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(54) Cylinder head lubricating system of an internal combustion engine

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EP 0 408 081 B1

Description

This invention relates to a cylinder head lubricating system of an internal combustion engine comprising a cylinder head having a first series of hydraulic lash adjusters for the operation of intake valves, a second series of hydraulic lash adjusters for operating exhaust valves, an oil pump, first conduit means extending to said first series of lash adjusters for lubricating said first series of lash adjusters, second conduit means extending to said second series of lash adjusters for lubricating said second series of lash adjusters including means for communicating said first and second conduit means with said oil pump, wherein the length of the first conduit from said oil pump to the first series of lash adjusters of said intake valves is shorter than the length of the conduit from said oil pump to the second series of lash adjusters of said exhaust valves.

The use of overhead valves operated by overhead mounted camshafts is well known. Although there are some advantages to direct valve actuation, the use of a rocker arm actuator has the advantage of permitting the incorporation of a hydraulic lash adjuster. Conventionally it has been the practice to supply lubricant to the lash adjusters for their operation and to the journals of the associated camshaft in a series flow relationship. Although this has the advantage of simplicity, it has certain disadvantages. Specifically, with a series flow arrangement when the engine is turned off, the fact that the camshaft journals are open to the atmosphere will cause leak down of the lubricant. That is, because the cam journals are generally open, the system does not maintain pressure and lubricant can drain down back through the series flow arrangement into the lubricant reservoir through the oil pump. This means that the lubricant in the lifters will become depleted when the engine is shut down. This can give rise to obvious difficulties on restarting.

As has been noted, the normal arrangement for an engine having a camshaft and hydraulic lash adjusters is to supply lubricant through a common conduit from the lubricant pump to the lash adjusters and the cam journals. Frequently the engine may employ two camshafts, each of which operates its own series of valves through an actuating mechanism that includes its own series of lash adjusters. With the type flow arrangement previously proposed, the pressure of the lubricant supplied to the lash adjusters will depend upon its distance from the lubricant pump and this means that the adjusters associated with one camshaft may receive lubricant at a substantially lower pressure than those associated with the other camshaft.

From EP-A-0 212 981 an oil supply system for a valve operating mechanism in internal combustion engines is known. In that case the number of lash adjustors at the intake and exhaust sides is the same and difficulties in view of a uniform distribution of the lubricating oil pressure are not indicated.

From US-A-4 709 667 a cylinder head lubricating system is known, wherein the conduits extending to the intake lash adjusters and the exhaust lash adjusters have a different length from the oil pump. The number of lash adjusters on the intake and exhaust side is the same and similar difficulties arise in distributing a uniform oil pressure. Moreover, the main oil conduit provides too little space causing a high flow resistance for supplying much lubricant.

In an arrangement incorporating a system for precluding leak down of the hydraulic lifters, a still further problem can result, particularly where the arrangement utilizes two camshafts and a plurality of lifters associated with it. Frequently, the arrangement is such that each cylinder of the engine is provided with different numbers of intake and exhaust valves. Where this is the case, a greater number of hydraulic lash adjusters may be associated with one camshaft than the other. This further aggravates the problems already discussed.

In connection which valve arrangements of the type already described, it is generally necessary to deliver oil to the camshafts through the cylinder block and cylinder head. The camshafts are conventionally journaled on the cylinder head by bearing surfaces formed integrally with the cylinder head and separate bearing caps that are affixed to the cylinder head. With such an arrangement, it is generally the practice to deliver the oil to one end of the camshaft by means of a passage that is formed in the cylinder head and this obviously adds to the length of the engine. Also, the internal passages of the cylinder head may, itself, present certain problems in connection with maintaining a compact construction.

Accordingly, it is an objective of the present invention to provide an improved cylinder head lubricating system of an internal combustion engine with a simple structure having a low flow resistance for supplying all lash adjusters with substantially the same lubricant pressure.

In order to perform said objective the cylinder head lubricating system as indicated above is improved in that the intake valves comprise a greater number of lash adjusters than the exhaust valves and that a main oil delivery passage which forms part of the first conduit extends upwardly outside of the head bolt bores through the lower face of the cylinder head.

Preferred embodiments are laid down in the further sub-claims.

In the following the present invention is explained in greater detail by means of preferred embodiments thereof wherein:

Figure 1 is a transverse cross sectional view taken through a cylinder head assembly constructed in accordance with an embodiment of the invention and is taken generally along the line 1-1 of Figure 5,

Figure 2 is an enlarged cross sectional view of one of the hydraulic lash adjusters,

Figure 3 is a partial cross sectional view taken generally along the line 3-3 of Figure 5, showing the cylinder block and cam cover in phantom,

Figure 4 is a cross sectional view taken along the line 4-4 of Figure 5, with a portion of the cylinder head assembly shown in phantom,

Figure 5 is a top plan view of the cylinder head assembly with the cam cover removed and portions of the camshafts broken away,

Figure 6 is a top plan view of the cam cover,

Figure 7 is a schematic view showing how the lubricant system is related to the cam bearing journals and the hydraulic lash adjusters,

Figure 8 is a cross sectional view taken along the line 8-8 of Figure 4,

Figure 9 is a cross sectional view taken along the line 9-9 of Figure 6,

Figure 10 is a bottom plan view of the combustion chamber,

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION

Referring now in detail to the drawings and initially primarily to Figure 1, a multiple cylinder internal combustion engine, constructed in accordance with an embodiment of the invention is identified generally by the reference numeral 21. The engine 21 includes a cylinder block which may be conventional and hence is only shown in phantom in Figure 3 in which a plurality of aligned bores 23 are formed. In the illustrated embodiment, the engine 21 is of the four cylinder in line type. It should be readily apparent, however, to those skilled in the art how the invention can be practiced in conjunction with engines having other numbers of cylinders and other cylinder configurations.

Since the invention deals primarily with the cylinder head assembly and more particularly to the valve actuating mechanism therefor, the details of the cylinder block, pistons and running component of the engine which may be considered to be conventional are not believed to be necessary to enable those skilled in art to practice the invention. Therefore, the cylinder head and valve train assembly and lubrication system therefor will now be described by particular reference to Figures 1, 4, 5 and 10 in addition to Figure 3.

A cylinder head assembly, indicated generally by the reference numeral 24 is affixed to the cylinder block 22 by means of a plurality of fasteners 25 that pass through appropriate openings in the cylinder head 24 and which are threaded into threaded openings in the cylinder block. It should be noted that the fasteners 25 are disposed so that they will be located at the four corners of the cylinder bores 23, as indicated by the broken circles in Figure 5, to show the relationship of these fasteners 25 to the cylinder bores 23.

The lower face of the cylinder head 24 is provided with a plurality of recesses 26 which have a generally pent roof configuration, as will be described. Three intake valves comprised of a pair of center intake valves 27 and 28 and a side intake valve 29 are supported for reciprocation within the cylinder head 24 by respective valve guides 31. It will be noted that the intake valves 27, 28 and 29 are oriented so that the center intake valves 27 and 28 reciprocate along axes Y_1 that are disposed at a relatively large acute angle α_2 to a plane A_1 (Figure 10) containing the cylinder bore axis X_2 and extending parallel to the axis of rotation of the associated crankshaft.

The side intake valve 29 reciprocates about an axis Y_3 which is disposed at a lesser acute angle to this plane, this angle being indicated at α_1 in Figure 3.

Each of the intake valves 27, 28 and 29 cooperates with a respective valve seat 32 pressed into the cylinder head 24 and defining an intake port at the termination of an intake passage 33 which extends through one side of the cylinder head. The intake passages 33 may be siamese so that one intake opening in the side of the cylinder head cooperates with each of the valve seats 32 or, alternatively, separate passages may be formed for each valve seat. The orientation of the heads of the valves 27, 28 and 29 gives the lower surface of the cylinder head cavity 26 a generally inclined portion 34 which extends across the plane A_1 so that a portion of the heads of the valves 27 and 28 lies on the opposite side of this plane when the valves are closed, as clearly shown in Figure 10.

