

June 11, 1940.

J. E. ESHBAUGH
HYDRAULIC LASH ADJUSTER

2,203,952

Filed Jan. 30, 1939

2 Sheets-Sheet 1

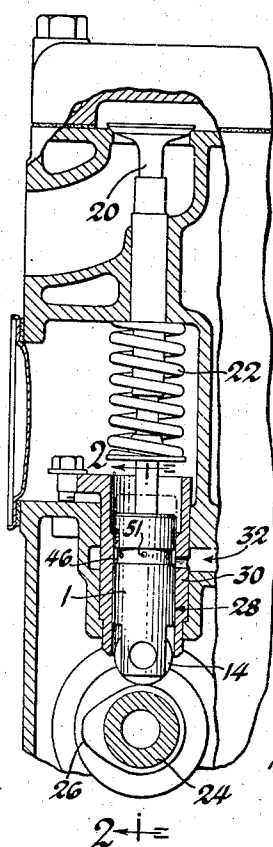


Fig. 1

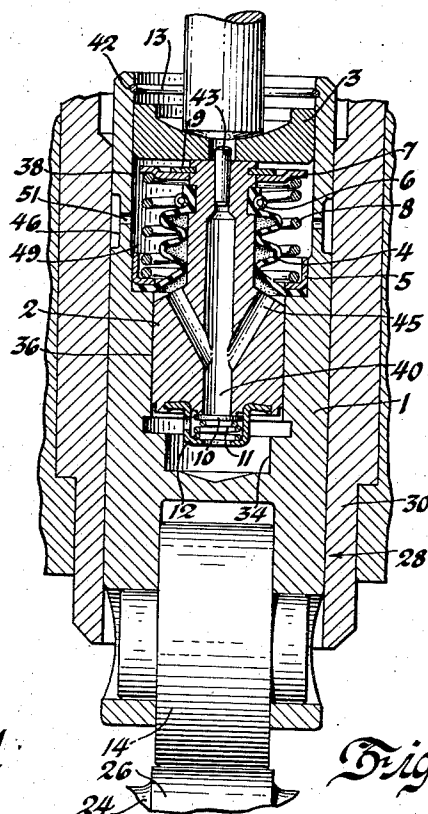


Fig. 2

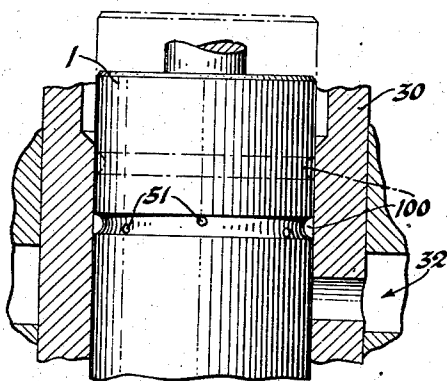


Fig. 3

Inventor
Jesse E. Eshbaugh
By *Blackman, Spence & Kirk*
Attorneys

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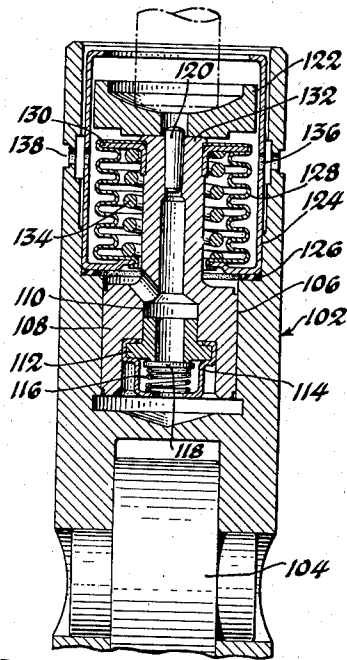


