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LUBRICATION SYSTEM FOR MOTORS

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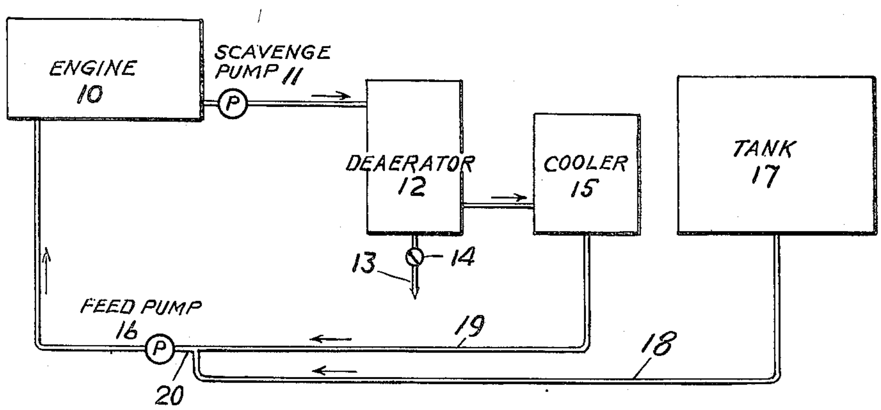

FIG. 1.

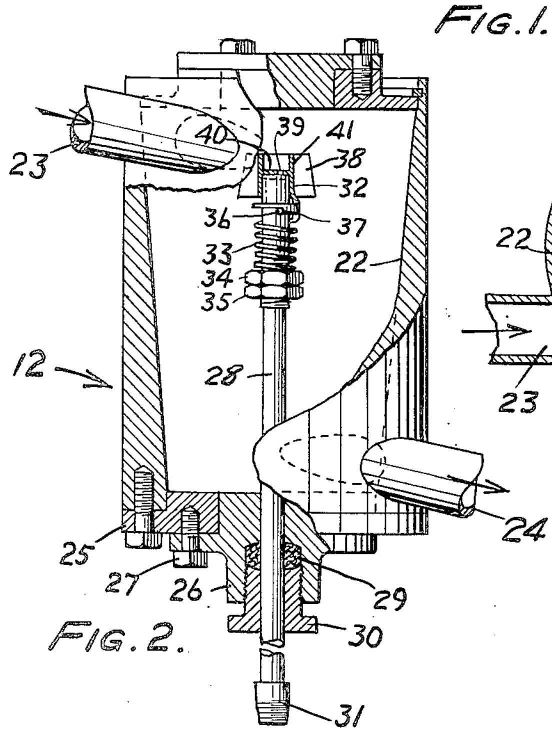

FIG. 2.

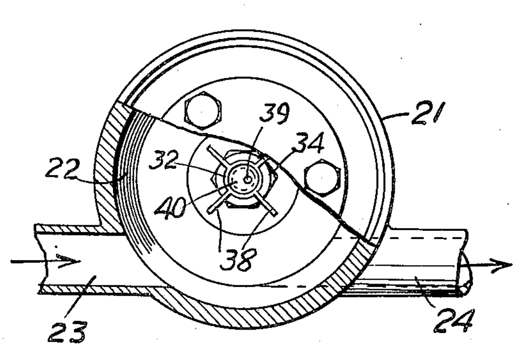

FIG. 3.

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LUBRICATION SYSTEM FOR MOTORS

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3 Claims. (Cl. 184—6)

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The present invention pertains to an oil circulating and feeding system for motors, and was conceived as a solution of problems encountered in feeding systems of this kind as applied to aviation motors. It will accordingly be described in reference to that problem, although it has wider possibilities.

The conventional lubricating system of an airplane engine consists of an oil storage tank, a conduit from the storage tank to the engine, a feed pump on or in the engine for pumping oil to the various parts of the engine to lubricate it, a sump in the engine into which the oil drains from the various parts of the engine, a scavenge pump for pumping oil from the sump and a conduit from the scavenge pump back to the oil storage tank. The system may include additional items such as an oil cooler, a relief valve to bypass oil around the cooler under certain conditions, a thermostatic valve for accomplishing this same purpose, and/or a centrifugal separator for purifying the oil after use, but the elements discussed above are the essential ones, insofar as the system of the present invention is concerned.

