COMPRESSOR LUBRICATING SYSTEM

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FIG. 1.

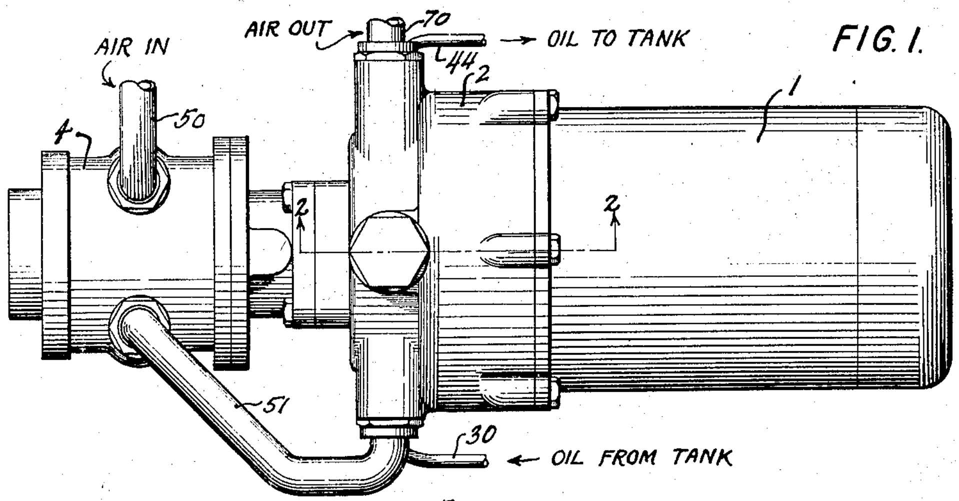

FIG. 2.

