United States Patent

Alcock

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[54] LUBRICATION OF BEARINGS OF RECIPROCATING ENGINES OR PUMPS

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Related U.S. Application Data

[62] Division of Ser. No. 752,967, Aug. 15, 1968, Pat. No. 3,545,569.

[30] **Foreign Application Priority Data**

Aug. 16, 1967 Great Britain 37,812/67

[52] **U.S. Cl.** ..... **184/6.5,** 123/196 R, 184/6.28, 184/24

[51] **Int. Cl.** **F01m 1/02**

[58] **Field of Search** ..... 184/6.28, 6.5, 6.17, 24, 26, 184/32, 74, 75; 123/196 R

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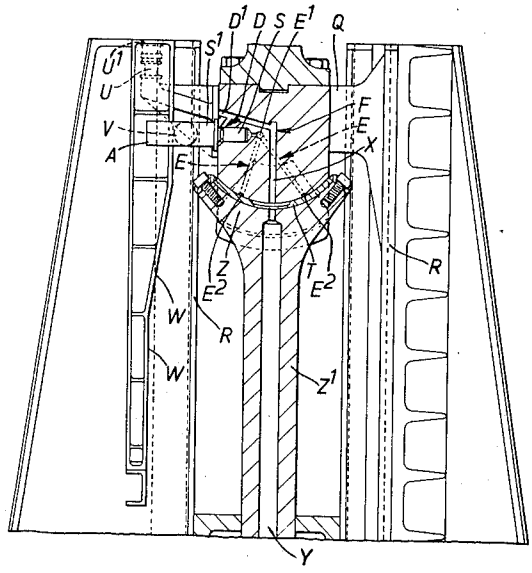
[57] **ABSTRACT**

A reciprocating piston mechanism in which the piston or piston rod is pivotally connected by a small end bearing to an angularly oscillating connecting rod and which includes a displacement type lubricating pump actuated independently of the oscillation of the connecting rod by the linear reciprocating movement of the piston assembly to deliver a timed feed of lubricant under pressure to the bearing during a selected portion of the reciprocating cycle. The pump is mounted on the crosshead block of the piston assembly with its operating axis at right angles to the direction to reciprocating movement of the piston and is actuated by a cam mechanism comprising a linear cam fixedly mounted to extend along the direction of reciprocating movement of the crosshead block assembly to one side thereof, and a movable cam follower carried by the cross head block assembly and acting on the pump plunger to actuate the pump, the cam follower being caused to ride along the fixed cam by the linear reciprocating movement of the piston assembly. A telescopic supply pipe supplies lubricant to the pump inlet, and also to thebig end bearing of the connecting rod via a longitudinal passage formed in the connecting rod.

