Oct. 12, 1954 T. R. THOREN 2,691,367

HYDRAULIC CLEARANCE ADJUSTER

Filed Sept. 27, 1950 2 Sheets-Sheet 1

Fig. 1

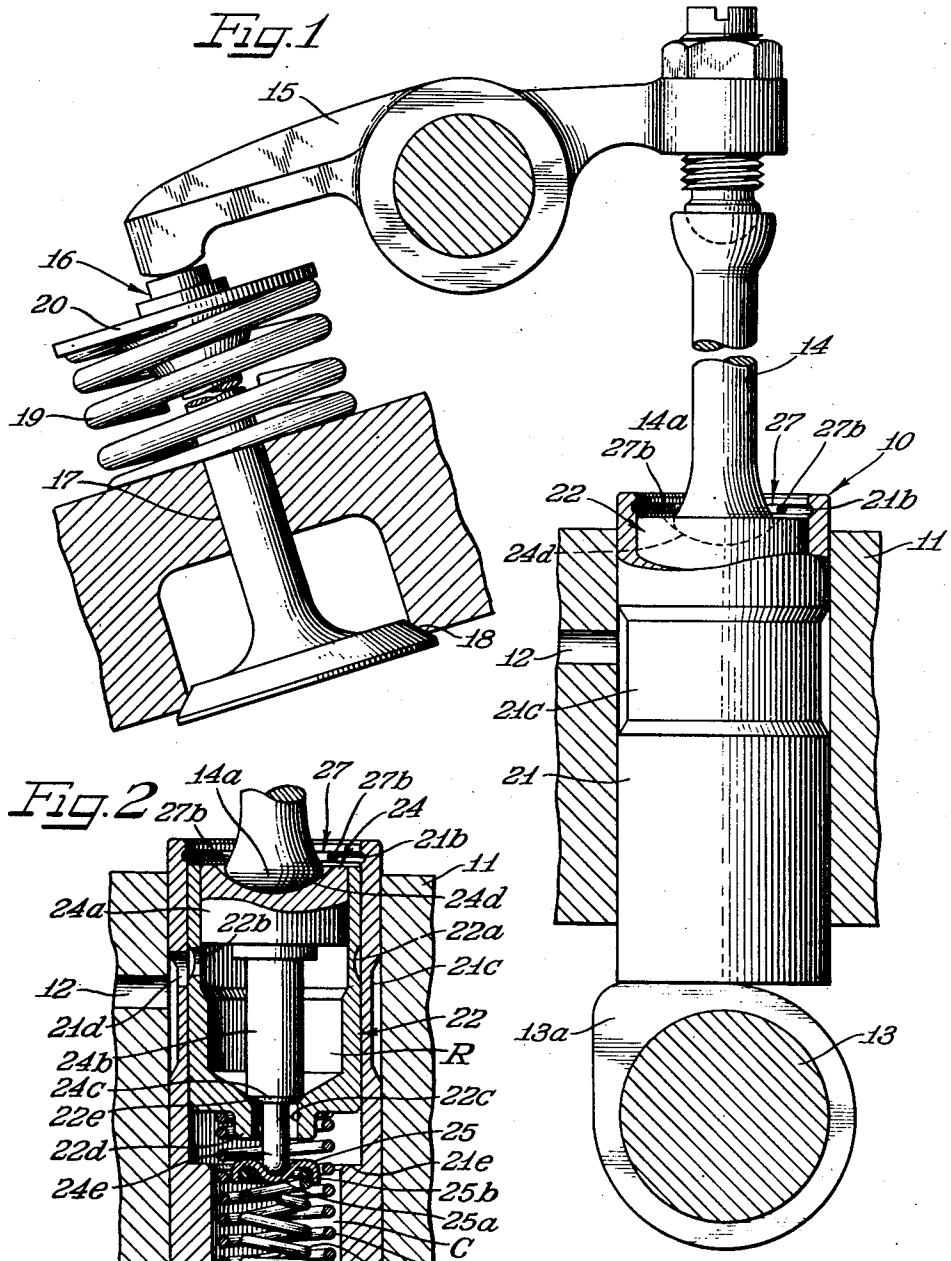


Fig. 2

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Filed Sept. 27, 1950 2 Sheets-Sheet 2