Coil compression springs 34 encircle the stems of the valves 27, 28 and 29 and act against keeper retainer assemblies 35 for urging the valves 27, 28 and 29 to their closed positions. The mechanism for opening the intake valves 27, 28 and 29 will be described later.

A pair of exhaust valves 36 and 37 are supported for reciprocation on the other side of the plane A_1 by valve guides 38 which are pressed into the cylinder head assembly 24. The exhaust valves 36 and 37 reciprocate about respective axes Y_2

which are disposed at an acute angle to the plane A_1 which angle is less than the angle α_2 and greater than the angle α_1. The exhaust valves 36 and 37 cooperate with respective valve seats 39 that are pressed into the cylinder head 24 and which form the exhaust ports of exhaust passages 41 that extend through the side of the cylinder head 24 opposite to the intake side. As with the intake passages 33, the exhaust passages 41 may be separate or siamese. It should be noted that the disposition of the heads of the exhaust valves 36 and 37 gives rise to the combustion chamber cavity having a generally inclined surface 42 that intersects the surface 34 on the exhaust side of the plane A_1 so that this intersection is slightly offset to the side of the combustion chamber.

Coil compression springs 43 cooperate with keeper retainer assemblies 44 on the stems of the exhaust valves 36 and 37 for urging the exhaust valves 36 and 37 to their closed positions.

The mechanism for opening the intake valves 27, 28 and 29 and exhaust valves 36 and 37 against the operation of the respective springs 34 and 43 will now be described. The cylinder head 24 has an upstanding peripheral wall that defines an upwardly facing sealing surface 45 that defines in part a cavity 46 in which the valve actuating mechanism is contained. The cavity 46 is enclosed by means of a cam cover 47 that is affixed to the cylinder head 24 in a manner as will be described. On the intake side of the cylinder head 24 there is provided a plurality of bosses 48 which define generally semi cylindrical shaped bearing surfaces 49. Adjacent the bosses 48, there are provided further bosses 51 that define quarter cylindrical bearing surfaces 52. An intake camshaft, indicated generally by the reference numeral 53 has spaced bearing surfaces 54 that are received within and journaled on the cylinder head bearing surfaces 49 and 52. The cylinder head 24 further has end bosses 55 that define further semi cylindrical bearing surfaces with which bearing portions 56 of the camshaft 53 cooperate so as to rotatably journal it. Unlike conventional arrangements wherein separate bearing caps are provided, in accordance with a feature of the invention, the cam cover 47 has a plurality of inwardly extending portions 58 that define semi cylindrical bearing surfaces 59 which cooperate with the camshaft bearing surfaces 54 and 56, respectively, so as to complete the journaling of the intake camshaft 53 in the cylinder head assembly.

The exhaust side of the cylinder head assembly 24 also has a plurality of inwardly extending bosses 61 which have respective bearing surfaces 62 which are of a semi cylindrical configuration. An exhaust camshaft 63 is rotatably journaled on these bearing surfaces by means of bearing portions 64 formed integrally thereon. In addition, end walls 65 of the cylinder head 24 are provided with bearing surfaces 66 which cooperate with end bearing surfaces 67 on the exhaust camshaft 63 for its rotational support. It should be noted that the intake camshaft 53 and exhaust camshaft 63 rotate about parallel axes which are parallel to the axis of rotation of the associated crankshaft.

Cooperating with the cylinder head bearing surfaces 62 and 66 are bearing surfaces 68 formed in inwardly extending portions 69 of the cam cover 47.

The cam cover 47 is provided with a plurality of appropriately spaced bolt clearance holes 71 that are positioned in a pattern as best shown in Figure 6, and which receive bolts 72 that are threaded into tapped openings formed in the cylinder head 24 so as to secure the bearing caps formed by the cam cover 47 and the cam cover in place. Because of this construction, the head assembly may be made more compact than prior art arrangements and also the use of separate bearing caps for the camshaft may be avoided.

A toothed sprocket 73 (Figure 5) is affixed to one exposed end of the exhaust camshaft 63 and is driven by a toothed belt 74 in timed relationship with the engine crankshaft (not shown). At the opposite end of the exhaust camshaft 63, and within the cylinder head assembly 24, there is affixed a sprocket 75. A chain 76 encircles the sprocket 75 and drives a sprocket 77 that is affixed to the intake camshaft 53 at this end. In this way, the intake and exhaust camshafts will be driven in timed relationship from the engine output shaft.

In order to operate the intake valves 27, 29 and 28, there are provided three cam lobes 78 on the intake camshaft 53 for each cylinder. One of the cam lobes 78 is disposed between the bearing surfaces 49 and 52 and the camshaft bearing surfaces 54. The other of the cam lobes 78 are positioned outwardly of these bearing surfaces. Individual rocker arm assemblies 79 (Figures 2 and 3) have an intermediate portion that is engaged by the cam lobe 78 and an end portion that is engaged with the stem of the respective intake valve 27, 28 and 29. The rocker arms 79 are pivotally supported by means of a hydraulically operated lash adjuster, indicated generally by the reference numeral 81 and having a construction as best shown in Figure 2.

Each lash adjuster 81 comprises a cylindrical body portion 82 having an internal bore in which a tappet member 83 is slidably supported. The tappet member 83 has a hollow central portion 84 which communicates with a pressure chamber 85 positioned at the bottom of the adjuster body 82 through a passageway 86 in which a spring biased check valve 87 is positioned. Hydraulic pressure is delivered to the central interior 84 of the adjusting member from a delivery passage 88 formed in the body 82 and a delivery passage 89 formed in the tappet 83. The hydraulic pressure acts under the tappet 83 so as to hold the clearance in the system to zero clearance. A light compression spring 91 also acts to hold the tappet 83 in position when the engine is not running.

A further passage 92 extends through the tappet 83 and communicates with a spherical socket 93 formed in the rocker arm 79 for lubrication. A delivery passage, to be described, supplies oil to the lash adjuster 81 for the aforedescribed operation.

The bores in which the adjusters 81 are positioned are indicated by the reference numeral 94 and are oriented as described in my aforenoted copending application. These bores terminate in lower shoulders 95 against which the adjuster bodies 82 react.

The exhaust camshaft 63 is provided with pairs of cam lobes 96 that are disposed on opposite sides of their bearing portions 64 so as to operate the exhaust valves 36 and 37. These cam lobes 96 cooperate with intermediate portions of exhaust rocker arms 97 which have one end portion engaged with the stems of the valves 36 and 37 for operating them. The opposite ends of the rocker arms 97 cooperate with hydraulic lash adjusters 98 which have an internal construction the same as those associated with the intake valves (lash adjusters 81). For this reason, the description of the exhaust lash adjusters 98 is not believed to be necessary.

However, these adjusters 98 are received in bores 99 configured as described in my aforenoted copending application and which have their tappets 83 cooperating with spherical recesses 101 in the rocker arms 97. The base of the bores 99 is formed with a surface 102 against which the adjuster body reacts.

The engine 21 is provided with a lubricating system that includes an oil reservoir which may be of either the wet or dry sump type and at least a pressure pump, indicated generally by the reference numeral 103 in Figures 1 and 7. The pump 103 is driven from the engine output shaft in a suitable manner and lubricates the crankshaft and components associated with the cylinder block in a well known manner. In accordance with the invention, this lubrication system includes a passageway that extends through the cylinder block 22 and which cooperates with a main oil delivery passage 104 (Figure 1) that extends upwardly through the lower face of the cylinder head 24 between a pair of cylinders thereof. The passageway 104 is, in the illustrated embodiment, on the intake side of the cylinder head 24 for a reason to be described. A cross drilled passageway 105 intersects the passage 104 and is closed by a closure plug 106. A further drilled passageway 107 extends down from the cylinder head sealing surface 45 through a side wall 108 of the cylinder head and intersects the passageway 105. A sleeve 109 is pressed into this passageway and cooperates with a corresponding passageway 111 formed in a side wall 112 of the cam cover 47.

