfaces which slide on flat surface 45 and 46 defined by the cylinder block, as shown in Figure 5. Whilst the components of the follower are represented in Figure 4 as having generally square profiles, it will be understood that components having different profiles may be provided. Nevertheless, each component will generally have opposed flat surfaces which are co-planar with corresponding surfaces of the other components and which slide on surfaces of the cylinder head.

The cam structure for driving the follower of Figures 4 and 5 is shown diagrammatically in Figure 6. The structure comprises three separate cam elements fixed on a camshaft 47, namely a central element 48 for co-operation with the cam track defined by the component 37, an outer element 49 for co-operation with the cam track defined by the component 41 and an outer component 50 for co-operation with

the cam track defined by the component 42. It will be understood that the exact profiles of the cam elements and of the openings defined by the follower are not shown in Figures 4, 5 and 6.

As can be seen from Figure 1, the valve gear is compact, is spaced a substantial distance from the chamber 14 and does not extend far from the plane 27. This enables almost rectilinear inlet ducts to be provided and enables sharp bends to be avoided in the exhaust ducts. Furthermore, the valve gear can be readily accessible for inspection and maintenance.

It will be understood that alternative forms of desmodromic valve gear may be used in place of the particular arrangement of cams and followers illustrated in the accompanying drawings.

A modified version of the engine illustrated in Figures 1 and 2 is shown in Figure 3. In this modified version, each combustion chamber is elongated, the longer dimension being parallel to the axis of the camshaft. The piston has a complementary elongated shape. There communicate with the combustion chamber through respective ports a number of ducts which exceeds four and preferably exceeds six. For example, there may be four inlet ducts and four outlet ducts. Each port is provided with a poppet valve 117-124 and the poppet valves are operated by a single, overhead camshaft.

As shown in Figure 3, the valves of the modified engine may be arranged with respective heads in two rows, each row extending parallel to the camshaft axis. There may be provided valves having heads of different sizes. Generally, the valve heads will lie at one or other side of a plane 127 which bisects the combustion chamber and contains the camshaft axis. Some of the valve heads, for example the valve heads of larger diameter, may lie nearer to the plane 127 than do other valve heads. The longitudinal centrelines of the stems of certain of the valves are inclined to the plane 127 at a first angle, whilst the longitudinal centrelines of stems of further ones of the valves are inclined to the plane 127 at a different angle. The valves may be driven by desmodromic valve gear similar to that hereinbefore described with reference to Figure 1.

As shown in Figure 3, respective centres of adjacent valve heads are off-set from one another in a direction along the camshaft axis so that successive cams along the camshaft operate respective valves lying on opposite sides of the plane 127.

In both the engine illustrated in Figure 1 and the modified engine illustrated in Figure 3, respective longitudinal centrelines of all of the valve stems preferably intersect the camshaft axis at right angles.

Claims

1. A cylinder head for an internal combustion engine, the cylinder head having a working face which, in use, is presented towards a combustion chamber and in which there are formed at least three valve ports, the cylinder head having guide means (23, 24) for guiding at least three valves (17, 18, 21), one for each port, for movement along re-

spective rectilinear paths, wherein the guide means defines a longitudinal centreline of each path, said centrelines converge towards a reference axis which is spaced from said working face in a direction which, in use, is away from the combustion chamber, and said centrelines intersect said reference axis substantially at right angles, characterised in that said centrelines, as viewed in a direction along the reference axis, radiate in at least three different directions and in that, as viewed in a direction along the reference axis, the angle of inclination between respective centrelines of first and second of said paths differs from the angle of inclination between respective centrelines of the first and a third of the paths.

2. An internal combustion, reciprocating piston engine having a cylinder head as defined in Claim 1, a combustion chamber (14) defined between the cylinder head and a piston (12), a respective poppet valve (17 to 22) in each of said paths mounted in the cylinder head and an overhead camshaft for operating the valves, the camshaft being mounted in the cylinder head with an axis of rotation of the camshaft coinciding with said reference axis.

3. An engine according to Claim 2 having valve gear which comprises a respective tappet (31) connected with each valve stem and a respective follower (30) for each tappet, the follower being arranged for co-operation with corresponding cams of the camshaft and for exerting on the tappet a valve-closing force during one part of each operating cycle of the engine and a valve-opening force during a further part of the operating cycle.

4. An engine according to Claim 3 wherein there is in the connection between each tappet and the associated valve stem a resilient element which is stressed when the valve is closed.