The scavenge pump ordinarily has a displacement from two to three times as great as the oil feed rate of the feed pump in the case of radial engines, and in the case of in-line engines, there are usually two scavenge pumps, one at each end of the crankcase, each of these pumps having a displacement about twice as great as that of the feed pump. This relationship of capacities between the scavenge pump or pumps and feed pump is necessary to insure the continuous removal of all of the oil which drains into the sump. A necessary incident to this relationship, however, is the fact that gas from the crankcase is pumped by the scavenge pump or pumps together with the oil.

The vapor carried into the oil stream through the scavenge pump requires, in conventional systems, that the oil-gas mixture be pumped to the oil storage tank so the gas may escape from the oil before the oil goes to the feed pump and engine bearings.

When flying at high elevation, there is difficulty with conventional systems, due to lack of atmospheric pressure to force oil from the storage tank to the inlet of the feed pump. This difficulty is aggregated by the air bubbles entrained in the oil, since these air bubbles seriously impair flow of oil to the feed pump at high elevations.

The present invention includes features for solution of each of the above-discussed problems.

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It includes, in the preferred form, a system to which the oil is fed, under pressure derived from the energy imparted to it by the scavenge pump, from that pump to a zone at the inlet of the feed pump. A separate conduit interconnects the oil storage tank with the feed pump inlet, and the small stream of make-up oil fed to the feed pump from the storage tank joins the large stream of oil returned to the feed pump by the scavenge pump at the feed pump inlet or in other words adjacent thereto.

By the use of such a system, a large part of the flow of oil to the feed pump is positively impelled to the inlet of the feed pump by energy derived from the scavenge pump, with the result that the portion of the oil passed independently from the oil storage tank to the feed pump inlet is much smaller than that which would otherwise be required to be furnished from the storage tank. As a consequence of this fact, much of the difficulty heretofore encountered in feed of oil to the engine at high altitudes is avoided, since the necessary pressure drop in passing oil from the storage tank to the feed pump inlet is minimized by minimizing the quantity of flow of such oil.

An important feature in the preferred practice of the invention is that the oil is passed through a deaerator during the course of its flow from the scavenge pump to the inlet of the pressure pump, thereby eliminating most of the gas incorporated in the oil by the action of the scavenge pump. This deaerator is preferably of such design as to permit flow of the oil therethrough during deaeration without loss of more than a part of the energy imparted to such oil by the scavenge pump, and the gas may thus be eliminated during the course of flow of oil from the scavenge pump to the pressure pump, without interference with the fundamental feature of the invention involving use of energy from the scavenge pump to cause the oil to flow to the feed pump inlet.

The invention will be better understood by reference to the attached drawing in the light of the following detailed description.

In the drawing,

Figure 1 is a flow sheet of the process and system of the invention,

Figure 2 is an elevational view, largely in cross section, illustrating a deaerator which may be used in practice of the invention, and

Figure 3 is a plan view, partly in section, of the apparatus of Figure 2.

Referring to the drawing by reference characters, it will be seen that Figure 1 illustrates an arrangement in which the oil is sucked from the engine 10 by a scavenge pump 11. From the scavenge pump, the oil and gas pass to a deaerator 12, which is preferably of the centrifugal tank type, and may be a stationary tank into which the oil is introduced tangentially as will be described hereinafter in connection with Figure 2. Gas separated from the oil in the deaerator 12 may be discharged from the system through a vent line 13 provided with a check valve 14 which prevents undesirable entry of gas into the lubricant circulating system. After treatment in the deaerator 12, the oil may be passed through a cooler 15, while still under energy derived from the scavenge pump, and it may be passed from this cooler directly to the inlet of the pressure pump 16, which forces it to the engine bearings.

Make-up oil is provided from oil storage tank 17 through conduit 18 which communicates with the conduit 19 through which oil flows from cooler 15 to pump 16. The zone of confluence 20 between the conduits 18 and 19 carrying the make-up oil from the tank 17 and the oil from the scavenge pump 11, respectively, is adjacent to the feed pump 16; i. e., directly in the casing of that pump or at a zone of juncture between the conduits 18 and 19 which is close to the pump. Thus, the oil from tank 17 is passed through the conduit 18 which is independent of the conduit 19 through which oil is passed from cooler 15 to pump 16, and these two conduits do not join until they reach a point closely adjacent the feed pump 16. The oil from scavenge pump 11 is thus passed through the deaerator and cooler and to feed pump 16 under pressure derived from the scavenge pump, while oil is supplied from tank 17 only in sufficient amount to make up for oil used up in operation of the engine. Since the conduit 18 is thus required to supply only a small part of the oil passed to the feed pump and thence to the engine 10, the resistance due to passage of oil through the conduit 18 is relatively slight, and oil can be satisfactorily passed from tank 17 through connection 20 to the feed pump 16. The connection 20 may be in the form of a simple T, which is, of course, substantially unrestricted.

