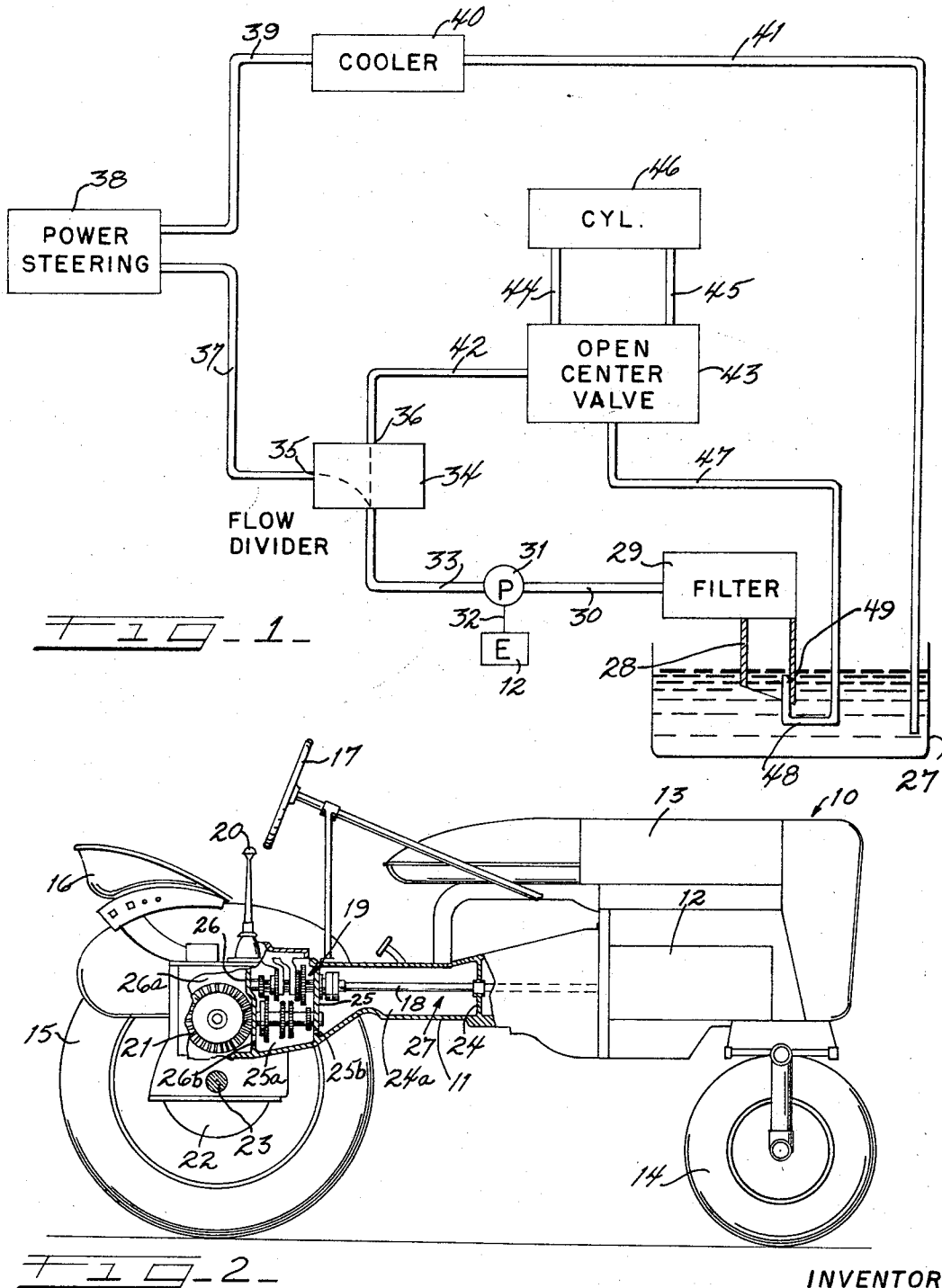


Nov. 19, 1968

H. G. AKINS

3,411,293

RECIRCULATING FLUID IN HYDRAULIC SYSTEMS HAVING
MOVING TRANSMISSION COMPONENTS IN
THE HYDRAULIC RESERVOIR
Filed Oct. 20, 1966



INVENTOR

HERBERT G. AKINS

BY

Walter G. Greany
ATT'Y.

