

PATENT SPECIFICATION (11)

1 411 978

1 411 978

(21) Application No. 40387/72 (22) Filed 31 Aug. 1972 (19)

(23) Complete Specification filed 27 July 1973

(44) Complete Specification published 29 Oct. 1975

(51) INT. CL.³ F04B 19/04

(52) Index at acceptance

F1A 1A1B 1A5 1A7 1B8A 3A2A 4A 4E1 4Q 4S2

(72) Inventor ALBERTO JORGE MORRIS



(54) LUBRICATING PUMP

(71) We, R. A. LISTER & COMPANY LIMITED, a British Company, of Victoria Iron Works, Long Street, Dursley, Gloucestershire, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a lubricating pump or circulating lubricant, the pump being particularly, but not exclusively, suitable for circulating lubricant to internal combustion engines, gearboxes and like machines.

In providing lubricant for internal combustion engines circulation of lubricating oil is sometimes by pressurised lubricating oil systems and in such systems the flow of oil is dependent on variations in the temperature and pressure of the oil and the clearances between component parts which define the passages through which the oil passes. It is generally desirable for the oil pressure to be maintained between predetermined limits and the clearances are subject to variation according to the manufacturing tolerances of the components and the amount of wear.

In view of these variations the flow of oil required in order to maintain the desired pressure varies considerably and one way of meeting this problem is to provide a positive displacement lubricating pump with excess flow capacity which makes it necessary to provide a pressure relief valve and the provision of this valve adds to the cost and complexity of the system.

Lubricating systems often use rotary pumps which are driven from the engine by gears and include a pressure relief valve. Sometimes a reciprocating pump is used for cheapness and simplicity, the pump being driven from an eccentric on the crankshaft of the engine. However the usual reciprocating pump only delivers oil once every two engine revolutions which can lead to insufficient oil being delivered. Moreover such pumps are usually assembled by screw-threaded or swaged fasteners.

An object of the invention is to provide a

lubricating pump suitable for use in circulating oil which overcomes at least some of the disadvantages of existing pumps.

According to the invention a pump, for delivering lubricant to lubricate an internal combustion engine, comprises a casing defining a bore, a piston reciprocally movable in said bore, a liquid inlet defined at one end of said bore, an inlet chamber defined between said liquid inlet and the adjacent end of said piston, operating means extending into the bore for moving the piston in one direction along said bore, means arranged in said inlet chamber for moving the piston in an opposite direction along the bore, a liquid outlet defined towards the opposite end of said bore, an axial duct defined by said piston through which lubricant will flow between said inlet chamber and said outlet, a one-way valve provided in said axial duct arranged to close the axial duct when the piston moves in said opposite direction, said piston defining a transverse bore upstream of said one-way valve, said transverse bore constituting an air-vent interconnecting the axial duct and said inlet chamber upstream of said one-way valve to facilitate priming of the pump, said operating means being arranged to discharge lubricant through said outlet at a rate not exceeding the minimum lubricant demand at said outlet, and the piston being arranged to discharge lubricant through said outlet when moving in said opposite direction along the bore, the amount of lubricant discharged by movement of the piston in said opposite direction being dependent on the lubricant demand at said outlet.

The operating means may be a rod drivable reciprocally longitudinally of the bore, one end of the rod being positioned within the bore, and the other end of the rod being positioned externally of the bore for engagement with drive means.

Preferably said means arranged in the inlet chamber for moving the piston in the opposite direction along the bore is a spring.

The piston may be formed as a composite

unit having a head member engageable with said operating means, and a body member incorporating said one-way valve. The head and body members may be formed with ducts which together define said axial duct.

The operating means is preferably of constant cross-sectional area, and the ratio of the cross-sectional area of the piston to the cross-sectional area of the operating means is desirably in the range 9:1 and 4:1.

Preferably the casing comprises an outer casing part and an inner sleeve located within the outer casing part, said inner sleeve defining the bore along which the piston is movable. The outer casing part may define a bore in which the sleeve is located. One end of the sleeve may define said liquid inlet, and said means for moving the piston in the opposite direction along the bore may be located between said one end of the sleeve and the adjacent end of the piston.

