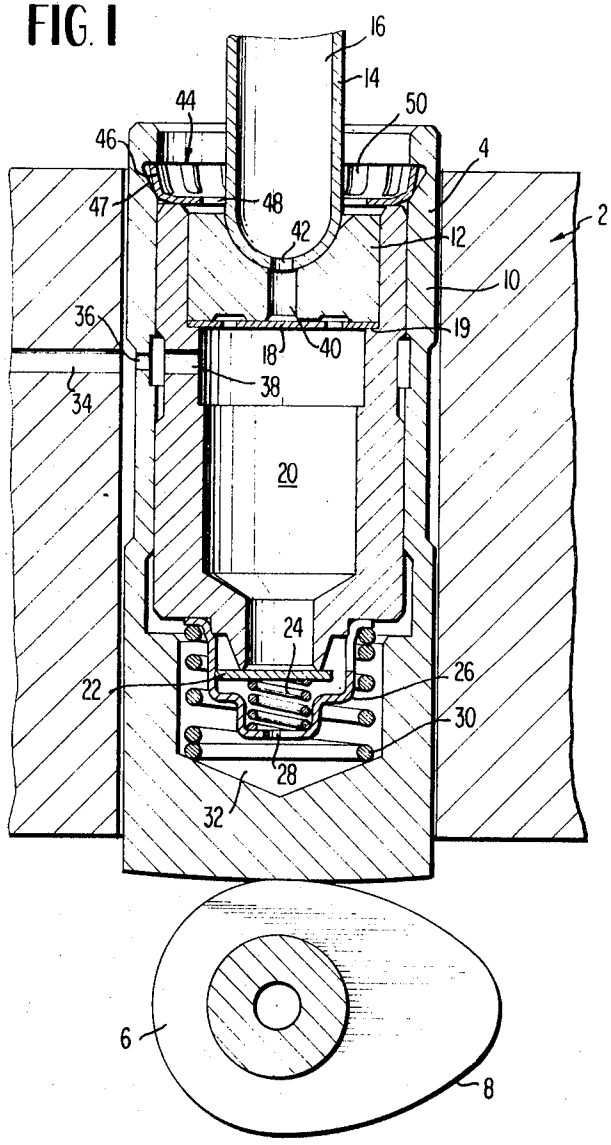
June 23, 1970 M. V. DADD 3,516,393

ANTI-PUMP-UP TAPPET

Filed June 4, 1968

FIG. 1



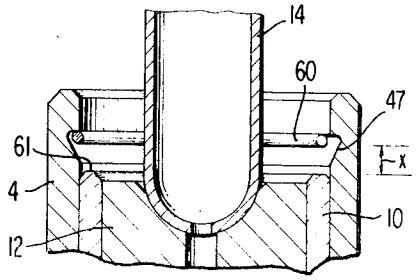


FIG. 3 (PRIOR ART)

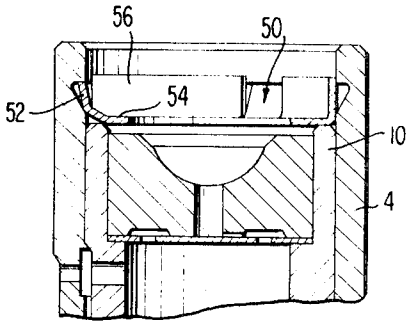


FIG. 4

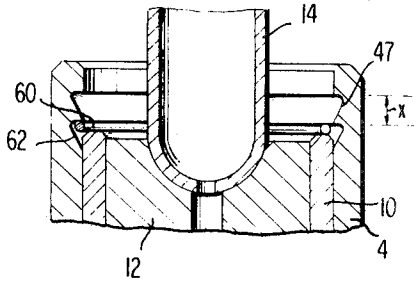


FIG. 5

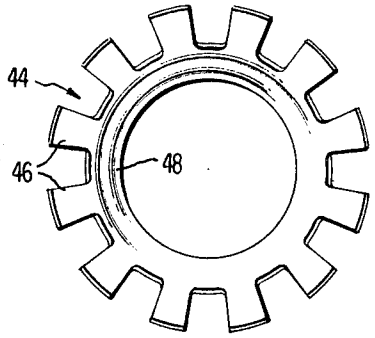


FIG. 2

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3,516,393

ANTI-PUMP-UP TAPPET

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Int. Cl. F01l 1/00
U.S. Cl. 123—90 9 Claims