5. An engine according to any one of Claims 2, 3 and 4 wherein the cylinder head (13) defines at least four valve ports which communicate with the combustion chamber, wherein four of said valves are arranged for closing respective ones of said ports, wherein respective stems of first and second of said four valves (18, 21) are mutually inclined, as viewed along the camshaft, at a first angle, respective stems of third and fourth of said four valves (17, 20) are mutually inclined, as viewed along the camshaft, at a second angle and wherein respective angles included between the first and second valve stems and between the third and fourth valve stems are bisected by a plane containing a longitudinal axis of the camshaft (13).

6. An engine according to any one of Claims 2, 3 and 4 wherein the cylinder head defines at least six valve ports which communicate with the combustion chamber, the plurality of poppet valves includes one for each of said ports, said valves have respective stems with longitudinal centrelines which substantially intersect the axis of rotation of the camshaft at first to sixth intersection positions respectively and wherein said intersection positions are spaced apart from each other along the camshaft axis.

7. An engine according to any one of Claims 2, 3 and 4 wherein the cylinder head defines at least

five valve ports which communicate with the combustion chamber and wherein, as viewed in the direction of its movement, the piston is elongated with its length substantially parallel to the axis of rotation of the camshaft (26) and wherein respective stems of the five valves associated with said five valve ports, when viewed in a direction along the camshaft axis, converge towards the camshaft.

8. An engine according to any one of Claims 2 to 7 wherein there is provided for each valve a follower comprising a central component (37) and further components (41, 42) between which the central component is secured, each of said components is hollow, an internal surface of the central component constitutes a cam track which co-operates with a portion of the camshaft (26) to control longitudinal movement of the associated valve in one direction and wherein the internal surface of each of said further components constitutes a respective cam track which co-operates with a corresponding part of the camshaft to control movement of the associated valve in an opposite direction, the internal surfaces of said further components having the same size and shape.

9. An engine according to Claim 8 wherein each of said components has a pair of opposite, substantially flat, external faces, each of said faces of the central component is substantially co-planar with corresponding faces of the other components and wherein said faces slide on surfaces of the cylinder head.

Patentansprüche

1. Zylinderkopf für eine Brennkraftmaschine mit innerer Verbrennung, wobei der Zylinderkopf eine Arbeitsseite hat, welche in Betrieb gegen eine Brennkammer gerichtet ist und in welcher mindestens drei Ventilöffnungen ausgebildet sind, wobei der Zylinderkopf Führungsmittel (23, 24) aufweist zum Führen mindestens dreier Ventile (17, 18, 21), eines für jede Öffnung, zur Bewegung entsprechender gradliniger Pfade, wobei die Führungsmittel eine longitudinale Mittellinie eines jeden Pfades festlegen, wobei die Mittellinien gegen eine Bezugsachse konvergieren, welche von der Arbeitsseite in einer Richtung beabstandet ist, die in Betrieb von der Brennkammer wegweist, und die Mittellinien die Bezugsachsen im wesentlichen rechtwinklig schneiden, dadurch gekennzeichnet, daß die Mittellinien in einer Richtung entlang der Bezugsachse gesehen sich in wenigstens drei Richtungen strahlenförmig ausbreiten, und daß in einer Richtung entlang der Bezugsachse gesehen der Neigungswinkel zwischen den entsprechenden Mittellinien eines ersten und eines zweiten der genannten Pfade sich von dem Neigungswinkel zwischen den entsprechenden Mittellinien des ersten und eines dritten der Pfade unterscheidet.

2. Hubkolben-Brennkraftmaschine mit innerer Verbrennung mit einem Zylinderkopf nach Anspruch 1, einer Brennkammer (14), die zwischen dem Zylinderkopf und einem Kolben (12) ausgebildet ist, einem entsprechenden Tellerventil (17-22) in jedem der in dem Zylinderkopf ausgebildeten Pfade und

einer obenliegenden Nockenwelle zum Betreiben der Ventile, wobei die Nockenwelle in dem Zylinderkopf derart angeordnet ist, daß die Rotationsachse der Nockenwelle mit der Bezugsachse koinzidiert.

