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(54) **A CYLINDER HEAD**

ZYLINDERKOPF

CULASSE DE CYLINDRE

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Description

Field of Invention

[0001] The invention relates to a cylinder head for use with an internal combustion engines in accordance with what is indicated in the preamble to patent claim 1 and also to an engine having such a cylinder head in accordance with what is indicated in the preamble to patent claim 9. (Compare with DE-C-826 216, which also discloses in such a combination a draining line connected to a fuel space surrounding the injector.)

Background

[0002] In diesel engines for use in heavier trucks or buses it is conventional for fuel to be supplied to different fuel injectors mounted in the respective combustion chambers. The fuel may be supplied to each injector under high pressure from a high pressure pump common to all the injectors. The fuel may alternatively be supplied to each injector under low pressure from a low pressure pump. In this case each injector, usually called unit injector, comprise an integrated high pressure pump driven by the engine camshaft. One advantage with unit injectors is that the fuel lines to the injectors can be of low pressure type and problems with leaking fuel lines to the injector can be reduced. Another advantage with unit injectors is that the fuel injection pressure can be higher than with a common fuel pump, and which is beneficial for the combustion process. However, this increases the risk of fuel leaks at the injector and in the cylinder head, where it can be difficult to detect the leaking fuel. This also increases the risk of fuel being mixed with the engine oil and causing malfunction of the engine.

[0003] Some heavier vehicle engines utilise a separate cylinder head for each respective combustion chamber and the fuel is supplied to the respective injectors mounted in bores in the respective cylinder heads. The fuel may be supplied to the injectors via an aluminium moulding secured to cylinder heads and then pass through passageways within the cylinder head to respective compartments in the bores surrounding the injectors. Separate compartments in each bore are separated from each other by O- ring seals. A prior art internal combustion engine of the above type is described in WO 93/01409.

[0004] Fuel injectors typically comprise upper and lower parts which are screwed together and sealed against leakage from between the two parts of the injector. It is possible for seals within the injectors, or for seals used externally of the injectors to separate the injector bores into separate compartments, to be omitted or damaged during assembly or servicing.

Object of the Invention

[0005] One object with the present invention is to provide means for the detection of the omission or failure of a seal associated with a fuel injector mounted in a cylinder head. Another object is to avoid leaking fuel from being mixed with the engine oil, which otherwise could dilute the engine oil and jeopardise the function of the engine. Yet another object is to reduce other disadvantages with leaking seals and leaking fuel lines.

Brief description of the invention

[0006] A cylinder head according to the invention is distinguished by the features indicated in the characterising part of patent claim 1 and a corresponding engine is distinguished by the features indicated in the characterising part of patent claim 9. By providing within the cylinder head a draining passageway leaking fuel can be evacuated from the area around the fuel injector and the evacuated fuel can easily be detected as an indication of a seal failure. This will also drain the leaking fuel to a locations where the fuel can not be mixed with the engine oil and cause harm to the engine.

[0007] Other features and advantages which distinguish the invention are indicated by the other patent claims and the description below of an exemplifying embodiment, which is described with reference the attached drawings.

Description of Drawings

[0008]

Fig. 1 is a schematic drawing of a fuel system for an engine,

Fig. 2 is a vertical cross-section through a cylinder head according to the present invention also showing a fuel injector and a mechanical actuation system therefor, and

Fig. 3 is an enlarged section of the injector from Fig. 2.

Description of an embodiment

[0009] With reference to Fig. 1 there is shown in schematic form a fuel system for a multiple cylinder internal combustion engine such as diesel engine, for example a six cylinder in-line-engine for a truck or bus. Fuel from a fuel tank 11 is fed through a suction pipe 12 to a fuel pump 13. Fuel is then fed under pressure from the pump 13 through a pressure line 14 to fuel injectors 15 via two check valves 16, a filter 17, and a cooler 18. A hand-pump 19 is provided for re-filling the fuel system if it has been emptied. Excess fuel returns to the tank 11 through a return line 21 and a pressure relief valve 22.

