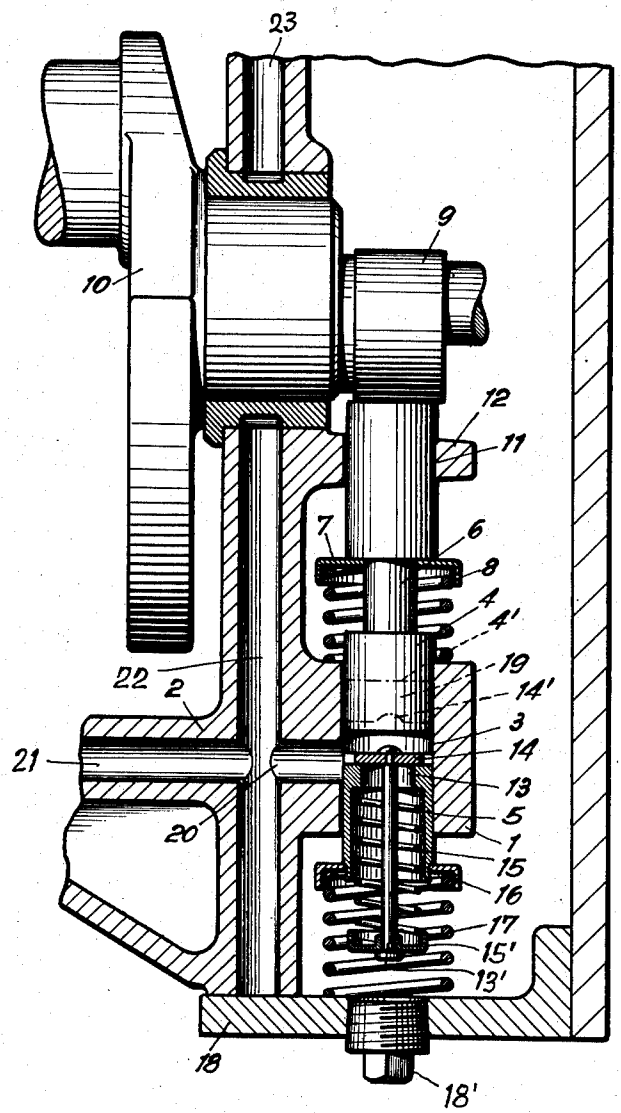
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PISTON PUMP FOR DELIVERING LUBRICATING OIL IN INTERNAL-COMBUSTION ENGINES

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PISTON PUMP FOR DELIVERING LUBRICATING OIL IN INTERNAL-COMBUSTION ENGINES

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This invention relates to improvements in oil pumps for internal combustion engines and more particularly to a piston type pump for delivering the lubricating oil to the parts to be lubricated in an internal combustion engine.

In known constructions of internal combustion engines provided with an oil pump of a piston type, it has been necessary to provide spaced suction and pressure valves to control the oil admission and discharge, and, in some constructions, also provide such valves in the piston. In such constructions the machining and boring for valves and valve seats involve considerable trouble and expense and this is more particularly true when the pump cylinders are bored in the casing or crankcase of the internal combustion engine. In addition to the foregoing, the usual oil supply systems for internal combustion engines are provided with a pressure relief valve which is set so that a predetermined pressure is not exceeded by the oil pump.

The primary object of the present invention is to provide an improved piston pump construction, which is relatively simple to make and which includes relatively few parts.

A further object of the invention is to provide a piston pump construction, in which it is unnecessary to machine and bore the cylinder of the pump to provide for valves and valve seats.

A further object of the invention is to provide a piston type lubricating oil pump for internal combustion engines, which limits the pump pressure automatically and in which a maximum predetermined pressure cannot be exceeded, thereby avoiding the necessity of providing a pressure relief valve in the lubricating oil system of the engine.

In accordance with the present invention, it has been discovered that a piston pump, more particularly for the delivery of lubricating oil in an internal combustion engine, may be constructed in such a way as to provide an effective pump which will pump a fluid at pressures up to a maximum, without exceeding the maximum pressure, and which includes relatively few simple parts.

In a preferred construction, the improved piston pump, according to the invention, comprises two opposing pistons mounted in facing relationship in a cylindrical pump chamber which may be made by boring a part of the crankcase of the engine. Means is provided for actuating one of these pistons by the engine, whereas the other piston is provided as a valve piston having a suction valve adapted to open and permit the

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flow of oil into the cylinder when the pump piston is actuated away from the valve piston in the chamber. In this construction, the oil outlet from the pump is arranged in the chamber wall intermediate its ends so that oil drawn into the chamber on the suction stroke of the pumping piston is forced under pressure through the outlet on the compression stroke and delivered to the parts of the engine to be lubricated.

In a preferred construction, the valve piston preferably comprises a hollow cylindrical sleeve, the outer surface of which fits the cylindrical pump chamber and the head of which is provided with a suction valve normally closed by a spring arranged in the hollow piston. The valve piston is biased toward the pump piston by means of a spring selected to provide the maximum desired pressure in the lubricating system and is arranged to have a definite length of stroke in the forward direction so that its piston head portion is adapted to cover the oil outlet from the pump chamber during the suction stroke of the pump piston.

