May 26, 1959 G. WOOD 2,887,996

HYDRAULIC LASH ADJUSTERS

Filed Oct. 28, 1957

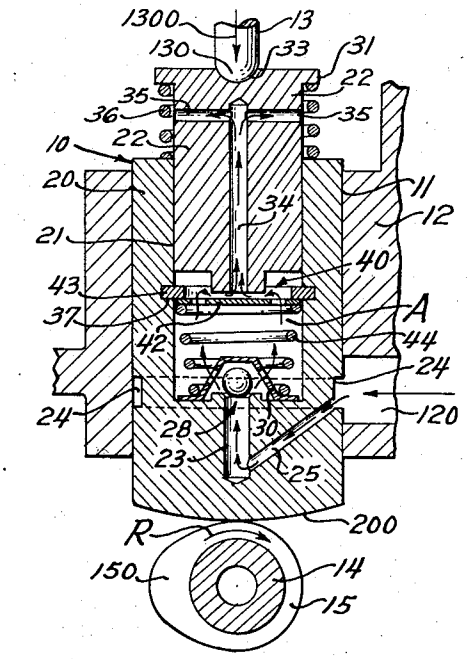


Fig. 1

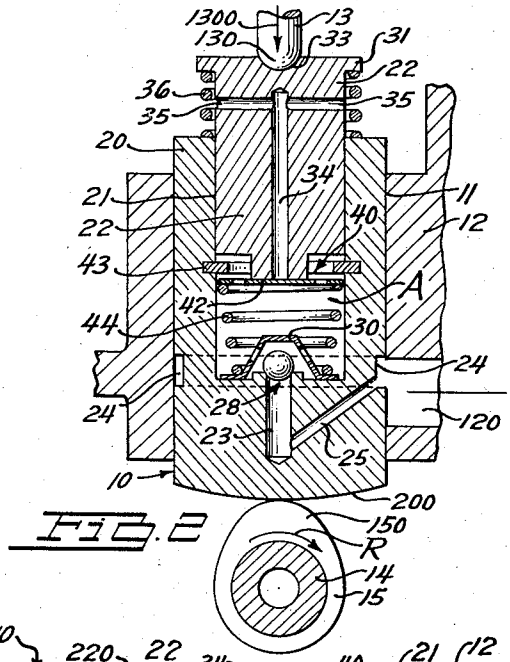


Fig. 2

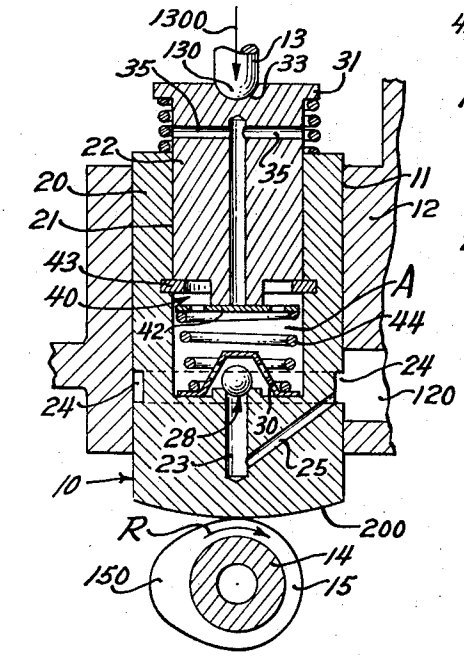


Fig. 3

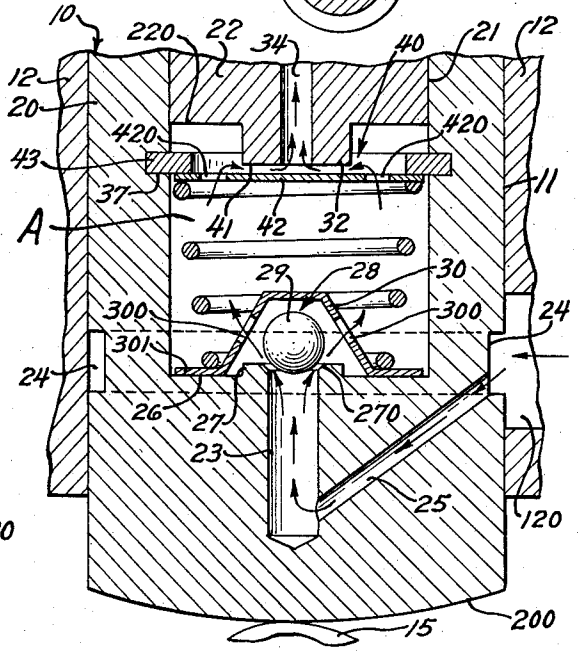


Fig. 4

INVENTOR.
GEORGE WOOD
BY
Everett F. Wright
ATTORNEY

United States Patent Office 2,887,996
Patented May 26, 1959

2,887,996

HYDRAULIC LASH ADJUSTERS

George Wood, Southfield Township,
Wayne County, Mich.

Application October 28, 1957, Serial No. 692,692

5 Claims. (Cl. 123—90)

This invention relates to hydraulic lash adjusters for automatically taking-up the play inherent in valve trains of internal combustion engines, and is an improvement over the hydraulic lash adjuster disclosed in my copending application for patent, Serial No. 609,560 entitled "Hydraulic Lash Adjusters," filed September 13, 1956, now Patent No. 2,818,844.

Internal combustion engine poppet valve operating mechanisms generally include a train of several elements which transfer motion from the valve actuating cam to the valve stem to open the valve against spring pressure constantly urging the valve to its closed position. Inasmuch as the operating clearances in the valve train vary in accordance with engine operating temperature variations and because of wear between the several elements of the valve train, it has been a generally accepted practice to employ lash adjuster means in the valve train to automatically take-up and compensate for the variable clearances therein.

Many of the hydraulic lash adjusters employed in internal combustion engines have not proven entirely satisfactory because of their malfunctioning as a result of gummy deposits which accumulate therein. The deposit of such gummy substances in hydraulic lash adjusters is known in the art as "varnishing." Also, prior art hydraulic lash adjusters are generally of complex construction, expensive to manufacture and difficult to service.

