HYDRAULIC FLUID RESERVOIR PRESSURIZATION ARRANGEMENT

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UNITED STATES PATENTS

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3,039,823 6/1962 Eaton.................................. 60/478 X
3,130,548 4/1964 Hunt............................... 60/478 X
3,150,650 9/1964 Dreessen et al..................... 123/119 C

FOREIGN PATENTS OR APPLICATIONS

580,604 9/1946 Great Britain ...................... 60/478

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ABSTRACT

A hydraulic fluid reservoir pressurization arrangement for a closed hydraulic system having a reservoir for containing a variable volume of hydraulic fluid below its full capacity so as to provide a variable air space therein including, an internal combustion engine having a forced air intake system providing a source of air under pressure, and a conduit connecting the source of pressurized air with the variable air space of the reservoir to insure a continuous supply of hydraulic fluid to the hydraulic system so as to avoid any cavitation to prevent interruptions in the flow of such fluid to the system.

5 Claims, 1 Drawing Figure
HYDRAULIC FLUID RESERVOIR PRESSURIZATION ARRANGEMENT

BACKGROUND OF THE INVENTION

The hydraulic systems used for controlling the implements of earthmoving vehicles are normally of the closed-type to alleviate oil contamination problems encountered during operation in dusty or other contaminant containing environments. Pressure fluctuations from a higher to a lower pressure occurring in the fluid reservoirs of such systems, however, frequently cause the hydraulic pump of the system to draw oil from the reservoir against a vacuum during periods of high fluid demands in the system. This causes cavitation of the hydraulic fluid in the pump which creates undesirable noise and an excessive amount of wear of the various pump components. Those skilled in the art will appreciate that one reason for such pressure fluctuations is the result of changes in fluid level in the reservoir during operation. Such changes in fluid level most frequently occur with the use of hydraulic jacks in the hydraulic system which require a greater volume of fluid when extended than when retracted due to fluid displacement by the rod within the cylinder of such jacks.

Various methods have been utilized in the past for maintaining a pressure at or slightly above atmospheric pressure in the reservoir of a closed hydraulic system during operation so as to insure a continuous supply of fluid to the pump to minimize such pump cavitation. Representative of such prior methods are those illustrated in U.S. Pat. Nos. 3,039,823 and 3,130,548 issued to Eaton and Hunt, respectively. However, such prior methods have not been widely accepted in the past because of their overall expense and complexity. In actuality, most of such prior methods have proved not to be economically feasible because the cost of their implementation greatly exceeds the value received in solving the intended problems.

OBJECTS OF THE INVENTION

Accordingly, it is an object of this invention to provide an improved hydraulic fluid reservoir pressurization arrangement for a closed-type hydraulic system to insure a continuous supply of hydraulic fluid to such a system.

Another object of this invention is to provide such an improved hydraulic fluid reservoir pressurization arrangement which is capable of maintaining a predetermined minimum pressure in the reservoir of such a closed hydraulic system in order to prevent system cavitation during high fluid demand conditions.

Another object of this invention is to provide such a hydraulic fluid reservoir pressurization arrangement which utilizes pressurized air from the forced air intake system of an internal combustion engine to minimize the cost and complexity of such an arrangement.

Other objects and advantages of the present invention will become more readily apparent upon reference to the accompanying drawing and following description.

BRIEF DESCRIPTION OF THE DRAWING

The drawing is a schematic view of an improved hydraulic fluid reservoir pressurization arrangement embodying the principles of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring more particularly to the drawing, an improved hydraulic fluid reservoir pressurization arrangement embodying the principles of the present invention is generally indicated at 10 in association with a closed-type hydraulic system 12 for an earthmoving vehicle, not shown. Such a vehicle is powered in the usual manner by an internal combustion engine, schematically shown at 14. For higher performance purposes, such an engine is provided with a forced air intake system 16. In the preferred embodiment, the forced air intake system includes an intake manifold 18, an exhaust manifold 20, and a turbocharger 22. Alternatively, a mechanically driven supercharger of any type commercially available may be utilized in place of the turbocharged system described herein. The turbocharger has a turbine wheel 24 which is in communication with the exhaust manifold 20 so as to be driven by the exhaust gases being expelled therethrough during operation of the engine. The turbine wheel drives a compressor wheel 26 of the turbocharger in the usual manner for compressing air which is drawn in through a conventional air filter 28 to supply pressurized air to the intake manifold 18.

