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Bergmann et al.

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[54] **HYDRAULIC LASH ADJUSTER FOR OVERHEAD CAM ENGINES**

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[52] **U.S. Cl.**..... **123/90.36,** 123/90.35, 123/90.43, 123/90.46, 123/90.55, 184/6.9

[51] **Int. Cl.** **F01m 9/10,** F01l 1/18, F01l 1/24

[58] **Field of Search**..... 123/90.35, 90.36, 90.34, 123/90.43, 90.46, 90.57, 90.56, 90.55, 90.63; 184/6.9

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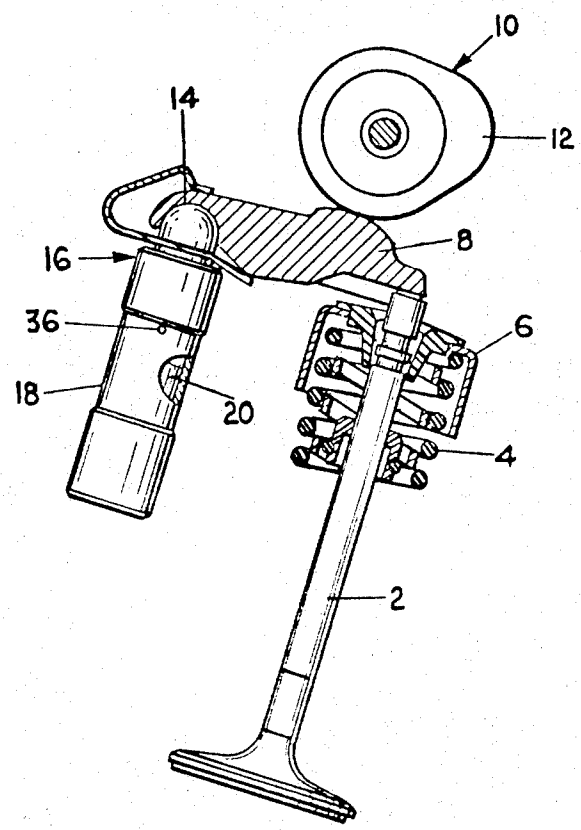
[57] **ABSTRACT**

A hydraulic lash adjuster including a body and a piston reciprocal within the body. Oil within a central cavity formed in the piston passes through the top of the piston to lubricate a socket between a rocker arm and the adjuster. An outlet from the cavity to the top of the piston includes a valve means having a ball and a seat for the ball, the valve being in an open position in the presence of air within the cavity and closed by the oil after the air has been vented to thereby prevent air from remaining in the cavity.

