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HYDRAULIC VALVE LIFTER

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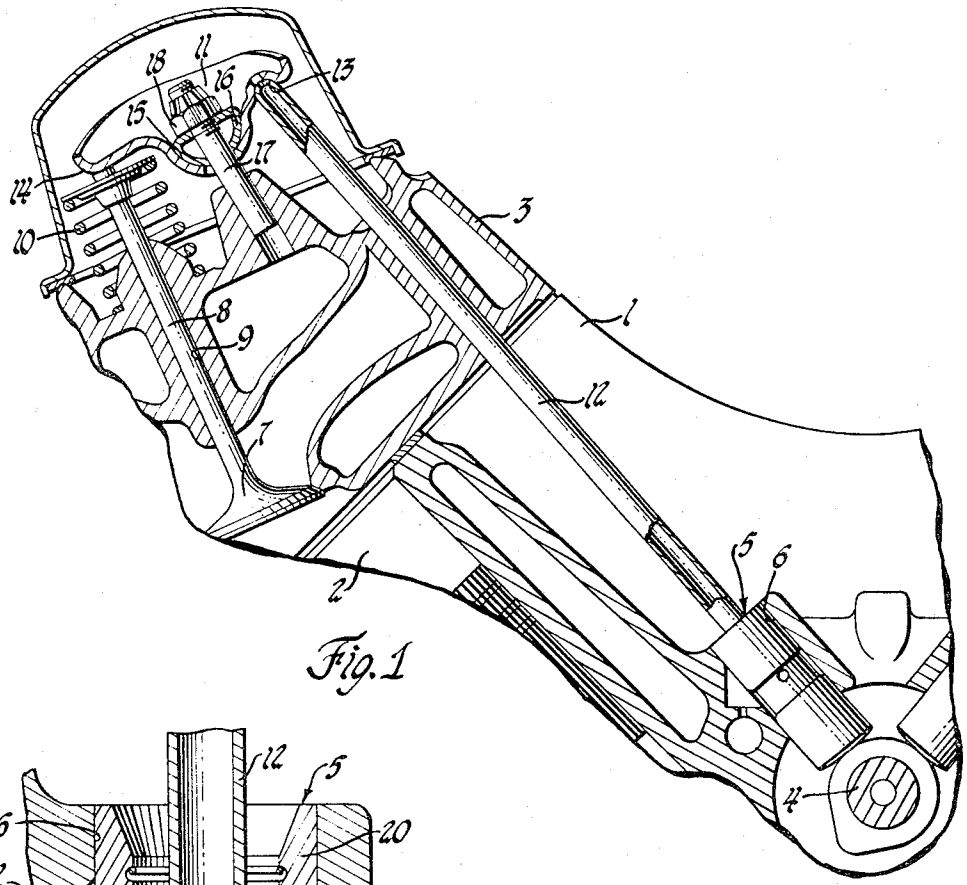


