May 13, 1969 C. A. L. RUHL 3,443,483

PILOT UNLOADING HYDRAULIC CIRCUIT

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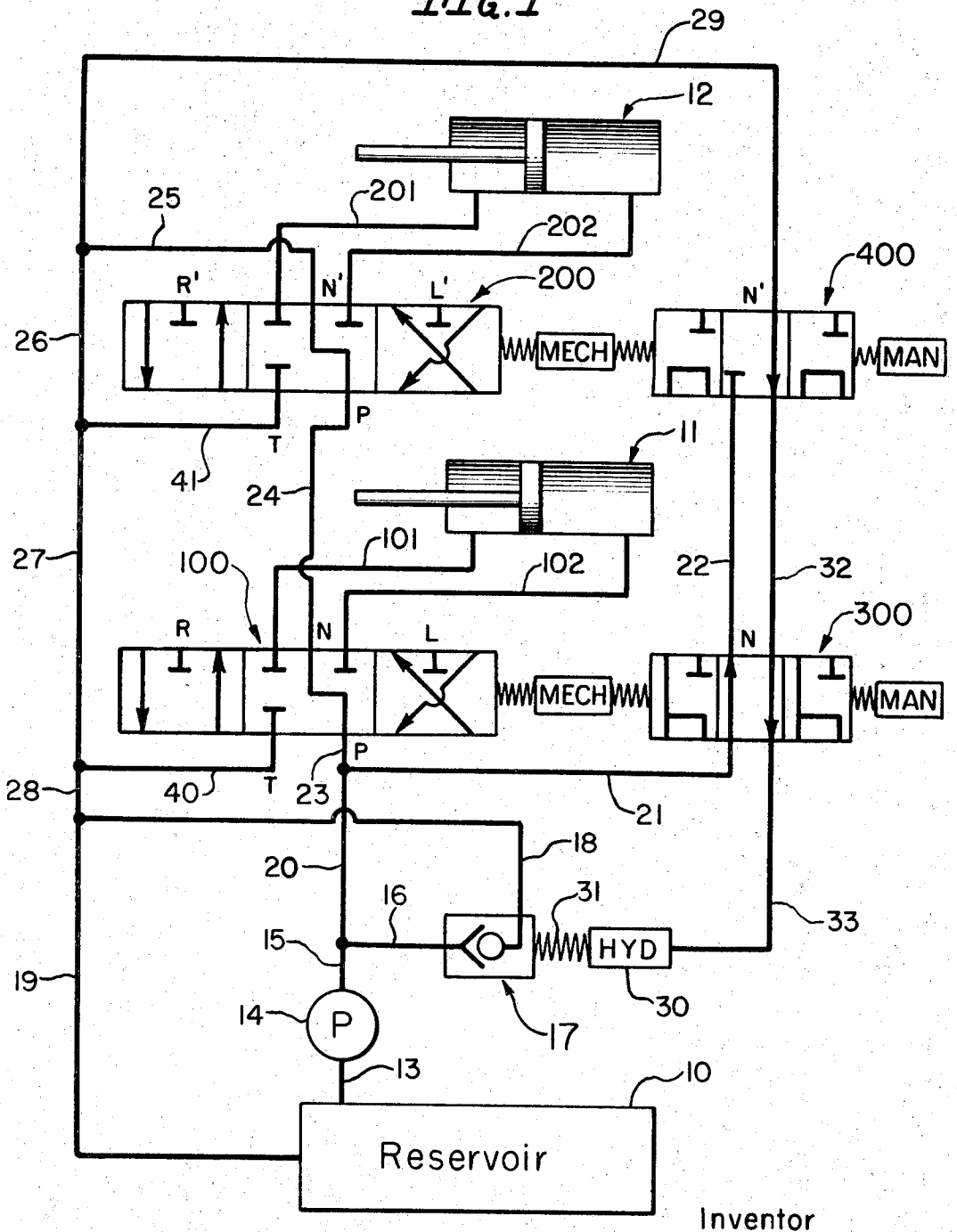
FIG. 1



