

PATENT SPECIFICATION

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(54) LUBRICATION SYSTEMS

(71) We, CATERPILLAR TRACTOR CO., a corporation organised and existing under the laws of the State of California, United States of America, of 100 N.E. Adams Street, Peoria, State of Illinois 61602, United States of America, 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 lubrication system, for example, to a lubrication system for an endless track vehicle final drive mechanism.

Vehicle final drives, such as employed on large endless-track tractors, often incorporate a separate lubrication system including a driven pump for filtering the oil and lubricating the bearings and gearing incorporated therein. Because of the desired ground clearance and specific nature of the gearing disposed in the case of such final drive, it is often necessary to locate the pump considerably above the level of the lubricant contained in the case. This requires a relatively long intake line, and gives rise to cavitation problems and loss of prime of the pump. This problem is particularly onerous where unidirectional pumps are used, because they function in a single direction of travel (normally forward) and in the reverse mode of vehicle travel the pump acts to direct fluid and air back to the pump. Upon reversal of the vehicle again, the pump reverses, acting in a state of loss of prime that results in inefficient operation.

U.S. Patent No. 3,618,712 discloses a pump having check valves to retain lubricating fluid in the pump, to aid in keeping the pump primed. However, it is to be noted that dirt in the lower check valve could allow lubricating fluid to drain from the pump, resulting in the above-mentioned problem. Of more general interest in this area is U.S. Patent No. 3,604,205.

It is an object of this invention to provide, in a lubricating system including a pump,

means for ensuring that the pump is primed, even if the pump is reversed temporarily.

It is a further object of this invention to provide, in a lubricating system including a pump, means which, while fulfilling the above object, are simple in design and effective in use.

According to a first aspect of the invention there is provided a lubrication system comprising: a source of lubricating liquid; a first line having a first end in communication with the source of lubricating liquid and extending upwardly therefrom to a second end; reservoir means for the lubricating liquid comprising a reservoir body, the second end of the first line being open and on an end portion of the first line extending into the reservoir body so as to render the first line in communication with the interior of the reservoir body; a second line having a first end on an end portion of the second line extending into the reservoir body; the first end being open so as to render the second line in communication with the interior of the reservoir body, the first end of the second line being at a lesser height than the second end of the first line, the second line having a second end on a portion of the second line extending outwardly of the reservoir body; and a liquid pump connected to the second end of the second line and capable of pumping the lubricating liquid through the second line to and from the interior of the reservoir body; actuation of the pump to pump fluid from the reservoir body through the second line, causing lubricating liquid to be drawn through the first line, into the reservoir body, through the second line and through the pump, to an area to be lubricated, and, actuation of the pump to pump fluid to the reservoir body through the second line, causing lubricating liquid to be pumped through the second line, into the reservoir body, up to the level of the second end of the first line, and through the first line, and air may be pumped through the second line into the reservoir body, and through the first

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line; the greater height of the second end of the first line as compared to the first end of the second line ensuring that, when fluid is pumped through the second line into the reservoir body, the level of the free surface of liquid in the reservoir body remains substantially at the level of the second end of the first line.

According to a further aspect of the invention there is provided in a fluid system reservoir means comprising: a reservoir body comprising a top portion, a bottom portion, and side portions; a liquid source; a first line having a first end communicating with the liquid source and a second end on an end portion of the first line extending into the reservoir body, the second end of the first line being open so as to render the first line in communication with the interior of the reservoir body; a second line having a first end on an end portion thereof extending into the reservoir body, the first end of the second line being open so as to render the second line in communication with the interior of the reservoir body, the second line having a second end on a portion of the second line extending outwardly of the reservoir body; the reservoir body being closed except for apertures therein through which said end portions of said first and second lines extend into the interior of the reservoir body; means for pumping from the liquid source through the first line, through the reservoir body, and through the second line; and a magnetic member fixed within the reservoir body and positioned so that at least some of the liquid from the liquid source flowing through the reservoir body flows along the magnetic member.

An embodiment of the present invention will hereinafter be described, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a side elevation of a tractor incorporating an embodiment of the lubrication system of the invention,

FIG. 2 is an enlarged view, partially broken away, of the lubrication system of FIG. 1; and

FIG. 3 is an enlarged view, in section, of the reservoir means of the lubrication system.

