June 11, 1957 J. P. HEISS 2,795,218

AUTOMATIC TAPPET

Filed April 13, 1955 3 Sheets-Sheet 1

Fig. 1

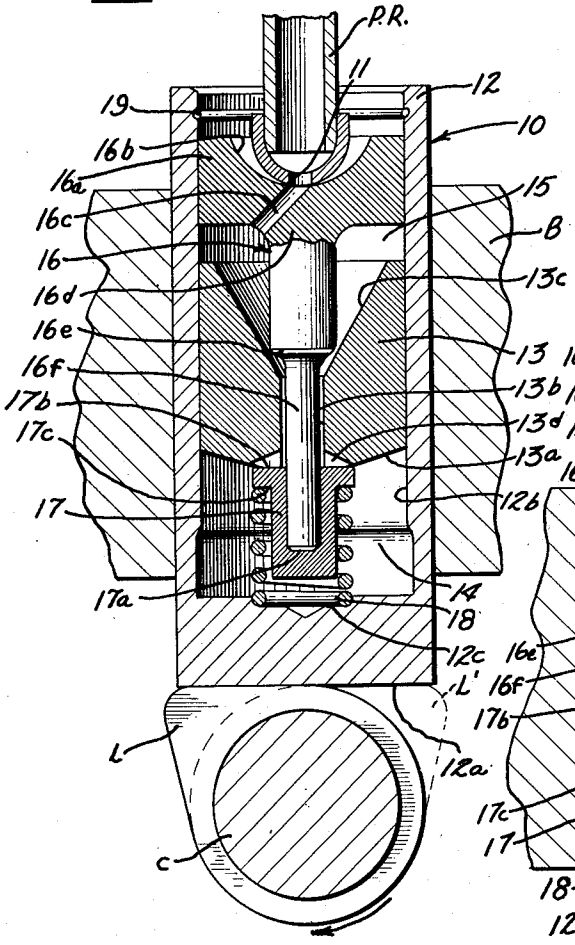


Fig. 2

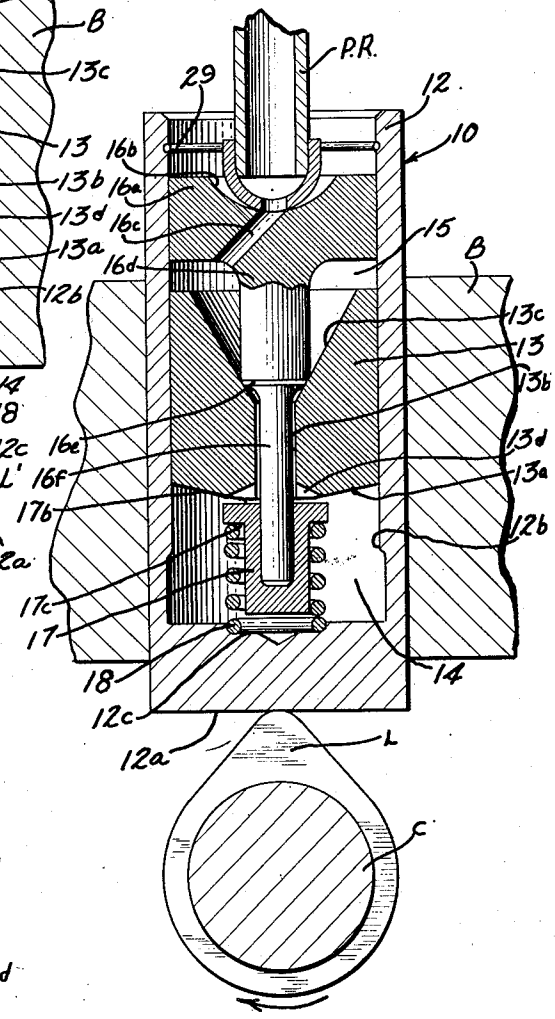
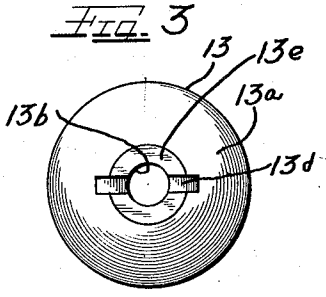