The primary object of the instant invention is to improve and simplify the construction of hydraulic lash adjusters for internal combustion engine valve trains by providing a free operating hydraulic piston through which engine oil under pressure flows continuously except during the engine valve lifting portion of the engine cam actuated movement of the engine valve train into which the hydraulic lash adjuster is incorporated, the said hydraulic lash adjuster including simplified self-cleaning valve means closing off the flow of engine oil through the said hydraulic piston during the valve lifting portion of the engine cam actuated movement of the engine valve train, all arranged to operate freely and silently against oil cushioning whereby to substantially eliminate valve train operating noises generally occurring in conventional constructions.

A further object of the invention is to provide hydraulic lash adjusters for internal combustion engine valve trains which are inexpensive to manufacture, positive, reliable and substantially noiseless in operation, substantially free from varnishing, and requiring little or no maintenance.

Other objects of the invention will become apparent by reference to the following detailed description taken in connection with the accompanying drawings, in which:

Fig. 1 is a vertical sectional view of a hydraulic lash adjuster embodying the invention operatively mounted in the block of an internal combustion engine, the said hydraulic lash adjuster being shown in the position assumed by it when the engine valve is closed.

Fig. 2 is a vertical sectional view similar to Fig. 1 except that the hydraulic lash adjuster is shown in the position to which it is moved when the engine valve timing cam has fully opened the engine valve.

Fig. 3 is a vertical sectional view similar to Figs. 1 and 2 except that the hydraulic lash adjuster is shown in the position which it may assume when the internal combustion engine is not in operation and has been standing for a sufficiently long time without supplying oil under pressure to the piston of the hydraulic lash adjuster to compensate for any minute leakage that may occur between the valve piston and its cylinder or through the ball back-flow check valve thereof.

Fig. 4 is an enlarged fragmentary sectional view similar to Fig. 1 showing in detail the lower end of the improved hydraulic lash adjuster and its preferred valving.