Where a pump in accordance with the immediately preceding paragraph is arranged in combination with the internal combustion engine, the outer casing part may be defined by the engine crankcase, and the sleeve may be held in position in the crankcase by a sump cover for the engine removably attached to the crankcase. In such a case, the operating means may conveniently be driven by a cam carried on a rotatable camshaft driven by the engine.

Further preferred features of the invention appear from the following description of an embodiment of the invention given by way of example only and with reference to the accompanying drawings in which:—

Figure 1 is a vertical section through a lubricating pump, and

Figure 2 is a plan view of a washer comprising a part of the pump of Figure 1.

Referring to the drawing the lubricating pump is intended for use in circulating oil through an internal combustion engine, a portion of the crankcase of which is shown at 12 and a portion of the sump cover of which is shown at 23.

The engine drives a camshaft 10 on which is formed an eccentrically-arranged cam 9. The crankcase portion 12 is formed with concentric cylindrical bores 1, 2 and 3 and the components of the pump are located in the bores and are held in position between the crankcase and the sump portions 12 and 23.

A cylindrical tappet 11 is located in the bore 1 and engages the cam surface 9. The lower end of the tappet 11 extends through the bore 2 and into the bore 3 to engage a composite piston comprising a head 15 and a body member 17. The head 15 has a longitudinal slot 14 and the diameter of its upper end is larger than the diameter of its lower end. The body member 17 has an axial bore 6, the diameter of which reduces

in step-wise manner from its upper end towards its lower end. In the upper, larger diameter portion of the bore 6 is located the lower end of the head 15, and at the junction between an intermediate portion of the bore 6 and the lower smallest diameter portion of the bore 5 is formed a seating for a ball valve 5. A radially-directed opening 18 communicates between the lower portion of the bore 6 and the external periphery of the body member 17 which, at its lower end, is of reduced external diameter. The head 15 is formed with an axial extension 4 which limits the upward travel of the ball valves 5.

The piston is urged upwardly by biasing means in the form of a spring 7. The spring 7 is located at its upper end about the reduced diameter lower end of the body member 17 and extends between the body member 17 and a washer 20.

A cylindrical sleeve 16 is located within the bore 3 of the crankcase and the inner surface of the sleeve locates the body member 17. The lower end of the sleeve 16 is formed with an annular seating for the washer 20, a seating for a ball valve 21, and an inlet opening 8 through which oil is drawn into the pump from an oil reservoir 22 in the sump 23. The lower ends of the body member 17 and the sleeve 16 define an inlet chamber 19 for oil and the sleeve 16 is held in position at its lower end by the sump portion 23.

The washer 20 has an opening 24 of cruciform shape, as shown in Figure 2, to allow the oil to pass around the ball valve 21 when the latter engages the underside of the washer 20.

The crankcase 12 is further provided with a discharge opening 13 communicating with the bore 3 through which oil is discharged from the pump into the engine.

The diameter of flow of oil through the pump is indicated by the arrows.

Operation of the pump is as follows. Assuming that the engine sump is filled with oil in the reservoir 22 to the correct level as indicated by 25 in Figure 1, and the cam 9 and tappet 11 are initially in the positions shown in Figure 1, the pump is at the beginning of a relatively lower volume delivery stroke. As the tappet moves downwardly, it engages the head 15 and the oil in the chamber 19 below the piston member 17 is compressed thereby closing the ball valve 21 and opening the ball valve 5 and transferring oil through the slot 14 and the discharge opening 13 into the engine, the amount of oil being discharged corresponding to the volume displaced by the tappet 11 as it moves into the bores 2 and 3. The opening 18 allows any air trapped around the lower end of the piston member 17 to be

vented as this air would otherwise impair the priming of the pump.

As the tappet 11 begins to move upwardly a relatively higher volume delivery stroke commences and the ball valve 21 opens to admit oil from the reservoir 22 through the inlet opening 8, the ball valve 5 closing and remaining closed during this stroke. The chamber 19 fills with fresh oil and the upward movement of the piston 15, 17 under the action of the spring 7 causes a flow of oil through the discharge-opening 13 equal to the swept volume of the piston 15, 17 less the swept volume of the tappet 11.

The pressure at which the oil is displaced during upward movement of the tappet 11 remains approximately constant because this pressure is derived from the action of the spring 7. If, as will generally be the case, the engine will not accept all the oil to be delivered at this pressure the piston 15, 17 will remain in an intermediate position until the tappet 11 again moves downwardly against the head 15.