Fig. 1

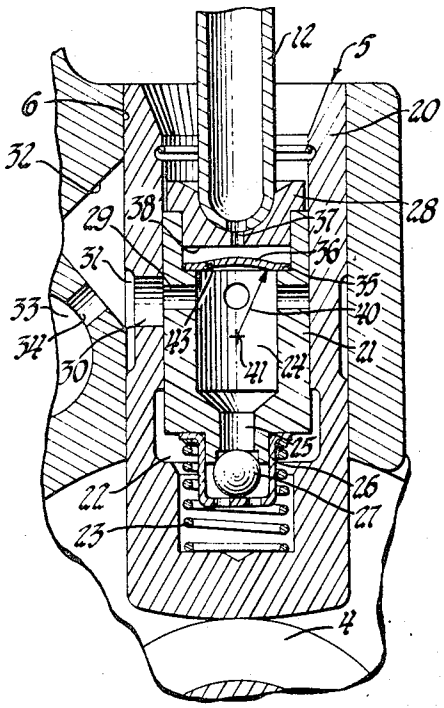


Fig. 2

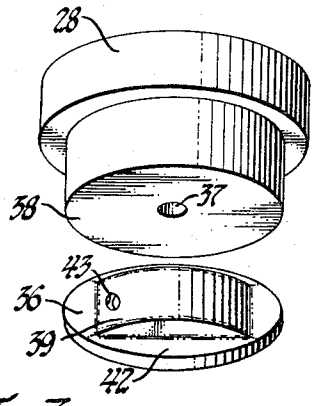


Fig. 3

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HYDRAULIC VALVE LIFTER

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ABSTRACT OF THE DISCLOSURE

A push rod and rocker operating mechanism including a side pressure oil fed hydraulic tappet having a hollow plunger open at its upper end through a central aperature in its push rod seat member for flow of oil to the rocker, there being a plate-like valve in the plunger having a part-cylindrical surface abuttable with a flat surface on the push rod seat member to variably restrict such flow, and the valve having a hole therethrough at one side of its curved surface to induce tilting of the valve when urged into abutment with the push rod seating member by forces of inertia or oil pressure in the plunger.

Background of the invention

Our invention relates to lubricating systems for internal combustion engines and the like, and particularly to tappets which control oil flow for lubricating the valve operating rockers and valve stems. More specifically, the invention concerns improvements in such tappets to better insure against the flow control valve therein becoming blocked by foreign particles or sludge in the oil.

The prior U.S. Patent 2,818,050 to Papenguth shows a hydraulic tappet having such a valve in the form of an imperforate flat plate movable into and out of abutment with a part-cylindrical curved surface surrounding the oil outlet opening through the push rod seat, also a modification in which the abuttable surface of the valve has the part-cylindrical curvature and the coacting face of the push rod seat is flat. Schumm U.S. Patent 3,151,603 also discloses use of a flat valve coacting with a part-cylindrical face on the push rod seat, the valve having an off-center opening therethrough. Bergmann U. S. Patent Nos. 2,948,270 and 3,111,119 both show apertured plate-like valves coacting with a flat surface on the push rod seat, the valve in the former having a part-cylindrical curvature while the curvature of the valve in the latter patent is generally part spherical. In both these Bergmann patents, however, the outer peripheral portion of the valve is restrained against any axial movement, and self-cleaning action is dependent on axial rotation of the valve.

We have found that such valves have better self-cleaning action when they have freedom for bodily movement into and out of abutment with the push rod seat, along with such incidental rotary movement as may be induced in the valve relative to the push rod seat, rather than when they are confined so that self-cleaning movement is dependent on such rotary motion alone. Also, both forms of the imperforate valves of the aforementioned Papenguth patent exhibit good self-cleaning action under normal conditions of engine usage in road vehicles. However, when operated at one constant speed for prolonged periods, we have found that the oil flow through the push rod seat hole tends to become plugged by accumulation

of rust, sludge, etc. between the opposing surfaces of the push rod seat and the valve. When this occurs, no oil is supplied through the push rods to the valve rockers and the resulting lack of lubrication of their bearing surfaces and of the valve stems and guides leads to catastrophic failure of the engine.

While this problem is lessened when using tappets having a flat valve with an offset hole in conjunction with a push rod seat having a part-cylindrical surface facing the valve as in the aforementioned Schumm patent, it may frequently happen that such a valve orients itself by rotation until the hole in the valve becomes aligned with the axis of curvature of the push rod surface. Consequently, no unbalance of pressure or inertia force on the valve is then present to cause the valve to rock on the push rod seat to effect the necessary self-cleaning action. We have found that this problem is overcome in accordance with our invention by putting the part-cylindrical curved surface on the valve and the flat surface on the push rod seat, and locating the hole in the valve on one side of its curved surface. In this way, in whatever position the valve may orient itself by rotation, the hole therein always insures its being unbalanced under inertia and oil pressure forces acting thereon in operation, tending to produce rocking or tilting action and resultant self-cleaning of the valve each time it moves into abutment with the push rod seat.

Brief description of the drawing

FIGURE 1 is a cross-sectional view of a portion of an internal combustion engine illustrating application of our invention wherein engine oil supplied under pressure to a hydraulic tappet is delivered through the hollow push rod to the overhead valve and rocker mechanism.