Fig. 3



Inventor
JOHN P. HEISS

By Hill, Sherman, Meroni, Gross & Simpson Attys

June 11, 1957 J. P. HEISS 2,795,218

AUTOMATIC TAPPET

Filed April 13, 1955 3 Sheets-Sheet 2

Fig. 4

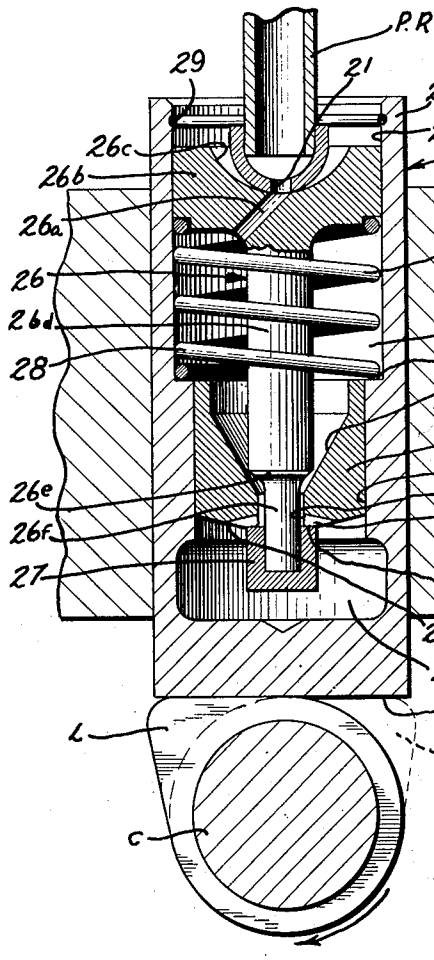
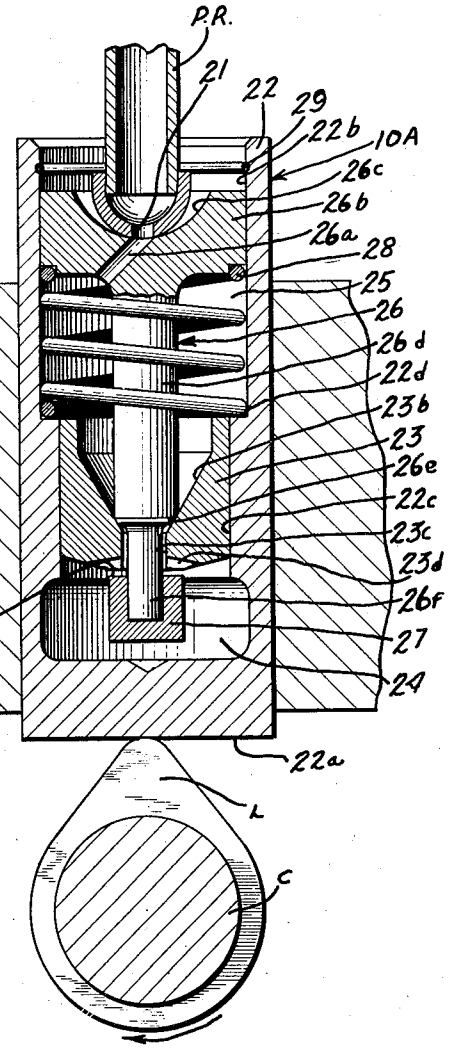


Fig. 5



Inventor
JOHN P. HEISS

By Hill, Sherman, Meroni, Gross & Simpson
Attys

June 11, 1957 J. P. HEISS 2,795,218

AUTOMATIC TAPPET

Filed April 13, 1955 3 Sheets-Sheet 3

Fig. 6

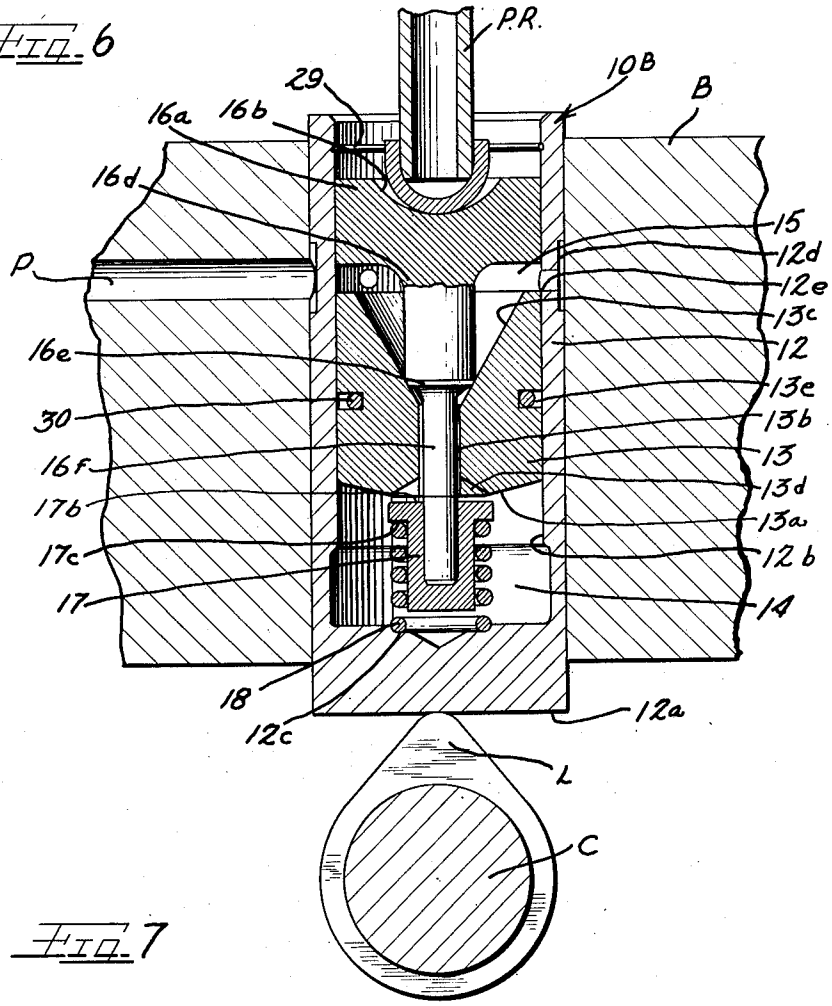
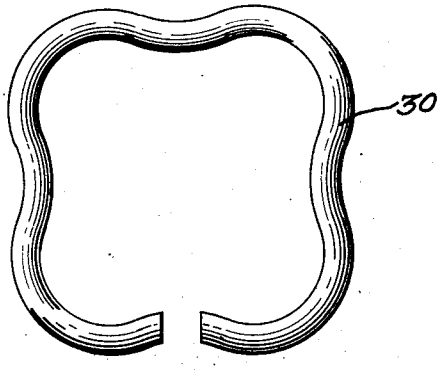