Referring now to the drawings wherein like reference numerals refer to like and corresponding parts throughout the several views, the particular hydraulic lash adjuster 10 disclosed for the purpose of illustrating the invention is reciprocatingly mounted in a bore 11 of the block 12 of an internal combustion engine, the said bore 11 being axially aligned with a push rod or valve stem 13 and is disposed normal to the longitudinal axis of the cam shaft 14 over an engine valve operating cam 15 thereof. As the cam shaft 14 rotates, the cam 15 raises the hydraulic lash adjuster 10 from the position shown in Fig. 1 to the position shown in Fig. 2 whereby to move the push rod upwardly and open an engine valve; the said push rod 13 being a part of an engine valve train generally employed in conventional internal combustion engines. The valve train to which reference is made usually consists of the push rod 13 and a rocker arm which opens a spring loaded closed engine valve responsive to the movement of the push rod 13 by the cam 15.

Inasmuch as the engine valve and valve train construction is conventional and is not a part of the instant invention, it has not been shown in the drawing. However, it is important to note that the engine valve spring operating through the valve train constantly urges the push rod 13 in the direction indicated by the arrow 1300 thereon. Because of necessary clearances in the engine valve train required to permit expansion and contraction therein occasioned by extreme differences in the non-operating and operating temperatures of the engine, the hydraulic lash adjuster 10 is employed to automatically and continuously take up the normal clearances or lash in the valve train.

The improved hydraulic lash adjuster 10 preferably consists of a cylinder 20 which is axially bored from its upper end at 21 to reciprocatingly accommodate a piston 22. The cylinder 20 is counterbored to provide a pressure oil inlet passage at 23 to the oil chamber A at the bottom of the bore 21 therein. The said cylinder 20 is provided with an outer peripheral groove 24 which communicates with the said oil pressure inlet passage 23 by means of a diagonal bore 25. The central portion of the cylinder 20 at the bottom 26 of the bore 21 therein is formed to provide a central annular collar 27 around the top of the counterbore 23. An anti-backflow ball valve 28 is provided in the cylinder 20 to prevent backflow of oil from the oil chamber A consisting of a valve ball 29 which seats on a valve seat 270 ground at the top of the annular collar 27 at the periphery of the counterbore 23 therein. A flanged valve ball retainer cap 30 having oil passage apertures 300 therethrough retains the valve ball loosely postioned over the valve seat 270. The flange 301 of the ball retainer cap 30 rests on the bottom 26 of the axial bore 21 of the cylinder 20.

The piston 22 is reciprocatingly mounted in the bore 21 of the cylinder 20 of the hydraulic lash adjuster 10. The said piston 22 is provided with an upper radially extending annular shoulder 31 and a lower central cylin-

drical stem 32. The top of the said piston 22 is provided with a central semi-spherical recess 33 to receive the end 130 of the push rod 13 of the engine valve train. The piston 22 is axially bored at 34 from its lower end to provide a fluid passage therein extending to a point somewhat below the upper annular shoulder 31 thereof and intersects a diametrical bore 35 through the said piston 22 near the top thereof to provide a fluid passage 34—35 from the oil chamber A of the cylinder 20 to within the engine block 12 just above the bore 11 therein in which the cylinder 20 of the hydraulic lash adjuster 10 is reciprocatingly mounted.

A compression spring 36 is preferably disposed in slight spaced relationship around the piston 22 of the hydraulic lash adjuster 10 and is located between the bottom of the annular upper shoulder 31 of the piston 22 and the top of the cylinder 20 thereof. The compression spring 36 is of less strength than the spring in the engine valve train urging the push rod 13 downwardly as indicated by the arrow 1300 in the drawings. The said compression spring 36 constantly urges the piston 22 of the hydraulic lash adjuster 10 upwardly against the push rod 13 and the cylinder 20 thereof downwardly against the cam 15, the said lash adjuster 10 being reciprocatingly mounted in the bore 11 of the engine block 12 as hereinbefore described. The bottom of the cylinder 20 of the hydraulic lash adjuster 10 is preferably slightly domed at 200 to provide a smooth cam follower surface regardless as to how the said cylinder 20 becomes oriented in the bore 11 of the engine block 12.

