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(54) **Internal combustion engine**

Brennkraftmaschine

Moteur à combustion interne

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(56) References cited:
EP-A- 0 499 601 **DE-C- 4 116 942**
GB-A- 2 216 187 **US-A- 4 957 079**

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Description

This invention relates to an internal combustion engine and more particularly to an improved lubrication system for the camshaft bearings of an overhead cam internal combustion engine, according to the preamble of claim 1 (GB-A-2216187).

The advantages of overhead camshaft internal combustion engines are well-known. However, because of the complexity of the cylinder head assembly attendant to overhead cam engines, there are some difficulties in designing and laying out the various components of the engine. For example, it is generally the practice to journal the camshaft or camshafts in bearing surfaces formed by the cylinder head assembly and bearing caps that are affixed to the cylinder head assembly. The fasteners for the bearing caps obviously pass through the cylinder head on opposite sides of the bearing surfaces. In addition, there is the placement of the valves, the porting for the engine and the cylinder head hold down bolts themselves all are in the same general area.

Therefore, in order to deliver lubricant to the bearing surfaces, rather complex structures have been employed. In accordance with one method, the main oil gallery is actually formed by a drilling through the camshaft. This has a number of disadvantages.

It has been proposed, therefore, to supply the bearing surfaces from a main oil gallery that is formed directly in the cylinder head. Normally, this is done by providing a longitudinal drilling through the cylinder head which serves as the main oil gallery for the camshaft bearings. Lubricant is delivered to this main gallery from the cylinder block in a variety of fashions.

It is obvious that the main gallery drilling with the prior art type of constructions have been located in such a way so as not to intersect the cylinder head passages and ports, the hold down openings for both the cam bearing caps or the cylinder head hold down fasteners, etc. As a result, it has been generally the practice to drill this main oil gallery in an area below the holes in the cylinder head that receive the bearing cap fasteners. This main gallery is then intersected by cross drillings that extend from the cylinder head bearing surfaces to the main gallery. This results in rather difficult drilling operations and relatively long passage.

Therefore, it is an objective of the present invention to provide an internal combustion engine having an improved lubricating system for the camshaft bearing surfaces of an overhead camshaft internal combustion engine.

More particularly, this invention aims to provide an improved overhead camshaft engine comprising a main oil gallery wherein the supply passages from the main oil gallery to the bearing surfaces can be kept quite short and wherein the drilling of the various passages is facilitated without interference from other components.

In order to perform said objective, the present invention provides an internal combustion engine accord-

ing to claim 1.

Preferred embodiments of the present invention are laid down in the further subclaims.

In the following, the present invention is explained in greater detail by means of a preferred embodiment thereof, in conjunction with the accompanying drawings, wherein:

Figure 1 is a cross-sectional view taken through a cylinder head of an internal combustion engine constructed in accordance with an embodiment of the invention and generally along the line 1-1 of Figure 2,

Figure 2 is a bottom plan view of a portion of the cylinder head of the engine, and

Figure 3 is a top plan view of the cylinder head assembly, with the bearing caps removed and the bearing cap hold down fastener shown in section.

Referring now in detail to the drawings, a portion of an internal combustion engine constructed in accordance with an embodiment of the invention is illustrated and is identified generally by the reference numeral 11. The invention deals primarily with the cylinder head assembly of the engine 11, which cylinder head assembly is indicated generally by the reference numeral 12, and for this reason it is not believed to be necessary to illustrate the associated cylinder block having the cylinder bores, pistons etc., as is well known in this art. Also, the invention is shown primarily in conjunction with a single cylinder of the engine and it is believed that those skilled in the art will readily understand how the invention can be practiced with multi-cylinder engines. Again, the cylinder head assembly 12 is designed so as to have plurality of aligned cylinders and this may be employed either with an in-line type engine or as the cylinder head for one bank of an engine having angularly disposed cylinder banks.

The cylinder head assembly 12 is comprised of a main cylinder head casting having a lower surface 13 that is adapted to be affixed in sealing engagement with a cylinder block by means of threaded fasteners that pass through hold down bolt holes 14 formed at spaced locations around the cylinder bores of the associated cylinder block. The bolt holes 14 may either pass studs that accommodate nuts to hold the cylinder head assembly 12 to the cylinder block or may pass bolts.

The lower sealing surface 13 of the cylinder head 12 is provided with a recess 15 which cooperates with each cylinder bore to form with the cylinder bore and the heads of the associated pistons the combustion chambers of the engine.

An intake charge is delivered to these combustion chambers by means of an induction system that is comprised of a pair of intake passages 16 and 17 which extend through one side of the cylinder head assembly

12 from a surface 18 that is adapted to receive an intake manifold (not shown) for delivering a charge to the intake passages 16 and 17.

In the illustrated embodiment, the engine 11 is of the five valve type and the intake passage 16 is a siamesed type and serves a pair of valve seats 19 and 21 which are received in a suitable manner in the cylinder head 12 in the area of the combustion recess 15. The intake passage 17 serves a further valve seat 22 which also is formed by an insert in the remaining portion of the combustion chamber recess 15. Although the invention is described in conjunction with an engine having three intake valves with two served by the same intake passage, it should be readily apparent to those skilled in the art that the invention may be employed in conjunction with engines having other number of valves and other types of induction passages. However, the invention does have particular application in multiple valve engines because of their complexity.

In the illustrated embodiment, the diameter of the intake valve seats 19 and 22 is set equal to each other while the diameter of the intake valve seat 21 is smaller. This permits the centres of the intake valve seats 19 and 21 B-B to lie on a line L that extends parallel to a plane containing the cylinder bore axis and the axis of rotation of the crankshaft of the engine. The outer periphery of the intake valve seat 21 lies outside of this plane L as clearly shown in Figure 2. This also permits the peripheral edge of the intake valve seat 21 to be spaced farther from the cylinder bore than the intake valve seats 19 and 21 as also shown in this figure wherein the circle 23, which forms the periphery of the combustion chamber recess 15 also is coincident with the cylinder bore of the associated cylinder block. To provide a compact structure of intake valve operation the distance of the axis of the intake camshaft 32 from a parallel vertical plane containing the cylinder bore axis 0 is smaller than the distance of the rotational axis of an exhaust camshaft 63.

