

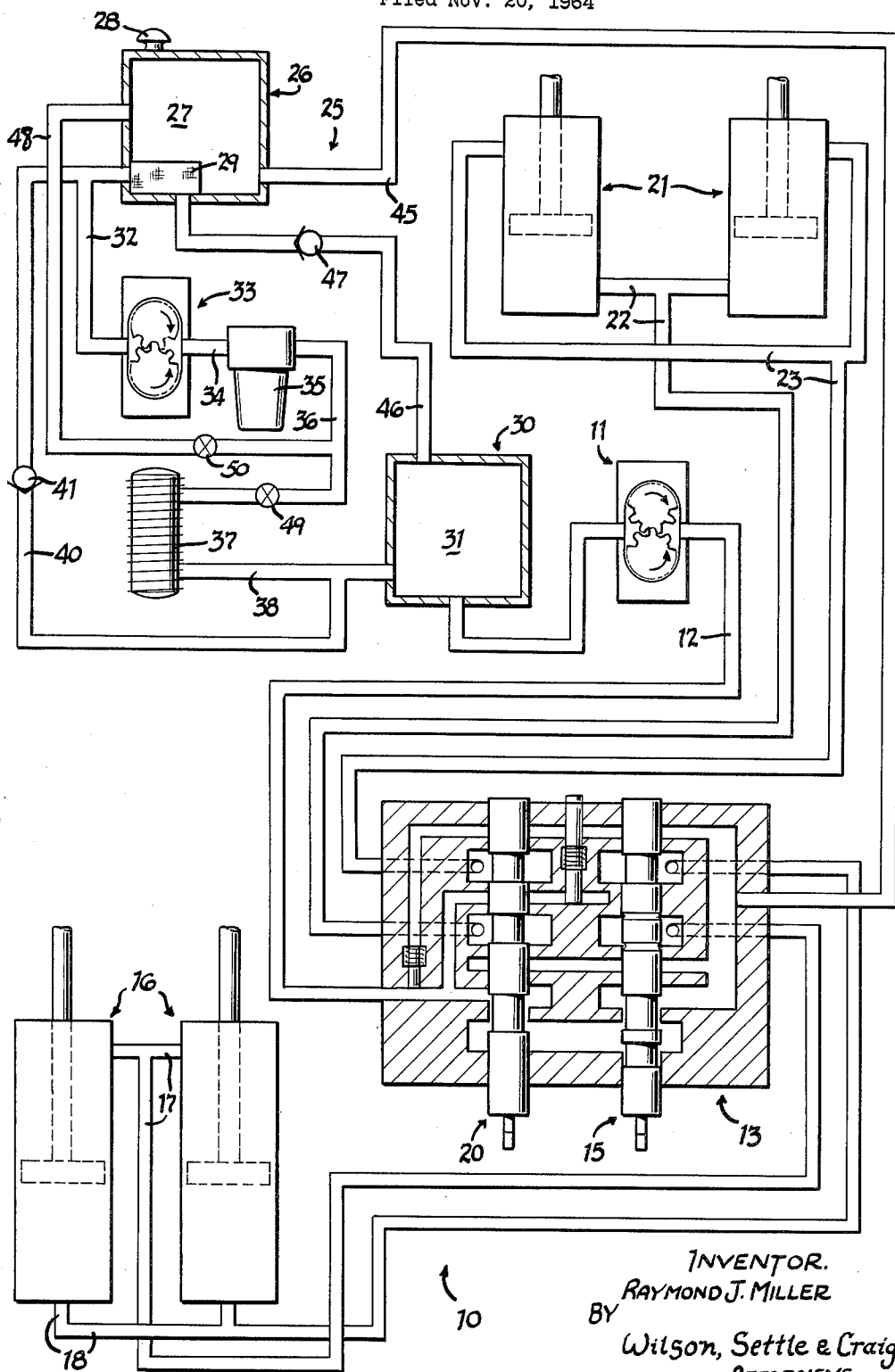
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HYDRAULIC APPARATUS AND METHOD

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HYDRAULIC APPARATUS AND METHOD

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The present invention relates to a hydraulic apparatus and method, and more particularly to a novel hydraulic system having incorporated therein means for supplying to a system pump pre-cleaned, pre-cooled, hydraulic fluid at superatmospheric pressures substantially less than the output pressure of the system pump, but sufficient to avoid the influx of contaminants during operation of the system pump.

