

Description

Technical Field

[0001] The present invention relates to an hydraulic lash adjuster apparatus.

Background

[0002] A typical lash adjustment arrangement using a typical hydraulic lash adjuster (HLA) P1 as known in the art is shown in Figure 1. The HLA P1 comprises a first oil-containing pressure chamber P2 defined between an outer body P3 and a plunger assembly P4 slidably mounted within the outer body P3, and a spring P5 arranged to enlarge the first chamber P2 by pushing the plunger assembly P4 outwardly relative to the outer body P3 to extend the HLA P1 to take up slack in a valve train assembly. For example, the outward movement of the plunger assembly P4 relative to the outer body P3 pushes a rocker arm P10 of the valve train assembly away relative to the outer body P3, and any slack in the valve train assembly is thereby removed. The plunger assembly P4 defines a second oil containing pressure chamber P6 which is in fluid communication with the engine's oil supply (not shown). An aperture P7 between the first chamber P2 and the second chamber P6 allows oil to flow from the second chamber P6 into the first chamber P2, via a one way valve P8, when the HLA P1 extends. The one way valve P8 comprises a ball P8a captured by a cage P8b and biased by a spring P8c to a position closing the aperture P8. As the plunger assembly P4 moves outwardly, the volume of the first chamber P2 increases and a resulting oil pressure differential across the ball P8a moves it against the bias of the spring P8c, opening the aperture P7 and enabling oil to flow from the second oil chamber P6 into the first oil chamber P2. When the plunger assembly P4 stops moving outwardly, and the oil pressure across the ball P8a equalises, the ball P8a closes the aperture P7 under the action of the spring P8c.

[0003] Accordingly, a typical HLA can extend to accommodate any slack in a valve train assembly (not shown in figure 1), such as between a cam and a roller, but, after it is extended, the incompressible oil in the first chamber P2 provides sufficient rigid support for the HLA P1 to open a valve when, for example, a rocker arm pivots under the control of a cam (i.e. the incompressible oil prevents the plunger assembly P4 being pushed back inwardly of the outer body P3 so that the HLA P1 acts as a solid body). The oil can escape the first chamber P2 only slowly, for example, via a small annular 'leak-down' gap P9 defined by closely spaced leak down surfaces of the outer body P3 and the plunger assembly P4. This oil leakage down the leak down surfaces from the first chamber P2 allows the HLP P1 to retract again.

[0004] Typically, HLAs (such as P1) are positioned between two components of the valve train. In the configuration shown in figure 1, HLA P1 may be installed be-

tween, for example, a valve, a valve bridge that carries a pair of valves or a push rod that carries a valve illustrated schematically as P11 and a rocker arm illustrated schematically as P10 of a valve train.

[0005] In a typical arrangement, the HLA P1 is housed in a cavity of a rocker arm with the bottom of the outer body P3 extending out from that aperture.

[0006] Such an arrangement can limit the compactness of engines due to the space that the arrangement consumes. Moreover, there is typically a requirement in engine design that moving parts in an engine (for example, components such as a rocker arm containing a HLA) should not pass closer than a minimum distance (e.g. 2.5 mm) to a static part of the engine (for example, a fuel injector). In fulfilling this requirement, therefore, the space consumed by a typical arrangement such as in figure 1 can limit the overall compactness of the engine design.

[0007] There are limits on the extent to which the size of a typical HLA such as P1 can be reduced. For example, one limit on the size of a typical HLA such as P1 is due to the limits on the maximum value of the pressure that the oil in first chamber P2 should reach when in use. The pressure of the oil in the first chamber P2 is dependant, among other things, on the diameter of the plunger assembly P4. Hence for a given HLA load, there is an associated minimum diameter of the plunger assembly P4 (and hence outer body P3) required so that the pressure in the first chamber P2 does not exceed the specified maximum value. For a given load, therefore, typical HLAs such as P1 have a given minimum size.

[0008] It is desirable to provide an improved arrangement for hydraulic lash adjustment, preferably one with a reduced space burden as compared to conventional arrangements using conventional HLAs such as P1.

Summary

[0009] According to a first aspect of the present invention, there is provided a hydraulic lash adjuster (HLA) for use with a valve train component comprising a first body that defines a first bore; the HLA comprising: a second body that defines a second bore; and a plunger; wherein, in use, a first end of the plunger is mounted within the first bore, and a second end of the plunger is mounted within the second bore for reciprocal sliding movement with respect to the second body; wherein the second body and the plunger define a first chamber for containing a hydraulic fluid and the plunger defines a second chamber for supplying hydraulic fluid to the first chamber through a valve located between the first and second chambers in response to movement of the plunger increasing the volume of the first chamber; and wherein, in use, all of the second body is located outside of the first body.

[0010] This provides for a HLA that is compact compared to existing corresponding HLAs.

[0011] According to a second aspect of the present

invention, there is provided an arrangement for a valve train assembly in an internal combustion engine, the arrangement comprising: the HLA according to the first aspect; and the valve train component comprising the first bore.

[0012] Further features and advantages of the invention will become apparent from the following description of preferred embodiments of the invention, given by way of example only, which is made with reference to the accompanying drawings.

Brief Description of the Drawings

[0013]

Figure 1 illustrates schematically a cross-sectional side view of a typical hydraulic lash adjuster as known in the art;

Figure 2 illustrates schematically a side view of an exemplary valve train assembly;

Figure 3 illustrates schematically a cross sectional view of an end of an exemplary rocker arm carrying a hydraulic lash adjuster arrangement; and

Figure 4 shows a schematic side view of the exemplary rocker arm partially illustrated in Figure 3.

