July 8, 1969 S. A. HENDERSON 3,454,138

LUBRICANT PUMP

Filed Aug. 9, 1967 Sheet 1 of 2

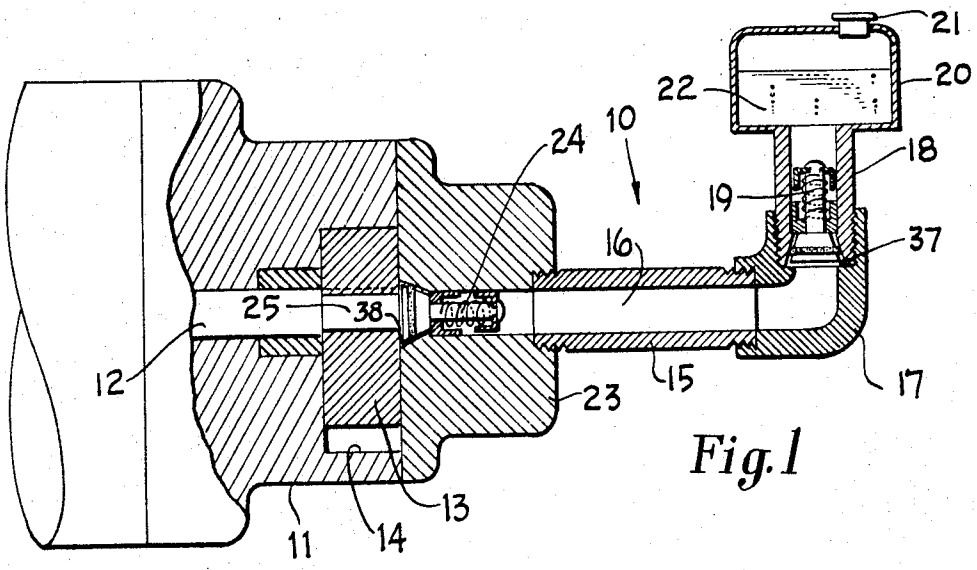


Fig. 1

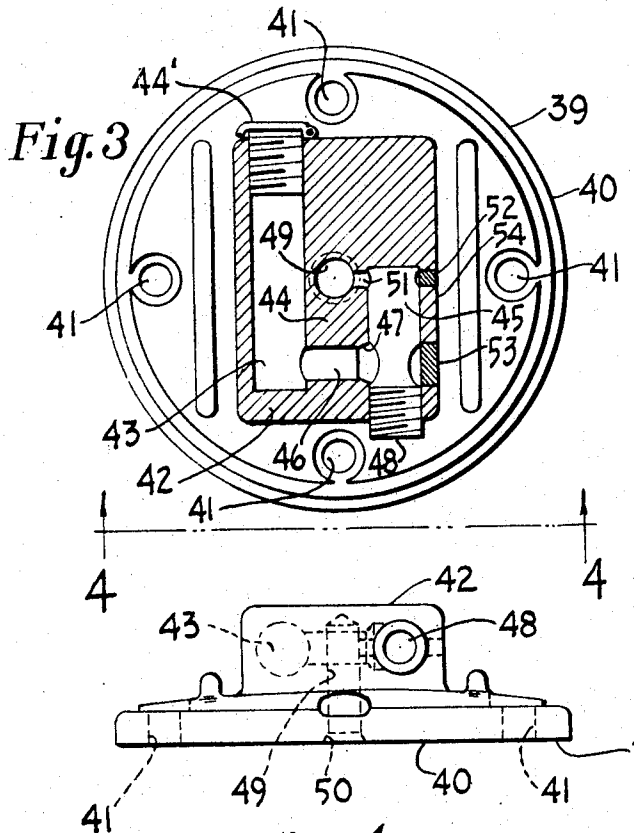


Fig. 3

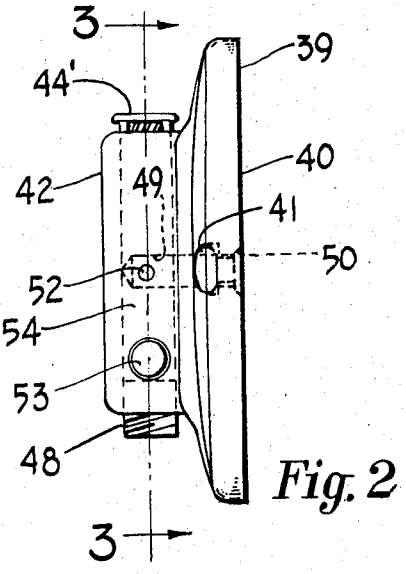