Intake valves 24, 25 and 26 have their head portions cooperating with the valve seats 19, 21 and 22, respectively, so as to control the flow through the intake passages 16 and 17. The stems of the intake valves 24, 25 and 26 are slidably supported within respective valve guides 27 that are pressed into the cylinder head 12. The intake valves 24, 25 and 26 reciprocate of the remaining intake valve 25. These planes intersect at the axis of rotation of the associated intake cam shaft, as will be described. It should also be noted that the outer peripheral edge of the head of the intake valve 25 lies on the outside of the plane L.

Each intake valve 24, 25 and 26 is urged to its closed position by means of a respective coil compression spring 28 loaded between the cylinder head 12 and a keeper retainer assembly 29 fixed to the upper end of the respective valve stem. A thimble tappet 31 is received over and engages the keeper retainer 29 or an adjusting shim for opening the intake valves 24, 25 and

26 by means of an overhead mounted intake cam shaft 32. The thimble tappets 31 are slidably supported within bores 33 formed by a projecting boss portion 34 of the cylinder head assembly 12.

The intake camshaft 32 has three cam lobes, one for each thimble tappet 29 associated with the respective intake valves 24, 25 and 26, these cam lobes being indicated by the reference numerals 35, 36 and 37, respectively. Between these lobes the cam shaft 32 is provided with a pair of bearing surfaces 38 and 39 with the bearing surface 38 being formed between the cam lobes 35 and 36 and the bearing surface 39 being formed between the cam lobes 36 and 37.

Bearing surfaces 41 and 42 are formed integrally with the cylinder head 12 and cooperate with these camshaft bearing surfaces 38 and 39 for rotatable journaling for the intake camshaft 32 is completed by means of bearing caps, indicated generally by the reference numeral 43 and which are comprised of beam portions 44 which may be formed as separate pieces or as a combined bearing cap and which have surfaces which are complementary to the camshaft bearing surfaces 38 and 39, respectively. These bearing caps 44 are held in place by threaded fasteners 45 which have lower ends that are received in threaded openings 46 formed in the cylinder head 12 on opposite sides of the bearing surfaces 42. These openings 46 are formed below counter-bored portions 47 that receive pilot sleeves 48 for aligning the bearing caps 44. These counter bores 47 also serve another purposes as will be noted.

The intake camshaft 32 is driven from the crankshaft of the engine by any known type of camshaft drive at one-half engine speed, as is well known in the art.

A spark plug, indicated generally by the reference numeral 49 is supported within a well 51 formed in the cylinder head 12 as part of the boss 34. The spark plug 49 has its spark terminals disposed substantially in line with the cylinder bore axis 0 as shown in Figure 2 and extends into the combustion chamber recess 15 of the cylinder head. The spark plug 49 is fired by any suitable type of ignition system and is disposed inclined toward the exhaust camshaft 63.

A siamesed exhaust passage 52 is formed on the side of the cylinder head 12 opposite the intake passages 16 and 17. The exhaust passage 52 extends from a pair of exhaust valve seats 53 and 54 which are formed by pressed in inserts in the cylinder head assembly 12. These exhaust valve seats 53 and 54 lie on the side of a plane containing the cylinder bore axis 0 opposite from the intake valve seats 19, 21 and 22.

Exhaust valves 55 and 56 have head portions that cooperate with the valve seats 53 and 54, respectively. These exhaust valves 55 and 56 have their stem portions slidably supported within valve guides 57 that are pressed or otherwise secured in the cylinder head 12. The valve guides 57 define reciprocal axis for the exhaust valves 55 and 56 which lie in a common plane that is disposed at an acute angle to the aforementioned plane

containing the axis of the cylinder bore 0. This acute angle is less than the acute angle of the intake valves 24 and 26 and greater than the acute angle of the intake valve 25.

Coil compression springs 58 are received around the stems of the exhaust valves 55 and 56 and operate against keeper retainer assemblies 59 affixed to the upper ends of the valve stems and the cylinder head for urging the exhaust valves 55 and 56 to their closed positions.

Thimble tappets 61 are slidably supported within bores 62 formed in the cylinder head 12 and specifically the boss 34 for actuation of the exhaust valves 55 and 56. The exhaust camshaft 63 is journaled in the cylinder head assembly 12 in a manner to be described and has a pair of cam lobes 64 and 65 that actuate the thimble tappets 61 associated with the exhaust valves 55 and 56, respectively, for opening and closing them in a well-known manner. The exhaust camshaft 63, like the intake camshaft 39, is driven any suitable manner at one half crankshaft speed.

The exhaust camshaft 63 is formed with bearing surfaces 66 disposed between the cam lobes 64 and 65 for each cylinder and which are journaled in bearing surfaces 67 formed in the cylinder head 12. Bearing caps 68 have bridge portions 69 which define bearing surfaces that cooperate with the camshaft bearing surface 66 and a cylinder head bearing surface 71 for rotatably journaling the exhaust camshaft 63.

The bearing caps 68 are held in position by threaded fasteners (cap bolts) 72 which have their lower ends received within tapped openings formed in the cylinder head 12 similar to the tapped openings that receive the threaded fasteners (cap bolts) 45 of the intake camshaft bearing caps 43. Like those threaded openings, a counterbore 73 is provided above the threaded portion that receives a bushing 74 for locating the exhaust camshaft bearing cap 68. In addition, this bore 73 forms a further function, which will now be described.