Fig. 3

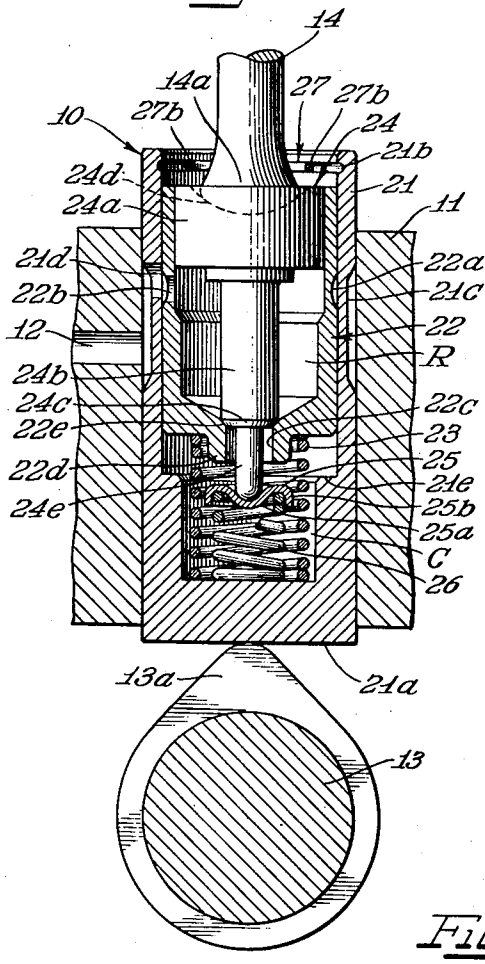


Fig. 4

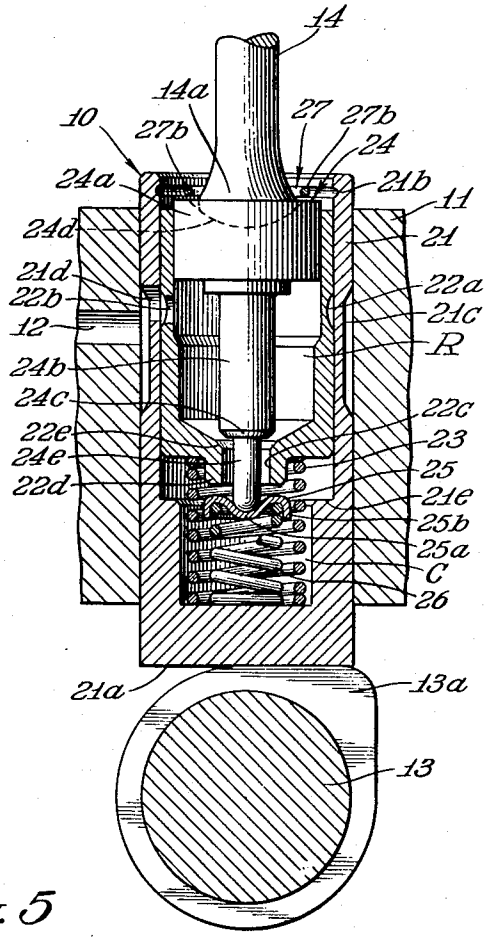
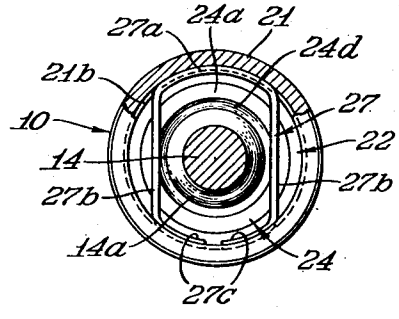


Fig. 5



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UNITED STATES PATENT OFFICE

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HYDRAULIC CLEARANCE ADJUSTER

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5 Claims. (Cl. 123—90)

1

This invention relates to a unitary preassembled hydraulic adjuster for automatically controlling clearances in a linkage assembly. Particularly, the invention deals with a hydraulic valve lifter or tappet assembled as a composite unit in a single housing with no loose parts extending outside of the housing.