The hydraulic system 12 includes a reservoir 30 for containing a variable volume of hydraulic fluid indicated at 31. The level of such hydraulic fluid is intended to be below the full capacity of the reservoir so as to define a variable air space 32 in the reservoir above such hydraulic fluid. The reservoir includes a top wall 33 having a filler pipe 34 extending therefrom. A sealed filler cap 35 is normally mounted on the filler pipe to maintain airtight integrity of the reservoir to minimize contamination of the hydraulic fluid. A relief valve 36 for relieving undue pressures which may otherwise be experienced in the system is disposed in a conduit 37 connected to the top wall 33 of the reservoir.

The reservoir 30 supplies hydraulic fluid through a conduit 38 to a hydraulic pump 40. The pump is drivingly connected to the engine 14 by any suitable conventional drive transfer mechanism, indicated by the dashed line 42. The pump supplies pressurized fluid through a conduit 43 to a control valve 44. The control valve is selectively actutable by a manual control handle 46. The control valve is connected through a pair of conduits 48, 49 to a variable capacity hydraulic motor means, such as a hydraulic jack 50, having an extendible and retractable rod 51. The control valve is also connected to the reservoir 30 via a conduit 54.

The fluid reservoir pressurization arrangement 10 includes a conduit 60 having one end connected to the intake manifold 18 and its opposite end connected to the top wall 33 of the reservoir 30. A one way check valve 62 is disposed within the conduit 60, permitting flow of pressurized air from the intake manifold to the reservoir, but prevents any reverse flow of fluid in the opposite direction.

OPERATION

While the operation of the present invention is believed to be clearly apparent from the foregoing description, further amplification will subsequently be made in the following brief summary of such operation. When the engine 14 is running exhaust gases from the
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exhaust manifold 20 are directed against the turbine wheel 24 of the turbocharger 22. Such exhaust gases cause rotation of the turbine wheel which drives the compressor wheel 26 to draw air through the air filter 28 for supplying pressurized air to the intake manifold 14 in the usual manner. Such pressurized air is delivered to the engine through the intake manifold and to the air space 32 of the reservoir 30 through the conduit 60 past the check valve 62.

Operation of the engine 14 also drives the hydraulic pump 40 through its drive transfer mechanism 42. The pump draws fluid from the reservoir 30 through the conduit 38 to supply pressurized fluid to the control valve 44 via conduit 43. Upon selective manipulation of the control handle 46 to a first position, the control valve 44 is actuated to direct pressurized fluid to the head end of the hydraulic jack 50 via the conduit 49 to cause extension of the rod 51. Hydraulic fluid expelled from the rod end of the jack during such extension is conducted through the conduit 48 to the control valve 44 and from there returned to the reservoir 30 by way of the conduit 54. Due to the displacement of fluid by the rod, a greater volume of fluid is needed to fill the head end of the jack than is being expelled from the rod end as the jack extends. As a result, the level of the hydraulic fluid 31 in the reservoir 30 drops in relation to the difference of fluid volume in the jack.

As the fluid level drops in the reservoir 30, the volume of the air space 32 increases which causes the air pressure therein to decrease. It will be apparent to those skilled in the art that the pressure in the reservoir of a closed-type hydraulic system will frequently drop below atmospheric pressure in such instances in the absence of an additional air supply. Under such circumstances, the pump 40 must draw hydraulic fluid from the reservoir against a partial vacuum which frequently causes cavitation of the fluid in the hydraulic system, especially in the pump itself. Such cavitation creates an undesirable noise problem and causes an excessive amount of wear of the various pump components.

The hydraulic reservoir pressurization arrangement of the present invention prevents such cavitation by maintaining a pressure greater than atmospheric pressure in the reservoir during operation. This is accomplished by communicating the pressurized air in the intake manifold with the air space 32 of the reservoir through the conduit 60 and the check valve 62.

