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ENGINE LUBRICATION AND COOLING SYSTEM

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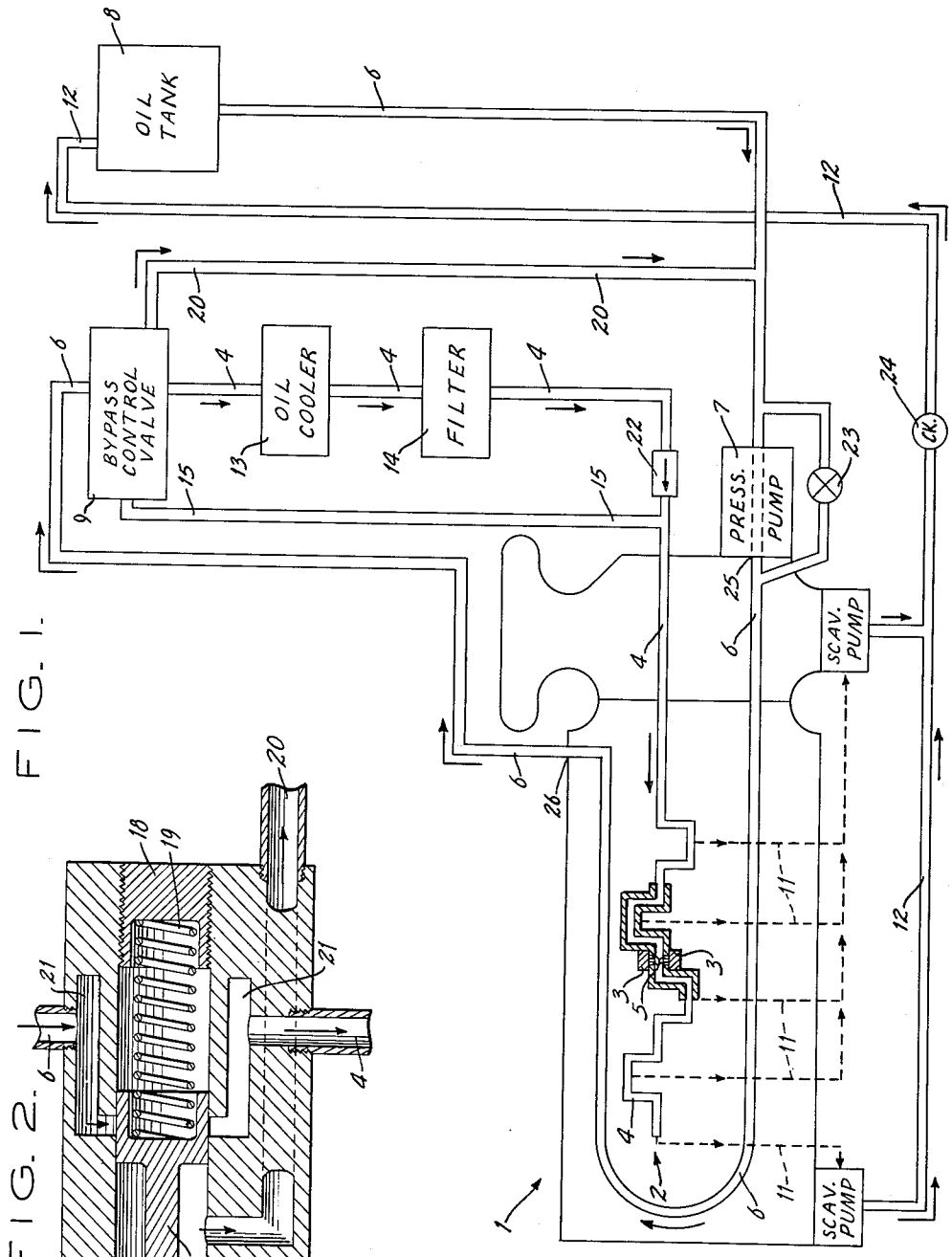


FIG. 1.

FIG. 2.

INVENTOR.
CONSTANTINE S. CONSTANTINO
BY
Morgan, Finnegan, Durham & Pine
ATTORNEYS

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ENGINE LUBRICATION AND COOLING SYSTEM

Constantine S. Constantino, Saddle River, N.J., assignor to Curtiss-Wright Corporation, a corporation of Delaware

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This invention is related to a cooling and lubricating system for internal combustion engines and more particularly is directed toward a cooling and lubricating system wherein a single cooling and lubricating fluid is fed to the housing for cooling the housing and at least a portion of said housing fluid flow is fed in series therewith to the shaft bearings for lubricating the bearings.

