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HYDRAULIC LASH ADJUSTER

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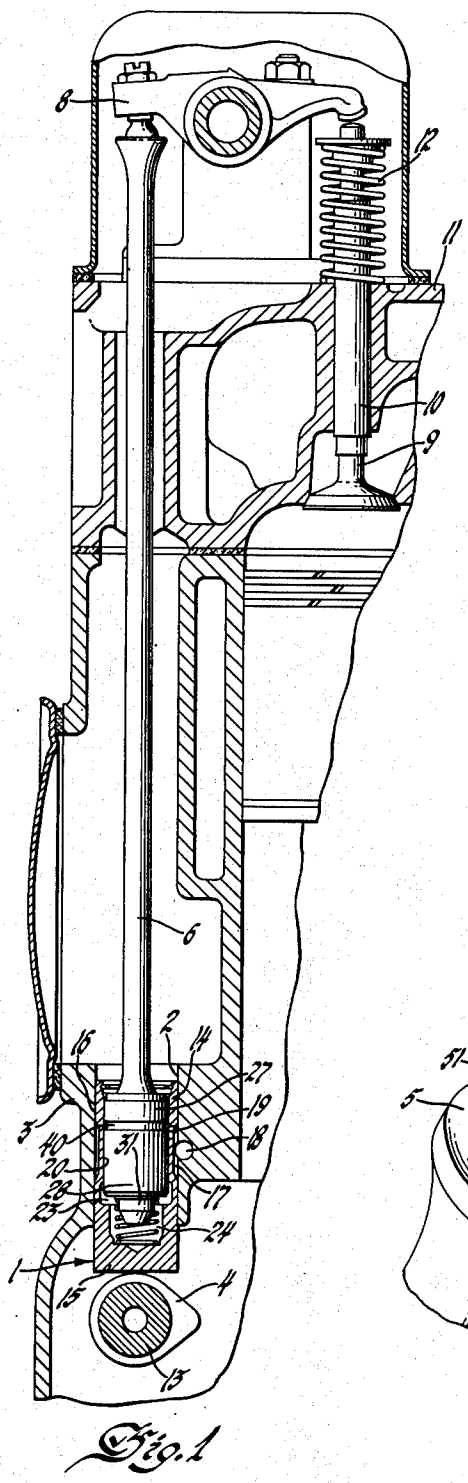


Fig. 1

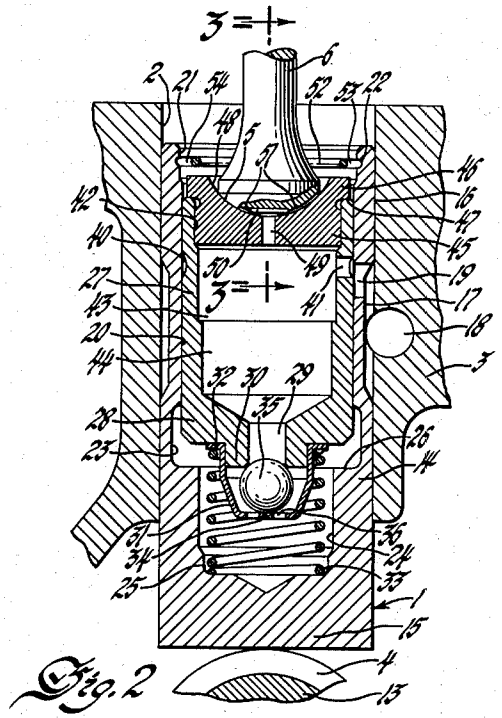


Fig. 2

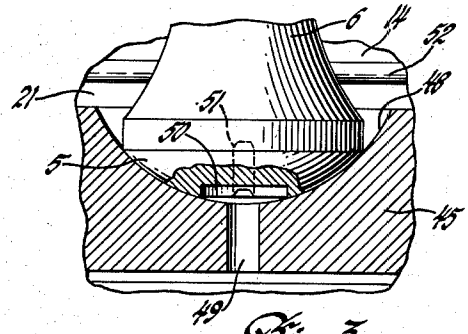


Fig. 3

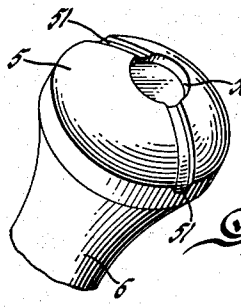


Fig. 4

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HYDRAULIC LASH ADJUSTER

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This invention relates to internal combustion engines and the like and particularly to valve operating mechanisms therefor of the automatic lash take-up type.

