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METERING VALVE FOR HYDRAULIC VALVE LIFTER

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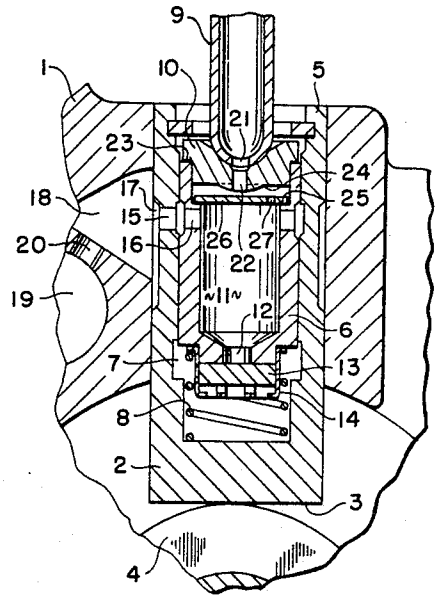

Fig. 1

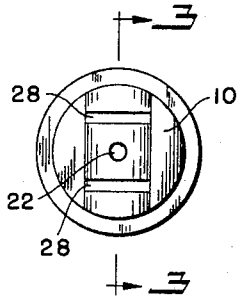

Fig. 2

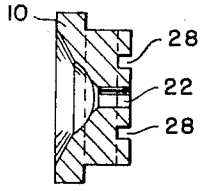

Fig. 3

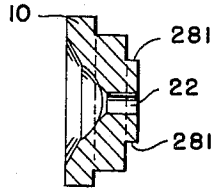

Fig. 5

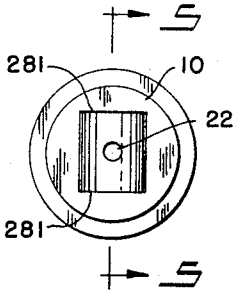

Fig. 4

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METERING VALVE FOR HYDRAULIC VALVE LIFTER

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This invention relates to lubricating systems for internal combustion engines, and more particularly to an improvement in the construction of reciprocally actuated hydraulic valve lifters or tappets, said tappets being associated with hollow push rods which serve as passageways for lubricating oil to the valve-actuating rocker arms.

In recent years, hydraulic valve lifters adapted to supply lubricating oil through hollow push rods to the rocker arms have come into wide use. Typical valve lifters of this type are disclosed in U.S. Patent 2,818,050. These valve lifters are of the automatic "anti-lash" type; that is, they are constructed so as to take up automatically the slack between the push rod and its bearing seat in the valve lifter during reciprocal motion of the camshaft, valve lifter and push rod.

If no control is exercised over the flow of oil through the push rods, there is an oversupply of oil to the rocker arms. In order to avoid this oversupply, a metering valve is ordinarily built into the valve lifter apparatus. This metering valve typically comprises a plate-like element which is capable of moving into and out of abutment with the upper wall of the oil chamber in the valve lifter, said oil chamber having an aperture through which oil is provided to the hollow push rod. One of the two abutting surfaces is curved about a single axis (e.g., cylindrically curved) with respect to the other so that when the two surfaces are in abutment, the outlet aperture is not completely closed but is still capable of receiving a small flow of oil. During reciprocation of the valve lifter and push rod, the plate-like element is urged toward and away from the wall of the oil chamber by oil pressure and inertia, respectively, thereby maintaining a substantially constant flow of oil through the outlet aperture to the push rod and thence to the rocker arm.

In engines with valve lifters of the type described above, it is frequently found that sizeable deposits of sludge and the like are formed on the metering valve surfaces after several hours of engine operation. As a result. the aperture for passage of oil to the push rods is blocked and there is failure of lubrication of the rocker arms. Such failure is, of course, intolerable in the operation of automobile and similar engines.

A principal object of the present invention, therefore, is to provide an improved hydraulic valve lifter apparatus adapted for the supply of oil to the valve rocker arms through hollow push rods.

A further object is to provide a valve lifter apparatus having low susceptibility to fouling of the metering valve controlling oil flow to the push rods and rocker arms.

Other objects will in part be obvious and will in part appear hereinafter.

It has now been discovered that fouling of the metering valve can be substantially decreased or eliminated by providing two transverse shoulders intersecting the curved surface of the valve, said shoulders forming boundaries of at least a portion of said surface. These shoulders are preferably defined by at least one transverse groove intersecting said curved surface; desirably, there are two such grooves on opposites sides of the center of the valve at equal distances therefrom and perpendicular to the axis of curvature of said surface.

The invention will be more fully understood with reference to the attached drawings, in which:

FIGURE 1 represents a cross-sectional view of a typical hydraulic valve lifter of the present invention.

FIGURE 2 is a bottom view of a preferred embodiment of the push rod seat in the apparatus of FIGURE 1.

FIGURE 3 is a cross-sectional view of the push rod seat of FIGURE 2, seen at a right angle to the view of FIGURE 1 and along the line 3—3 of FIGURE 2.

FIGURES 4 and 5 are views corresponding to those of FIGURES 2 and 3 of an alternative embodiment of the invention.

Referring in detail to FIGURES 1–3, **1** represents an engine block in which is mounted a hydraulic valve lifter or tappet **2**, the lower end **3** of which is in contact with cam **4**. The tappet itself comprises a hollow cylinder **5** in which is nested a cup-shaped plunger **6**. Plunger **6** fits closely in cylinder **5** and the two define, with their closed ends, an oil pressure or cushion chamber **7**. Plunger **6** is urged outward by spring **8**, exerting upward pressure on hollow push rod **9** via push rod seat **10**.