ABSTRACT OF THE DISCLOSURE

This disclosure relates to a hydraulic tappet having a retainer ring and a groove in the upper portion of the tappet body to restrict the upward movement of the tappet plunger relative to the tappet body to less than that normally permitted by the conventional groove and retainer ring. For example, a retainer ring has an outer portion seated in the normal groove in the inside of the tappet body and a downwardly extending central portion which restricts the upward movement of the plunger. The purpose of this design is to minimize tappet pump-up.

This invention relates to hydraulic tappets having anti-pump-up properties. In one of its aspects it relates to a novel feature for preventing pump-up in a hydraulic tappet having a body which reciprocates within an engine block, a plunger within the body, the plunger being biased upwardly within the body and having means for engaging a push rod, fluid inlet means in the body and the plunger and check valve means in the bottom of the plunger to permit the oil to flow out of the plunger through the valve. This novel feature includes a means for restricting the normal upward travel of the plunger. More specifically, this improved tappet contains a retainer ring means in the upper portion of the body for restricting the upward travel of the plunger to a position lower than that normally permitted by the aforementioned groove and ring relative to the body.

Hydraulic tappets in internal combustion engines are designed to take up lash, caused by change in the dimensions of the valve train as the engine operates at various conditions. Compensation for this lash is made in a normal hydraulic tappet by a plunger within the tappet body. This plunger rises in the tappet body so as to effectively increase the length of the tappet. Modern engines, however, operate at higher speeds which causes troublesome valve spring surge. The surge, which is due to natural harmonics of the valve spring, allows momentary lash in the valve train. When this momentary lash, is taken up by the hydraulic tappet the plunger of the tappet does not have sufficient time to return to its normal operating position resulting in the failure of the intake or exhaust valve to close at the end of the valve event. This non-closing of the valve results in power loss. This response of the tappet to valve spring surge is called "pump-up." In other words, the plunger pumps-up or creeps-up into a position where the effective length of the tappet is not proper for permitting the intake or exhaust valve to close.

One solution proposed to this pump-up problem is to drill a hole in the side of the tappet body to vent the high pressure chamber to atmospheric pressure or inlet oil pressure as the piston moves upwardly past a certain point. Although this method is relatively effective to stop pump-up, it is a relatively expensive modification of a conventional hydraulic tappet and renders the tappet substantially useless in lower speed engines.

I have now discovered an improved means for reducing tappet pump-up by providing a stop for the plunger, which stop is associated with a groove in the upper inner

portion of the tappet body to limit the upward travel of the plunger to less than that normally permitted.

By various aspects of this invention one or more of the following, or other, objects can be obtained.

It is an object of this invention to provide an anti-pump-up hydraulic tappet.

It is a further object of this invention to provide a means for modifying a conventional tappet to prevent pump-up without machining or forming operations and without effecting its use in lower speed engine operations.

It is a still further object of this invention to provide an anti-pump-up tappet which can be made from a conventional tappet by introducing a retaining ring in a simple operation.

It is still a further object of this invention to provide an anti-pump-up tappet which can be made from a conventional tappet that provides proper engine rocker arm geometry in the extended position.

Other aspects, objects, and the several advantages of this invention are apparent to one skilled in the art from a study of this disclosure, the drawings, and the appended claims.

According to the invention, a hydraulic tappet with a plunger reciprocable within a body is prevented from the full extent of normal upward movement by a retainer ring means in the upper portion of the body.

The retainer ring can comprise a concave member, with the outer portion seated in the normal groove for the normal tappet retainer ring and the central portion extending downwardly of the normal groove and contacting the tappet plunger at its upper extremity of movement.

In accordance with the broadest aspect of the invention, the plunger restraining means can comprise any combination of retaining rings and grooves which restrict the plunger from moving to the extent which normally is permitted.