Detailed Description

[0014] Figure 2 schematically illustrates a valve train assembly 2 comprising a rocker arm 4 according to an example embodiment of the present invention. The valve train assembly 2 may be, for example, a standard overhead cam (SOHC) valve train.

[0015] The rocker arm 4 comprises a hydraulic lash adjustment arrangement 6 at one end 14 thereof and a roller 10 rotatably mounted on an axle 12 at the other end 8 thereof. The rocker arm 4 is pivotally mounted, at around its midpoint, on a rocker arm axle 16. The hydraulic lash adjustment arrangement 6 comprises an outer body 30 and a plunger 38 (to be described in more detail below). The outer body 30 comprises a part spherical end 17 for engaging a complimentary shaped socket of a so called 'Elephant' foot 19 that engages a valve (bridge) carrying or engaging component 20. For example, the component 20 may be a valve bridge that carries a pair of exhaust valves 18 or a pair of inlet valves 18 of an engine cylinder 21. Alternatively, for example, the component 20 may be a push rod that engages a single exhaust valve 18 or a single inlet valve 18 of the engine cylinder 21.

[0016] A cam 22 mounted on a cam shaft 24 has a lobe 24a which as the cam 22 rotates with the cam shaft 24 engages the roller 10 and thus causes the rocker arm 4 to pivot counter clockwise, as shown in the drawing, about the axle 16 whereby the plunger 38 depresses the valve 18 (or valves) against the force of a valve spring (not shown) to open the valve (or valves) 18. As the cam 22 continues to rotate, once the peak of the lobe 24a has

passed out of engagement with the roller 10 the valve (or valves) 18 begins to close under the action of a valve spring(s) (not shown). Once a base circle 24b of the cam 22 is engaged with the roller 10 the valve (or valves) 18 is fully shut.

[0017] Referring now to Figures 3 and 4, the rocker arm 4 defines, at the first end 14 thereof, a bore 301 formed along a longitudinal axis A-A of the first end 14. The bore 301 extends part way into the rocker arm 4 from a surface 304 of the rocker arm 4 to a bore end 306 within the rocker arm 4.

[0018] A first end 400 of the plunger 38 of the hydraulic lash adjustment arrangement 6 is mounted in the bore 301 of the rocker arm 4 and is fixedly connected to the rocker arm 4. A clip 380 (e.g. "C" shaped) partially sitting in a circumferential cavity 384 of the first end 400 of the plunger 38 abuts against a corresponding cavity 62 of the bore 301 within the rocker arm 4 to hold the plunger 38 fixed with respect to the rocker arm 4. For example, during installation of the plunger 38 into the bore 301 of the rocker arm 4, the clip 380 is placed in the cavity 384 of the plunger, and when the plunger 38 is inserted into the bore 301 of the rocker arm 4, the clip 380 snaps (i.e. expands outwardly) to partially sit in the cavity 62 of the bore 301 of the rocker arm 4. The clip 380 may be a wire clip and may be any suitable state, e.g. toroidal. A second end 410 of the plunger 38 extends out of the bore 301 beyond the rocker arm 4.

[0019] The outer body 30 of the hydraulic lash adjustment arrangement 6 has a closed end 32 and an open end 34 and defines a longitudinal bore 36 between the closed 32 and open 34 ends. The closed end 32 is formed partly spherical and is for engaging the complimentary shaped socket 19 that engages the valve carrying or engaging component 20 (not shown in figures 3 and 4). The second end 410 of the plunger 38 is mounted for sliding movement back and forth within the bore 36 of the outer body 30, the upper end 400 of the plunger 38 extending above the bore 36. The outer body 30 does not extend into the bore 301 of the rocker arm 4, that is, the whole of the outer body 30 is located outside of the rocker arm 4. There is a middle portion 382 of the plunger 38 that is neither within the bore 301 of the rocker arm 4, nor within the bore 36 of the outer body 30. The outer diameter of the outer body 30 is not larger than the outer diameter of the end 14 of the rocker arm 4 in which the plunger 38 is mounted. That is, the radial profile of the outer body 30 does not extend beyond the profile of the end 14 of the rocker arm 4 in which the plunger 38 is mounted. More specifically, no part of the outer body 30 extends beyond the end 14 of the rocker arm 4 in which the plunger 38 is mounted in a direction parallel to the axis along which plunger 38 and outer body 30 reciprocally slide.

[0020] As described above, the first end 400 of the plunger 38 is mounted in bore 301 of rocker arm 4, and the second end 410 of the plunger 38 is mounted in bore 36 of the outer body. In one example, the length of the second end 410 of the plunger 38 that is mounted (i.e.

mountable) in bore 36 of the outer body 30 is less than 80% of the total length of the plunger 38. This is different to typical HLAs such as HLA P1 in figure 1, in which the length of the plunger P4 mountable in outer body P3 is typically a minimum of 80% of the total length of the plunger P4. The length of the second end 410 of the plunger 38 mountable in bore 36 of the outer body 30 being less than 80% of the total length of the plunger 38 allows the first end 400 of the plunger 38 to be securely mounted in bore 301, and fixedly connected to the rocker arm 4. In one example, the length of the second end 410 of the plunger 38 that is mounted (i.e. mountable) in bore 36 of the outer body 30 is in the range of 50% to 80% of the total length of the plunger 38, and preferably is in the range of 50% to 65% of the total length of the plunger 38, although this percentage may be even less than 50%. Correspondingly, in some examples, the length of the first end 400 of the plunger 38 is a significant proportion, for example in the range 30% to 50%, or an even higher percentage, of the total length of the plunger 38. In some examples, the ratio of the total length of the plunger 38 to the outer diameter of the plunger 38 is greater than 2, for example, the ratio may be in the range 2.3 to 3.5, and preferably is in the range 2.3 to 2.5, although other ratios may be used. This is different to typical HLAs such as HLA P1 in figure 1, in which the ratio of the total length of the plunger assembly P4 to the outer diameter of the plunger assembly P4 is typically 2 or less.