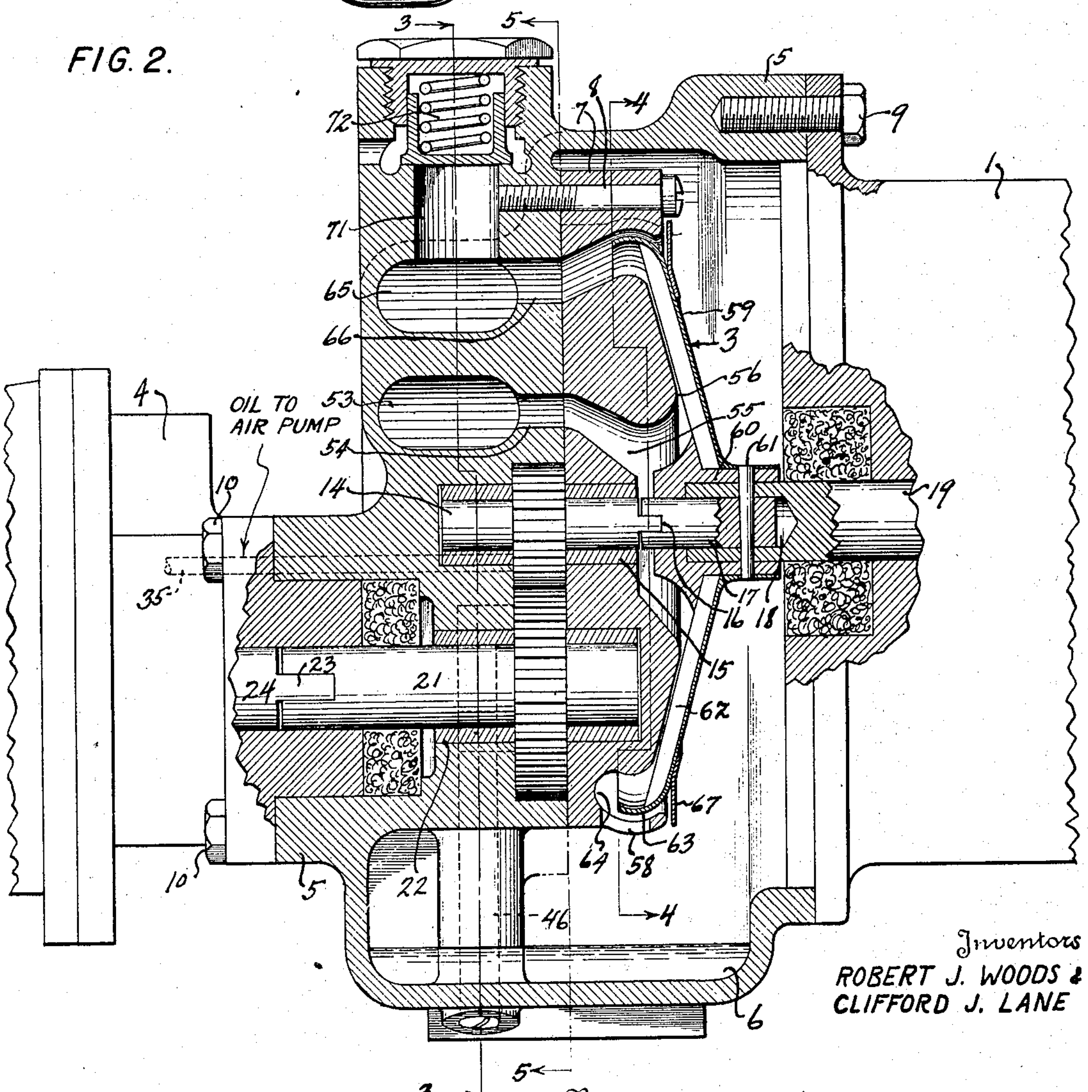

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FIG. 3.

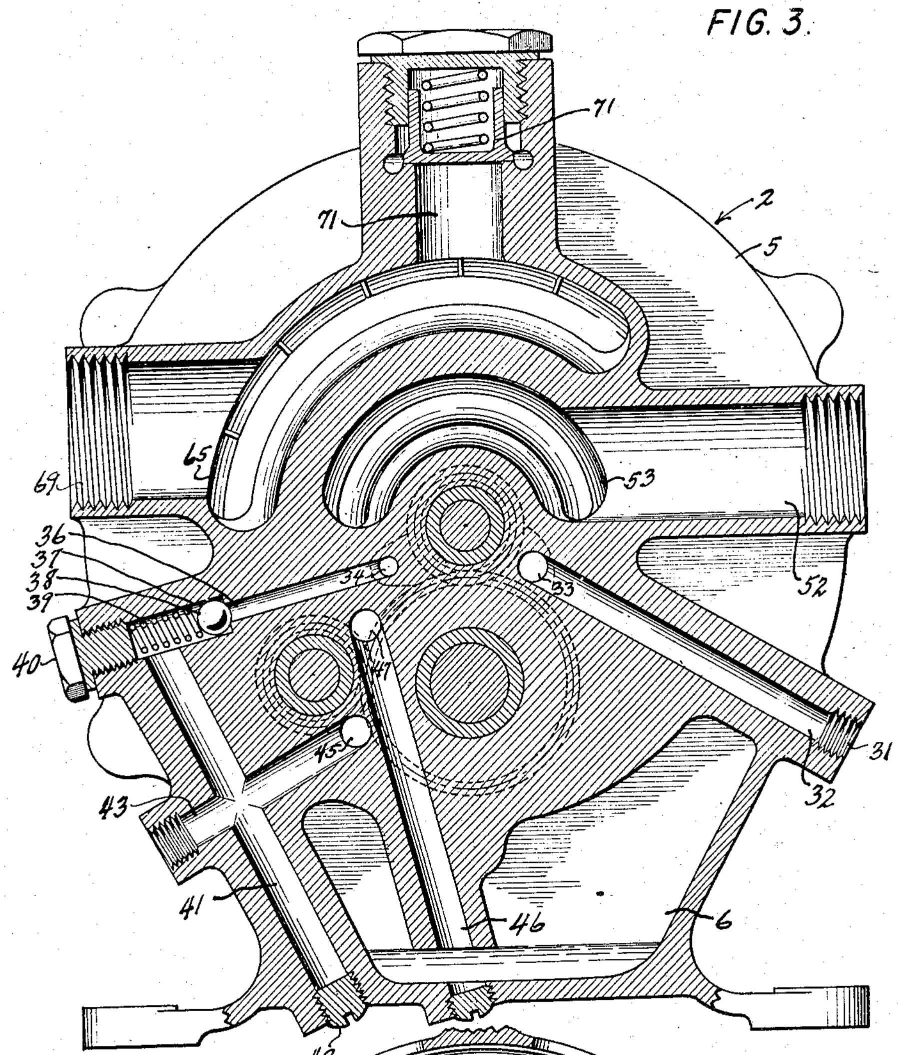

FIG. 4.