A cross drilled passageway 113 extends transversely across the cam cover 47 as shown in Figures 1 and 6, and intersects the passageway 111. This cross drilled passageway 113 is closed at its outer end by means of a closure plug 114.

A further passageway 115 is drilled in the opposite wall 116 of the cam cover 47 and cooperates with a sleeve 117 that is pressed into a side wall 118 of the cylinder head 24 around a further oil passageway 119 which is likewise drilled in the cylinder head 24.

The passageway 105 at the intake side of the cylinder head assembly is intersected by a transversely extending oil gallery 121 which intersects the bores 94 in which the lash adjusters 81 are slidably supported adjacent the delivery ports 88. Hence, there is defined a series flow oil delivery for supplying lubricant under pressure to the intake adjusters 81.

In a similar manner, a gallery 122 is drilled in the opposite wall 118 of the cylinder head and intersects the bores 99 in which the exhaust valve adjusters 98 are positioned. Since the intake oil gallery 121 is closer to the source of oil pressure, there is a greater likelihood that uniform pressure will be delivered to both the intake adjusters 81 and exhaust adjusters 98, bearing in mind the fact that there are more intake adjusters than exhaust adjusters, and thus the system will operate at a more uniform pressure. Also, because of the fact that the adjuster galleries 121 and 122 are served off the main oil delivery comprised of the passageways 104, 105, 107, 111, 113, 115 and 119, rather than in series flow relationship with the camshaft journals, to be described, leakage caused by the opening of the camshaft journals to the atmosphere will not cause the adjusters 81 and 98 to leak down as rapidly as with conventional series flow arrangements.

This concept may be best understood by reference to Figure 7 where the main oil gallery aforereferred to is identified by the reference numeral 123. As may be seen in this Figure, intake camshaft delivery passages 124 intersect this main gallery 123 and exhaust camshaft delivery passages 125 also intersect this gallery. As may be seen in Figures 1, 4, 6, 7 and 8, these passages extend through the bosses 58 and 69 of the cam cover 47 for lubricating these journals. The passageways 124 are all supplied with lubricant from a cross drilled passageway 126 that extends along the cam cover 47 and which is closed at one end thereof by means of a plug (not shown). In a like manner, a drilled passageway 127 that extends parallel to the passageway 126 intersects the passageways 125 and supplies lubricant to them for the exhaust camshaft journals 64.

It should be readily apparent that the described construction insures that there will be adequate lubrication for the camshaft journals and also adequate lubrication supplied to the hydraulic lash adjusters 81 and 89 and the pressure will be substantially uniform throughout the system. Also, because the oil delivery passages are formed in the cam cover 47, the overall engine construction may be made more compact. Furthermore, since the delivery to the gallery 121 for the more numerous intake lash adjusters 81 is closer to it than that for the exhaust gallery 122, there will not be a substantial pressure difference between the intake and exhaust adjusters.

As may be seen in Figure 1, one or more oil drain passageways 128 are formed in the cylinder head 24 for draining lubricant back to the crankcase of the engine.

Each combustion chamber of the engine is provided with a single spark plug for firing the charge therein. The cylinder head 24 is provided with a tapped opening 129 for receiving the spark plug. This tapped opening is formed at the base of the larger opening 131. The cam cover has an even larger opening 132 for accessing these spark plugs. This construction appears best in Figure 9.

Claims

1. Cylinder head lubricating system of an internal combustion engine (21) comprising a cylinder head (24) having a first series of hydraulic lash adjustors (81) for the operation of intake valves (27,28,29), a second series of hydraulic lash adjustors (98) for operating exhaust valves (36,37), an oil pump (103), first conduit means (104,121) extending to said first series of lash adjustors (81) for lubricating said first series of lash adjustors (81), second conduit means (104,122) extending to said second series of lash adjustors (98) for lubricating said second series of lash adjustors (98) including means for communicating said first and second conduit means (104,121,104,122) with said oil pump (103), wherein the length of the first conduit (104,121) from said oil pump (103) to the first series of lash adjustors (81) of said intake valves (27,28,29) is shorter than the length of the conduit (104,122) from said oil pump (103) to the second series of lash adjustors (98) of said exhaust valves (36,37), **characterised in that,** the intake valves (27,28,29) comprise a greater number of lash adjustors (81) than the exhaust valves (36,37) and that a main oil delivery passage (104) which forms part of the first conduit (104,121) extends upwardly outside of the head bolt bores through the lower face of the cylinder head (24).

2. Cylinder head lubricating system as claimed in claim 1, **characterised by** a camshaft (53,63) journaled for rotation about at least one bearing (49,52; 62,64), wherein the oil pump (103) and the first and second conduit means (104,121,122) supply lubricating oil under pressure from said oil pump (103) to said lash adjustors (81,98) and said bearing (49,52; 62,64).

3. Cylinder head lubricating system as claimed in claims 1 or 2, **characterised by** a plurality of camshaft bearings (49,52; 62,64)

4. Cylinder head lubricating system as claimed in at least one of the preceding claims 1 to 3, **characterised in that** the camshaft bearings (49,52; 62,64) and the lash adjustors (81,98) are lubricated in series.

5. Cylinder head lubricating system as claimed in at least one of the preceding claims 1 to 4, **characterised by** a pair of camshafts (53,63), each associated to a plurality of bearings (49,52; 62,64) and a plurality of lash adjustors (81,98), the lubricating oil being supplied to the camshaft bearings (49,52; 62,64) in a series flow relationship with the lubricating oil being supplied to the lash adjustors (81,98) associated with each of the camshafts (53,63) in parallel flow relationship and with the individual lash adjustors (81,98) associated with each camshaft (53,63) being lubricated in a series flow relationship.

6. Cylinder head lubricating system as claimed in at least one of the preceding claims 1 to 5, **characterised in that** the lubricating oil is delivered to the lubricant system adjacent the one camshaft (53) associated to the greater number of lash adjustors (81) so as to maintain substantially the same lubricant pressure to all lash adjustors (81,98).

7. Cylinder head lubricating system as claimed in at least one of the preceding claims 1 to 6, **characterised in that** the camshafts (53,63) are journaled within a cavity formed by a cyl-

inder head and wherein the cavity (46) is closed by a cam cover (47), at least a portion of the lubricating oil conduit means (104,121,122) being formed in the cam cover (47).

8. Cylinder head lubricating system as claimed in at least one of the preceding claims 1 to 7, **characterised in that** the camshaft bearings (49,52; 62,64) are formed in part by the cam cover (47) and the conduitry delivering the lubricating oil to the camshaft bearings is formed in the cam cover (47).

9. Cylinder head lubricating system as claimed in at least one of the preceding claims 1 to 8, **characterised in that** the lubricant conduits for supplying the lash adjustors (81,98) are formed in the cylinder head (24) and that the cylinder head (24) has passages (106,107) communicating with the cam cover (47) for communicating the cam cover lubricant passages (111,113) with the cylinder head lubricant passages (106,107) whereas the oil pump (103) delivers the lubricating oil to the engine through the cylinder head (24).

10. Cylinder head lubricating system as claimed in at least one of the preceding claims 1 to 8, **characterised in that** there are three lash adjustors (81) per cylinder associated with a first camshaft (53) and two lash adjustors (98) per cylinder associated with the second camshaft (63).

11. Cylinder head lubricating system as claimed in at least one of the preceding claims 1 to 10, **characterised in that** there are a plurality of cylinders associated with the cylinder head.

