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⑤④ **Cylinder head for internal combustion engines.**

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DE-C-3 209 901
US-A-2 016 734
US-A-3 672 338

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Description

This invention relates to an improvement in cylinder heads for an internal combustion engine, in particular for a direct injection diesel engine, on which a camshaft rotates for operating the engine valves and has its axis disposed to one side of the plane containing the engine cylinder axes.

In cylinder heads of the indicated type, the camshaft is normally supported by sliding bearings, each of which has a first portion formed on the body of the cylinder head and a second portion formed on a cover fixed to this body. This latter is fixed to the engine crankcase by two sets of tie bolts with their threaded shanks screwed into the engine crankcase, a first set being disposed on the aforesaid side of the plane containing the cylinder axes, and the second set being disposed on the opposite side of the plane.

The tie bolt shanks are normally housed in corresponding bores in the body, and their heads are disposed in corresponding seats provided in said body.

A cylinder head of this type is described in DE-C 3 209 901.

Cylinder heads of the indicated type have the following drawback.

With them it is normally not possible to arrange the camshaft-operated valves in every given geometrical configuration because the distance of the axis of this valve from the plane containing the axes of the relative cylinders cannot be very large. This is because if this distance exceeds a predetermined value dependent on the geometrical characteristics of the cylinder head, the outer surface of the camshaft can interfere with the seats housing the heads of the said first set of tie bolts. Again, the minimum thickness of the material lying below the cylindrical surfaces of the body and cover which form the sliding bearings for said shaft may be insufficient to ensure adequate bearing strength.

The object of the present invention is to provide a cylinder head for an internal combustion engine of the aforesaid type which is free from the said drawback and in which the distance of the camshaft axis from the plane containing the cylinder axes can be very large to enable the valves to be arranged in any desired geometrical configuration.

This object is attained by an internal combustion engine cylinder head on which a camshaft rotates for operating the valves of said engine and has its axis disposed to one side of the plane containing the engine cylinder axes, said camshaft being supported by sliding bearings each of which has a first portion formed on the body of said cylinder head and a second portion formed at least on a cover fixed to said body, said body being fixed to the engine crankcase by two sets of tie bolts with their threaded shanks screwed into said crankcase and of which a first set is disposed on said side of the plane containing the cylinder axes on which is disposed said camshaft axis and the second set is disposed on the opposite side of said plane, said tie bolt shanks being housed in corresponding bores of said body and the heads of said tie bolts being housed in corresponding seats in said body each of said seats

for the heads of the tie bolts of said first set is positioned below said camshaft axis, said body having a first flat inclined surface which contains the camshaft axis and forms an angle of between 0° and 90° with said plane containing the engine cylinder axes and on which a corresponding flat surface of said cover rests, and couples of tie bolts of said two sets being disposed in planes which are perpendicular to said plane containing the cylinder axes, characterised in that each of said seats for the heads of the tie bolts of said first set is a bore defined by a cylindrical lateral surface, and said planes in which said couples of tie bolts of said two sets are disposed intersect said respective first portion of said sliding bearings, and the distance s between the camshaft surface and the point of intersection of that generating line of said cylindrical lateral surface which is closest to said plane containing the cylinder axes and said first flat inclined surface satisfies the relationship:

$$d$$

$$\sin \alpha = \frac{d}{r + s}$$

$$r + s$$

in which α is the angle formed by said first inclined surface with said plane,

d is the distance between said generating line and the axis of said camshaft, and

r is the camshaft radius, and

in which said distance d being equal or less than the radius r of said camshaft.

The present invention will be more apparent from the detailed description given hereinafter by way of example with reference to the accompanying drawings in which:

Figure 1 is a vertical section through part of a direct injection diesel engine cylinder head in which the improvement of the present invention is applied;

Figure 2 represents certain geometrical elements of Figure 1;

Figure 3 is a section through a second embodiment of the cylinder head according to the invention.

The improvement of the invention relates to a direct injection diesel engine cylinder head which is indicated overall by 1 and is fixed to the engine crankcase 2. On this head a camshaft 3 rotates for operating the engine valves (not shown) and has its axis, indicated by the point 4, disposed to one side of the plane containing the engine cylinder axes (plane indicated by the line 5 in Figure 1). The outer surface 6 of said shaft is supported by sliding bearings each of which has a first support surface 7 formed on the body 8 of the cylinder head, and a second support surface 9 formed on one or more cylinder head covers 10 fixed to the body 8.