In accordance with this invention, an open-topped closed bottomed housing with an internal stop above the closed bottom, slidably receives a hollow orificed plunger or piston. The plunger, in turn, slidably supports a needle valve which controls flow through the orifice. The plunger and needle valve assembly divide the housing into an oil reservoir compartment and a hydraulic fluid force transmitting chamber. A first spring acts on the needle valve for causing the needle valve to take up slack in a valve train actuated by the device. A second and lighter spring acts on the plunger to urge the plunger against the needle valve. The housing and plunger contain registering ports for feeding oil into the reservoir which in turn supplies oil to the chamber under the plunger through the orifice in the plunger. The plunger has a free sliding fit in the housing and some oil can leak down around the plunger. The stop in the housing forms a bottom seat for the plunger to cause the plunger to impact against the needle valve and smash any dirt between the valve and its seat which is effective to hold the valve in an open position.

A single retainer snapped into a groove near the open top of the housing has legs bridging across both the top face of the plunger and needle valve head for holding the parts in the housing. It will therefore be understood that the device is preassembled and all of its component parts are retained in a single housing by a single retainer. In operation of the device, this retainer is not subjected to load, since the normal valve spring load on the lifter will be effective to partially load the springs in the lifter and cause the plunger and valve head to be spaced from the retainer. This condition obtains even when the valve is closed.

An important feature of this invention therefore resides in the provision of a composite unitary hydraulic valve lifter or tappet with no loose parts available for separation from the assembly.

A still further feature of the invention resides in the utilization of a single retainer for maintaining a plurality of exposed separately movable valve parts in a single lifter housing.

A further feature of the invention resides in

2

the nesting of a force transmitting plunger or piston and a needle valve to provide a composite unitary assembly from a minimum amount of material.

It is, then, an object of this invention to provide a hydraulic valve lifter or tappet with nested plunger and valve parts held in a single housing by a single retainer.

Another important object of the invention is the provision of a hydraulic clearance adjuster with all of its component parts being held in preassembled operative position in a single housing by a single retainer.

A still further object of the invention is to provide a hydraulic valve tappet of the type having an orificed force transmitting plunger or piston wherein a needle valve controlling the orifice has a head slidably mounted in the plunger or piston and spring urged to an extended slack take-up position.

Another object of this invention is to provide a hydraulic valve tappet wherein an orificed plunger slidably carries an orifice controlling valve which is spring loaded to take up slack in the valve train and wherein a spring acts on the plunger to seat the plunger against the valve.

Other and further objects of this invention will be apparent to those skilled in the art from the following detailed description of the annexed sheets of drawings which, by way of a preferred example only, illustrate one embodiment of the invention.

On the drawings:

Figure 1 is a broken elevational view of a valve linkage equipped with a hydraulic tappet according to this invention and showing the position of the tappet when the valve is in closed position.

Figure 2 is a vertical cross-sectional view of the tappet of Figure 1 and showing the position of all of the tappet parts when the valve is in closed position.

Figure 3 is a view similar to Figure 2, but showing the positions of the tappet parts when the valve is fully opened.

Figure 4 is a view similar to Figure 2, but illustrating the positions of the tappet parts immediately following the valve opening operation.

Figure 5 is a top plan view of the tappet with a part broken away and shown in horizontal cross section.

As shown on the drawings:

In Figure 1, the valve lifter or hydraulic tappet 10 of this invention is slidably mounted in the tappet bore of an engine block 11 and receives engine oil from a passageway 12 in the

block. A cam shaft 13 acts on the tappet 10 and has a lobe 13a for reciprocating the tappet in the block 11 to actuate a push rod 14. The push rod 14, in turn, actuates a rock shaft 15 which acts on the end of a valve stem of a poppet valve 16 slidably mounted in a guide 17 of the engine for coacting with an engine valve seat 18. A spring 19 surrounding the valve stem is bottomed on one side on the engine and on the other side on a retainer 20 carried by the valve stem. The spring 19 is loaded to urge the valve 16 to the closed position of Figure 1 and the valve linkage is adjusted so that some of the force of the spring 19 is effective to cause the push rod 14 to load the tappet 10 even when the valve is in closed position.

As best shown in Figures 2 to 4, the tappet 10 includes a cylindrical hollow housing 21 slidable in the engine block 11 and having a closed bottom 21a riding on the cam shaft 13. The housing 21 has an open top with an internal groove 21b therein closely adjacent the open top. A reduced diameter external localized portion 21c is provided around the housing 21 between the top and bottom thereof for alignment with the oil passageway 12. A hole 21d is provided through the housing 21 in the reduced diameter localized portion 21c thereof to feed engine oil to the interior of the housing.