One of the objects of the invention is to provide an improved hydraulic lash adjuster for use in such mechanisms requiring a minimum number of component parts each of simple design and low manufacturing cost.

Another object of the invention is to provide such a lash adjuster designed to be supplied during operation with hydraulic fluid in the form of oil under pressure from the engine lubricating system, novel means being incorporated in the lash adjuster structure for venting the same of entrained air in the engine oil supplied thereto.

Another object of the invention is to provide an improved valve operating mechanism including a hydraulic lash adjuster wherein the aforesaid venting is accomplished by an axial passage through one thrust transmitting end thereof, and a member in thrust receiving relation with said lash adjuster end having means for conducting such vented air to the outside atmosphere.

The means by which these and other objects of my invention are attained will be readily apparent from the following description, having reference to the drawing, wherein:

Figure 1 is a sectional elevational view of a portion of an internal combustion engine incorporating a valve operating mechanism in accordance with my invention.

Figure 2 is an enlarged fragmentary view similar to Figure 1 showing the details of the hydraulic lash adjuster and the lower end of the push rod.

Figure 3 is a further enlarged detail sectional view taken substantially on line 3—3 of Figure 2.

Figure 4 is an enlarged perspective view of the lower end of the push rod.

Referring to the drawing there is shown a hydraulic lash adjuster designated generally by the numeral 1 which is rotatably and slidably supported in a bore 2 provided therefor in the engine cylinder casing or frame 3. Opposite ends of the lash adjuster respectively abut the lower end face 5 of the push rod 6 and the working surface of the cam 4, which cam is offset longitudinally of its shaft 13 from the axis of the bore 2. The upper end of the push rod, in turn, engages one arm of the valve rocker 8 whose other end engages the upper end of the engine valve 9 which is slidably supported for reciprocable movement in a bushing 10 secured in the engine cylinder

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head 11, there being a spring 12 biasing the valve 9 to closed position as shown. Rotation of the cam shaft 13 during engine operation causes the cam 4 thereon to both rotate and reciprocate the lash adjuster 1, reciprocably carrying with it the engine push rod 6 and oscillating the rocker 8 to effect opening and closing of the valve 9. Providing the lash adjuster 1 is of proper length, the valve spring 12 will serve to return it to the base circle of the cam 4 after each valve lift; and no clearance (lash) will exist between the cam and the valve while the latter is in closed position, thereby preventing noise and wear due to hammering of the parts, all in a manner well understood in the art.

As best seen in Figure 2 our lash adjuster 1 comprises a member having the general shape of an upright cup shaped cylinder 14, the end wall 15 of which rests directly on the cam 4. The external cylindrical periphery 16 of the cylinder 14 is provided with an annular groove 17 intermediate the ends of the cylinder 14, which groove is in registry with an oil passage or gallery 18 leading from the engine oil pressure lubricating system (not shown) through the engine cylinder casing 3. Extending through the wall of the cylinder 14, at the upper end of the annular groove 17, is a port 19 by means of which the oil for supplying the lash adjuster is conducted to the cylindrical bore 20 of the cylinder 14. This bore 20 is of uniform diameter for a considerable distance above and below the port 19 and terminates at its upper end in an enlargement 21 adjacent the upper end of the cylinder 14, which enlargement is provided with an annular groove 22. The lower end of the bore 20 terminates in an enlargement 23 which in turn terminates at its lower end in a well 24 of smaller diameter than the bore 20, the lower end of which well has a further reduced portion 25. The reduction in diameter between the enlargement 23 and the well 24 provides a shoulder 26 which in the event the engine is stopped with the valve 9 not fully closed will limit the downward travel of the part now to be described.