[0010] With reference to Fig 2 there is shown a vertical cross-section of a cylinder head 23 having an injector 15 mounted therein. The cylinder head 23 is preferably of the type used with an engine having a separate cylinder head 23 for each combustion chamber, all the cyl-

inder heads being of identical design and therefore only one cylinder head will be described in detail.

[0011] The injector 15 is mounted at an upper side of the cylinder head in a vertical stepped bore 24, that may be sleeved where it intersects with the usual cooling water passageways 33. The injector 15 is a so called unit injector which develops the high pressure necessary for fuel injection by mechanical actuation. A rocker arm 25 mounted on a shaft 26 is connected at one end to a push rod 30 and at its other end rests on an injector rod 31. The injector rod 31 is biased upwardly by the compression spring 32. The push rod 30 has a cam follower 27 at its lower end which rests on a cam 29 fixed on a cam shaft 28, which is the same cam shaft that controls the engine inlet and outlet valves (not shown). Rotation of the cam shaft 28 causes the push rod 30 to operate the rocker arm 25 so that fuel is injected into the combustion chamber in sequence with the operation of the combustion chamber piston and valves (not shown) as is well known. The injector 15 also includes a solenoid operated valve 36 which in a known manner controls the fuel injection.

[0012] The cylinder head 23 has a lower side 34 which in use is secured to an engine block. The injector 15 is located in the substantially vertical stepped bore 24 with its nozzle 35 open to the combustion chamber and substantially in the centre of the combustion chamber. The injector 15 has an upper part 41 projecting upwardly out of the bore 24 and a lower part 42 housed in the bore 24. The injector rod 31 is reciprocated within the upper part 41 by the spring 32 and rocker arm 25. The lower part 42 of the injector comprises a plurality of portions of sequentially smaller diameter, the largest being adjacent the upper part 41 and the smallest being adjacent the nozzle 35. The upper part 41 has an external shoulder 43 by which the injector is secured in the bore 24 by a clamp 44. An air inlet manifold 40 is secured on one longitudinal side 50 of the head 23 and an exhaust manifold (not shown) is secured on an opposite longitudinal side.

[0013] The injector 15 has three axially spaced O-ring type seals 51,52,53, on its external surface. The seals are located on different diameter portions of the injector 15 and cooperate with different diameter portions of the bore 24 to form a sealed lower compartment 54 and a sealed upper compartment 55, between the injector and the walls of the bore 24. The upper seal 51 is located in a groove 57 in the upper part 41 of the injector and seals between the upper end portion of the bore 24 and the injector 15. This upper seal 51 also seals the upper compartment 55 from the upper side of the cylinder head. The lower seal 53 is located in a groove 58 in the lower part 42 and seals between a lower end portion thereof and the lower end portion of the bore 24. The middle seal 52 is located in a groove 59 in the lower part 42 intermediate the upper and lower seals 51,53 and divides the bore 24 into the two compartments 54 and 55. The two parts 41 and 42 are screwed together with the connection being located between the seals 51 and 52 and the two part are sealed to each other to prevent leakage from within the injector 15.

[0014] The compartments 54,55 comprise the lower first compartment 54 and the upper second compartment 55. The lower compartment 54 is connected to a feed passageway 56 which passes through the cylinder head 23 to the longitudinal side 50 thereof at which the inlet manifold 40 is secured. The passageway 56 is connected to the fuel pressure line 14 in an aluminium moulding 63 bolted to the side 50 of the head below the air inlet manifold 40. The upper second compartment 55 is a draining compartment and is connected to a second passageway (draining passageway) 62 which passes through the head 23 to the side 50 thereof. The second passageway 62 is threaded at its end that opens to the side 50 and receives a bolt 64 securing the moulding 63 in place. The bolt 64 has an axial through-passageway 61 therein that connects the second passageway 62 with an open outlet port 60 (drain port) on an outer surface of the moulding.