Fig. 7



Inventor
JOHN P. HEISS

By Lill, Sherman, Meroni, Gross & Simpson Attys

United States Patent Office 2,795,218 Patented June 11, 1957

2,795,218

AUTOMATIC TAPPET

John P. Heiss, Flint, Mich., assignor to Thompson Products, Inc., Cleveland, Ohio, a corporation of Ohio

Application April 13, 1955, Serial No. 501,142

14 Claims. (Cl. 123—90)

This invention relates to a hydraulic automatic adjuster for taking up clearances in a linkage assembly without, however, causing the linkage to become too tight so as to interfere with the proper operation thereof. The invention more particularly deals with a hydraulic valve lifter or tappet for maintaining zero valve lash or tappet clearance having a needle valve controlled orifice which provides positive valving when filling.

In accordance with this invention, a spring biased load carrying needle valve cooperates with an orificed plunger which is slidably mounted in a hollow body to divide the body into an oil reservoir compartment and a hydraulic fluid force transmitting chamber. The needle valve itself is slidably mounted in the body and is spring biased to an extending position. The hydraulic fluid in the transmitting chamber acts on the underside of the plunger during upward travel of the body to close the orifice and thereby separate the reservoir and chamber of the body. The needle valve spring takes up all slack in the valve train and when the body is lifted by the operating cam, oil in the chamber will be trapped to force the plunger and needle valve to move with the body. However, some oil leakdown will occur through the plunger fit in the body, and, when the body returns to its initial position after opening the valve, the assembly will be somewhat shorter than its original height due to this leakdown. Then when the valve spring load is relieved from the linkage after the valve is seated, the oil pressure in the force transmitting chamber will drop to zero and allow the plunger orifice to move away from the needle valve, whereupon the oil pressure in the reservoir and chamber are again balanced to allow the flow of oil into the force transmitting chamber for the refilling cycle. A bottoming bumper is provided to coact with the needle valve and limit the clearance between the valve and orifice of the plunger. In other words, the plunger is a free or floating body within limits and is able to positively charge the force transmitting chamber with oil. The bottoming bumper also serves to provide a safe stop for the needle valve and plunger when the lifter is collapsed for lack of oil.

In one embodiment of the invention, the bottoming bumper is freely received on the end of a reduced section of the needle valve which extends through the orifice plunger, and is held in place by the elongating spring which is disposed between the bottom of the hollow body and a flange on the bottoming bumper. This allows the use of a full diameter plunger having a long sealing length.

In another embodiment, the bottoming bumper is fixed below the plunger to the downwardly extending section of the needle valve and the elongating spring is bottomed on a shoulder in the body and is positioned above the plunger to act on an upper section of the needle valve. In this arrangement a reduced diameter plunger is employed which does not enjoy the long sealing length.

Still a further embodiment provides a split corrugated ring mounted in an annular groove of the piston or plunger bearing alternately against the piston and the bore of the

tappet barrel. This feature improves valve action at low engine speed when inertia may not be dependable.

Accordingly, it is an object of this invention to provide a hydraulic valve lifter employing a needle valve arrangement wherein positive valving is obtained when refilling the lower force transmitting chamber or cavity.

It is a further object of this invention to provide a hydraulic needle valve tappet having a minimum number of parts, thereby effecting a low cost hydraulic tappet.

Still another object of this invention resides in the provision of a hydraulic needle valve lifter having a bottoming bumper which protects the needle valve and piston from damage should the lifter collapse from lack of oil and controls the clearance between the valve and its seat.

A further object of this invention is to provide a hydraulic needle valve tappet having a push rod seat and needle valve made in one piece which causes the valving to occur positively, and accurately aligns the parts.

A further feature of this invention is to provide a full barrel needle valve tappet wherein a long sealing length is effected.

Still another object of this invention is to provide a hydraulic needle valve tappet wherein the needle valve is integral with the push rod seat, and wherein the needle valve, the piston, and a bottom main bumper consist of a pressed together assembly which remains together even though the tappet is taken apart for cleaning purposes.

Another object of this invention resides in the provision of a hydraulic needle valve lifter having a piston with a coned bottom and a depressed valve seat for purposes of minimizing any entrapped air.

A still further object of this invention is to provide a hydraulic valve lifter having a piston mounting a split corrugated ring for effecting frictional drag with respect to the tappet barrel and thereby improving valve action at low engine speeds when inertia may not be dependable.

Other objects, features, and advantages of the invention will be apparent from the following detailed description of the drawings, which, by way of preferred examples only, illustrate the invention.