The body 8 is fixed to the crankcase of the engine 2 by two sets of tie bolts indicated by 11 and 12 respectively, those of the first set being disposed on

one side of the plane 5 containing the cylinder axes and those of the second set being disposed on the opposite side of the plane as can be clearly seen in the figures. Each of these tie bolts passes through a corresponding bore 14 and comprises a lower threaded end 15 screwed into the crankcase 2 and a head 16 which allows the shank to be screwed down. This head is conveniently cylindrical and is provided with a cavity suitably shaped to cooperate with the end of a suitable operating key. Each head 16 of the tie bolts of the first set of tie bolts 10 is housed in a corresponding seat 17 conveniently defined by a cylindrical surface. In contrast, the heads 16 of the tie bolts of the second set 14 rest on a flat surface of the body 8, a washer 18 being conveniently disposed between each head and the relative support surface.

As can be clearly seen from the figures, each seat 17 is positioned below the axis of the camshaft 3 in such a manner that its cylindrical lateral surface 19 does not interfere with the outer surface 6 of the camshaft 3 but lies a certain distance from this surface. In addition the body 8 is bounded upperly by an inclined flat surface 21 which forms an angle α (Figure 2) of between 0° and 90° with the plane 5 containing the cylinder axes. On this surface there rests a corresponding flat surface 22 of each cover 10. This latter is fixed to the body 8 in any convenient manner, for example by studs 23 fixed to the body 8 and on which nuts 24 are screwed. A covering element 25, fixed to the body 8 by the studs 23, upperly closes the cylinder head.

The angle α can assume any value between 0° and 90° , and is chosen such as to define a required value of the distance s (Figure 2) between the point at which that generating line of the surface 19 closest to the plane 5 intersects the plane 21, and the outer surface 6 of the camshaft 3. This distance s obviously represents the minimum thickness of the sliding bearing which supports the camshaft, and on which the mechanical strength and operating characteristics of said bearing obviously depend. Consequently, with reference to Figure 2, it is apparent that in order to define a required value of s , the angle α must be chosen to satisfy the following relationship between the radius r of the cylindrical surface 6 and the distance d between the said generating line and the point 4:

$$\sin \alpha = d/(r + s).$$

It is therefore apparent that the position of the axis of each tie bolt of the first set 11 and the dimensions of the relative seat 17 can be chosen such that the said distance d is equal to or less than the radius r of the camshaft 3. As can be clearly seen from Figure 2, under these geometrical conditions, by suitably choosing the angle α it is possible to define a minimum thickness s of the bearing for the camshaft 3 which is sufficient for proper operation thereof. The geometrical condition represented diagrammatically in Figure 2 corresponds to that in which the distance d is equal to the radius r of the cylindrical surface 6.

It is therefore apparent that with the described constructional arrangement it is possible to position the axis 4 of the camshaft 3 at a considerable dis-

tance from the plane 5 containing the cylinder axes without the risk of interfering with the tie bolts of the first set 14 or with the seats 17 of the tie bolt heads, or of creating minimum thicknesses for the sliding bearing supporting the camshaft 3 which are totally insufficient. By positioning the axis 4 a large distance from the plane 5, a greater freedom is obviously allowed in positioning the axes of the engine valves and thus in the possible choice of geometrical arrangements for the valves themselves.

In each cover 10 there is provided a plurality of holes 26, each of which is coaxial with a corresponding tie bolt of the first set 11 as can be clearly seen in the figures. Each of these holes allows passage of an operating key for screwing said tie bolts, the end of the key having a shape suitable for insertion into the cavity provided in the tie bolt head. The tightness of the tie bolts 11 can thus be periodically checked in a simple and rapid manner without the need to remove the cover 10 from the body 8, but instead by simply removing the covering element therefrom.

The embodiment of Figure 3 differs from that of Figure 1 only by the height of each seat 17, which in this second case is chosen at least equal to the sum of the height of the relative tie bolt head 16 and the length of the threaded tie bolt portion 15 screwed into the corresponding threaded bore of the crankcase 2. With this constructional arrangement the entire cylinder head can be removed from the crankcase 2 without removing the covers 10 from the body. For this purpose it is necessary only to insert a suitable key through the holes 26 and unscrew the tie bolts of the first set 11 until their threaded end 15 has been completely separated from the corresponding threaded bore of the crankcase 2. When this condition has been attained, the tie bolt heads 16 are in their upper limiting position within the relative seats 17.

