

[54] **HYDRAULIC VALVE LIFTER**
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[58] Field of Search123/90.55, 90.57, 90.46, 90.63,
123/90.16

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[57] **ABSTRACT**

A hydraulic lifter with bleed provisions opening near the end of every lift (valve opening) stroke to pump down the lifter's high pressure oil chamber. A lifter body, centrally bored, houses a plunger which is movable to expand and contract the high pressure chamber. Plunger movement adjusts the lifter length. The lifter rides in a close fitting sleeve. An oil feed opening through the sleeve supplies oil, once per cycle, to a reservoir through aligned openings in the lifter body and plunger. Near the end of each lift stroke, when the compression on the lifter is great, a bleed hole through the lifter body aligns with a bleed passage in the sleeve. Oil is repeatedly forced from the high pressure chamber, assuring the removal of all air accumulated in the chamber and stopping initial valve lash and clatter.

9 Claims, 2 Drawing Figures

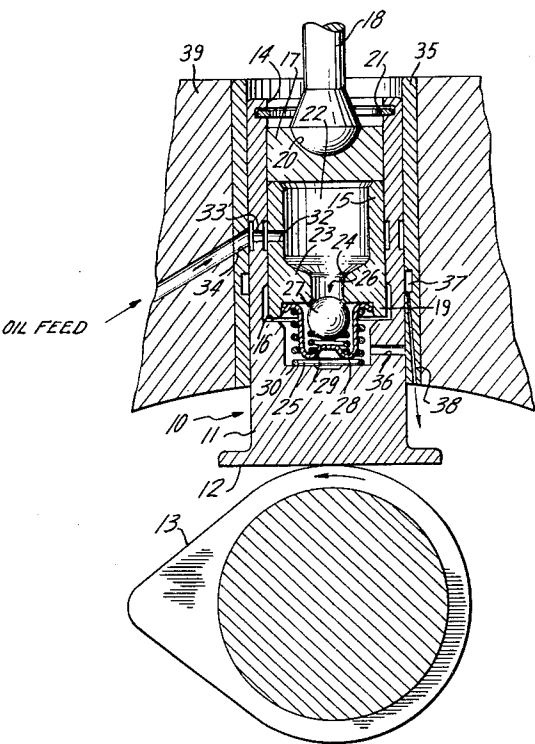
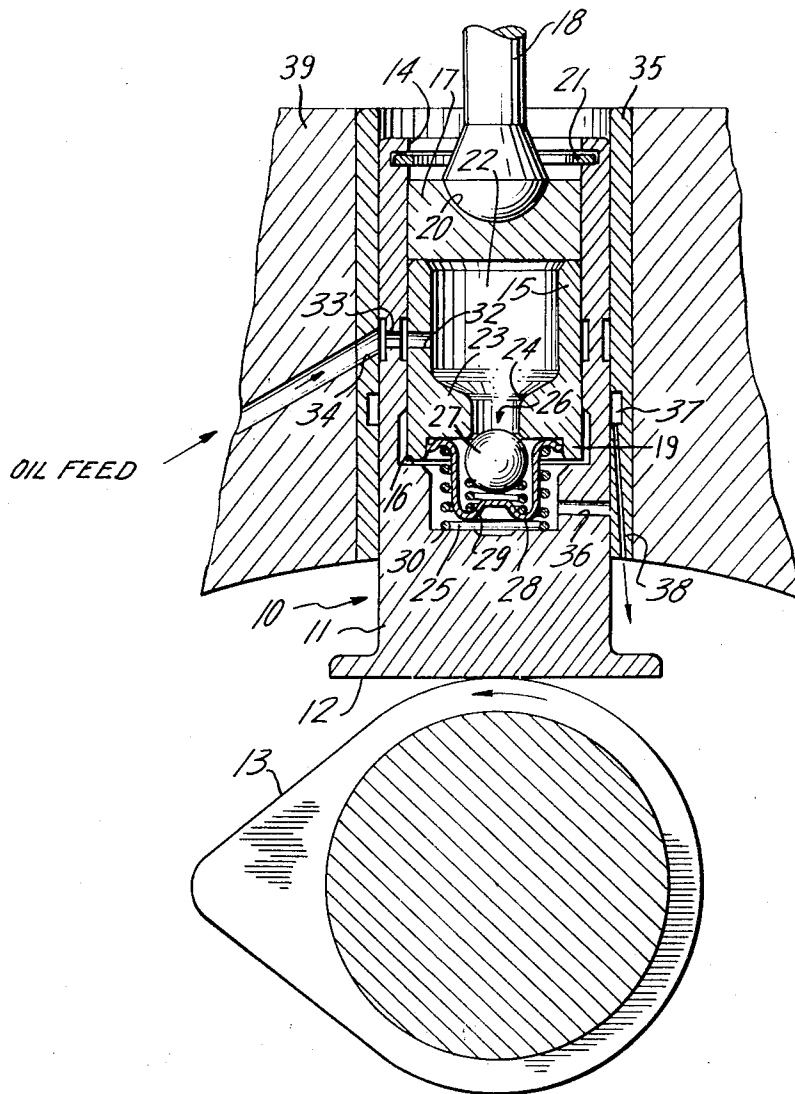