12. Cylinder head lubricating system as claimed in at least one of the preceding claims 1 to 11, **characterised in that** wherein the first and second conduit means (104,121,122) are formed in the cylinder head.

13. Cylinder head lubricating system as claimed in claim 12, **characterised in that** at least a portion of a third conduit means (124,125) is formed in a cam cover (47) closing a cavity formed in the cylinder head in which the camshafts (53,63) are journaled.

14. Cylinder head lubricating system as claimed in claim 13, **characterised in that** the bearings (58) are formed at least in part by the cam cover (47) and the third conduit means (124,125) terminates in each of said cam cover bearing surfaces (58).

Patentansprüche

1. Zylinderkopf-Schmierungssystem eines Verbrennungsmotors (21) mit einem Zylinderkopf (24) mit einer ersten Reihe hydraulischer Spieleinstellelemente (81) zur Betätigung von Einlaßventilen (27, 28, 29), einer zweiten Reihe hydraulischer Spieleinstellelemente (98) zur Betätigung von Auslaßventilen (36, 37), einer Ölpumpe (103), einer ersten Leitungseinrichtung (104, 121), die sich zu der ersten Reihe von Spieleinstellelementen (81) zur Schmierung der ersten Reihe von Spieleinstellelementen (81) erstreckt, einer zweiten Leitungseinrichtung (104, 122), die sich zu der zweiten Reihe von Spieleinstellelementen (98) zur Schmierung der zweiten Reihe von Spieleinstellelementen (98) erstreckt, einschließlich einer Einrichtung zur Verbindung der ersten und zweiten Leitungseinrichtungen (104, 121; 104, 122) mit der Ölpumpe (103), wobei die Länge der ersten Leitung (104, 121) von der Ölpumpe (103) zu der ersten Reihe von Spieleinstellelementen (81) der Einlaßventile (27, 28, 29) kürzer ist als die Länge der Leitung (104, 122) von der Ölpumpe (103) zu der zweiten Reihe von Spieleinstellelementen (98) der Auslaßventile (36, 37), **dadurch gekennzeichnet**, daß die Einlaßventile (27, 28, 29) eine größere Anzahl von Spieleinstellelementen (81) als die Auslaßventile (36, 37) aufweisen und daß ein Hauptölzufuhrkanal (104), der einen Teil der ersten Leitung (104, 121) bildet, sich nach oben außerhalb der Kopfbolzenbohrungen durch die untere Stirnfläche des Zylinderkopfes (24) erstreckt.

2. Zylinderkopf-Schmierungssystem nach Anspruch 1, **gekennzeichnet durch** eine Nockenwelle (53, 63), die drehbar um zumindest ein Lager (49, 52; 62, 64) gelagert ist, wobei die Ölpumpe (103) und die ersten und zweiten Leitungseinrichtungen (104, 121, 122) Schmieröl unter Druck von der Ölpumpe (103) zu den Spieleinstellelementen (81, 98) und dem Lager (49, 52; 62, 64) zuführen.

3. Zylinderkopf-Schmierungssystem nach Anspruch 1 oder 2, **gekennzeichnet durch** eine Mehrzahl von Nockenwellenlagern (49, 52; 62, 64).

4. Zylinderkopf-Schmierungssystem nach zumindest einem der vorhergehenden Ansprüche 1-3, **dadurch gekennzeichnet**, daß die Nockenwellenlager (49, 52; 62, 64) und die Spieleinstellelemente (81, 98) in Reihe geschmiert werden.

5. Zylinderkopfschmierungssystem nach zumindest einem der vorhergehenden Ansprüche 1-4, **gekennzeichnet durch** ein Paar Nockenwellen (53, 63), die jeweils einer Mehrzahl von Lagern (49, 52; 62, 64) und einer Mehrzahl von Spieleinstellelementen (81, 98) zugeordnet sind, wobei das Schmieröl zu den Nockenwellenlagern (49, 52; 62, 64) in einer seriellen Strömungsverbindung zugeführt wird, wobei das Schmieröl zu den Spieleinstellelementen (81, 98), die jeder der Nockenwellen (53, 63) zugeordnet sind, in einer parallelen Strömungsverbindung zugeführt wird und wobei die einzelnen Spieleinstellelemente (81, 98), die jeder Nockenwelle (53, 63) zugeordnet sind, in einer seriellen Strömungsverbindung geschmiert werden.

6. Zylinderkopf-Schmierungssystem nach zumindest einem der vorhergehenden Ansprüche 1-5, **dadurch gekennzeichnet**, daß das Schmieröl den Schmiersystem benachbart zu der einen Nockenwelle (53) die der größeren Anzahl von Spieleinstellelementen (81) zugeordnet ist, zugeführt wird, um den Schmiermitteldruck an allen Spieleinstellelementen (81, 98) im wesentlichen gleich zu halten.

7. Zylinderkopf-Schmierungssystem nach zumindest einem der vorhergehenden Ansprüche 1-6, **dadurch gekennzeichnet**, daß die Nokkenwellen (53, 63) in einer Vertiefung, die durch einen Zylinderkopf gebildet ist, gelagert sind und wobei die Vertiefung (46) durch einen Nockendeckel (47) geschlossen ist, wobei zumindest ein Abschnitt der Schmieröl-Leitungseinrichtung (104, 121, 122) in dem Nockendekkel (47) ausgebildet ist.

8. Zylinderkopf-Schmierungssystem nach zumindest einem der vorhergehenden Ansprüche 1-7, **dadurch gekennzeichnet**, daß die Nokkenwellenlager (49, 52; 62, 64) teilweise durch den Nockendeckel (47) gebildet sind und die Leitungseinrichtung, die das Schmieröl zu den Nockenwellenlagern zuführt, in dem Nockendeckel (47) ausgebildet ist.

9. Zylinderkopf-Schmierungssystem nach zumindest einem der vorhergehenden Ansprüche 1-8, **dadurch gekennzeichnet**, daß die Schmiermittelleitungen zur Versorgung der Spieleinstellelemente (81, 98) in dem Zylinderkopf (24) ausgebildet sind und daß der Zylinderkopf (24) Kanäle (106, 107) aufweist, die mit dem Nockendeckel (47) verbunden sind, um die Nockendeckel-Schmiermittelkanäle (111, 113) mit den Zylinderkopf-Schmiermittelkanälen (106, 107) zu verbinden, während die Ölpumpe (103) das Schmieröl dem Motor durch den Zylinderkopf (24) zuführt.

10. Zylinderkopf-Schmierungssystem nach zumindest einem der vorhergehenden Ansprüche 1-8, **dadurch gekennzeichnet**, daß drei Spieleinstellelemente (81) je Zylinder, die einer ersten Nockenwelle (53) zugeordnet sind, und zwei Spieleinstellelemente (98) je Zylinder, die der zweiten Nockenwelle (63) zugeordnet sind, vorgesehen sind.

11. Zylinderkopf-Schmierungssystem nach zumindest einem der vorhergehenden Ansprüche 1-10, **dadurch gekennzeichnet**, daß eine Mehrzal von Zylindern, die dem Zylinderkopf zugeordnet sind, vorgesehen sind.

12. Zylinderkopf-Schmierungssystem nach zumindest einem der vorhergehenden Ansprüche 1-11, **dadurch gekennzeichnet**, daß die ersten und zweiten Leitungseinrichtungen (104, 121, 122) in dem Zylinderkopf ausgebildet sind.

13. Zylinderkopf-Schmierungssystem nach Anspruch 12, **dadurch gekennzeichnet**, daß zumindest ein Abschnitt einer dritten Leitungseinrichtung (124, 125) in einem Nockendeckel (47) ausgebildet ist, der eine in dem Zylinderkopf ausgebildete Vertiefung schließt, in der die Nockenwellen (53, 63) gelagert sind.