In accordance with an important feature of the invention, the engine 11 is provided with a system for lubricating the camshaft bearings and this system includes a pair of main oil galleries comprised of an intake camshaft oil gallery 75 and an exhaust camshaft oil gallery 76. These galleries 75 and 76 are formed by drilling longitudinally extending passages through the cylinder head 12 at a location disposed outwardly of the intake and exhaust camshaft cylinder head bearing surfaces 42 and 71, and at a level that is substantially at the same level as the lower portion of these bearing surfaces. These drillings 75 and 76 are disposed outwardly of the bearing cap hold down fasteners 45 and 72, respectively, and positioned above the threaded area of the cylinder head in which these fasteners are received. As may be seen clearly from Figures 1 and 2, this positions the main oil gallery 75 and 76 in close proximity to the respective cylinder head bearing surfaces 42 and 71.

The main oil galleries 75 and 76 are drilled from one

end of the cylinder head 12 and then these drillings are closed by plugs (not shown). The other ends of the drillings 75 and 76 are blind and hence closed by the cylinder head 12 itself.

There is provided a transversely extending drilling 77 across the cylinder head from the exhaust side to the intake side and which terminates at a point axially aligned with the intake camshaft main oil galleries 75 and 76. The outer end of this drilling 77 is closed by a plug 78.

The drilling 77 is intersected by a vertically extending drilling (not shown) that extends from the cylinder head lower sealing surface 13 up to the drilling 77. This drilling intersects an oil delivery passage formed in the adjacent cylinder block and which receives oil from the cylinder block lubrication system in any well-known manner.

A pair of vertically extending drillings 79 and 81 are formed at a suitable place along the length of the cylinder head 12 for connecting the main oil gallery 75 and 76 to the cross drilling 77 so that the main oil gallery 75 and 76 for the camshafts 32 and 63 will be supplied with pressurized oil from the cylinder block lubrication system. The upper ends of the drilling 79 are closed by plugs.

A plurality of drilled passages 82 and 83 extend from the cylinder head camshaft bearing surfaces 42 and 71 to the main oil gallery 75 and 76, respectively. These drillings 82 and 83 intersect the counterbores 47 and 73 formed in the cylinder head which receive the locating bushings 48 and 74 and are closed at the upper end thereby. Thus, the counter bores 47 and 73 form a portion of the oil passage which connects the main gallery 75 and 76 to the bearing surfaces 42 and 71. This permits a very easy drilling operation for forming these passages and very short runs between the main oil gallery 75 and 76 and the lubricated surfaces.

As will be readily apparent from Figure 1, the different inclination of the intake valves 24, 25 and 26 from a vertical axis than those of the exhaust valves 54 and 55 dictates that the intake camshaft 39 has its rotational axis closer to a plane containing the axis of the cylinder bore 0 than that of the exhaust camshaft 66. Therefore, the spark plugs 49 are mounted in the cylinder head 12 so that there spark gaps is disposed generally on the cylinder bore axis 0, but the spark plugs are inclined from the vertical toward the exhaust side of the cylinder head 12. This facilitates the positioning of the main oil gallery 75 for the intake camshaft 39.

The cam chamber containing the camshafts 32 and 63 and bearing caps 43 and 68 is closed by a cam cover 85 which carries a sealing gasket 86 in its lower end that sealingly engages an outer peripheral edge 87 of the cylinder head 12.

It should be readily apparent from the foregoing description that the described lubricating system is very effective in providing adequate lubrication for the camshafts of an overhead camshaft engine with a minimum

amount of machining operations and without interfering with any of the other components of the engine or of the cylinder head assembly.

Claims

1. Internal combustion engine comprising a cylinder head (12) defining at least a pair of spaced apart bearing surfaces (41,42;67) for journaling corresponding bearing surfaces (38,39;66) of at least one camshaft (32,63) to operate at least one intake and/or exhaust valve (24,25,26;55,56), bearing cap means (43;68) defining bearing surfaces cooperating with said cylinder head bearing surfaces (41,42;67) for journaling the camshaft, cap bolts (45,72) accommodated in hold down openings (46,47;73) formed in said cylinder head (12) for affixing said bearing cap means (43,68) to said cylinder head (12) and a lubricating system for said overhead camshaft (32,63) comprising at least one main oil gallery (75,76) formed in said cylinder head (12) and extending along one side of said bearing surface (41,42;67) and supply passages (82,83) connecting said main oil gallery (75,76) to the bearing surfaces (41,42;62), **characterised** in that said supply passages (82,83) are partially formed by said hold down openings (46,47;73) receiving said fastening cap bolts (45,72) therein, and in that said supply passages (82,83) cross the laterally outwardly disposed hold down opening (47,73) surrounding the associated cap bolt (45,72) with an annular space in between the cap bolt (45,72) and the surrounding wall of the hold down openings (46,47,73).
2. Internal combustion engine as claimed in claim 1, **characterised in that**, the main oil gallery (75,76) is formed by a drilled passage extending longitudinally of the cylinder head (12).
3. Internal combustion engine as claimed in claim 1 or 2, **characterised in that**, the supply passages (82,83) are formed by cross drillings intersecting the drilling of the main oil gallery (75,76).
4. Internal combustion engine as claimed in at least one of the preceeding claims 1 to 3, **characterised in that**, the supply passages (82,83) are formed by inclined cross drillings intersecting the vertical hold down openings (46,47;73) accommodating the cap bolts (45,72) for fastening the bearing caps (43,68) to the cylinder head (12).
5. Internal combustion engine as claimed in at least one of the preceeding claims 1 to 4, **characterised in that**, the supply passages (82,83) are formed as drillings extending through the cylinder head (12)

from the bearing surfaces (41,42;67) to the main oil gallery (75,76).