The hydraulic lash adjuster 10 is provided with a through flow shut-off valve generally designated by the numeral 40. The lower central cylindrical stem 32 of the piston 22 is ground smooth to provide a valve seat 41 against which a valve disc 42 reciprocably mounted in the bore 21 of the cylinder 20 may seat to close off the flow of oil under pressure from the oil chamber A in the cylinder 20 through the piston 22. A valve disc retainer ring 43 is sprung into an annular groove 37 provided in the wall of the bore 21 of the cylinder 20 below which the said valve disc 42 is positioned. An inverted frusto-conical compression spring 44 is interposed between the valve disc 42 and the flange 301 of the ball retainer cap 30 and serves the dual function of holding the ball retainer cap 30 is position and constantly urging the valve disc 42 resiliently against either the valve disc retainer ring 43 or the valve seat 41, as the operation of the hydraulic lash adjuster 10 requires. The said valve disc 42 has ports 420 therethrough providing communication between the chamber A of the hydraulic lash adjuster 10 and the fluid passage 34 of its piston 22 when the through flow shut-off valve 40 is open.

When installed in a valve train of an internal combustion engine, the hydraulic lash adjuster 10 assumes the position indicated in Fig. 1 during the period of time the engine valve is closed. In the engine valve closed position, the cam follower dome 200 of the cylinder 20 of the hydraulic lash adjuster 10 follows the normal cam surface of the cam 15. As the cam shaft rotates, the lobs 150 of the cam 15 lifts the hydraulic lash adjuster 10 by pressure on the cam follower dome 200 thereof from its position shown in Fig. 1 to its position shown in Fig. 2.

In the engine valve closed position of the hydraulic lash adjuster 10 as shown in Fig. 1, the anti-backflow ball valve 29 is open, and the through flow shut-off valve 40 is open with the valve seat 41 thereof spaced from the valve disc 42 which is spring urged by the compression spring 44 against the bottom of the valve disc retainer ring 43. When the engine valve controlled by the hydraulic lash adjuster 10 is closed, engine oil under pressure from a suitable oil pressure supply port 120 in the engine block 12 flows through the said hydraulic lash adjuster 10 via the outer peripheral groove 24, the diagonal bore 25, the inlet passage 23, the anti-backflow ball valve 28, and chamber A of its cylinder 20, through the through-flow shut-off valve 40, and through the oil passages 34 and 35 of its piston 22 into the crank case of the engine block 12. This through-flow of engine oil provides a self-cleaning effect and maintains the hydraulic lash adjuster clean and free from harmful deposits from the engine oil. Because of the fact that the oil passages 35 are relatively restricted, sufficient oil pressure is developed against the bottom of the piston 22 to maintain it in its UP position shown in Fig. 1, the separation between the valve seat 41 and the valve disc 42 of the through-flow shut-off valve 40 representing the amount of clearance or play to which the engine valve train is adjusted to compensate for expansion of the elements thereof and to provide a minimum of operating clearances therein.

As the crankshaft 14 and cam 15 thereon rotate clockwise as indicated by the arrow R in the drawing, the lobe 150 of the said cam 15 lifts the hydraulic lash adjuster 10 upwardly from its engine valve closed position shown in Fig. 1 to its engine valve open position shown in Fig. 2. During the first portion of the said upward movement of the hydraulic lash adjuster 10, the cylinder 20 moves upwardly in respect to the piston 22 closing the through-flow shut-off valve 40 interrupting the flow of oil under pressure through the said hydraulic lash adjuster 10. This takes up the clearance or play in the engine valve train, and, further upward lifting of the said hydraulic lash adjuster 10 by the lobe 150 of the cam 15 opens the engine valve controlled by the engine valve train. The seating of the valve seat 41 of the through-flow shut-off valve 40 against the valve disc 42 thereof is always sufficiently oil cushioned as to assure substantially noiseless operation of the hydraulic lash adjuster 10. When the through-flow shut-off valve 40 is closed, as in Fig. 2, the anti-backflow valve 28 is also closed to maintain an oil cushion in the chamber A of the cylinder 20 of the hydraulic lash adjuster 10.