14. Zylinderkopf-Schmierungssystem nach Anspruch 13, **dadurch gekennzeichnet**, daß die Lager (58) zumindest teilweise durch den Nokkendeckel (47) ausgebildet sind und die dritte Leitungseinrichtung (124, 125) in jeder der Nockendeckel-Lageroberflächen (58) endet.

Revendications

1. Système de lubrification de la culasse d'un moteur à combustion interne (21) comportant une culasse (24) présentant une première série d'organes hydrauliques (81) de réglage du jeu pour la manoeuvre des soupapes d'admission (27,28,29), une seconde série d'organes hydrauliques (98) de réglage du jeu pour la manoeuvre des soupapes d'échappement (36,37), une pompe à huile (103), des premiers moyens formant conduits (104,121), s étendant jusqu' à ladite première série d'organes (81) de réglage du jeu pour lubrifier ladite première série d'organes (81) de réglage du jeu, des

seconds moyens formant conduits (104,122) s'étendant jusqu'à ladite seconde série d'organes (98) de réglage du jeu pour lubrifier ladite seconde série d'organes (98) de réglage du jeu, incluant des moyens pour faire communiquer les dits premiers et lesdits seconds moyens, formant conduits (104,121,101,122), avec ladite pompe à huile (103), la longueur du premier conduit (104,121) entre ladite pompe à huile (103) et la première série d'organes (81) de réglage du jeu desdites soupapes d'admission (27,28,29) étant inférieure à la longueur du conduit (104,122) entre ladite pompe à huile (103) et la seconde série d'organes (98) de réglage du jeu desdites soupapes d'échappement (36,37), caractérisé par le fait que les soupapes d'admission (27,28,29) comportent un plus grand nombre d'organes (81) de réglage du jeu que les soupapes d'échappement (36,37) et qu'un passage principal (104) d'amenée d'huile, qui fait partie du premier conduit (104,121), s'étend vers le haut, à l'extérieur des perçages de vis de culasse, à travers la face inférieure de la culasse (24).

2. Système de lubrification de la culasse comme revendiqué dans la revendication 1, caractérisé par un arbre à cames (53,63) tourillonnant dans au moins un palier (49,52; 62,64), la pompe à huile (103) et les premiers et les seconds moyens formant conduits (104,121,122) envoyant de l'huile de lubrification sous pression, depuis ladite pompe à huile (103), auxdits organes (81,98) de réglage du jeu et audit palier (49,52; 62,64).

3. Système de lubrification de la culasse comme revendiqué dans les revendications 1 ou 2, caractérisé par une pluralité de paliers (49,52; 62,54) d'arbre à cames.

4. Système de lubrification de la culasse comme revendiqué dans au moins l'une des revendications précédentes 1 à 3, caractérisé par le fait que les paliers (49,52; 62,64) d'arbre à came et les organes (81,98) de réglage du jeu sont lubrifiés en série.

5. Système de lubrification de la culasse comme revendiqué dans au moins l'une des revendications précédentes 1 à 4, caractérisé par une paire d'arbres à cames (53,63), chacun associé à une pluralité de paliers(49,52; 62,64) et à une pluralité d'organes (81,98) de réglage du jeu, l'huile de lubrification étant envoyée aux paliers (49,52; 62,64) d'arbre à came selon un écoulement en série, l'huile de lubrification étant envoyée aux organes (81,98) de réglage du jeu associés à chacun des arbres à cames (53,63) selon un écoulement en parallèle et les différents organes (81,98) de réglage du jeu associés à chaque arbre à cames (53,63) étant lubrifiés selon un écoulement en série.

6. Système de lubrification de la culasse comme revendiqué dans au moins l'une des revendications précédentes 1 à 5, caractérisé par le fait que l'huile de lubrification est amenée au système de lubrification près de celui (53) des arbres à cames qui est associé au plus grand nombre d'organes (81) de réglage de jeu de façon à maintenir sensiblement la même pression du lubrifiant pour tous les organes (81,98) de réglage du jeu.

7. Système de lubrification de la culasse comme revendiqué dans au moins l'une des revendications précédentes 1 à 6, caractérisé par le fait que les arbres à cames (53,63) tourillonnent à l'intérieur d'une cavité formée par une culasse, la cavité (46) étant obturée par un couvre-culasse (47), au moins une portion des moyens (104,121,122) formant conduits d'huile de lubrification étant formée dans le couvre-culasse (47).

8. Système de lubrification de la culasse comme revendiqué dans au moins l'une des revendications précédentes 1 à 7, caractérisé par le fait que les paliers (49,52; 62,64) d'arbre à cames sont formés en partie par le couvre-culasse (47) et que le réseau de conduits amenant l'huile de lubrification aux paliers d'arbre à cames est formé dans le couvre-culasse (47).

9. Système de lubrification de la culasse comme revendiqué dans au moins l'une des revendications précédentes 1 à 8, caractérisé par le fait que les conduits de lubrifiant pour alimenter les organes (81,98) de réglage de jeu sont formés dans la culasse (24) et que la culasse (24) présente des passages (106,107) communiquant avec le couvre-culasse (47) pour faire communiquer les passages (111,113) de lubrifiant situés dans le couvre-culasse avec les passages (106,107) de lubrifiant situés dans la culasse, la pompe à huile (103) envoyant l'huile de lubrification au moteur à travers la culasse (24).

10. Système de lubrification de la culasse comme revendiqué dans au moins l'une des revendications précédentes 1 à 8, caractérisé par le fait qu'il y a trois organes (81) de réglage du jeu par cylindre associés à un premier arbre à

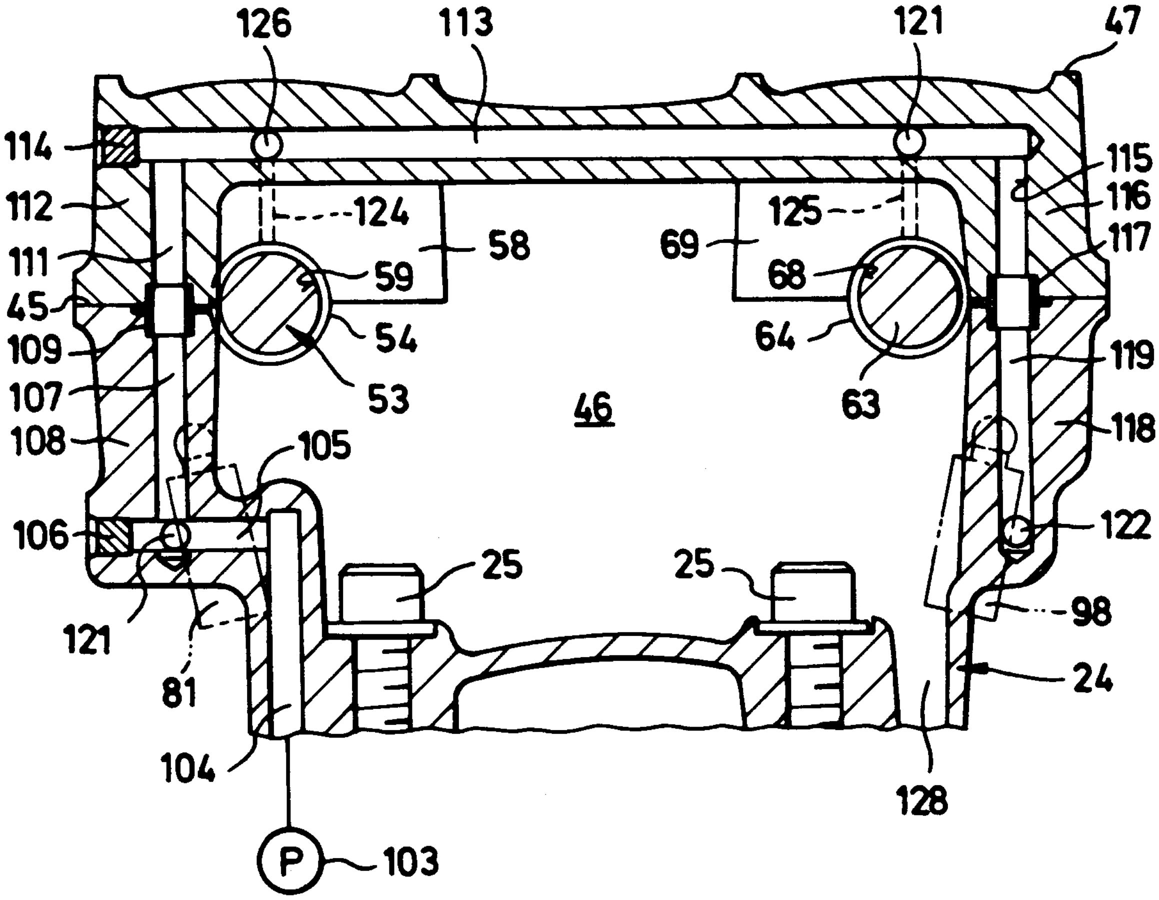
cames (53) et deux organes (98) de réglage du jeu par cylindre associés au second arbre à cames (63).

