Nov. 19, 1963 P. F. BERGMANN 3,111,119

ROCKER ARM OILING SYSTEM

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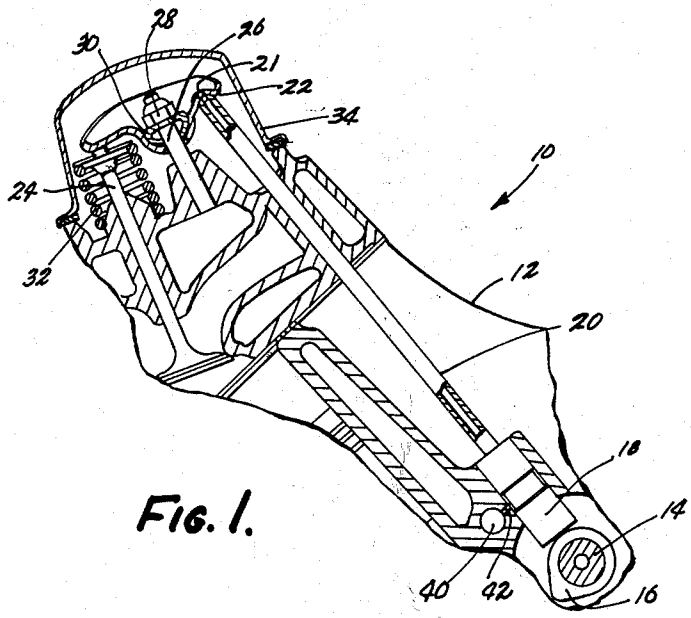


FIG. 1.

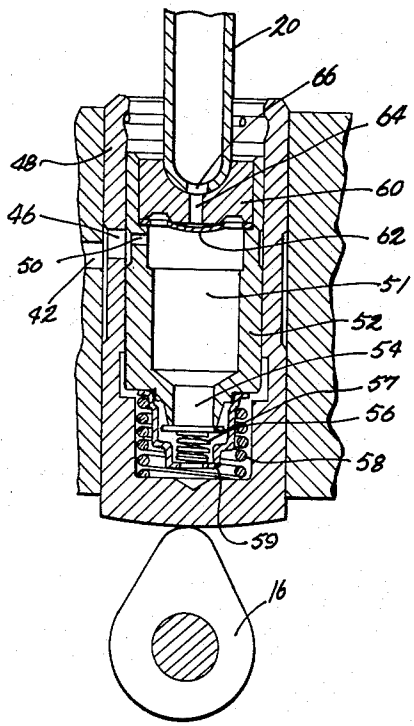


FIG. 2.

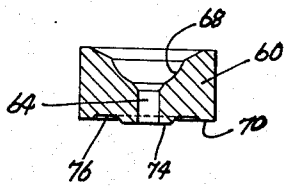


FIG. 3.

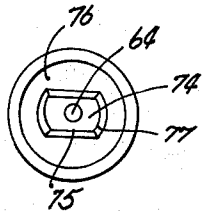


FIG. 4.

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ROCKER ARM OILING SYSTEM

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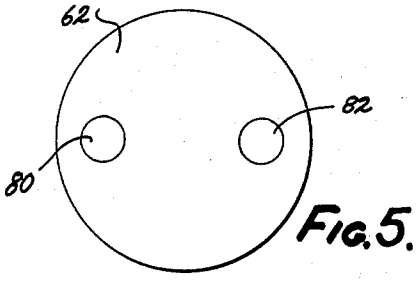


FIG. 5.



FIG. 6.