A vehicle 10, such as a relatively large endless-track-type tractor used for moving earth and the like, incorporates a vehicle frame 12, a forwardly disposed motive-power plant 14, and a rearwardly associated power-transmission 16 disposed within the frame 12 in driving relation with a final drive assembly shown generally at 18. In the tractor shown, the final drive assembly 18 includes a driving input pinion 20, a conventional reduction gearing arrangement 22 driven thereby (only a portion of which is

shown for illustrative clarity), an output shaft 24 driven by the reduction gear 22, and a sprocket 26 driven thereby which propels the vehicle 10 through contact with an endless track chain 28. The final drive assembly 18 further includes a final drive case 30 secured to the vehicle frame 12 and a removable outer cover 32 defining an enclosed chamber 34 which is normally filled with a lubricating liquid 36 up to a predetermined level such as shown by an elevational plane "A".

A lubrication system shown generally by the reference numeral 38 is disposed substantially within the final drive case 30 and includes a unidirectionally effective but reversible gear-type fluid pump 40 driven in conjunction with the input pinion 20. A line 42 has a lower end 44 which extends to the lower end of the chamber 34 and includes a conventional intake screen 46. The line 42 extends upwardly from the chamber 34, and has an end portion 43 which enters into reservoir means 48 comprising a reservoir body 50. The reservoir body 50 includes a top portion 52, a bottom portion 54, and side portions 56. The line 42 actually extends through the bottom portion 54 of the body 50. A second line 58 also has an end portion 60 extending into the reservoir body 50 through the bottom portion 54. The other end portion 62 of the line 58 extends outwardly of the body 50. The reservoir body 50, it should be noted, is closed except for apertures in the bottom portion 54 through which the end portions 43 and 60 of the lines 42 and 58 extend. It is also to be noted that the upper end of the end portion 60 of the line 58 is at a lesser height than that of the end portion 43 of line 42 as shown.

The fluid pump 40 is connected to the end portion 62 of the line 58. Extending from the pump 40 is a line 64 through which fluid is delivered to and through a ball check valve 66, a line 68, and a filter 70 to a plurality of branch conduits 72 to lubricate the various bearings and gears associated with the final drive assembly 18. The pump 40, as shown, is at an elevation "B" substantially the same as the elevation of the upper end of the end portion 43 of line 42.

The body 50, as shown in FIG. 3, has a substantially flat magnetic member 74 resting on a wall 76 extending upwardly from bottom portion 54, the member 74 being slidable vertically between pairs of ribs 78 formed on two further side portions (only one of which is shown in Fig. 3) interconnecting the side portions 56 of the body 50. The wall 76 defines a lower passage 79 adjacent the bottom portion 54, and the magnetic member 74 is disposed between the end portion 43 of line 42 and the end portion 60 of line 58, and extends to ad-

adjacent the top portion 52 of the reservoir body 50, parallel with the end portion 43 of the line 42.

Baffles 80, 82 extend downwardly from the top portion 52 to adjacent bottom portion 54, baffle 80 being disposed between end portion 43 of line 42 and magnetic member 74 and baffle 82 being disposed on the other side of the magnetic member 74. These baffles 80, 82 define passages 84, 86 respectively adjacent the top portion of the body 50, above the level of the upper end of the end portion 43 of line 42. A plug 88 is threadably connected to body 50 for filling the body 50 with lubricating liquid as desired and allowing access to the magnetic member 74 for removal thereof.

With forward movement of the vehicle 10 and accompanying rotation of the pump 40, liquid in chamber 34 is drawn through screen 46, line 42, and end portion 43 into the body 50, and out of the body 50 via line 58 through the pump 40 and to the area to be lubricated. It is to be understood that if the body 50 is initially empty of liquid, the pump 40 evacuates air from the body 50 until liquid begins to enter the body 50. While some lubricating liquid passes through passage 79, it is sized to limit the flow rate so that the left side of body 50 is substantially filled with liquid before appreciably filling the right side thereof. Upon further operation, the amount of air left in the body 50, and particularly above end portion 60 of line 58, decreases. This causes the flow of liquid through a circuitous route upwardly from line 42, downwardly along baffle 80, upwardly along baffle 80 and magnetic member 74, downwardly along the baffle 82 and magnetic member 74, and through the line 58, to improve the operational effectiveness of the magnetic member 74 and its ability to remove deleterious particles of steel that may be in the liquid. Reversing the direction of movement of the vehicle 10, and direction of rotation of the pump 40, will serve to evacuate the liquid in the pump 40 and the line 64 and positively seat or close the ball check valve 66 so that the liquid in the filter 70, etc., will not be withdrawn. While some liquid in reservoir body 50 may be expelled via the supply line 42, the reservoir body 50 arrangement generally limits the expelled amount to some intermediate, predetermined volume. Thus, while the pump 40 acts in reverse to suck some air in via the pump bearings (not shown) and expels it out the line 42 via the passages 84, 86 above the magnetic member 74, there is still a positive supply of liquid remaining in the body 50, substantially to the level of the upper end of the end portion 43 of the line 42, because of the differential elevational heights of the

upper ends of the end portions 43 and 60 of lines 42 and 58.

