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Rhoads

[11] **3,921,609**

[45] **Nov. 25, 1975**

[54] **VARIABLE DURATION HYDRAULIC VALVE TAPPET**

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[52] **U.S. Cl.** **123/90.55;** 123/90.57

[51] **Int. Cl.²** **F01L 1/14**

[58] **Field of Search** 137/513.3, 513.5; 123/90.55, 90.16, 90.56, 90.57, 90.58

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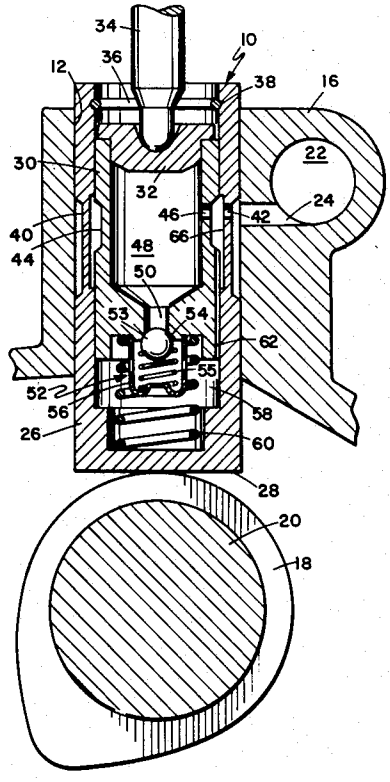
[57] **ABSTRACT**

A hydraulic valve lifter for use in high performance engines to prevent valve overlap at low operating speeds, the lifter having a restricted oil bleed passageway leading to the pressure chamber to prevent the lifter from pumping up to a fully solid condition at low speeds, the passageway being narrow enough to become substantially inoperative at high speeds to produce effectively solid lifter action.