FIGURE 2 is an enlarged sectional view similar to FIGURE 1 showing the parts of the hydraulic tappet embodying the oil flow control valve arrangement of our invention.

FIGURE 3 is a further enlarged view showing the flow control valve and its associated push rod seat member in perspective.

Description of the preferred embodiment

Referring now in detail to the drawing, the engine shown in FIGURE 1 is of the V-type including a cylinder block and crankcase **1** in each side of which one or more cylinders **2** are provided and closed at their upper ends by a cylinder head **3**. Suitably journaled in the crankcase is a camshaft **4** which operatively engages a tappet **5** so as to cause it to reciprocate in a suitable support shown as a bore **6** formed in the crankcase. An engine poppet valve **7**, having a stem **8** reciprocably supported in a valve guide bore **9** formed in the cylinder head, is biased to its closed position shown by a return spring **10**. The valve **7** is operatively connected to the tappet **5** by a valve rocker **11** and a hollow push rod **12**. The particular valve rocker illustrated is in the form of a generally channel-shaped metal stamping having downwardly presenting opposite end surfaces **13** and **14** in bearing engagement with the upper ends of the push rod and poppet valve respectively, and an intermediate upwardly presenting bearing surface **15** journaling on a bearing member **16** which is fixed to the cylinder head by a stud **17** and nut **18**. It will be appreciated that the rocker bearing surfaces **13**, **14** and **15** and the sliding surfaces of the valve stem **8** and its guide **9** all require lubrication during operation

of the engine. Oil therefor is supplied via the tappet 5 through the hollow push rod 12, and in metered amounts, as hereinafter described.

Referring to FIGURE 2, the hydraulic tappet 5 comprises a cup-shaped cylinder member 20 having a cup-shaped plunger 21 telescopically slidable therein and defining an oil pressure or cushion chamber 22 between their respective closed ends. Within this pressure chamber and biasing the plunger outwardly of the cylinder member is a plunger spring 23. The interior of the plunger forms a reservoir chamber 24 for supplying the pressure chamber 22 through a check valve control passage 25. Secured to the lower end of the plunger by the plunger spring 23 is a cage 26 which loosely confines the check valve 27. During each lift stroke of the cylinder member 20 by the cam 4, oil is trapped in the pressure chamber by closure of the passage 25 by the check valve 27 and the plunger is forced to travel upward with the cylinder carrying with it the push rod seat 28 and the push rod 12. The upward movement of the push rod causes the rocker to fulcrum on the bearing member 16 and open the poppet valve 7 against its spring 10. During each such cam lift stroke, a small amount of the oil trapped in the pressure chamber 22 of the tappet escapes around the plunger, which leakage is termed "leak down" and is necessary in order to insure that the poppet valve 7 may fully close on the subsequent return stroke, which occurs with continued rotation of the cam 4.

After the poppet valve 7 closes, the plunger spring 23 continues to maintain the tappet cylinder member 20 in contact with the surface of the cam while holding the plunger in abutment with the push rod seat to take out all "lash" in the system. While the cylinder member is regaining its engagement with the base circle of the cam, the plunger is therefore moved outwardly of the cylinder to compensate for all or substantially all of its "leak-down" movement inwardly on the lift stroke. This results in re-enlarging the pressure chamber and oil flowing thereinto past the then open check valve 27 from the reservoir chamber 24. Although a major portion of the leak-down oil escaping around the plunger during the lift stroke re-enters the reservoir chamber through the oil inlet opening or ports 29, in order to insure that the reservoir chamber is maintained full at all times one or more inlet openings or ports 30 are provided in the side wall of the cylinder member to communicate with the plunger ports 29, and these ports 30 in turn are continuously supplied with oil under pressure from the engine lubricating system via an external groove 31 on the cylinder member registering with a recess 32 in the tappet guide bore. This recess 32 connects with an engine oil gallery 33 via a passage 34 in the engine crankcase.