[0021] The plunger 38 and the outer body 30 define between them a first oil chamber 40 towards the bottom of the bore 36 of the outer body 30 (i.e. towards the bottom of the hydraulic lash adjustment arrangement 6). An aperture 42 at the bottom of the plunger 38 allows oil to flow from a second oil chamber, or oil reservoir, 44 within the plunger 38 into the first oil chamber 40 when the hydraulic lash adjustment arrangement 6 expands. Below the aperture 42, a ball valve 46 is provided which comprises a ball 48 captured by a cage 50 and biased by a spring 52 to a position closing the aperture 42. The plunger assembly 38 is biased outwardly of the outer body 30 by means of a spring 54 held within the first oil chamber 40.

[0022] In use, the spring 54 expands the overall length of the hydraulic lash adjustment arrangement 6 by pushing the plunger 38 outwardly of the outer body 30 so as to take up any slack in the valve train assembly 2. As the plunger 38 moves outwardly, the volume of the first chamber 40 increases and a resulting oil pressure differential across the ball 48 moves it against the bias of the spring 52, opening the aperture 42 and enabling oil to flow from the second oil chamber 44 into the first oil chamber 40. When the plunger 38 stops moving outwardly, and the oil pressure across the ball 48 equalises, the ball 48 closes the aperture 42 under the action of the spring 52. When pressure is applied to the upper end of the plunger 38 by the rocker arm 4 as the rocker arm 4 pivots, inward movement of the plunger 38 is inhibited by the high pressure of oil in the first oil chamber 40. The oil in the first oil chamber 40 cannot flow back into the second oil chamber

44 because of the ball 48. Oil can escape the first oil chamber 40 (which enables the hydraulic lash adjustment arrangement 6 to collapse again) by leaking between the surface of the bore 36 of the outer body 30 and the outer surface of the plunger 38 (as illustrated by thick dashed arrows in figure 3), but this can occur only very slowly (particularly if the oil is cold) because the bore 36 and the plunger 38 are made to tight tolerances to restrict oil flow.

[0023] A clip 324 encompasses the outside of the outer body 30 at end 34 of the outer body 30 and sits in recess 396 in the outside of outer body 30 so as to be fixedly connected to outer body 30. The outer surface of the plunger 316 has steps 395 and 397 that define between them a shallow cavity 399 in the outer surface of the plunger 38. The clip 324 comprises a section 386 that extends into the bore 36 of the outer body 30 so as to engage or abut against either step 395 or step 397 in the outer surface of the plunger 316 and thereby restricting sliding movement of the outer body 30 with respect to the plunger 38 to within the range defined by the distance between the steps 395 and 397. The clip 324 prevents the outer body 30 from sliding off of the plunger 38 completely when the rocker arm is not connected in a valve train, for example during shipping of the rocker arm 4, or during a service of the engine comprising the rocker arm 4. The clip 324 lies within the profile of the outer body 30, that is, the radial extent of the clip is not more than the radial extent of the outer body 30. Advantageously, the clip 324 therefore does not impact the space consumed by the hydraulic lash adjustment arrangement 6. Optimally, the clip 324 may be removed from the outer body 30 after the hydraulic lash adjustment apparatus 6 is installed in a valve train, or if left in situ, does not perform any function in the operating HLA.

[0024] As mentioned above, the outer body 30 of the hydraulic lash adjustment apparatus 6 does not extend into rocker arm 4. That is, the whole of the outer body 30 is located outside of the rocker arm 4, including during use. This is different to typical arrangements such as shown in figure 1 using typical HLAs such as HLA P1, where the outer body P3 extends into rocker arm P10. Advantageously, having only the plunger 38 (and not the outer body 30) extending into the bore 301 of rocker arm 4 allows for the thickness of end 14 of rocker arm 4 to be reduced (by at least the thickness of the outer body walls that would have otherwise been inside the rocker arm), and hence allows for a more compact engine design. This reduction is made without compromising the load for which the hydraulic lash adjustment apparatus 6 is suitable, that is the reduction is made without needing to reduce the diameter of the outer body 30 or the plunger 38. Further, as mentioned above, the outer diameter of the outer body 30 is not larger than the outer diameter of the end 14 of the rocker arm 4 in which the plunger 38 is mounted. This allows for the overall space that the combination of end 14 of rocker arm 4 and outer body 30 consume (at least radially with respect to the outer