5 Claims, 7 Drawing Figures



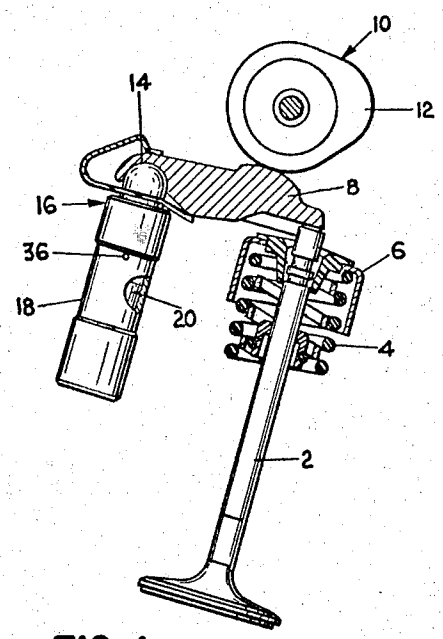


FIG. 1

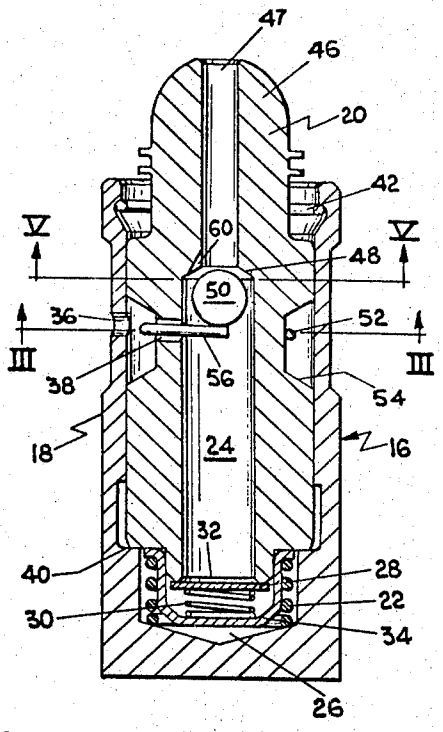


FIG. 2

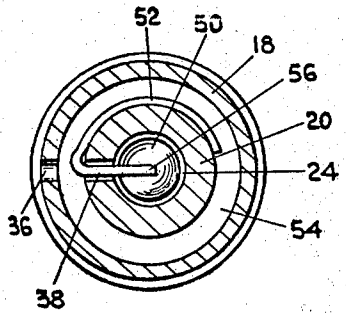


FIG. 3

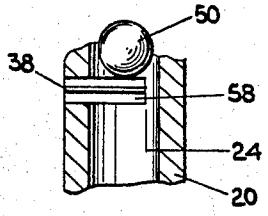


FIG. 4

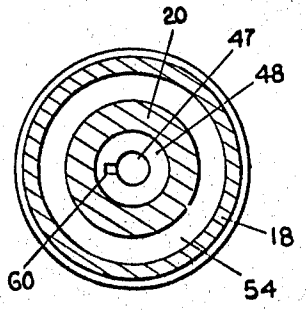


FIG. 5

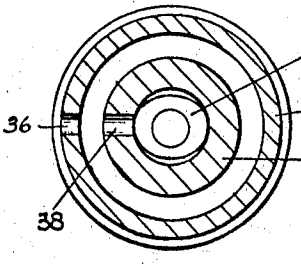


FIG. 6

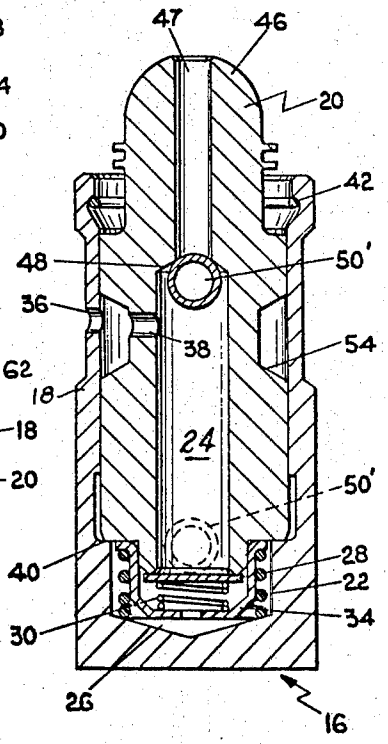


FIG. 7

HYDRAULIC LASH ADJUSTER FOR OVERHEAD CAM ENGINES

BACKGROUND OF THE INVENTION

In some overhead cam shaft engines, the cam shaft typically runs against a rocker arm which opens and closes the engine intake or exhaust valve. The opposite end of the rocker arm is more or less stationary and supported by a lash adjuster which takes up slack in the valve train as the engine heats up. A hydraulic lash adjuster automatically adjusts itself to a no-lash condition in a manner similar to a hydraulic tappet in a push-rod type engine except that there is no up-and-down motion of the hydraulic unit since it is fixed in position within the engine block. When the engine is inoperative, oil within the lash adjuster drains admitting air to the oil reservoir cavity. Since air is compressible and the oil is not, when the engine is started, the oil and air mixes, the air is compressed, and the lash adjuster will not quickly automatically adjust itself to a no-lash condition thereby resulting in noisy operation until the air has been eliminated from the lash adjuster so that it can operate in a conventional fashion.