5 Claims, 4 Drawing Figures



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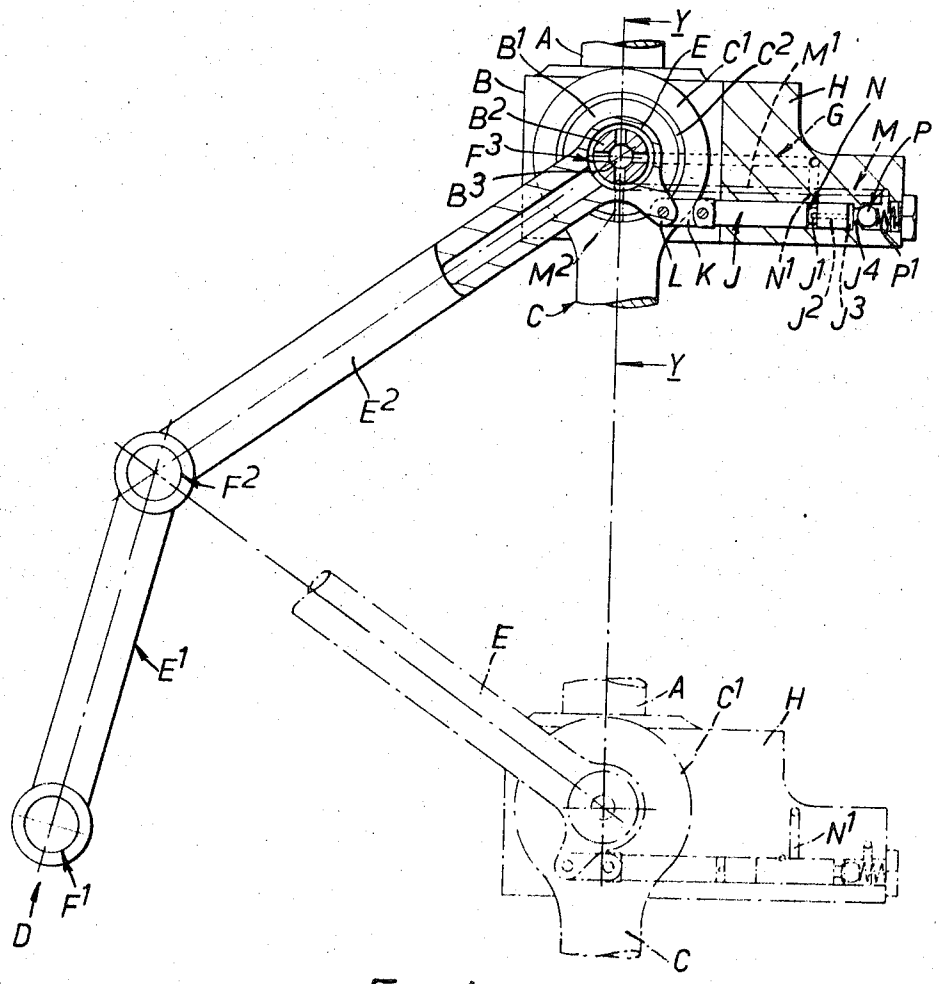

FIG. 1.

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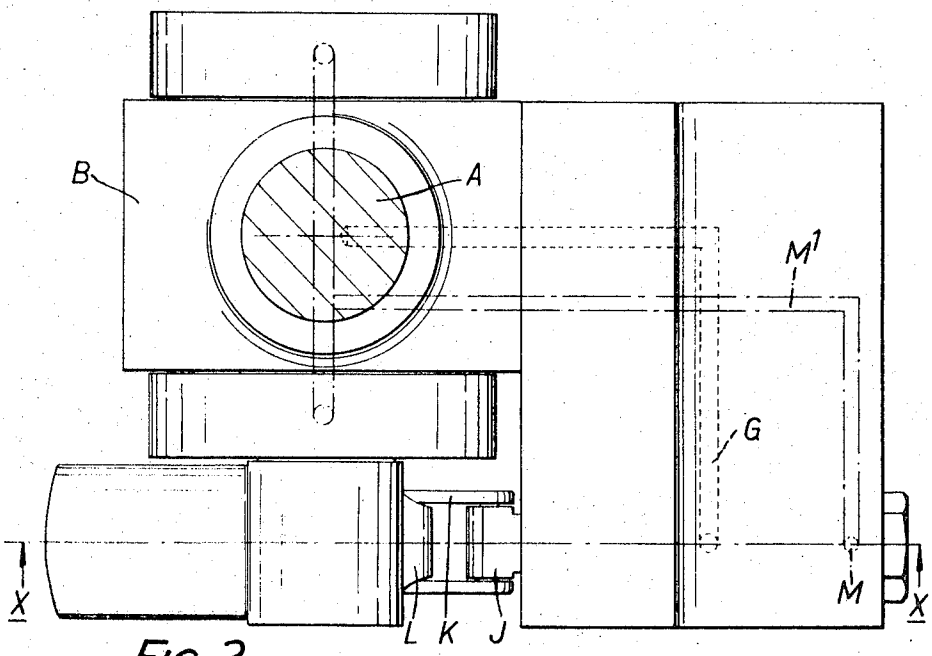

FIG. 2.