1

2

3,411,293
RECIRCULATING FLUID IN HYDRAULIC SYSTEMS HAVING MOVING TRANSMISSION COMPONENTS IN THE HYDRAULIC RESERVOIR
Herbert G. Akins, Downers Grove, Ill., assignor to International Harvester Company, Chicago, Ill., a corporation of Delaware
Filed Oct. 20, 1966, Ser. No. 588,188
10 Claims. (Cl. 60—52)

ABSTRACT OF THE DISCLOSURE

A hydraulic system having a fluid reservoir accommodating rotating components and including a low volume priority circuit with an intake manifold, filter, pump, flow divider, energy-using device, and cooler connected in series communication with the reservoir and a high volume nonpriority circuit including the intake manifold, filter, pump and flow divider in common with the priority circuit and further including an open center valve for controlling a hydraulic energy translation device connected in series with the common portion of the priority circuit and communicating directly with the intake manifold so that substantial mixing with agitated fluid within the reservoir is avoided.

This invention relates to hydraulic systems, but more particularly to such systems wherein the fluid reservoir thereof accommodates moving elements or components therewithin.

In many of the modern agricultural and industrial tractor vehicles the frame thereof is fashioned to provide housing-like portions or compartments that enclose or encompass the change-speed transmission gears and the differential and bull gear elements of the vehicle while additionally conveniently functioning as a reservoir for the fluid of the hydraulic system, which fluid may also lubricate these elements. Even though this type construction has long been popularly accepted on the commercial markets a significant shortcoming or drawback to such an arrangement results from the fact that the moving components or elements in the reservoir by continuously churning and stirring-up the contents thereof agitate the hydraulic fluid and thereby throwing it into contact with the air above the fluid level in the partially filled reservoir causing excessive aeration of the fluid which, in turn, results in increased noise and cavitation of the hydraulic system.

It is a principle object, therefore, of the present invention to provide a hydraulic system which satisfactorily overcomes the aforementioned objectionable shortcoming in such systems.

Another object is to provide in a hydraulic system, in which the fluid reservoir thereof accommodates rotating components that cause aeration of the fluid therein, means for recirculating a large portion of the fluid flow through certain elements of the system without returning such portion of the flow to the aerated fluid in the system reservoir.

A further object is to provide an open center hydraulic system wherein noise and cavitation are minimized.

A still further object is to provide in a hydraulic system, wherein the fluid reservoir thereof accommodates moving components, means for dividing the fluid flow in the system into a non-priority flow constituting a large portion of the system flow and recirculating that portion of the flow through components of the system without passing through the aerated fluid in the system reservoir, and into a priority flow of a small portion of system flow

which is circulated through a circuit including a cooler and the system reservoir.

An important object is to provide in a hydraulic system wherein the reservoir source of fluid supply thereof is subjected to substantial agitation resulting from movement of rotating elements therein, means for maintaining a large portion of the fluid in the system recirculating therewithin without passing through the reservoir source of fluid supply thereof.

The foregoing and other objects and features of the invention will become apparent as the disclosure is more fully made in the following detailed description of a preferred embodiment of the invention, as illustrated in the accompanying sheet of drawing in which:

FIGURE 1 is a schematic representation of a hydraulic system incorporating the teachings of the present invention therein; and

FIGURE 2 is a vertical elevational view, with portions thereof shown in section and with the rear wheels removed for clarification, of a vehicle of the type to which the present invention is adaptable.

Referring now to the drawings it will be seen that an agricultural tractor vehicle 10, selected for purposes of illustrating a preferred application of the present invention includes a frame 11 supporting an engine 12 and a body portion 13 which, in turn, is suitably carried at the front end by a pair of steerable wheels 14 (only one of which is shown) and at the rear end by a pair of traction wheels 15 (only one of which is shown). An operator's seat 16 is suitably mounted at the rear of the frame while a steering assembly 17 is provided for the steerable wheels thereof. Since these components are conventional further detailing thereof is believed unnecessary.