11. Système de lubrification de la culasse comme revendiqué dans au moins l'une des revendications précédentes 1 à 10, caractérisé par le fait qu'il y a une pluralité de cylindres associés à la culasse.

12. Système de lubrification de la culasse comme revendiqué dans au moins l'une des revendications précédentes 1 à 11, caractérisé par le fait que les premiers et les seconds moyens formant conduits (104,121,122) sont formés dans la culasse.

13. Système de lubrification de la culasse comme revendiqué dans la revendication 12, caractérisé par le fait qu'au moins une portion d'un troisième moyen formant conduit (124,125) est formée dans un couvre-culasse (47) qui obture une cavité, formée dans la culasse, dans laquelle les arbres à cames (63) tourillonnent.

14. Système de lubrification de la culasse comme revendiqué dans la revendication 13, caractérisé par le fait que les paliers (58) sont formés au moins en partie par le couvre-culasse (47) et que le troisième moyen formant conduit (124,125) se termine dans chacune desdites surfaces de palier (58) du couvre-culasse.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128
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103

FIG.1

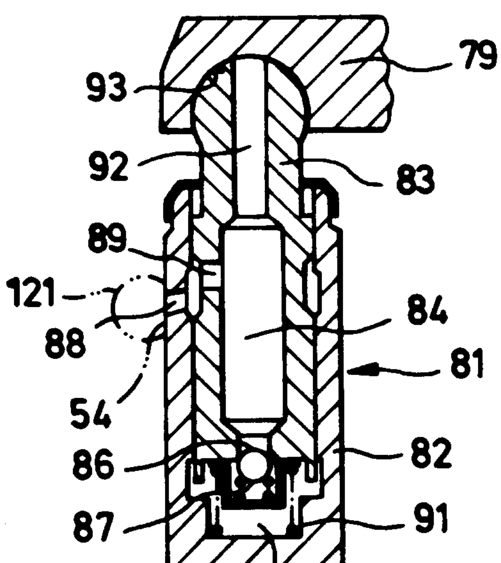
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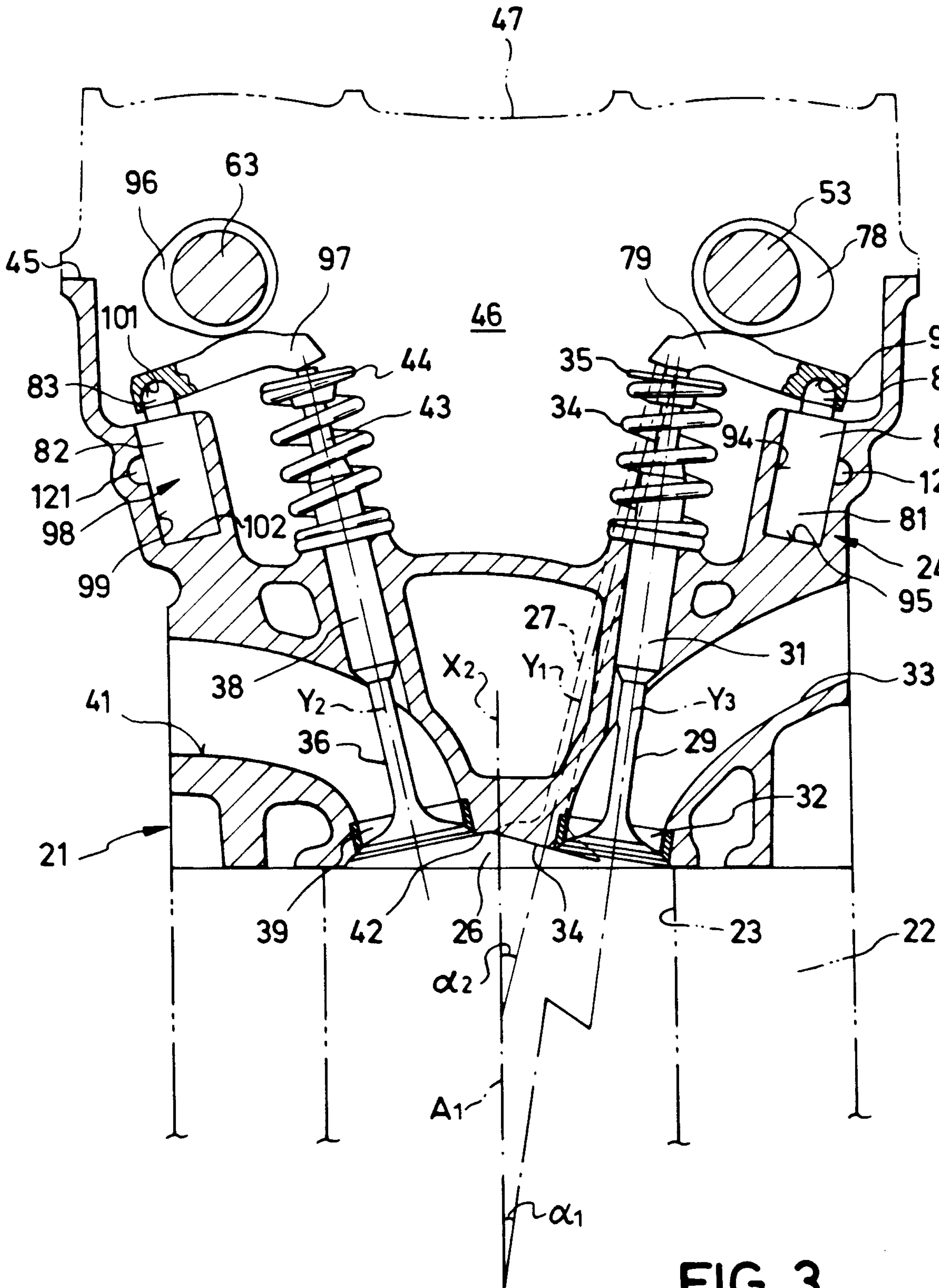
FIG.2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122
98
102
81
99
24
95
27
31
X2
Y1
33
38
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Y3
41
36
29
32
21
39
42
26
34
23
22
α2
A1
α1