It is known to those skilled in the internal combustion art that proper engine performance requires effective lubrication of the power shaft or crankshaft bearings as well as effective cooling of the engine housing. It is also a known desideratum that the pressure of the lubricating fluid should not exceed a predetermined amount which may be, for example, 40 to 50 p.s.i. In known constructions it has been the practice to provide one fluid, such as water or a water and ethylene glycol mixture, for cooling and another fluid for lubricating. This practice has been required since previously known systems were designed to accommodate two fluids and, as a result, previous cooling and lubricating constructions embodied separate and independent means for the cooling and lubricating fluids. Where such independent systems have been used, it has been obviously necessary to provide for both the lubrication and cooling systems separate fluid supply tanks, pumps, passage lines, filters, scavenging means and heat exchangers. In addition, it was frequently necessary, when such independent systems were used, to provide separate control means for regulating the amount of and pressure of the fluid being supplied to the cooling and lubricating systems. In short, the systems were virtually completely independent of one another and required the use of almost twice as many elements as would be necessary were a single fluid system for cooling and lubricating the engine utilized.

With the discovery several years ago of synthetic oils of the diester, fluoro-carbon and silicone types there has been available a single fluid having stability and acceptable viscosity over wide temperature ranges. These fluids, however, have laid dormant insofar as engine cooling and lubrication is concerned for the lack of a single system which would accommodate the cooling and lubricating requirements of the engine. A single system for cooling and lubricating the engine has the advantages that only one-half as many parts are required as compared to conventional systems where separate cooling and lubricating systems are provided; that there is a substantial reduction in the weight of the engine; that there is a substantial reduction in the cost of the engine; that a less complex and more trouble-free unit is possible.

It is also known that as the speed of an internal combustion engine increases the temperature of the housing is increased owing to the increased activity of the combustion chamber. On the other hand, the lubrication fluid pressure requirements for the power shaft bearing remains substantially constant irrespective of the engine speed. In accordance with this invention a single system is provided for cooling the engine housing and lubricating the power shaft bearings wherein the cooling fluid supplied to the housing is increased with engine speed while the lubrication pressure for the power shaft bearings remains constant despite varying speeds.

This invention is applicable to internal combustion engines, including both rotary combustion engines of the

type having an outer body and an inner body or rotor and conventional reciprocating piston type engines. The advantages of this invention have particular value in aircraft engines where a light weight, less complex structure is always a desideratum. It will be recognized by those in the art, however, that the present invention is not limited to aircraft engines and will lead to beneficial, novel, and unexpected results wherever used.

It is, therefore, a primary object of this invention to provide a cooling and lubricating system for an internal combustion engine which will substantially reduce the weight, cost and number of parts of the engine.

It is a further object of the invention to provide means for using a single fluid to cool and lubricate the engine.

It is still a further object of the invention to provide a cooling and lubricating system wherein a single fluid is fed to cool the engine housing and at least a portion is fed in series therewith to the engine bearing for lubrication of said bearings.

It is yet another object of this invention to provide a cooling and lubricating system wherein the lubricating pressure will remain constant for varying speeds of the engine.

A further object of the present invention is to provide a lubricating and cooling system wherein the amount of fluid supplied for cooling the housing is substantially proportional to the engine speed.

It is a still further object of the present invention to provide a cooling and lubricating system which utilizes a control means responsive to the pressure being fed to the shaft bearings to control the amount of flow to the shaft bearings.

A further object of this invention is to provide a cooling and lubricating system including control means which will insure that when the lubricating pressure reaches a predetermined amount, that a portion of the fluid will be redirected for cooling the housing.

It is yet another object of this invention to provide a cooling and lubricating system which provides a control means responsive to the pressure of fluid being fed to the shaft bearings for bypassing a portion of the fluid being fed to the shaft bearings to the housing member.

It is still a further object of the present invention to provide a cooling and lubricating system including a control means wherein a single fluid will be fed to cool the engine housing and at least a portion is fed to the engine bearings to lubricate said bearings wherein the quantity of fluid supplied to cool the housing is proportional to the engine speed but the lubricating pressure for the bearings remains constant for varying engine speeds.