The relative dimensions of the tappet 11 and the body member 17 are selected according to the characteristics of the engine and the pump. It will be appreciated that the pressure of oil delivery during the upward movement of the piston 15, 17 is determined by the strength of the spring 7 and no overloading or hydraulic locking can occur, and movement of the piston 15, 17 will be automatically limited according to the flow requirements of the engine and the back pressure of oil at the discharge opening 13. On the downward movement of the tappet, only a relatively small amount of oil is delivered but hydraulic locking can occur if the amount supplied exceeds the engine requirement. Thus the displacement of oil by the tappet must not exceed the minimum oil flow requirements of the engine whilst the volume displacement of the piston 15, 17 less the volume displacement of the tappet 11, during the upward stroke, should exceed the maximum engine oil requirement by at least 50% if approximately continuous oil supply at constant pressure is to be achieved.

In practice we have found that the ratio of the cross-sectional area of the piston to the cross-sectional area of the tappet should be in the range 9:1 to 4:1.

WHAT WE CLAIM IS:—

1. A pump, for delivering lubricant to lubricate an internal combustion engine, comprising a casing defining a bore, a piston reciprocally movable in said bore, a liquid inlet defined at one end of said bore, an inlet chamber defined between said liquid inlet and the adjacent end of said piston, operating means extending into the bore for moving the piston in one direction along said

bore, means arranged in said inlet chamber for moving the piston in an opposite direction along the bore, a liquid outlet defined towards the opposite end of said bore, an axial duct defined by said piston through which lubricant will flow between said inlet chamber and said outlet, a one-way valve provided in said axial duct arranged to close the axial duct when the piston moves in said opposite direction, said piston defining a transverse bore upstream of said one-way valve, said transverse bore constituting an air-vent interconnecting the axial duct and said inlet chamber upstream of said one-way valve to facilitate priming of the pump, said operating means being arranged to discharge lubricant through said outlet at a rate not exceeding the minimum lubricant demand at said outlet, and the piston being arranged to discharge lubricant through said outlet when moving in said opposite direction along the bore, the amount of lubricant discharged by movement of the piston in said opposite direction being dependent on the lubricant demand at said outlet.

2. A pump, according to Claim 1, in which the operating means is a rod drivable reciprocally longitudinally of the bore, one end of the rod being positioned within the bore, and the other end of the rod being positioned externally of the bore for engagement with drive means.

3. A pump, according to Claim 1 or 2, in which said means arranged in the inlet chamber for moving the piston in the opposite direction along the bore is a spring.

4. A pump, according to any preceding claim, in which the piston is formed as a composite unit having a head member engageable with said operating means, and a body member incorporating said one-way valve.

5. A pump, according to Claim 4, in which the head and body members are formed with ducts which together define said axial duct.

6. A pump, according to any preceding claim, in which the operating means is of constant cross-sectional area, and the ratio of the cross-sectional area of the piston to the cross-sectional area of the operating means is in the range 9:1 and 4:1.

7. A pump, according to any preceding claim, in which the casing comprises an outer casing part and an inner sleeve located within the outer casing part, said inner sleeve defining the bore along which the piston is movable.

8. A pump, according to Claim 7, in which the outer casing part defines a bore in which the sleeve is located.

9. A pump, according to Claim 7 or 8, in which one end of the sleeve defines said liquid inlet, and said means for moving the piston in the opposite direction along the

vented as this air would otherwise impair the priming of the pump.

As the tappet 11 begins to move upwardly a relatively higher volume delivery stroke commences and the ball valve 21 opens to admit oil from the reservoir 22 through the inlet opening 8, the ball valve 5 closing and remaining closed during this stroke. The chamber 19 fills with fresh oil and the upward movement of the piston 15, 17 under the action of the spring 7 causes a flow of oil through the discharge-opening 13 equal to the swept volume of the piston 15, 17 less the swept volume of the tappet 11.

The pressure at which the oil is displaced during upward movement of the tappet 11 remains approximately constant because this pressure is derived from the action of the spring 7. If, as will generally be the case, the engine will not accept all the oil to be delivered at this pressure the piston 15, 17 will remain in an intermediate position until the tappet 11 again moves downwardly against the head 15.