FIG. 3

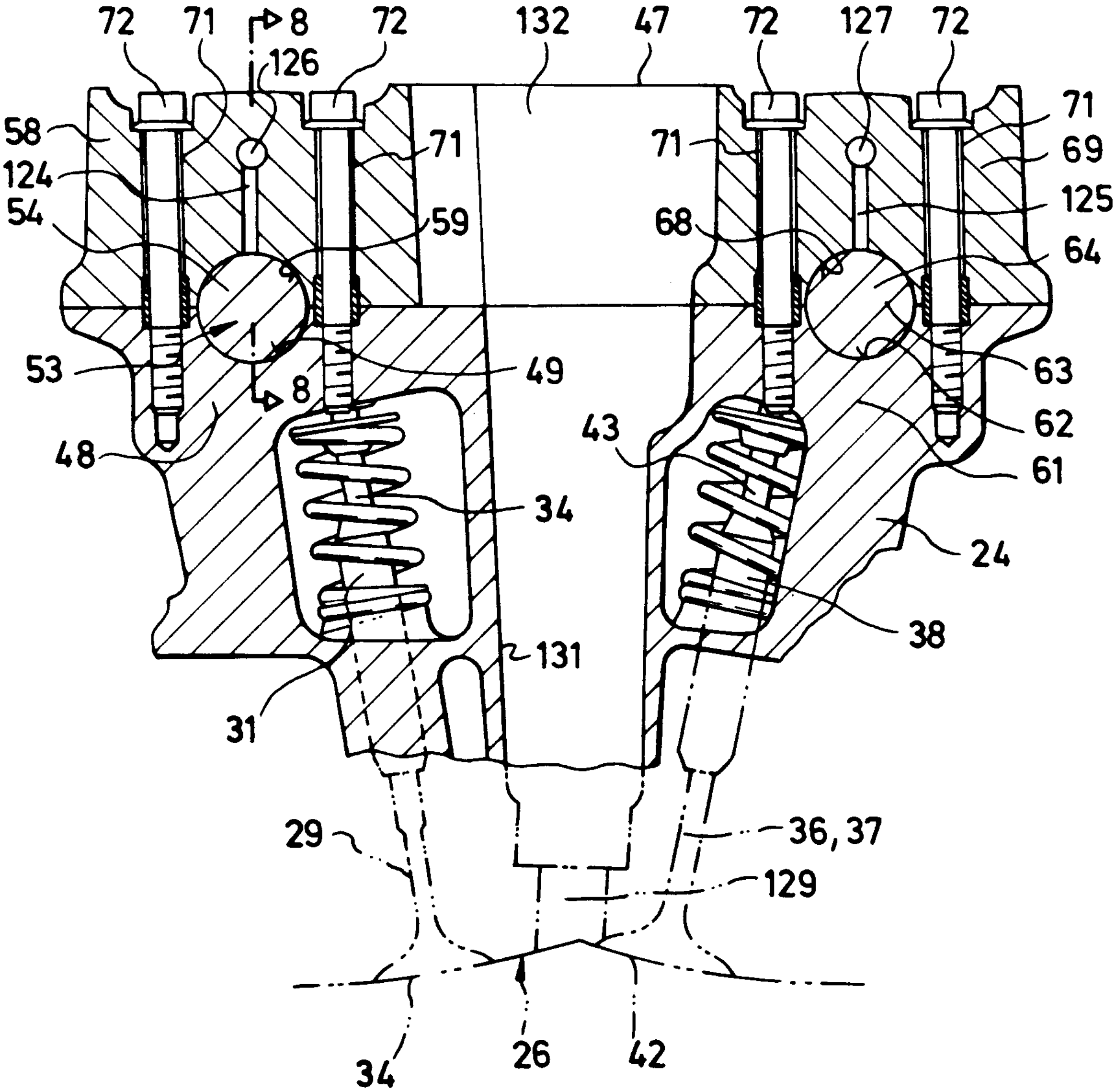
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FIG. 4