An internal shoulder 21e is formed in the body above the bottom 21a thereof to provide a stop for a purpose to be hereinafter described.

A cup-shaped plunger or piston 22 is slidably mounted in the housing 21 above the stop 21e and has a cylindrical outer wall freely riding on the cylindrical wall of the housing. The plunger or piston has an external groove 22a therearound adapted to register with the hole 21d in the housing. A hole 22b is formed through the plunger and communicates with the groove 22a so that oil from the housing opening 21d can flow into a reservoir R provided in the hollow piston.

The piston 22 has an orifice 22c through the bottom wall thereof joining the reservoir R with a chamber C in the housing 21 beneath the piston. A reduced diameter cylindrical extension 22d on the bottom of the piston receives the end coils of a compression spring 23 therearound. The spring 23 is bottomed on the bottom wall 21a of the housing.

A needle valve 24 is mounted in the piston 22 and has a cylindrical head 24a slidably guided on the cylindrical wall defining the side of the reservoir R of the piston. A stem 24b depends from the central portion of the head 24a and has a shoulder 24c coacting with the seat 22e at the top end of the orifice 22c to control flow through the orifice.

The head 24a of the needle valve has a fragmental spherical recess 24d in its top face for receiving the rounded end 14d of the push rod in tiltable relation therein.

A reduced diameter stem portion 24e depends from the central portion of the shoulder 24c freely through the orifice 22c into the chamber C beneath the piston 22. A cap 25 in the chamber C is seated on the top end of a coil spring 26 which is bottomed on the bottom 21a of the housing. The cap has a rounded depression 25a receiving the rounded end of stem portion 24e and a depending flange 25b receiving the top end coil of the spring 26.

The spring 26 is heavier than spring 23 and is effective to act on the needle valve 24 with sufficient force to take up all slack in the valve linkage when the poppet valve 16 is closed.

A snap ring type retainer 27, as best shown in Figure 5, of U-shaped configuration has the bight portion 27a thereof seated in the internal groove 21b of the housing and has a pair of legs 27b spanning the top of the housing and overlying both the needle valve head 24a and the piston 22. The ends of the legs 27b have inturned arcuate portions 27c seated in the groove 21b. The legs are therefore held at both ends in the groove and span both the piston and needle valve to retain these parts in the housing.

As best shown in Figures 2 to 4, the retainer legs 27b straddle the rounded end 14a of the push rod 14 so that the push rod can freely tilt in the recess 24d without interference from the retainer.

The retainer 27 can be made of relatively fine wire, since it is not subjected to thrust after the tappet is operatively mounted in an engine and its sole function is maintenance of the needle valve, the piston, and the springs in the housing 21 prior to installation of the tappet in the engine. As shown in Figure 1, even when the valve 16 is fully closed, the force of the valve spring 19 is effective through the push rod to maintain the plunger and needle valve in spaced relation from the retainer.

Operation

The hydraulic valve tappet or lifter 10 receives oil from the passageway 12 of the engine body and both the reservoir R and the chamber C are filled with oil. The spring 26 is effective to hold the needle valve 24 against the push rod 14 for taking up any slack in the valve linkage. The spring 23 is effective to hold the piston or plunger 22 against the shoulder 24c of the needle valve for closing the orifice 22c. Oil is thereupon trapped in the chamber C.

As the cam lobe 13a raises the lifter from the position of Figures 1 and 2 to the position of Figure 3, the piston 22 is raised with the housing 21 on a solid column of oil trapped in the chamber C. However, due to the free sliding fit of the piston or plunger in the housing 21, some of the trapped oil will leak past the piston, thereby permitting the piston to slide downwardly in the housing toward the stop 21e as shown in Figure 3. This downward movement of the piston also permits the needle valve 24 to move therewith, thereby shortening the assembly. The needle valve under these conditions acts as a thrust transmitting member bottomed on the piston which in turn is supported by a trapped column of oil.