[0015] The first and second compartments 54,55 are normally sealed from each other by the seal 52, and fuel entering the first compartment 54 enters the injector 15 and as is known in the an passes internally through the injector, from where it can be injected into the combustion chamber by downward movement of the injector rod 31.

[0016] During normal use the second upper compartment 55 do not contain any fuel or is in any other way involved in or part of the fuel system. However, if the seal 52 has been omitted or damaged fuel can leak into the second compartment 55 and will flow through the groove 59 and the passageways 62 where it can be seen on a surface outside of the cylinder head 23 adjacent the outlet port 60 or in extreme cases may manifest itself as a pool on the ground beneath the engine. Furthermore, a fuel leakage between the upper and lower parts 41,42 of the injector may be similarly detected.

[0017] For safety reasons the outlet port 60 should be located on a side of the engine remote from the engine exhaust manifold, that is on the same side as the air inlet manifold 40.

[0018] In the described example each cylinder head is associated with a separate bolt 60, each having a draining passageway and a separate draining port. This enable an easy detection of which specific fuel injector is leaking. In alternative embodiments each bolt can be connected to a common passageway, preferable in the moulding 63 on the cylinder head surfaces. Such a common passageway can be open at one end of the moulding to the atmosphere where a draining port is arranged in a similar manner as described.

[0019] In other embodiments the draining ports can be connected with a line or passageway that will locate the draining port from the side surface of the cylinder head to other places that are more favourable, either at a close location to the head or at a distance therefrom.

It is also possible to locate the draining port so that fuel is evacuated to a separate container or to the ordinary fuel tank, to avoid the fuel from being drained to the ground. In such a case the line should preferable have means to detect presence of fuel in the line, such as an electronic liquid detection device or a visible container at which the fuel can be seen. In those cases the draining passage comminicates with the atmosphere through the vent lines in the fuel tank or correspondning container.

Claims

1. A cylinder head (23) for use with an internal combustion engine having at least one combustion chamber and which cylinder head comprises at least one bore (24) for mounting a fuel injector (15) therein, and a first passageway (56) within the cylinder head (23) for feeding fuel to a first compartment (54) formed by the injector and a first portion of the bore (24), **characterised in that** there is further provided within the cylinder head a draining compartment (55) that is formed by the injector and a portion of the bore (24) and which draining compartment (55) is sealed from the first compartment (54), and a draining passageway (62) extending from the draining compartment (55) to a drain port (60) that is open to the atmosphere, so that in use fuel leaking from the first compartment (54) into the draining compartment (55) can be evacuated from the area around the fuel injector (15) and the evacuated fuel can be detected as an indication of a seal failure.

2. A cylinder head as claimed in claim 1 **characterised in that** the drain port (60) is located at a side surface of the cylinder head (23).

3. A cylinder head as claimed in Claim 1 or 2 **characterised in that** the drain port (60) is located on the same side of the engine as an inlet manifold (40).

4. A cylinder head as claimed in Claim 1 **characterised in that** the drain port (60) is located at a distance from of the cylinder head (23).

5. A cylinder head as claimed in any one of Claims 1 to 4, **characterised in that** the bore (24) is a stepped bore with the draining compartment (55) having a larger diameter than the first compartment (54) and **in that** the draining compartment (55) is adjacent the first compartment (54).

6. A cylinder head as claimed in any one of Claims 1 to 5 **characterised by** an seal (51) that seals the draining compartment (55) from an upper side of the cylinder head.

7. A cylinder head as claimed in any one of Claims 1 to 6 **characterised in that** the fuel is delivered to the first passageway (56) via a moulding (63) secured to the cylinder head (23) by a bolt (64) secured in the second passageway (62), the bolt (64) having an axial passageway (61) therein which connects said draining passageway (62) with the draining port (60) and **in that** the draining port (60) is arranged at an outer axial end of the bolt.