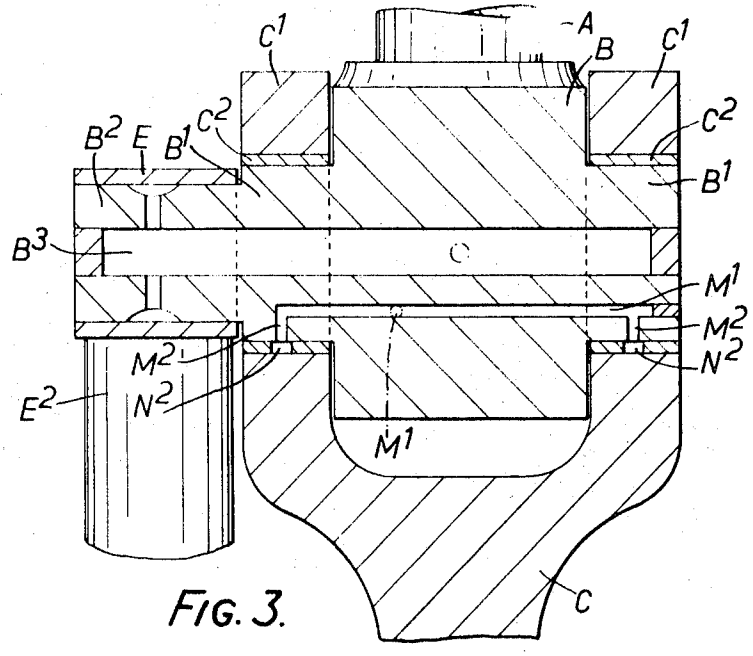

FIG. 3.

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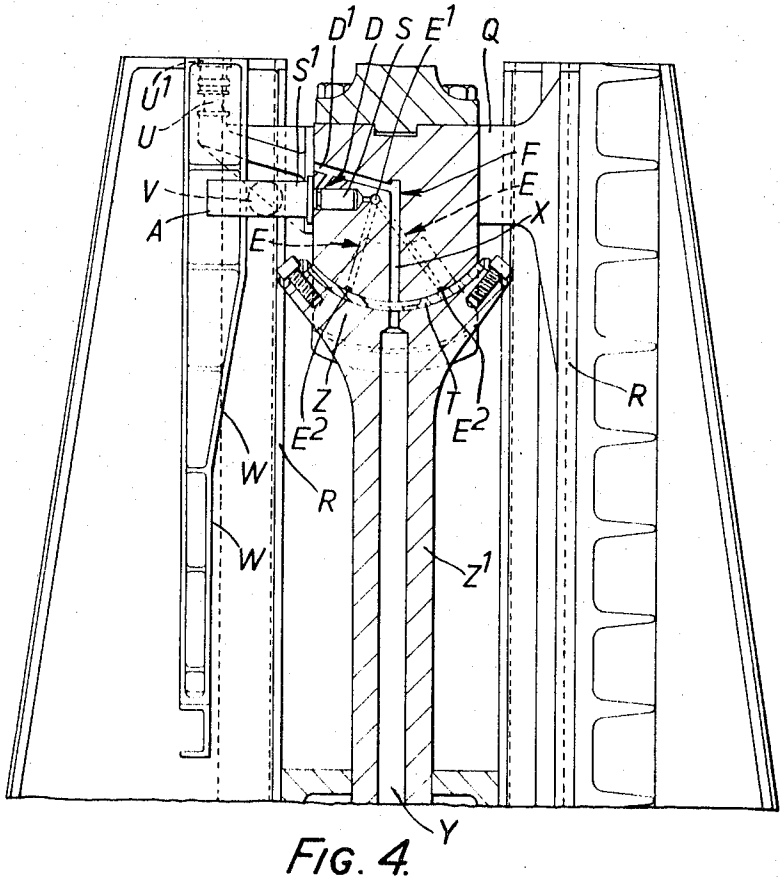

FIG. 4.

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LUBRICATION OF BEARINGS OF RECIPROCATING ENGINES OR PUMPS

CROSS-REFERENCE TO RELATED APPLICATION

This application is a divisional application from my co-pending application Ser. No. 752,967, now U.S. Pat. No. 3,545,569.

BACKGROUND OF THE INVENTION

This invention relates to reciprocating piston mechanism such as reciprocating engines or pumps, which term is used to include compressors for gaseous fluids, and is concerned with the lubrication of the small end bearings of such mechanisms that is to say the bearing by which the connecting rods are connected to the pistons or piston rods, e.g. in the latter case via a crosshead.

