Dec. 26, 1961 F. O. WISMAN 3,014,472

HYDRAULIC VALVE TAPPET

Filed June 13, 1960 2 Sheets-Sheet 1

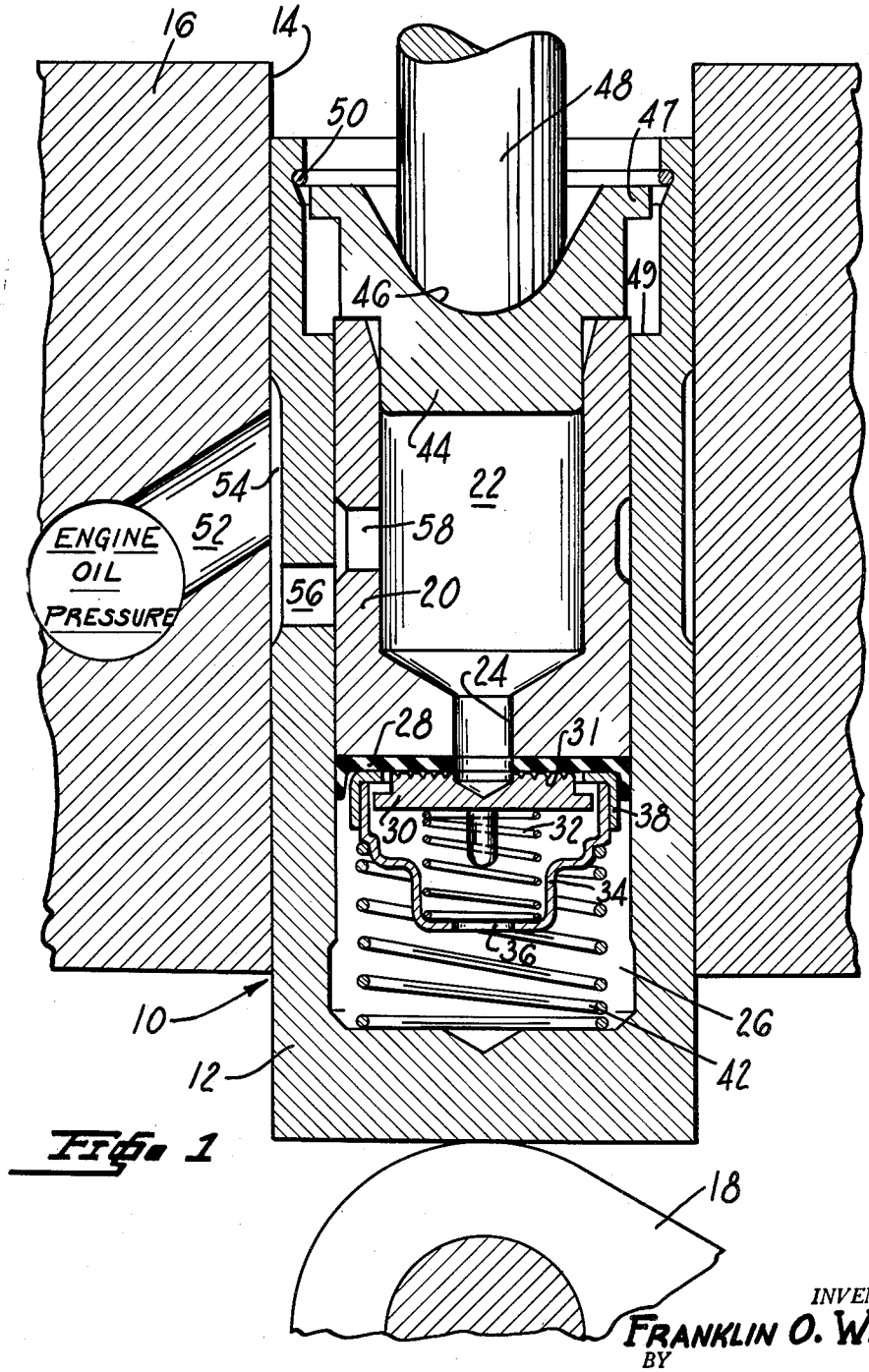


Fig. 1

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HYDRAULIC VALVE TAPPET

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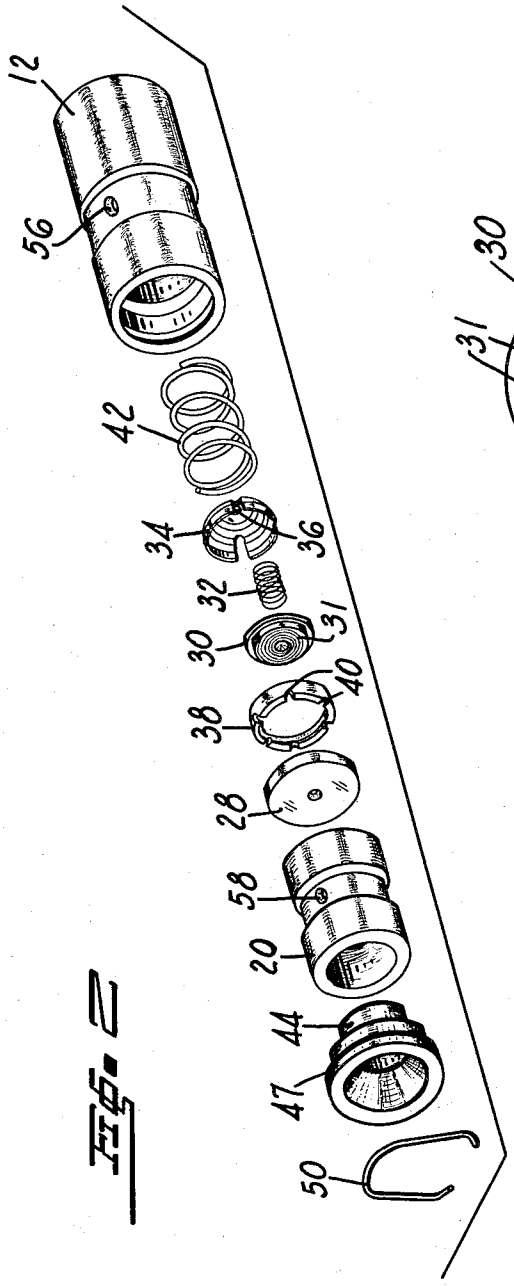


Fig. 2

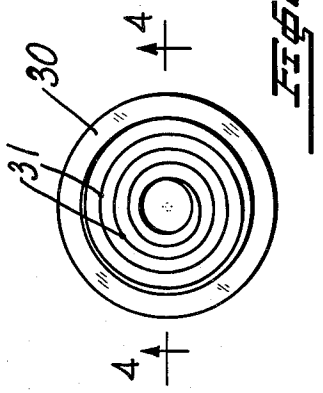


Fig. 3

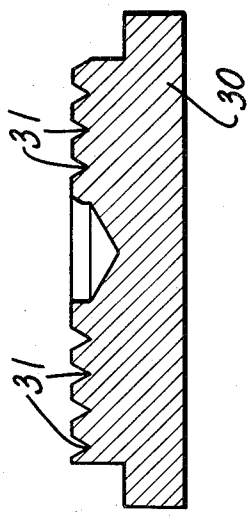


Fig. 4

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HYDRAULIC VALVE TAPPET

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9 Claims. (Cl. 123—90)

This invention relates to automatic clearance regulators or lash adjustors for providing a predetermined clearance in mechanical linkages and more particularly to hydraulic valve tappets for opening and closing poppet valves in internal combustion engines.

To achieve optimum efficiency in an internal combustion engine it is necessary that the engine poppet valves be opened and closed at predetermined intervals in the engine combustion cycle. These intervals are controlled by cams which operate the engine valves through means of a valve actuating mechanism. Such mechanism usually includes numerous parts each of which is subject to changing engine temperatures with consequent expansion and contraction, and to normal wear.

In order to automatically compensate for changes in the overall length of the valve actuating mechanism, and thus maintain the desired timing pattern set by the cams, hydraulic valve tappets have been used with reasonable success for many years. Such tappets are normally located between the timing cam and the valve actuating mechanism, so that any thermal changes will result in an increase or decrease of the effective length of the tappet to eliminate lash at all times.