Additional objects and advantages of the invention will be set forth in part in the description which follows and in part will be obvious from the description or may be learned by practice of the invention, the objects and advantages being realized and attained by means of the instrumentalities and combinations particularly pointed out in the appended claims.

In accordance with the present invention means are provided for supplying a single fluid for cooling the housing and lubricating the shaft bearings wherein the amount of fluid being supplied to cool the housing will increase with engine speed but the lubrication pressure remains constant.

Briefly described, the present invention comprises means for directing fluid to the housing for cooling the same and thence to the shaft for lubricating its bearings wherein a bypass control valve, responsive to the lubricating fluid pressure will direct fluid toward the shaft bearings or in part toward the shaft bearings and in part bypassing the shaft bearings back toward the housing inlet whereby the amount of fluid supplied to the housing will

be proportional to the engine speed but the lubricating pressure will remain constant.

The invention includes the novel elements and combinations hereinafter described.

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate one embodiment of the invention, and together with the description, serve to explain the principles of the invention.

Of the drawings:

FIGURE 1 is a schematic view of the cooling and lubricating system in which the shaft and associate bearing structure are shown in partial cross section.

FIGURE 2 is a sectional view showing a control valve which may be used in the practice of this invention.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory, but are not restrictive of the invention.

Reference will now be made in detail to the preferred embodiment of the invention which is illustrated in the attached drawings.

As embodied, the present invention, as shown in FIGURE 1, includes a housing **1** for an internal combustion engine and within which is mounted a power shaft or crankshaft **2** for relative rotation. The engine, for example, may be a conventional piston-type internal combustion engine. The shaft **2** is mounted in conventional bearings **3**, as illustrated in FIGURE 1. As the shaft **2** rotates it is well known and obvious that the friction developed between the shaft **2** and bearings **3** will cause scoring, pitting and possible binding between the shaft and bearings unless means are provided for effectively lubricating the bearings. It is also obvious that a portion of the heat generated by the combustion phase of the engine will be rejected to the power shaft and its bearings resulting in an increase of friction between the shaft and bearings.

In accordance with this invention means are provided for cooling and lubricating the shaft bearings. As embodied herein, this means comprises a lubricating line **4** in the shaft **2** which communicates with passage means **5** leading directly to the shaft bearings **3**.

It is also obvious that a large portion of the heat generated during the combustion phase of the engine will be rejected into the walls of the housing **1**. The amount of heat generated during the combustion phase will increase with the engine speed and if allowed to continue unchecked, would result in engine failure. For the purpose of cooling the housing **1** member, the housing is provided with a conventional cooling jacket (not shown) which includes a passage line **6** having an inlet **25** and an outlet **26** for accommodating a combined lubricating and cooling fluid as it passes through the housing.

In the past it has been customary to pass water or an ethylene glycol and water mixture through the housing passage line in the cooling jacket for conducting the heat generated by combustion away from the housing, thereby reducing the temperature of the housing. On the other hand, a mineral oil-type fluid was used to lubricate the shaft bearings. When such separate fluids were used for cooling the housing and lubricating and cooling the shaft bearings, it was obviously necessary to provide independent systems for accommodating these fluids.

Synthetic oils, including diesters, fluoro-carbons and silicones, however, have been available for some time. These fluids, and other equivalent fluids, have characteristics which would make them ideal for cooling and lubricating engines if a suitable system were discovered for using them for this purpose. The characteristics of these fluids include a greater temperature rise without carbonizing or oxidizing which would result in clogging of passage lines and a viscosity over a wide temperature differential consistent with cooling and lubricating requirements. In accordance with this invention, a single system is provided for lubricating and cooling the engine, resulting in a substantial reduction of the number of parts, cost and weight of the cooling and lubricating system.

It is apparent that as the speed of the engine increases that the amount of heat generated by the combustion phase also increases, thus requiring an increased flow of cooling fluid to maintain the housing at desirable operating temperatures. On the other hand, the bearings for the power shaft require approximately the same lubrication pressure despite differences in the engine speeds. In accordance with this invention means are provided for supplying coolant fluid to the housing dependent on the engine speed while maintaining a constant lubrication pressure for the shaft bearings. This means, as herein embodied, comprises, briefly, a conventional pressure pump **7**, preferably a positive displacement pump, which is driven by the engine in a conventional manner and which cooperates with passages in the housing and shaft and with a bypass control **9** in a novel manner providing new, useful and beneficial results.