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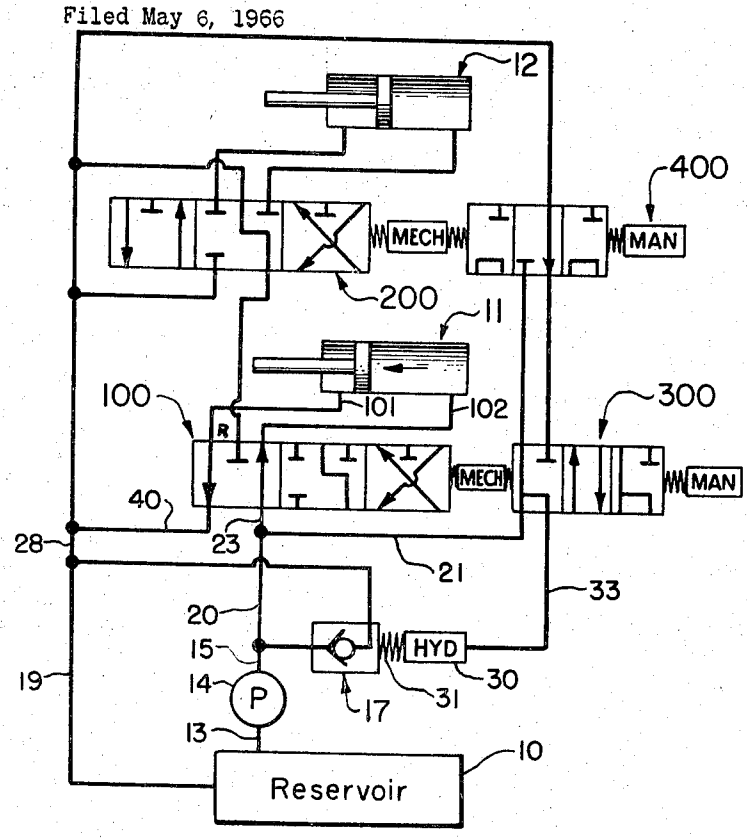

FIG. 2

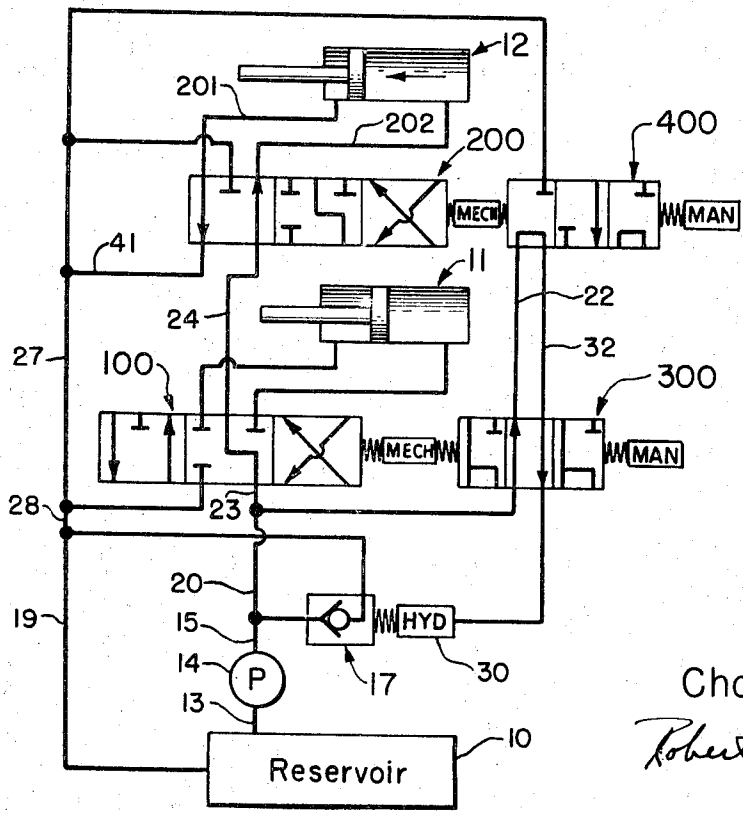

FIG. 3

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PILOT UNLOADING HYDRAULIC CIRCUIT

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U.S. Cl. 91—418 2 Claims

ABSTRACT OF THE DISCLOSURE

A hydraulic circuit for controlling a hydraulic motor having a pump supplying fluid under pressure to an unloading valve, a pilot valve and an operating valve which is selectively positionable to direct fluid pressure to either side of a hydraulic motor to be controlled thereby. The unloading valve in its unseated position communicates directly with the reservoir and in its seated position blocks communication with the reservoir. The pilot valve is manually shiftable from a center neutral position and is mechanically, resiliently connected to the operating valve for selective positioning on either side of neutral. Movement of the pilot valve from center neutral position simultaneously directs fluid pressure to the unloading valve to effect seating thereof and exerts a force on the operating valve to move it to the selected position in order to direct fluid pressure to the desired side of the hydraulic motor.

This invention relates to hydraulic circuits and more particularly to a hydraulic circuit utilizing pilot and unloading valves to reduce the overall distance the hydraulic fluid must flow when the system is in a nonfluid demand condition, thereby reducing frictional heat and power loss in the circuit.