8. A cylinder head as claimed in any one of Claims 1 to 6 **characterised in that** the fuel is delivered to the first passageway (56) via a moulding (63) secured to the cylinder head (23) by a bolt (64) secured in the second passageway (62), the bolt (64) having an axial passageway (61) therein which connects said draining passageway (62) to a channel in the moulding and **in that** the draining port (60) is arranged in the moulding.

9. A multiple cylinder internal combustion engine **characterised in that** the engine has at least one cylinder head (23) as claimed in any one of Claims 1 to 6 and **in that** the fuel injector (15) for each respective chamber is a unit injector.

10. An internal combustion engine as claimed in Claims 9 **characterised in that** each combustion chamber has a respective cylinder head (23) and that the cylinder heads are identical.

Patentansprüche

1. Zylinderkopf (23) für einen Verbrennungsmotor mit mindestens einer Brennkammer, wobei der Zylinderkopf mindestens eine Bohrung (24) zum Einbauen eines Kraftstoffinjektors (15) aufweist und ferner einen ersten Durchlass (56) innerhalb des Zylinderkopfes (23), um Kraftstoff in ein erstes Abteil (54) einzuspeisen, das vom Injektor und einem ersten Abschnitt der Bohrung (24) gebildet ist, **dadurch gekennzeichnet, dass** innerhalb des Zylinderkopfes ferner ein Entlastungsabteil (55) vorgesehen ist, das vom Injektor und einem Abschnitt der Bohrung (24) gebildet und gegen das erste Abteil (54) abgedichtet ist, und ein Entlastungsdurchlass (62), der sich vom Entlastungsabteil (55) zu einer Entlastungsöffnung (60) erstreckt, welche zur Umgebung offen ist, sodass im Betrieb aus dem ersten Abteil (54) in das Entlastungsabteil (55) sickernder Kraftstoff aus dem Bereich um den Kraftstoffinjektor (15) herum abgeführt werden kann und der abgeführte Kraftstoff als Anzeichen eines Versagens der Dichtung festgestellt werden kann.

2. Zylinderkopf nach Anspruch 1, **dadurch gekennzeichnet, dass** die Entlastungsöffnung (60) an ei-

ner Seitenfläche des Zylinderkopfes (23) angeordnet ist.

3. Zylinderkopf nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Entlastungsöffnung (60) auf der selben Seite des Motors wie ein Einlasskrümmer (40) angeordnet ist.

4. Zylinderkopf nach Anspruch 1, **dadurch gekennzeichnet, dass** die Entlastungsöffnung (30) in einem Abstand vom Zylinderkopf (23) angeordnet ist.

5. Zylinderkopf nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** die Bohrung (24) eine Stufenbohrung ist, in der das Entlastungsabteil (55) einen größeren Durchmesser als das erste Abteil (54) hat, und dass das Entlastungsabteil (55) dem ersten Abteil (54) benachbart ist.

6. Zylinderkopf nach einem der Ansprüche 1 bis 5, **gekennzeichnet durch** eine Dichtung (51), die das Entlastungsabteil (55) gegen eine Oberseite des Zylinderkopfes abdichtet.

7. Zylinderkopf nach einem der Ansprüche 1 bis 6, **dadurch gekennzeichnet, dass** der Kraftstoff dem ersten Durchlass (56) über ein Formstück (63) zugeführt wird, das am Zylinderkopf (23) mit einer Schraube (64) befestigt ist, die in dem zweiten Durchlass (62) befestigt ist und in sich einen axialen Durchlass (61) hat, der den Entlastungsdurchlass (62) mit der Entlastungsöffnung (60) verbindet, und dass die Entlastungsöffnung (60) an einem äußeren axialen Ende der Schraube angeordnet ist.

8. Zylinderkopf nach einem der Ansprüche 1 bis 6, **dadurch gekennzeichnet, dass** der Kraftstoff dem ersten Durchlass (56) über ein Formstück (63) zugeführt wird, das am Zylinderkopf (23) mit einer Schraube (64) befestigt ist, die in dem zweiten Durchlass (62) befestigt ist und in sich einen axialen Durchlass (61) hat, der den Entlastungsdurchlass (62) mit einem Kanal in dem Formstück verbindet, und dass die Entlastungsöffnung (60) in dem Formstück angeordnet ist.