The engine 12 may be connected through suitable clutching means (not shown) and a drive shaft 18 to a change speed gear transmission unit, such as indicated generally at 19, which may be shiftably controlled by a lever 20 as is well known. Said transmission, in turn, connects with a differential gear unit such as 21 that may be connected by way of a bull gear 22 with the rear axle 23 upon which the traction wheels 15 are connected. Transverse partitions or wall members 24, 25 and 26 cooperate with frame 11 to provide a plurality of compartments such as 24a, 25a and 26a interconnected by suitable openings 25b, 26b in the respective wall members 25, 26. As thus constituted it will be seen that the interconnected compartments cooperate to provide a fluid reservoir or tank, indicated in its entirety by reference numeral 27, in a generally conventional fashion for vehicles of this type. It will also be seen that the fluid in said reservoir in addition to serving the hydraulic system may also function to lubricate rotatable components disposed therewithin, and which components upon rotation cause the agitation that aerates the fluid therein.

The reservoir 27 has a manifold pipe or suction conduit 28 conventionally supported and extending thereinto and the outlet of said manifold conduit communicates with a filter unit 29 of conventional construction, while the outlet of the filter connects by conduit 30 with the suction inlet of a hydraulic pump 31. Said pump may be suitably connected by conventional drive means represented at 32 with the engine 12 of the vehicle and the outlet of said pump is connected by conduit 33 with the inlet of a flow divider unit 34 of conventional design, such, for instance, as the unit disclosed in U.S. Patent 2,799,996 to Vanmeter. Said flow divider is fashioned to proportion the outflow therefrom to a first priority outlet 35 and to a second or non-priority outlet 36 according to the demands of the system. In the present instance it was found that a division in the proportion of $\frac{1}{3}$ to the priority circuit and $\frac{2}{3}$ to the non-priority circuit for normal oper-

ations operated very satisfactorily. However, it should be understood that these proportions are only indicative and not limiting for purposes of defining the bounds of the invention.

Outlet 35, of flow divider 34, connects by conduit 37 with a fluid using or energy translating device such as the power steering unit indicated at 38, while the return from said unit flows by conduit 39 to an oil cooling unit 40 of conventional design. The return from cooler 40 connects by conduit 41 into the reservoir 27 where it intermingles with the remainder of the agitated fluid in said reservoir.

Outlet 36, of flow divider 34, connects by conduit 42 into an open center valve 43 which may be of conventional design such for instance of the type shown in the U.S. Patent 2,873,762 to Tennies. The latter valve may be communicatively connected by conduits 44, 45 with an appropriate hydraulic using or energy translating device, such as the hydraulic cylinder or ram indicated at 46, while the return flow from valve 43 is carried by way of conduit 47 to the interior of intake manifold 28. Conduit 47 is fashioned with an upwardly extending discharge end portion 48 that is dimensioned to extend into manifold 28 to a point disposed proximate the top level of the fluid in the reservoir and may be secured to said manifold by any suitable securing means such as the welds indicated at 49. It will be understood however, that if desired the end of conduit 48 may extend into the manifold 28 to a point above the liquid level without deviating from any of the teachings hereof.

By so positioning the discharge conduit 48 the outflow or discharge therefrom is directed into filter 29 thereby avoiding any appreciable intermixture with the agitated fluid in the reservoir. In this manner the fluid flow circulating in the non-priority circuit portion of the system is maintained circulating therein without having to intermingle with any appreciable quantity of the highly aerated fluid supply in the reservoir. It is appreciated that a portion of this aerated supply in the reservoir will find its way into the filter 29 and intermingle with the recirculated fluid from the non-priority circuit but since the amount of fluid so picked up from the reservoir is so small is has been found that such limited intermixing does not interfere with the satisfactory accomplishments of the objectives of the invention.

It will be understood, of course, that suitable mounting means will be provided for supportably carrying the components of the hydraulic system including the reservoir intake manifold on the associated vehicle, but since these constructions may all be conventional it was felt that a showing of the details thereof was unnecessary herein.

While only one form of the invention has been shown, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof, and it is desired, therefore, that only such limitations shall be placed thereon as are specifically set forth in the appended claims.