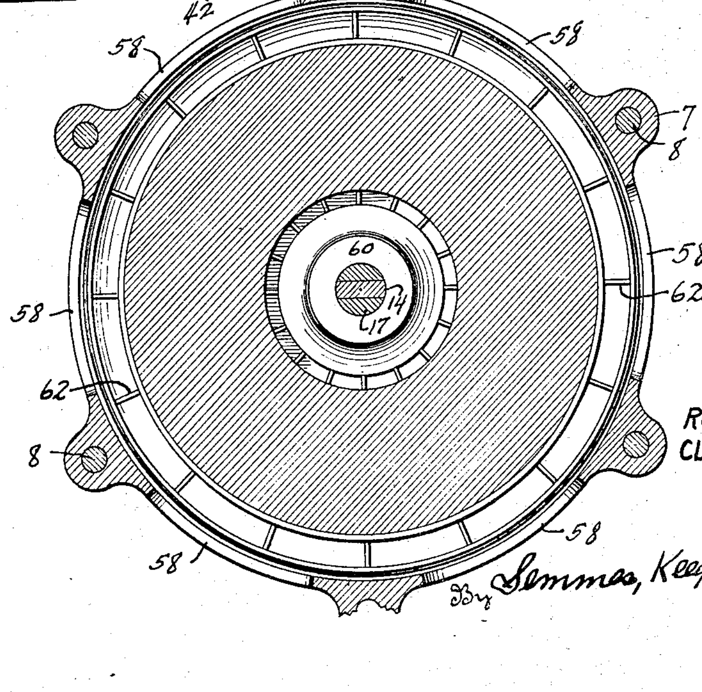

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FIG. 5.

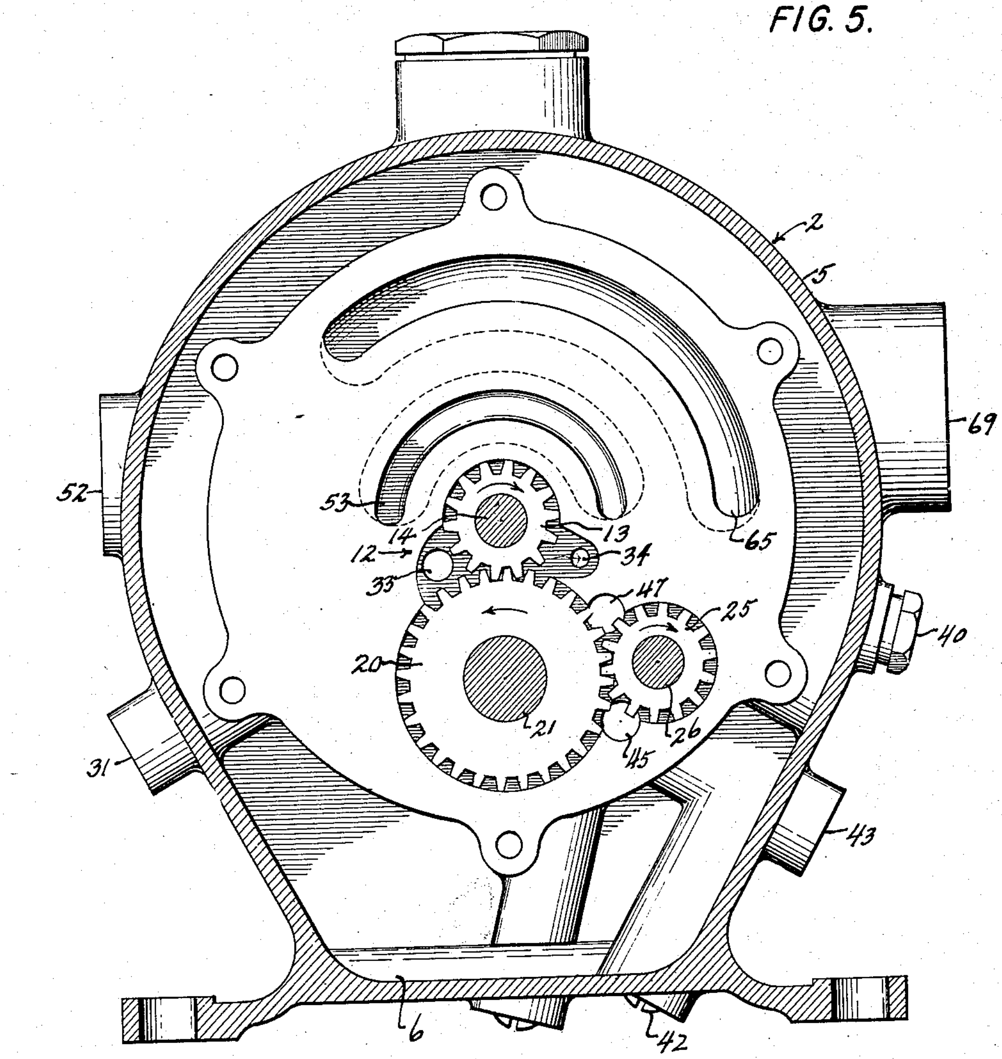

FIG. 6.