4 Claims, 7 Drawing Figures



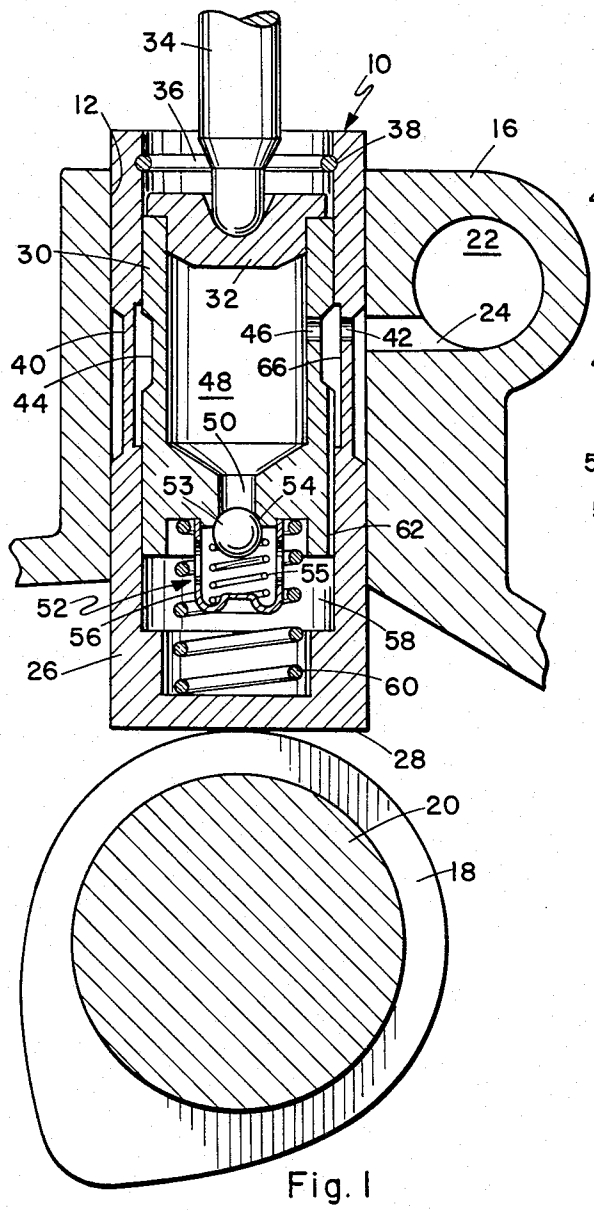


Fig. 1

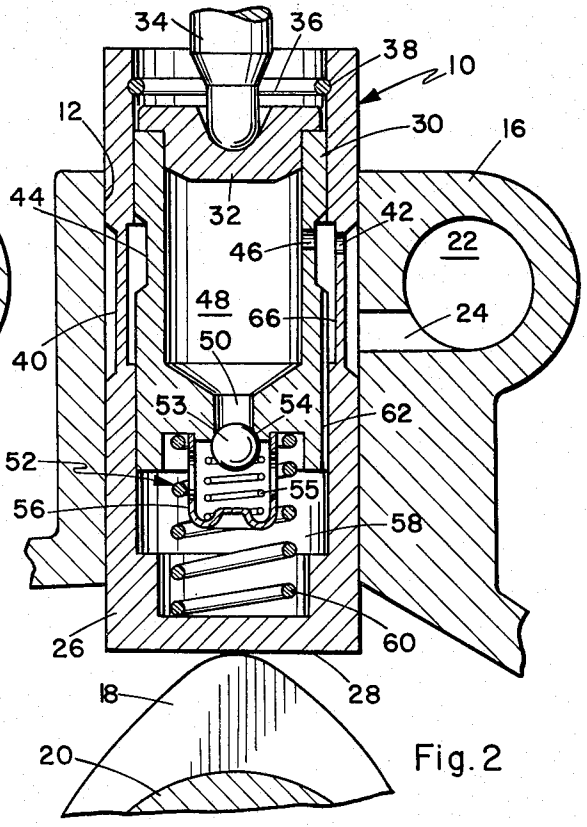


Fig. 2

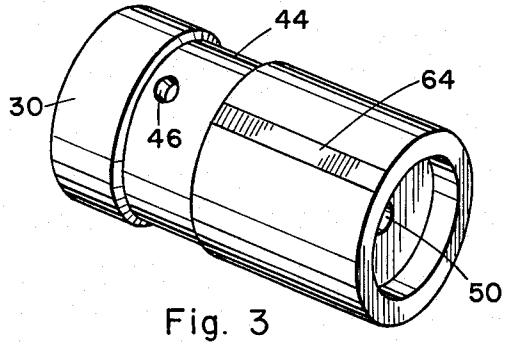


Fig. 3

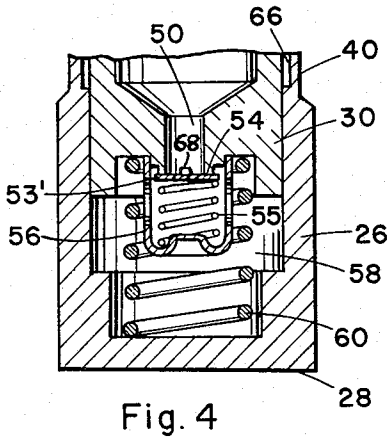


Fig. 4

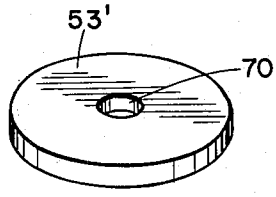


Fig. 5

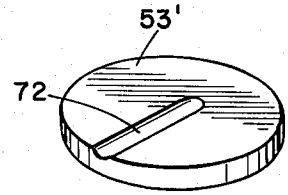


Fig. 6

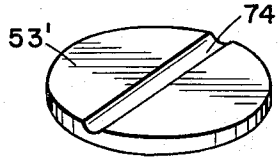


Fig. 7

VARIABLE DURATION HYDRAULIC VALVE TAPPET

BACKGROUND OF THE INVENTION

With conventional types of hydraulic valve lifters, each valve actuating push rod seats in a plunger axially slidable in a lifter body, and the lifter body rides on one lobe of the cam. Oil from the engine lubrication system is introduced under pressure between the body and plunger and at increased engine speeds the valve lifter assembly expands axially to tighten the linkage in the valve actuating train. Many lifters are designed to trap oil in the body chamber and pump up to an effectively solid condition at relatively low speed. However, with high performance cams the valves are timed to have considerable overlap in order to provide for a large flow through the engine. At low speeds this large overlap is not necessary and the engine runs inefficiently, resulting in a loss in low speed horsepower. Basically, increasing the valve lash will shorten valve open duration and reduce overlap, since more crankshaft rotation is necessary to overcome the lash in the valve train. This will result in an improvement in low speed performance. However, excessive lash causes considerable noise and wear at idling and low speeds. Decreasing lash, as by tightening or pumping up the lifters, will lengthen valve duration and improve high speed performance.