Most conventional hydraulic valve tappets operate on the principle of transmitting the energy of the actuating cam through a confined column of hydraulic fluid whose length is adjusted automatically upon every revolution of the cam shaft. This fluid is normally confined in a chamber formed by a plunger located within the tappet body and is permitted to escape in small quantities from the chamber so that the plunger may adjust its relative position in the tappet body. This escape of fluid is often referred to as "leakdown" and in conventional tappets occurs between the tappet body wall and the plunger. Since in conventional tappets, "leakdown" is controlled solely by the fit of the plunger with the tappet body, the plungers and tappet body members must be precision machined, carefully sorted, and selectively fitted together. Precision tolerances must be maintained, since the clearance between the two parts is quite critical. Even with above average care in the selective assembly of the tappet parts a significant percentage of the assembled tappets are substandard. Many of these tappets are found to have a "leakdown" which is too fast or too slow, and therefore, must be refitted and reassembled in order to operate satisfactorily. Obviously, this conventional arrangement for controlling the necessary "leakdown" greatly increases tappet costs.

With the foregoing in mind, it is an object of this invention to provide an improved hydraulic valve tappet assembly which can be manufactured in a much simpler manner, and with considerably less expense than automatic hydraulic valve tappets heretofore utilized.

Another object of this invention is to provide a hydraulic valve tappet which will operate more reliably than valve tappets heretofore used, especially in dirty engines.

A further object of this invention is to provide a hydraulic valve tappet which will not be dependent on the control of leakdown between the plunger and tappet body members in the manner of conventional hydraulic tappets.

More specifically, it is an object of this invention to provide a hydraulic valve tappet having a definite controlled "leakdown" groove on the face of a check valve disc which is located between the chamber containing the confined column of hydraulic fluid and a reservoir, said groove permitting the escape of hydraulic fluid during each cycle. Such an arrangement permits larger clearances between the plunger and tappet body members, thereby eliminating the precision machining, sorting, and selective assembly operations previously required.

A still further object of this invention is to provide a hydraulic valve tappet which incorporates a self cleaning feature to maintain the "leakdown" groove on the face of the check valve free from dirt particles and other solid contaminants. Such a feature will certainly reduce the possibilities of operational failure which often resulted from minute particles in the hydraulic fluid being caught in the annular clearance space between the plunger and tappet body members.

Another object of this invention is to provide means for limiting movement of the plunger within the tappet body, said means being located on the end of the tappet nearest the engine poppet valves.

The above and other objects and features of this invention will be more apparent to those familiar with hydraulic tappets upon a reading of the following description and an examination of the accompanying drawings which form a part of this specification, and in which:

FIGURE 1 is an enlarged sectional view of the hydraulic valve tappet;

FIGURE 2 is an exploded perspective view of the hydraulic valve tappet;

FIGURE 3 is plan view of the check valve showing a spiral "leakdown" groove configuration on the face thereof; and

FIGURE 4 is an enlarged section taken through line 4—4 of FIGURE 3.

Referring to the drawings, the numeral **10** refers to a hydraulic valve tappet having a tappet body **12** which is slidable in a bore **14** of a housing **16**, such as would be provided by an engine block. The tappet body **12** is open at one end and closed at the other end, said closed end being in contact with a cam **18**. A hollow plunger **20** is slidable within the tappet body and forms a hydraulic fluid reservoir **22**. A passage **24** is formed through the lower end of the plunger to provide means for communicating the reservoir **22** with a pressure chamber **26** formed between the end of the plunger and the closed end of the tappet body. Located at the head of the plunger **20** is a sealing cup **28**, which may be formed from resilient materials such as the inert fluorocarbons "Teflon" or "Kel-F," said sealing cup serving to prevent leakage between the plunger and the bore **14**. The sealing cup also acts as a check valve seat for check valve disc **30** having a spiral groove **31** formed on the face thereof, thereby offering some resilience to insure more positive check valve action. The check valve, which is urged against the sealing cup by a light weight spring **32**, remains in contact with the sealing cup, except when the pressure in the reservoir **22** exceeds the pressure in the pressure chamber by an amount sufficient to overcome the spring **32**. The lower end of check valve spring **32** bears against a cap **34** having an aperture **36** formed at the bottom thereof. Attached to the other end of the cap is a flanged ring **38** having a plurality of slots **40** formed thereon to permit flow of hydraulic fluid therethrough. Although the cap **34** and ring **38** are illustrated as being separate members, they may be, if desired, formed as a single integral part. A return spring **42**, which abuts cap **34**, urges the plunger **20** away from the closed end of the tappet body **12**.