The provision of the deaerator 12 in the line of flow of oil from the scavenge pump 11 to the feed pump 16 forms an important feature of my invention in the above combination. By providing this deaerator, the oil from the engine may be recycled repeatedly, without producing the difficulty of feeding a large quantity of gas back to the engine 10.

The deaerator 12 may be of any suitable type designed to receive oil from the scavenge pump 11 and permit removal of air from that oil while passing the oil through the system to the feed pump 16 under energy derived from the scavenge pump. It may be a stationary tank provided with a vent or check valve designed to permit removal of gas while precluding removal of more than a small quantity of oil, and permitting passage of the oil stream forwardly through the system without destroying more than a small part of the energy which the oil contains when it enters the deaerator.

While, as explained above, the deaerator may be a simple tank provided with a vent or check valve and inlet and outlet conduits for the oil under treatment, one form of deaerator which is satisfactory for practice of the invention is that described and claimed in the co-pending application of Leo D. Jones and John J. Serrell, Serial No. 495,262, which has matured into Patent No. 2,401,079, dated May 28, 1946. The type of deaerator there described is illustrated in Figures 2 and 3 of the attached drawing. The deaerator consists of a tank 21 provided with an interior surface 22 which is preferably circular, and which may be cylindrical or frustoconical as shown. This tank is provided with an inlet connection 23 for injecting oil tangentially into the tank along the surface 22 in a direction having a longitudinal component toward the tangential outlet 24 which receives the oil after the gas has been separated by centrifugal force due to rotating movement of the oil during passage along the surface 22 from entrance to exit.

The tank 21 is provided with an end plate 25, which is removably mounted to permit access to the interior of the tank. This end plate is provided with a central opening to receive a housing 26 for a packing gland, this housing being secured to the end plate by bolts 27. A hollow tube 28 is slidably mounted in a central bore of the housing 26, the upper end of this tube extending to a position within the tank 21, and this position being adjustable by longitudinal movement of the tube. A packing gland 29 surrounds the tube 28 within the bore of the housing 26, and the prevention of leakage and longitudinal securement of the tube in the desired position are both accomplished by tightening of the gland nut 30.

Tube 28 is provided with a nipple 31 at its lower end for connection to other piping. A valve 32 is secured in sliding relationship upon the upper end of the tube 28, and the upper end of the valve is urged downwardly and held in contact with the upper end of the tube 28 by the spring 33. The lower end of the spring 33 is secured in position longitudinally with respect to the tube 28 by the nut 34, which may be locked by nut 35, both of these nuts being threaded to the tube 28. These nuts provide a method of securing the spring in position longitudinally, and also a method of altering the tension on the spring, as will be evident from inspection of the drawing. A stop pin 36 is secured to the tube 28 adjacent the bottom of the valve 32, and this stop pin coacts with an abutting surface 37 of the lower end of the valve to secure the valve in open position under the influence of the spring 33 until accumulation of a predetermined thickness of an annular layer of liquid along the interior of the wall 22, as will be evident from further discussion of details by which this result is accomplished. A plurality of wings 38 extend outwardly from the cylindrically extending portion of the outer surface of the valve 32, and this valve is also provided with a cylindrically extending portion 41 above the upper end of the tube 28, in order to minimize leakage of oil into the tube 28 by splashing. When the abutment 37 is in contact with the pin 36, an opening 39 in the upper, otherwise closed, end 40 of the valve 32 registers with an opening in the upper end of the tube 28 to permit discharge of gas through these registering openings and the tube 28. When the abutment 37 is moved in a counter-clockwise direction away from the pin 25, on the other hand, these openings are brought out of registry with each other, with the result that the valve connection and possibility of discharge of gas through the tube 28 is closed, much after the fashion of a talcum powder can.