body 30) to be small, and hence also allow for more compact engine design. The outer diameter of the plunger 38 may typically be, for example, in the range of 11 mm to 16 mm, the outer diameter of the outer body 30 may correspondingly be in the range 16 mm to 22 mm, and the outer diameter of the end 14 of rocker arm 4 may be correspondingly in the range 24 mm to 30 mm. In one example, for a maximum load of 3500 N, the outer diameter of the plunger 38 is preferably 11 mm, the outer diameter of the outer body 30 is preferably 16 mm, and the outer diameter of end 14 of the rocker arm 4 is preferably 24 mm. In another example, for a maximum load of 8000 N, the outer diameter of the plunger 38 is preferably 16 mm, the outer diameter of the outer body 30 is preferably 22 mm, and the outer diameter of end 14 of the rocker arm 4 is preferably 30 mm. The reduced space burden associated with the hydraulic lash adjustment apparatus 6 may be of particular use, for example, in a medium duty engine valve train, where a rocker arm 4 is typically positioned in close proximity to fuel injectors (not shown in the figures) that are static with respect to the engine block. The reduced radial profile of the hydraulic lash adjustment apparatus 6 allows for the rocker arm 4 to be placed closer to the static fuel injector whilst still fulfilling the requirement that the moving rocker arm 4 does not pass closer than a minimum distance (e.g. 2.5 mm) to the static fuel injector. Hence a more compact engine design may be achieved.

[0025] As is most clearly seen in Figure 4, the oil in the second oil chamber 44 is kept supplied from the engine's oil supply (not shown) via an oil supply path at least in part defined by a first conduit (not shown) formed in the rocker shaft 16 and a second conduit 56 drilled through the rocker arm 4 from an aperture 60, through which the rocker shaft 16 (not shown in Figure 4) extends, to the recess 62 in which the plunger 38 is supported by the clip 62. Oil supplied via the oil supply path into the cavity 62 can flow into the first oil chamber 44 through a hole 64 formed through a side wall 65 of the plunger 38.

[0026] As mentioned above, in some examples, the ratio of the total length of the plunger 38 to the outer diameter of the plunger 38 is significantly greater than 1.5, for example, the ratio may be in the range 2 to 3. This is different to typical arrangements such as shown in figure 1 using typical HLAs such as HLA P1, where the corresponding ratio is typically around 1.5. As a result of the relatively long plunger 38, the oil reservoir 44 within the plunger 38 has an increased length, and hence increased volume compared to typical HLAs. Advantageously, the resulting larger volume of oil that can be stored in the oil reservoir 44 is useful for the operation of the hydraulic lash adjustment apparatus 6 for example when an engine in which the hydraulic lash adjustment apparatus 6 is installed is cold, and hence the oil supply to the reservoir 44 via the second conduit 56 is delayed.

[0027] As most clearly seen in Figure 3, the top of the second oil chamber 44 within plunger 38 is closed by a lid portion 388. The lid portion 388 is supported by a re-

cess 390 in the inner walls of the outer body 30, and is fixedly connected thereto, for example via a press fit. The lid portion 388 is concave so as to extend partially into the second oil chamber 44 of the outer body 30. This allows a space between the lid portion 388 and the bore end 306 of rocker arm 4 to fit a bolt 76 (described in more detail below). The lid portion 388 substantially prevents oil from spilling from the oil chamber 44. The lid portion 388 has an aperture 320 extending all of the way through the lid portion 388. The aperture 320 is threaded and, in use, a bolt 76 is received in the aperture 320 so as to substantially prevent oil from leaking from the first oil chamber 44 through the aperture 320. The lid portion 388 is concave to ensure that the bolt 76 does not extend beyond the outer profile of the plunger 38 when fitted into aperture 320, that is to ensure the bolt 76 does not come into contact with the rocker arm 4. Advantageously, in such a way, force may be transferred between the rocker arm 4 and the plunger 38 directly via the plunger 38 itself, and not via lid portion 388 or bolt 76. Advantageously, the concave shape of the lid portion 388 allows the lid portion to 388 to be easily pressed from a thin metal sheet. Further, the concave shape allows for a reliable press fit of the lid portion 388 into the recess 390 in the inner walls of the outer body 30. However, the lid portion 388 need not necessarily be concave. For example the lid portion 388 may instead may be substantially flat, but have a recessed portion (not shown in the figures) in which the bolt 76 may be located such that the bolt 76 does not extend beyond the outer profile of the plunger 38.

[0028] The aperture 320 has a diameter that is large enough so that during assembly and/or testing of the hydraulic lash adjustment apparatus 6 it is possible to insert a needle, or any other suitable implement or tool through the aperture 320 to repeatedly push down on and hence open the ball 48 so that oil can flow from the first chamber 44 to the second chamber 40. This procedure is known as the 'pump-up' procedure. The 'pump-up' procedure is commonly performed when testing the leakage characteristics of the hydraulic lash adjustment apparatus 6 to ensure first that the chamber 40 is suitably filled with oil. For example, the 'pump-up' procedure may be performed prior to a measurement of the so called 'leak-down time' of the hydraulic lash adjustment apparatus 6, i.e. the characteristic time taken for oil to leak from the second oil chamber 40.

[0029] Preferably, the bolt 76 has an engagement recess (not shown) for allowing the bolt 76 to be screwed and unscrewed from the aperture 320 using, for example a screwdriver or the like that engages with the engagement recess.

[0030] As mentioned above, advantageously, when in place, the bolt 76 substantially prevents oil from spilling out of the first chamber 44 through the aperture 320. Preferably, however, even when the bolt 76 is screwed tightly into the aperture 320, the bolt 76 does not form an airtight seal between the first oil chamber 44 and the outside of

the first oil chamber 44 so that air can be purged from the first oil chamber 44 when the housing 318 fills with oil.