The closing of the engine valve of the engine valve train is accomplished by a compression spring in the engine valve train as the cam lobe 150 of the cam 15 moves clockwise as indicated by the arrow R from its position shown in Fig. 2 toward its position shown in Fig. 1 whereupon the hydraulic lash adjuster 10 again functions as hereinbefore described for its engine valve closed position.

The lower cylindrical stem 32 of the piston 22 of the hydraulic lash adjuster 10 is sufficiently long that, in the normal operation of the hydraulic lash adjuster 10, the annular shoulder 220 of the said piston 22 will not seat on the valve disc 42. However, when an engine equipped with hydraulic lash adjusters 10 is not running and should there be a leakage of oil out of the oil chamber A, or, if for any reason oil under pressure is not available to a hydraulic lash adjuster 10 at the oil pressure supply port 120 in the engine block 12, then, the piston 22 may travel downwardly against the top of the retainer ring 43 as shown in Fig. 3, and there remain until oil under pressure is again supplied to the hydraulic lash adjuster 10 and fills the oil chamber A of the cylinder 20 thereof whereupon the said hydraulic lash adjuster 10 will resume its normal operation.

The improved hydraulic lash adjuster 10 provides a trouble free anti-varnishing construction which operates efficiently and quietly over long periods of engine operation and avoids the necessity of frequent adjustment of valve train clearances in any valve train in which the hydraulic lash adjuster 10 of the invention is employed. Furthermore, the improved hydraulic lash adjuster is of relatively simple construction, its ports and oil passages are large, its valves close under oil pressure cushioning to provide extremely quiet engine operation, and it is readily and economically manufactured, assembled and serviced.

Although only a single embodiment of the invention has been disclosed and described in detail, it is obvious that many changes may be made in the size, shape, arrangement and proportions of the various elements thereof, all without departing from the spirit and scope of the invention as defined by the appended claims.

I claim:

1. A hydraulic lash adjuster for cam actuated valve trains of internal combustion engines reciprocably mountable in a bore in the engine block having an engine oil pressure supply port communicating therewith, said hydraulic lash adjuster comprising an outer cylinder having an axial bore at one end and closed at its other end, a piston reciprocably mounted axially in said cylinder forming an oil chamber therein, said cylinder having passages therein communicating with said engine oil pressure supply port, an apertured valve disc reciprocably mounted in said cylinder including spring means constantly urging said valve disc toward said piston, a retainer ring in said cylinder limiting said spring loaded movement of said valve disc, the said piston having therein an axial oil passage communicating with relatively restricted oil passages therefrom, the said cylinder and said piston having a free flow of engine oil under pressure therethrough when the engine valve is closed, the said piston including a central cylindrical lower stem having its lower surface formed to provide a valve seat which seats against said valve disc to interrupt the free flow of engine oil under pressure through said hydraulic lash adjuster during the cam actuated engine valve opening cycle of operation thereof, and an anti-backflow valve means in said oil chamber preventing backflow of oil from said oil chamber to said oil pressure supply port when the free flow of oil under pressure through said valve lifter is interrupted.

2. A hydraulic lash adjuster for cam actuated valve trains of internal combustion engines reciprocably mountable in a bore in the engine block having an engine oil pressure supply port communicating therewith, said hydraulic lash adjuster comprising an outer cylinder having an axial bore at one end and closed at its other end, a piston including a flanged head reciprocably mounted axially in said cylinder forming an oil chamber therein, a compression spring disposed between the head of said piston and the adjacent end of said cylinder constantly urging said piston and said cylinder to elongate and take up play in said valve train, said cylinder having passages therein communicating with said engine oil pressure supply port, an apertured valve disc reciprocably mounted in said cylinder including spring means constantly urging said valve disc toward said piston, a retainer ring in said cylinder limiting said spring loaded movement of said valve disc, the said piston having therein an axial oil passage communicating with relatively restricted oil passages therefrom, the said piston including a central cylindrical lower stem having its lower surface formed to provide a valve seat which seats against said valve disc to interrupt the free flow of oil under pressure through the several passages in the said cylinder and said piston of the said hydraulic lash adjuster during the engine valve opening cycle of operation thereof, and an anti-backflow valve means in said oil chamber preventing backflow of oil from said cylinder when the free flow of oil under pressure through said valve lifter is interrupted.