The cooling and lubricating fluid, which may be a synthetic oil, is fed to the housing passage line **6**, through the housing inlet **25** as herein embodied, by means of a pressure pump **7** from an oil storage tank **8**. The pressure pump **7** forces the fluid through the engine housing from the outlet end **26** of the housing passage **6** to a bypass control valve **9**, and thence to the shaft bearings **3**. As more fully explained below, the bypass valve **9**, depending upon the fluid pressure in the shaft bearings, may bypass some of the fluid so that it returns to the pressure pump **7** and thence to the housing **1**. Oil which has lubricated the shaft bearings drains through passages **11** into a conventional sump (not shown) and is drawn by means of conventional scavenging pumps from the sump and forced through the return line **12** to the oil storage tank **8**.

In order that the hot oil removed from the housing may be cooled and cleansed, there is provided intermediate the bypass valve **9** and the shaft passage line **4**, a conventional oil cooler **13** and a conventional oil filter **14**.

In engine lubrication practice it is recognized that a predetermined pressure in the power shaft lubrication line, which may be 40 to 50 p.s.i. for example, is sufficient to lubricate the shaft bearings despite an increase in engine speed which will require an increased amount of coolant fluid for the housing. The present invention includes means for limiting the lubrication pressure in the shaft lubrication line **4** such that the pressure pump will be provided with sufficient fluid to force coolant fluid through the housing at a rate which is proportional to the speed of the engine.

As herein embodied, this means comprises a pressure sensing line **15** which cooperates with the shaft lubrication line **4** and the bypass control valve **9**. Although the bypass control valve **9** is conventional by itself and no novelty is claimed therein, the particular use and combination of the valve with the other components of the system hereinafter described leads to novel, beneficial and unexpected results.

The bypass control valve **9**, as shown for purposes of illustration in FIGURE 2, includes a housing **16** which is in sliding fluid sealing contact with a sliding valve element **17**. Fixedly attached to the valve housing is a spring seat means **18** for locating and seating one end of a spring means **19**. The other end of the spring means is located and seated in one end of the sliding valve element **17**. The other end of the sliding valve element **17** is in pressure communicating contact with the pressure sensing line **15**.

The valve housing **16**, in addition to being in communication with the pressure sensing line **15**, is in communication with the housing cooling passage line **6**, with the shaft lubricating line **4** and with a bypass housing

line 20. The bypass control valve 9 is provided with an annulus or passageway 21 which is arranged in combination with the valve spring 19 and sliding valve element 17 so that there is always communication between the housing cooling line 6 and the shaft lubricating line 4. The valve spring 19 is selected so that when the pressure in the crankshaft lubricating line reaches a predetermined amount, e.g. 40–50 p.s.i., the sliding valve element 17 is moved against the spring 19 and a portion of the lubricating and cooling fluid is bypassed to the bypass housing line 20 which communicates with the inlet side of the pump 7 whereby the pump returns the bypassed fluid to the inlet end 25 of this housing passage 6.

Through use of the novel elements and combinations herein embodied, it is possible to use a single lubricating and cooling fluid to its greatest advantage. Thus, when the shaft fluid pressure reaches a predetermined amount, determined by the lubrication requirements, the additional fluid is bypassed to the pressure pump 7. The pressure pump 7 is operated by the engine and as the engine speed increases the pump speed and capacity increases. The bypass means insures that when the engine speed increases that a sufficient quantity of fluid will be bypassed to the pressure pump whereby coolant fluid will be supplied to the housing proportional to the speed of the engine.

The lubrication and cooling means, as herein disclosed, also includes a check valve 22 to insure that the oil lines remain full when not operating, thus insuring that there will be cooling and lubricating fluid available as soon as the engine commences operation and a check valve 24 to prevent draining during shutdown. In addition, the pump 7 is provided with a conventional pressure relief valve 23 to limit the maximum output pressure of the pump.

The invention in its broader aspects is not limited to the specific mechanisms shown and described but departures may be made, therefrom, within the scope of the accompanying claims, without departing from the principles of the invention and without sacrificing its chief advantages.

What is claimed is:

1. A cooling and lubricating system for use in a mechanism having a housing, a rotatable member and bearing means for supporting the rotatable member in the housing; said system comprising first passage means in the housing and having an inlet and an outlet for flow of a lubricating and cooling fluid therethrough for cooling said housing; means including a second passage means communicating with said housing outlet for supplying at least a portion of said fluid to and for lubrication of said bearing means and thence back to said housing inlet; and means including a third passage means communicating with said outlet and bypassing said bearing means for returning the remaining portion of said fluid to said inlet.