Another hydraulic valve lifter invented by applicant and described in U.S. Pat. No. 3,304,925, permits oil bleed from the pressure chamber to occur at a predetermined minimum speed but prevents bleed at high speeds, causing the desired solid lifter action to occur. However, it has been found that under certain circumstances it is not necessary to prevent oil bleed below a minimum speed and there are reasons for designing the lifter to allow bleeding at low as well as intermediate speeds.

SUMMARY OF THE INVENTION

The valve lifter described herein is designed to provide favorable characteristics over the entire speed range. At low and intermediate speeds a closely controlled oil leak in the pressure chamber is permitted to prevent pumping up to a fully solid condition. At high speeds the motion is so rapid that the oil can no longer escape to any degree through the restricted leak path and the lifter becomes effectively solid.

This is accomplished by providing a bleed passageway to the pressure chamber which is continually open at all operating speeds and may be manifested in several different configurations, including a flat ground on the side of the plunger and a groove, port, or other irregularity provided in the check valve or valve seating at the bottom of the piston to prevent the valve from completely sealing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a sectional view, taken axially along a valve lifter, showing the mechanism in the valve closed position;

FIG. **2** is a similar sectional view with the mechanism in the valve open position;

FIG. **3** is a perspective view of the plunger;

FIG. **4** is a sectional view, similar to a portion of FIG. **1**, showing a wafer type check valve;

FIG. **5** is an enlarged perspective view of the wafer check valve element;

FIG. **6** is a perspective view of an alternative wafer element; and

FIG. **7** is a perspective view of a further wafer element.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. **1** and **2** show the valve lifter **10** axially slidably mounted in a bore **12** in a portion of the engine head casting **16.** A single valve is shown, there being one lifter for each valve in the engine, with each lifter operated by a lobe **18** on a comshaft **20.** In the head **16** is an oil gallery **22** with a supply duct **24** leading to bore **12** to supply oil to the lifter from the pressure side of the engine oil system.

Valve lifter **10** comprises a cylindrical body **26** having a closed lower end **28,** and axially slidable within the body is a hollow cylindrical plunger **30.** In the upper end of plunger **30** is a cup **32** in which is seated the end of a push rod **34,** the push rod being coupled to a conventional rocker arm and valve, not shown. Plunger **30** is retained by a snap ring **36** in a groove **38** within the upper end of body **26.** Body **26** has an external peripheral collecting channel **40** which registers with the supply duct **24.** A port **42** communicates from channel **40** to the interior of body **26** and plunger **30** has a peripheral channel **44** which registers with port **42** at all times. From channel **44** a port **46** leads to the interior of plunger **30,** so that oil is continuously admitted into the inner chamber **48** of the plunger from the oil gallery regardless of any rotational or axial displacement experienced by the lifter components.

At the lower end of plunger **30** is a small outlet **50,** the lower end of which is closed by a check valve **52** having a sealing element **53** held in place against the seating **54** by a seating spring **55,** the spring and valve being held in place by a perforated retaining cage **56.** The space between plunger **30** and the lower end of body **26** comprises a pressure chamber **58** and in this chamber is a return spring **60** which biases the plunger upwardly out of the body, until stopped by the snap ring **36.** In normal assembly the plunger **30** is pressed down against return spring **60** by the push rod **34,** which is loaded by the much stronger valve spring, not shown.

The structure thus far described is conventional and representative of hydraulic valve lifters, which may vary somewhat in porting and check valve arrangements. In operation the plunger chamber **48** receives oil under pressure at each upward stroke of the lifter, the oil being forced down through check valve **52** into pressure chamber **58.** At low pressure the plunger rides low in the body and is raised by increasing pressure to tighten the valve train. With no return leakage, or only that which may occur through the normal sliding clearance of plunger **30** in the body **26,** the oil in chamber **58** is pumped up rapidly and the lifter becomes effectively solid.

The novel action is provided by a bleed passageway providing continuous communication between the pressure chamber **58** and the oil collecting channel **40.** The valve lifter described in the previously mentioned U.S. Pat. No. 3,304,925 also provided a bleed passageway but it was not continuously open, being blocked at low speeds. The continuously open passageway can be incorporated in several different ways which would not

be possible in the earlier unit, and one form, in which the passageway includes a bleed duct **62** comprising a flat **64** ground along the outer surface of the plunger from the bottom to the channel **44**, is simply an extension of the earlier bleed duct and has the advantage of being easier to mill. Body **26** has an internal return channel **66** extending axially to port **42**, and since the channel **66** is in constant communication with the channel **44**, there is provided at all times a complete passageway from the pressure chamber **58** to the channel **66** and to the external collecting channel **40** and thus to the oil gallery **22**.