In the operation of the above apparatus, the mixture of air and oil, which may be under pressure derived from the scavenge pump, enters through the tangential inlet pipe 23. The mixture flows around the inner wall 22 of the tank 21, during its passage from the inlet 23 to the outlet 24, and this rotating flow causes separation of air toward the center of the tank under the influence of centrifugal force. After being relieved of its air in this manner, the oil leaves the tank through the tangential outlet 24. The air flows through the hole 39 and registering hole in the top of tube 28, and escapes from the apparatus through this tube. So long as the valve is maintained in open position by the action of the spring 33 in holding the abutment 37 against the pin 36, the air will discharge rapidly through the valve and tube 28. During this operation, the thickness of the body of oil rotating within the surface 22 during its passage longitudinally along that surface will gradually increase until the inner surface of this layer strikes the wings 38 and causes these wings to move in a counterclockwise direction against the influence of the spring 33. This rotary movement of the wings 38 under the impelling effect of the rotation of the body of oil within the tank causes the opening 39 to be moved out of registry with the coacting opening in the otherwise closed upper end of the tube 28, and prevents further discharge of air so long as this condition continues to prevail. As the operation continues after this condition is reached, the pressure in the central part of the tank 21 will increase, due to the fact that the released air cannot be discharged through the tube 28, and this increase in pressure will cause an increase in the amount of oil discharged through tangential outlet 24, with the result that the amount of discharge will ultimately exceed the amount of feed, and the inner surface of the stratum of oil within the surface 22 will again recede. When this happens, the spring 33 will again return the valve to open position, with the result that the air can again be discharged through tube 28.

The above description of the operation of the centrifugal deaerating apparatus is somewhat idealized for the sake of simplicity of explanation. As a matter of fact, in the actual operation of the apparatus, the valve may not be moved completely either to absolutely closed or absolutely open position, after the operation is well under way. This valve moves to an intermediate position after a condition fairly close to equilibrium is established between the effect of the spring 33 in moving the valve to open position and the effect of wings 38 in moving it to closed position.

Various modifications of the invention are available to those skilled in the art, in addition to those discussed above, and I do not accordingly intend that the invention shall be limited except by the scope of the following claims.

I claim:

1. In an oil circulating and feeding system for a motor, the combination comprising, a scavenge pump for removing oil from the motor, an oil storage tank, a feed pump for feeding oil to the motor, a conduit for conducting oil from said scavenge pump under energy derived from said scavenge pump to the inlet of said feed pump, and a conduit separate from said first-mentioned conduit for separately conducting oil from said storage tank to the feed pump inlet and into confluence adjacent said inlet with oil passed by said first-mentioned conduit to said feed pump inlet from said scavenge pump, said first-mentioned conduit being substantially unrestricted at the point of said confluence, whereby oil from said scavenge pump and storage tank are passed through said feed pump together but are passed independently to the inlet to said feed pump.

2. In an oil circulating and feeding system for a motor, the combination comprising, a scavenge pump for removing oil from the motor, an oil storage tank, a feed pump for feeding oil to the motor, a conduit for conducting oil from said scavenge pump under energy derived from said scavenge pump to the inlet of said feed pump, a deaerator for removing gas from said oil during passage thereof from said scavenge pump to said feed pump, and a conduit separate from said first-mentioned conduit for separately conducting oil from said storage tank to the feed pump inlet and into confluence adjacent said inlet with oil passed by said first-mentioned conduit to said feed pump inlet from said scavenge pump, said first-mentioned conduit being substantially unrestricted at the point of said confluence, whereby oil from said scavenge pump and storage tank are passed through said feed pump together but are passed independently to the inlet to said feed pump.

3. The combination comprising an airplane motor having an oil inlet and an oil outlet, an oil feed pump having its outlet connected to said oil inlet of said motor, a scavenge pump having its inlet connected to said oil outlet of said motor, a conduit connecting the outlet of said scavenge pump to the inlet of said oil feed pump, an oil storage tank having an outlet, a conduit connecting said outlet of said oil storage tank to the inlet of said oil feed pump, said last-mentioned conduit being separate from said first-mentioned conduit, and said conduits being connected to said oil feed pump without substantial restriction in said first-mentioned conduit at the point of connection of said last-mentioned conduit to said oil feed pump.

LAURENCE PRICE SHARPLES.

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