Upon forward movement of the vehicle 10 again, the pump 40 will be substantially immediately provided with liquid from the body 50, even though the line 42 is in the initial filling process, thus positively avoiding loss of prime of the pump 40. It should be noted that the predetermined volume of liquid in the reservoir body 50 has its free surface at an elevational level generally above the level of the upper end of the line 58, ensuring rapid pumping action of the lubrication system 38.

WHAT WE CLAIM IS:—

1. A lubrication system comprising: a source of lubricating liquid; a first line having a first end in communication with the source of lubricating liquid and extending upwardly therefrom to a second end; reservoir means for the lubricating liquid comprising a reservoir body, the second end of the first line being open and on an end portion of the first line extending into the reservoir body so as to render the first line in communication with the interior of the reservoir body; a second line having a first end on an end portion of the second line extending into the reservoir body, the first end being open so as to render the second line in communication with the interior of the reservoir body, the first end of the second line being at a lesser height than the second end of the first line, the second line having a second end on a portion of the second line extending outwardly of the reservoir body; and a liquid pump connected to the second end of the second line and capable of pumping the lubricating liquid through the second line to and from the interior of the reservoir body; actuation of the pump to pump fluid from the reservoir body through the second line, causing lubricating liquid to be drawn through the first line, into the reservoir body, through the second line and through the pump, to an area to be lubricated, and, actuation of the pump to pump fluid to the reservoir body through the second line, causing lubricating liquid to be pumped through the second line, into the reservoir body, up to the level of the second end of the first line, and through the first line, and air may be pumped through the second line into the reservoir body, and through the first line; the greater height of the second end of the first line as compared to the first end of the second line ensuring that, when fluid is pumped through the second line into the reservoir body, the level of the free surface of liquid in the reservoir body remains substantially at the level of the second end of the first line.



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jacent the top portion 52 of the reservoir body 50, parallel with the end portion 43 of the line 42.

Baffles 80, 82 extend downwardly from the top portion 52 to adjacent bottom portion 54, baffle 80 being disposed between end portion 43 of line 42 and magnetic member 74 and baffle 82 being disposed on the other side of the magnetic member 74. These baffles 80, 82 define passages 84, 86 respectively adjacent the top portion of the body 50, above the level of the upper end of the end portion 43 of line 42. A plug 88 is threadably connected to body 50 for filling the body 50 with lubricating liquid as desired and allowing access to the magnetic member 74 for removal thereof.

With forward movement of the vehicle 10 and accompanying rotation of the pump 40, liquid in chamber 34 is drawn through screen 46, line 42, and end portion 43 into the body 50, and out of the body 50 via line 58 through the pump 40 and to the area to be lubricated. It is to be understood that if the body 50 is initially empty of liquid, the pump 40 evacuates air from the body 50 until liquid begins to enter the body 50. While some lubricating liquid passes through passage 79, it is sized to limit the flow rate so that the left side of body 50 is substantially filled with liquid before appreciably filling the right side thereof. Upon further operation, the amount of air left in the body 50, and particularly above end portion 60 of line 58, decreases. This causes the flow of liquid through a circuitous route upwardly from line 42, downwardly along baffle 80, upwardly along baffle 82 and magnetic member 74, downwardly along the baffle 82 and magnetic member 74, and through the line 58, to improve the operational effectiveness of the magnetic member 74 and its ability to remove deleterious particles of steel that may be in the liquid.

Reversing the direction of movement of the vehicle 10, and direction of rotation of the pump 40, will serve to evacuate the liquid in the pump 40 and the line 64 and positively seat or close the ball check valve 66 so that the liquid in the filter 70, etc., will not be withdrawn. While some liquid in reservoir body 50 may be expelled via the supply line 42, the reservoir body 50 arrangement generally limits the expelled amount to some intermediate, predetermined volume. Thus, while the pump 40 acts in reverse to suck some air in via the pump bearings (not shown) and expels it out the line 42 via the passages 84, 86 above the magnetic member 74, there is still a positive supply of liquid remaining in the body 50, substantially to the level of the upper end of the end portion 43 of the line 42, because of the differential elevational heights of the

upper ends of the end portions 43 and 60 of lines 42 and 58.