Claims

1. An internal combustion engine cylinder head (1) on which a camshaft (3) rotates for operating the valves of said engine and has its axis (4) disposed to one side of the plane (5) containing the engine cylinder axes, said camshaft being supported by sliding bearings each of which has a first portion (7) formed on the body (8) of said cylinder head and a second portion (9) formed at least on a cover (10) fixed to said body, said body being fixed to the engine crankcase by two sets (11, 12) of tie bolts with their threaded shanks screwed into said crankcase and of which a first set (11) is disposed on said side of the plane (5) containing the cylinder axes on which is disposed said camshaft axis (4) and the second set (12) is disposed on the opposite side of said plane, said tie bolt shanks being housed in corresponding bores (14) of said body and the heads (16) of said tie bolts being housed in corresponding seats (17) in said body each of said seats (17) for the heads of the tie bolts of said first set is positioned below said camshaft axis, said body having a first flat inclined surface (21) which contains the

camshaft axis (4) and forms an angle of between 0° and 90° with said plane (5) containing the engine cylinder axes and on which a corresponding flat surface (22) of said cover (10) rests, and couples of tie bolts (11, 12) of said two sets being disposed in planes which are perpendicular to said plane (5) containing the cylinder axes, characterised in that each of said seats (17) for the heads of the tie bolts of said first set (11) is a bore defined by a cylindrical lateral surface (19), and said planes in which said couples of tie bolts of said two sets are disposed intersect said respective first portion (7) of said sliding bearings, and the distance s between the camshaft surface (6) and the point of intersection of that generating line of said cylindrical lateral surface (19) which is closest to said plane (5) containing the cylinder axes and said first flat inclined surface (21) satisfies the relationship:

$$\sin \alpha = \frac{d}{r + s}$$

in which α is the angle formed by said first inclined surface (21) with said plane (5),

d is the distance between said generating line and the axis (4) of said camshaft (3), and

r is the camshaft radius, and

in which said distance d being equal or less than the radius r of said camshaft.

2. A cylinder head as claimed in claim 1, characterised in that each of said covers (10) is fixed to said body by couples of fixing members (23) provided with shank inserted into bores in said body, the members of each couple being disposed in one of said planes which are perpendicular to said plane (5) on opposite sides of said camshaft (3), said tie bolts (11) of said first set being disposed between said camshaft (3) and said fixing members located on one side of said camshaft.

3. A cylinder head as claimed in claims 1 or 2, characterised in that in each cover (10) there are provided through bores (25), each of which has its axis coinciding with the axis of one of said tie bolts (11) of said first set, the diameter of said bore being chosen to enable insertion therein of a key able to cooperate with the head (16) of the corresponding tie bolt, so as to screw down the tie bolt and adjust its tightness.

4. A cylinder head as claimed in claim 3, characterised in that the height of each said seats (17) for the heads (16) of the tie bolts (11) of said first set is substantially equal to the height of the head (16) of the relative tie bolt.

5. A cylinder head as claimed in one of the preceding claims, characterised in that the height of each of said seats (17) for the heads (16) of the tie bolts (11) of said first set is at least equal to the sum of the height of the head (16) of the relative tie bolt and the length of that threaded portion of the tie bolt which is screwed into the corresponding threaded

bore of the crankcase, so as to be able to remove said cylinder head from said crankcase without separating said cover from said body.