The relative dimensions of the tappet 11 and the body member 17 are selected according to the characteristics of the engine and the pump. It will be appreciated that the pressure of oil delivery during the upward movement of the piston 15, 17 is determined by the strength of the spring 7 and no overloading or hydraulic locking can occur, and movement of the piston 15, 17 will be automatically limited according to the flow requirements of the engine and the back pressure of oil at the discharge opening 13. On the downward movement of the tappet, only a relatively small amount of oil is delivered but hydraulic locking can occur if the amount supplied exceeds the engine requirement. Thus the displacement of oil by the tappet must not exceed the minimum oil flow requirements of the engine whilst the volume displacement of the piston 15, 17 less the volume displacement of the tappet 11, during the upward stroke, should exceed the maximum engine oil requirement by at least 50% if approximately continuous oil supply at constant pressure is to be achieved.

In practice we have found that the ratio of the cross-sectional area of the piston to the cross-sectional area of the tappet should be in the range 9:1 to 4:1.

WHAT WE CLAIM IS:—

1. A pump, for delivering lubricant to lubricate an internal combustion engine, comprising a casing defining a bore, a piston reciprocally movable in said bore, a liquid inlet defined at one end of said bore, an inlet chamber defined between said liquid inlet and the adjacent end of said piston, operating means extending into the bore for moving the piston in one direction along said

bore, means arranged in said inlet chamber for moving the piston in an opposite direction along the bore, a liquid outlet defined towards the opposite end of said bore, an axial duct defined by said piston through which lubricant will flow between said inlet chamber and said outlet, a one-way valve provided in said axial duct arranged to close the axial duct when the piston moves in said opposite direction, said piston defining a transverse bore upstream of said one-way valve, said transverse bore constituting an air-vent interconnecting the axial duct and said inlet chamber upstream of said one-way valve to facilitate priming of the pump, said operating means being arranged to discharge lubricant through said outlet at a rate not exceeding the minimum lubricant demand at said outlet, and the piston being arranged to discharge lubricant through said outlet when moving in said opposite direction along the bore, the amount of lubricant discharged by movement of the piston in said opposite direction being dependent on the lubricant demand at said outlet.

2. A pump, according to Claim 1, in which the operating means is a rod drivable reciprocally longitudinally of the bore, one end of the rod being positioned within the bore, and the other end of the rod being positioned externally of the bore for engagement with drive means.

3. A pump, according to Claim 1 or 2, in which said means arranged in the inlet chamber for moving the piston in the opposite direction along the bore is a spring.

4. A pump, according to any preceding claim, in which the piston is formed as a composite unit having a head member engageable with said operating means, and a body member incorporating said one-way valve.

5. A pump, according to Claim 4, in which the head and body members are formed with ducts which together define said axial duct.

6. A pump, according to any preceding claim, in which the operating means is of constant cross-sectional area, and the ratio of the cross-sectional area of the piston to the cross-sectional area of the operating means is in the range 9:1 and 4:1.

7. A pump, according to any preceding claim, in which the casing comprises an outer casing part and an inner sleeve located within the outer casing part, said inner sleeve defining the bore along which the piston is movable.

8. A pump, according to Claim 7, in which the outer casing part defines a bore in which the sleeve is located.

9. A pump, according to Claim 7 or 8, in which one end of the sleeve defines said liquid inlet, and said means for moving the piston in the opposite direction along the



bore is located between said one end of the sleeve and the adjacent end of the piston.

- 5 10. A pump, according to Claim 7, 8 or 9, in combination with the internal combustion engine, in which the outer casing part is defined by the engine crankcase, and the sleeve is held in position in the crankcase by a sump cover for the engine removably attached to the crankcase.

- 10 11. A combination, according to Claim 10, in which the operating means is driven by a cam carried on a rotatable camshaft driven by the engine.

12. A pump constructed and arranged substantially as described herein with reference to, and as illustrated in, the accompanying drawings. 15

EDGAR A. GODDIN & SON,
Chartered Patent Agents,
17, Waterloo Place,
Leamington Spa,
Warwickshire.
Agents for the Applicants.

Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1975.
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY
from which copies may be obtained.