6. Internal combustion engine as claimed in at least one of the preceeding claims 1 to 5, **characterised in that**, the main oil gallery (75,76) is disposed outwardly of the hold down openings (46,47;73) for passing the cap bolts (45,72) for affixing the bearing caps to the cylinder head (12).
7. Internal combustion engine as claimed in at least one of the preceeding claims 1 to 6, **characterised in that**, the main oil gallery (75,76) is formed adjacent an outer peripheral side of the cylinder head (12).
8. Internal combustion engine as claimed in at least one of the preceeding claims 1 to 7, **characterised in that**, the hold down openings (46,47;73) accommodating the cap bolts (45,72) for affixing the bearing caps (43,68) to the cylinder head (12) are disposed at opposite sides of the camshaft (32,63).
9. Internal combustion engine as claimed in at least one of the preceeding claims 1 to 8, **characterised in that**, the main oil gallery (75,76) extends substantially at the level of a unthreaded/threaded transitional area of the cap bolt receiving opening (47,73).
10. Internal combustion engine as claimed in at least one of the preceeding claims 1 to 9, **characterised in that**, the cylinder head (12) comprises first and second pairs of spaced apart bearing surfaces (41,42;67) for journaling corresponding bearing surfaces (38,39;66) of first and second camshafts (32,63) and further including first and second main oil galleries (75,76) formed in the cylinder head (12) and extending along the one side of said first and second bearing surfaces (41,42;67) and that first and second series of supply passages (82,83) extend from said first and second pairs of bearing surfaces (41,42;67) to said first and second main oil galleries (75,76) intersecting the cap bolt accommodating holes (47,73) of the first and second bearing cap means (43,68) wherein said first and second main oil galleries (75,76) communicate to each other through a cross bore (77) and vertical bore (79,81) and are connected to a common source of lubricating oil under pressure.
11. Internal combustion engine as claimed in claim 10, **characterised in that**, the opposite main oil galleries (75,76) are disposed outwardly of the respective bearing surfaces (41,42;67) and of the laterally outwardly disposed cap bolt accommodating holes (47,73), respectively.

12. Internal combustion engine as claimed in claim 11, **characterised in that**, the main oil galleries (75,76) are disposed adjacent to an upper surface of the cylinder head (12).

13. Internal combustion engine as claimed in at least one of the preceding claims 1 to 12, **characterised in that**, the one camshaft (32) is rotated about an axis defined by the bearing surfaces (41,42) that is closer to a vertical plane containing the axis (0) of the cylinder bore of an associated cylinder block than the rotational axis of the other camshaft (63), and that a spark plug (49) is supported within the cylinder head (12) and having a spark gap disposed substantially coincident to the cylinder bore axis (0), said spark plug (49) being inclined toward said other camshaft (63).

14. Internal combustion engine as claimed in at least one of the preceding claims 1 to 13, **characterised in that**, the main oil gallery is adapted to intersect a plurality of vertical bores receiving the cap bolts of the cap bearing means.

15. Internal combustion engine as claimed in at least one of the preceding claims 1 to 14, **characterised in that**, a plurality of threaded openings (14) are formed in the cylinder head (12) inwardly of the cap bolts (45,72) for receiving additional threaded fastening means for affixing the cylinder head (12) to an associated cylinder block.

Patentansprüche

1. Brennkraftmaschine mit einem Zylinderkopf (12), der mindestens ein Paar mit Abstand voneinander angeordneter Lagerflächen (41,42;67) bestimmt, um entsprechende Lagerflächen (38,39;66) mindestens einer Nockenwelle (32,63) zum Betreiben mindestens eines Einlaß- und/oder Auslaß-Ventils (24,25,26;55,56) zu lagern, mit Lagerdeckelmitteln (43; 68), welche mit den Zylinderkopf-Lagerflächen (41,42;67) zum Lagern der Nockenwelle zusammenwirkende Lagerflächen bestimmen, mit in Niederhalteöffnungen (46,47;73), welche in dem Zylinderkopf (12) zum Befestigen der Lagerdeckelmittel (43,68) an dem Zylinderkopf (12) vorgesehen sind, aufgenommenen Deckelschrauben (45,72), und mit einem Schmiersystem für die obenliegende Nockenwelle (32,63), das mindestens eine in dem Zylinderkopf (12) ausgebildete und sich längs einer Seite der Lagerfläche (41,42;67) erstreckende Hauptölbohrung (75,76) umfaßt, und mit Zuführkanälen (82,83), welche die Hauptölbohrung (75,76) mit den Lagerflächen (41,42;62) verbinden, **dadurch gekennzeichnet, daß** die Zuführkanäle (82,83) teilweise durch die Niederhalteöffnungen

(46,47;73) gebildet sind, welche die Deckelbefestigungsschrauben (45,72) in sich aufnehmen, und daß die Zuführkanäle (82,83) die seitlich nach außen versetzten Niederhalteöffnungen (47,73) kreuzen, welche die zugeordnete Deckelschraube (45,72) mit einem Ringraum zwischen der Deckelschraube (45, 72) und der umgebenden Wand der Niederhalteöffnungen (46, 47; 73) umgeben.

2. Brennkraftmaschine nach Anspruch 1, **dadurch gekennzeichnet, daß** die Hauptölbohrung (75,76) durch einen sich in Längsrichtung des Zylinderkopfs (12) erstreckenden gebohrten Kanal gebildet ist.

3. Brennkraftmaschine nach Anspruch 1 oder 2, **dadurch gekennzeichnet, daß** die Zuführkanäle (82, 83) durch Querbohrungen gebildet sind, welche die Hauptölbohrung (75, 76) überschneiden.

4. Brennkraftmaschine nach mindestens einem der vorangehenden Ansprüche 1 bis 3, **dadurch gekennzeichnet, daß** die Zuführkanäle (82,83) durch geneigte Querbohrungen gebildet sind, welche die vertikalen Niederhalteöffnungen (46,47;73) überschneiden, welche die Deckelschrauben (45,72) zum Befestigen der Lagerdeckel (43,68) an dem Zylinderkopf (12) aufnehmen.

5. Brennkraftmaschine nach mindestens einem der vorangehenden Ansprüche 1 bis 4, **dadurch gekennzeichnet, daß** die Zuführkanäle (82,83) als Bohrungen ausgebildet sind, welche sich von den Lagerflächen (41,72; 67) zu der Hauptölbohrung (75, 76) durch den Zylinderkopf (12) erstrecken.