In some arrangements the connection between a piston or piston rod and a connecting rod is by a single bearing while in other cases it is by two axially spaced bearings and for convenience herein the bearing assembly will in each case be referred to simply as a small end bearing.

Where, as with a small end bearing of a single-acting reciprocating internal combustion engine operating on the two-stroke cycle, or a small end bearing associated with the piston of a pump operating in a cylinder to which the working fluid is delivered under pressure, (e.g. by an earlier stage of the pump as a whole) the load on the small end bearing, though varying, is, at least over a large proportion of the range of working conditions, continuously in one direction, difficulty arises in maintaining an adequate lubricant film between the working surfaces of the bearing, the rubbing velocity being too low for a hydrodynamic film of sufficient thickness to be formed while the absence of load reversal prevents lubricant being sucked into the substantially continuously loaded area of the working clearance or being forced in to this area of the clearance by the comparatively low oil pressure of a normal force-feed lubricating system. Moreover the provision of a continuous oil feed to such a small end bearing at a sufficiently high pressure to force the continuously loaded area of the bearing surfaces apart, even during the period of relatively low loading, would involve excessive leakages at the ends of the bearing clearance and other practical inconvenience due, for example, to the fact that the high pressure oil delivery would also necessarily include relatively moving parts the connection between which would have to be adequately sealed against leakage at the high pressure in question.

DESCRIPTION OF THE PRIOR ART

A known method of overcoming this difficulty is to provide, in association with each small end bearing between a connecting rod and a crosshead of a reciprocating internal combustion engine a reciprocating oil pump which delivers to the substantially continuously loaded area of the bearing a "shot" of lubricant at high pressure during a short period a little before each period of maximum bearing loading, so that the substantially continuously loaded faces are forced apart and an oil film thus provided too thick to be completely squeezed out during the high load period, this pump being mounted upon the crosshead and its plunger or plungers being actuated through appropriate mechanism acted upon by the connecting rod so as to be operated by its angular oscillating movement on the crosshead pin. Since the high pressure delivery thus provided can be of short duration the end leakage from the bearing is tolerable. Such arrangements, however, have disadvantages in that if the engine is reversible (for example a reversible marine engine) and the best period for delivery is to be used for each direction of rotation, two pumps are required, and in such an arrangement the nominally idle pump - i.e. the "astern" pump when going ahead and the "ahead" pump when going astern, is delivering during the period of maximum load, which may be of the order of 2,500 pounds per square inch and this puts a heavy load on its operating mechanism which itself needs lubrication and tends to be complex.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a form of lubricating apparatus for the small end bearing of a reversible reciprocating piston mechanism such as a reversible single-acting internal combustion piston engine operating on the two-stroke cycle, or for a reversible reciprocating-piston pump in which, for example, for the reasons given above, the small end bearing or bearings are subject to a substantially continuous load in one direction, which lubricating arrangement will not be subject to the above drawbacks.

Another object of the invention is to provide a form of lubricating apparatus for the small-end bearing of a reciprocating-piston mechanism in which the lubricating pump is carried by the reciprocating piston assembly and is actuated by the linear reciprocating movement of the piston assembly without depending on the angular swinging movement of the connecting rod.

Another object of the present invention is to provide a reversible reciprocating-piston mechanism in which the piston or piston rod is pivotally connected by a small end bearing to an angularly oscillating connecting rod and which including a single-acting reciprocating-type lubricating pump carried by the piston assembly for bodily movement therewith and having a pump body and a displacement member movable relatively thereto, the pump having an inlet connected to a supply of lubricant and having an outlet communicating with the small end bearing for the supply of pressurised lubricant thereto during the working strokes of the pump, a fixed cam mounted to extend in the direction of movement of the piston assembly and a movable cam follower carried by the piston assembly in a position in which it coacts with the fixed cam, the cam follower being mechanically coupled to the displacement member of the pump and being arranged to follow the fixed cam and thereby to actuate the pump in response to the reciprocating movement of the piston assembly.

In one construction arrangement in which the reciprocating mechanism is a reciprocating engine or pump, the lubricating pump is arranged to deliver lubricant to the small end bearing during each instroke of the piston.

Moreover, in such an arrangement the inlet passage of the reciprocating pump may be supplied with lubricant through a telescopic lubricant supply pipe assembly, the two telescopic parts of which are respectively connected to the piston or piston rod and a part fixed with respect to the mechanism.