3. A hydraulic lash adjuster for a cam operated valve train of an internal combustion engine comprising a cylinder having one open end and one closed end, a piston reciprocatingly mounted axially in said cylinder forming an oil chamber therein, the said cylinder and piston having passages therein providing a free flow of engine oil under pressure through said hydraulic lash adjuster, said piston having an inwardly disposed central annular collar thereon with a flat valve seat formed at the inner end thereof,

an apertured valve disc reciprocatingly mounted in said cylinder including spring means constantly urging it toward said piston valve seat to close off the oil passage therethrough, a retainer ring in said cylinder limiting the said spring loaded movement of the valve disc toward said piston and the movement of said piston toward said valve disc, spring means constantly urging said piston valve seat off said valve disc, the said normal flow of engine oil through the said hydraulic lash adjuster being interrupted by the seating of said piston valve seat on said valve disc when axial pressure is applied on the hydraulic lash adjuster during the cam opening of the normally spring loaded closed engine valve of said valve train.

4. A hydraulic lash adjuster for the cam operated valve train of an internal combustion engine comprising a cylinder having one open end and one closed end, a piston reciprocatingly mounted axially in said cylinder forming an oil chamber therein, the said cylinder and piston having passages therethrough providing a normal free flow of engine oil under pressure through said hydraulic lash adjuster when the engine valve of the engine valve train is closed, said piston having an inwardly disposed central annular collar thereon with a flat seat formed at the inner end thereof, an apertured valve disc reciprocatingly mounted in said cylinder including spring means constantly urging it toward said piston valve seat to close off the oil passage therethrough, a retainer ring in said cylinder limiting the said spring loaded movement of the valve disc toward said piston and the movement of said piston toward said valve disc, a collar on the outer end of said piston, a compression spring constantly urging said piston and said cylinder in extended relationship within said valve train whereby to urge said piston valve seat off said valve disc, the said normal flow of engine oil through the said hydraulic lash adjuster being interrupted by the seating of said piston valve seat on said valve disc when axial pressure is applied on the hydraulic lash adjuster during the cam opening of a normally spring loaded closed engine valve of said valve train, and an anti-backflow valve means in said cylinder preventing backflow of oil therefrom when the flow of engine oil therethrough is interrupted.

5. A hydraulic lash adjuster for a cam operated valve train of an internal combustion engine having a spring closed engine valve comprising a cylinder having one open end and one closed end, a piston reciprocatingly mounted axially in said cylinder forming an oil chamber therein, the said cylinder and piston having passages therethrough providing a free flow of engine oil under pressure in one direction through said hydraulic lash adjuster, anti-backflow valve means in said cylinder at the point of entrance of oil under pressure thereinto, said piston having a central annular collar thereon with a flat valve seat formed at the outer end thereof, a valve disc reciprocatingly mounted in said cylinder including spring means constantly urging it toward said piston valve seat to close off the oil passage therethrough, a retainer ring in said cylinder limiting the said spring loaded movement of the valve disc toward said piston and the movement of said piston toward said valve disc, spring means constantly urging said piston off said valve disc, the said normal pressure flow of engine oil through the said hydraulic lash adjuster being interrupted responsive to the piston valve seat seating on said valve disc as axial pressure is applied to said hydraulic lash adjuster during cam opening of the engine valve, and an anti-backflow valve means in said piston preventing backflow of oil from said oil chamber.

References Cited in the file of this patent

UNITED STATES PATENTS

2,356,900	Voorhies	Aug. 29, 1944
2,745,391	Winkler	May 15, 1956