In the operation of hydraulically actuated prime movers or the like field equipment, contamination of the hydraulic fluid proposes a serious and ever-present problem. Such systems are conventionally provided with hydraulic fluid from a reservoir which is open to the atmosphere and in which the level of fluid fluctuates as the requirement for hydraulic fluid in the system varies. As the fluid level in such a reservoir drops, atmospheric air enters the reservoir to avoid the formation of a vacuum therein. Since such machines normally operate in the field where dust and air-borne solids are necessarily present, solid contaminants readily become intermixed with the oil in the reservoir, and the entire system shortly becomes contaminated. Various attempts to provide air cleaners or filters to avoid such contamination in the reservoir have been unsuccessful, since such cleaners or filters readily become clogged and must be continuously and conscientiously maintained in order to be effective.

The present invention provides a new and novel solution to this problem of hydraulic fluid contamination and provides a simple, positive and inexpensive method of and apparatus for supplying clean, cool, contaminant-free hydraulic fluid to a system pump for circulation throughout the system.

Functionally, the present invention utilizes a first atmospheric reservoir of the conventional or atmospheric type and a second sealed reservoir adapted to receive fluid from the atmospheric reservoir under pressure and to store this fluid under pressure for circulation throughout the system by the system pump. A fluid supply line interconnects the atmospheric reservoir and the sealed reservoir, and interposed in this supply line is a supply pump, a filter and a heat exchanger. In this manner, fluid supplied to the reservoir is pressurized, filtered and cooled prior to its entry into the reservoir. A pressure relief by-pass is provided from the sealed reservoir to the atmospheric reservoir to recirculate fluid in excess of that required at the reservoir.

The return line from the hydraulic system returns used fluid to the atmospheric reservoir, so that it is again pressurized, filtered and cooled prior to its introduction into the sealed reservoir from which it is again dispensed prior to its reutilization in the system.

Thus, no attempt is made to maintain the fluid in the atmosphere reservoir under sanitary conditions. There is no necessity for any elaborate and costly air cleaning mechanisms which normally require maintenance, filter element replacement and the like. Rather, the oil is pressurized, pre-filtered and pre-cooled prior to its introduction into the system reservoir. By supplying fluid under pressure from the system reservoir, any danger of pump cavitation is positively eliminated and a full and adequate supply of fluid under pressure to the system pump is assured, thus assuring maximum pump life and efficiency. By returning previously utilized hydraulic fluid to the atmospheric reservoir, such fluid is cleaned and cooled prior to its reintroduction into the system.

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It is, therefore, an important object of the present invention to provide a new and improved method of and apparatus for supplying hydraulic fluid to a hydraulic system.

Another important object of this invention is the provision of means for supplying pressured, pre-filtered, pre-cooled hydraulic fluid to the pump of a hydraulic system.

Yet another object is the provision of a novel reservoir arrangement for a hydraulic system and including a pair of reservoirs interconnected by a supply line having interposed therein a pump, a filter, and a heat exchanger so that fluid is supplied to the second reservoir in an ideal condition for utilization, and fluid circulating through the system is returned to the system pump by flow through the conduit interconnecting the reservoirs, so that it, too, is supplied to the system in the same ideal condition.

Yet another, and no less important, object of this invention is the provision of the method of supplying hydraulic fluid to a hydraulic system by providing an atmospheric fluid reservoir of fluctuating level, removing fluid from the atmospheric reservoir, pressurizing, filtering and cooling the removed fluid, introducing the filtered and cooled fluid under pressure into a sealed reservoir, and delivering fluid from the sealed reservoir to the system pump for utilization in the hydraulic system.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawing forming a part of this specification.