Fig. 4

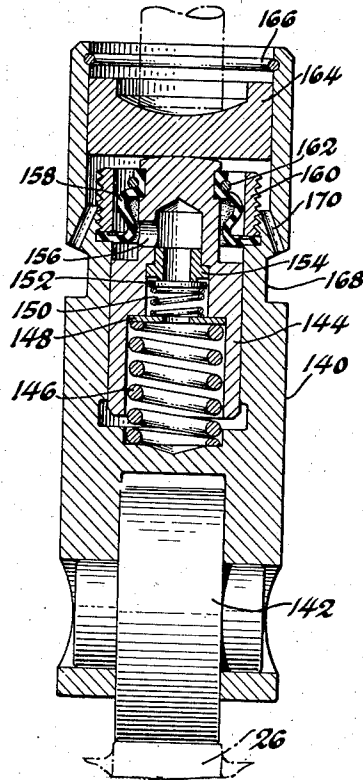


Fig. 5

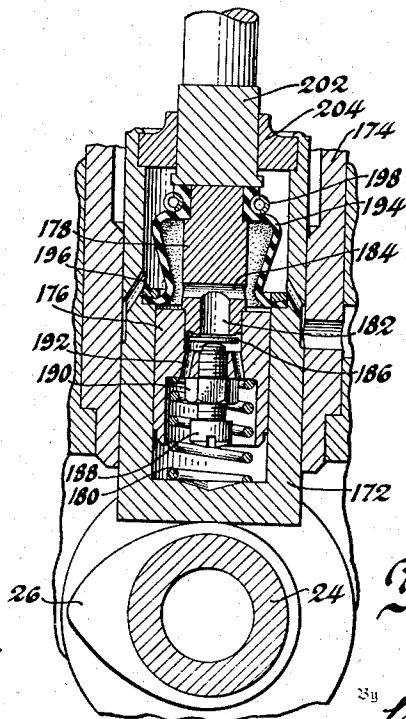


Fig. 6

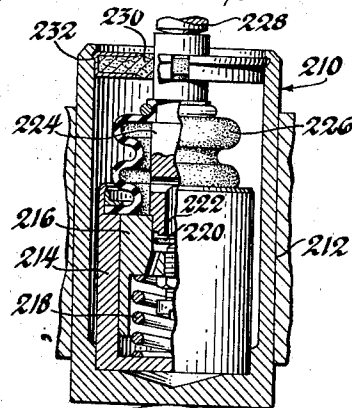


Fig. 7

Inventor
Jesse E. Eshbaugh

By
Blackburn, Spencer & Flunk
Attorneys

UNITED STATES PATENT OFFICE

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HYDRAULIC LASH ADJUSTER

Jesse E. Eshbaugh, Flint, Mich., assignor to General Motors Corporation, Detroit, Mich., a corporation of Delaware

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3 Claims. (Cl. 123-90)

This invention has to do with valve lash adjusters of the type in which there is a cylinder containing a body of liquid, usually oil, on which rests a piston which engages the valve or valve operating mechanism or positions some part in the valve operating train. In such construction a valved passage is usually provided for supplying oil from a suitable reservoir to the hydraulic chamber supporting the piston. Means is provided to yieldingly urge the piston out of the cylinder. The fluid system comprising the hydraulic chamber, reservoir and passage is sealed by means of a suitable diaphragm secured at one end of the cylinder and at the other end to the piston. It will be found most convenient to make this diaphragm of oil-resistant rubber or other suitable flexible material.

It will be found that where the type of lash adjuster above described is arranged in the train of valve operating mechanism and moves with the valve, the diaphragm will be subject to considerable distortion during operation by the movement of the supply fluid back and forth under the influence of inertia.

An important object of the present invention consists in the provision of oil or other fluid on the other side of the diaphragm so as to counter-balance the effect of inertia on the liquid confined in the cylinder. With this arrangement the forces operating on the diaphragm are balanced and it is relieved of any substantial strain, thereby lengthening its life.

Other features of the invention will be pointed out in the course of the description in which:

Figure 1 is a section through a portion of the valve mechanism of an L-head internal combustion engine showing one form of the improved lash adjuster.

Figure 2 is a section on line 2-2 of Figure 1. Figure 3 is a fragmentary sectional view showing a slight modification of the construction of Figure 2.

Figures 4, 5, 6 and 7 are views corresponding to Figure 2 showing further modifications.