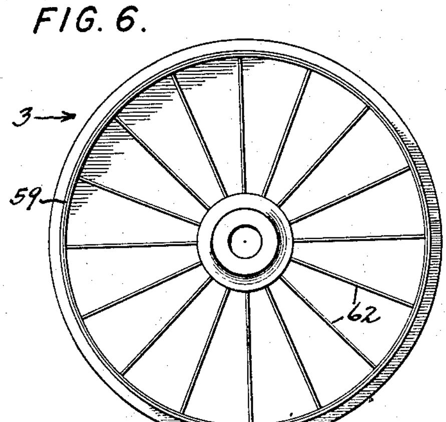

FIG. 7.

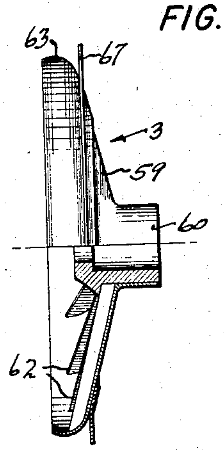

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FIG. 8.

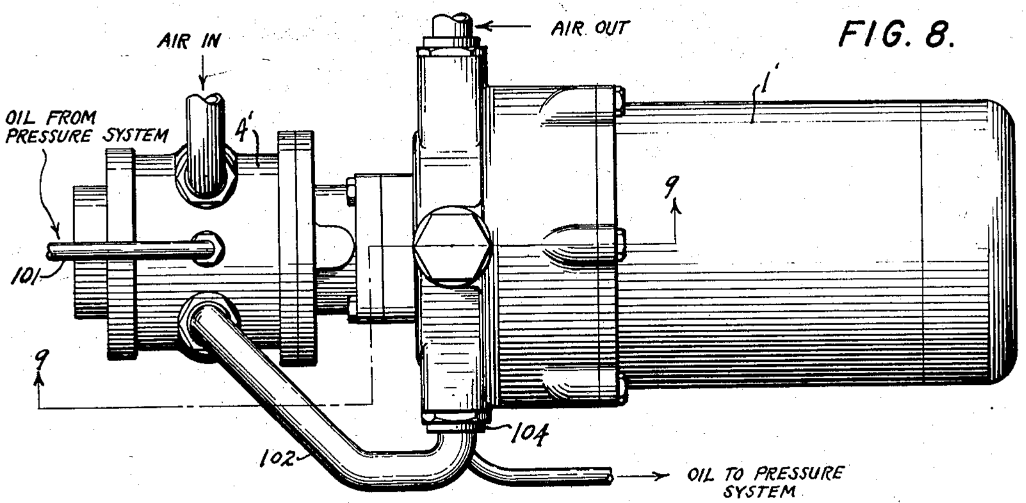
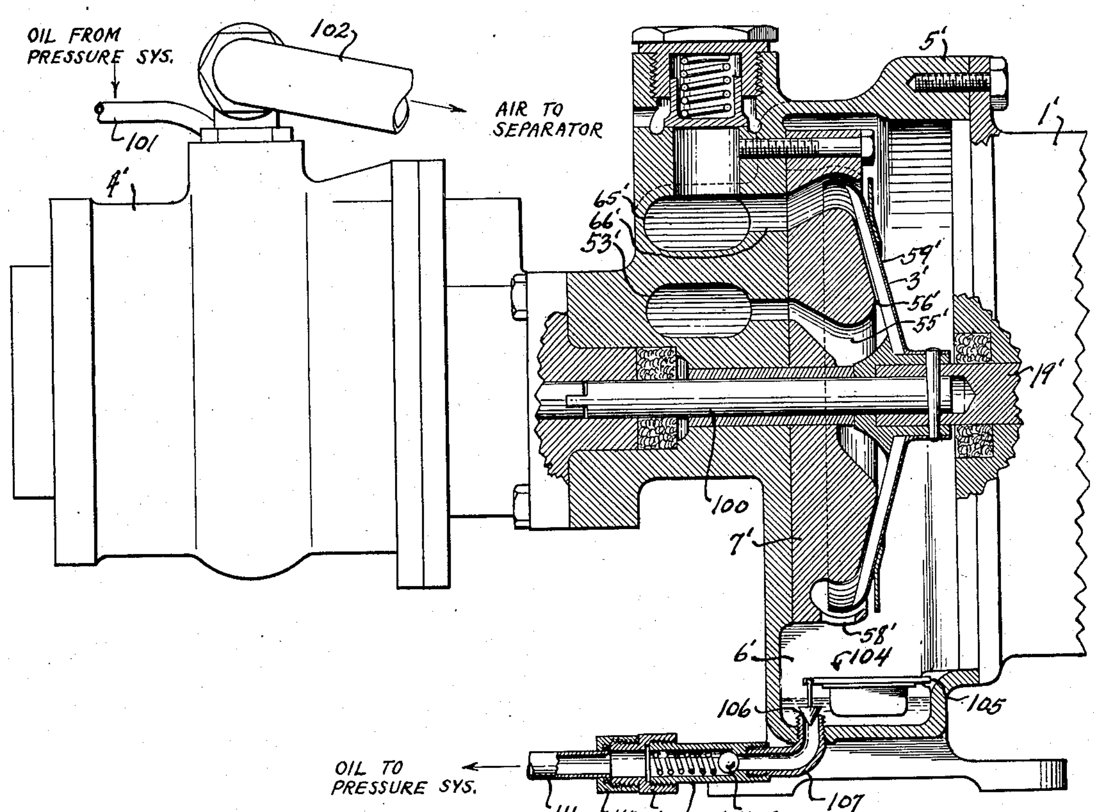