In many of the present day earthmoving machines and construction equipment it is necessary to have long distances of hydraulic tubing and hoses to conduct the hydraulic fluid from the pumps and valving to the hydraulic motors and rams performing the actual, physical moving of the machine parts. Much of this machinery is heavy duty equipment requiring extremely high pressures in the hydraulic circuits. Thus when the hydraulic motors and rams are resting in a nonfluid demand condition an unnecessary fluid flow through the circuit results, giving rise to wasted power in maintaining high fluid pressures throughout the system and power losses from frictional heat as the fluid flows through the entire hydraulic circuit.

It is therefore an object of this invention to provide a means for reducing fluid flow in a hydraulic circuit at all times when there is no actual demand for hydraulic fluid by the hydraulic motors.

Another object of this invention is to provide a means for supplying hydraulic fluid to the hydraulic motors simultaneously with the motors demand upon actuation of an operating valve by eliminating the reduced fluid flow in the hydraulic circuit.

A still further object of this invention is to provide a hydraulic circuit utilizing an unloading valve to short circuit a portion of the entire hydraulic circuit, and provide pilot valves operatively connected to the operating valves to signal the unloading valve when fluid flow in the entire hydraulic circuit is needed.

Yet another object of the present invention is to provide a hydraulic circuit including a pump, operating valves, hydraulic motors, and a fluid reservoir wherein pilot valves operatively connected to the operating valves control an unloading valve providing two fluid flow paths, one directly from the pump to the reservoir through the unloading valve when there is no fluid demand on the circuit, and the other path from the pump to the reservoir through the operating valves and hydraulic motors when the operating valve is actuated to satisfy a fluid demand by the motors thereby causing the pilot valves to close the unloading valve thus shutting off the first fluid path.

Other objects and advantages will become readily apparent from the following detailed description taken in connection with the accompanying drawings, in which:

FIGURE 1 is a diagrammatic view of the hydraulic circuit including a reservoir, a pump, an unloading valve, two pilot valves and two operating valves, all operatively connected wherein both operating valves are in their neutral position thus illustrating the short hydraulic path;

FIGURE 2 is similar to FIG. 1 showing the fluid flow path when one of the operating valves is open; and,

FIGURE 3 is similar to FIG. 1 showing the fluid flow path when the other of the operating valves is open.

It is, of course, possible for the two operating valves to assume other positions and combinations than those illustrated, for example: one in neutral the other to the left. It is further possible that additional operating valves and pilot valves be incorporated into the present hydraulic system to control additional hydraulic rams, along with various check valves to improve operation as is well known in the art. However the examples shown are deemed sufficient to provide a complete and operative description of the invention.

While an illustrative embodiment of the invention is shown in the drawings and will be described in detail herein, the invention is susceptible of embodiment in many different forms and it should be understood that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiment illustrated. The scope of the invention will be pointed out in the appended claims.

Referring now to the drawings, FIGURE 1 is representative of all three figures wherein the entire hydraulic system is illustrated. Hydraulic fluid is stored in a sump or reservoir **10**, and depending on the demand status of the hydraulic rams **11** and **12**, one of two fluid paths will conduct fluid from the reservoir, through the circuit and back to the reservoir.

The first path, as shown in FIG. 1, represents the short circuit path when neither ram **11** or **12** requires fluid. In this condition the fluid flow path is from reservoir **10**, up passage **13**, through a pump **14**, through passages **15** and **16**, through unloading valve **17** (shown as a spring biased ball check valve), through passages **18** and **19** and back to reservoir **10**.

With the rams **11** and **12** in this condition and operating valves **100** and **200** in neutral (shown as the N position on valve **100** and N^1 on valve **200**), the fluid from pump **14** has two additional possible paths.

A flow path through passages **20** and **21**, to pilot valve **300** (shown in FIGURE 1 in the neutral position N), through passage **22** and to pilot valve **400** (shown in its neutral position N^1) connects the pilot valves to the high pressure side of the pump **14**. A second flow path through passage **23**, through operating valve **100**, through passage **24**, through operating valve **200**, and back to reservoir **10** through passages **25**, **26**, **27**, **28** and **19** provides the normal path in a hydraulic system of this type without an unloading valve.

As necessary to the functioning of unloading valve **17**, wherein the valve **17** is operated by a hydraulic means **30** and a spring **31**, reservoir pressure (when operating valves **100** and **200** are in neutral as in FIGURE 1) is fed to hydraulic means **30** by means of a flow path between means **30** and reservoir **10** including passages

19, 28, 27, 26, 29, pilot valve 400, passage 32, pilot valve 300 and passage 33.