FIG. 1

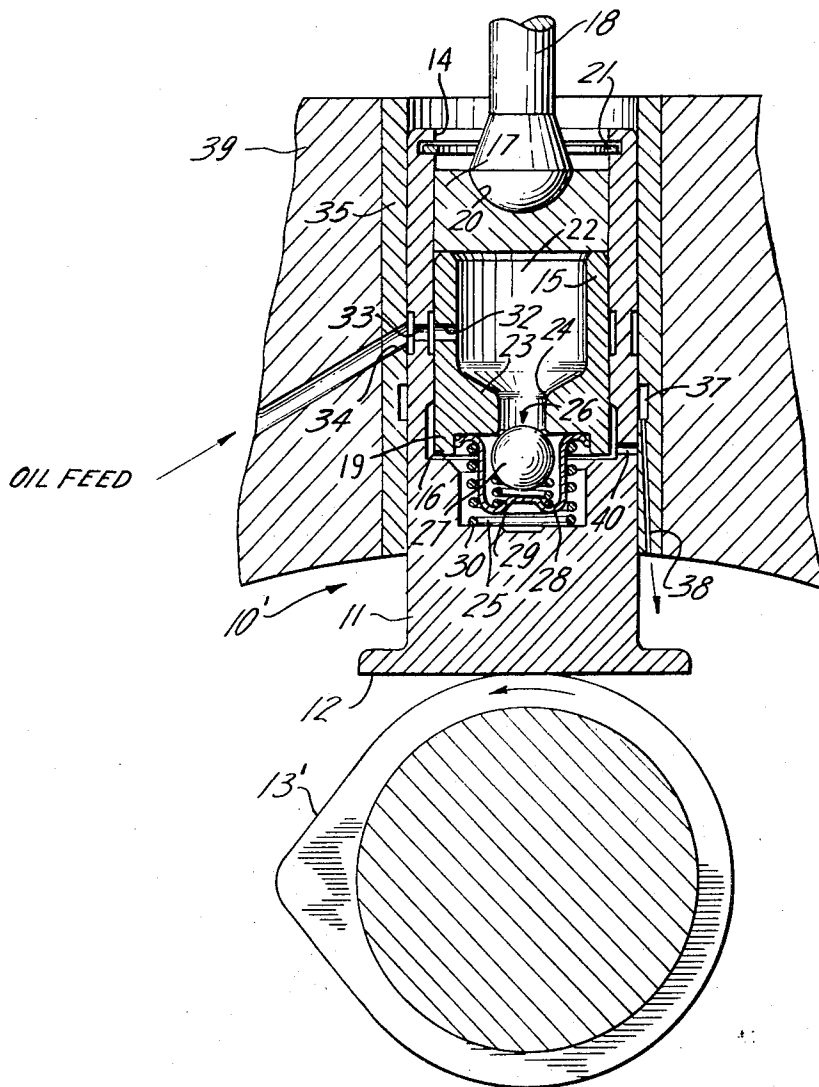


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FIG. 2



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HYDRAULIC VALVE LIFTER

BACKGROUND OF THE INVENTION

This invention relates to hydraulic valve adjusters and more particularly relates to hydraulic adjusters with bleed off provisions for the removal of accumulated air.

Hydraulic valve lifters which compensate for the cyclic expansion and contraction of valve gear components to eliminate lash have been employed now for quite some time. When operating correctly, hydraulic lifters provide not only quiet operation, but better control of the timing of valve movements. For proper expansion and contraction during each cycle of operation, oil under pressure must be admitted to the pumping elements of the lifter, completely filling the internal chambers. When air has accumulated in the chambers, the lifters operate as though purely mechanical or solid. Then, excessive lash results in clatter.