Upon selective actuation of the control handle 46 to a second position, the control valve 44 is effective to direct fluid pressure to the rod end of the hydraulic jack 50 via the conduit 48 and to return hydraulic fluid from the head end to the reservoir 30 via conduits 49 and 54 to cause the retraction of the rod 51. The difference between the volumetric capacities of the rod and head ends of the jack, as noted earlier, causes the fluid level in the reservoir to raise because more fluid is being expelled from the jack than is being received therein. The rise in the fluid level decreases the volume of the air space 32 causing the air pressure therein to correspondingly increase. However, such air pressure is prevented from escaping through the conduit 60 to the intake manifold 18 by the check valve 62. This also protects the engine 14 from possible back flow of hydraulic fluid from the reservoir 30 preventing engine run away or loss of control. The possibility of back flow is also minimized by connecting the conduit 60 well above the hydraulic fluid level in the reservoir in the event of check valve failure. The hydraulic system is designed to be capable of withstanding such pressure increases which are experienced under normal operating conditions with no harmful effects to any of its components. However, if the pressure within the system becomes unduly high for whatever reason, such pressure is relieved through the relief valve 36.

It will readily be appreciated that a large number of earthmoving vehicles in use today are powered by turbocharged internal combustion engines because of the efficiency and high performance characteristics of such engines. Consequently, the more costly components of the present fluid reservoir pressurization arrangement are inherently provided in such a vehicle so that the adaptation costs of the present arrangement are minimal compared to the prior art pressurization systems which require a separate air compressor or the like.

Further savings are obtained because of the relatively low maximum pressure produced by conventional turbochargers, typically within a range of from 5 to 10 PSIG, which is an ideal range for pressurizing hydraulic reservoirs. Therefore, the need for a regulator valve for controlling the pressure supply to the reservoir is also eliminated.

Furthermore, because the air in the intake manifold is already thoroughly cleaned and sufficiently dried by the normal air filter 28 of the intake system 16, a separate filter and dehumidifier are also not needed.

Another advantage of the present pressurization arrangement is in the ability of the hydraulic system to withstand the increase in pressure experienced during normal operating conditions so that the relief valve is not required to relieve pressure after each cycle as in some prior art pressurization systems. Consequently, the reservoir needs to be pressurized only once by the forced air intake system 16 during a particular period of vehicular operation, instead of being a continual drain thereon.

While the invention has been described and shown with particular reference to the preferred embodiment, it will be apparent that variations might be possible that would fall within the scope of the present invention, which is not intended to be limited except as defined in the following claims.

What is claimed is:

1. A hydraulic fluid reservoir pressurization arrangement for a closed hydraulic system having a reservoir for containing a variable volume of hydraulic fluid below its full capacity so as to provide a variable air space above such hydraulic fluid comprising:
   an internal combustion engine having a forced air intake system providing a source of air under pressure; and
   conduit means connecting said source of air under pressure with said variable air space in the reservoir to insure a continuous supply of hydraulic fluid to the system so as to avoid any cavitation forming interruptions in the flow of such fluid to the system.

2. The hydraulic fluid reservoir pressurization arrangement of claim 1 wherein said forced air intake system of said internal combustion engine includes:
   an intake manifold; and
   an exhaust gas driven compressor supplying pressurized air to said intake manifold, and wherein said conduit means is connected to said intake manifold.
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for communicating such pressurized air to said air space in the reservoir.

3. The hydraulic fluid reservoir pressurization arrangement of claim 2 including check valve means disposed in said conduit means to prevent reverse flow of fluid from the reservoir toward said intake manifold.

4. The hydraulic fluid reservoir pressurization arrangement of claim 3 wherein said closed hydraulic system includes:

a hydraulic pump drivingly connected to said internal combustion engine for providing pressurized fluid to said hydraulic system and adapted to draw hydraulic fluid from said reservoir;

hydraulic motor means adapted to receive and discharge differential quantities of hydraulic fluid;

and control valve means for selectively directing such pressurized fluid of said hydraulic pump to said motor and returning said hydraulic fluid therefrom to the reservoir.

5. The hydraulic fluid reservoir pressurization arrangement of claim 4 including relief valve means for releasing said pressurized air in said air space of the reservoir when the pressure therein exceeds a predetermined maximum to prevent damage to said hydraulic system.

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