In nesting relation within and slidably supported by the cylinder bore 20 is a second member in the form of a cup shaped piston 27 having an end wall 28 from which centrally depends a reduced diameter portion 30. A central aperture 29 extends through the end wall 28 and portion 30. Loosely surrounding the portion 30 is a generally conical-shaped inverted cup or cage member 31 having an external flange 32 at its upper end which is held against the end wall 28

by a compression coil spring 33 whose lower end seats on the end wall 15 of the cylinder within the reduced portion 25 of the well 24. The end wall 34 of this cage member serves to loosely retain the ball 35 in position for closing the lower end of the aperture 29 and has a number of openings 36 extending therethrough.

The internal surface of the piston comprises a series of aligned connecting bores 42, 43 and 44 the diameters of which are arranged in stepped decreasing relation from the upper end of the piston downwardly. An annular groove 40 is provided around the external periphery of the piston for communication with the cylinder port 19, and a port 41 extending radially through the side wall of the piston connects this groove 40 with the intermediate bore 43 of the piston. The aperture 29 through the end wall 28 and reduced portion 30 of the piston communicates at its upper end with the lowermost piston bore 44.

Closing the upper end of the piston is a plug 45 which fits the uppermost bore 42 and has an outwardly flanged rim 46 abutting the upper end face 47 of the piston. This plug 45 is centrally recessed at its upper end to form a spherically concave seat 48 for the lower end face 5 of the push rod 6, and extending centrally through the plug between the seat 48 and its lower end is an air vent passage 49.

The lower end face 5 of the push rod as best shown in Figure 4 is convex in shape to conform with the spherical seat 48 of the plug and has a centrally disposed depression 50 which is of larger diameter than the passage 49 and in direct communication therewith. The push rod end face 5 is further provided with one or more (two being shown) grooves 51 which lead outwardly generally from depression 50 to the lateral extremities of end face 5.

Retained by the annular groove 22 provided in the uppermost bore 21 of the cylinder 14 is an outwardly expansible snap ring 52. This ring is preferably non-circular in shape, having side portions 53 and 54 which serve as abutments for the plug 45 to prevent complete withdrawal of the piston 27 from the cylinder 14 under the force of the spring 33 during installation and removal of the lash adjuster assembly from the engine.

In operation, a body of oil completely fills the space between the piston 27 and the lower end of the cylinder 14 at all times and serves to transmit thrust between these members during each valve lifting stroke of the cam 4. By reason of the cam 4 being offset longitudinally of the axis of its shaft 13 with respect to the axis of the cylinder 14, this cylinder rotates continuously in one direction since its end wall 15 remains in constant surface engagement with the cam. The relatively close fit of the piston in the cylinder causes the piston to rotate in the same direction, though generally at a somewhat lower rate because of the frictional drag effected thereon by the push rod 6. During each lifting stroke the ball check valve 35 closes the lower end of the passage 29 preventing the escape of oil therethrough to the interior of the piston. Some oil, however, will leak between the piston and cylinder to the annular groove 40 from which it flows into the piston through the port 41. A limited amount of such leakage is necessary in order that the lash adjuster will shorten somewhat with each lifting stroke and thereby accommodate any elongation of the push rod 6 or valve stem 10 due to increased operating temperatures.

Following each lifting stroke and return of the valve 9 to its closed position, the lash adjuster spring 33 operates to elongate the lash adjuster by moving the piston 27 outwardly of the cylinder 14 the necessary amount to maintain the cylinder 14 in contact with the cam 4 and the piston 27 in solid abutting relation (through the plug 45, push rod 6 and rocker 8) with the upper end of the engine valve 9. This elongation of the lash adjuster and consequent enlargement of the space between the piston and cylinder causes the ball 35 to leave its seat on the reduced diameter portion 30 of the piston and oil to flow through the passage 29 from the interior of the piston in sufficient quantity to maintain the space below the piston completely filled.