On the drawings:

Figure 1 is a longitudinal cross sectional view, with parts in elevation, of the hydraulic valve lifter according to this invention showing the position of the parts just prior and just subsequent to the valve opening operation;

Figure 2 is a view similar to Figure 1 but showing the positions of the parts as the valve is fully opened;

Figure 3 is a bottom plan view of the plunger utilized in the valve tappet of Figure 1;

Figure 4 is a longitudinal cross sectional view, with parts in elevation, similar to Figure 1 but illustrating a modification of the invention, and showing the position of the parts just prior and just subsequent to the valve opening operation;

Figure 5 is a view similar to Figure 4 but showing the positions of the parts as the valve is fully opened;

Figure 6 is a longitudinal cross sectional view with parts in elevation, similar to Figure 1, but illustrating a modification of the invention; and

Figure 7 is a plan view of a split corrugated friction ring utilized with the embodiment of Figure 6.

As shown on the drawings:

The first embodiment of the invention is illustrated in Figures 1–3, inclusive, wherein the valve lifter 10 of this invention is slidably mounted in the engine block B. A cam C has the majority of the periphery thereof concentrically disposed about its axis to provide a base circle for the cam. A lobe L on the camshaft serves to actuate the lifter 10 upon rotation of the cam for reciprocating a push rod P. R. to open and permit closing of the valve (not shown) in the valve train linkage. Engine oil is

fed to the hydraulic lifter or tappet **10** through the hollow push rod P. R. and a suitable aperture, in the end nipple of the push rod, indicated by the numeral **11**. The engine oil is, of course, delivered to the hollow push rod P. R. by any suitable known means, such as through oil passages in the rocker arm and the ball stud at the head end of the pusher rod.

The lifter **10** includes a cylindrical hollow body or tappet barrel **12** with a bottom **12*a*** riding on the cam C, and an elongated internal bore **12*b***.

The plunger or piston **13** is slidably received in the bore **12*b*** of the body **12**. The plunger **13** takes substantially the shape of a cylinder including a coned bottom **13*a***, a substantially centrally disposed oil passage **13*b***, and an inclined and depressed valve seat **13*c***. The coned bottom as well as the depressed valve seat minimizes entrapped air in the tappet. The plunger **13** divides or separates the interior bore of the body **12** to provide a lower cell or load transmitting chamber **14** and an upper cell or oil reservoir **15**.

A needle valve, generally indicated by the numeral **16**, is slidably received in the internal bore **12*b*** of the body **12** and includes a guiding and push rod seat portion **16*a*** having a socket **16*b*** for receiving the lower end of the push rod P. R. and an inclined oil hole **16*c*** for delivering oil to the lifter. The upper end of the oil hole **16*c*** registers with the aperture **11** in the hollow push rod P. R. and leads downwardly at an angle to the oil reservoir **15**. A valve shank **16*d*** extends downwardly from the push rod seat and guiding portion **16*a*** of the needle valve, and terminates with a beveled valve face **16*e*** which coacts with the valve seat **13*c*** of the plunger **13** to control the flow of oil between the reservoir **15** and the lower cell **14**. Extending downwardly from the valve face **16*e*** is a diametrically reduced section **16*f*** which terminates at a predetermined distance below the bottom of the plunger **13**.

While the oil is shown to be gravity fed to the tappet, it is contemplated that the oil may be pressure fed to the reservoir **15** by a waist band groove and cross hole in the body wall in the conventional manner, such as disclosed in Figure 6.

The extending section **16*f*** of the needle valve **16** is sized to allow oil to freely pass therearound and through the oil passage **13*b*** of the plunger **13**, although restricting the oil passage, and has mounted at its free end a hat-shaped bottoming bumper **17** in inverted position. The bottoming bumper is loosely received over the end of the extending section **16*f*** so that the end of the section bottoms on the inside of the crown of the bumper as indicated by the numeral **17*a***. The upper surface of the brim of the hat, as indicated at **17*b*** functions as a limiting or stopping face for the bottom of the plunger **13**. It may be noted that a small circular flat portion **13*e*** (see Fig. 3) is provided on the plunger to coact with upper surface **17*b*** of the bumper. Thus, the bottoming bumper **17** coacts with the valve face **16*e*** of the needle valve **16** to limit the relative movement between the needle valve **16** and the plunger **13** to within prescribed limits, preferably between .003–.010 inch. In other words, the piston or plunger **13** is a free body within prescribed limits.

An elongating spring **18** is bottomed in a suitable recess **12*c*** at the closed end of the body **12** to prevent lateral shifting thereof and surrounds at its upper end the crown of the hat-shaped bottoming bumper **17** to seat on the under face of the brim, as indicated at **17*c***. The elongating spring **18** maintains the bottoming bumper **17** in position over the end of the needle valve **16**, and is effective to take up all slack in the valve train linkage. A cross-slot is provided in the coned bottom **13*a*** of the plunger **13**, as indicated by the numeral **13*d***, and functions to permit oil to pass through the oil passage **13*b*** in the plunger **13** when the plunger is in its down position in contact with the brim of the hat-shaped bottoming bumper **17**. As well as limiting the movement of the plunger **13**, the bottoming bumper also serves to prevent damage to the needle valve **16** and the plunger **13** if the lifter **10** should collapse for lack of oil.