20 indicates a poppet valve of a conventional internal combustion engine held upon its seat by the usual coil spring 22. 24 indicates a portion of the automobile cam shaft carrying cam 26 which engages roller 14 of tappet 28 in which my improved lash adjuster is incorporated. This tappet reciprocates in guide 30. Oil is supplied from the engine lubricating system to the guide 30 through aperture 32. Tappet 28 consists of cylinder 1 having an inner bore 34, an intermediate bore 36 and an outer bore 38, of graduated diameters as shown. In the intermediate bore 36 is guided the piston 2 having central passage 40, the lower end of which is closed by disk valve 10 yieldingly held on its seat by spring 11 held in place by retainer 12 which is press-fitted in an annular groove formed in the bottom of the piston 2. The portion of the cylinder below the piston constitutes the hydraulic chamber. 4 indicates a diaphragm or bellows preferably made of oil-resistant rubber which is secured to the outer end of piston 2 by means of tension spring or band 6 surrounding the outer end of the bellows and holding it in a groove provided in the outer end of the piston as shown. The inner end of the bellows is clamped under a retainer 5, preferably made of sheet metal, which is press-fitted into the outer bore 38 of the piston and on to a shoulder formed at the junction of the outer bore and the intermediate bore.

8 indicates a coil spring seated at one end on the retainer 5 and at the other end bearing against stamped ring 7 held in place by a C-shaped washer 9 engaged in an annular groove formed in the extreme outer end of piston 2.

3 indicates a valve stem engaging member in the form of a disk guided in the outer bore 38 and held against withdrawal by means of split ring 13 snapped into groove 42 formed in the outer end of the bore 38.

In the manufacture of the device the cylinder 1 with the piston assembly in it is immersed in oil under vacuum so as to displace with oil all the air in the assembly. Thereafter the outer end of the central passage 40 in the piston 2 is sealed by driving a suitable plug 43 of soft metal or other material into it and the diaphragm 4 is secured in place as described, thereafter disk 3 is inserted in the cylinder and split ring 13 is snapped in position. The unit is now ready for insertion in the engine in the position indicated in Figure 1 and during the operation of the engine acts as follows to take up lash or clearance that may develop:

When the cam 26 engages the roller 14, moving the tappet cylinder 1 upwardly, oil cannot get out of the hydraulic chamber below the piston because valve 10 is held closed not only by spring 11 but also by the much greater pressure exerted through the oil as the result of the upward movement of the cylinder. Consequently, the piston 2 is forced upwardly and with it the valve engaging member 3 and the valve 20. During the opening and closing movement of the valve 20 the valve spring 22 is under compression and the parts are held in the described relation. After the

valve reaches its seat if any lash or clearance exists in the valve operating mechanism, spring 8 expands, pushing the tappet down against the cam 14 and pushing the piston 2 and valve engaging member 3 upwardly against the valve stem. This increases the volume of the hydraulic chamber beneath the piston causing oil to be drawn down from the supply inside the diaphragm 4 through passages 45 and central passage 40 past the valve 10 into the hydraulic chamber. Such action occurs whenever any lash or clearance develops in the valve operating mechanism.

At times it is necessary that the over-all length of the tappet should decrease to enable the valve to rest on its seat when the roller 14 is on the base circle of the cam. This condition occurs when the valve and tappet become heated during engine operation and expand. When this occurs the valve spring 22 exerts pressure against the valve stem engaging member 3 and piston 2 not only during the valve opening and closing movements but also when the tappet engages the base circle of the cam. This heavy pressure causes increased leakage of oil between piston 2 and cylinder 1 thereby allowing the piston to descend further into the cylinder permitting the valve 20 to seat.

The above is a simplified statement of operation rather than a precise one. It will be understood that there is always a certain amount of leakage of oil between the piston 2 and cylinder 1 during each valve operating cycle and there is also, during each cycle a certain amount of oil which passes through valve 10 into the hydraulic chamber. Any adjustments of the piston 2 in the cylinder 1 are effected by a succession of very small movements. Thus, increase in the over-all length of the tappet to take up lash is accomplished by a series of additions to the supply of oil in the hydraulic chamber in excess of the amount escaping between the piston and cylinder. Shortening of the over-all length of the tappet is accomplished through a succession of valve operating cycles in which oil is forced out between the piston and cylinder and none is admitted owing to the fact that valve 10 is always held upon its seat by spring 11 and the pressure on the oil resulting from the failure of the engine valve to completely close. The described adjustments are taking place continuously during the operation of the engine and insure that the valve operating mechanism will be continuously operating without substantial lash or clearance.