Fig. 2

Fig. 4

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Fig. 5

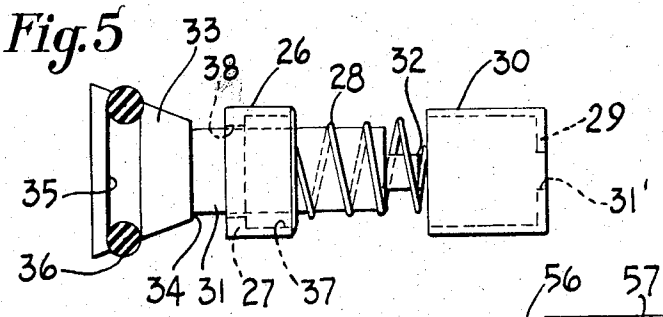


Fig. 6

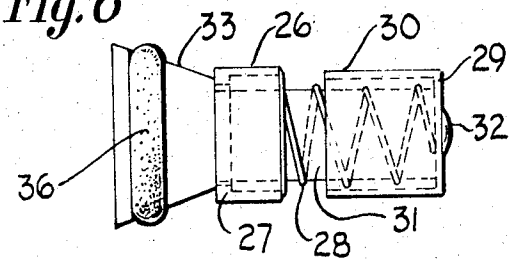
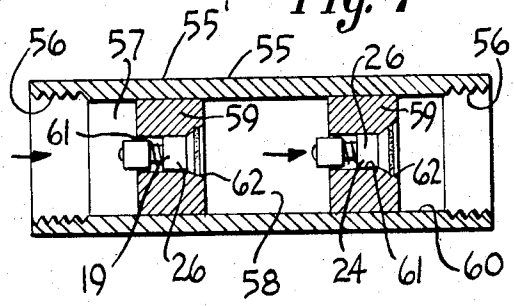