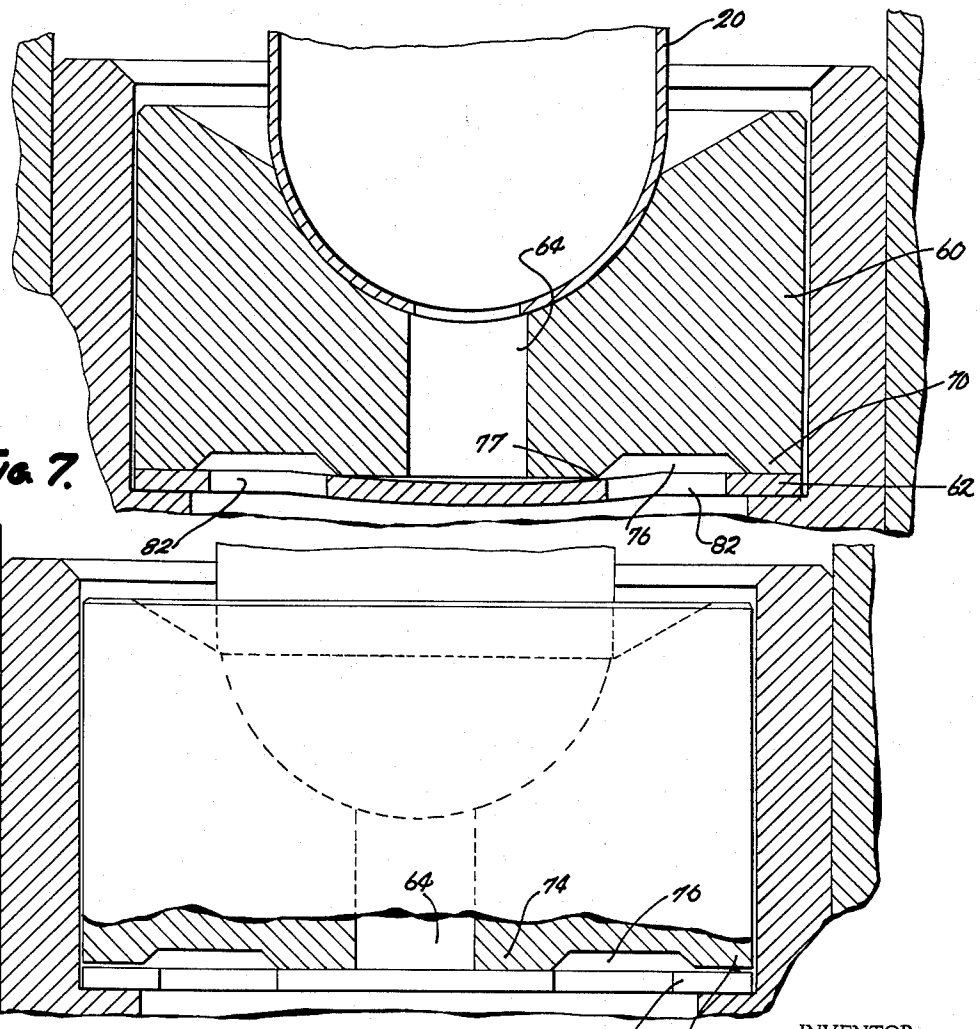


FIG. 7.

FIG. 8.

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ROCKER ARM OILING SYSTEM

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This invention relates to internal combustion engines, and more particularly to oil flow control means for lubricant to the rocker arm assembly from the tappet through the push rod of a valve train assembly of an internal combustion engine.

Rocker arm assemblies of internal combustion engines are, in some cases, lubricated by oil from the pressurized engine lubricant system by conducting the oil through the hollow push rod from the tappet. Flow control of the oil is required, or otherwise the oil flow would be excessive and cause flow into the cylinders. Some prior devices achieve limited regulation by including an element responsive to the oil pressure itself to shift and throttle flow. These are generally quite complex and expensive to manufacture as well as being subject to inertial forces in a sliding action.

In contrast to these, one widely accepted oil metering apparatus in the auto industry is the metering plate structure cooperative with the bottom surface of the push rod seat element as in my Patent Reissue 25,154. The present invention likewise employs a metering plate of simple construction, but regulates flow in response to a completely different principle of operation. As far as is known, no flow regulator to the rocker arm assembly has heretofore been responsive to the intermittent force of the valve train, or more specifically, to the force or pressure through the push rod on the tappet push rod seat, to regulate lubricant flow, especially not in the manner of this invention.

It is therefore a primary object of this invention to provide a unique oil flow regulator in a valve train assembly that regulates flow in response to the push rod load during engine operation. The assembly includes a resilient plate or disc which is simple in construction and actuated intermittently to close and open a flow passageway with each valve train reciprocation. It cooperates with a special surface on the tappet push rod seat member. The plate is not responsive to or dependent upon oil pressure. It does not slide up or down in the tappet to create sticking problems. It is not dependent upon or responsive to inertial forces. The plate is ordinarily a plain, flat, orificed circular disc which can be stamped out by the thousands at a minor expense. It is actuated positively and forcefully with each valve train shift to provide a completely dependable action. There are no sliding surfaces, biasing springs or other such moving parts subject to wear. It positively shuts off the flow of oil intermittently using inherent resilience in the disc or plate itself as the closing force. The valve cannot stick in this closed position since it is forcefully opened by the large load on the push rod when the engine valve is opened.