Thus when all the operating valves and pilot valves are in neutral, fluid flow will be through the unloading valve since the pump pressure in line 16 is greater than the combination of the tank pressure in line 33 and the bias force of spring 31, thereby keeping the unloading valve 17 open. This short circuit flow path also has less resistance than the alternate path through the operating valves 100 and 200 and thus allows the pump 14 to dump back to reservoir 10 without pumping fluid through the entire hydraulic system, which provides a saving of energy normally lost in heat, long line flow and excess pump pressure.

Each of the valves, the unloading valve 17, the two operating valves 100 and 200, and the pilot valves 300 and 400 have means for actuating the valves as is well known in the art. The hydraulic means and spring bias of valve 17 have already been discussed. It is to be noted that each operating valve is operatively connected to a pilot valve (in the present case a mechanical connection) and each of the valve pairs (one operating valve and one pilot valve) will function as a single unit when operated. As shown in the instant construction the manual operator is on the pilot valve, but the operating valve could be moved to thereby control the movement of the pilot valve. Also, as is well known in the art, each of the operating valves and pilot valves are spring biased to their neutral position.

Referring now to FIGURE 2, pilot valve 300 and operating valve 100 are shown shifted to their right hand position (as indicated by R) to thereby provide fluid flow to hydraulic ram 11 through supply conduit 102 and return conduit 101. It will be noted that operating valve 200 and pilot valve 400 are in the same position as FIGURE 1 thereby indicating no fluid flow to ram 12. In order to provide fluid flow to ram 11 it is necessary that the fluid flow path through unloading valve 17 be closed so that only the flow path through the operating valves 100 and 200 remains. This is accomplished by the pilot valves in general and more specifically pilot valve 300 as shown in FIGURE 2. With the pilot valve 300 in this position the high pressure fluid will flow through passage 21 as before but instead of flowing through the pilot valve with no actuating purpose, the high pressure fluid is routed to passage 33. Thus the unloading valve 17 now has high pressure fluid on the inlet side and a combination of high pressure fluid and the spring 31 biasing valve 17 closed. Accordingly fluid flow will actuate ram 11 through the following flow path: reservoir 10, passage 13, pump 14, passages 15, 20, and 23, through operating value 100, passage 102, to ram 11. Return to tank flow follows a path from ram 11, through passage 101, operating valve 100, and passages 40, 28, and 19 back to reservoir 10. When no further fluid flow to ram 11 is wanted, pilot valve 300 is returned to its neutral position. This removes high pressure from passage 33 and unloading valve actuator 30, and substitutes tank pressure therefor. As before, the tank pressure plus the bias force of spring 31 is less than the inlet pressure in line 16. The pressure differential once again opens the unloading valve 17 and allows pump 14 to dump directly to reservoir 10 without high pressure fluid flow through operating valves 100 and 200.

FIGURE 3 illustrates the hydraulic system when the other of the hydraulic rams, ram 12, requires fluid to actuate a work load (not shown). In this case operation of pilot valve 400 applies high pressure to actuator 30 of unloading valve 17 through lines 22 and 32 to close valve 17 and thereby eliminate the unloading valve short circuit. This provides a high pressure source through ram 12 by way of reservoir 10, passage 13, pump 14, passages 15, 20 and 23, through operating valve 100, passage 24, through operating valve 200 and passage 202. The return to tank from ram 12 follows a flow path including passage 201, operating valve 200, and passages 41, 27, 28 and 19 to reservoir 10. When fluid flow is no longer needed the pilot is returned to neutral and the hydraulic system is returned to its short circuit condition as previously explained hereinabove.

Thus with a hydraulic system as described herein it is possible to provide fluid to the working rams at all times when fluid pressure is required, and to provide a short hydraulic circuit to eliminate heat and energy loss in the hydraulic system when no fluid demand is present, by utilizing standard valves in a novel piping arrangement.

What is claimed is:

1. In a hydraulic circuit having a pump, a hydraulic motor, an operating valve selectively positionable to direct fluid pressure from the pump to either side of the hydraulic motor, and a fluid reservoir, the improvement comprising:

an unloading valve including fluid operator means having an unseated position wherein fluid communication is provided directly from the pump to the reservoir and a seated position wherein such communication is blocked;

and a manually operable pilot valve mechanically connected to the operating valve for shifting the latter in response to movement of the former;

said pilot valve being manually shiftable in either direction from a central neutral position and including passages directing fluid pressure from the pump to the unloading valve operator means to urge said unloading valve towards its seated position while blocking fluid flow from said operator means to said reservoir when so shifted.

2. In a hydraulic circuit according to claim 1 wherein said pilot valve is resiliently connected to said operating valve, whereby manual shifting of the pilot valve will be isolated from the resistance to movement of the operating valve.

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MARTIN P. SCHWADRON, *Primary Examiner.*

U.S. Cl. X.R.

91—411; 137—596.13