Fig. 7



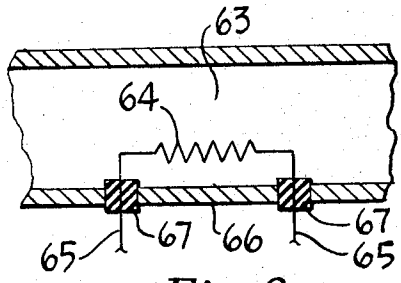


Fig. 8

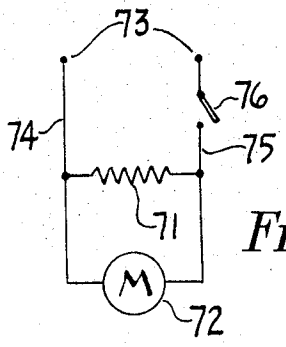


Fig. 10

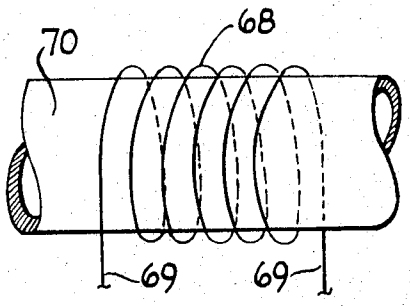


Fig. 9

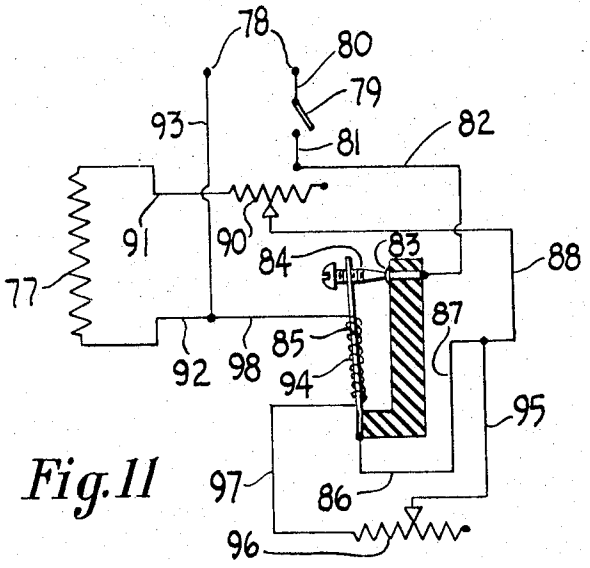


Fig. 11

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3,454,138

LUBRICANT PUMP

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U.S. Cl. 184—26 13 Claims

ABSTRACT OF THE DISCLOSURE

A pump for supplying lubricant to a device including a reservoir for lubricant, a pumping chamber, a first check valve for effecting communication between said reservoir and said pumping chamber, a second check valve for permitting flow of lubricant from said chamber to said device, means for periodically supplying heat to said chamber to effect a pumping action, and expansion means for permitting lubricant in said chamber to expand in response to increases in ambient tempreature without causing said second check valve to open. In one embodiment the pump is incorporated as an integral part of a cover for the device to be lubricated.

Background of the invention

The present invention relates to an improved pump for selectively providing charges of lubricant to a device.

In the past there have been lubrication pumps which were heat-responsive, that is, they would pump lubricant in response to the heat generated by a device as, for example, shown in United States Patent No. 2,861,652. Devices of this type were relatively complex in that they required heat-responsive members to provide the necessary mechanical movement for effecting the desired pumping action. However, devices of this type, because of their complexity, were subject to malfunctions. There was no known way of effecting the necessary pumping action while eliminating the necessary mechanical movements. It is with an improved lubricant pump which overcomes the above described shortcoming of prior devices that the present invention is concerned.

Summary of the invention

It is accordingly the primary object of the present invention to provide an improved lubricant pump which pumps lubricant to a device without utilizing mechanical movements for providing the pumping action.

Another object of the present invention is to provide an improved lubricant pump which is capable of providing a single charge of lubricant to a device incidental to the starting of the device thereby obviating the possibility of unnecessarily feeding lubricant to said device when it is not in operation, and which feeds said lubricant slowly as the device heats up thereby prolonging the lubrication process. A related object of the present invention is to provide an improved lubricant pump which provides charges of lubricant to a device at periodically timed intervals.

A further object of the present invention is to provide an improved heat-responsive pump for delivering lubricant to a device in response to the heat generated thereby but which will not deliver lubricant in response to small swings in ambient temperature.

A still further object of the present invention is to provide an improved self-contained lubricant pump consisting of a heat conductive conduit having check valves therein which will take in a charge of lubricant when it cools and will discharge the lubricant due to its expansion when it heats. Other objects and attendant advantages of the present invention will readily be perceived hereafter.

Broadly, the improved lubricant pump of the present invention includes a lubricant reservoir, a housing containing a pumping chamber, a first check valve interposed between the reservoir and the pumping chamber to permit lubricant to flow into said pumping chamber when said chamber cools and a second check valve for permitting flow of lubricant from said chamber to a device to be lubricated when the lubricant in said chamber expands in response to being heated, and means for heating said lubricant within said chamber to cause the expulsion of said lubricant through said second check valve. In addition, expansion means are associated with the pumping chamber to permit the lubricant to expand due to increases in ambient temperature without being discharged through said second check valve. The preferred embodiment of the present invention incorporates the foregoing structure in the end cap or cover of a device to be lubricated. In another form of the present invention the improved pump of the present invention is incorporated within a heat-conductive length of tubing. Another modification of the present invention utilizes an external heating source for heating lubricant within the chamber, either incidental to the energization of the device to be lubricated or by means of a circuit which effects periodic timed heating of the lubricant chamber to thereby provide periodic discharges of lubricant. The present invention will be more fully understood when the following portions of the specification are read in conjunction with the accompanying drawings wherein:

Brief description of the drawings

FIGURE 1 is a schematic side elevational view partially in cross section showing the improved lubricant pump of the present invention mounted on a device containing a rotating element such as a air pump or compressor; FIGURE 2 is a side elevation view of a preferred embodiment of the improved pump of the present invention wherein it is incorporated into the end cap or cover of a device; FIGURE 3 is a view partially in cross section taken substantially along line 3—3 of FIGURE 2; FIGURE 4 is a bottom plan view taken substantially in the direction of the arrows 4—4 of FIGURE 2; FIGURE 5 is a side elevational, semi-exploded view, partially in cross section showing the construction of the check valves used in the pump of FIGURES 1–4; FIGURE 6 is a side elevational view showing the parts of FIGURE 5 assembled; FIGURE 7 is a side elevational view, partially in cross section showing another embodiment of the improved pump which is incorporated into a length of tubing such as a nipple; FIGURE 8 is a fragmentary view partially in cross section, showing the lubricant pumping chamber with a resistance heating element incorporated therein to supply the heat required for pumping; FIGURE 9 is a fragmentary side elevational view of the pumping chamber, but showing a heating coil wound around the outside of the chamber; FIGURE 10 is a schematic wiring diagram showing the manner of energizing the heating coils of FIGURES 8 or 9 incidental to energizing the device which is to be lubricated so as to provide a single charge of lubricant; and FIGURE 11 is an electrical wiring diagram showing how the heating coils of FIGURES 8 or 9 can be energized cyclically to periodically provide charges of lubricant to a device.

Description of the preferred embodiments

In FIGURE 1 one embodiment of the improved lubricant pump **10** is shown mounted on a device such as an air compressor or pump **11** having a shaft **12** mounting a rotor **13** which is located within chamber **14**, the shaft **12** being driven by a suitable electric motor, not shown. The

pump 11 may be of the type in which spring biased vanes, not shown, move radially of rotor 13 in following the surface of chamber 14 to thereby trap and move air which is supplied from a suitable inlet and moved to a suitable outlet conduit. While an air compressor or pump has been mentioned above, it will be appreciated that the improved pump of the present invention can be used with any conceivable type of device having moving parts which require periodic lubrication.

The improved pump 10 includes a housing 15 forming a pumping chamber 16. Mounted at one end of housing 15 is an elbow 17 which in turn mounts nipple 18 carrying an inlet check valve 19. An oil reservoir 20 having a cap 21 mounted thereon contains a body of lubricant 22. Check valve 19 will permit lubricant to flow from reservoir 20 into chamber 16 but will not permit flow in a reverse direction. Therefore, once a charge of lubricant has been taken into pumping chamber 16 from reservoir 20, it cannot pass out of the chamber through inlet check valve 19. The other end of housing 15 is mounted on cover 23 which carries outlet check valve 24 which permits flow of lubricant from chamber 16 onto the end of portion 25 of shaft 12. Cap 23 and housing 15 are preferably fabricated from heat-conducting metallic material so that the heat generated by device 11 will be transmitted to chamber 16 through cap 23 and housing 15. Chamber 16 is full of lubricant and when this lubricant expands due to the heat conducted thereto, it will cause outlet check valve 24 to unseat to permit flow of lubricant onto the end portion 25 of shaft 12. Since this shaft is rotating, the lubricant will travel radially along the wall of chamber 14 to provide lubrication.