A retaining spring clip **19** is provided at the very open end of the body **12** along the circumference of the internal bore **12*b*** to function only when the lifter **10** is not installed in a valve train linkage, since it is contemplated that the operating position of the retained parts will be at a lower level when installed in the engine, such as shown in Figures 1 and 2.

In operation, engine oil is fed down the hollow push rod **12** through the oil inlet **16*c*** and into the reservoir **15**, and the parts in the lifter **10** take substantially the positions as shown in Figure 1 before the operation of the lifter begins. The elongating spring **18** acting on the pusher rod P. R. through the needle valve **16** and bottoming bumper **17** takes up all slack in the valve train, and the piston or plunger **13** will be in the down position resting against the bottoming bumper **17**, thereby permitting free flow of oil between the reservoir **15** and the force transmitting chamber **14**.

Then as the cam C rotates in the clockwise direction shown by the arrow to move the lobe L against the bottom **12*a*** of the body, the lifter will tend to rapidly empty the chamber **14** through the restricted oil passage **13*b*** which will snap the plunger **13** upward to seat the valve seat **13*c*** against the valve face **16*e*** due to the unit area pressure exerted against the bottom of the plunger, and trap the oil in the force transmitting chamber **14** and raise the push rod P. R. on a solid column of oil trapped below the plunger **13**. The part will then take the positions indicated in Figure 2.

As the valve opening operation continues, some of the trapped oil will leak past the plunger due to its fit with the internal bore **12*b*** of the body **12** into the reservoir **15**, thereby permitting the plunger and needle valve to move downward slightly into the chamber **14** as illustrated in Figure 2. This downward movement, of course, partially compresses the elongating spring **18**, and the assembly will thereupon become shorter.

Subsequent to the valve opening operation when the cam lobe has passed the bottom **12*a*** of the body, the pressure of the trapped oil in the force transmitting chamber **14** is relieved, the load on the elongating spring **18** is somewhat relieved, and the needle valve **16** will unseat from the plunger **15** thereby again opening the communication between the reservoir **15** and the force transmitting chamber **14**. Thus, as the lifter moves downwardly, and in its down position, the force transmitting chamber will be refilled with oil from the reservoir to ready the lifter for the next cycle. The position of the parts in the lifter after the cam lobe L has allowed the lifter to assume its down position is shown in Figure 1 with the cam lobe L' in dotted position.

Referring now to Figures 4 and 5, a modified needle valve lifter **10A** is illustrated, which functions in substantially the same manner as the lifter in Figures 1–3.

This valve lifter **10A** is likewise slidably mounted in an engine block B and receives engine oil through the hollow push rod P. R. having an oil hole **21**. A cam C has the majority of its periphery thereof concentrically disposed about its axis to provide the base circle for the cam. A lobe L on the cam-shaft raises the lifter **10A** for reciprocating the push rod P. R. to open and permit closing of the valve (not shown) in the valve train linkage.

Engine oil is fed to the lifter **10A** in the same manner as in lifter **10**, namely through a suitable aperture **21** in the nipple on the end of the follow push rod P. R. As in the first embodiment, it is alternatively contemplated that oil may be pressure fed to lifter **10A** to the reservoir **25** through a waist band groove and cross hole in the conventional manner, such as disclosed in Figure 6.

The lifter **10A** includes a cylindrical hollow body or tappet barrel **22** having a bottom **22*a*** riding on the cam

C, an internal bore 22*b* extending from the closed end to the open end of the lifter, but interrupted by a reduced bore 22*c*.

A plunger 23 is slidably mounted in the body 22 and in the region of the reduced bore 22*c*, and is provided with a coned bottom 23*a*, a depressed and inclined valve seat 23*b*, and an oil feed hole 23*c*. The plunger separates the body into a lower cell or force transmitting chamber 24 and an upper cell or reservoir 25.

An angularly disposed oil passage 26*a* in a guiding and push rod seat portion 26*b* of a needle valve 26 has its upper end in registry with the aperture 21 in the push rod P. R. and leads to the reservoir 25, thereby providing a gravity feed for oil and to the reservoir. Oil is received by the push rod P. R. in any suitable known manner such as through oil passages in the respective rocker arm and ball stud at the head of the pusher rod which receives oil from the lubrication system of the engine. The shank of the needle valve 26 depends from the push rod seat and guiding portion 26*b*, as indicated at 26*d*, and terminates in a beveled valve face 26*e* to coact with the valve seat 23*b* of the plunger 23 and control the oil flow between the chamber 24 and reservoir 25. The lower end of the push rod P. R. is seated in the socket 26*c* provided in the push rod seat and guiding portion 26*b* which serves to properly align the parts in the body 22. A downwardly extending reduced section 26*f* depends from the valve shank 26*d* and passes through the oil feed hole 23*c* of the piston or plunger 23 to receive in press fit or other equivalent securing manner a bottoming bumper 27.