The invention will now be described with reference to the accompanying drawings in which:

FIG. 1 is a transverse sectional view of a fragmentary portion of an internal combustion engine showing a portion of a push rod and the tappet illustrating an embodiment of the invention;

FIG. 2 is a plan view of a retaining ring shown in section in FIG. 1;

FIG. 3 is a fragmentary view of a portion of a tappet illustrating the prior art;

FIG. 4 is a fragmentary view of a portion of a tappet showing a modified form of the invention; and

FIG. 5 is a fragmentary view of a portion of a tappet showing a second modified form of the invention.

Referring now to FIGS. 1, 2, and 3 in particular, a tappet body **4** is reciprocable within an engine block **2** and is actuated by a cam shaft **6** having a cam lobe **8**. A plunger **10** is reciprocable within tappet body **4** and has a shoulder **19** for seating an apertured plate **18** and push rod socket **12**. A push rod **14** having a passageway **16** bears against the push rod socket **12**. At the bottom portion of the plunger **10**, a check valve plate **22** is biased by check valve spring **24** against the bottom portion of the cavity **20** formed within the plunger **10**. A plunger spring **30** and a valve cage **26** hold the check valve plate **22** and the check valve spring **24** in place.

A passage **34** is provided to supply oil to the tappet. The oil passes through passage **36**, passage **38**, and into cavity **20** within the plunger **10**. The oil in cavity **20** can flow through the check valve formed by valve plate **22**, and into the pressure chamber **32**. The oil in pressure chamber **32** can then flow under pressure between tappet body **4** and plunger **10** back to passages **36** and **38**. Also, the oil in cavity **20** is metered through the holes in aperture plate **18** and flow into passage **40**, through

hole 42 into passageway 16. The above described portions of the drawings are conventional in hydraulic tappets.

FIG. 3 discloses a conventional tappet wherein a snap ring 60 is positioned within annular groove 47 of tappet body 4. It will be noted that the upper extremity 61 of the plunger 10 is spaced a distance X (usually about .060 inch) from snap ring 60, this being indicated as the "allowable pump-up." This is a standard tappet design properly adjusted for optimum rocker arm geometry action. However, at higher engine speeds, it has been discovered that this allowable pump-up creates a serious problem during maximum engine valve surge conditions. Under such conditions the plunger moves, or creeps, upwardly as it compensates for the momentary lash caused by valve spring surge. Each time it so moves upwardly, the high speed of the engine does not permit it to return. Eventually the plunger 10 reaches the snap ring where it stays. In this position the optimum geometry of the valve train is destroyed resulting in the failure of the intake or exhaust valves to close, and power loss occurs in the engine.

According to the present invention, I correct this undesirable effect by substituting for snap ring 60 a special retainer ring 44 positioned within annular groove 47 of tappet body 4. This retainer ring 44 contains a plurality of prongs 46 which are seated in groove 47 and an annular stop 48 which is spaced axially of the annular groove 47. Thus, the annular stop 48 limits the extent to which the plunger 10 can move upwardly away from cam shaft 6 to adjust for momentary lash caused by spring surge. In this manner, optimum rocker arm geometry or positioning is possible within the restricted pump-up. With this assembly, the engine can maintain power output while experiencing the engine valve surge conditions of engine with higher speeds. In FIGS. 1 and 2, the snap ring has been shown with many spaced prongs. However, the snap ring could be made with as few as two large spaced projections which seat in annular groove 47.

With this invention, in cold engine conditions on normal warm idling, the rocker arms are adjusted at no-lash, with the plunger 10 extended so its upper extremity 60 engages the annular stop 48. When so adjusted at high speeds and high temperature conditions, the valve train expansion causes the plunger 10 to position itself only slightly lower in the body 4, that is, with the upper extremity 61 slightly spaced below the annular stop 48. This permits only a minute pump-up during excessive engine valve surge conditions which maintains proper valve train geometry and prevents the intake and exhaust valves from being held open more than a few thousandths of an inch. Accordingly, under these conditions the engine can still maintain power output and go through the spring surge range of speeds of the higher engine speeds at full power output.

A modified form of the invention is shown in FIG. 4. In this form of the invention, the retainer ring 50 has a plurality of spaced prongs 52 which are seated in annular grooves 47. An annular stop 54 is positioned to limit the upward movement of plunger 10 and/or push rod socket 12. In this form of the invention, a plurality of spaced upstanding walls are provided adjacent the inner walls of the tappet body 4.