It can be seen that there will be a gradual discharging or weeping of lubricant into chamber 14 from chamber 16 when outlet check valve 24 opens. This discharging or weeping occurs as long as the temperature of chamber 16 is increasing and will cease when the temperature stops increasing or falls. The weeping of lubricant from chamber 16 provides improved lubrication because the lubricant is discharged gradually over a relatively long period of time as the device 11 heats up. After the discharging has been completed, the valve will close and no more discharging of lubricant will occur until chamber 16 has been refilled. This refilling occurs when housing 15 cools, that is, after the device 11 stops operating, at which time a vacuum will be created in chamber 16 which will cause outlet check valve 24 to remain closed and inlet check valve 19 to open to permit lubricant 22 from reservoir 20 to enter chamber 16. Upon subsequent start-up, the above described cycle of providing a charge of lubricant to chamber 14 via outlet check valve 24 will be repeated.

The check valves 19 and 24, which are identical, are shown in greater detail in FIGURES 5 and 6. Each check valve includes a central cylindrical collar or sleeve 26 which is press-fitted into the member in which it is positioned. This collar includes an end flange 27 which forms a seat for one end of compression spring 28, the other end of which bears on flange 29 formed integrally with cylindrical sleeve 30 which is mounted on stem 31 of the valve member by means of a pin 32 formed integrally with stem 31 which extends through aperture 31' in sleeve 30 and is staked thereto. It is to be noted at the present time, as can be seen from FIGURES 1 and 5 and 6, that sleeve 26 is of greater diameter than sleeve 30 so that sleeve 30 may travel axially within the bore in which the check valve is located. There is a clearance between the outside of sleeve 30 and the inner wall of the chamber to permit lubricant to travel past sleeve 30. Formed integrally with stem 31 is a frustoconical poppet valve 33 which terminates at base 34 which forms a shoulder. An annular groove 35 is formed on valve 33 and this groove receives a resilient O-ring 36 which seats on frustoconical valve seat 37 of housing 18 (FIG. 1) or frustoconical valve seat 38 of end cap 23.

Whenever there is a sufficient build-up of pressure in chamber 16, poppet valve 33 and O-ring 36 will be forced off of its seat. This will permit lubricant to flow through the space between the housing and the outer surface of sleeve 30 and through the inside portion 37 of sleeve 26 and through the oversized aperture 38 formed by flange 27 which provides a clearance between it and stem 31. This type of action occurs through both valves 19 and 24 which are identical to the structure shown in FIGURES 5 and 6. It will be appreciated that whenever there is no pressure tending to unseat the poppet valve 33, spring 28, which is in compression, will force the O-ring 36 onto its seat by virtue of providing a force tending to separate sleeves 30 and 26.

At this point it is to be noted that the springs 28 are calibrated to permit the valves to open only when there is a temperature rise in excess of a predetermined number of degrees. However, it is undesirable that the valves open with swings in ambient temperature. If this occurred, there would be a pumping action and this could result in pumping substantial quantities of oil or lubricant into chamber 14 when the device was not being used. In order to obviate this possibility, O-ring 36 in each valve is sufficiently resilient so that it will compress, especially in inlet valve 19, to provide the extra volume within chamber 16 which may be required to accommodate the expansion of lubricant which is experienced due to an ambient temperature rise. This compression of O-ring 36 occurs before spring 28 can compress to permit outlet valve 24 to unseat. It can thus be seen that the embodiment of FIGURE 1 provides a pumping action in response to the heating of lubricant within chamber 16 without requiring mechanical devices to provide the necessary motion to effect a pumping action.