The bottoming bumper 27 is cup-shaped of a diametral size substantially greater than the aperture 23*c* in the plunger 23, and the top edge 27*a* coacts with the valve face 26*e* of the needle valve 26 to limit the relative movement between the plunger 23 and the needle valve 26, but allowing the plunger to move freely thereon. As shown in Figure 3, the plunger 23 also carries a small circular flat portion, as indicated at 23*e*, to coact with the top edge 27*a* of the bumper. Preferably, the limits of movement may be .003–.010 inch so that the piston is able to positively charge the lower cell 24 with oil. Of course, the extension 26*f* of the needle valve is of such smaller size than the oil feed hole 23*c* in the plunger 23 to allow at all times oil to pass therearound but restricting the passage flow, and a cross slot 23*d* (similar to the cross slot 13*d* in the piston 13 of the first embodiment) allows oil to freely pass over the bottoming bumper 27 when the piston 23 is in the down position.

An elongating spring 28 is received within the body 22 and bottomed on an annular shoulder 22*d* provided by the reduced diameter bore 22*c* and acts against the underside of the push rod seat and guiding portion 26*b* of the needle valve 26 to continually urge the elongation of the tappet 10A and take out all slack in the valve train linkage. It is noted that the helical spring 28 is sized to freely allow the piston 23 to be received within its confines. The push rod seat and needle valve, the piston or plunger, and the bottoming bumper consist of one pressed together assembly and normally stay married for life even though the lifter 10A is taken apart for cleaning purposes. As in the first embodiment, the bottoming bumper 27 further functions to provide a safe stop for the piston 23 and the needle valve 26 when the lifter is collapsed for lack of oil.

A retaining clip 29 is provided to coact with a groove near the top of the internal bore 22 to maintain the parts in the tappet barrel 22 when the lifter is not installed in a valve train linkage. As seen in Figures 4 and 5 the clip does not function otherwise since it is contemplated that the parts will operate at a lower level.

As already stated, the operation of lifter 10A is substantially similar to the operation of lifter 10, wherein the parts in the lifter take the position as illustrated in Figure 5 before the valve opening operation. In this position, the piston 23 will rest against the bottoming bumper 27 to allow the free flow of oil between the reservoir 25 and the force transmitting chamber 24 so that the chamber 24 is full of oil before the lifting operation begins. Thus in the position shown at Figure 4, the needle valve is open and free flow of oil between the force transmitting chamber 24 and the reservoir 25 is obtained.

Then as the cam C rotates in the clockwise direction shown by the arrow to move the lobe L against the bottom 22*a* of the body, to initiate the valve opening operation, the oil in the chamber 24 will tend to rush out thereof through the restricted opening provided by the oil hole 23*c* of the plunger 23 and the extension 26*f* of the needle valve 26, whereupon tremendous unit area pressure will be brought against the coned bottom 23*a* of the plunger to urge it in an upward direction and sealingly seat the valve face 26*e* of the needle valve against the valve seat 23*b* to trap the oil in the force transmitting chamber 24 and raise the push rod P. R. on a solid column of oil. As the valve opening operation continues, some of the trapped oil in the chamber 24 will leak past the plunger and the bore 22*c* into the reservoir 25, thereby permitting the plunger to move slightly downward into the chamber 24 as illustrated in Figure 5, this movement shortening the assembly. It is contemplated that all entrapped air escape at the outside diameter between the piston and barrel through the upper reservoir.

As illustrated in Figure 4, after the valve opening operation when the cam lobe L' in dotted view has passed the bottom 22*a* of the body, the pressure on the trapped oil in the chamber 24 is relieved, the load on the spring 28 is somewhat lessened, and due to the fast downward movement of the tappet barrel, the piston will again attain its down position to open the needle valve and allow oil to pass from the reservoir into the force transmitting chamber and thereby replenish that lost by the leakdown past the plunger in the valve opening operation.

Referring now to Figures 6 and 7 another modified valve lifter is illustrated, designated by the numeral 10B, which functions generally in the same manner as the lifter 10 of Figures 1–3. Except for the addition of a friction ring to the piston or plunger, and the fact that oil is fed to the tappet 10B by pressure rather than by gravity feed, this tappet is identical as to structure of parts and operation. Therefore, identical reference numerals will be applied to those parts identical with the tappet 10 of Figures 1 and 2 for clarity purposes.

Oil is pressure fed to the tappet 10B through a passageway P which registers with a waste band groove 12*d* of the tappet barrel or body 12 to enter the reservoir 15 through a plurality of circumferentially spaced cross holes 12*e*. The passageway P is connected at a pressure point to the lubrication system of the engine.

The plunger 13 of this embodiment differs from that in Figures 1 and 2 in including a circumferential ring groove 13*e* intermediate the side wall of the piston which receives a corrugated friction ring 30, as illustrated more clearly in Figure 7, which bears alternately against the piston 13 and the internal bore 12*b* of the tappet barrel 12 to provide a friction drag for the piston 13. The feature of providing frictional drag for the piston 13 improves the needle valve action at low engine speeds when inertia may not be completely dependable; by more positively maintaining the needle valve open as the cam lobe L passes the bottom face 12*a* of the tappet barrel so that the force transmitting chamber 14 may be more positively replenished with engine oil in preparation for its next upward stroke. Thus, the efficiency of the lifter at low speeds is greatly enhanced.

Thus it is seen that the instant invention provides a hydraulic valve lifter or tappet having a minimum number of parts which may be easily assembled to attain a highly efficient lifter of relatively low cost.