6. Brennkraftmaschine nach mindestens einem der vorangehenden Ansprüche 1 bis 5, **dadurch gekennzeichnet, daß** die Hauptölbohrung (75,76) außerhalb der Niederhalteöffnungen (46, 47;75) zum Durchführen der Deckelschrauben (45, 72) zum Befestigen der Lagerdeckel an dem Zylinderkopf (12) angeordnet ist.

7. Brennkraftmaschine nach mindestens einem der vorangehenden Ansprüche 1 bis 6, **dadurch gekennzeichnet, daß** die Hauptölbohrung (75,76) einer Außenumfangsseite des Zylinderkopfes (12) benachbart ausgebildet ist.

8. Brennkraftmaschine nach mindestens einem der vorangehenden Ansprüche 1 bis 7, **dadurch gekennzeichnet, daß** die die Deckelschrauben (45,72) zum Befestigen der Lagerdeckel (43, 68) an dem Zylinderkopf (12) aufnehmenden Niederhalteöffnungen (46, 47; 73) an einander gegenüberliegenden Seiten der Nockenwelle (32, 63) angeordnet sind.

9. Brennkraftmaschine nach mindestens einem der vorangehenden Ansprüche 1 bis 8, **dadurch gekennzeichnet, daß** die Hauptölbohrung (75, 76) sich im wesentlichen an dem Niveau eines Übergangsbereiches von gewindefrei zu gewinde führend der die Deckelschraube aufnehmenden Öffnung (47, 73) erstreckt.

10. Brennkraftmaschine nach mindestens einem der vorangehenden Ansprüche 1 bis 9, **dadurch gekennzeichnet, daß** der Zylinderkopf (12) erste und zweite Paare von gegeneinander mit Abstand versehenen Lagerflächen (41, 42; 67) zum Lagern entsprechender Lagerflächen (38, 39; 66) erster bzw. zweiter Nockenwellen (32, 63) umfaßt und weiter erste und zweite Hauptölbohrungen (75, 76) enthält, die in dem Zylinderkopf (12) ausgebildet sind und sich längs der einen Seite der ersten bzw. zweiten Lagerflächen (41, 42; 67) erstrecken, und daß erste und zweite Reihen von Zuführkanälen (82, 83) sich von den ersten bzw. zweiten Paaren von Lagerflächen (41, 42; 67) zu den ersten bzw. zweiten Hauptölbohrungen (75, 76) erstrecken und die Deckelschrauben-Aufnahmeöffnungen (42, 73) des ersten und des zweiten Lagerdeckelmittels (43, 68) überschneiden, worin die erste und die zweite Hauptölbohrung (75, 76) miteinander durch eine Querbohrung (77) und Vertikalbohrung (79, 81) in Verbindung und an einer gemeinsamen Quelle für unter Druck stehendes Schmieröl angeschlossen sind.

11. Brennkraftmaschine nach Anspruch 10, **dadurch gekennzeichnet, daß** die einander gegenüberliegenden Hauptölbohrungen (75, 76) außerhalb von den jeweiligen Lagerflächen (41, 42; 67) bzw. von den in Querrichtung außerhalb angeordneten Deckelschrauben-Aufnahmeöffnungen (47, 73) angeordnet sind.

12. Brennkraftmaschine nach Anspruch 11, **dadurch gekennzeichnet, daß** die Hauptölbohrungen (75, 76) zu einer oberen Fläche des Zylinderkopfs (12) benachbart angeordnet sind.

13. Brennkraftmaschine nach mindestens einem der vorangehenden Ansprüche 1 bis 12, **dadurch gekennzeichnet, daß** die eine Nockenwelle (32) um eine durch die Lagerflächen (41, 42) bestimmte Achse gedreht wird, die näher zu einer die Achse (O) der Zylinderbohrung eines zugeordneten Zylinderblocks enthaltenden Vertikalebene liegt als die Drehachse der anderen Nockenwelle (63), und daß eine Zündkerze (49) in dem Zylinderkopf (12) abgestützt ist und einen Funkenspalz besitzt, der im wesentlichen mit der Bohrungsachse (O) des Zylinders zusammenfallend angeordnet ist, welche Zündkerze (49) zu der anderen Nockenwelle (63) hin geneigt ist.

14. Brennkraftmaschine nach mindestens einem der vorangehenden Ansprüche 1 bis 13, **dadurch gekennzeichnet, daß** die Hauptölbohrung ausgelegt ist, eine Vielzahl von die Deckelschrauben des Lagerdeckelmittels aufnehmenden vertikalen Bohrungen zu überschneiden.

15. Brennkraftmaschine nach mindestens einem der vorangehenden Ansprüche 1 bis 14, **dadurch gekennzeichnet, daß** eine Vielzahl von Gewindeöffnungen (14) in dem Zylinderkopf (12) einwärts von den Deckelschrauben (45, 72) ausgebildet ist zur Aufnahme zusätzlicher Gewindebefestigungsmittel zum Befestigen des Zylinderkopfes (12) an einem zugehörigen Zylinderblock.

Revendications

1. Moteur à combustion interne, comprenant une culasse (12) définissant au moins un couple de surfaces porteuses (41, 42; 67) espacées l'une de l'autre, afin de supporter en rotation des surfaces porteuses (38, 39; 66) correspondantes d'au moins un arbre à cames (32, 63) afin d'actionner au moins une soupape d'admission et/ou d'échappement (24, 25, 26; 55, 56), un moyen formant capuchon porteur (43; 68) définissant des surfaces porteuses coopérant avec lesdites surfaces porteuses de culasse (41, 42; 67) afin de supporter en rotation l'arbre à cames, des boulons de capuchon (45, 72) logés dans des ouvertures de maintien (46, 47; 73) formées dans ladite culasse (12) afin de fixer ledit moyen formant capuchon porteur (43, 68) à ladite culasse (12) et un système de lubrification destiné audit arbre à cames en tête (32, 63) comprenant au moins un conduit d'huile principal (75, 76), formé dans ladite culasse (12) et s'étendant le long d'un côté de ladite surface porteuse (41, 42; 67), et des passages d'amenée (82, 83) reliant ledit conduit d'huile principal (75, 76) aux surfaces porteuses (41, 42; 62), caractérisé en ce que lesdits passages d'amenée (82, 83) sont partiellement formés par lesdites ouvertures de maintien (46, 47; 73) logeant en leur sein lesdits boulons de capuchon de fixation (45, 72), et en ce que lesdits passages d'amenée (82, 83) traversent l'ouverture de maintien (47, 73) disposée latéralement vers l'extérieur, entourant le boulon de capuchon (45, 72) associé, en laissant un espace annulaire entre le boulon de capuchon (45, 72) et la paroi environnante des ouvertures de maintien (46, 47, 73).