FIG. 9.



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UNITED STATES PATENT OFFICE

2,307,251

COMPRESSOR LUBRICATING SYSTEM

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Application May 4, 1940, Serial No. 333,432

6 Claims. (Cl. 230—207)

In general, the present invention relates to lubricating systems and more particularly has reference to systems for lubricating an air compressor and separating the oil from the air, thereby permitting oil free air to be delivered to the units to be operated by the compressor. While this invention is best adapted for use in aircraft such as for operating the de-icers, starting the power plants or pumping tires, it is, of course, obvious that its range is of broader scope.

An object of this invention is to provide in a single unit means for supplying oil to an air compressor and then separating the oil that is delivered by the compressor.

Another object of this invention is to provide a pump for supplying oil to an independently driven air compressor, means for separating the oil from the air that is delivered by the compressor and means for preventing the oil from mingling with the air.

Yet another object of this invention is to provide in a single unit an oil pump for supplying oil from a supply tank to an air compressor, means for separating the oil from the air that is delivered by the compressor, means for transmitting the air to the units to be operated and means for returning the separated oil to the supply tank.

And a further object is to provide a lubricating system for air compressors to be used in aircraft which can be easily and cheaply manufactured and which consists of relatively few principal working parts.

To accomplish the above and other important objects, the invention in general embraces the idea of providing in a unitary structure means for supplying oil from a source of supply to an independently driven air pump, separating the oil from the air that is delivered by the pump, returning the oil to the source of supply and then transmitting the oil free air to the units to be operated. More specifically, the invention consists of an oil pump which comprises reduction gearing that drives the air pump and also draws oil from a supply tank and forces it to the air compressor under pressure, and the pressure can be controlled by a relief valve. A second pump is formed by including a third idler gear which functions to return the separated oil back to the supply tank. A separator such as an impeller shaped disc is attached to the drive shaft of the pump and the air from the compressor enters the impeller at the center and is discharged at the periphery. The impeller is so formed that the oil which separates from the air due to centrifugal force collects on the impeller surface and is eventually thrown off without passing through the air stream. The air then passes out through a suitable conduit to the units to be operated, for instance, the de-icers. An air pressure relief valve may also be incorporated to control the maximum pressure in the system.

In lieu of the above assembly, the separator can be used alone and an outside oil pressure supply may be employed. Also, it is possible to make use of a direct drive unit and to use separate oil pumps.

In the drawings in which the same numerals designate similar parts:

Figure 1 is a top plan view of my novel lubricating system.

Figure 2 is a sectional view taken along the line 2—2 of Figure 1 looking in the direction of the arrows.

Figure 3 is a sectional view taken along the line 3—3 of Figure 2 looking in the direction of the arrows.

Figure 4 is a sectional view taken along the line 4—4 of Figure 2 looking in the direction of the arrows.

Figure 5 is a sectional view taken along the line 5—5 of Figure 2 looking in the direction of the arrows.

Figure 6 is a front elevational view of the impeller member.

Figure 7 is a side elevational view, partly in section, of the impeller shown in Figure 6.

Figure 8 is a top plan view of a modified form of my lubricating system employing an outside oil pressure supply in lieu of the pump shown in Figures 1 to 7 inclusive.