3. Maschine nach Anspruch 2, mit einem Ventilsteuergestänge, welches einen entsprechenden Mitnehmer (31) aufweist, der mit jeder Ventilstange und einem entsprechenden Ventilstößel (30) für jeden Mitnehmer verbunden ist, wobei der Ventilstößel für ein Zusammenwirken mit entsprechenden Nocken der Nockenwelle und zum Ausüben einer Ventilschließkraft während eines Teiles des Betriebszyklus der Maschine und einer Ventilöffnungskraft während eines weiteren Teiles des Betriebszyklus auf den Mitnehmer ausgelegt ist.

4. Maschine nach Anspruch 3, wobei in der Verbindung zwischen jedem Mitnehmer und der zugehörigen Ventilstange ein nachgiebiges Element vorgesehen ist, das unter Spannung gesetzt wird, wenn das Ventil geschlossen wird.

5. Maschine nach einem der Ansprüche 2, 3 und 4, wobei der Zylinderkopf (13) mindestens vier der Ventilöffnungen festlegt, welche mit der Brennkammer kommunizieren, wobei vier der Ventile dazu ausgelegt sind, Entsprechende der Öffnungen zu schließen wobei entsprechende Stangen eines ersten und eines zweiten der vier Ventile (18, 21) entlang der Nockenwelle gesehen gegeneinander geneigt sind, und zwar mit einem ersten Winkel dazwischen entsprechende Stangen eines dritten und eines vierten der vier Ventile (17, 20) entlang der Nockenwelle gesehen gegeneinander geneigt sind, und zwar mit einem zweiten Winkel dazwischen, und wobei entsprechende Winkel, welche zwischen der ersten und der zweiten Ventilstange sowie zwischen der dritten und der vierten Ventilstange ausgebildet sind, von einer Ebene, welche eine Längsachse der Nockenwelle (13) beinhaltet, halbiert werden.

6. Maschine nach einem der Ansprüche 2, 3 und 4, wobei der Zylinderkopf mindestens sechs Ventilöffnungen festlegt, welche mit der Brennkammer kommunizieren, wobei die Mehrzahl Tellerventile jeweils eines für jede der Öffnungen beinhaltet, wobei die Ventile entsprechende Stangen mit longitudinalen Mittellinien umfassen, die im wesentlichen die Rotationsachse der Nockenwelle an ersten bis sechsten Schnittpunkten schneiden und wobei die Schnittpunkte entlang der Nockenwellenachse voneinander beabstandet sind.

7. Maschine nach einem der Ansprüche 2, 3 und 4, wobei der Zylinderkopf wenigstens fünf Ventilöffnungen festlegt, welche mit der Brennkammer kommunizieren, und wobei in der Richtung seiner Bewegung gesehen der Kolben in seiner Längsausdehnung im wesentlichen parallel zu der Rotationsachse der Nockenwelle (26) verlängert ist und wobei entsprechende Stangen der fünf Ventile, welche den fünf Ventilöffnungen zugeordnet sind, in Richtung entlang der Nockenwellenachse gesehen gegen die Nockenwelle konvergieren.

8. Maschine nach einem der Ansprüche 2 bis 7, wobei für jedes Ventil ein Ventilstößel vorgesehen ist, welcher eine zentrale Komponente (37) und weitere Komponenten (41, 42) umfaßt, zwischen denen

die zentrale Komponente gesichert ist, wobei jede der Komponenten hohl ist, wobei eine Innenfläche der zentralen Komponente eine Nockenspur darstellt, welche mit einem Teil der Nockenwelle (26) zusammenwirkt um die Längsbewegung des zugehörigen Ventils in einer Richtung zu überwachen, und wobei die Innenfläche einer jeden der weiteren Komponenten eine entsprechende Nockenspur darstellt, welche mit einem entsprechenden Teil der Nockenwelle zusammenwirkt, um die Bewegung des zugehörigen Ventils in einer entgegengesetzten Richtung zu überwachen, wobei die Innenflächen der weiteren Komponenten dieselbe Größe und Form haben.

9. Maschine nach Anspruch 8, wobei eine jede der Komponenten ein Paar einander entgegengesetzte im wesentlichen ebene Außenflächen aufweist, wobei jede der Flächen der zentralen Komponente im wesentlichen koplanar mit den entsprechenden Flächen der anderen Komponenten liegt und wobei die Flächen auf Flächen des Zylinderkopfes gleiten.