Upon forward movement of the vehicle 10 again, the pump 40 will be substantially immediately provided with liquid from the body 50, even though the line 42 is in the initial filling process, thus positively avoiding loss of prime of the pump 40. It should be noted that the predetermined volume of liquid in the reservoir body 50 has its free surface at an elevational level generally above the level of the upper end of the line 58, ensuring rapid pumping action of the lubrication system 38.

WHAT WE CLAIM IS:—

1. A lubrication system comprising: a source of lubricating liquid; a first line having a first end in communication with the source of lubricating liquid and extending upwardly therefrom to a second end; reservoir means for the lubricating liquid comprising a reservoir body, the second end of the first line being open and on an end portion of the first line extending into the reservoir body so as to render the first line in communication with the interior of the reservoir body; a second line having a first end on an end portion of the second line extending into the reservoir body, the first end being open so as to render the second line in communication with the interior of the reservoir body, the first end of the second line being at a lesser height than the second end of the first line, the second line having a second end on a portion of the second line extending outwardly of the reservoir body; and a liquid pump connected to the second end of the second line and capable of pumping the lubricating liquid through the second line to and from the interior of the reservoir body; actuation of the pump to pump fluid from the reservoir body through the second line, causing lubricating liquid to be drawn through the first line, into the reservoir body, through the second line and through the pump, to an area to be lubricated, and, actuation of the pump to pump fluid to the reservoir body through the second line, causing lubricating liquid to be pumped through the second line, into the reservoir body, up to the level of the second end of the first line, and through the first line, and air may be pumped through the second line into the reservoir body, and through the first line; the greater height of the second end of the first line as compared to the first end of the second line ensuring that, when fluid is pumped through the second line into the reservoir body, the level of the free surface of liquid in the reservoir body remains substantially at the level of the second end of the first line.

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2. A lubrication system as claimed in claim 1 wherein the reservoir body is closed except for apertures therein through which said end portions of said first and second lines extend into the interior of the reservoir body.

3. A lubrication system as claimed in claim 1 or 2 further comprising a magnetic member fixed within the reservoir body and positioned so that at least some of the liquid lubricant therein flows along the magnetic member.

4. A lubrication system as claimed in claim 3 wherein the magnetic member is substantially flat and disposed between the second end of the first line and the first end of the second line.

5. A lubrication system as claimed in claim 3 or 4 further comprising baffle means disposed within the reservoir body for directing at least some of the liquid lubricant flow therein along the magnetic member.

6. A lubrication system as claimed in any preceding claim wherein the height of the pump is substantially the same as the height of the second end of the first line.

7. In a fluid system reservoir means comprising: a reservoir body comprising a top portion, a bottom portion, and side portions; a liquid source; a first line having a first end communicating with the liquid source and a second end on an end portion of the first line extending into the reservoir body, the second end of the first line being open so as to render the first line in communication with the interior of the reservoir body; a second line having a first end on an end portion thereof extending into the reservoir body, the first end of the second line being open so as to render the second line in communication with the interior of the reservoir body, the second line having a second end on a portion of the second line extending outwardly of the reservoir body; the reservoir body being closed except for apertures therein through which said end portions of said first and second lines extend into the interior of the reservoir body; means for pumping liquid from the liquid source through the first line, through the reservoir body, and through the second line; and a magnetic member fixed within the reservoir body and positioned so that at

least some of the liquid from the liquid source flowing through the reservoir body flows along the magnetic member. 55

8. A fluid system as claimed in claim 7 wherein the first line extends upwardly from the liquid source, and the second end of the first line is at a greater height than the first end of the second line. 60

9. A fluid system as claimed in claim 8 wherein the end portion of the first line extends through the bottom portion of the reservoir body, and the end portion of the second line extends through the bottom portion of the reservoir body, and wherein the magnetic member is substantially flat, is fixed relative to the bottom portion of the reservoir body, extends to adjacent the top portion of the reservoir body and is disposed between the second end of the first line and the first end of the second line, parallel to the end portion of the first line. 65 70 75

10. A fluid system as claimed in claim 9, further comprising first and second baffles extending downwardly from the top portion of the reservoir body to adjacent the bottom portion of the reservoir body on either side of the magnetic member, the first baffle being disposed between the second end of the first line and the magnetic member, so that liquid from the liquid source flows upwardly through the first line, downwardly along the first baffle, upwardly along the first baffle and magnetic member, downwardly along the second baffle and magnetic member, and through the second line. 80 85 90

11. A fluid system as claimed in claim 10, further comprising means for pumping fluid from the second line through the reservoir body and through the second line, and wherein the first and second baffles define first and second passages respectively adjacent the top portion of the reservoir body above the level of the second end of the first line. 95

12. A lubrication system substantially as described with reference to the accompanying drawings. 100

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