2. A cooling and lubricating system as defined in claim 1 wherein said first passage means, said second passage means and said third passage means are in communication with a control valve.

3. A cooling and lubricating system as defined in claim 2 wherein said control valve acts in response to the fluid pressure being fed to the bearings.

4. A cooling and lubricating system as defined in claim 3 wherein the fluid is fed to the bearings at substantially constant rate and directly to the housing at a rate substantially proportional to the engine speed.

5. A cooling and lubricating system as defined in claim 4 which includes a pressure pump in communication with said housing inlet.

6. A cooling and lubricating system comprising a housing shaft means mounted with the housing, bearing means for mounting said housing and said shaft means for relative rotation said system comprising a first passage means in the housing having an inlet and an outlet for flow of a lubricating and cooling fluid therethrough for cooling said housing; means including a second passage means communicating with said housing outlet for supplying at least a portion of said fluid to and for lubrication of said bearing means and thence back to said housing inlet, means including a third passage means communicating with said outlet and bypassing said bearing means for returning the remaining portion of said fluid to said inlet and means for directing fluid to said inlet at a rate which is proportional to the rate of relative rotation of said housing and said shaft means.

7. A cooling and lubricating system comprising a housing, shaft means mounted within the housing, bearing means for mounting said housing and said shaft means for relative rotation, first passage means extending through said housing for circulation of a cooling fluid therethrough in heat exchange relation with said housing, second passage means for directing fluid to said bearing means, lubricating and cooling fluid supply means for feeding the fluid through said first passage means proportional to the rate of relative rotation of said housing and said shaft means and to said second passage means independent of the rate of relative rotation for cooling the housing and lubricating said bearings.

8. A cooling and lubricating system comprising a housing, shaft means mounted within said housing, bearing means for mounting said housing and said shaft means for relative rotation, first passage means extending through said housing for circulation of a cooling fluid therethrough in heat exchange relation with said housing, second passage means within said shaft means cooperating with said bearing means, lubricating and cooling fluid supply means for feeding the fluid through said housing proportional to the rate of relative rotation of said housing and said shaft means and through said shaft independent of the relative rotation for cooling the housing and lubricating said bearings, and means responsive to the pressure in said second passage means for bypassing fluid from said shaft passage means.

9. A cooling and lubricating system as in claim 8 wherein said responsive means includes a control valve responsive to the pressure in said second passage means.

10. A cooling and lubricating system for internal combustion engines comprising a housing, shaft means mounted within said housing, bearing means for mounting said housing and said shaft means for relative rotation, passage means including first passage means extending through said housing for circulation of a cooling fluid therethrough in heat exchange relation with the housing and having an inlet and an outlet means for directing fluid from said housing outlet to said bearings, bypass means for directing fluid away from said bearing means and toward said housing inlet cooperating with fluid supply means for feeding fluid through said housing at a rate proportional to the engine speed and to said bearing independent of the engine speed.

11. A cooling and lubricating system as in claim 10 wherein said fluid supply means includes a pressure pump operated by the engine.

12. A cooling and lubrication system for use in internal combustion engines comprising a housing, shaft means mounted within said housing, bearing means for mounting said housing and said shaft means for relative rotation, first passage means extending through said housing for circulation of a cooling fluid therethrough in heat exchange relation of said housing, second passage means in said shaft in communication with said bearing means, a pressure pump, bypass means in communication with said first passage means, said second passage means and said pressure pump for directing fluid through said housing and for bypassing a portion of the fluid being directed to said second passage means to said pressure pump whereby the fluid is supplied to said housing at a rate proportional to engine speed and to said bearing means at a substantially constant pressure.

13. A cooling and lubrication system as defined in claim 12 wherein said bypass means operates in response to pressure in said second passage means.

14. A cooling and lubrication system as defined in claim 13 wherein said bypass means includes a control valve.

15. A cooling and lubrication system as in claim 14 which is provided with a pressure sensing line intermediate said control valve and said second passage means.

References Cited in the file of this patent

UNITED STATES PATENTS

2,085,810	Ljungstrom	July 6, 1937
2,674,506	Dow	Apr. 6, 1954
2,943,453	Jonkers et al.	July 5, 1960

FOREIGN PATENTS

554,099	France	Feb. 23, 1923