In either of the above arrangements the lubricating pump may be arranged to draw lubricant from a supply pipe which is also arranged to supply lubricant via the small end bearing and a passage in the connecting rod to an associated big-end bearing and crosshead slipper of the engine or pump.

BRIEF DESCRIPTION OF THE DRAWINGS

Further details of the invention will be understood from the following description of the accompanying drawings, in which:

FIG. 1 is a somewhat diagrammatic view in side elevation of the piston rod and connecting rod assembly of a single-acting 2-stroke cycle reciprocating diesel engine of a type employed for marine propulsion and for other uses where a large engine operating at comparatively low speeds is required, the parts being shown partly in cross-section, the cross-section being taken on the line X—X of FIG. 2,

FIG. 2 is a plan view of the arrangement shown in FIG. 1 with part of the walking pipe omitted,

FIG. 3 is a cross-section in the plane Y—Y of FIG. 1, and

FIG. 4 is a somewhat diagrammatic side elevation of another construction employing a cam mechanism.

DETAILED DESCRIPTION

In the construction shown in FIGS. 1, 2 and 3, there is shown a small end bearing lubrication arrangement for a reversible single-acting 2-stroke cycle reciprocating diesel engine. In FIGS. 1 to 3, reference A is the piston rod of the engine, of which B is the crosshead block provided with two

coaxial pins B^1 constituting the "crosshead pin." The connecting rod C has a forked small end C^1 having secured therein a pair of bearings C^2, C^2 together constituting the small end bearing. One of the parts of the crosshead pin B^1 has a cylindrical projection B^2 which is connected by a banjo type pivotal joint E to one end of a walking pipe the two parts of which are shown respectively at E^1 and E^2 and are pivotally connected by a banjo type "knee" joint at F^2 while the lower end of the part E^1 of the walking pipe being pivotally connected at F^1 by a banjo type joint to a fixed part of the engine. The construction and arrangement of the walking pipe is of usual type so that it serves to deliver oil from a passage communicating with its lower end via the banjo type joint F^1, to a passage B^3 extending through the crosshead pin and block B.

The walking pipe thus constitutes a low pressure oil feed to the passage in the crosshead pin.

Secured to the crosshead block B is a pump unit comprising a casing H in which is formed a pump cylinder containing a reciprocating plunger J provided with an annular recess N communicating through a transverse passage J^1 and an axial passage J^2 with the working chamber J^3 of the pump. The plunger J is connected by a link K to a lug L on the part E^2 of the walking pipe so that during reciprocation of the crosshead, the pivotal movement of the walking pipe on the projection B^2 causes reciprocation of the piston J within its cylinder. At the end of the cylinder is a delivery port controlled by a spring pressed non-return valve P while an inlet port N^1 communicates with the bore of the cylinder at a point such that it will be uncovered by the piston at the end of its outstroke to permit oil to flow into the working chamber of the pump and will come into communication with the recess N towards the end of the delivery stroke of the pump. The port N communicates by way of the passage G formed partly in the pump casing H and partly in the crosshead pin block B and pin B^2 with the passage B^3 in the pin crosshead block B and pin B^1 while a delivery port J^4 communicates by way of the valve P with a delivery chamber P^1. The delivery chamber P^1 communicates through passages M, M^1, M^2 with distributing grooves N^2 in the two parts of the small end bearing.

The position of the parts at the end of the outstroke of the engine piston is shown in dotted line in FIG. 1.

Thus, during each outstroke of the engine piston the plunger J is moved on its suction stroke from the position shown in full line in FIG. 1 until it uncovers the port N^1, whereupon lubricating oil is drawn into the working chamber J^3 of the pump by the depression created, while on each instroke of the piston the plunger J returns lubricating oil to the passage G until it covers the port N, after which it delivers lubricating oil through the non-return valve P and the passages M, M^1, M^2, to the substantially continuously loaded areas of the small end bearing until this delivery is terminated when the annular recess N comes into communication with the port N^1, i.e. at the position shown in full line in FIG. 1.