It will be understood that modifications and variations may be effected without departing from the scope of the

novel concepts of the present invention, but it is understood that this application is to be limited only by the scope of the appended claims.

I claim as my invention:

1. A hydraulic valve lifter comprising a cylindrical cup-shaped body having a closed bottom and an open top, a thrust transmitting needle valve having a push rod seat portion slidably received within the body and closing the open end, a downwardly extending reduced portion underlying said seat portion and terminating to form a valve face portion, and a second downwardly extending reduced portion smaller than said first reduced portion and underlying same, an orificed plunger slidable in said body separating the hollow of the body into two compartments, said orifice in the plunger coacting with said needle valve to control the fluid flow therethrough and sized to freely receive the second reduced portion of said needle valve, a bottoming bumper between the plunger and closed bottom of the body, mounted on the end of the needle valve below the plunger and effeective to limit clearance between the needle valve and plunger orifice and to abut the plunger for bottoming the plunger, and a spring urging said valve away from the closed end of the body for increasing the length of said lifter.

2. A hydraulic valve adjuster comprising a hollow body, an orificed plunger slidable in said body, a thrust transmitting needle valve having a push rod seat portion, a valve face portion, and a reduced downwardly extending portion underlying said valve face portion and being freely received within the orifice of said plunger, said extending portion terminating below said plunger, means confronting the plunger adapted to abut the plunger and seat on the valve body, said means being mounted on the end of the extending portion for limiting the plunger movement with respect to said needle valve and preventing the needle valve and plunger from directly bottoming in said body, and spring means urging said valve away from the closed end of the body for increasing the operating length of the lifter.

3. A hydraulic valve lifter comprising a cylindrical cup-shaped body having a closed bottom and an open top, a thrust transmitting needle valve having a push rod seat and guide portion slidably received within the body and closing the open end, a downwardly extending reduced portion underlying said seat portion and terminating to form a valve face portion, and a second downwardly extending reduced portion smaller than said first reduced portion and underlying same, an orificed plunger slidable in said body separating the hollow of the body into two compartments, said orifice in the plunger coacting with said needle valve to control the fluid flow therethrough and sized to freely receive the second reduced portion of said needle valve so that fluid may at all times flow along said reduced portion, a bottoming bumper mounted on the free end of the second reduced portion below the plunger serving to limit the relative axial movement between the needle valve and plunger and to provide a safe stop for the valve and plunger when the lifter is collapsed for lack of oil, a cross-slot in the bottom of the piston plunger to permit fluid flow when the plunger is in the down position against the bottoming bumper, and spring means urging said valve away from the closed end of the body for increasing the length of the lifter.

4. A hydraulic valve lifter comprising a cylindrical cup-shaped body having a closed bottom and an open top, a thrust transmitting needle valve having a push rod seat and guide portion slidably received within the body and closing the open end, a downwardly extending reduced portion underlying said seat portion and terminating to form a valve face portion, and a second downwardly extending reduced portion smaller than said first reduced portion and underlying same, an orificed plunger slidable in said body separating the hollow of the body into two compartments, said orifice in the plunger coacting with said needle valve to control the fluid flow therethrough and sized to freely receive the second reduced portion of said needle valve so that fluid may at all times flow along said reduced portion, a bottoming bumper mounted on the free end of the second reduced portion below the plunger serving to limit the relative axial movement between the needle valve and plunger and to provide a safe stop for the valve and plunger when the lifter is collapsed for lack of oil, a cross-slot in the bottom of the piston plunger to permit fluid flow when the plunger is in the down position against the bottoming bumper, said bottoming bumper being hat-shaped but in inverted position, and a helical spring surrounding the crown of said bumper to seat against the brim, the other end of said spring seating against the closed end of said body, whereby the spring urges the needle valve away from the closed end of said body and takes up any slack in the valve train.

5. A hydraulic valve lifter comprising a cylindrical cup-shaped body having a closed bottom and an open top, a thrust transmitting needle valve having a push rod seat portion slidably received within the body and closing the open end, a downwardly extending reduced portion underlying said seat portion and terminating to form a valve face portion, and a second downwardly extending reduced portion smaller than said first reduced portion and underlying same, an orificed plunger slidable in said body separating the hollow of the body into two compartments, said orifice in the plunger coacting with said needle valve to control the fluid flow therethrough and sized to freely receive the second reduced portion of said needle valve, a bottoming bumper adapted to bottom on the closed end of the body and abut the plunger to hold the plunger above the bottom of the body, said plunger being mounted on the end of the needle valve close to and below the plunger, said bumper having a radial flange and a spring acting against the closed end of said body and the flange of said bumper for increasing the operating length of the lifter.

6. A hydraulic valve lifter comprising a cylindrical cup-shaped body having a closed bottom and an open top, a thrust transmitting needle valve having a push rod seat portion slidably received within the body and closing the open end, a downwardly extending reduced portion underlying said seat portion and terminating to form a valve face portion, and a second downwardly extending reduced portion smaller than said first reduced portion and underlying same, an orificed plunger slidable in said body separating the hollow of the body into two compartments, said orfice in the plunger coacting with said needle valve to control the fluid flow therethrough and sized to freely receive the second reduced portion of said needle valve, a bottoming bumper fixedly secured to the free end of the needle valve below the plunger and effective to limit clearance between the valve and plunger orifice, and spring means urging said valve away from the closed end of said body for increasing the operating length of said lifter and taking up any slack in the valve train.