Revendications

1. Une culasse de cylindre pour un moteur à combustion interne, cette culasse comportant une face active qui, en service, est dirigée vers une chambre de combustion et dans laquelle sont formés au moins trois orifices de soupape, la culasse de cylindre comportant des moyens de guidage (23, 24) pour guider au moins trois soupapes (17, 18, 21), une pour chaque orifice, pour qu'elles se déplacent selon des trajectoires rectilignes correspondantes, dans lequel les moyens de guidage définissent une ligne médiane longitudinale pour chaque trajectoire, lesdites lignes médianes convergeant vers un axe de référence qui est placé à distance de ladite face active dans une direction qui, en service, est à distance de la chambre de combustion, et lesdites lignes médianes coupant ledit axe de référence sensiblement à angle droit, caractérisée en ce que lesdites lignes médianes, vues dans la direction de l'axe de référence, sont disposées radialement selon au moins trois directions différentes et en ce que, vues dans la direction de l'axe de référence, l'angle d'inclinaison entre les lignes médianes correspondantes des première et seconde desdites trajectoires diffère de l'angle d'inclinaison entre les lignes médianes correspondantes de la première et d'une troisième de ces trajectoires.

2. Un moteur à combustion interne à piston à déplacement alternatif, comportant une culasse de cylindre selon la revendication 1, une chambre de combustion (14) définie entre la culasse du cylindre et un piston (12), une soupape à plateau correspondante (17 à 22) dans chacune desdites trajectoires, montée dans la culasse de cylindre et un arbre à cames en tête pour actionner les soupapes, l'arbre à cames étant monté dans la culasse du cylindre avec son axe de rotation coïncidant avec ledit axe de référence.

3. Un moteur selon la revendication 2, comportant une commande de soupape qui comprend un poussoir correspondant (31) relié à chaque tige de soupape et un guide de soupape correspondant (30)

pour chaque poussoir, ce guide de soupape étant agencé pour coopérer avec des cames correspondantes de l'arbre à cames et pour exercer sur le poussoir une force de fermeture de la soupape pendant une partie de chaque cycle de fonctionnement du moteur et une force d'ouverture de la soupape pendant une autre partie du cycle de fonctionnement.

4. Un moteur selon la revendication 3, dans lequel est prévu, dans la liaison entre chaque poussoir et la tige de soupape associée, un élément élastique qui est sollicité lorsque la soupape est fermée.

5. Un moteur selon l'une quelconque des revendications 2, 3 et 4, dans lequel la culasse de cylindre (13) définit au moins quatre orifices de soupape qui communiquent avec la chambre de combustion, dans lequel quatre desdites soupapes sont agencées pour obturer lesdits orifices correspondants, dans lequel les tiges correspondantes des première et seconde desdites quatre soupapes (18, 21) sont inclinées l'une par rapport à l'autre, vues le long de l'arbre à cames, d'un premier angle, les tiges correspondantes des troisième et quatrième desdites quatre soupapes (17, 20) sont inclinées l'une par rapport à l'autre, vues le long de l'arbre à cames, d'un second angle et dans lequel les angles correspondants entre la première et la seconde tiges de soupape et entre la troisième et la quatrième tiges de soupape sont coupés par un plan contenant l'axe longitudinal de l'arbre à cames (13).

6. Un moteur selon l'une quelconque des revendications 2, 3 et 4, dans lequel la culasse de cylindre définit au moins six orifices de soupape qui communiquent avec la chambre de combustion, la pluralité des soupapes à plateau comprend une soupape pour chacun desdites orifices, lesdites soupapes comportant des tiges correspondantes dont les lignes médianes longitudinales coupent sensiblement l'axe de rotation de l'arbre à cames sur des première à sixième positions d'intersection correspondantes et dans lequel lesdites positions d'intersection sont placées à distance l'une de l'autre le long de l'axe de l'arbre à came.

7. Un moteur selon l'une quelconque des revendications 2, 3 et 4, dans lequel la culasse de cylindre définit au moins cinq orifices de soupape qui communiquent avec la chambre de combustion et dans lequel, vu dans la direction de son déplacement, le piston présente une forme allongée, sensiblement parallèle dans le sens de la longueur à l'axe de rotation de l'arbre à cames (26) et dans lequel les tiges correspondantes des cinq soupapes associées auxdits cinq orifices de soupape, vues dans la direction de l'axe de l'arbre à cames, convergent vers l'arbre à cames.