Located at the top end of the plunger **20** is a rod seat member **44** having a recess **46** for receiving the end of a rod **48** which is suitably connected to an engine valve

(not shown). The entire internal structure of the tappet is prevented from disassembly from the tappet body 12 by a snap ring 50 seated in a groove formed on the inner wall of the tappet body. It should be noted that movement of plunger 20 is limited within tappet body 12 by flange 47 formed on rod seat member 44, said flange being seatable on shoulder 49 at its lowermost position and abutting ring 50 at its uppermost position. Engine oil pressure is communicated to the reservoir 22 through means of a passage 52 formed in housing 16, annular channel 54, passage 56 in tappet body 12, and passage 58 in plunger 20. The length of annular channel 54 assures continued communication between the channel and passage 52 as the tappet body reciprocates within the housing due to the action of the cam.

The valve train mechanism has not been shown since it is considered to be of such conventional design as to be readily understood and its relation to the parts shown to be adequately known, without illustration.

Operation of the hydraulic valve tappet is as follows: Initially the forces within the tappet are substantially in balance. The plunger return spring 42 holds the plunger 20 against the rod seat member 46 which in turn is held against the rod 48. The rod 48 is backed by the resistance of the engine valve spring (not shown) to prevent further upward movement of the push rod seat member. The reservoir chamber 22 and pressure chamber 26 are filled with hydraulic fluid at substantially equal pressures.

As the cam 18 rotates and the eccentric portion thereof engages the bottom of the tappet body 12, the tappet body will move upward along with the plunger 20. There is effectively no relative movement between the plunger and the tappet body because of the incompressible nature of the hydraulic fluid which is trapped in pressure chamber 26. As the tappet body 12 rises under the influence of cam 18, the rod seat member 44 transmits the cam lift force to the rod 48 in the effort to lift the engine valve against the resistance of the engine valve spring.

So long as the engine valve is off of its seat, the load is carried by the column of oil confined in the pressure chamber 26. During this period a predetermined slight leakage of oil from pressure chamber 26 occurs through the spiral groove 31 formed on the face of the check valve disc 30. This is necessary in order to subsequently permit a given amount of fluid to enter the pressure chamber to achieve the required increase or decrease in the length of the tappet. More specifically, this flow of fluid occurs as soon as the tappet body leaves the eccentric portion of the cam and contacts the base circle thereof. In other words, after the cam 18 has revolved back to its low point, the pressure in chamber 26 will have dropped sufficiently so that the pressure in the reservoir 22 will cause the check valve disc to open and permit flow of fluid from the reservoir to the chamber 26. The surge of fluid past the check valve disc and into the pressure chamber will not only provide a lash adjustment for each cycle but will also tend to clean the spiral groove of any dirt particles or other contaminants that might tend to prevent subsequent leakage through the groove.

In discussing the operation of the disclosed tappet, it is to be remembered that such tappets operate at high speeds and that the adjustments involved and the fluid exchange to effect the adjustments involved are all small incremental measurements. The disclosed tappet is actually considerably smaller than illustrated and the valve opening, groove spaces, etc. have been exaggerated for purposes of illustration.

Although this invention has been described in connection with a specific embodiment, it will be obvious to those skilled in the art that various changes may be made in the form, structure and arrangement of parts without departing from the spirit of the invention. Accordingly, applicant does not desire to be limited to the specific embodiment disclosed herein primarily for purposes of illustration, but instead desires protection falling within the scope of the appended claims.

Having thus described the various features of the invention, what I claim as new and desire to secure by Letters Patent is:

1. A hydraulic valve tappet comprising a hollow body closed at one end and open at the other end, a plunger slidable within said body, said plunger dividing the hollow interior of said body into a pressure chamber and a reservoir chamber, a sealing member located on the end of said plunger for preventing leakage between the plunger and the wall of said body and for serving as a check valve seat, passage means located in said plunger and said sealing member for communicating said reservoir chamber with said pressure chamber, pressure responsive check valve means seatable on said sealing member and located between said reservoir and pressure chambers for controlling flow through said passage means, said check valve means having a closed and an open position, and leakdown passage means formed in the face of said check valve means which contacts said sealing member for permitting leakage from the pressure chamber to the reservoir chamber while said check valve means is in a closed position.

2. A hydraulic valve tappet as defined in claim 1 wherein said leakdown passage means comprises at least one groove formed on the face of said check valve means.

3. A hydraulic valve tappet as defined in claim 1 wherein said leakdown passage means comprises a spiral groove formed on the face of said check valve means.