SUMMARY OF THE INVENTION

This invention relates to a hydraulic lash adjuster having a ball valve positioned in its central cavity to control an oil outlet means in the piston for lubricating the connection between the piston and the rocker arm in an internal combustion engine. The novel valve means remains in an open position when air is present in the chamber to allow the air to vent and automatically closes when the oil within the chamber has reached a predetermined level. In one embodiment, means are provided within the valve to allow a metered amount of oil to pass through the outlet to lubricate the socket of the rocker arm. The plunger can be machined from a single elongated piece of material, the central cavity, the valve, and the outlet opening extending along its length through its medial axis. The adjuster of the present invention includes a minimal number of relatively inexpensive and simple-to-machine parts; it is readily and easily assembled resulting, in significantly reduced material and manufacturing costs.

Accordingly, it is an object of this invention to provide an improved hydraulic lash adjuster for overhead cam shaft engines.

It is another object of this invention to provide a hydraulic lash adjuster wherein the piston thereof including the central cavity, the valve seat, and the oil outlet means could be machined in a single piece of material.

It is another object of this invention to provide a novel ball-valve means within the piston of a hydraulic adjuster to allow the air contained therein to be vented and closing in response to the presence of oil therein.

It is still a further object of this invention to provide a socket rocker arm assembly having a hydraulic lash adjuster with an improved lubricating means for the socket connection.

Other aspects, objects, and the many advantages of this invention will become apparent to those skilled in the art from a study of this disclosure, the drawings, and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described with reference to the accompanying drawings within:

FIG. 1 is a schematic representation of an overhead cam valve train having a hydraulic lash adjuster according to the invention;

FIG. 2 is an enlarged, cross-sectional view of the lash adjuster shown in FIG. 1;

FIG. 3 is a cross-sectional view taken along the plane III—III of FIG. 2;

FIG. 4 is a cross-sectional view illustrating an alternate embodiment of the retaining means as shown in FIG. 3;

FIG. 5 is a cross-sectional view taken along the plane V—V of FIG. 2;

FIG. 6 is a view similar to FIG. 5 illustrating an alternate lubricating oil metering means suitable for use in the present invention; and

FIG. 7 is an enlarged, sectional view of an alternate embodiment of the hydraulic lash adjuster illustrated in FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIGS. 1 and 2, a valve 2 having a spring 4 and retainer 6 is actuated by a rocker arm 8 through a cam shaft 10 and cam 12. The rocker arm 8 pivots about a socket 14 on a lash adjuster 16. The lash adjuster which automatically adjusts for zero or no-lash includes a body 18 with a plunger or piston 20 movable therein. The plunger 20 is biased in the upward position against the socket 14 of rocker arm 8 by a spring 22. The plunger 20 has an internal cavity 24 which opens into a bottom compression chamber 26 through check valve plate 28. A spring 30 biases valve plate 28 against a bottom opening 32 of plunger 20. A valve retainer, or cage, 34 which holds the check valve assembly in place is held against the body of plunger 20 by spring 22.

Lubricating oil enters cavity 24 through port 36 in the side wall of the body 18 and port 38 in the side wall of plunger 20. As is conventional in hydraulic lash adjustment assemblies, the oil passes through cavity 24, through the bottom opening 32 of the plunger 20, and into the bottom compression chamber 26.

The reciprocal motion of the plunger 20 is limited at the lower extremity by shoulder 40 and at the upper extremity by splitting retainer 42 positioned in annular groove 44.

It is necessary to lubricate the socket 14 as it rotates about the upper spherical head or nose 46 of the plunger 20. To this end, a bore or oil outlet port 47 is provided in communication with the central cavity 24 within the plunger 20. The piston or plunger body 20 can be conveniently formed in one piece with the cavity 24 and the outlet port 47 being conveniently machined from the open end 32. Cavity 24 has a diameter slightly larger than the diameter of the outlet port 47 and a valve seat 48 is formed at the upper extremity of the cavity at the entrance to the outlet port. A ball valve 50 positioned within the cavity is adapted to move into the valve seat 48 to restrict the flow of lubricating oil from the chamber 24 through the outlet port 47. The ball 50 is held in position within the cavity 24 by retaining means 52 (see also, FIG. 3) extending through the inlet port 38 and holding the ball valve 50

closely adjacent but not in actual contact with the valve seat **48.** The retaining means **52** is in the form of a spring clip wrapped about the plunger **20** in a depression **54** formed in its outer diameter. An inwardly extending end **56** of the spring clip passes through the port **38** and enters partially into the cavity **24.**