Figure 9 is a sectional view taken along the line 9—9 of Figure 8.

Referring to Figures 1 and 2, it will be noted that our novel assembly comprises a motor 1 (preferably electric), an oil pump, and separator 2 and 3, respectively, and an air compressor 4. The oil pump and separator comprise a casting 5 which is so formed at its lower extremity as to provide an oil reservoir 6. A cover plate 7 is attached to the front face of the casting 5 by screws 8. The pump and separator housing 5 is fixed to the motor 1 by bolts 9 and compressor 4 is secured to the pump 2 as indicated at 10. It will be appreciated from the above that we have provided in a single unit, the means for supplying the oil to the compressor, and the device for separating the oil from the air that is delivered by the compressor.

In Figures 2 and 5, we have shown our oil pumping means being comprised of reduction gearing indicated generally 12. The gearing 12 includes a drive pinion 13 keyed to shaft 14 which is journaled in a bearing 15. The shaft 14 is flexibly coupled as shown at 16 to stub shaft 17 which latter shaft is secured in bore 18 formed in the end of drive shaft 19 of the motor 1. Meshing with the teeth of the pinion 13 and mounted therebelow is a large gear 20 carried by shaft 21 journaled in bearing 22. The pinion 13 and the gear 20 serve to force the oil from the supply source to the moving parts of the compressor 4. The shaft 21 is coupled as shown at 23 with drive shaft 24 of the compressor 4. Consequently, the pump and the compressor are driven by the motor 1 through the reduction gearing.

Also meshing with the large gear 20 is a small idler pinion 25 rotatably mounted on shaft 26. As will later be more fully described, the small pinion 25 functions to return the separated oil back to the supply tank.

In Figures 1, 3 and 5, there is illustrated a conduit 30 connected at one end to the oil supply tank (not shown) and communicating at its other end with an oil inlet 31 for the oil pump 2. The oil flows from inlet 31 through oil passage 32 to a point 33 adjacent the reduction gearing 12. The oil is then carried by the teeth of the drive pinion 13 to point 34 which communicates with oil duct 35 that extends to the air compressor 4 thus lubricating the working parts of the compressor.

If the oil pressure should become too great, the oil will be forced from point 34 through another oil passage 36 which has an oil relief valve 37 positioned at the end of the passage. This valve comprises a ball 38 which is held in its closed position by one end of coil spring 39, the other end of the spring bearing against the bottom of a threaded cap 40. When the oil pressure is sufficient to overcome the action of the spring, the ball 38 will be forced from its seat and the oil will flow past the valve and empty into oil duct 41 which is closed at its lower end by a threaded plug 42. Located substantially midway of the length of the duct 41 and at approximately right angles thereto is another oil duct 43, the outer end of which is adapted to have secured thereto an oil line 44 which returns to the oil supply tank. The inner end of the duct 43 terminates at point 45 adjacent the gear 20 and the idler pinion 25.

In communication with the reservoir 6 is the lower end of oil passage 46, and the upper end of the passage extends to point 47 which is adjacent the gear 20 and the pinion 25 for returning the oil back to the tank. The passage 46 is especially advantageous in that it will keep the oil level in the reservoir at a low point thus preventing the separator from becoming flooded during acrobatic maneuvers.

The compressor 4 is adapted to have air admitted thereto through line 50. A mixture of air and oil re-enters the pump 2 from the compressor outlet through a conduit 51 which communicates with an enlarged bore 52 formed in the pump 2. The mixture then passes into an arcuate chamber 53, that is provided with a port 54 which empties into a downwardly extending opening 55 in the cover plate 7. The opening is flared at its outer end as shown at 56 adjacent the mid point of the separator 3.

It can be seen that the separator 3 includes a disc-like member 59 carried by a hub 60 which is attached to the drive shaft 19 by a pin 61. The hub supports a plurality of radial vanes 62, and in Figure 2, it will be noted that the outer periphery of the disc is provided with a curved surface 63 which is positioned in a circumferential recess 64 formed in the outer face of cover plate 7. The upper portion of the recess 64 communicates with an arcuate chamber 65 formed in the pump 2 through a bore 66. A second deflector 67 is also carried by the separator 3 and extends substantially radially to prevent the air from being discharged into the oil reservoir 6.

The arcuate chamber 65 empties into conduit 69 which has secured thereto pipe 70 for permitting the oil free air to be delivered to the unit or units to be operated. A second bore 71 communicates with the chamber 65 and is positioned above the chamber, and an air relief valve 72 is disposed above the bore 71 to control the maximum pressure in the system.