The defect just mentioned commonly is noticed when an engine is initially started after a period of disuse, for example, when a vehicle has been parked overnight. Valve clatter remains in evidence until oil pressure is established in the engine and the air within the lifter is bled out of the lifter chambers. Normally, it is necessary for the air to leak through the rather close clearances between an internal pumping element and the lifter bore to permit oil completely to fill the lifter chambers. In this case, clatter is evident for a prolonged period.

Lifters have been designed to bleed air from the internal chambers more effectively. Some, for example, depend on the collapse of the high pressure chamber when air is present therein, to align escape passages, venting the high pressure chamber. In these, partial expansion of the lifter would appear to close the air bleed passages even if some air remains. If this occurs, the full hydraulic expansion and contraction of the lifter will not be achieved. Also, some lifter designs assume air will remain uppermost in a particular chamber. A bleed passage opens only initially into the uppermost part of the chamber. If during the initial lifter strokes, the air is thoroughly intermixed with the oil, the air may not entirely be removed, until the intermixed air and oil has finally bled through the internal lifter clearances in the usual fashion.

Other arrangements propose bleeding down the internal reservoir, not the high pressure chamber, during each cycle. This proposal overlooks the accumulation of air in the high pressure chamber where the effects are most pronounced. Another proposal has been to open a path to the high pressure chamber when the lifter is under least pressure; then pumping of air from the high pressure chamber will be least because the fluid pressure in the chamber is reduced.

Many of the lifters designed to expell accumulated air and eliminate initial clatter require numerous parts machined to close tolerances and these would be costly to produce. None is known which provides cycle-to-cycle opening of a bleed path to the high pressure chamber when the lifter is under increased compression, thereby to effect continued forceful pumping effectively to remove all air.

SUMMARY OF THE INVENTION

In view of the foregoing, it is an object of the invention to provide a hydraulic valve lifter or adjuster with improved provisions for removing accumulated air while avoiding the disadvantages of the prior art.

Another object of the invention is to provide a hydraulic adjuster with cycle-to-cycle pumping action from the high pressure chamber during each stroke in which the adjuster is under increased compression.

A further object of the invention is to provide an adjuster assuring controlled shortening of the adjuster's length each cycle by repeatedly bleeding down the high pressure chamber through aligning bleed passages.

Still another object of the invention is to provide improved hydraulic adjusters which quickly and effectively expell accumulated air and stop clatter, but which cost less to produce than many relatively complex lifters.

The foregoing objects are achieved by a novel lifter arrangement wherein a bleed hole opens through the lifter body into the high pressure chamber. As the lifter rides up upon the cam, the bleed hole is lifted into alignment with an external bleedoff passage in the outer, lifter guide member. During this stroke, the lifter is under increased compression between the cam and the push rod; the fluid pressure in the high pressure chamber is great. Oil is forcefully pumped from the high pressure chamber through the bleed hole and passage each time the lifter approaches the top of its lift cycle. Trapped air escapes with the pumped oil, and pumping continues so that no air remains. Bleeding down the high pressure chamber near the top of the lift cycle does not, itself, cause clatter, since then compression on the lifter is greatest and the associated push rod and cam maintain contact with the lifter.

The above and other objects of the invention as may hereinafter appear will be more clearly understood with reference to the following detailed description of preferred embodiments, the accompanying drawings, and the appended claims. IN THE DRAWINGS

FIG. 1 is a cross sectional view showing a hydraulic lifter with high pressure chamber bleed passages of the type described.

FIG. 2 is a cross sectional view of a further lifter embodiment with a modified high pressure chamber bleed passage through the lifter body.

DESCRIPTION OF PREFERRED EMBODIMENTS

In FIG. 1, a lifter 10 includes a body 11 terminating in a cam follower end surface 12. Surface 12 is shown riding, in conventional fashion, on a cam 13. The lifter body 11 has a central bore 14 which houses a cylindrical plunger 15 in close fitting relation to the surface of the bore. When the lifter 10 is contracted to its least length, the plunger 15 seats on an annular shoulder 16 near the lower end of the bore. A cap 17 closes the bore 14 at the push rod end of the lifter and receives an enlarged end of a push rod 18 within a push rod socket 20 defined by the exposed surface of the cap. A snap ring 21 retains the cap 20 within the bore 14 and defines the maximum expansion of the lifter 10.