On the drawings:

The single figure of drawings is a schematic representation of a hydraulic system of conventional type provided with means of the present invention for supplying fluid under pressure to the system.

Before explaining the present invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawing since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

As shown on the drawings:

Reference numeral 10 indicates generally a hydraulic system of the type conventionally utilized in off-the-road utility mechanisms, such as loaders and the like. For example, the system is particularly utilizable with a loader such as that sold by the J. I. Case Company of Racine, Wisconsin, under the designations "W-9 Terraload'r".

As is typical in such installations, the system includes a gear-type system pump, indicated generally at 11, delivering pressurized fluid through a conduit 12 to a dual-spool control valve, indicated generally at 13. The right-hand spool 15 of the valve 13 can be actuated to deliver fluid under pressure to bucket lift cylinders 16 through conduits 17 and 18. The left-hand spool 20 delivers fluid under pressure to bucket tilt cylinders 21 through conduits 22 and 23.

This much of the system is conventional, and it is unnecessary to describe the system in greater detail.

The pump 11 is supplied with hydraulic fluid through a reservoir system of the present invention, indicated generally at 25. This reservoir system includes a first, atmospheric reservoir tank 26 enclosing an interior space 27, vented to the atmosphere by conventional means, as by a breather cap 28. Disposed interiorly of the reservoir space 27 is a filter screen 29. A second, sealed, pressurized reservoir 30 is provided in spaced relation to the reservoir tank 26, this second tank 30 being completely enclosed and being fluidtight to provide a sealed

interior reservoir chamber 31. Of course, a manually actuated air bleed valve should be provided for start-up. The reservoir chambers 31 and 27 are interconnected by a conduit, indicated generally at 32, and having disposed therein a gear-type hydraulic fluid pump of conventional design, indicated generally at 33.

This pump 33 has its intake side connected through the conduit 32 to the reservoir chamber 27, and has its pressure output side connected by the portion 34 of the conduit 32 to a filter 35, also of conventional design. The filter 35, in turn, is connected through a conduit portion 36 to the inlet side of a conventional finned heat exchanger 37. The outlet side of the heat exchanger 37 is connected through conduit portion 38 to the enclosed reservoir space 31.

A further conduit, designated 48, provides a by-pass fluid return from conduit portion 36 of conduit 32, intermediate filter 35 and heat exchanger 37, to atmospheric reservoir chamber 27 to accommodate additional filtering action by recirculation of the fluid, one or more additional times through filter 35. This feature is especially valuable where the filter element within filter 35 is removed and replaced resulting in inadvertent unavoidable dislodging of contaminating particles from the old filter into the fluid in conduit 32. Procedurally, a manual valve 49 within conduit portion 36 adjacent the entrance to heat exchanger 37 is closed, a manual valve 50 in conduit 48 is opened, and the contaminated fluid is recirculated through conduit 32, filter 35, conduit 48 and reservoir chamber 27 for a time sufficient to purge the contaminating particles from the fluid at which time normal circulation through heat exchanger 37 into sealed reservoir 31 is resumed. Of course, system pump 11 is not operated during the above-described interval.

Thus, the conduit 32 interconnecting the reservoir spaces 27, 31 has interposed therein the pump 33, the filter 35 and the heat exchanger 37, so that hydraulic fluid is supplied to the chamber 31 in a pressurized, filtered and cooled condition. Another by-pass conduit 40 also interconnects the ends of conduit 32, this by-pass conduit 40 having interposed therein a conventional pressure relief valve 41. This pressure relief valve 41 accommodates the return flow of fluid under pressure from the pump 31 back to the atmospheric reservoir space 27 whenever the pressure in the reservoir space 31 exceeds the setting of the pressure relief valve 41.

Thus, the pressure relief valve 41 sets the pressure attained and maintained in the reservoir space 31, this pressure preferably being on the order of about 25 pounds per square inch, as a maximum.