These and many other objects and advantages of this invention will be apparent upon studying the following specification in conjunction with the drawings in which:

FIG. 1 is a fragmentary perspective cut-away view of an engine valve train assembly utilizing the invention;

FIG. 2 is an enlarged fragmentary sectional view of the tappet in FIG. 1 showing the inventive structure;

FIG. 3 is a sectional elevational view of the push rod seat member forming part of this invention;

FIG. 4 is a bottom view of the push rod seat member in FIG. 3;

FIG. 5 is a plan view of the plate or disc in this invention;

FIG. 6 is an elevational view of the disc;

FIG. 7 is a further enlarged sectional elevational view of the plate and push rod seat element during maximum push rod load and valve opening; and

FIG. 8 is an enlarged perspective sectional view of the apparatus in FIG. 2 shown under minimum push rod load, with the valve being shifted closed by its inherent resilience.

Basically, the inventive flow control means is in each valve train assembly of an internal combustion engine, including a cam shaft with a cam, a tappet, a hollow push rod, a rocker arm, and lubricant flow passageway means from the tappet through the push rod to the rocker arm assembly with the flow control means comprising a main passageway in the push rod seat member, having on the inner axial end thereof a surface area, generally oblong in configuration, surrounding the passageway and projecting axially thereof, with an axially recessed area around at least portions of the surface area and preferably surround it, a resilient orificed plate or disc in contact with the surface area around the passageway and normally stopping flow from the recessed area to the passageway since the orifices are not coincident with the passageway. The recessed area has portions extending radially towards the passageway to a spacing smaller than a larger spacing from the passageway to certain edge portions of the surface area. These edge portions are adapted to deform or bow the central part of said plate when engine valve opening pressure is applied to the train, to temporarily shift center portions of the plate away from portions of the surface area to allow temporary flow of lubricant from the recessed area through the passageway.

More specifically, referring to the drawings, the assembly **10** includes an internal combustion engine **12** having a cam shaft **14** driving a series of cams **16**, one for each valve train, a tappet **18** with its lower surface in contact with the cam, and its upper surface in contact with push rod **20**, which has its upper surface in contact with rocker arm **22** to actuate engine valve **24**. The rocker arm **22** is affixed to the cylinder head by a suitable stud or post **26** and nut **28** in conventional fashion, and rocks on bearing surface **30** affixed beneath nut **28**, to open valve **24** against its valve spring **32**. When the valve **24** is depressed to open, a large pressure load is placed on the valve train by compression spring **32**. When the valve is allowed to close, only the slight pressure of the plunger return spring **58**, and the oil pressure inside of tappet **18** remains on the valve train. The entire assembly is enclosed and sealed by a conventional cover **34**.

The pressurized oil system of the engine is provided with a common passageway **40** in the engine for several tappets or valve lifters, with each having an outlet orifice **42** of any desired size and shape into communication with the annular external groove around each tappet **18**. Adjacent this groove is an orifice **46** in the tappet body **48** (FIG. 2) into a second annular groove in the exterior of plunger **52**, and communicating with adjacent orifice **50** into the interior reservoir chamber **51** in the plunger. The hollow plunger member has an open upper end and a generally closed lower end except for a coaxial passageway **54** governed by a check valve assembly with spring **56** and plate **57**. Another coil spring **58** urges the cap **59** and therefore plunger member **52** toward the open end of the hollow tappet body **48** in conventional fashion.

Closing the open upper end of hollow plunger **52** is a push rod seat member **60** which has in its upper surface a concave push rod seat **68** (FIG. 3) to receive the convex lower end of hollow push rod **20**.

The lower end of the push rod seat member, i.e. the lower inner surface thereof, is especially formed in this invention to cooperate with the novel regulating plate or disc 62. Extending axially centrally through member 60 is a flow passageway 64 which coincides with a port 66 in the lower end of push rod 20. The lower surface configuration includes a peripheral edge shoulder 70 in the form of an annular projecting flat which retains the peripheral edge of plate 62 tightly against a corresponding peripheral shoulder machined in the inner wall surface of hollow plunger 52. Surrounding the lower end of passageway 64 is an axially projecting surface area 74 which is oblong in configuration as illustrated in FIG. 4. The surface is formed by machining a circular or annular surface around passageway 64 by removing metal in recessed area 76, and then milling off the side edges on a chord on each side so that the elongated ends have arcuate edges 77 and the sides have flat edges 75 closer to passageway 64. The recess portion 76 surrounds this surface 74 inside annular shoulder 70, and has portions closer to passageway 64, i.e. adjacent edges 75, than the end edges 77 of the oblong flat. The recess need not always completely surround surface 74, and may conceivably take a variety of configurations other than the preferred one shown. Surface 74 projects axially a few thousandths of an inch beyond the annular shoulder 70 for a definite purpose to be described hereinafter.