An alternate retainer is illustrated in FIG. **4,** wherein the retaining means may be in the form of a hollow roll pin **58** pressed into the inlet port **38** and extending partially into the cavity **24** a distance sufficient to hold the ball **50** in position below the valve seat **48.** The hollow center of the roll pin will, allow the lubricating oil to flow from the port **36** through the hollow pin into the cavity **24.**

When ball **50** is seated on the valve seat **48,** a limited amount of oil is metered from the cavity **24** to the outlet port past the ball **50** and seat **48** to lubricate the head of the plunger and the socket **14.** This is accomplished by means of a small metering slot **60** (FIG. **5**) extending from the cavity **24** into the outlet port **47** through a side wall of the valve seat **48.** When the ball valve is closed, the metering slot **60** allows a limited amount of oil to flow about the ball **50** from the cavity **24** through the outlet port **47.**

An alternate embodiment of a metering mechanism is illustrated in FIG. **6.** In this embodiment, an apertured disk **62** having the shape of an elipse is positioned within the cavity **24** adjacent its intersection with the outlet port **47.** The major axis of the elipse is slightly greater than the diameter of the cavity **24** such that when the disk is pressed into the bore of the cavity, it is warped slightly. The minor axis of the elipse pulls slightly from the walls of the cavity to thereby allow a slight oil flow about the disk.

When the engine is started, lubricating oil which serves as the hydraulic fluid for the adjuster is delivered as part of the engine lubrication system through a conventional oil gallery in the engine head (not shown). The oil passes from the gallery through port **36** into annular groove **54** and port **38** into the cavity **24.** The oil also flows into the compression chamber **26** below check valve **28.** Pressure is normally maintained for lubrication through the outlet port **47** in a conventional manner by incoming engine oil under pressure supplied by the engine's oil pump. When the engine is shut down, however, oil in the compression chamber **26** and cavity **24** may gradually escape by normal leakage. When restarting the engine, a quantity of air may be trapped in the cavity **24** or compression chamber **26** and unless immediately eliminated, noisy operation of the adjuster and perhaps damage will result. The ball valve **50,** therefore, remains in an open position with respect to the seat **48** such that air is vented from the cavity **24** through the outlet port **47** as the engine is started. When the oil pressure builds up and the level of oil raises within the cavity **24,** the normal pressure and flow of the oil will move the ball **50** into the valve seat **48** thereby closing the valve and allowing only a controlled metered amount of oil flow through the slot **60** and the outlet port **47** for lubrication of the rocker arm socket.

Referring now briefly to FIG. **7,** an alternate embodiment of a lash adjuster is illustrated. The construction of the adjuster is similar to that as shown in connection with FIG. **2.** The difference resides primarily in the construction and operation of the ball check valve. In addition, no retaining means is necessary within the chamber as the chamber **24** confines the ball, and restricts its movement upwardly and downwardly within the chamber. Like reference numerals are therefore used to indicate like parts and only an explanation of the valve and its operation within the chamber will be provided.

In this embodiment, the ball valve **50'** is illustrated in two positions. The uppermost position shown in solid lines indicates a closed position wherein the ball is positioned against the valve seat **48.** The lowermost position is indicated in phantom such as would be assumed if all the oil has drained from cavity **24.** This embodiment does not require a retaining means as the embodiment shown in FIG. **2** since the ball is free to move within the cavity **24.** The ball **50'** is constructed such that it floats on the oil within the cavity. This may be accomplished by using a hollow ball or by forming the ball of a lightweight material such as a plastic having a specific gravity less than that of the oil such that it floats thereon. As oil comes into the cavity **24,** the ball rises upwardly on top of the oil and seats against the valve seat **48** at the top of the cavity. In the event air is in the reservoir or comes into the reservoir, the air moves above the ball because the ball is heavier than the air and is vented through the outlet port **47** prior to the time the port is sealed by the ball floating on the oil blocking the opening at valve seat **48.** A metering slot similar to slot **60** shown in FIG. **2** may be provided in this embodiment to allow a limited oil flow about the ball **50'** through the outlet port **47.**