[0031] In one example, the bolt 76 does not form an airtight seal due to the small gaps (not shown) between the thread of the bolt 76 and the thread of the aperture 320. In an alternative example, the bolt 76 does not form an airtight seal because of one or more narrow longitudinal holes (not shown) running from one end of the bolt to the other end of the bolt.

[0032] The bolt 76 need not be threaded. For example the bolt 76 may be a stopper (not shown in the figures) that is placed into the aperture 320.

[0033] Although in the above reference is made to "oil", this may be substituted for any suitable hydraulic fluid. Therefore, it will be appreciated that an "oil chamber" and the like as described above may be substituted for a "hydraulic fluid chamber" and the like.

[0034] Although in the above described embodiment, the valve train component comprising the hydraulic lash adjustment apparatus 6 is a rocker arm, in other examples, different valve train components may be provided with such a hydraulic lash adjustment apparatus including other components that move in dependence upon a cam of the valve train, for example, a valve bridge, or a push rod, or static components, for example, a valve train cover.

[0035] The above embodiments are to be understood as illustrative examples of the invention. It is to be understood that any feature described in relation to any one embodiment may be used alone, or in combination with other features described, and may also be used in combination with one or more features of any other of the embodiments, or any combination of any other of the embodiments. Furthermore, equivalents and modifications not described above may also be employed without departing from the scope of the invention, which is defined in the accompanying claims.

Claims

1. A hydraulic lash adjuster (HLA) (6) for use with a valve train component comprising a first body (4) that defines a first bore (301); the HLA comprising:

a second body (30) that defines a second bore (36); and
a plunger (38);

wherein, in use, a first end of the plunger (38) is mounted within the first bore (301), and a second end of the plunger (38) is mounted within the second bore (36) for reciprocal sliding movement with respect to the second body (30);
wherein the second body (30) and the plunger (38) define a first chamber (40) for containing a hydraulic fluid and the plunger (38) defines a second chamber (44) for supplying hydraulic fluid to the first chamber

(40) through a valve (46) located between the first (40) and second (44) chambers in response to movement of the plunger (38) increasing the volume of the first chamber (40); and
wherein, in use, all of the second body (30) is located outside of the first body (4).

2. The HLA (6) according to claim 1, the HLA (6) comprising:

a restricting means (386) for restricting the reciprocal sliding movement of the plunger with respect to the second body to within a limited range to inhibit the second body from sliding off the plunger completely when the HLA (6) is not connected in a valve train.

3. The HLA (6) according to claim 2, wherein the plunger comprises a step in the diameter of the outer surface of the plunger; and the restricting means (386) is a clip that is fixedly connected to the second body and is arranged so as to abut against either the step of the plunger so as to restrict the reciprocal sliding movement of the plunger with respect to the second body.

4. The HLA (6) according to any preceding claim, wherein the (HLA) (6) further comprises a first biasing means arranged to bias the second body away from the plunger.

5. The HLA (6) according to any preceding claim wherein a first portion of the plunger comprises an aperture that provides access to the second chamber, the plunger further comprising a stopper inserted into the aperture, wherein the stopper is arranged so as to substantially prevent hydraulic fluid from exiting the second chamber while allowing air to be purged from the second chamber.

6. The HLA (6) according to claim 5 wherein the stopper comprises a threaded stem for engaging a complementary threaded part of the first portion of the plunger to fasten the stopper in the aperture.

7. The HLA (6) according to claim 5 or claim 6, wherein the first portion of the plunger is concave with respect to the outside of the plunger such that the stopper, when inserted into the aperture, is contained within the outer profile of the plunger.

8. The HLA (6) according to any of claims 5 to 7, wherein the first portion of the plunger is a removable lid of the plunger located on a side of the plunger opposite to the first chamber.

9. The HLA (6) according to any preceding claim wherein, in use, the first end of the plunger (38) is

fixedly connected to the first body (4).

10. The (HLA) (6) according to any preceding claim wherein the second body (30) comprises an engaging portion for engaging a further component of the valve train. 5
11. The HLA (6) according to any preceding claim, wherein an outer diameter of the second body is smaller than or the substantially the same as an outer diameter of a portion of the first body that is adapted to hold the hydraulic lash adjuster. 10
12. The HLA (6) according to any preceding claim, wherein a ratio of a length of the plunger to an outer diameter of the plunger is greater than 2. 15
13. The HLA (6) according to any preceding claim, wherein a length of the plunger mountable into the second bore is less than 80% of a total length of the plunger. 20
14. An arrangement for a valve train assembly (2) in an internal combustion engine, the arrangement comprising: 25

the HLA (6) of any preceding claim; and

the valve train component comprising the first bore (301). 30
15. The arrangement of claim 14 wherein the valve train component is a rocker arm.
16. The arrangement of claim 14 or 15 wherein the valve train assembly comprises a valve bridge for carrying two or more valves of an engine cylinder, and the second body comprises an engaging portion for engaging the valve bridge. 35