Referring to FIG. 5, disc 62 is there shown including the two spaced orifices or holes 80 and 82 between the center and opposite sides thereof, i.e. not coincidental with the central passageway 64 of the push rod seat member. This number of orifices is arbitrary. In the preferred form of the invention, this plate is completely flat as shown in FIG. 6. Thus, the plate may be a mere steel stamping, and has resilience to return to a flat when deformed slightly for reasons to be explained hereinafter.

Operation

During engine operation, pressurized oil flows through passageway 40 in the engine block, through outlet 42, orifice 46 and orifice 50 into the central reservoir chamber 51 of the tappet. The oil creates a pressurized liquid valve lifting force in a conventional manner when cam 16 rotates. Simultaneously, the pressurized oil in the central chamber 51 intermittently flows past disc 62 out passageway 64 through opening 66 and up hollow push rod 20 to the rocker arm assembly through outlet 21 to the bearing surfaces 30. This occurs as follows. When the engine valve 24 is closed by spring 32, there is only a slight pressure of a few pounds at most on the valve train assembly so that push rod 20 presses against push rod seat member 60 with only a slight pressure. During this condition, the plate assumes its normal flat condition and position illustrated in FIG. 8. A slight clearance then exists between the annular shoulder 70 and the peripheral edge of disc 62. The central surface area 74 which projects axially further into the tappet housing than shoulder 70 contacts the central portion of the disc over the entire area of surface 74 so that the disc completely closes passageway 64 to any oil flow. As soon as the lobe of cam 16 rotates to contact the lower surface of the tappet 18, and raises the tappet and push rod 20 to tilt rocker arm 22 and depress valve 24 against the force of the stiff valve spring 32, a considerable load of many p.s.i. is applied to the valve train, including between the push rod and the push rod seat. This load causes the arcuate edges 77 of surface 74 to depress the entire central portion of the disc in a dishing action while shoulder 70 lowers to meet the peripheral edge of the disc and clamp it against the plunger shoulder as illustrated in FIGS. 2 and 7. The depression of the central area of the disc is generally circular in nature, i.e. forming a three-dimensional concavity or dishing effect. Since surface 74 is oblong, only the arcuate end edges 77 remain in contact with the disc, while other portions of

the disc shift away from the side edges 75. Therefore, oil which passes through orifices 80 and 82 of plate 62 and into annular recess 76 can then flow between the disc and the side edges 75 of surface 74 into passageway 64 as long as the push rod load is applied. As soon as the push rod load is released by further rotation of cam 16 and closing of valve 24, the inherent resilience of the metallic disc or plate causes it to flatten out and shift the central projecting portion of the push rod seat member 60 upwardly again to force the shoulder 70 out of contact with the peripheral edge of the disc, and to seal off the area around passageway 64 and stop the oil flow. This is repeated with each reciprocation of the overhead valve train assembly to cause a constant intermittent flow and stoppage of flow, thereby regulating the flow to the rocker arm assembly in response to the push rod load action. During greater engine speeds therefore, when bearing surface 30 needs more oil, it is automatically supplied. The rocker gets a squirt each time the valve train reciprocates.

The operation has been found to be completely dependable. There are no rubbing surfaces. There are, in effect, no internal moving parts except for the constant dishing action of the disc which moves a couple of thousandths of an inch each time.

It is realized that although this is the preferred form of the invention, the specific physical configuration of the lower end surface of the push rod seat member 60 may be modified somewhat as long as the recess portions approach passageway 64 at some areas closer than the outer edge portion of the axially projecting surface 74 to create this momentary clearance. Also, it is conceivable that in a less preferred form of the invention, the valve disc may be dished slightly upwardly during the closed portion of the cycle and deformed downwardly to a flat or oppositely dished condition to create a temporary passageway through which the lubricant may flow. Also, in the broadest aspects of this invention, a slight flow may be made to occur even when the disc "closes down" the flow with the push rod load removed. Preferably, however, the closing down of the flow completely stops it. These and other obvious modifications which are readily apparent once the principles and basic structural features are understood, are deemed to be part of this invention, which is to be limited only by the scope of the appended claims and the reasonably equivalent structures to those defined therein.