In the construction shown in FIG. 4 which embodies the present invention as claimed herein, the crosshead block assembly Q, which slides in fixed guides indicated at R, and is connected to the small end Z of a connecting rod Z^1, has secured to it a pump block A having formed therein a cylinder in which reciprocates a pump plunger S having its axis at right angles to the direction of movement of the crosshead block. Communicating with the pump cylinder is an inlet passage D and delivery passages indicated at E,E controlled by a non-return valve indicated at E^1. The delivery passages E communicate with distributing grooves E^2 in the highly loaded part of the working face of the small end bearing T.

The inlet passage D communicates via a supply passage D^1 with the lower end of a telescopic oil supply pipe the lower part of which is indicated at U and is secured to the crosshead block Q while the upper part is secured to the engine frame as indicated at U^1. The plunger S is formed integral with a lateral projection S^1 which is arranged to reciprocate in a guide rigid with the crosshead and carries a cam follower in the form of a roller V which bears upon a linear cam W extending in the direction of movement of the crosshead and against which the roller V is urged by a spring (not shown). Thus, owing to the form of the cam W the plunger S will be caused by its spring to move to the left as the engine piston moves on its outstroke until the plunger S uncovers the passage D, whereupon lubricating oil will flow into the working chamber of the pump, and during each instroke of the engine piston the plunger S will be forced to the right under the action of the cam W on the follower roller V to force lubricating oil through the passages E, E into the substantially continuously loaded area of the small end bearing T.

As will be seen in the arrangement shown, the supply passage D also communicates via a passage X with a longitudinally extending passage Y in the connecting rod Z^1, and this passage leads to the working clearance of the big end bearing so that the big end bearing is also lubricated by oil from the telescopic pipe U, U^1.

What we claim as our invention and desire to secure by Letters Patent is:

1. A reversible reciprocating-piston mechanism which comprises a cylinder mounted in a fixed structure, a linearly reciprocating piston assembly slidable in the cylinder, a rotary crank, an angularly oscillating connecting rod one end of which is pivotally connected to the piston assembly by a small end bearing, and the other end of which is journalled on the crank by a big end bearing, a single-acting reciprocating-type lubricating pump carried by the piston assembly for bodily movement therewith and having a pump body and a displacement member movable relatively thereto, the pump having an inlet connected to a supply of lubricant and having an outlet communicating with the small end bearing to deliver pressurized lubricant thereto during the working of the pump, a linear cam mounted fixedly on the fixed structure and extending in the direction of movement of the piston assembly, and a movable cam follower carried by the piston assembly in a position in which it coacts with the fixed linear cam, the cam follower being mechanically coupled to the displacement member of the pump and being arranged to actuate the pump in response to displacement of the cam follower by the cam caused by the reciprocating movement of the piston assembly, whereby the pump is driven in a predetermined operating cycle synchronized with the rotation of the crank to deliver a timed feed pulse of pressurized lubricant to the small end bearing, the said operating cycle being the same during rotation of the crank in a forward direction as it is during rotation of the crank in a reverse direction, and said timed feed pulse starting at the same predetermined point in the same predetermined stroke of the working cycle of the reciprocating piston mechanism regardless of the direction of rotation of the crank.

2. A reciprocating piston mechanism as claimed in claim 1 in which the displacement member of the pump comprises a plunger disposed with its axis of reciprocation at right angles to the direction of reciprocating movement of the piston assembly, the cam follower being mounted directly on the outer end of the plunger, and spring means acting on the plunger to urge it in the direction towards the fixed cam.

3. A reciprocating piston mechanism as claimed in claim 1 which includes a telescopic lubricant supply pipe assembly interconnecting the pump inlet and the supply of lubricant, the telescopic pipe assembly comprising two pipe sections one of which telescopes within the other, one pipe section being attached to the piston assembly and the other being fixed.

4. A reciprocating piston mechanism as claimed in claim 3 in which the connecting rod is formed with a longitudinal passage communicating with the telescopic supply pipe and extending to the big end bearing through which passage pressurised lubricant from the telescopic supply pipe is supplied to the big end bearing.

5. A reciprocating piston mechanism as claimed in claim 1 in which the lubricating pump is arranged to deliver lubricant to the small end bearing at a predetermined point during each in-stroke of the piston assembly.

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