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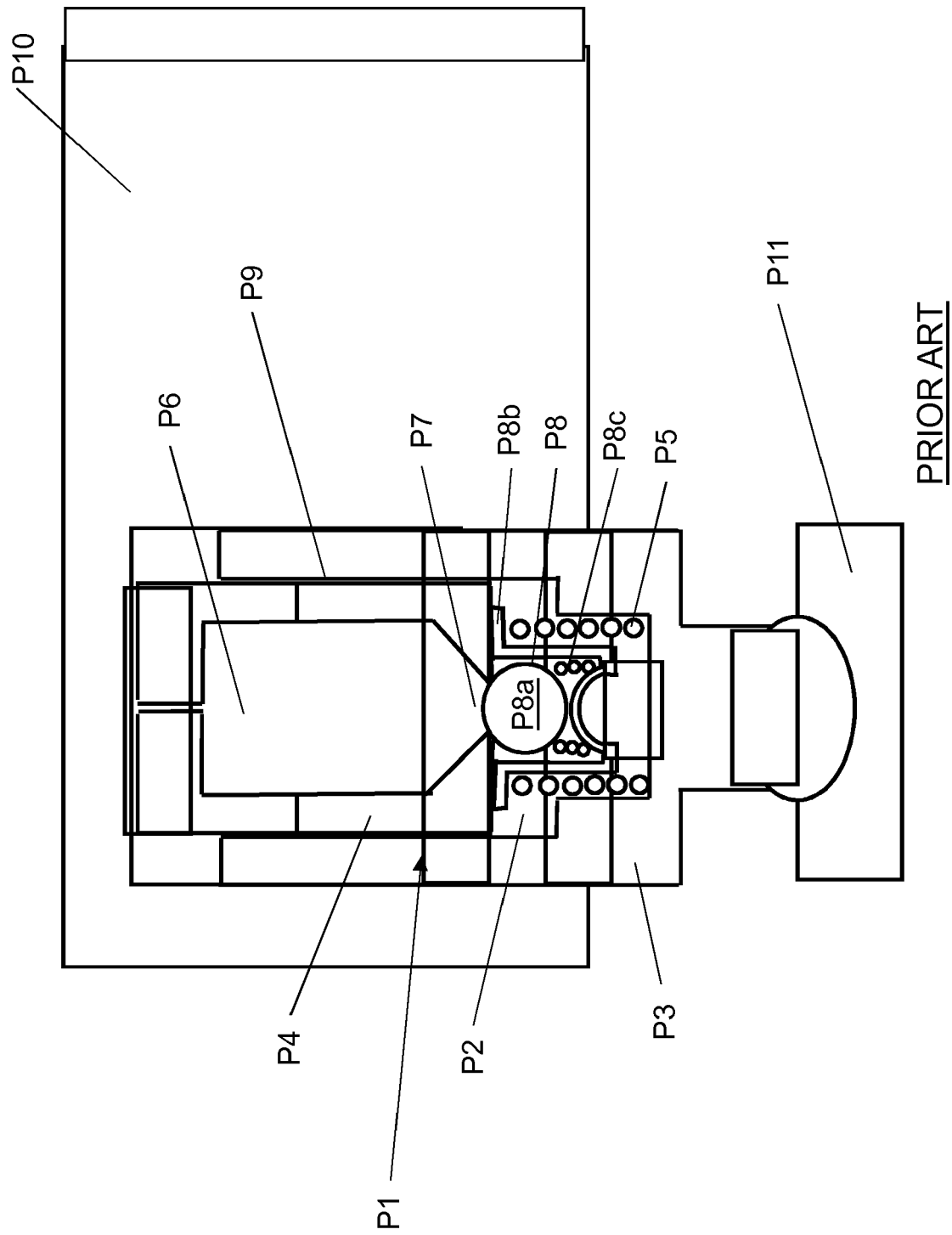