Patentansprüche

1. Ein Brennkraftmaschinen-Zylinderkopf (1), in dem eine Nockenwelle (3) zur Betätigung der Ventile der Maschine rotiert, deren Achse (4) auf einer Seite der Ebene (5) liegt, die die Maschinenzylinderachsen enthält, welche Nockenwelle durch Gleitlager abgestützt ist, von denen jedes einen ersten Bereich (7) an dem Körper (8) des Zylinderkopfes und einen zweiten Bereich (9) umfaßt, der wenigstens an einem mit dem Körper verbundenen Deckel (10) ausgebildet ist, welcher Körper an dem Maschine-Kurbelgehäuse mit Hilfe von zwei Sätzen (11, 12) von Zugbolzen befestigt ist, deren Gewindeschäfte in das Kurbelgehäuse eingeschraubt sind und von denen ein erster Satz (11) auf der erwähnten Seite der Ebene (5), die die Zylinderachsen enthält, angeordnet ist, auf der sich die Achse (4) der Nockenwelle befindet, und von denen ein zweiter Satz (12) auf der gegenüberliegenden Seite der Ebene angeordnet ist, welche Zugbolzenschäfte in entsprechenden Bohrungen (14) des Körpers liegen, während die Köpfe (16) der Zugbolzen in entsprechenden Sitzen (17) des Körpers liegen, wobei die Sitze (17) für die Köpfe der Zugbolzen des ersten Satzes unterhalb der Nockenwellenachse liegen, welcher Körper eine erste, flache, geneigte Oberfläche (21) aufweist, die die Nockenwellenachse (4) enthält und einen Winkel von 0° bis 90° in bezug auf die Ebene (5) bildet, die die Maschinenzylinderachsen enthält, und auf der eine entsprechende flache Oberfläche (22) des Deckels (10) ruht, wobei Paare der Zugbolzen (11, 12) der beiden Sätze in Ebenen senkrecht zu der Ebene (5) angeordnet sind, die die Zylinderachsen enthält, dadurch gekennzeichnet, daß jeder der Sitze (17) für die Köpfe der Zugbolzen des ersten Satzes (11) eine Bohrung ist, die durch eine zylindrische seitliche Oberfläche (19) begrenzt ist, wobei die Ebenen, in denen die Paare der Zugbolzen der beiden Sätze liegen, den jeweiligen ersten Bereich (7) der Gleitlager schneiden und der Abstand zwischen der Nockenwellen-Oberfläche (6) und dem Schnittpunkt der Erzeugenden der zylindrischen seitlichen Oberfläche (19), die der Ebene (5) am nächsten ist, die die Zylinderachsen enthält, und der ersten flachen geneigten Oberfläche (21) folgende Beziehung erfüllt:

$$\sin \alpha = \frac{d}{r + s}$$

in welcher α der Winkel zwischen der ersten geneigten Oberfläche (21) und der Ebene (5),

d der Abstand zwischen der Erzeugenden und der Achse (4) der Nockenwelle (3),

r der Radius der Nockenwelle und

der Abstand d gleich oder kleiner als der Radius r der Nockenwelle ist.

2. Zylinderkopf nach Anspruch 1, dadurch gekennzeichnet, daß jeder der Deckel (10) an dem Körper mit Hilfe von Paaren von Befestigungsgliedern (23) befestigt ist, die einen Schaft aufweisen, der in Bohrungen des Körpers eingeführt ist, wobei die Glieder jedes Paares in einer der Ebenen angeordnet sind, die senkrecht zu den Ebenen (5) auf gegenüberliegenden Seiten der Nockenwelle (3) verlaufen, welche Zugbolzen (11) des ersten Satzes angeordnet sind zwischen der Nockenwelle (3) und den ersten Befestigungsgliedern, die sich auf einer Seite der Nockenwelle befinden.

3. Zylinderkopf nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß in jedem Deckel (10) Durchgangsbohrungen (25) angeordnet sind, deren Achsen mit den Achsen eines der Zugbolzen (11) des ersten Satzes zusammenfallen und deren Durchmesser so gewählt ist, daß ein Schlüssel eingeführt werden kann, der mit dem Kopf (16) des entsprechenden Zugbolzens zusammenwirken kann, so daß der Zugbolzen eingeschraubt und in seiner Festigkeit eingestellt werden kann.

4. Zylinderkopf nach Anspruch 3, dadurch gekennzeichnet, daß die Höhe jedes Sitzes (17) für die Köpfe (16) der Zugbolzen (11) des ersten Satzes im wesentlichen gleich der Höhe des Kopfes (16) des jeweiligen Zugbolzens ist.

5. Zylinderkopf nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Höhe des Sitzes (17) der Köpfe (16) der Zugbolzen (11) des ersten Satzes mindestens gleich der Summe der Höhe des Kopfes (16) des jeweiligen Zugbolzens und der Länge des Gewindebereichs des Zugbolzens ist, der in die entsprechende Bohrung des Kurbelgehäuses eingeschraubt ist, so daß der Zylinderkopf von dem Kurbelgehäuse ohne Trennung des Deckels von dem Körper entfernt werden kann.