The described construction has the advantage that the hydraulic chamber and the oil supply for the chamber are sealed against the entrance of dust and air, but is open to the objection that the flexible diaphragm 4 is subject to distortion as a result of surging of the oil confined within it by reason of its inertia. This objection I have overcome by providing a body of oil within the outer bore 38 surrounding the diaphragm. This oil comes from the engine lubricating system through passage 32. Groove 46 collects some of it from the tappet guide and it reaches the reservoir 49 in the interior of the tappet through suitable passages 51. The reservoir 49 fills with oil soon after the engine is put into service and remains filled. Any air that may find its way into the reservoir escapes through the clearance between disk 3 and the tappet bore.

In Figure 3 there is shown a slight modification

of the tappet, the cylinder 1 being provided with a narrow annular groove 100 provided with apertures 51 communicating with the chamber surrounding the diaphragm 4. Here oil is supplied, as before, through passage 32 connected to the pressure lubricating system. This oil lubricates the guide 30. The groove 100 receives some of this oil which passes through openings 51 to the chamber surrounding the diaphragm. As shown by dotted lines the length of the tappet movement is such that groove 100 is always covered by a portion of the guide 30 throughout its stroke so that oil reaching the chamber 49 has little chance of escape and so is at all times in position to counterbalance the pressure of the oil inside the diaphragm.

In the modification shown in Figure 4, tappet 102 provided at its lower end with roller 104, has a central bore 106, receiving piston 108 having a central recess 110 in one portion of which there is secured by force fit a thimble 112 on which is spun a cage 114 housing spring 116 and disk valve 118. The upper end of the bore 110 is closed by plug 120 after the device has been completely filled with oil. On the piston 106 there rests disk 122 guided for sliding movement in stamping 124 which is a press fit in the enlarged portion of the recess in the upper part of the tappet 102. Sealing gasket 126 is interposed between the stamping and a shoulder in the cylinder 102. 128 indicates a corrugated bellows which is shown made of metal although it may be made of rubber as in the previous form. The upper end of this bellows is clamped between ring 130 secured to the upper end of the piston 108 and the headed over portion 132 of the upper end of the piston 108. The lower end of the diaphragm 128 is secured to the intumed edge of the stamping 124. Coil spring 134 positioned within the diaphragm as shown exerts yielding upward pressure on the piston 108 through its engagement with the member 130.

With this construction the interior of the diaphragm 128 and the portion of the bore of the cylinder 102 below it, including the passages in the tappet, are completely filled with oil before inserting the tapered plug 120. Oil is supplied to the exterior of the diaphragm 128 through passages 136 in the cylinder 102 and stamping 124 as shown. The passages 136 communicate as before with an annular groove 138 in the outer surface of the cylinder 102. This groove is supplied with oil from the engine lubricating system in the ways previously described.

This modification as well as those later to be described operates in the same way as the preferred form.

In the modification shown in Figure 5, tappet 140 provided with roller 142 is centrally bored to receive piston 144 urged outwardly of the cylinder by spring 146 bearing against apertured washer 148 on which rests weaker spring 150 urging disk valve 152 against its seat which is formed on thimble 154 which is a press fit in the central bore in the piston 144. The bore in the piston communicates through passage 156 with the interior of the chamber formed by flexible diaphragm 158, one end of which is clamped between a shoulder inside the tappet 140 and a sleeve 160 threaded to the body of the tappet. The upper end of the diaphragm 158 is secured to a groove in the upper end of piston 144 by a wire or other suitable clamping device 162. Disk 164 rests on the upper end of the piston 144. An expanding split ring 166 is secured in a groove

in the upper end of the bore of the tappet to limit the outward movement of the disk 164.

Tappet 140 is grooved at 168 as shown and this groove communicates by passages 170 with the chamber surrounding the diaphragm 158. This construction is very simple and has certain advantages in ease of manufacture.

In the form shown in Figure 6, tappet 172 reciprocating in guide 174 is bored out to receive piston 176 made in two parts, the upper part 178 preferably being a press fit in the lower part. Spring 180 urges piston 176 out of the body of the tappet, the part 178 of the piston is provided with a central bore 182 and an intersecting bore 184, the lower end of the part 178 provides a seat for disk valve 186 the movement of which is limited by screw 188 provided with lock nut 190, the screw being threaded into the lower end of the piston 176. Passages 192 connect the chamber below the piston with the passages leading beyond the valve 186.