7. A hydraulic valve lifter comprising a hollow body having a closed end, a reduced bore portion intermediate the body, a plunger slidable in said bore portion, said plunger having a feed hole therethrough and coacting with said closed end of the body to provide a load transmitting compartment, a needle valve having an enlarged guide portion and push rod seat slidable in the body and closing the open end of said body, a working valve face portion coacting with the mouth of the feed hole for controlling the fluid flow therethrough, a reduced end portion depending from said valve face portion and extending through said feed hole terminating therebelow, a bottoming bumper underlying said plunger and secured to the end portion of said valve for coacting with the valve face portion in limiting the relative movement between the valve and plunger, and a spring bottomed on an annular shoulder provided by said reduced bore portion

and acting against the enlarged guide portion for increasing the operating length of said lifter.

8. A hydraulic valve lifter which comprises, a hollow body having a closed end, a plunger slidably received in the body, said plunger having a depressed valve seat, a coned bottom, and an oil feed hole and coacting with the closed end of said body to provide an oil chamber, a valve slidably mounted in said body having a push rod seat and a reduced portion freely received with in said feed hole terminating below said plunger, a bottoming bumper received on the free end of said reduced portion adapted to seat on the closed end of the body and abut the plunger to hold the plunger in spaced relation above the closed end of the body, and means for urging said valve away from the closed end of the body for increasing the operating length of said lifter.

9. A hydraulic valve lifter comprising a cylindrical cup-shaped body having a closed bottom and an open top, a thrust transmitting needle valve having a push rod seat portion slidably received within the body and closing the open end, a downwardly extending reduced portion underlying said seat portion and terminating to form a valve face portion, and a second downwardly extending reduced portion smaller than said first reduced portion and underlying same, an orificed plunger slidable in said body separating the hollow of the body into two compartments, said plunger having a coned bottom and a depressed valve seat to minimize entrapped air, said valve seat coacting with said needle valve to control the fluid flow therethrough, said orifice sized to freely receive the second reduced portion to allow continuous fluid flow therealong, a bottoming bumper mounted on the very end of the valve below the plunger, and spring means urging said valve away from the closed end of the body.

10. A hydraulic valve tappet comprising a hollow body, a passaged plunger slidable in the body adapted to trap the fluid in the body to be supported thereon, a thrust load transmitting valve movable in the body controlling flow through the plunger passage, means mounted on said valve to abut the plunger for limiting the axial movement between the valve and plunger, and spring means urging the valve in a direction to increase the effective length of the tappet and bring said means into abutment with the plunger.

11. In a hydraulic tappet having a hollow body with a closed lower end, a piston reciprocable within the body and coacting with the closed end to provide a liquid pressure chamber and an upper liquid supply reservoir, said piston having a passage connecting said chamber and reservoir with a valve seat, a valve coacting with said seat to control the liquid flow between the chamber and the reservoir, an extension depending from said valve and through said passaged piston, a bottoming bumper mounted on the end of said extension coacting with said valve to limit the relative movement between the valve and piston and abutting the piston to bottom the piston and prevent damage thereto if the tappet should collapse for lack of liquid, and spring means acting on said valve to elongate said tappet.

12. A hydraulic valve lifter which comprises, a hollow body having a closed end, a plunger slidably received in the body, said plunger having an oil feed hole and coacting with the closed end of said body to provide an oil chamber, a valve in said body having a push rod seat and a reduced portion freely received within said feed hole terminating below said plunger, a bottoming bumper between the plunger and closed end of the body received on the free end of said reduced portion effective to abut and bottom the plunger, and a spring bottomed on the closed end of said body acting against said bottoming bumper to elongate said lifter.

13. A hydraulic valve lifter which comprises, a hollow body having a closed end, a plunger slidably received in the body, said plunger having an oil feed hole and coacting with the closed end of said body to provide an oil chamber, means carried by said plunger for exerting a frictional drag with respect to the body, a valve in said body having a push rod seat and a reduced portion freely received within said feed hole terminating below said plunger, a bottoming bumper between the plunger and closed end of the body received on the free end of said reduced portion to abut the plunger and seat on the closed end of the body and a spring bottomed on the closed end of said body acting against said bottoming bumper to elongate said lifter.

14. A hydraulic valve lifter which comprises, a hollow body having a closed end, a plunger slidably received in the body, said plunger having an oil feed hole and coacting with the closed end of said body to provide an oil chamber, an annular groove in the side wall thereof, a corrugated ring carried by said groove bearing alternately against the plunger and the body, a valve in said body having a push rod seat and a reduced portion freely received within said feed hole terminating below said plunger, a bottoming bumper received on the free end of said reduced portion, and a spring bottomed on the closed end of said body acting against said bottoming bumper to elongate said lifter.

References Cited in the file of this patent

UNITED STATES PATENTS

2,541,953	Banker	Feb. 13, 1951
2,691,367	Thoren	Oct. 12, 1954