The pump chamber is preferably an open-ended cylinder of uniform inside diameter.

The improved piston pump of the present invention and the improved lubricating oil system for internal combustion engines provided thereby includes other features, objects, and advantages described more in detail hereinafter in connection with the accompanying drawing illustrating one embodiment of the invention.

In the drawing the single figure is a broken longitudinal sectional view through a portion of an engine showing a piston pump constructed and arranged according to the invention.

Referring to the drawing, in which the pump is arranged vertically in the crankcase of an internal combustion engine below the crankshaft thereof, a projection 1 comprising an integral part of the wall of the casing 2 of the engine is provided with a cylindrical bore 3 forming the pump cylinder and chamber. The bore 3 is preferably made of uniform diameter throughout its length to simplify construction and accommodates a pump piston 4 and a valve piston 5 slidable therein. The pump piston 4 comprises a part in addition to that which reciprocates in cylinder 3 including an intermediate portion 6 of reduced diameter, the upper shoulder formed thereby being engaged by a flanged plate 7 held against the shoulder by a spring 8 surrounding the piston 4 and resting on the upper surface of the projection 1. The spring 8 is mounted under compression and biases the piston 4 upwardly

against a cam 9, provided, for example, on a crankshaft 10 of the internal combustion engine. The upper part of the pump piston 4 extends through a bore 11 in a projection 12 integral with the casing 2 of the engine. The bore 11 in the projection 12 serves to guide the pump piston 4 and maintain it in proper alignment when acted upon by the cam 9. The bore 11 is preferably of the same diameter as the cylindrical bore 3 and may be made at the same time and with the same tools as those used for making and machining the bore 3.

The valve piston 5, the head of which is located in the lower portion of the pump cylinder 3 is provided with a longitudinal stepped bore 13, the smaller upper end of which is in the piston head and closed by means of a valve disc 14 resting on the head of the valve piston 5. The valve disc 14 is normally maintained on its seat by a compression spring 15 mounted in the larger portion of the bore 13 and seated in a flanged plate 15' supported by a pin 13' connected to the valve disc 14. The spring 15 is under compression and need be only of sufficient strength to seat the valve disc 14 while at the same time permitting the valve disc to be unseated when suction is supplied thereabove.

The lower end of the valve piston 5 is provided with an annular flanged plate 16, the inner rim of which advantageously rests in a shouldered recess adjacent the lower end of the valve piston 5. The flange of the plate 16 extends downwardly for retaining a spring 17 mounted under compression between the plate 16 and a cover 18 for the crankcasing 2. The cover 18 serves to close the bottom of the casing 2 below the pump and is provided with an oil drainage plug 18'. The plate 16 is set on the valve piston 5 at the proper distance from the top of the piston so that the upper surface of the plate 16 engages the lower surface of the block or projection 1 when the upper portion of the piston 5 extends above and covers the oil outlet 20 for the pump chamber. In this position of the valve piston, its upper end is located at the position of the dot-and-dash line 14'.

In the operation of the pump, it may be assumed that the engine oil in the crankcase extends to a level somewhat above the projection 1, possibly up to the projection 12, so that oil surrounds the pump and is available inside the valve piston 5 as soon as the crankshaft 10 commences to rotate. The drawing illustrates the position of the piston 4 in its lower dead center position with oil being forced through the outlet 20. As the oil flows out of the pump chamber the piston 5 moves up under the action of the spring 17 until, under normal conditions, it engages the lower end of the piston 4.

During the upward stroke of the pump piston 4, under the action of the spring 8, the valve piston 5 follows along until the plate 16 engages the lower surface of the block 1, corresponding to the position of the dot-and-dash line 14', and the pump piston 4 continues on to a higher point or until its lower end reaches the position of the dot-and-dash line 4'. As the piston 4 leaves the piston 5 it applies suction in the cylinder 3, lifts the valve disc 14 and causes the flow of oil into the pump cylinder 3 between the pistons. When the piston 4 is at its top dead center position, a space or volume 19 is provided in cylinder 3 which is under a reduced pressure and filled with oil drawn in from that surrounding the pump. This oil flows in through

the bore 13, around the disc 14 and into the space 19, it being noted that during this operation, the valve piston 5 effectively covers and seals off the outlet 20, so that the oil pressure is maintained in the oil lines of the engine during the suction stroke of the pump.

During the downward movement of the pump piston 4, under the action of the cam 9, the pressure on the oil between the pistons in space 19 is increased because of the sealing of the disc 14 and power of the spring 17. The piston 5 is therefore forced downwardly until the outlet 20 is uncovered, permitting the oil from cylinder 3 to flow thereinto. The drawing shows the position of the parts of the pump at this stage of the operation.