2. Moteur à combustion interne selon la revendication 1, caractérisé en ce que le conduit d'huile (75, 76) principal est formé par un passage percé s'étendant longitudinalement par rapport à la culasse (12).

3. Moteur à combustion interne selon la revendication 1 ou 2, caractérisé en ce que les passages d'amenée (82, 83) sont formés par des perçages transversaux coupant le perçage du conduit d'huile (75, 76) principal. 5
4. Moteur à combustion interne selon au moins l'une des revendications 1 à 3 précédentes, caractérisé en ce que les passages d'amenée (82, 83) sont formés par des perçages transversaux inclinés coupant les ouvertures de maintien (46, 47; 73) verticales, logeant les boulons de capuchon (45, 72) afin de fixer les capuchons porteurs (43, 68) à la culasse (12). 10
5. Moteur à combustion interne selon au moins l'une des revendications 1 à 4 précédentes, caractérisé en ce que les passages d'amenée (82, 83) sont réalisés sous la forme de perçages traversant la culasse (12) depuis les surfaces porteuses (41, 42; 67) jusqu'au conduit d'huile (75, 76) principal. 15
6. Moteur à combustion interne selon au moins l'une des revendications 1 à 5 précédentes, caractérisé en ce que le conduit d'huile (75, 76) principal est disposé vers l'extérieur des ouvertures (46, 47; 75) de maintien afin de faire passer les boulons de capuchon (75, 76) afin de fixer les capuchons porteurs à la culasse (12). 20
7. Moteur à combustion interne selon au moins l'une des revendications 1 à 6 précédentes, caractérisé en ce que le conduit d'huile (75, 76) principal est formé de manière adjacente à une face périphérique extérieure de la culasse (12). 25
8. Moteur à combustion interne selon au moins l'une des revendications 1 à 7 précédentes, caractérisé en ce que les ouvertures de maintien (46, 47; 73), logeant les boulons de capuchon (45, 72) afin de fixer les capuchons porteurs (43, 68) à la culasse (12), sont disposés sur des côtés opposés de l'arbre à cames (32, 63). 30
9. Moteur à combustion interne selon au moins l'une des revendications 1 à 8 précédentes, caractérisé en ce que le conduit d'huile (75, 76) principal s'étend sensiblement au niveau d'une zone de transition non filetée/filetée de l'ouverture de logement de boulons de capuchon (47, 73). 35
10. Moteur à combustion interne selon au moins l'une des revendications 1 à 9 précédentes, caractérisé en ce que la culasse (12) comprend des premier et deuxième couples de surfaces porteuses (41, 42; 67) espacées l'une de l'autre, afin de supporter en rotation des surfaces porteuses (38, 39; 66) correspondantes de premier et deuxième arbres à cames (32, 63) et comprenant en outre des premier et deuxième conduits d'huile (75, 76) principaux, formés dans la culasse (12) et s'étendant le long de la première face desdites premières et deuxième surfaces porteuses (41, 42; 67), et en ce que des première et deuxième séries de passages d'amenée (82, 83) s'étendent depuis lesdits premier et deuxième couples de surfaces porteuses (41, 42; 67) jusqu'aux dits premier et deuxième conduits d'huile (75, 76) principaux en coupant les trous de logement de boulons de capuchon (47, 73) des premier et deuxième moyens formant capuchons porteurs (43, 68) dans lequel lesdits premier et deuxième conduits d'huile (75; 76) principaux communiquent entre eux via un alésage transversal (77) et un alésage vertical (79, 81) et sont reliés à une source commune d'huile lubrifiante sous pression. 40
11. Moteur à combustion interne selon la revendication 10, caractérisé en ce que les conduits d'huile (75, 76) principaux opposés sont disposés respectivement à l'extérieur des surfaces porteuses (41, 42; 67) respectives et des trous de logement de boulons de capuchon (47, 73) disposés latéralement vers l'extérieur. 45
12. Moteur à combustion interne selon la revendication (11), caractérisé en ce que les conduits d'huile (75, 76) principaux sont disposés de manière adjacente à une surface supérieure de la culasse (12). 50
13. Moteur à combustion interne selon au moins l'une des revendications 1 à 12 précédentes, caractérisé en ce que le premier arbre à cames (32) est entraîné en rotation autour d'un axe défini par les surfaces porteuses (41, 42) qui est plus proche d'un plan vertical contenant l'axe (0) de l'alésage cylindrique d'un bloc de cylindres associés que l'axe de rotation de l'autre arbre à cames (63), et en ce qu'une bougie d'allumage (49) est montée dans la culasse (12) et présente un interstice d'allumage disposé de façon à coïncider sensiblement avec l'axe d'alésage cylindrique (0), ladite bougie d'allumage (49) étant inclinée vers ledit autre arbre à cames (63). 55
14. Moteur à combustion interne selon au moins l'une des revendications 1 à 13 précédentes, caractérisé en ce que le conduit d'huile principal est adapté de façon à couper une pluralité d'alésage verticaux logeant les boulons de capuchon des moyens formant capuchons porteurs. 60
15. Moteur à combustion interne selon au moins l'une des revendications 1 à 14 précédentes, caractérisé en ce qu'une pluralité d'ouvertures taraudées (14) est formée dans la culasse (12) vers l'intérieur des boulons de capuchon (45, 72), afin de loger des moyens de fixation filetés supplémentaires servant

à fixer la culasse (12) à un bloc cylindre associé.