9. Mehrzylinder-Verbrennungsmotor, **dadurch gekennzeichnet, dass** der Motor mindestens einen Zylinderkopf (23) nach einem der Ansprüche 1 bis 6 aufweist, und dass der Kraftstoffinjektor (15) für jede der Kammern eine Injektoreinheit ist.

10. Verbrennungsmotor nach Anspruch 9, **dadurch gekennzeichnet, dass** jede Brennkammer einen eigenen Zylinderkopf (23) hat, und dass die Zylinderköpfe identisch sind.

Revendications

1. Tête de cylindre (23) destinée à être utilisée avec un moteur à combustion interne ayant au moins une chambre de combustion, et laquelle tête de cylindre comporte au moins un alésage (24) pour montage d'un injecteur de carburant (15) dans celui-ci, et un premier passage (56) à l'intérieur de la tête de cylindre (23) pour alimenter du carburant vers un premier compartiment (54) formé par l'injecteur et une première partie de l'alésage (24), **caractérisée en ce que** sont fournis de plus, à l'intérieur de la tête de cylindre, un compartiment de drainage (55) qui est formé par l'injecteur et une partie de l'alésage (24), et lequel compartiment de drainage (55) est rendu étanche à partir du premier compartiment (54), et un passage de drainage (62) s'étendant à partir du compartiment de drainage (55) vers un orifice de drainage (60) qui est ouvert vers l'atmosphère, de sorte que, en utilisation, du carburant qui fuit à partir du premier compartiment (54) dans le compartiment de drainage (55) peut être évacué à partir de la zone située autour de l'injecteur de carburant (15), et le carburant évacué peut être détecté comme une indication d'une défaillance d'étanchéité.

2. Tête de cylindre selon la revendication 1, **caractérisée en ce que** l'orifice de drainage (60) est positionné au niveau d'une surface latérale de la tête de cylindre (23).

3. Tête de cylindre selon la revendication 1 ou 2, **caractérisée en ce que** l'orifice de drainage (60) est positionné sur le même côté du moteur qu'un collecteur d'admission (40).

4. Tête de cylindre selon la revendication 1, **caractérisée en ce que** l'orifice de drainage (60) est positionné à une distance à partir de la tête de cylindre (23).

5. Tête de cylindre selon l'une quelconque des revendications 1 à 4, **caractérisée en ce que** l'alésage (24) est un alésage étagé, le compartiment de drainage (55) ayant un diamètre plus grand que le premier compartiment (54), et **en ce que** le compartiment de drainage (55) est adjacent au premier compartiment (54).

6. Tête de cylindre selon l'une quelconque des revendications 1 à 5, **caractérisée par** un joint d'étanchéité (51) qui assure l'étanchéité du compartiment de drainage (55) à partir d'un côté supérieur de la tête de cylindre.

7. Tête de cylindre selon l'une quelconque des revendications 1 à 6, **caractérisée en ce que** le carburant est acheminé vers le premier passage (56) via

une moulure (63) fixée sur la tête de cylindre (23) par l'intermédiaire d'un boulon (64) fixé dans le second passage (62), le boulon (64) ayant un passage axial (61) dans celui-ci, qui connecte ledit passage de drainage (62) et l'orifice de drainage (60), et **en ce que** l'orifice de drainage (60) est agencé au niveau d'une extrémité axiale extérieure du boulon.

8. Tête de cylindre selon l'une quelconque des revendications 1 à 6, **caractérisée en ce que** le carburant est acheminé vers le premier passage (56) via une moulure (63) fixée sur la tête de cylindre (23) par un boulon (64) fixé dans le second passage (62), le boulon (64) ayant un passage axial (61) dans celui-ci, qui connecte ledit passage de drainage (62) à un canal situé dans la moulure, et **en ce que** l'orifice (60) est agencé dans la moulure.