8. Un moteur selon l'une quelconque des revendications 2 à 7, dans lequel est prévu pour chaque soupape un guide comprenant un composant central (37) et d'autres composants (41, 42) entre lesquels est fixé le composant central, chacun desdits composants étant creux, dans lequel une surface interne du composant central constitue un profil de came qui coopère avec une partie de l'arbre à cames (26) pour commander le déplacement longitudinal de la soupape associée dans une direction et dans lequel

la surface interne de chacun desdites autres composants constitue un profil de came correspondant qui coopère avec une partie correspondante de l'arbre à cames pour commander le déplacement de la soupape associée dans une direction opposée, les surfaces internes desdites autres composants présentant la même taille et la même forme.

9. Un moteur selon la revendication 8, dans lequel chacun desdits composants comporte deux faces externes opposées sensiblement planes, chacune desdites faces du composant central étant sensiblement coplanaire aux faces correspondantes des autres composants et dans lequel lesdites faces glissent sur des surfaces de la culasse du cylindre.

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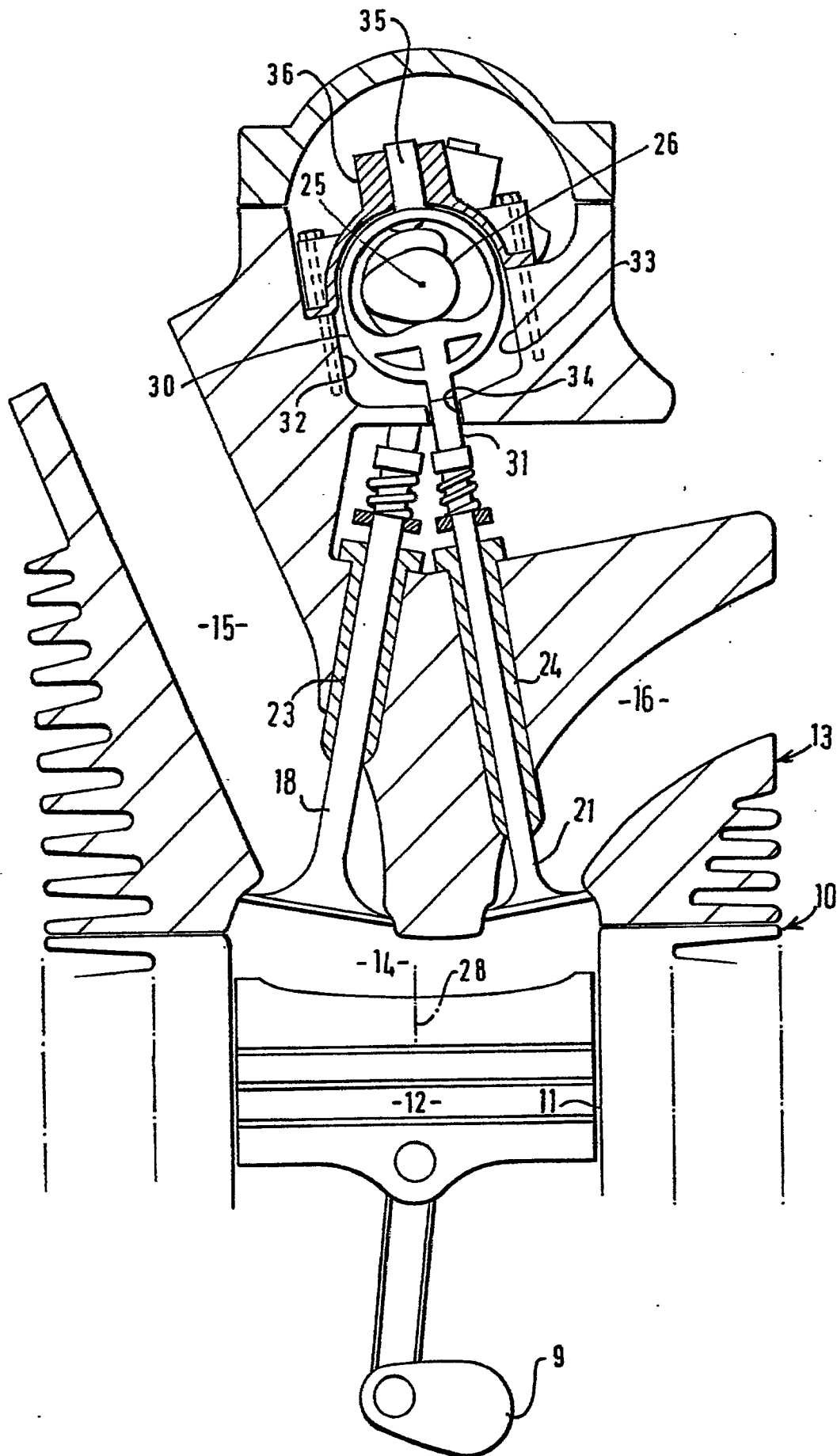
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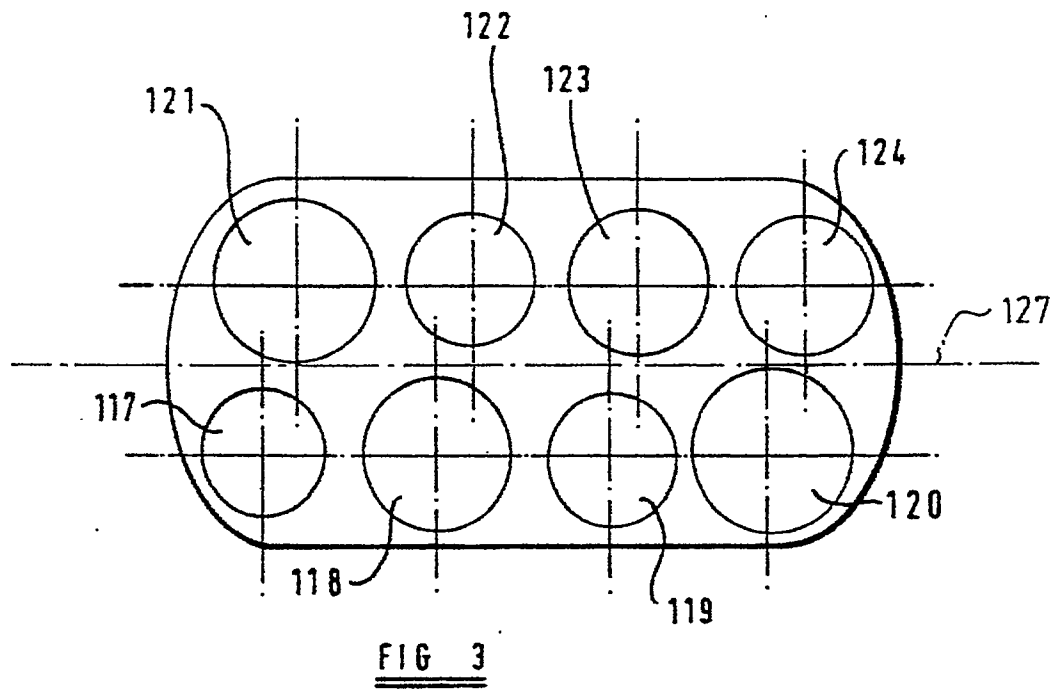
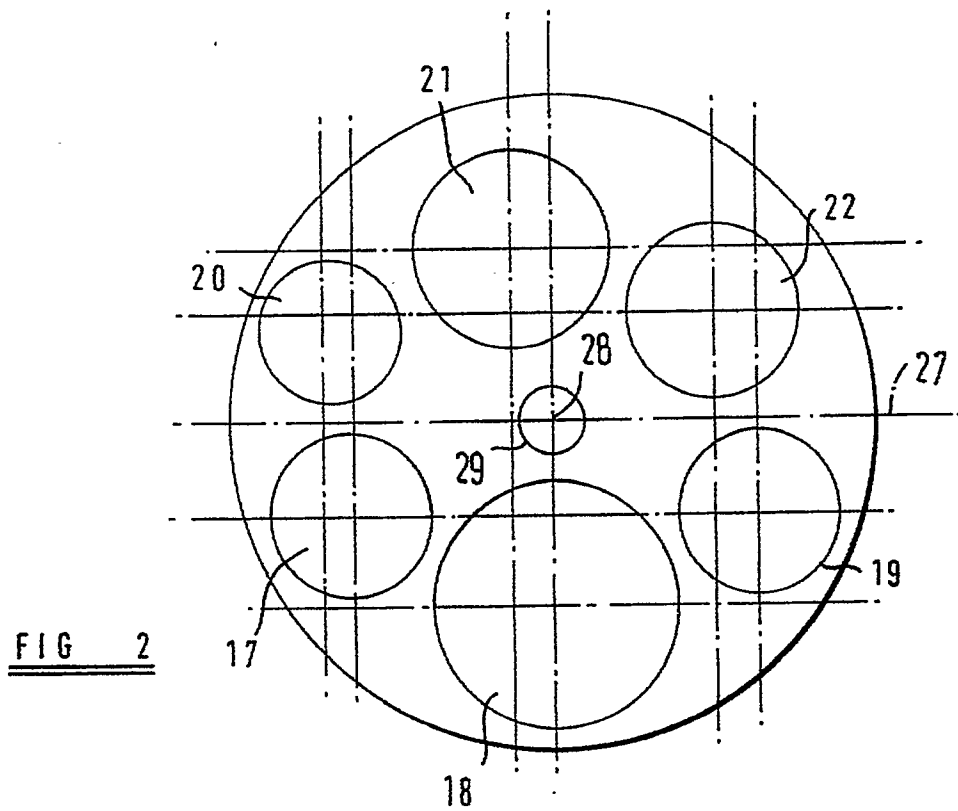