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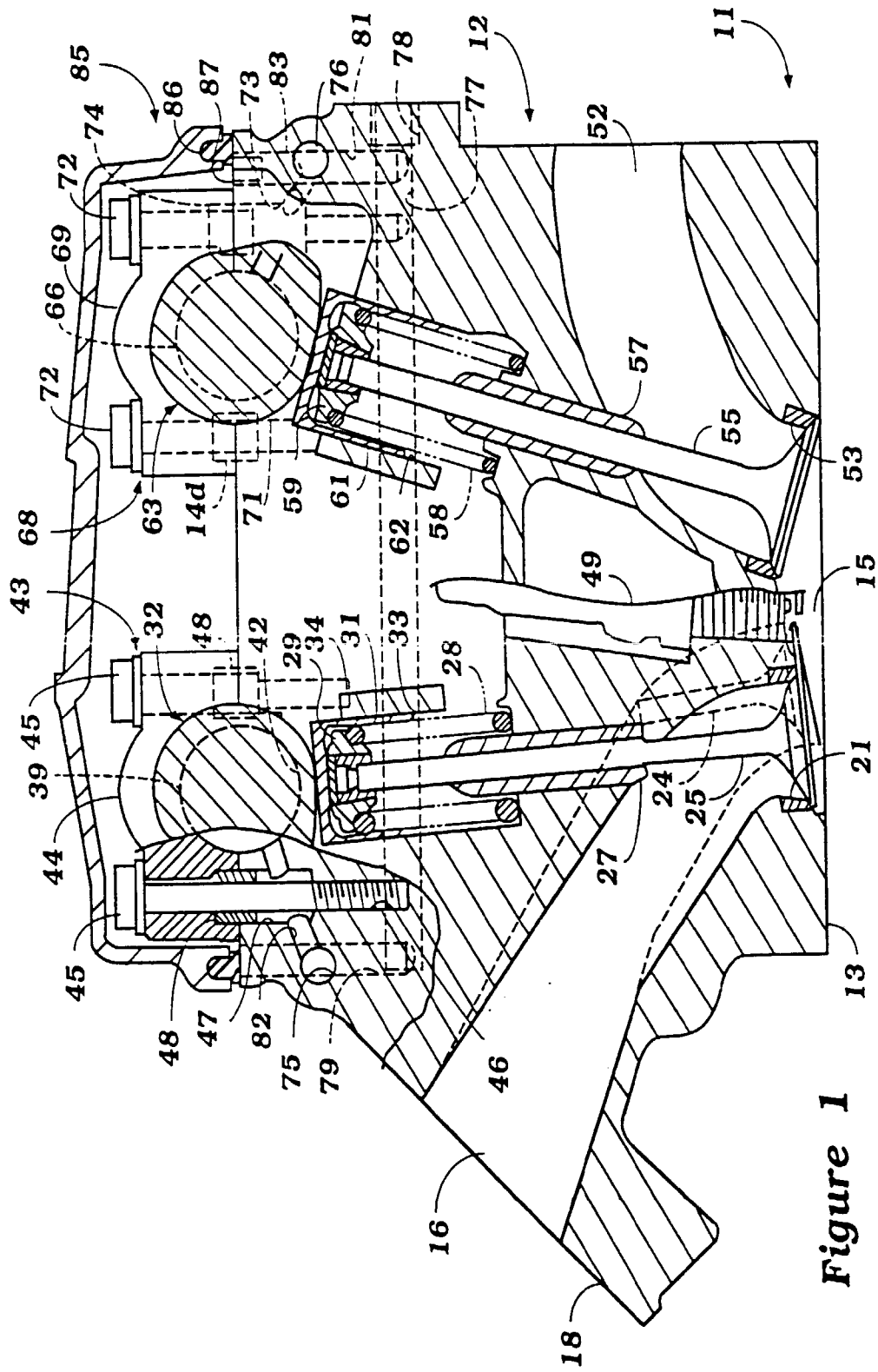