The interior of plunger **6** forms an oil reservoir chamber **11** which communicates with cushion chamber **7** via port **12**. This port is normally held closed by a check valve **13**, which is held in place by a partially resilient cage **14**. While check valve **13** is shown as a cylindrical element, those skilled in the art will appreciate that its shape is not critical and that the valve may, for example, be spherical or any other suitable shape.

Oil is supplied to the tappet through ports **15** and **16** via groove **17** in the side of the tappet; said groove **17** communicates with a recess **18** in the engine block which receives oil from an oil gallery **19** through passage **20**. The method by which oil enters and leaves cushion chamber **7** during reciprocation of the tappet is well known and will not be discussed in detail here.

The end of hollow push rod **9**, containing an opening **21** for admission of oil, is seated in push rod seat **10**, which has an outlet aperture **22** for oil. Seat **10** in turn rests on the upper end **23** of plunger **6**. Within the space defined by the lower surface **24** of the push rod seat and shoulder **25**, a generally plate-like element **26** is free to move into and out of abutment with surface **24**. This plate-like element may contain an opening **27** therethrough, said located opening being radially spaced beyond the outlet aperture; its function is probably to unbalance the plate-like element so as to minimize the possibility of blockage of aperture **22**.

One of the abuttable surfaces of push rod seat **10** and plate-like element **26** is at least partially curved about a single axis with respect to the other; in FIGURE 1 the push rod seat is curved, but it is also possible for the push rod seat to be flat and the plate-like element curved. Thus, although plate-like element **26** is normally urged by oil pressure into contact with surface **24**, the passage of oil through aperture **22** and push rod opening **21** is never completely blocked. The mass of the plate-like element and the diameter of aperture **22** may be chosen so that the valve will open or (partially) close at a predetermined engine speed.

According to the present invention, fouling of the metering valve is eliminated or at least substantially decreased by cutting at least one groove **28** through the curved valve surface. In the embodiment shown in the drawing, the curved surface contains two grooves spaced equidistant from aperture **22**, on opposite sides thereof and perpendicular to the curved surface. The opening **27** in the plate-like element is preferably at a distance from the center of said element equal to the distance of the grooves from the center of push rod seat **10**. Thus, the opening and grooves are in corresponding relation. The depth and width of grooves **28** are subject to wide variation, but they may, for example, be about $\frac{1}{32}$ inch wide and their depth may be such that the level of the

groove corresponds with the level of the flat surface on either side of the curved portion. The distance of said grooves from the center of outlet aperture **22** may, for example, be about ⅛ inch.

In the alternative embodiment of the invention shown in FIGURES 4 and 5, the curved surface of push rod seat **10** is bounded by two shoulders **281** on opposite sides of outlet aperture **22**. The remainder of the surface is substantially flat.

By the use of the grooved metering valves of this invention, fouling of the valves and consequent failure of rocker arm lubrication is substantially decreased. This is shown by the following results obtained in engine tests runs according to Ford Motor Company specification M2C96 for evaluation of motor oils. Using a standard reference motor oil and ordinary valve lifters, lubrication to the rocker arm area failed after 4¾ hours. The test was stopped and the metering valves freed; upon resumption of operation, fouling occurred again after 7¼ hours. New valve lifters were installed and the test was resumed, but fouling again occurred after four hours. After a second valve lifter replacement, the engine operated for 24 hours before failure of lubrication to the rocker arm area. At this time, the valve lifters of the present invention were installed and operation continued for the remaining 152 hours of the test without fouling of the metering valves or failure of rocker arm lubrication.

What is claimed is:

1. In a valve apparatus for metering oil from an oil chamber through an outlet aperture, said valve apparatus comprising a seat at the chamber end of said outlet aperture and a generally plate-like element movable into and out of abutment with said seat, the abutting surface of one of said seat and plate-like element being at least partially curved about a single axis and the other surface being substantially flat whereby said outlet aperture is only partially closed when said seat and plate-like element are in abutment; the improvement which comprises at least one transverse groove intersecting said curved surface.

2. Apparatus according to claim **1** wherein said groove is spaced from one side of said outlet aperture.

3. Apparatus according to claim **2** wherein a second transverse groove intersecting said curved surface is spaced from the opposite side of said outlet aperture.

4. Apparatus according to claim **1** wherein the seat is curved and the plate-like element substantially flat.

5. Apparatus according to claim **1** wherein said plate-like element has an opening therethrough, said opening being radially beyond said outlet aperture.

6. In a hydraulic valve lifter apparatus containing an oil chamber; an oil inlet aperture; an outlet aperture for the passage of oil to a hollow push rod; and valve means for controlling the flow of oil through said outlet aperture, said valve means comprising a seat at the chamber end of said outlet aperture and a generally plate-like element freely movable into and out of abutment with said seat, the abutting surface of said seat being at least partially cylindrically curved about a single axis and said plate-like element being substantially flat; the improvement which comprises two transverse grooves in said curved surface, said grooves being perpendicular to the axis of curvature of said surface and equidistant from the center of said outlet aperture.

7. Apparatus according to claim **6** wherein said plate-like element has an opening therethrough, said opening being at a distance from the center thereof equal to the distance of said grooves from the center of said outlet aperture.

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