The oil delivered by the pump through the outlet 20 is distributed through ducts 21, 22, and 23 to the various bearings and other parts of the internal combustion engine to be lubricated, and lubricating oil is delivered to these lines under the pump pressure as long as the engine is running. When the engine is stopped, the pump maintains a perfect seal against the reverse flow of oil through the line 20, regardless of the position of the piston 4. Therefore, the built-up oil pressure will cause flow of oil through the bearings and parts of the engine to be lubricated after the engine stops running.

If some trouble should develop in the engine which would result in a pressure increase in the oil lines 20 to 23, for instance the stoppage of one of these lines, the pump would not increase the pressure above the normal maximum pressure for which the pump is made and controlled by the power of the spring 17. Furthermore, the pump will deliver only the amount of oil used by the operative parts of the lubricating system under such conditions and, if no oil is permitted to flow through the outlet 20, the pump will automatically cease delivering oil when the maximum pressure is reached even though the pistons continue to reciprocate. Therefore, the pump and lubricating system of the present invention requires no pressure relief valve.

In the circumstance referred to above where the pressure in the outlet 20 is at the maximum set pressure, the downward movement of the pump piston 4 will not cause the flow of oil into the outlet 20 but the volume of oil between the pistons 4 and 5 will remain approximately the same and the piston 5 will merely be forced down to a greater extent, than under normal operation, to accommodate the volume of oil held between the pistons at the maximum pressure in the system. While the pump is operating under such conditions, there will be no reduction of pressure between the pistons during the up stroke and the valve 14 will not be opened to draw in additional oil from the space surrounding the pump. The pump, therefore, continues to work under no-load conditions, and only when the pressure in the pipe 20 falls below the maximum set pressure of the spring 17 will the pump begin to deliver oil. A pump constructed and arranged according to the invention, therefore, has the advantage that no pressure is developed in the oil system above the predetermined set maximum, which could damage the pump or the piping system of the engine.

The improved piston pump of the present invention is particularly useful in the lubricating systems of internal combustion engines wherein the pump piston is actuated by the engine, but it may have a corresponding advantage in other

systems where it is desired to pump a fluid and operate the system at a predetermined maximum pressure or at some lower pressure. While the pump described and illustrated in connection with the present invention is operated by a cam to force the piston in one direction, it is apparent that a cam may be used which would effect positive actuation of the pump piston in both directions, or that other driving means coupled to the engine could be employed for reciprocating the pump piston in either or both directions.

What is claimed as new is:

1. A piston pump for the delivery of lubricating oil to the parts of an internal combustion engine to be lubricated, comprising a pump cylinder, a pump piston in said cylinder, means operatively associated with the engine for operating said piston, said cylinder being provided with an oil outlet opening through the side wall of the cylinder intermediate its ends, a second piston in said cylinder having the same diameter as and facing said pump piston, said pistons being operable on a common axis in the pump cylinder, means for biasing said second piston toward the pump piston, and means including a non-return valve for admitting oil into said cylinder between said pistons.

2. A piston pump for internal combustion engines as claimed in claim 1 in which said second piston is biased toward the pump piston by means of a spring having a power adapted to provide not more than a predetermined maximum pressure in the pump cylinder.

3. A piston pump as claimed in claim 1 in which said second piston is provided with an axial passageway therethrough for admitting oil into the pump cylinder between the pistons, said valve for admitting oil being located in a position to control the passageway through said second piston and being adapted to prevent the flow of oil from the cylinder through said passageway.

4. A piston pump as claimed in claim 1, including means for limiting the forward movement of the second piston to a position in the pump cylinder at which the side wall of the second piston just covers the oil outlet in the side wall of the pump cylinder.

5. In an internal combustion engine including a crankcase and a crankshaft therein, a piston pump for the delivery of lubricating oil to the parts of the internal combustion engine to be lubricated, said pump including a cylinder located in the portion of the crankcase normally containing a body of lubricating oil, a reciprocable piston in said cylinder, means operated by the crankshaft for moving said piston in at least one direction in said cylinder, said cylinder being provided with an oil outlet opening through the side wall of the cylinder intermediate its ends, means for conducting oil from said outlet to the parts of the engine to be lubricated, a valve piston in said cylinder having the same diameter as and facing said pump piston, spring means for biasing said valve piston toward the pump piston, said valve piston having a passageway therethrough for the flow of oil into the cylinder between the said pistons, a suction valve for said passageway adapted to prevent the flow of oil from the cylinder through said passageway, and means for limiting the forward movement of said valve piston in the cylinder to a position just beyond where the side wall of the valve piston covers the oil outlet in the side wall of the pump cylinder.

6. An internal combustion engine and a piston pump therefor as claimed in claim 5 in which the crank case of the engine includes a block-like portion located in the portion of the crank case normally containing a body of lubricating oil, said pump cylinder being located in said block and having open ends on opposite sides of the block into which the pump piston and the valve piston extend respectively, said block constituting at least in part the means for limiting the forward movement of the valve piston, and means carried by the valve piston for engaging said block when the forward end of the valve piston has moved to a position to cover the oil outlet in the side wall of the pump cylinder.

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