In FIGURES 2, 3 and 4 the preferred embodiment of the present invention is disclosed. In this embodiment, the improved lubricant pump of the present invention is entirely incorporated into end cap 39 of a compressor or air pump. Cap 39 includes a base 40 having a plurality of spaced apertures 41 which receive suitable fastening members such as screws for attaching the end cap 39 to the remainder of the compressor housing. A housing 42 is cast integrally with cap 39 and includes a lubricant reservoir 43 having a cap 44' mounted thereon. A pumping chamber 45 is also mounted in housing 42 and is separated from reservoir 43 by common wall 44. An inlet check valve such as 19 fits into bore 46 with sleeve 26 being pressed into said bore and O-ring 36 seating on frustoconical seat 47. A removable plug 48 is inserted into the end of chamber 45. A second bore 49 is located in housing 42 and receives sleeve 26 of outlet check valve 24 in press-fitted relationship with the O-ring 36 of the check valve seating on frustoconical valve seat 50. Bore 49 is in communication with pumping chamber 45 through bore 51 in wall 44. As can be seen from FIGURES 2 and 3, plugs 52 and 53 are placed in wall 54 of housing 42 inasmuch as this wall must be bored in order to drill bores 51 and 46, respectively. The end cap 39 is fabricated from material which is a relatively good conductor of heat so that the heat generated by the operation of the pump or compressor on which end cap 39 is mounted will be conducted to the lubricant in chamber 45 to cause it to expand and thus unseat the outlet check valve from valve seat 50 to force the lubricant into the device to be lubricated, as explained above relative to the embodiment in FIGURE 1. After the device is shut off and it cools, a vacuum will be created in pumping chamber 45 which will cause the inlet check valve to be unseated from its valve seat 47 and thus permit lubricant to pass into pumping chamber 45 from reservoir 43. As noted above, the check valves which are inserted in bores 46 and 49 are identical to those shown in FIGURES 5 and 6 and it is therefore deemed that a detailed repetition of the manner of operation of said check valves is not necessary.

In FIGURE 7 a further embodiment of the present invention is shown. This embodiment discloses a lubricant pump 55 which may be installed as a unit for lubricating

any type of device with single charges of lubricant. This pump **55** is essentially a length of heat-conductive pipe **55'** which is preferably fabricated from brass or copper having good heat conducting qualities. Conduit **55'** is tapped at **56** to permit it to be attached to inlet and outlet conduits, with the inlet conduit being in communication with a suitable lubricant reservoir, not shown. Alternatively, the inlet portion **57** may be made of a suitable configuration to contain a reservoir of lubricant and a cap may be inserted into threaded tapped portions **56** associated therewith. As can be seen, pump **55** includes a pumping chamber **58** haing an inlet check valve **19** and an outlet check valve **24**. The inlet and outlet check valves **19** and **24** are identical in all respects to the check valve described in detail above relative to FIGURES 5 and 6 and it is therefore believed that a detailed description is unnecessary. These check valves are mounted within pump **55** by having the center sleeves **26** press-fitted within annular members **59** which are in turn press-fitted into the bore **60** of unit **55**. Members **59** each have a cylindrical bore **61**, which receives sleeve **26**, and a frustoconical seat **62** for receiving the O-ring **36**. The mode of operation of the embodiment of FIG. 7 is the same as the embodiment of the preceding figures, namely when pipe **55'** heats up, there will be a build-up of pressure within chamber **58** and outlet check valve **24** will be open to permit lubricant to flow in the direction of the arrow. When pipe **55'** cools, a vacuum will be created within pumping chamber **58** to cause inlet check valve **19** to open to permit lubricant to flow into chamber **58** from inlet portion **57** which may be considered as the lubricant source or reservoir.

A further modification of the present invention is shown in FIGURE 8 which may be added to any of the devices shown in the preceding FIGURES 1 to 4 and 7. In certain cases there may not be a sufficient heat flow to the pumping chamber **63**, which is analogous to pumping chamber **16** of FIGURE 1, **45** of FIGURES 2 to 4, and **58** of FIGURE 7. Therefore, it becomes necessary to heat the lubricant in chamber **63** for the purpose of expanding it and causing it to flow to the part to be lubricated. To this end, a resistance heater **64** is located within chamber **63**, said resistance heater being in communication with a source of electric current through lead wires **65** which extend through the wall **66** of chamber **63** by being held within nonconductive plugs **67**.