The interior of the piston 14 thus serves as a reservoir for supplying the space below the piston, and this reservoir is maintained substantially filled by delivery of oil thereto under pressure from the engine lubricating system through the gallery 18, annular groove 17 and ports 19 and 41. Since the oil flowing into the piston from the engine lubricating system generally contains a substantial amount of entrained air it is desirable that means be provided for venting the piston in order that this air is not carried downward with the oil through the passage 29 to the space below the piston. In accordance with our invention, this air and the engine oil delivered in excess of that required to maintain the reservoir filled is permitted to pass out of the piston through the aperture 49 in the plug 45 to the depression 50 in the push rod end face 5 and thence along the grooves 51 to atmosphere. By having the vent passage 49 thus located centrally of and at the uppermost end of the oil reservoir within the piston, a most effective venting of the lash adjuster is obtained. The explanation of this is believed to be that the oil-entrained air within the piston tends to concentrate as a vortex around the longitudinal axis thereof by reason of the centrifuging effect produced by the rotation of the lash adjuster in operation while the air, being lighter than the oil, tends also to rise therein toward the vent passage 49, the flow of excess oil from the reservoir in the same direction insures against the lower end of the air vortex interfering with the supply of air-free oil to the valved passage 29. The continuous communication, which the depression 50 and grooves 51 in the end face of the push rod provide, between the upper end of the vent passage 49 and the atmosphere above the lash adjuster permits this flow of oil in the manner described.

We claim:

1. In an internal combustion engine valve operating mechanism, a cam, a hydraulic lash adjuster mounted for reciprocation and axial rotation by the cam, and a push rod for transmitting reciprocating movements of the lash adjuster to the valve, said lash adjuster having a hollow piston with a removable plug in one end forming an abutment for the push rod, said plug being centrally apertured end-wise of the piston and said push rod having its plug abutting surface relieved by a transverse groove connecting said aperture to atmosphere.

2. In combination with a cam for operating a poppet valve, an upright cup shaped cylinder arranged for axial rotation and reciprocation

by the cam, an upright cup-shaped piston within and slidably supported by the cylinder, and a push rod between the piston and the valve, said piston having an opening in its bottom end for passage of fluid from within the piston, said cylinder and piston having communicating side ports above said opening for admitting fluid under pressure into the piston, a plug substantially closing the upper end of the piston and forming a socket for the lower end of the push rod, said plug having an aperture terminating in said socket for conducting excess fluid and entrained air from the interior of the piston to said socket, said push rod having its lower end relieved by a groove extending from said aperture to exterior of the socket for conducting said excess fluid and entrained air out of said socket.

3. In an internal combustion engine valve operating mechanism including two telescoping cup shaped members having a body of fluid in thrust transmitting relation therebetween, means for supplying fluid to said body including a reservoir in the inner cup shaped member, a source of fluid external to the outer cup-shaped member, said inner and outer cup-shaped members having communicating passages connecting said reservoir and said external fluid source a plug on the end of the inner member farthest from said body having a central passage therethrough, a valve engaged member in abutment with said plug circumferentially of said passage having a groove in its plug abutting surface for conducting fluid from said passage to the atmosphere.

4. In combination with a cam and a push rod for operating a valve, an upright cup shaped cylinder arranged for axial rotation and reciprocation by the cam, a cup shaped piston slidably supported by and in nesting relation with the cylinder, means for introducing fluid to the interior of the piston for subsequent delivery to the cylinder below the piston, a plug substantially closing the upper end of the piston and forming an abutment thereon for the push rod, said plug having a passage aligned with the axis of rotation of the cylinder through which excess fluid and entrained air supplied to the piston may pass, and cooperating grooves on the plug opposed end of the push rod for conducting said excess fluid and entrained air to atmosphere from the upper end of said passage.