Revendications

1. Culasse de moteur à combustion interne (1) sur laquelle tourne un arbre à cames (3) pour commander les soupapes dudit moteur et dont l'axe (4) est disposé sur un premier côté du plan (5) contenant les axes des cylindres du moteur, ledit arbre à cames étant supporté par des paliers lisses comportant chacun une première partie (7) formée sur le corps (8) de ladite culasse et une seconde partie (9) formée au moins sur un chapeau (10) fixé audit corps, ledit corps étant fixé au carter du moteur par deux jeux (11, 12) de tirants dont les tiges filetées sont vissées dans ledit carter et dont un premier jeu (11) est disposé sur ledit côté du plan (5) contenant les axes des cylindres et sur lequel est disposé ledit axe (4) de l'arbre à cames et dont le second jeu (12) est disposé sur le côté opposé dudit plan, lesdites tiges des tirants étant logées dans des alésages correspondants (14) dudit corps et les têtes (16) desdits tirants étant logées dans des sièges correspondants (17) ménagés dans ledit corps, chacun desdits sièges (17) pour les têtes des tirants dudit premier jeu étant placé au-dessous dudit axe de l'arbre à cames, ledit corps présentant une première surface plane inclinée (21) qui contient l'axe (4) de l'arbre à cames et forme un angle compris entre 0° et 90°

avec ledit plan (5) contenant les axes des cylindres du moteur, et sur laquelle une surface plane correspondante (22) dudit chapeau (10) repose, et des couples de tirants (11, 12) desdits deux jeux étant disposés dans des plans qui sont perpendiculaires audit plan (5) contenant les axes des cylindres, caractérisée en ce que chacun desdits sièges (17) pour les têtes des tirants dudit premier jeu (11) est un alésage défini par une surface latérale cylindrique (19), et lesdits plans dans lesquels sont disposés lesdits couples de tirants desdits deux jeux coupent ladite première partie respective (7) desdits paliers lisses, et la distance s entre la surface (6) de l'arbre à cames et le point d'intersection de la génératrice de ladite surface latérale cylindrique (19) qui est la plus proche dudit plan (5) contenant les axes des cylindres et de ladite première surface inclinée plane (21) satisfait la relation:

$$\sin \alpha = \frac{d}{r + s}$$

dans laquelle α est l'angle formé par ladite première surface inclinée (21) avec ledit plan (5),

d est la distance entre ladite génératrice et l'axe (4) dudit arbre à cames (3), et

r est le rayon de l'arbre à cames, et

dans laquelle ladite distance d est égale ou inférieure au rayon r dudit arbre à cames.

2. Culasse selon la revendication 1, caractérisée en ce que chacun desdits chapeaux (10) est fixé audit corps par des couples d'éléments (23) de fixation munis de tiges insérées dans des alésages dudit corps, les éléments de chaque couple étant disposés dans l'un desdits plans qui sont perpendiculaires audit plan (5) sur des côtés opposés dudit arbre à cames (3), lesdits tirants (11) dudit premier jeu étant disposés entre ledit arbre à cames (3) et lesdits éléments de fixation situés sur un premier côté dudit arbre à cames.

3. Culasse selon les revendications 1 ou 2, caractérisée en ce que chaque chapeau (10) est traversé par des alésages (26) ayant chacun son axe en coïncidence avec l'axe de l'un desdits tirants (11) dudit premier jeu, le diamètre dudit alésage étant choisi de façon qu'il soit possible d'y insérer une clé pouvant coopérer avec la tête (16) du tirant correspondant afin de visser le tirant et de régler son serrage.

4. Culasse selon la revendication 3, caractérisée en ce que la hauteur de chacun desdits sièges (17) pour les têtes (16) des tirants (11) dudit premier jeu est sensiblement égale à la hauteur de la tête (16) du tirant correspondant.

5. Culasse selon l'une des revendications précédentes, caractérisée en ce que la hauteur de chacun desdits sièges (17) pour les têtes (16) des tirants (11) dudit premier jeu est au moins égale à la somme de la hauteur de la tête (16) du tirant correspondant et de la longueur du tronçon fileté du tirant qui est vissé dans le trou taraudé correspondant du carter, afin qu'il soit possible d'enlever ladite culasse dudit carter sans retirer ledit chapeau dudit corps.