In FIGURE 9 a still further modification of the present invention is shown wherein a heating wire **68** which is suitably coupled to a source of electric current through leads **69** encircles a pumping chamber wall **70** for supplying heat thereto to expand the lubricant therein and provide the pumping action described in detail above. Housing **70** may be analogous to housing **15** of FIGURE 1, housing **42** of FIGURES 2 to 4 or housing **55'** of FIGURE 7.

In FIGURE 10 an electric circuit is shown which can be used for energizing heating coil **71** which heats the lubricant, said coil **71** being analogous to heating elements **64** and **68** of FIGURES 8 and 9, respectively. As can be seen from FIGURE 10, the device which is to be lubricated, such as the compressor having a motor **72**, is coupled across voltage source **73** by leads **74** and **75** and through switch **76**, with heating coil **71** being placed across leads **74** and **75** in parallel with motor **72**. Thus, whenever motor **72** is energized by the closing of switch **76**, heating coil **71** will be energized simultaneously to heat the lubricant in the pumping chamber and cause it to expand to thereby be forced to the part to be lubricated. It will be noted that once the switch **76** is closed, heating coil **71** will remain energized until switch **76** is again opened. This type of system for heating the lubricant is suitable where the motor **72** will be energized periodically for short periods of time.

In FIGURE 11 another circuit is shown for supplying heat to the lubricant in any of the pumping chambers described above. In this respect, the circuit includes a heating coil **77** which is analogous to heating coil **71** in FIGURE 10, said heating coil **77** being for the purpose of placement within a chamber, such as shown in FIGURE 8 or in encircling relationship to a chamber as shown in FIGURE 9 and said heating coil **77** can be used in conjunction with any of FIGURES 1 through 4 and 7. The circuit of FIGURE 11 includes a voltage source **78** which supplies electric current to heating element **77** when switch **79** is closed via lead **80**, switch **79**, lead **81**, lead **82**, contact **83**, contact **84**, bimetallic arm **85**, lead **86**, lead **87**, lead **88**, rheostat **90**, lead **91**, heating element **77**, lead **92** and lead **93**. It is to be noted that when bimetallic element **85** is cool, contact **84** is in engagement with contact **83** to complete the foregoing circuit. In addition with the completion of the above mentioned circuit, there will be a flow of current through heating coil **94** encircling bimetallic element **85**. In this respect there is also a circuit completed from source **78** through lead **80**, switch **79**, lead **81**, lead **82**, contact **83**, contact **84**, bimetallic element **85**, lead **86**, lead **87**, lead **95**, rheostat **96**, lead **97**, heater winding **94**, lead **98** and lead **93** back to the voltage source. The heating circuit will be maintained until bimetallic element **85** warps in the well-known manner to cause contact **84** to move out of engagement with contact **83** whereupon the entire circuit to lubricant heating element **77** is disrupted. When bimetallic element **85** cools and warps so that contact **84** engages contact **83**, the foregoing circuit will be reestablished. The making and breaking of the foregoing circuit will cause periodic energization of heating coil **77** to cause the pump associated therewith to periodically supply charges of lubricant to the device to be lubricated. As noted above, there is a rheostat **96** in the circuit of bimetallic heating coil **94** and the adjustment of the resistance of rheostat **96** will determine the length of time that it takes for bimetallic element **85** to be heated so as to thereby in turn determine the cycle of operation of the heating circuit. Rheostat **90** associated with lubricant heating element **77** can be used to adjust the time required for heating the lubricant in the chamber. It will be appreciated that as element **77** heats and cools a pumping action will be effected.

An alternate pumping arrangement can be obtained with a modified circuit similar to that of FIGURE 11 by immersing bimetallic element **85** in the lubricant in the pumping chamber and eliminating the bimetal heating coil **94**. In this modification, heating coil **77** will heat the oil in the pumping chamber when contacts **83** and **84** are engaged and they will disengage after the heated lubricant has caused flexing of the bimetal. After the lubricant cools bimetallic element **85** will deflect to cause contacts **84** and **83** to again engage and complete a heating circuit through element **77**. In this modification the placing of bimetallic element **85** and its associated contacts in the lubricant chamber permits the elimination of heating coil **94** and its related circuit.