Referring to Figure 4, it will be seen that the cover plate 7 is provided with a plurality of radial peripheral slots 58 which will permit the oil to be thrown by the separator through centrifugal force into the oil reservoir 6.

As heretofore pointed out, when oil is admitted to the pump 2, the drive pinion 13 forces the oil to the point 34 from whence it flows through passageway 35 to the compressor. However, oil is also forced by the teeth of the gear 20 from the point 33 to the point 45 from where it flows through passage 43 and conduit 44 back to the tank. When the mixture of oil and air returns from the compressor to the pump, this mixture moves from the chamber 53 through mouth 54 to the mid point of the disc 59 and the oil which separates from the air due to centrifugal force, collects on the impeller surfaces and is eventually thrown through the slots 58 into the reservoir 6 without passing through the airstream.

The air then goes to the chamber 65 and into the bore 69 where it is delivered by conduit 70 to the units to be operated. The oil in the reservoir 6 moves through bore 46 to the point 47 and the teeth of the pinion 25 force the oil to the passageway 43 from whence it flows back to the oil supply tank. Consequently, there is no danger of the oil in the reservoir flowing into the system.

By the above described arrangement it is believed readily apparent that we have provided a novel structure whereby oil can be supplied to an air compressor and the mixture of oil and air returned from the compressor can be separated. Also, the gearing which constitutes the oil pumping means affords a drive for the air compressor. Furthermore, with our invention there can be no danger of the separator being flooded due to acrobatic maneuvers of the airplane, a feature which is of course most advantageous.

Referring to Figures 8 and 9, it will be noted that we have disclosed in these figures a modified form of our novel system. In this embodiment it can be seen that we omit the oil pump 2 and employ an outside oil pressure supply.

In these figures it is apparent that the separator is substantially identical with that shown in Figures 1 to 7 with the exception that the reduction gearing and its associated parts are not shown. In view of this we will employ the same numerals in the description of this embodiment with the exception that they will be primed. With reference to Figure 9, it will be observed that the compressor 4' is directly driven by the drive shaft 19' of the motor 1' through shaft 100. Oil from a pressure system (not shown) is admitted to the compressor 4' through feed line 101.

The mixture of air and oil from the compressor passes through conduit 102 into the oil separator 3' as shown at 104. The mixture is then admitted into the arcuate chamber 53' and is directed to the midpoint of the disc member 59' of the separator by the downwardly extending aperture 55' formed in the front plate 7' of the separator. The oil is separated from the air by virtue of centrifugal force and collects on the surface of the disc and is thrown through the peripheral slots 58' into the oil reservoir 6'.

The separated air passes through opening 66' into the arcuate chamber 65' and from there is delivered to the various units to be operated by a conduit (not shown).

In view of the fact that the oil separated from the air should not exceed a certain level in the reservoir 6' we provide the following assembly. A float valve designated generally 104 is disposed in the reservoir and is pivoted to the casing at the point 105. The opposite end of the valve carries a valve member 106 which is adapted to be fitted in the upper end of an elbow 107 which extends through an opening provided in the lower wall of the reservoir. A tube section 108 is threaded on the elbow 107 and a spring pressed ball valve 109 is disposed therein. A conduit 110 which is in communication with the oil pressure system is removably attached to the tube section 108 by means of fittings 111 and 112.

It will be appreciated that when the oil level becomes too high in the reservoir 6' the valve member 106 will be lifted from its seat and the oil will be forced past valve 109 back to the oil pressure system by the internal air pressure in the separator. Of course this arrangement is particularly efficacious in that it will prevent the oil in the reservoir from exceeding a certain level thus removing the danger of the oil re-entering the system during acrobatic maneuvers of the aircraft.

From the above description it is believed apparent that we have provided a novel system for lubricating an air compressor or the like for use in aircraft which is highly effective and which will permit oil free air to be delivered to the units to be operated by the compressor. Furthermore, there can be no danger of the separated oil re-mixing with the air after it has been separated, nor is it possible for the oil to re-enter the system while the aircraft is performing acrobatic maneuvers. The system comprises relatively few principal working parts and can of course be easily manufactured. In addition the oil pumping means and the air compressor are driven from a single prime mover through the gearing which forms the oil pump in the form of device shown in Figs. 1 to 7.

Although we have shown and described certain specific embodiments of our invention, we are of course fully aware that numerous modifications thereof are possible by persons skilled in this art. Our invention therefore is not to be restricted except insofar as is necessitated by the prior art and by the spirit of the annexed claims.