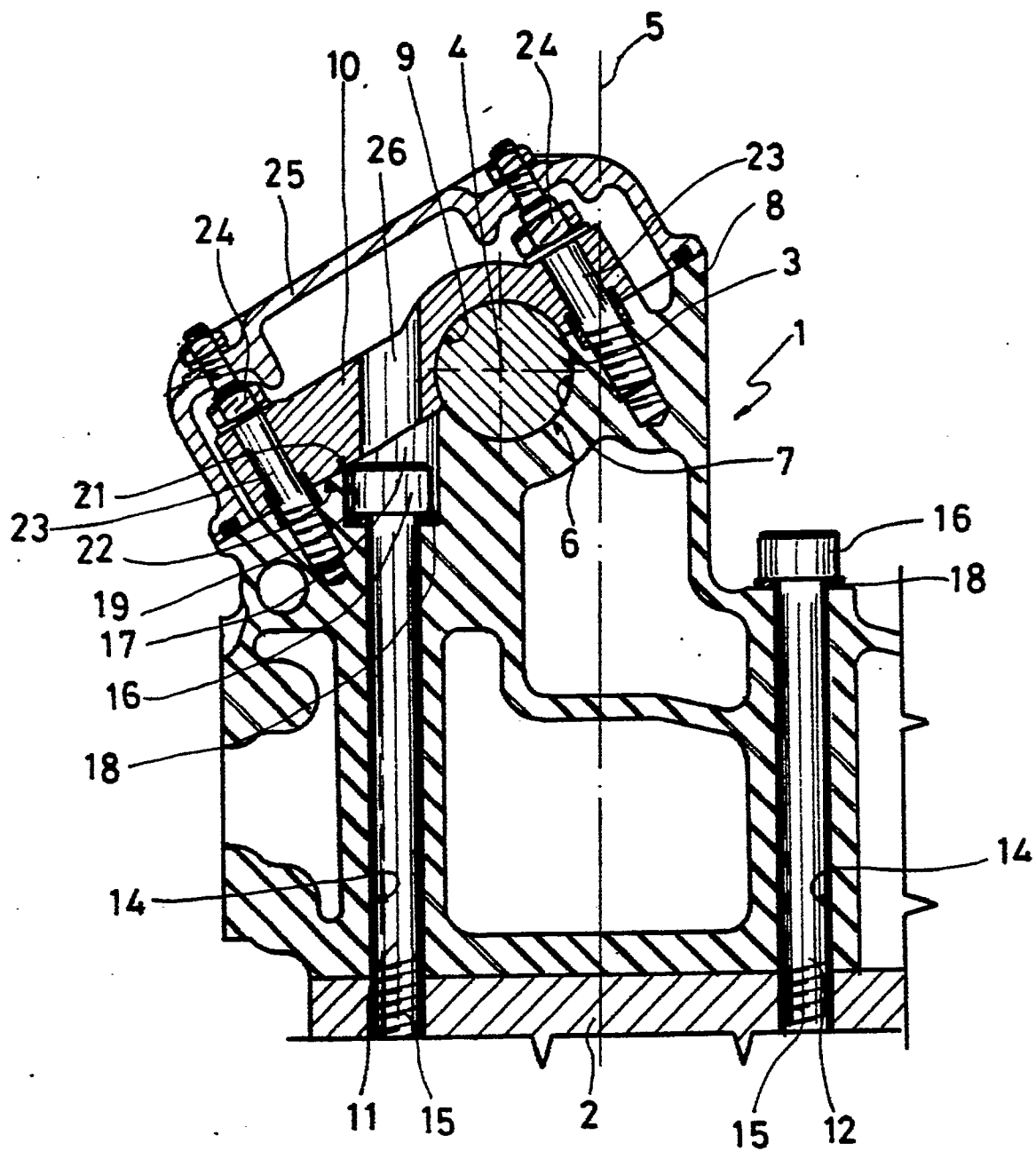


Fig.1

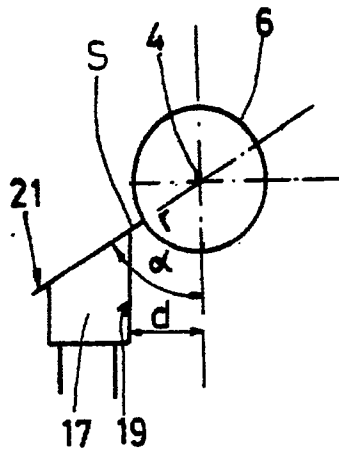