Figure 1

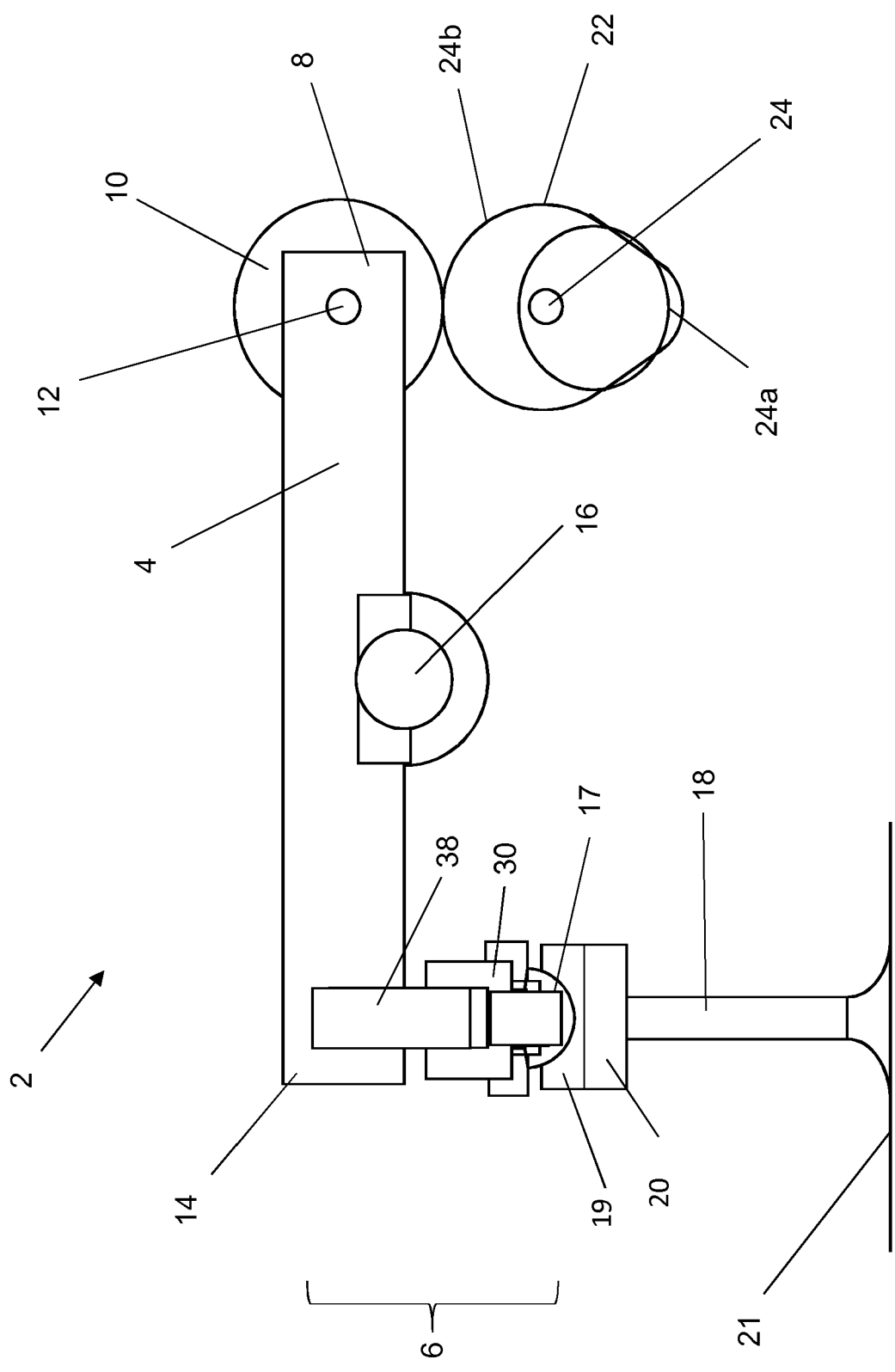
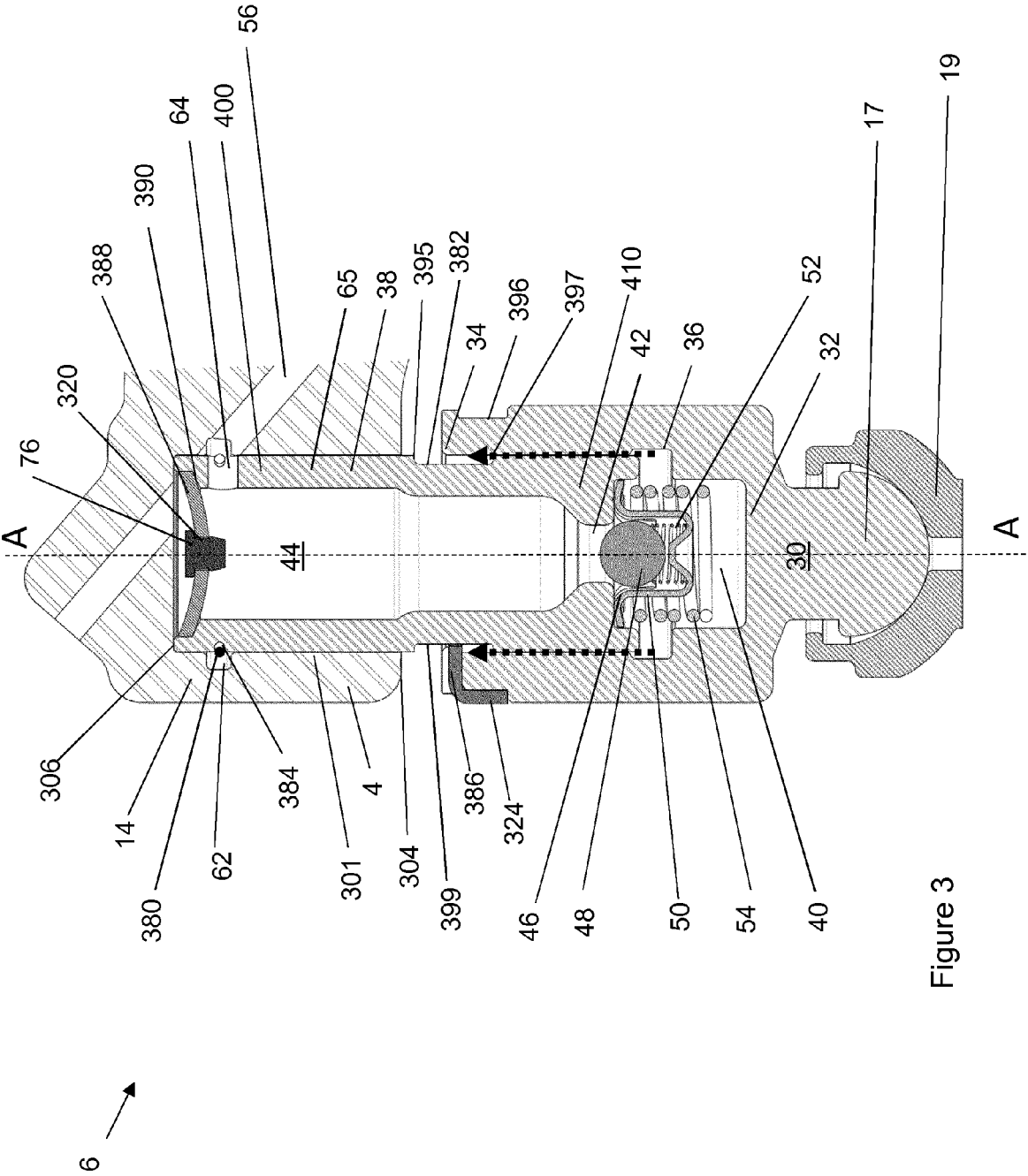