The cap 17, and the cylindrical plunger 15 cooperate to define an oil reservoir 22 within the plunger. An inner plunger wall portion 23, with an opening 24, separates the reservoir 22 and a high pressure chamber 25. Controlling the flow of oil between the reservoir 22 and the high pressure chamber 25, a check valve 26 employs a ball 27, a retainer 28, a ball biasing spring 29, and a retainer positioning and plunger biasing spring 30. The valve 26, housed in the high pressure chamber, normally closes the opening 24 under the influence of the springs 29 and 30 and the oil pressure within the chamber 25. The check valve blocks oil flow from the high pressure chamber to the reservoir.

The reservoir 22 is replenished through a pair of aligned oil feed openings 32 and 33 in the walls of the plunger 15 and the lifter body 11, respectively. Replenishing oil enters the reservoir 22 through a further oil feed opening 34 formed in an external guide sleeve 35 within which the lifter 10 moves. The sleeve closely fits the lifter body and is secured within a supporting member 39, normally part of the engine block. A high pressure bleed hole 36 opens once per cycle by moving into communication with a recess 37 and a bleed path passage 38, both formed in the sleeve 35.

In normal operation, the lifter 10 takes up the expansion and contraction of valve gear elements on a cycle-to-cycle basis, as do most hydraulic lifters. Compression on the lifter is least when the lifter has ridden down the cam. As shown, the lifter begins to expand as oil enters the oil feed openings 34, 33 and 32. Under the influence of the spring 30, the plunger 15 and the cap 17 move toward the push rod end of the lifter, oil is fed to the reservoir, the valve 26 opens, and oil passes from the reservoir 22 into the high pressure chamber 25. The high pressure chamber is now expanded and the lifter is extended. As the lifter body 11 begins to ride up the lobe of the

cam 13, the compression forces of the cam and the push rod on the lifter increase. Pressure increases within the expanded high pressure chamber 25 as increased forces are applied to the fluid in the chamber.

However, as the lifter body 11 approaches the end of the valve opening stroke, and while the compressive forces on the lifter and the pressure in the chamber 25 are still considerably greater than when the lifter has ridden down the cam, the bleed path 36, 37 and 38 opens. At this point, the compressive forces on the lifter move the plunger downward within the bore to contract the high pressure chamber, expelling under pressure a small amount of oil from the chamber. During initial operation and in the first few cycles thereof, air is physically pumped from the high pressure chamber 25, rather than being allowed merely to bleed slowly past the plunger 15 and the cap 17. Since the pumping down of the high pressure chamber 25 occurs with every cycle, all air rapidly will be expelled.

Since the lifter shortens, as required, each time the high pressure chamber is pumped down, oil need not leak past the plunger 15 to reduce the lifter length in the usual fashion. The bore 14 and plunger 15 may be machined for very close clearance with little or no chance for oil to escape from the high pressure chamber. The expanded lifter length will then remain the same until the oil bleed provisions open and the lifter will collapse to the same extent with each cycle. This allows close, reliable control of the sequence of valve operating events.

Opening the high pressure chamber bleed path to shorten the lifter near the top of the lift cycle does not, itself, produce valve lash and noise since the push rod 18 is, at this time, heavily biased against the cap 17. The rod 18, then, maintains contact within the socket 20 as the lifter 10 shortens.

FIG. 2 illustrates a hydraulic valve lifter 10' like the lifter 10 described above, but with modified bleed down provisions. Similar parts are designated by similar reference numerals.

The cam 13' in FIG. 2 imparts a shorter stroke to the lifter 10'. The cycle of operation of the lifter 10' is like that described above. Here however, a high pressure chamber bleed hole 40 opens through the lifter body 11 opposite a lower end portion 19 of the cylindrical plunger 15. When the high pressure chamber is expanded the lower plunger portion 19 is spaced slightly from the annular shoulder 16 and the bleed hole 40 is in communication with the high pressure chamber 25. As the lifter 10' nears the end of its lift stroke, oil and accumulated air flow from the high pressure chamber past the lower end 19 of the plunger, through the bleed hole 40, and out the recess 37 and the passage 38. Again, pumping occurs on a cycle-to-cycle basis, assuring the complete elimination of trapped air. Within a few cycles of operation, valve lash is eliminated and valve clatter is silenced.