The upper end of the plunger is counterbored to slidably receive the push rod seat member 28 which is flanged at its upper end to rest on the open end of the plunger. The internal shoulder 35 formed by this counterbore surface acts as a retainer for a plate-like flow control valve 36 which serves to meter oil flow from the reservoir 24 through a central outlet aperture 37 in the push rod seat member. As best shown in FIGURE 3, the lower end surface 38 of the push rod seat member 28 is made substantially flat, and the flow control valve 36 has its central portion formed with a part-cylindrical curvature 39. The radius of this curvature is indicated in FIGURE 2 by the arrow 40 extending from the axis 41 of such curvature. Adjacent its outer periphery the flow control valve 36 is formed with a generally flat portion 42 which overlies the shoulder 35 in the plunger. Between this peripheral flat portion and the axis of curvature of the surface 39 is an opening 43 which extends through the flow control valve.

By reason of the part-cylindrical curvature of the valve surface 39, when the valve 36 moves away from the shoulder 35 and into abutment with the generally flat seat formed by the lower end surface 38 of the push rod seat member the flow of oil through the aperture 37 and into the push rod is not completely blocked but is partially restricted relative to such flow when the valve 36 is out of abutment with the push rod seat member. When out of such abutment there is ample freedom for oil to flow between the peripheral edge of the valve 36 and the counterbore in the plunger.

During operation, oil pressure within the reservoir, e.g. of the order of 30 lbs. per square inch, tends to urge the valve 36 into abutment with the push rod seat member. However, due to reciprocatory movement of the plunger, inertia forces acting on the valve cause it to move bodily within the clearance provided between the lower end face 38 of the push rod seat member and the shoulder 35 on the plunger. By reason of the opening 43 being located in off-set relation to the part-cylindrical curvature an unbalance of such pressure and inertia forces results, such that the valve 36 tends to rock or tilt on the flat surface 38 of the push rod seat member, aiding its ability to maintain itself free of rust and other foreign particles, sludge, etc. which may be carried into the tappet with the oil. Without this rocking or tilting movement, the valve 36 has the benefit of considerable self-cleaning action merely by reason of its axial movement between the push rod seat and the shoulder 35. While such axial movement generally proves adequate for the purpose under normal conditions of engine operation in vehicles, prolonged operation at certain constant speeds tends to result in buildup of such foreign particles between the valve and the push rod seat member, blocking the aperture 37 in the latter. Under such conditions, the additional tilting or rocking action undergone by the valve 36 of our invention serves to prevent any such plugging or stoppage of the passage 37. By reason of the opening 43 being located to one side of the part-cylindrical curved surface 39, it remains effective to produce the unbalance of pressure and inertia forces irrespective of whatever position it may orient itself rotatably about the axis of the plunger.

It is appreciated that minor changes in the parts and their arrangement may be made without departing from the spirit and scope of the invention as hereinafter claimed.

What is claimed is:

1. In a lubricating system for an engine or the like having a rocker with a bearing surface to be supplied with oil during operation, means for operating said rocker including a cam, a tappet for transmitting cam-induced movement to the rocker, and a support slidably guiding reciprocal movements of the tappet, said tappet having a chamber for reception of oil, said chamber having an oil inlet, an oil outlet connected to said bearing surface, and a valve seat defining the chamber end of said outlet, a valve in said chamber abuttable with said seat, retainer means for said valve accommodating limited movement of the valve relative to the seat, said seat being substantially flat and the seat engageable surface of the valve having a part-cylindrical curvature whereby flow of oil from the chamber to said outlet is only partially restricted when said surface and seat are in abutment with each other, said valve having an opening extending therethrough from said surface, said opening being laterally offset from the axis of said part-cylindrical curvature.

2. The invention of claim 1, wherein said tappet includes a hollow plunger open at one end, a push rod seat member carried by and closing said open end of the plunger, said plunger and push rod seat member defining said chamber, said valve seat being on said push rod seat member, said plunger having an intrenal shoulder facing said seat, said shoulder constituting said valve retaining means, and said opening being located inwardly of the plunger from said shoulder.

3. The invention of claim 3, wherein said valve is relatively thin in relation to the extent of its lateral extremities and has a generally flat peripheral portion overlying said shoulder, said part-cylindrical surface projecting to-

ward said push rod seat member from said flat peripheral portion.

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