Fig. 2

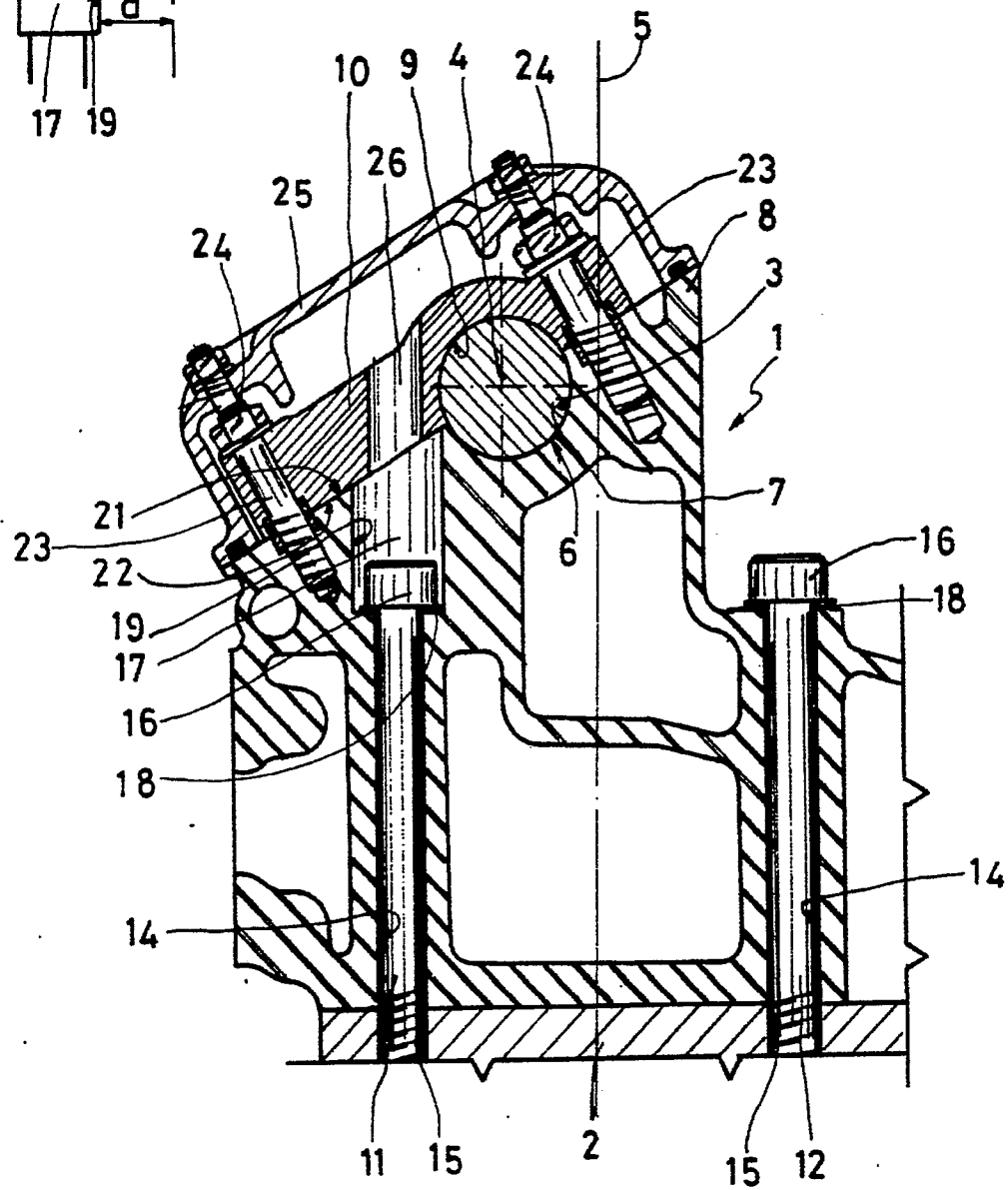


Fig. 3