It will also be noted that the valve body 13 is connected with the atmospheric reservoir space 27 by means of a return line 45. Used hydraulic fluid, i.e., return fluid from the cylinders 16, 21, or fluid merely by-passed through the valve body 13 from the constant displacement pump 11, is returned to the atmospheric reservoir space 27. During the operation of the apparatus utilizing the hydraulic system 10, the volume of hydraulic fluid utilized in the cylinders 16 and 21 will vary substantially, thereby causing fluctuation in the level of hydraulic fluid in the atmospheric reservoir space 27. By venting the return line 45 to the space 27, the reservoir space 31 is isolated from any such variations in fluid level.

As a safety precaution and utilized solely in the event of failure of the pump 33, or clogging of the filter 35 or the heat exchanger 37, the reservoir spaces 27 and 31 are also interconnected by a safety line 46 having a check valve 47 therein, this check valve being open in the event of cavitation in the reservoir space 31 to admit hydraulic fluid directly from the reservoir space 27 into the reservoir space 31 to avoid starving the system.

The operation of the system heretofore described will be readily appreciated by those skilled in the art. The presence in the reservoir chamber 31 of fluid at a pressure sufficient to maintain the reservoir filled at all times,

the provision of filtered, contaminant-free liquid in the reservoir space 31, and the presence of cooled hydraulic fluid in the space 31 insures the continuous, accurate, non-cavitating supply of hydraulic fluid to the constant displacement or gear-type supply pump 11. The venting of return fluid through conduit 45 into the atmospheric reservoir 27 confines to the atmospheric reservoir 27 any fluctuations in fluid level, and also insures the cooling of this fluid in the heat exchanger 37 prior to its reintroduction into the system through the system pump 11. The utilization of the relief valve 41 and the by-pass line 40 easily and simply regulates the pressure in the reservoir space 31 and insures the presence therein of sufficient fluid to maintain the reservoir space 31 completely full at all times. Since there is no substantial fluctuation in level in the space 31, there is no tendency to "breathe in" any contaminants.

I claim:

1. In a hydraulic system wherein a system pump supplies hydraulic fluid under relatively high pressure to a motor element under the control of a valve element, a novel reservoir system for supplying said system pump with clean cool hydraulic fluid at superatmospheric pressures substantially less than the output pressure of said system pump comprising first and second reservoirs separate and distinct from one another, said first reservoir being vented to the atmosphere and receiving return fluid from said valve element, said first reservoir thus containing a fluctuating volume of fluid at atmospheric pressure, said second reservoir being sealed from the atmosphere and supplying fluid directly to said system pump, a conduit interconnecting said reservoirs, a supply pump interposed in said conduit and supplying fluid to said second reservoir at superatmospheric pressure less than the pressure supplied by said system pump, a filter and a heat exchanger interposed in said conduit between said supply pump and said second reservoir, and means for returning to said first reservoir fluid delivered by said supply pump when said second reservoir is full.

2. In a method of supplying hydraulic liquid to the system pump of a hydraulic system, the steps of

- (1) removing liquid from a reservoir space at atmospheric pressure,
- (2) pressurizing said liquid,
- (3) filtering said liquid and
- (4) cooling said liquid,
- (5) confining the pressurized, filtered and cleaned liquid in a second reservoir space,
- (6) supplying liquid under pressure from said second reservoir space to said system pump, and recirculating return liquid from said system to said first atmospheric reservoir for subsequent reintroduction into said second reservoir only after steps (1) through (4) have been performed thereon.

3. In a hydraulic system having a system pump, a valve element and a hydraulically powered motor element receiving hydraulic fluid under pressure from said pump and under the control of said valve, the improvements of a sealed system reservoir for supplying fluid under pressure to said system pump, an atmospheric reservoir of maintaining a supply of fluid at atmospheric pressure, a constant delivery supply pump, a first conduit connecting the intake of said supply pump with said atmospheric reservoir, a second conduit connecting the pressure side of said pump with said system reservoir, a filter and a heat exchanger serially interposed in said second conduit, a by-pass return conduit interconnecting said first and second conduits and by-passing said supply pump, said filter and said heat exchanger, a pressure relief valve in said by-pass return conduit, and a system return line interconnecting said valve element and said atmospheric reservoir to dump return fluid in said system to said atmospheric reservoir.