Figure 2



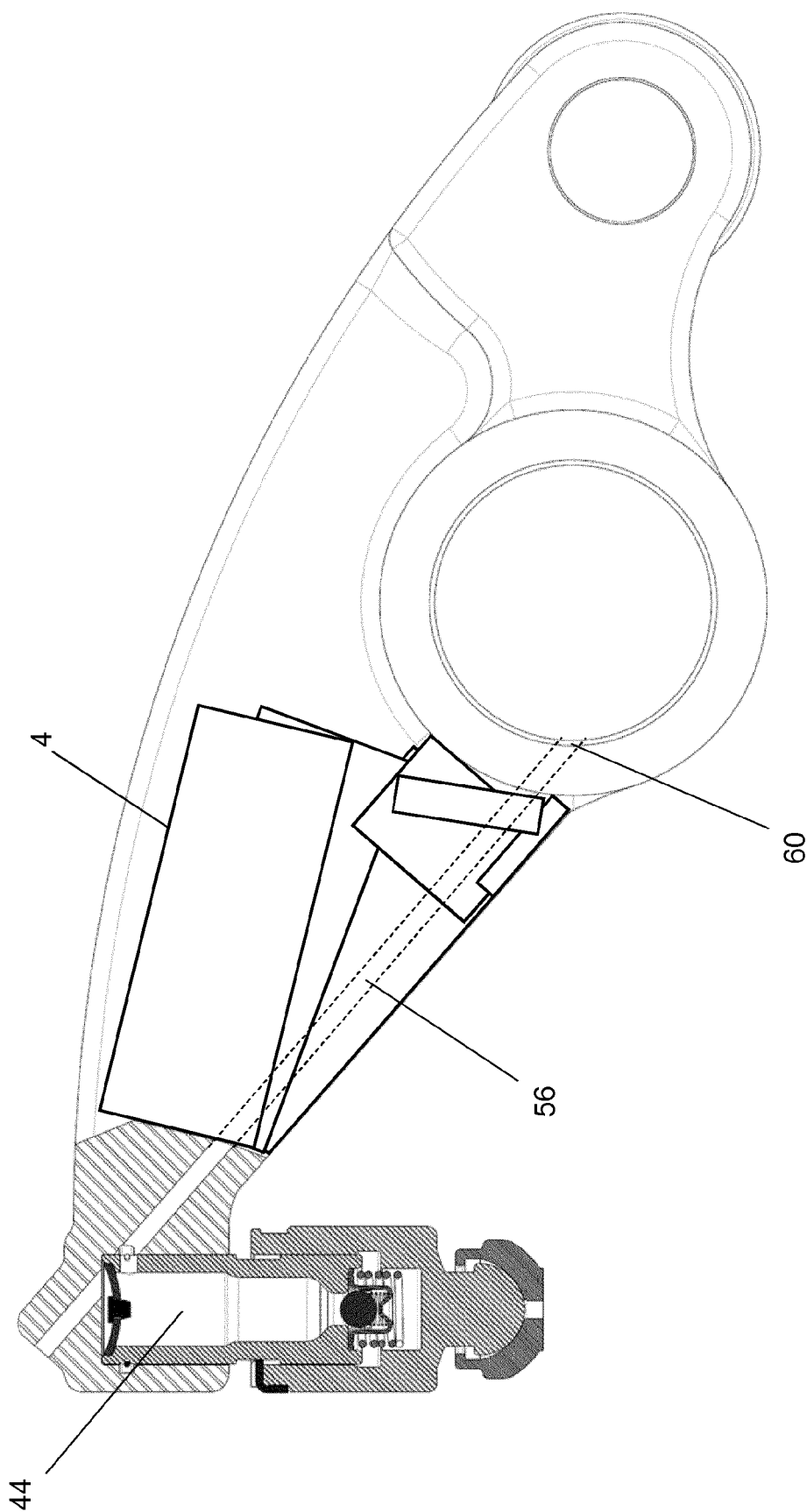


Figure 4



EUROPEAN SEARCH REPORT

Application Number
EP 16 18 7707

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	DE 195 02 497 A1 (SCHAEFFLER WAEELZLAGER KG [DE]) 1 August 1996 (1996-08-01) * the whole document *	1-16	INV. F01L1/24
A	DE 10 02 162 B (SULZER AG) 7 February 1957 (1957-02-07) * the whole document *	1-16	
A	DE 199 35 296 A1 (PFLEIDERER ERNST [DE]) 20 April 2000 (2000-04-20) * the whole document *	1-16	
			TECHNICAL FIELDS SEARCHED (IPC)
			F01L
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 13 January 2017	Examiner Klinger, Thierry
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 16 18 7707

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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13-01-2017

10	Patent document cited in search report	Publication date	Patent family member(s)	Publication date
	DE 19502497	A1	01-08-1996	NONE
	DE 1002162	B	07-02-1957	NONE
15	DE 19935296	A1	20-04-2000	NONE
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82