In operation, as the engine speed increases and the oil pressure rises, the lifter will attempt to pump up. However, since oil can leak from the pressure chamber through the bleed passageway, the pumping up will be retarded. As higher engine speeds are achieved, the resistance of the bleed passageway effectively increases since it is too narrow to pass oil in quantity at high speeds, resulting in the gradual pumping up of the lifters with increased engine speed and effectively solid lifter at high speeds.

It has been found in tests that a flat portion **64** ground off to provide a bleed duct having a depth on the order of from two to five thousandths of an inch will provide the required characteristics in the engine of a passenger automobile. The exact amount will depend on the normal oil pressure in the engine, the cam design with regard to valve timing and duration and to the overall performance range of the engine. In racing engines it would be possible to enlarge the bleed duct to as much as ten or fifteen thousandths of an inch. An oil bleed of this magnitude would result in considerable valve lash and noise at idle speeds, but this can be tolerated in a racing engine.

The crucial requsite for proper operation of the lifter resides in the continually open bleed passageway between the pressure chamber and the collecting channel **40** so the pressure chamber can bleed to the oil gallery **22**. Other groove configurations in the plunger surface, and even in the internal surface of the cylinder body, are conceivable which would produce the desired result. In addition, the check valve **52** could be altered slightly so that it cannot completely seal, whereby a bleed pathway would be defined through the valve, plunger chamber **48**, and through the ports **42** and **46**. This could be accomplished in numerous ways, such as scoring or etching the ball **53** if a ball check valve is used, providing a notch **68** or other irregularity in the valve seating **54** as shown in FIG. **4**.

Three other means of altering the check valve are shown as examples in FIGS. **5–7**, in which a wafer check valve is used rather than a ball check valve. The wafer sealing element **53'** is apertured **70** in FIG. **5** and provided with radial and diametric grooves of insufficient size to sustain oil bleed at high engine speed on its sealing surface at **72** and **74** in FIGS. **6** and **7** respectively, any of which produce the obvious result of rendering a complete seal of the check valve impossible and providing a proper bleed passageway from the pressure chamber **58** to the collecting channel **40**.

The various arrangements described herein are adaptable to a variety of engines and can be incorporated into many existing types of valve lifter, without requiring any changes in the engines. In fact existing lifters already in use can be modified in accordance with this disclosure. It is understood that minor variation from the form of the invention disclosed herein may be made without departure from the spirit and scope of the invention, and that the specification and drawings are to be considered as merely illustrative rather than limiting.

I claim:

1. In a hydraulic valve lifter having a hollow cylindrical body with a closed lower end for engagement with a cam; a hollow cylindrical plunger axially slidable in said body and enclosing a pressure chamber in the lower end of the body; an external collecting channel on said body to receive oil from a pressurized source; a port opening into said body from said channel; a port in said plunger communicating with said first mentioned port to admit oil into the plunger; and a one-way valve in said plunger opening into said pressure chamber:

an improvement comprising:

at least one restricted oil bleed passageway providing, at all points of operation of the hydraulic valve lifter, continuous communication between said pressure chamber and said collecting channel; said oil bleed passageway being substantially dimensionally independent of temperature induced volumetric changes in said valve lifter;

the cross sectional area of at least a portion of said bleed passageway being insufficient to sustain oil bleed beyond a predetermined flow rate at high engine speed.

2. Structure according to claim **1** wherein said body has an internal channel communicating with the first mentioned port and said bleed passageway includes a duct defined by a flat portion on the outer surface of said plunger extending from said pressure chamber to said internal channel.

3. Structure according to claim **1** wherein said plunger has an enternal peripheral channel communicating with said parts and said bleed passageway includes a duct defined by a flat portion on the outside of said plunger extending from said pressure chamber to said peripheral channel.

4. Structure according to claim **1** wherein said valve has a seating and a wafer sealing element therefrom having a groove traversing at least a portion of the seating side thereof, whereby the passageway provided from said pressure chamber to the interior of said chamber through said groove comprises a portion of said bleed passageway.

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