4. In a hydraulic valve tappet having a closed end hollow tappet body member, a plunger member slidably disposed therein for forming a pressure chamber with the closed end thereof, a rod seat member located in said hollow tappet body member for forming a reservoir chamber with said plunger member, and passage means for permitting communication between said chambers, sealing means for preventing leakage from one of said chambers to the other of said chambers via the clearance between the plunger member and the interior of said hollow body member and for serving as a check valve seat, pressure responsive check valve means seatable on said sealing means for controlling flow between said chambers, and grooved means formed on the face of said pressure responsive means which contacts said sealing means for permitting leakdown from said pressure to said reservoir chamber to allow for axial adjustment of said plunger member relative to said tappet body member.

5. In a hydraulic valve tappet having a closed end hollow tappet body member, a plunger member slidably disposed therein for forming a pressure chamber with the closed end thereof, a rod seat member located in said hollow tappet body member for forming a reservoir chamber with said plunger member, and passage means for permitting communication between said chambers, sealing means for preventing leakage from one of said chambers to the other of said chambers via the clearance between the plunger member and the interior of said hollow body member and for serving as a valve seat, pressure responsive valve means seatable on said sealing means for controlling flow between said chambers, and means formed on the face of said pressure responsive means which contacts said sealing means for permitting leakdown from said pressure to said reservoir chamber to allow for axial adjustment of said plunger member relative to said tappet body member.

6. In a hydraulic valve tappet having a closed end hollow tappet body member, a plunger member slidably disposed therein for forming a pressure chamber with the closed end thereof, means for forming a reservoir chamber with said plunger member, and passage means for permitting communication between said chambers, sealing means for preventing leakage from one of said chambers to the other of said chambers at all times via

the clearance between the plunger member and the interior of said hollow body member and for serving as a valve seat, pressure responsive valve means seatable on said sealing means for controlling flow between said chambers, and passage means formed between the contacting faces of said sealing means and valve means for permitting leakdown from said pressure to said reservoir chamber to allow for axial adjustment of said plunger member relative to said tappet body member.

7. A hydraulic valve tappet comprising a hollow body closed at one end and open at the other end, a plunger slidable within said body, said plunger dividing the hollow interior of said body into a pressure chamber and a reservoir chamber, a rod seat located at the open end of said body and seatable on one end of said plunger, stop means formed on said rod seat for limiting relative motion between said plunger and said body, a sealing member located on the end of said plunger for preventing leakage between the plunger and the wall of said body and for serving as a check valve seat, passage means located in said plunger and said sealing member for communicating said reservoir chamber wtih said pressure chamber, pressure responsive check valve means seatable on said sealing member and located between said reservoir and pressure chambers for controlling flow through said passage means, said check valve means having a closed and an open position, and leakdown passage means formed in the face of said check valve means which contacts said sealing member for permitting leakage from the pressure chamber to the reservoir chamber while said check valve means is in a closed position.

8. A hydraulic valve tappet comprising a hollow body closed at one end and open at the other end, a plunger slidable within said body, said plunger dividing the hollow interior of said body into a pressure chamber and a reservoir chamber, means located at the open end of said hollow body and operatively connected to said plunger for seating on said body to thereby limit relative motion between said plunger and body, passage

means for permitting communication between said chambers, sealing means for preventing leakage from one of said chambers to the other of said chambers via the clearance between the plunger and the interior of said hollow body and for serving as a valve seat, pressure responsive valve means seatable on said sealing means for controlling flow between said chambers, and passage means formed between the contacting faces of said seating means and valve means for permitting leakdown from said pressure to said reservoir chamber to allow for axail adjustment of said plunger relative to said body.

9. A hydraulic valve tappet having a closed end hollow tappet body member, a plunger member slidably disposed therein for forming a pressure chamber with the closed end thereof, said plunger member having valve seat means located on the end thereof, means for forming a reservoir chamber with said plunger member, passage means for permitting communication between said chambers, sealing means for preventing leakage from one of said chambers to the other of said chambers at all times via the clearance between the plunger member and the interior of said hollow body member, pressure responsive valve means seatable on said valve seat means for controlling flow between said chambers, and passage means formed between the contacting faces of said valve seat means and valve means for permitting leakdown from said pressure to said reservoir chamber to allow for axial adjustment of said plunger member relative to said tappet body member.

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