FIG 4

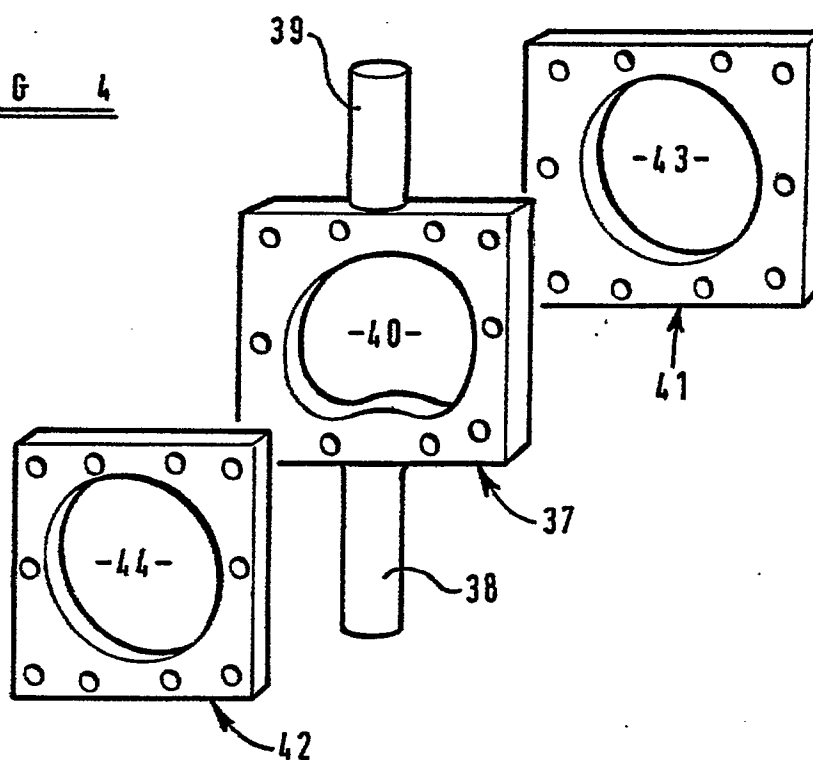


FIG 5

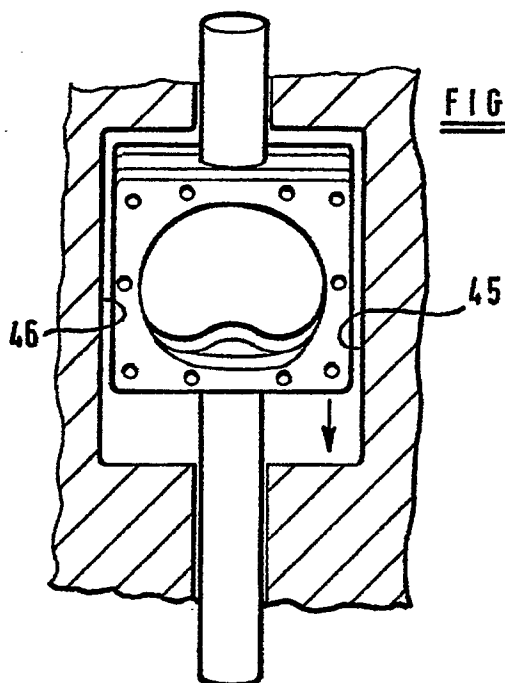


FIG 6