I claim:

1. A hydraulic tappet including a plunger having an open end; a push rod seat member closing said open end, and having an outer surface with a push rod seat, an inner surface, and a passageway therebetween; a surface area on said inner surface circumscribing said passageway and projecting axially inwardly of said plunger with respect to the remainder of said inner surface; a resilient disc adjacent said surface, including orifice means non-coincident with said passageway; circumferential contact between said surface and disc normally closing down flow from said orifice means to said passageway; edges of said projecting surface area adapted to constantly engage said disc and centrally deform the same between a generally flat condition and a dished condition to force portions of said disc away from portions of said surface area; and a recessed area around at least part of said surface area extending radially toward said passageway further than the outermost edges of said surface area, thereby being out of contact with said disc and creating a temporary flow passage between said surface area and said disc when the latter is deformed by edges of said protruding surface area.

2. A hydraulic tappet including a plunger having an open end, and a push rod seat member in said open end having a push rod seat in its outer surface; a resilient flow control disc held between said plunger and the peripheral edge of the inner surface of said member; said inner

surface including a central portion protruding beyond said edge to deform said disc in a reversible dishing action when pressure is applied to said push rod seat; a passageway extending from said central portion to said push rod seat; said surface when not deforming said disc, serving to circumferentially contact said disc to close down flow through said passageway; and said inner surface including axially-recessed portions, extending radially toward the center of said surface inside the radial location of some edges of said protruding portions to be out of contact with said disc and form a temporary passageway when said disc is deformed.

3. A hydraulic tappet including a plunger having an open end; a push rod seat member in said open end, including a push rod seat in its outer surface, and an inner surface; a resilient flow control disc between said plunger and the peripheral edge of the inner surface of said member; the central portion of the inner surface of said member comprising an oblong axial projection, the ends of which cause said disc to deform temporarily between a generally flat configuration and a dish-type configuration upon the occurrence of valve opening push rod pressure on said seat; a passageway extending from said projection through said member to said seat, and being closed by said disc in the absence of valve opening push rod pressure; said inner surface including recessed portions along the sides of said oblong projection to temporarily form passageway means contiguous with said member passageway, when said plate is deformed to create a temporary clearance between the sides of said projection and said disc.

4. A hydraulic tappet comprising: a hollow plunger having an open end; a push rod seat member in said open end, and having a passageway extending axially therethrough; a resilient flow control disc held between the inner end of said seat member and the interior of said hollow plunger and normally closing off flow through said passageway; said inner end of said seat member having central portions extending axially beyond adjacent portions to contact the central area of said disc to bow it inwardly of said plunger when valve opening pressure is applied to said member; and areas of said central portion being recessed to define temporary flow passage to said passageway while said disc is bowed.

5. In an overhead valve train assembly for opening a valve, including a cam, tappet, push rod, and rocker arm assembly, lubricant flow passageway means from said tappet through said push rod to said rocker arm assembly, and a flow control means comprising, a main

passageway having on one axial end thereof a flat, oblong, surrounding surface; a generally flat resilient plate in contact with said surface and normally preventing flow; a recessed area circumscribing said flat oblong surface; and the ends of said surface adapted to bow said plate into a dished configuration when valve opening pressure is applied to said train, to thereby create a temporary flow passageway from said recessed area adjacent the sides of said surface to said main passageway.

6. In an overhead valve train assembly for opening a valve, including a cam, tappet, push rod, and rocker arm assembly, lubricant flow passageway means from said tappet through said push rod to said rocker arm assembly, and a flow control means comprising, a main passageway; a surface area surrounding one end of said passageway, in a plane normal thereto, and projecting axially thereof; an axially recessed area around at least portions of said surface area; a resilient plate in contact with said surface area around said passageway and normally preventing flow from said recessed area to said passageway; said recessed area having portions extending toward said passageway into said surface area to a spacing from said passageway smaller than the largest spacing from said passageway of edge portions of said surface area; and said edge portions contacting and adapted to deform said plate when valve opening pressure is applied, to temporarily shift central portions of said plate away from portions of said surface area adjacent said recessed area portions to allow temporary flow from said recessed area portions to said passageway.

7. In a tappet an oil flow regulator comprising: a resilient plate adapted to be retained by its periphery in the tappet; an element adjacent said plate responsive to valve train pressure to forcefully shift toward said plate a limited amount; said element having an oblong central portion projecting axially into full contact with said plate; a flow passageway in said element normally closed down by said full contact; said oblong portion having substantial lateral breadth to deform the central part of said plate into a dish-type concavity when shifted toward said plate to temporarily open said passageway to its maximum flow condition; and said plate having sufficient resilience upon removal of said pressure to return to its full contact position.

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