What is claimed is:

1. In a vehicle hydraulic system having a reservoir containing fluid therein subjected to substantial agitation incident to the rotation of certain vehicle components therewithin, and wherein certain of the components of the system are interconnected for fluid communication in a first fluid circuit with other components of the system being interconnected for fluid communication in a second circuit fashioned as a common portion of the system, the combination therewith of a fluid inlet means for said system including fluid carrying means for transmitting agitated fluid from said reservoir to said first fluid circuit for circulation therethrough, and fluid carrying means for recirculating fluid through said second circuit without substantial commingling with the fluid in said reservoir.

2. The invention according to claim 1 but further characterized in that said circuit includes a return fluid portion that discharges into said reservoir, and further in that said second circuit includes a return fluid portion that discharges into said first circuit through said fluid inlet means and said common portion of the system.

3. The invention according to claim 2 but further characterized in that said second circuit discharge portion opens into said common portion at a point within said fluid carrying means.

4. The invention according to claim 2 and further characterized in that the return fluid portion of said second circuit connects to and discharges into the said common portion of the system.

5. The invention according to claim 1 but further characterized in that said first circuit includes a return fluid portion that discharges into said reservoir and an intake manifold portion extending into the agitated fluid in said reservoir and having an intake opening in said manifold disposed below the level of the fluid in said reservoir, and further in that said second circuit includes a return fluid portion that opens for the discharge of fluid into said intake manifold at a point proximate the top level of the agitated fluid therein.

6. The invention according to claim 5 wherein the return fluid portion and the intake manifold portion of said first circuit are disposed in spaced apart relation in said reservoir.

7. The invention according to claim 5 but further characterized in that the return fluid portion of said second circuit comprises a conduit extending along and affixed to an interior surface of said intake manifold and having the discharge end of said conduit disposed proximate the level of the reservoir fluid in said manifold.

8. In a vehicle having a hydraulic fluid reservoir with rotatable components of the vehicle disposed therein which upon rotation agitate fluid contained in the reservoir causing the aeration thereof, a hydraulic system, in combination, comprising: means providing a first hydraulic circuit including, a fluid filter communicating with agitated fluid in said reservoir, a hydraulic pump adapted for driving connection to a source of motive power, fluid flow dividing means having an inlet and a first outlet, a first hydraulic energy translating device, and a fluid cooler interconnected in a series flow fashion for circulating fluid from said reservoir therethrough and back to said reservoir; means providing a second hydraulic circuit including, the portion of said first circuit extending from the filter through the pump to the inlet of said fluid flow dividing means, means providing a fluid passage between said inlet and a second outlet of said fluid flow dividing means, and open center valve means communicating with said second outlet and adapted for fluid flow connection to a remote hydraulic energy translating device interconnected in a series flow fashion for circulating fluid therethrough, and return conduit means providing direct communication between said open center valve means and said portion of said first circuit upstream of said filter.

9. In a hydraulic system of the class described, the combination comprising: a reservoir containing a quantity of hydraulic fluid partially filling the interior thereof with an air space above the fluid, and having moving components disposed in and agitating the fluid; a fluid filter; a hydraulic pump adapted for operation to circulate fluid through the system; fluid flow dividing means having an inlet and first and second outlets with passages communicating said inlet with said first and with said second outlets; open center valve means adapted for fluid flow connection with at least one hydraulic energy translating device; fluid cooler means; a hydraulic energy using device; means providing a priority fluid circuit including the reservoir, filter, pump, the inlet and first outlet of said fluid flow dividing means, hydraulic energy using device and cooler in a series flow relation for circulating a small quantity of agitated fluid from the reservoir, therethrough

5

and back to said reservoir; means providing a non-priority fluid circuit including the filter, pump, the inlet and second outlet of said fluid flow dividing means and open center valve means in a series flow relation for circulating a large quantity of fluid therethrough without substantial mixing with the agitated fluid contained in said reservoir.

10. The invention according to claim 9 but further characterized in that the portion of the system than in-

6

cludes the filter, the pump and the inlet of the fluid flow dividing means is common to both said priority and non-priority circuits.

No references cited.

EDGAR W. GEOGHEGAN, *Primary Examiner.*