5. A push rod for transmitting thrust between a hydraulic lash adjuster and a rocker in a poppet valve operating mechanism having an external generally spherical thrust face adapted to socket in one end of the lash adjuster, said thrust face having an external groove extending outwardly from the center thereof to one side of the push rod for the passage of excess fluid and entrained gases conducted to said socket from within the lash adjuster.

6. A push rod for transmitting thrust between a hydraulic lash adjuster and a rocker in a poppet valve operating mechanism having an end portion terminating in a central depression, a generally spherical external surface bordering said depression adapted to seat in a spherical socket of the lash adjuster, said surface terminating at the side edges of said end portion and having an external groove interconnecting said side edges and said depression for venting said depression to atmosphere when the push rod is in thrust transmitting relation with the lash adjuster.

7. In an internal combustion engine valve operating mechanism, a cam, a hydraulic lash adjuster mounted for reciprocation and axial rotation by the cam, and a push rod for transmitting reciprocating movements of the lash adjuster to the valve, said lash adjuster comprising a cylinder closed at one end, a body of hydraulic fluid in the closed end of the cylinder and a hollow cup-shaped piston resting on said body, means in the bottom of said piston for introducing fluid to said body from the interior of the piston, a source of fluid under pressure externally of the lash adjuster cylinder, said cylinder and piston having communicating side ports through which fluid from said source is delivered in excess of requirements to the interior of the piston, a member interposed between the push rod and the piston and forming a closure for the push rod end of the piston, said member having an air and excess fluid escape passage extending therethrough in line with the axis of rotation of the lash adjuster, said push rod having a groove in its end face opposite said member connecting said passage to atmosphere.

8. In combination, a pair of slidably nested cup-shaped members forming a fluid pressure chamber between their bottom walls, a fluid reservoir within the inner member, said inner member having a one-way valved passage through which fluid may enter the pressure chamber from said reservoir, an external source of fluid under pressure, said members having communicating side ports connecting said reservoir to said source, and a member capping said inner member to confine fluid therein, said capping member having a vertical passage extending centrally therethrough and open at its lower end to said reservoir, a spherically concave seat on said capping member surrounding the upper end of said passage, and a rod having a spherical end socketed in said seat, said spherical end having a downwardly presenting relief groove connecting the upper end of said passage to the atmosphere exteriorly of said push rod and members.

9. In a reciprocating hydraulic lash adjuster and push rod assembly in which high rotating speeds are imparted to the lash adjuster during rotation, said lash adjuster having a cylinder, a body of fluid, and a hollow piston in series thrust transmitting relation with each other, means for supplying fluid to said body including a second body of fluid within the piston and a one-way valved passage interconnecting said bodies, said piston and cylinder having communicating side ports for supplying fluid to replenish said second body, said piston and push rod having a ball and socket abutment on the axis of rotation of the lash adjuster, and means for centrally venting the interior of the piston at its push rod end, said means including a central aperture extending through the push rod end of the piston and a connecting groove extending transversely across the piston end of the push rod.

10. In combination, a rotatively and reciprocatively driven hydraulic lash adjuster including an upright cup-shaped piston in one end forming a reservoir for receiving aerated hydraulic fluid during rotation and reciprocation, said piston having a plug in its upper end forming the upper end of said reservoir, said plug having a passage extending therethrough coaxial with the axis of rotation of the piston and an upwardly presenting concave seating surface surrounding the upper terminus of said passage, a source of aerated hydraulic fluid externally of the lash

adjuster, means for conducting fluid from said source to the reservoir including a port in the side of the piston below said plug, and a push rod for transmitting reciprocative movements to and from the lash adjuster, said push rod having one of its ends formed with a convex surface socketably fitting said plug seating surface, said convex surface being relieved by a central recess facing the upper terminus of said plug passage and a groove connecting said recess to the atmosphere exteriorly of the lash adjuster and push rod.

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