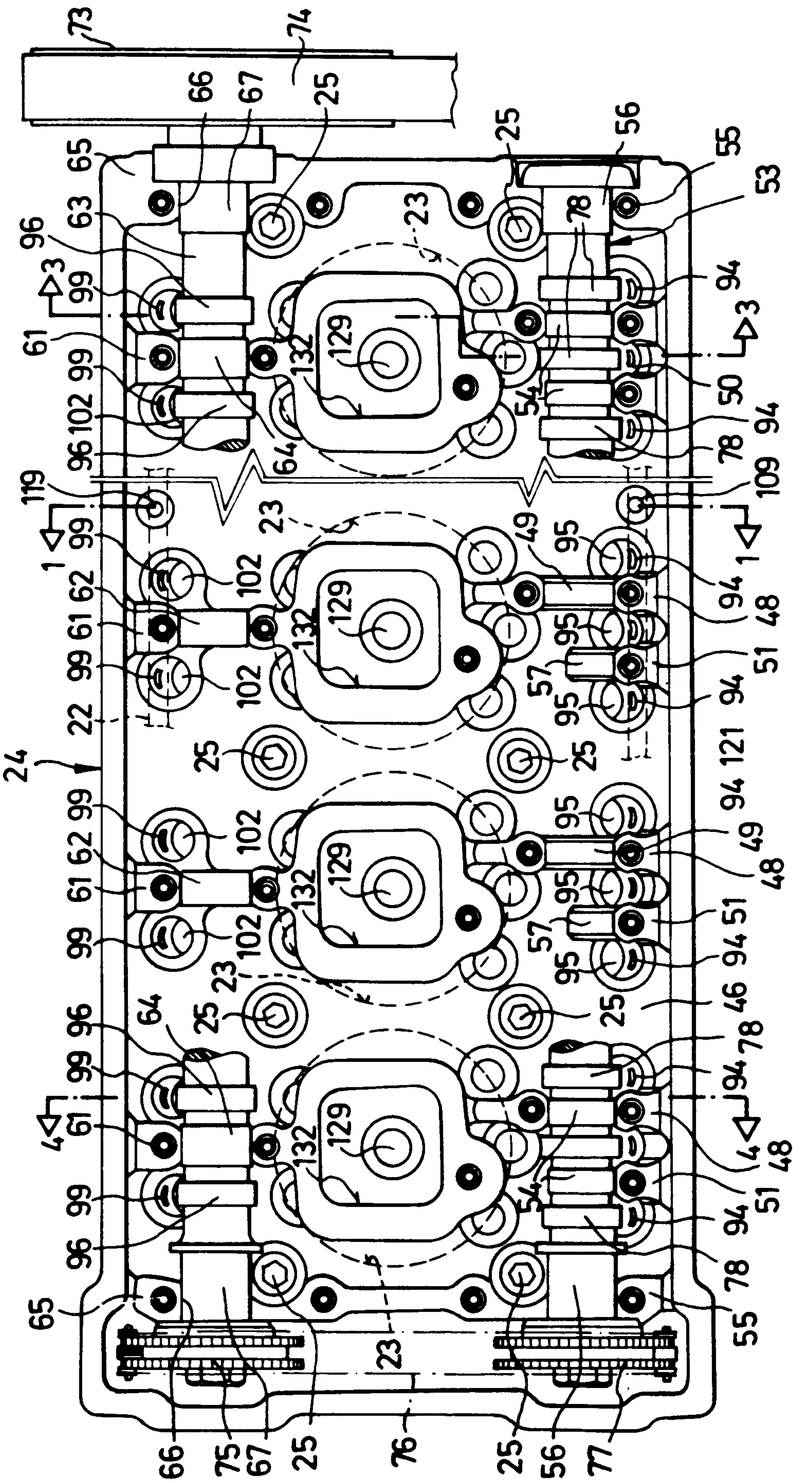

FIG.5

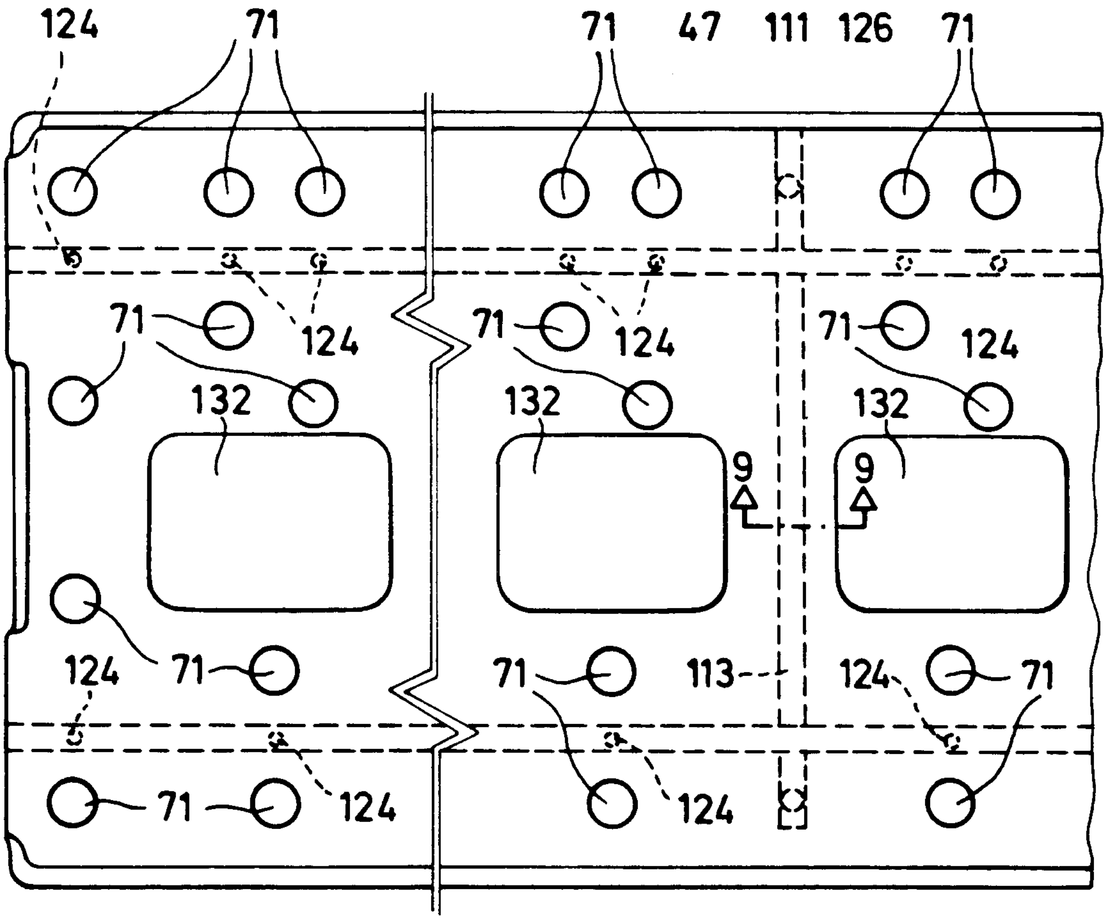
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FIG.6

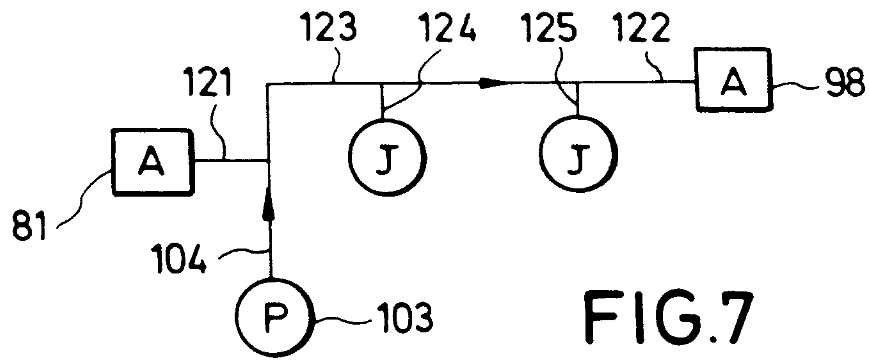

FIG.7

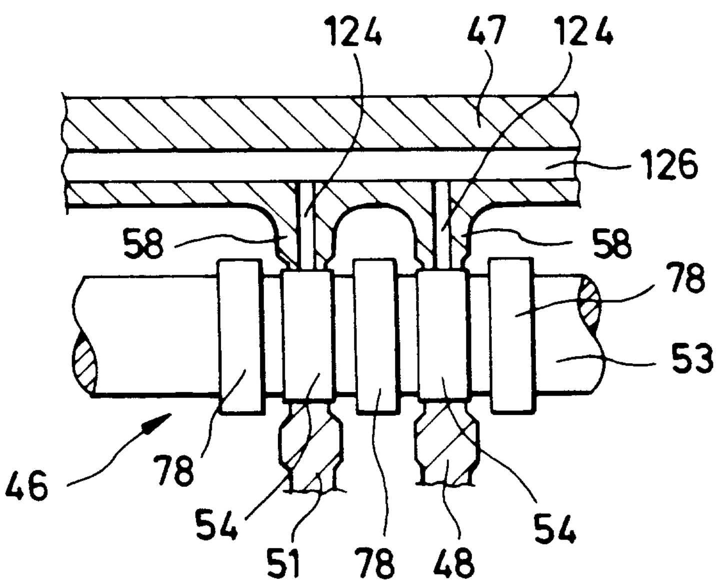

FIG. 8

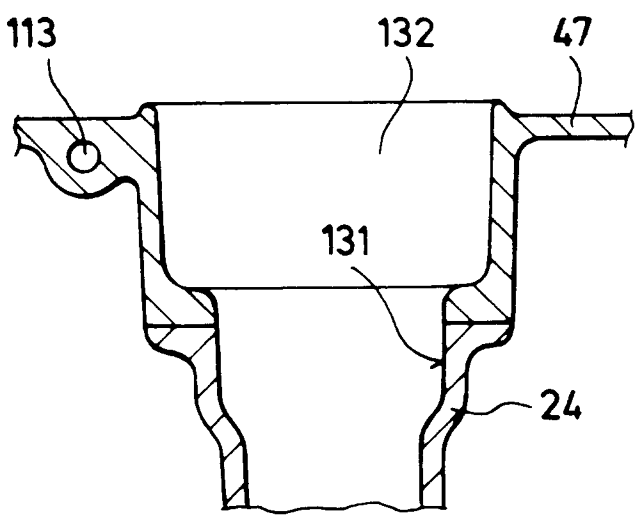

FIG.9

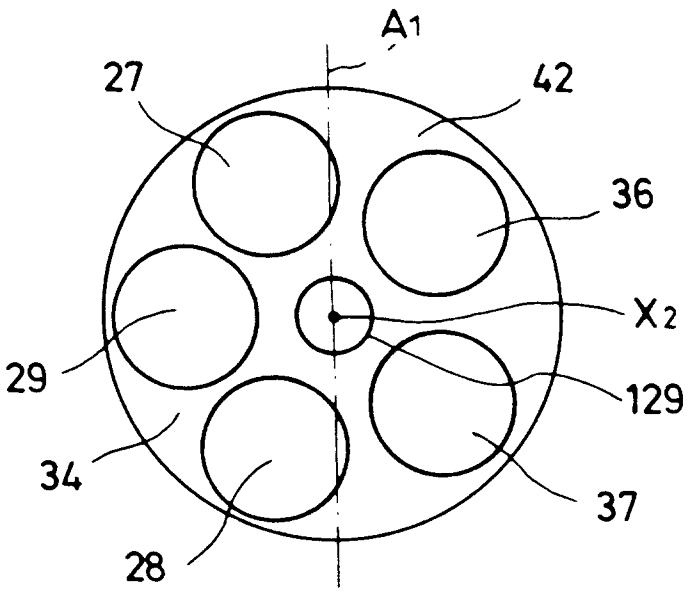

FIG.10