It can thus be seen that the improved lubrication system of the present invention is manifestly capable of achieving the above numerated objects and while preferred embodiments of the present invention have been disclosed, it will readily be appreciated that it is not limited thereto but may be otherwise embodied within the scope of the following claims.

I claim:

1. A pump for supplying lubricant to a device which is to be lubricated comprising a housing including a pumping chamber, a first check valve for permitting flow of lubricant into said chamber, a second check valve for permitting flow out of said chamber to said device, and means operatively associated with said housing for supplying heat to said pumping chamber to thereby expand said lubricant in said chamber and thus cause said lubricant to be forced through said second check valve to said device, said first check valve opening on the cooling of

said chamber to permit flow of lubricant into said chamber.

2. A pump as set forth in claim 1 including first and second spring means for normally biasing said first and second check valves, respectively, to a closed position.

3. A pump as set forth in claim 1 including expansion means for permitting lubricant in said chamber to expand with changes in ambient temperature without causing said second check valve to open.

4. A pump as set forth in claim 2 wherein said first check valve includes a poppet valve, a valve seat, and a resilient member interposed between said valve and said valve seat for compressing when said lubricant in said chamber expands, said resilient member having greater effective resilience than said second spring means, whereby said resilient member compresses before said second spring means permits said second check valve to open, to thereby permit expansion of lubricant in said chamber due to ambient temperature changes without causing lubricant to be discharged through said second valve means.

5. A pump as set forth in claim 1 wherein said means for supplying heat to said chamber comprises conductor means providing a heat path between said device and said chamber.

6. A pump as set forth in claim 1 wherein said means for supplying heat to said chamber comprises an electrical heating coil for heating said lubricant in said chamber.

7. A pump as set forth in claim 6 wherein said heating coil is located externally of said chamber.

8. A pump as set forth in claim 6 including means for periodically and cyclically energizing said heating means.

9. A pump as set forth in claim 6 including expansion means for permitting lubricant in said chamber to expand with changes in ambient temperature without causing said second check valve to open.

10. A pump as set forth in claim 6 including first and second spring means for normally biasing said first and second check valves, respectively, to a closed position, and wherein said first check valve includes a poppet valve,

a valve seat, and a resilient member interposed between said valve and said valve seat for compressing when said lubricant in said chamber expands, said resilient member having greater effective resilience than said second spring means, whereby said resilient member compresses before said second spring means permits said second check valve to open, to thereby permit expansion of lubricant in said chamber due to ambient temperature changes without causing lubricant to be discharged through said second valve means.

11. A pump as set forth in claim 1 wherein said pump comprises a cap adapted to be mounted on said device, a first chamber forming a reservoir on said cap, and wherein said pumping chamber comprises a second chamber on said cap, conduit means for effecting communication between said first and second chambers, and wherein said first check valve is mounted in said conduit means.

12. A pump as set forth in claim 4 including expansion means for permitting lubricant in said chamber to expand with changes in ambient temperature without causing said second check valve to open.

13. A pump as set forth in claim 12 wherein said pump comprises a cap adapted to be mounted on said device, and wherein a first chamber forming a reservoir on said cap, and wherein said pumping chamber comprises a second chamber on said cap, conduit means for effecting communication between said first and second chambers, and wherein said first check valve is mounted in said conduit means.

References Cited

UNITED STATES PATENTS

2,007,482	7/1935	Stitt	184—26
2,861,652	11/1958	Small.	
2,867,224	1/1959	Martiniak et al.	60—23 X
2,954,845	10/1960	Minera	60—23 X
3,099,222	7/1963	Poliseo	60—23 X

HALL C. COE, *Primary Examiner.*

U.S. Cl. X.R.

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