4. In a hydraulic system wherein a system pump supplies hydraulic fluid under relatively high pressure to a

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motor element under the control of a valve element, a novel reservoir system for supplying said system pump with clean cool hydraulic fluid at superatmospheric pressures substantially less than the output pressure of said system pump comprising first and second reservoirs separate and distinct from one another, said first reservoir containing fluid at atmospheric pressure and receiving return fluid from said valve element, said second reservoir being sealed from the atmosphere and supplying fluid directly to said system pump, a first conduit interconnecting said reservoirs, a supply pump, a filter, and a heat exchanger interposed in said first conduit, a recirculation conduit interconnecting said reservoirs, and a pressure relief valve in said recirculating conduit for returning to said first reservoir fluid delivered by said supply pump when said second reservoir is full.

5. In a hydraulic system having a system pump, a valve element and a hydraulically powered motor element receiving hydraulic fluid under pressure from said pump and under the control of said valve, the improvements of a sealed system reservoir for supplying fluid to said system pump, an atmospheric reservoir containing a body of fluid at atmospheric pressure, a supply pump receiving fluid from said atmospheric reservoir and supplying fluid to said system reservoir, a first return line interconnecting said reservoirs, a pressure relief valve in said first return line venting to said atmospheric reservoir fluid in said system reservoir at pressures in excess of a predetermined maximum, a second return line interconnecting said valve element and said atmospheric reservoir to dump return fluid in said system to said atmospheric reservoir, and a filter interposed between said supply pump and said system reservoir.

6. In a method of supplying hydraulic fluid at a predetermined pressure from a system pump to a hydraulic system including hydraulic motor means controlled by a valve means, the steps of

- (1) initially supplying fluid at atmospheric pressure from a first reservoir to a first conduit,
- (2) conducting fluid through said first conduit to a second reservoir,
- (3) during said conducting step pressurizing filtering and cooling said fluid,
- (4) confining said fluid in said second reservoir under pressure,

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(5) withdrawing fluid under pressure from said second reservoir by said system pump, and

(6) returning previously utilized fluid from said valve means to said first atmospheric reservoir.

7. In a hydraulic system having a system pump, a valve element and a hydraulically powered motor element receiving hydraulic fluid under pressure from said pump and under the control of said valve, the improvements of a sealed system reservoir for supplying fluid under pressure to said system pump, an atmospheric reservoir for maintaining a supply of fluid at atmospheric pressure, a supply pump, a first conduit connecting the intake of said supply pump with said atmospheric reservoir, a second conduit connecting the pressure side of said pump with said system reservoir, a filter and a heat exchanger serially interposed in said second conduit, and a return by-pass conduit interconnecting said second conduit and the atmospheric reservoir to accommodate selective recirculation of potentially contaminated fluid within the first and second conduits through the filter to insure delivery of a fully purged filtrate to the system reservoir.

8. In a method of supplying hydraulic liquid to the system pump of a hydraulic system, the steps of

- (1) removing liquid from a reservoir space at atmospheric pressure,
- (2) pressurizing said liquid,
- (3) filtering said liquid and
- (4) recirculating said liquid to the atmospheric reservoir space,
- (5) refiltering said liquid to insure a fully purged filtrate,
- (6) cooling said liquid,
- (7) confining the pressurized, filtered and cleaned liquid in a second reservoir space,
- (8) supplying liquid under pressure from said second reservoir space to said system pump, and recirculating return liquid from said system to said first atmospheric reservoir for subsequent reintroduction into said second reservoir only after steps (1), (2), (3) and (6) have been performed thereon.

No references cited.

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