After the valve opening operation when the cam lobe 13a permits the housing 21 to drop in the bore of the engine block 11, as shown in Figure 4, the load on the trapped oil in the chamber C is removed and the load on the springs 23 and 26 is relieved, whereupon the spring 26 acting on the thrust transmitting needle valve through cap 25 will elongate to maintain the housing 21 on the base circle of the cam shaft 13 and thereby elongate the tappet to take up looseness or slack in the valve train. The piston 22 being loaded by the weaker spring 23 will not immediately follow the needle valve and the orifice 22c will be opened as shown in Figure 4 to connect the chamber C with the reservoir R. Under these conditions, pressures in these two chambers will be balanced and oil from the reservoir R will flow through the orifice 22c to replenish the chamber C with oil lost therefrom during the valve opening cycle due

to the leak down past the piston. Any oil lost out of the housing 21 will, of course, be replenished with oil from the passageway 12 through the holes 21*d* and 22*b*. Immediately upon replenishment of the chamber C with oil, the spring 23 forces the plunger against the needle valve to trap this oil in the chamber for the next valve opening operation.

In the event that any foreign matter lodges between the shoulder 24*c* of the needle valve and the seat 22*c* of the piston, preventing full closing of the orifice 22, the oil in the chamber C will not be trapped and on the next valve opening operation the piston will crash down against the stop 21*e*. This impacting of the piston against the stop will, of course, be transmitted to the needle valve and the foreign matter will be crushed or dislodged.

From the above descriptions it will be understood that this invention provides a self-contained composite hydraulic valve tappet wherein a spring loaded thrust transmitting needle valve member cooperates with the orifice in a lesser spring loaded piston for trapping oil beneath the piston during the valve opening operation and for replenishing oil lost through leak down during the valve operation.

It will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention.

I claim as my invention:

1. A hydraulic tappet comprising an open topped closed bottom housing having an internal stop above the closed bottom and an internal groove adjacent the open top, a spring loaded orificed hollow plunger slidable in the housing above the stop, a thrust transmitting needle valve in the plunger having a head slidable in the plunger and a seating face controlling said orifice, said valve head being recessed and adapted to receive a push rod end in the recess thereof, a retainer in said groove having legs straddling the recess in the valve head and overlying the valve head and plunger to form an abutment adapted to be engaged by said valve head and plunger for retaining the assembly within the housing, a first spring bottomed in the housing acting on said needle valve, and a second spring bottomed in the housing acting on said plunger, said housing and plunger having registering oil ports to feed oil into the plunger, and said plunger having a free sliding fit in the housing to permit leak down of oil trapped in the housing beneath the plunger.

2. A hydraulic take-up means comprising a housing, an orificed hollow open topped piston slidable in the housing, a needle valve in the piston having a head slidable in the piston and a seating face controlling the orifice thereof, a retainer in the housing overlying the piston and needle valve to form an abutment therefor for maintaining the parts in operative assembled relation, a first spring between the housing and needle valve, and a second spring between the housing and piston.

3. A hydraulic take-up device comprising a housing, an orificed hollow open topped plunger slidably telescoped in the housing, an orifice control valve slidably telescoped in the plunger, said plunger being adapted to rest on a body of fluid contained in the housing, said valve controlling flow to and from said body of fluid through said orifice and being adapted to transmit thrust from the housing, and a retainer coacting with the housing to simultaneously maintain the plunger in the housing and the valve in the plunger.

4. A hydraulic valve lifter comprising an open topped closed bottomed housing having an internal groove adjacent the open top thereof and a reduced diameter external portion intermediate the ends thereof, a port joining said reduced diameter portion with the interior of the housing, a first spring bottomed on the closed bottom of the housing, a hollow orificed open topped bottom piston slidable in the housing and bottomed on said first spring, said piston having a free sliding fit in the housing and providing a reservoir adapted to communicate with said port, a valve slidable in said hollow piston controlling the orifice of the piston, a second spring urging said valve toward opened position, and a retainer in said groove overlying both the valve and the piston for maintaining the spring loaded parts in assembled relation in the housing.

5. A hydraulic take-up device comprising telescoped relatively sliding housing, orificed piston and needle valve thrust transmitting members, said needle valve having a stem projecting freely through the piston orifice and a seating face for closing the piston orifice, a cap in the housing beneath the piston, a first spring urging the cap against the stem to open the valve, and a second spring urging the piston against the seating face for closing the valve.

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