As will be readily appreciated by those skilled in the art, the hydraulic lash adjuster of the present invention is particularly adaptable for maximum efficiency of operation. It will prevent noisy operation and damage in its provision for bleeding air from the chamber and yet will provide adequate lubrication for the rocker arm as it meters a controlled amount of oil. The lash adjuster will further automatically adjust itself to a no-lash condition by the unique operation of the valve as soon as the air is eliminated. The simplicity of construction of the cavity, outlet port, and valve seat make it particularly adaptable for quantity production and assembly. The simple construction further contributes to substantial reduction in manufacturing and assembly costs. The ball check valve utilized in the embodiment shown is extremely simple, exceedingly durable, and dependable in operation.

While a preferred and an alternate embodiment of the invention have been disclosed herein, many modifications and variations of the present invention are possible in view of the above teachings. Accordingly, all modifications embodying the principles of this invention are to be considered as included in the amended claims unless these claims by their language expressly state otherwise.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows.

1. A hydraulic lash adjuster having a body, a plunger reciprocal within said body, said plunger having a central cavity and an outlet passage extending axially along its length, a lubricating oil inlet means in said body and said plunger communicating with said central cavity, valve means in said cavity and said outlet means for bleeding air from said cavity and controlling the flow of lubricating oil through said outlet means, said valve means including:

a valve seat adjacent said outlet opening and said cavity;

a ball check valve in said cavity, means for moving said ball valve into an open position with respect to said seat in the presence of air in said chamber and means for moving said ball valve into abutment with said seat in the presence of lubricating oil at said outlet;

said ball being hollow and thereby having a specific gravity less than that of said lubricating oil and greater than that of air to thereby float on said lubricating oil for movement with said oil into position in said valve seat after said air has been vented through said outlet.

2. The apparatus as defined in claim **1** wherein a metering means includes an elongated slot extending from said chamber to said outlet means through said valve seat.

3. A hydraulic lash adjuster having a body, a plunger reciprocal in said body, said plunger having a central cavity and an outlet passage extending axially along its length, a lubricating oil inlet means in said body and said plunger communicating with said central cavity, valve means in said cavity and said outlet means for bleeding air from said cavity and controlling the flow of lubricating oil through said outlet means, said valve including: a valve seat adjacent said outlet opening and said cavity; a ball check valve in said cavity, means for moving said ball valve into an open position with respect to said seat in the presence of air in said chamber and means for moving said ball valve into abutment with said seat in the presence of lubricating oil at said outlet; said plunger being an elongated body having an opening along its axial length, said opening forming said central chamber, said valve seat, and said outlet passage, said inlet means extending transversely through said plunger into said chamber below said seat, said ball positioned between said inlet means and said seat, and retaining means including a hollow roll pin extending through said inlet means into said chamber below said ball and said valve seat to thereby allow the unrestricted flow of said lubricating oil through said hollow roll-pin into said chamber.

4. The apparatus as defined in claim **3,** wherein a metering means includes an elongated slot extending from said chamber to said outlet means through said valve seat.

5. A hydraulic lash adjuster having a body, a plunger reciprocal within said body, said plunger having a central cavity and an outlet passage extending axially along its length, a lubricating oil inlet means in said body and said plunger communicating with said central cavity, valve means in said cavity and said outlet means for bleeding air from said cavity and controlling the flow of lubricating oil through said outlet means, said valve means including: a valve seat adjacent said outlet opening and said cavity; a ball check valve in said cavity, means for moving said ball valve into an open position with respect to said seat in the presence of air in said chamber and means for moving said ball valve into abutment with said seat in the presence of lubricating oil at said outlet, said valve seat including an eliptically shaped disk having an aperture therein positioned within said cavity adjacent said outlet means, said disk having a major axis slightly larger than the diameter of said cavity such that the minor axis thereof forms a passage for said lubricating oil when said disk is pressed into said chamber.

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