Figure 1

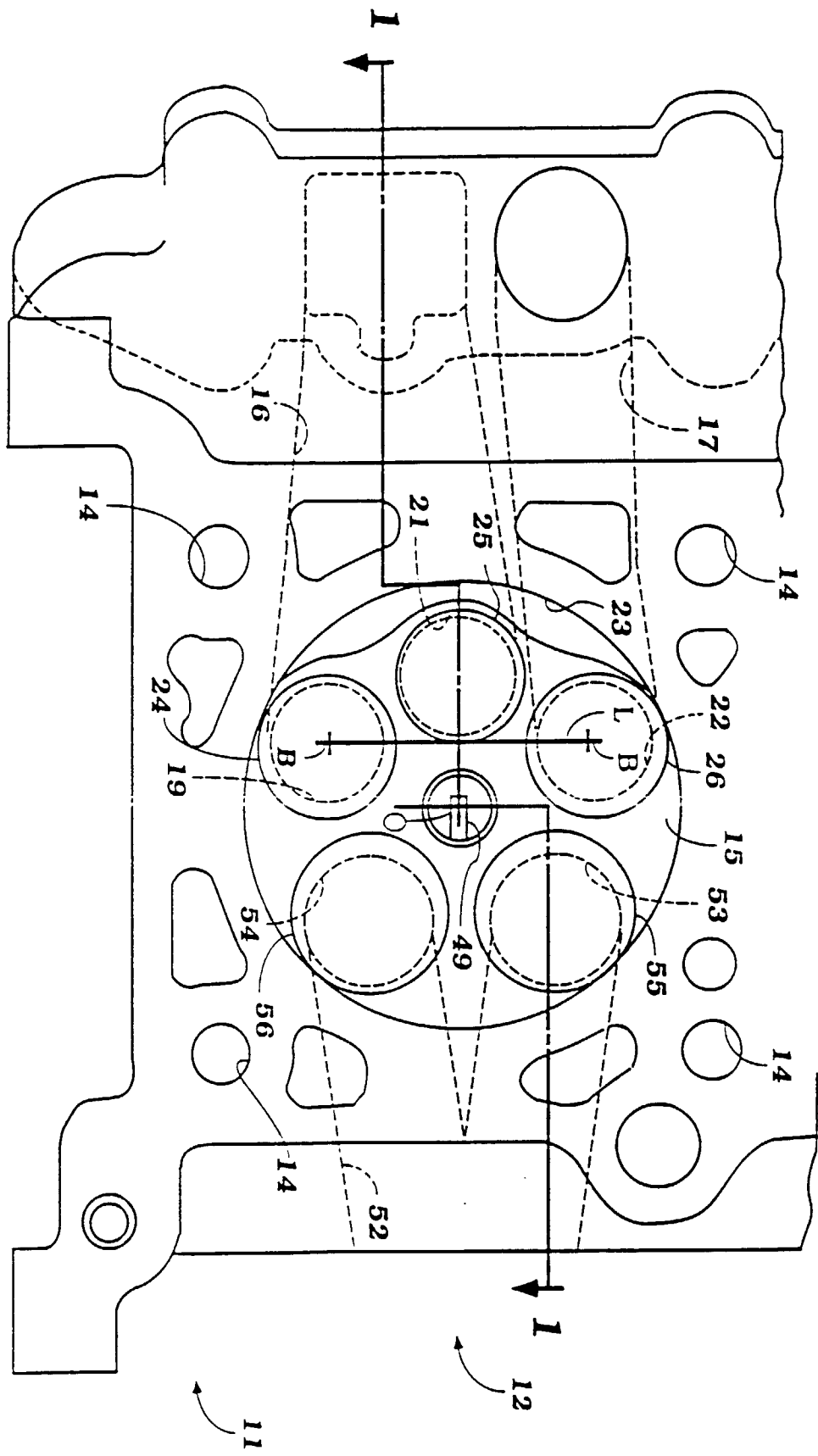


Figure 2

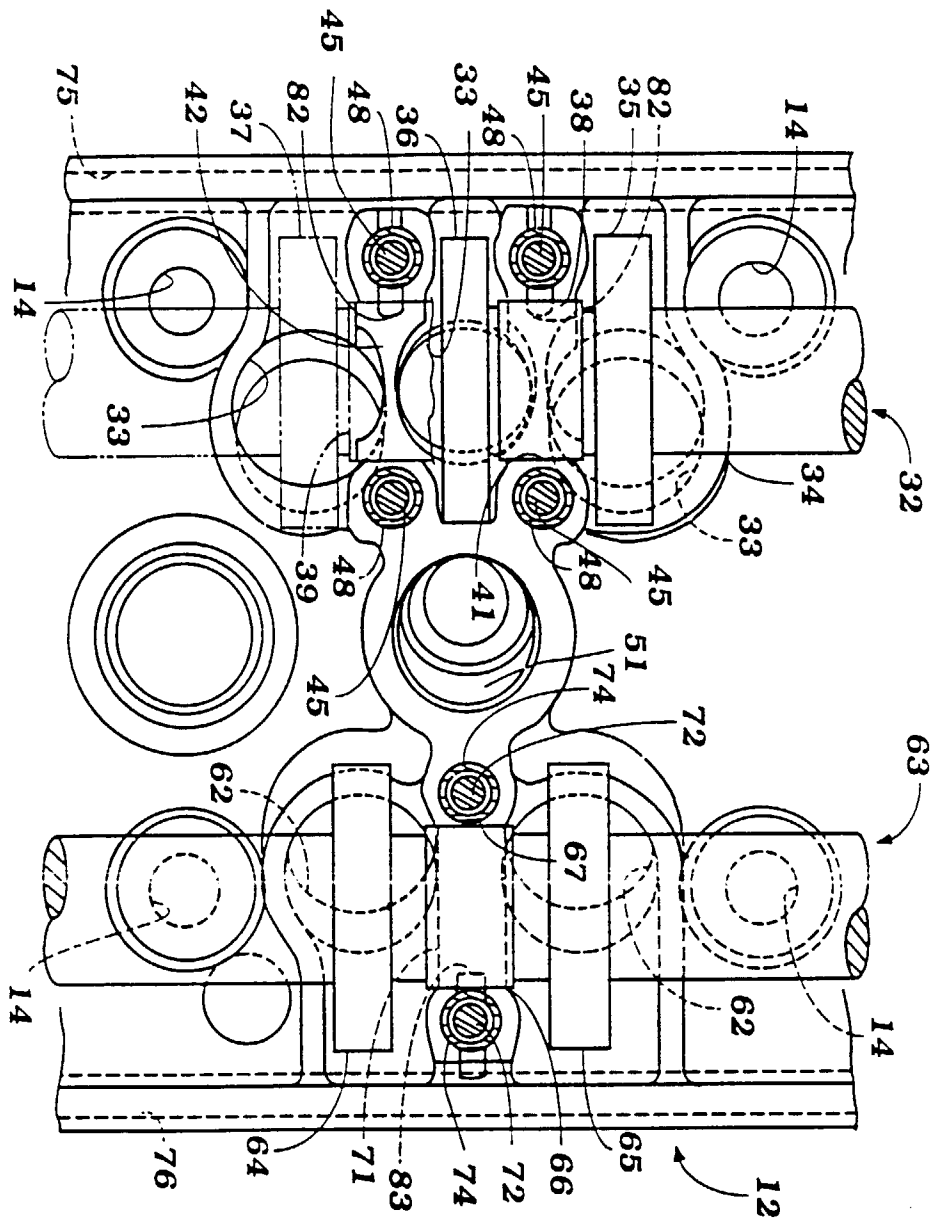


Figure 3