We claim:

1. In a system of lubricating an air compressor which is adapted to operate units in aircraft, an air compressor, a source of air in communication with the compressor, a source of oil, a prime mover, an oil pump adapted to withdraw oil from the source and force it into the compressor, a connection between the prime mover and the oil pump for driving the pump, a second driving connection between the pump and the compressor for operating the compressor, an impeller disc secured to the connection between the prime mover and the pump, a conduit for returning the oil and air from the compressor to project them against the impeller whereby the oil and air are separated by centrifugal force, a conduit for returning the thus separated oil to the source, and means to deliver the air to the units to be operated.

2. In a system of lubricating an air compressor adapted to operate units in aircraft, an air compressor, a source of air in communication with the compressor, a source of oil, a prime mover, an oil pump comprising reduction gears adapted to withdraw oil from the source and force it to the compressor, a drive connection between the prime mover and the reduction gears for driving said reduction gears, a second drive connection between the reduction gears and the compressor whereby the compressor is operated, a conduit from said reduction gears to the compressor through which the oil is adapted to be forced to lubricate the compressor, a rotatable disc attached to the drive connection between the prime mover and the oil pump, a conduit extending from the air compressor to a point adjacent to the rotatable disc for projecting the air and oil returned from the compressor against said disc whereby they are separated by centrifugal force, a line for returning the separated oil to the source, and means to deliver the separated air to the units to be operated.

3. In a system of lubricating an air compressor adapted to operate units in aircraft, an air compressor, a source of air in communication with the compressor, a source of oil, an oil pump comprising reduction gears, a prime mover, a connection between the prime mover and the oil pump for driving the reduction gears to withdraw oil from the source and force it to the compressor, a second connection between the reduction gears and the compressor whereby the compressor is operated, a conduit extending from the reduction gears to the compressor through which the oil is forced to the compressor, an impeller disc removably fixed to the drive connection between the prime mover and the oil pump, a conduit extending from the air compressor to the mid point of the impeller whereby the air and oil are projected against the impeller and separated by centrifugal force, means carried by the impeller for preventing the oil thus separated from re-entering the air, a line for returning the separated oil to the source, and means to direct the separated air to the units to be operated.

4. In a system of lubricating an air compressor adapted to operate units in aircraft, an air compressor, a source of air in communication with the air compressor, a source of oil, an oil pump comprising reduction gears, a prime mover, a connection between the prime mover and the oil pump for driving the reduction gears whereby oil is withdrawn from the source and forced to the air compressor, a second drive connection between the oil pump and the compressor whereby the compressor is operated, a conduit leading from the reduction gears into the air compressor through which the oil is forced into the compressor, an impeller disc attached to the connection between the prime mover and the oil pump, a conduit extending from the air compressor to a point adjacent to the mid point of the impeller

whereby the oil and air returning from the compressor are separated by centrifugal force, and means to direct the separated air to the units to be operated and a line leading to the source of oil, said reduction gears being adapted to force the separated oil through said line to the source.

5. In a system of lubricating an air compressor adapted to operate units in aircraft, an air compressor, a source of air in communication with the air compressor, a source of oil, an oil pump comprising reduction gears, a prime mover, a connection between the prime mover and the oil pump for driving the oil pump to withdraw oil from the source and force it to the air compressor, a second drive connection between the oil pump and the air compressor whereby the air compressor is operated, a conduit extending from the oil pump to the air compressor through which the pump forces the oil into the air compressor, an impeller disc attached to the connection between the prime mover and the oil pump, a conduit extending from the air compressor to a point adjacent to the impeller disc for directing the air and oil into engagement with said disc whereby they are separated by centrifugal force, means provided on said impeller disc to prevent the separated oil from reentering the air, a line for directing the air to the units to be operated, and a second line extending to the source of oil, said reduction gears being adapted to force the separated oil back to the source.

6. In a system of lubricating an air compressor adapted to operate units in aircraft, an air compressor, a source of air in communication with the compressor, a source of oil, an oil pump, a prime mover, a drive connection between the prime mover and the oil pump whereby oil is withdrawn from the source and forced to the compressor, a second drive connection between the oil pump and the air compressor whereby the air compressor is operated, a conduit extending from the oil pump to the air compressor through which the oil is forced, an impeller disc attached to the drive connection between the prime mover and the oil pump, a conduit extending from the air compressor to a point adjacent to the impeller disc whereby the oil and air returned from the compressor are directed against the impeller disc and are separated by centrifugal force, means provided on said impeller disc to prevent the separated oil from reentering the air, a line to direct the air to the units to be operated and a second line to return the oil to the source of oil.

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