In both embodiments shown in FIGS. 1, 2, and 4, the retainer rings are fixed in the grooves so that there is no vertical movement between the retainer ring and the tappet body 4.

In the embodiment shown in FIG. 5 the tappet body has a conventional annular groove 47 and an anti-pump-up groove 62. The snap ring is positioned in the lower anti-pump-up groove 62 to limit the allowable pump-up of the plunger 10 and push rod socket 12. With this embodiment of this invention, the snap ring can be positioned in the upper groove 47 for normal driving or in the lower groove 62 for high speed driving. The distance Y between the grooves 47 and 60 is generally in the range of .060, the same as distance X in FIG. 3 and restricts pump-up as shown in FIG. 1.

In all embodiments, the amount of allowable pump-up is limited to a few thousandths of an inch engine hot. Expressed in other terms, the degree of allowable pump-up for the tappets is generally in the range of 1% to 5% of that normally permitted for engine valve pump-up. The tappets may also be adjusted for zero clearance engine hot eliminating pump-up entirely while maintaining proper rocker arm geometry.

Whereas the invention has been described with reference to a hydraulic tappet containing a push rod socket 12, it is within the scope of the invention to employ a hydraulic tappet such as that disclosed and claimed in my U.S. Pat. 3,146,767.

Reasonable variations and modifications are possible within the scope of the foregoing disclosure and the drawings without departing from the spirit of the invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows.

I claim:

1. In a hydraulic tappet having a body; a plunger within said body, said plunger being biased upwardly within said body and having means for engaging a push rod, fluid intake means in said body and said plunger; check valve means in the bottom of said plunger to permit oil to flow out of said plunger through said valve; a groove in the inner portion of said body for receiving a retainer ring to retain said plunger within said body; and with said retainer ring in said groove, the movement of said plunger within said body being restricted to a predetermined distance for normal engine speeds; the improvement which comprises: means located below said groove providing a stop substantially below said groove for limiting the upward travel of said plunger within said body to a distance substantially less than said predetermined distance, thereby modifying said tappet for high speed engine operation so as to prevent pump-up at high engine speeds.

2. A hydraulic tappet according to claim 1 wherein said stop means comprises a ring having an outer portion seated in said groove and a downwardly extending central portion shaped such that said central portion restricts the upward travel of said plunger relative to said body, said position lower than said groove being such that proper engine rocker arm geometry is maintained.

3. A hydraulic tappet according to claim 2 wherein said ring outer portion comprises a plurality of separate, spaced prongs the ends of at least some of said prongs being positioned in said grooves.

4. A hydraulic tappet according to claim 3 wherein some of said prongs extend upwardly against the inner portions of said body above said groove.

5. A hydraulic tappet according to claim 2 wherein said central portion comprises an annular ring.

6. A hydraulic tappet according to claim 1 wherein said body has a second groove in said inner portion thereof below said first mentioned groove, and said stop means comprises a retainer ring in said second groove.

7. In a valve train for an internal combustion engine including a rocker arm, a push rod, a cam shaft, and a hydraulic tappet located between the cam shaft and the push rod; said tappet having a body, a plunger within said body; said plunger being biased upwardly within said body and having means for engaging a push rod, fluid intake means in said body and said plunger, check valve means in the bottom of said plunger to permit oil to flow out of said plunger through said valve, a groove in the upper inner portion of said body for receiving a retainer ring to retain said plunger within said body by means of a portion of said plunger abutting said retainer ring, said

rocker arm being adjusted at zero lash under warm idling conditions and under optimum rocker arm geometry conditions such that said portion of said plunger is located below said groove at a predetermined allowable pump-up distance, the improvement comprising: means fixed within said body and located below said groove a distance substantially equal to said predetermined allowable pump-up distance for limiting the upward travel of said plunger and substantially eliminating any allowable pump-up of said plunger.

8. A valve train according to claim 7 wherein said predetermined allowable pump-up is less than 5% of the distance between said groove and said portion of said plunger.

9. A hydraulic tappet according to claim 1 wherein said stop limits the upward travel of said plunger within said body to a distance less than 5% of said predetermined distance.

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MARK M. NEWMAN, Primary Examiner