Although a preferred embodiment of the invention has been described, it will be apparent to those skilled in the art that various modifications may be made without departure from the spirit and scope of the invention as defined in the appended claims. For example, those skilled in the art will recognize that the high pressure chamber bleed provisions described may be employed with other known or suitable adjusters, for example, rocker followers and lifters employable in many different valve gear layouts such as overhead cam arrangements.

I claim:

1. A hydraulic valve adjuster arrangement adapted to compensate lash in automotive valve gear and of the type extensible and retractable slightly with cyclically increased and decreased compression applied thereto to compensate cyclic variations in the length of valve gear elements without substantially varying valve operation; the arrangement including an outer body with a bore therein, a plunger movable in the bore to extend and retract the adjuster, a high pressure fluid chamber expansible and contractable with movement of the plunger relative to the outer body, means for supplying fluid to the high pressure chamber, means for bleeding down the high

pressure chamber only during each increased compression portion of the adjuster operation cycle to assure the escape of gas from the high pressure chamber and out of the adjuster arrangement, and a guide member receiving the body therein for reciprocation, the bleed means comprising an opening of fixed size through the guide member separate from the fluid supplying means and a bleed hole directly from the high pressure chamber through the body, the bleed hole being located to move into and out of registration with the opening while the increased compression on the adjuster has increased fluid pressure in the chamber.

2. The arrangement according to claim 1, wherein the plunger and the body apply pressure to the fluid in the chamber as the compression on the adjuster is increased, and relative movement of the plunger and body contracts the chamber to pump fluid from the chamber when the opening and bleed hole align.

3. The arrangement according to claim 2, wherein the fluid supplying means includes a valve opening into the chamber to replenish the fluid therein, permitting expansion of the chamber following each expulsion of fluid from the chamber.

4. A hydraulic valve adjuster arrangement slightly expansible and contractable for compensating cyclic expansion and contraction of valve operating gear while applying movement from a driving cam to a driven valve element without substantially altering the effect of the cam on the valve element; the arrangement including a reciprocable body with a central bore therein, an adjuster guide within which the body is disposed for reciprocating movement, a high pressure fluid chamber portion of the bore, a plunger within the bore and in pressure exerting relationship to the fluid in the chamber, means for interconnecting the plunger with an external valve gear element for movement of the external element with the plunger, means for supplying fluid to the adjuster including an opening through the guide, means for replenishing fluid in the high pressure chamber with every cycle of adjuster operation, a second opening, fixed in size, into the adjuster guide for venting the high pressure chamber separate from and free of communication with the fluid supplying means, a bleed path opening directly from the high pressure chamber to the exterior of the body, said bleed path being located to move with the adjuster body once every cycle of operation into and out of communication with the second guide opening only during that portion of each cycle when compressive forces on the adjuster and pressure in the chamber are greater, thereby to cause pumping of fluid from the high pressure chamber and a continued change of fluid in the high pressure chamber with each completion of a number of operating cycles.

5. The adjuster according to claim 3, wherein the adjuster transmits forces applied to the body to the plunger via the fluid in the chamber, the body being movable to a predetermined position in the guide when said forces are applied thereto, said bleed path and second guide opening being located to communicate when the body is in said predetermined position, and the plunger being movable relative to the body to contract the high pressure chamber, forcing fluid from the chamber when the bleed path and second opening communicate.

6. The arrangement according to claim 5, wherein the adjuster guide comprises a sleeve adapted to fit within a support member, encircling the adjuster body in close fitting relation thereto, and defining the second guide opening therein extending along the sleeve to open out of the adjuster arrangement, and the bleed path opens through the lifter body.

7. The arrangement according to claim 5, wherein the body includes a cam follower end engageable by a cam lobe to move the adjuster to the predetermined position during a valve opening stroke, the second guide opening and the bleed path being positioned to communicate every time the adjuster approaches the end of the valve opening stroke.

8. The arrangement according to claim 5, wherein the fluid replenishing means comprises associated oil feed openings in the body and the guide, located to align when the adjuster has

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moved to a second predetermined position in which the compressive forces on the adjuster are relieved, and check valve means permitting fluid flow to replenish and expand the chamber when the pressure therein decreases and preventing fluid flow from the chamber therethrough when chamber pressure increases.

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9. The adjuster according to claim 5, wherein the second guide opening and bleed path are located to communicate near the end of a valve opening adjuster stroke to shorten the adjuster by said movement of the piston relative to the body and contraction of the high pressure chamber.

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