Diaphragm 194 which is preferably of rubber is clamped between the shoulder formed in the bore of the tappet and a ring 196 which is a press fit in the bore. The upper end of the diaphragm is secured to the part 178 by an encircling member 198 which may take the form of an annular coiled spring. Upon the part 178 rests the valve stem engaging member 202 which is guided in an aperture in member 204 clamped in the open end of the tappet 172 as shown.

An advantage of the modification last described is the adjustable play of the valve 186. If desired, a small coil spring may be provided to yieldingly hold valve 186 on its seat.

Figure 7 shows a further modification in which the tappet 210 comprises an outer cylinder 212 in which is fitted or secured an inner cylinder 214 in which is slidably guided the piston 216 yieldingly urged outwardly by coil spring 218. Disc valve 220 controls passages 222 which may be of the same construction as those shown in Figure 6, extending through the upper part 224 of the piston. Diaphragm 226 of a construction substantially the same as that shown in Figures 5 and 6 is secured at its lower end to the upper end of cylinder 214 and at its upper end to the part 224 of the piston. The piston part 224 engages the end of the valve stem indicated at 228.

In this form of the invention a felt washer 230 mounted in stamping 232 fitted in the upper end of cylinder 210 engages the upper portion of piston part 224.

This device operates in substantially the same manner as those previously described except that the felt washer 230 permits oil to slowly seep through into the chamber below thereby providing fluid around the outside of the diaphragm 226 to counterbalance the force exerted on it by the oil within the diaphragm due to the rapid movement of the tappet. With this arrangement it is unnecessary to provide any other means for the entrance of oil into the interior of the tappet.

Obviously this invention is applicable to hydraulic valve mechanism of other types, for ex-

ample, the type shown in Almen Patent 1,936,653 in which the hydraulic dash pot serves to adjust the position of a member in the valve operating train but is not itself subjected to the full valve operating pressure.

It will be noted that the bottom of the piston 2 is spaced but a short distance from the shoulder formed at the junction of the inner bore 34 and the intermediate bore 36 of the tappet. This is for the purpose of making it possible for the shoulder to engage the piston and operate the valve even though there be no oil at all in the tappet. This assures that the engine may be operated at all times even though the operation be very noisy.

In the forms of the invention shown in Figures 5, 6 and 7 it will, of course, be desirable to employ filling plugs like plug 43 of Figure 2 and plug 120 of Figure 4 for convenience in initially filling the tappets with oil.

I claim:

1. In a valve lash adjuster the combination of a cylinder, a piston in the cylinder, means yieldingly urging the piston out of the cylinder, a passage leading from the portion of the cylinder on one side of the piston to the portion of the cylinder on the other side of the piston, a valve in said passage preventing the escape of oil from the bottom of the cylinder when pressure is applied thereto, a flexible diaphragm connected to the piston at a point above said passage and to the cylinder, a body of oil sealed within the cylinder by the diaphragm, a body of oil in the cylinder surrounding the diaphragm, and means for confining the last-named body of oil in said cylinder so as to prevent surging thereof while permitting a slight amount of leakage so that entrained air may escape.

2. In the combination as defined in claim 1, said last named means including a valve stem engaging member slidably guided in said cylinder and supported by said piston.

3. In valve operating mechanism for internal combustion engines and the like the combination of a valve, means for yieldingly holding the valve on its seat, and means for moving the valve from its seat comprising a tappet in the form of a cylinder having one end closed, a guide for the tappet, a piston in the cylinder, means for yieldingly urging the piston out of the cylinder, a passage through the piston to admit oil to the hydraulic chamber formed between the piston and the bottom of the cylinder, a check valve in said passage, a diaphragm connected to the piston and the cylinder forming a reservoir between it and the upper end of the piston, a body of oil filling said chamber, passage and reservoir and sealed in place by said diaphragm, means for supplying oil to the interior of the cylinder above said diaphragm to counterbalance the oil on the other side, and means for confining within the cylinder the oil above the diaphragm so as to prevent surging thereof while permitting a slight amount of leakage so that entrained air may escape.

JESSE E. ESHBAUGH.