9. Moteur à combustion interne à plusieurs cylindres, **caractérisé en ce que** le moteur a au moins une tête de cylindre (23) selon l'une quelconque des revendications 1 à 6, et **en ce que** l'injecteur de carburant (15) pour chaque chambre respective est un injecteur unitaire.

10. Moteur à combustion interne selon la revendication 9, **caractérisé en ce que** chaque chambre de combustion a une tête de cylindre respective (23), et **en ce que** les têtes de cylindre sont identiques.

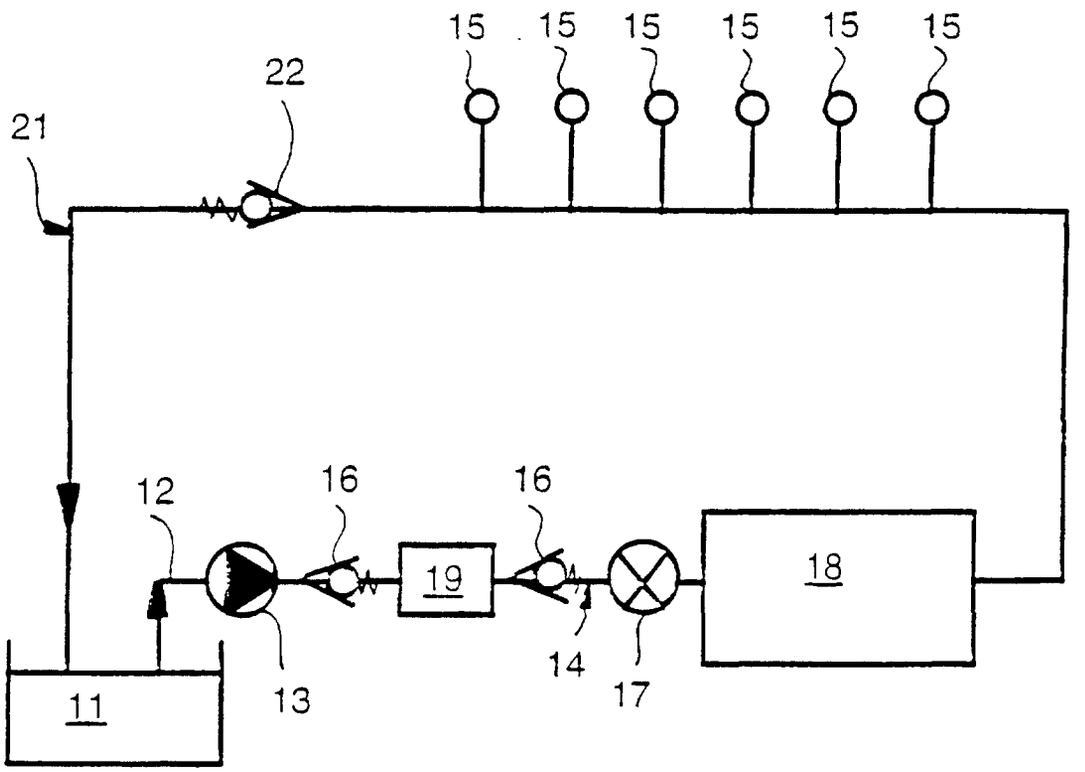

FIG 1

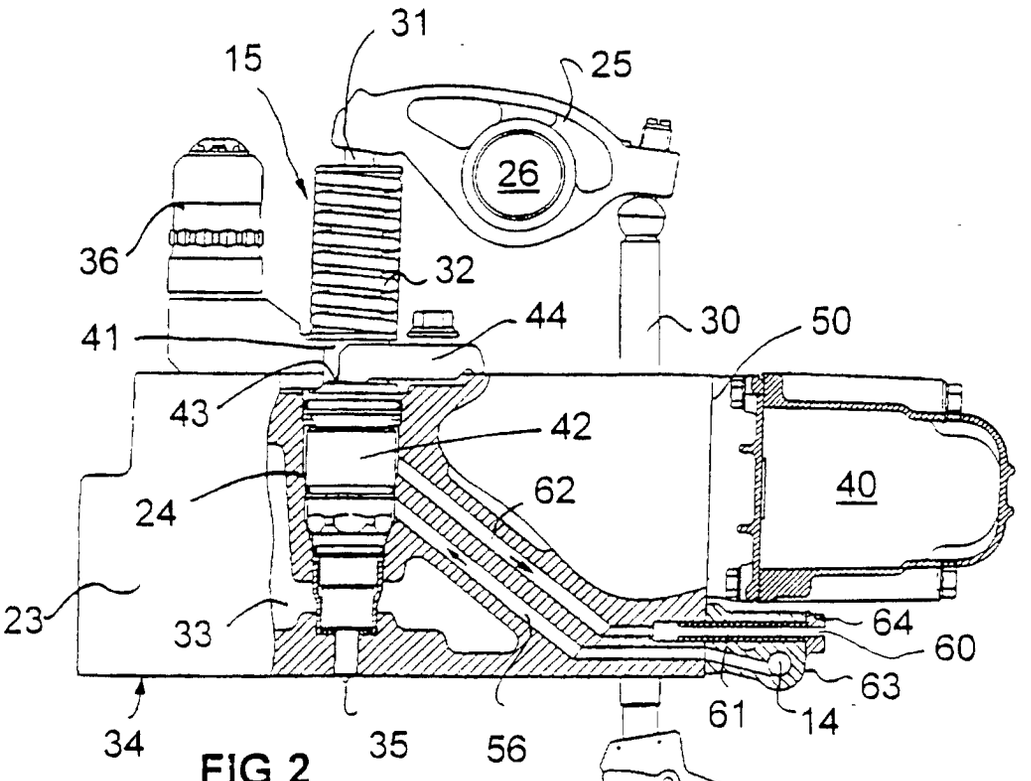
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FIG 2

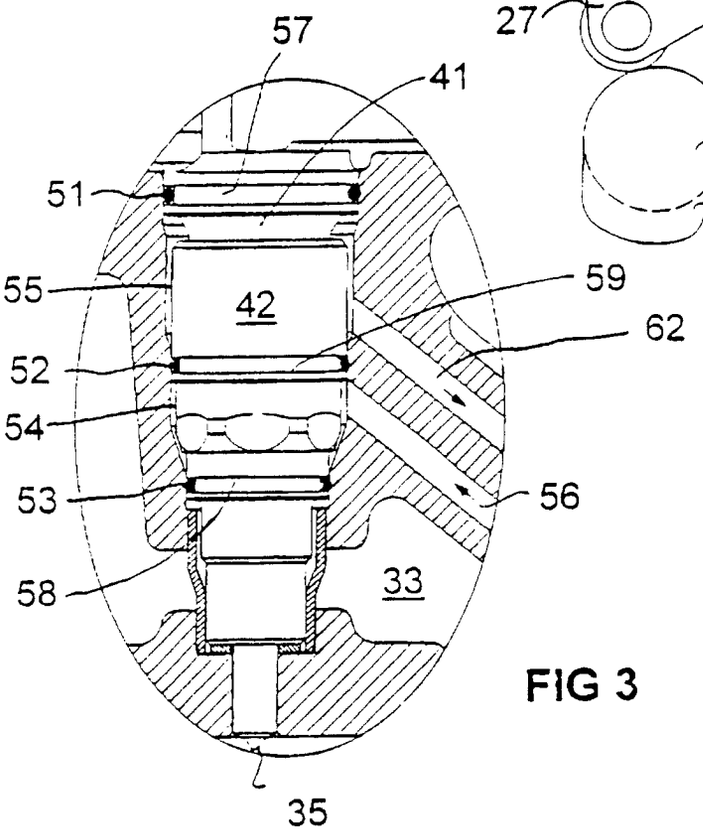
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FIG 3