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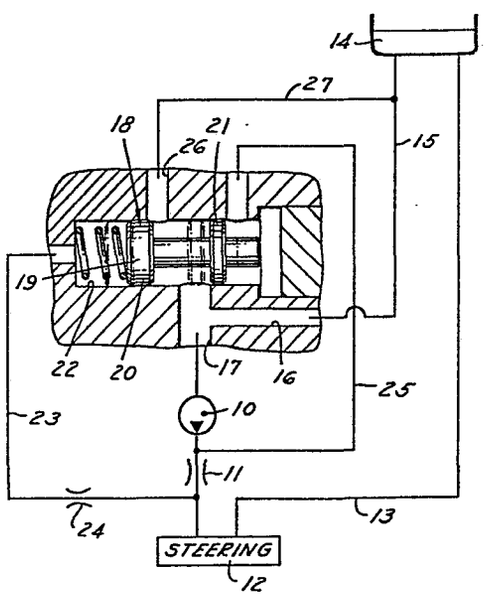
(54) Power transmission.

(57) A hydraulic system comprising a fixed displacement pump (10) driven by a prime mover operable at variable speeds and a flow control valve (18) operable to return a portion of the hydraulic fluid from the outlet of the pump (10) to the inle (17) of the pump (10) and draw fluid from a reservoir (14) to replenish the fluid at the inlet (17) when the pump (10) is operated at higher speeds. An auxiliary passage (26, 27) extends from the reservoir (14) and communicates with the inlet (17) of the pump (10) upstream from the system flow drawn from the reservoir (14) by the opening of the flow control valve (18) and normally isolated during low speed operation from the bypass flow (25) by the flow control valve (18, 21) thereby providing auxiliary flow to the inlet (17) at lower speeds.



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POWER TRANSMISSION

This invention relates to hydraulic systems and particularly to hydraulic systems such as power steering systems which utilize a fixed displacement pump driven by a prime mover that operates at variable speeds.

BACKGROUND AND SUMMARY OF THE INVENTION

In hydraulic systems utilizing fixed displacement pumps driven by variable speed prime movers such as utilized in power steering systems for automotive vehicles, the system operates at a predetermined constant volume controlled by a flow control valve. The flow control valve also provided the fluid mechanics for replenishing the flow directed to the power steering booster by bypassing some of the fluid to the inlet of the pump when the pump is operated at higher speeds. However, in such a system, at the lower speeds, because of the restricted size of the passage for replenishing the flow by fluid returning from the power booster, it is common that there may be excessive inlet vacuum and cavitational damage especially at larger control flows and at cold temperatures when the fluid is very viscous. Typical systems are shown in United States Patents 2,880,674 and 3,207,077.

Accordingly, the present invention is intended to provide a hydraulic system which will adequately provide hydraulic fluid at the lower speeds before the flow control valve begins to bypass fluid, which will permit an increased control discharge flow range, which will lower the sound level of operation of the pump, which will produce less wear associated with cavitation, which will permit more effective use of the shaft seals because of the lesser tendency to draw vacuum, and which will increase the pressure of the inlet due to the normal replenishing by the flow control valve.

In accordance with the invention, an auxiliary passage extends from the reservoir and communicates with the inlet of the pump upstream from the system flow drawn from the reservoir by opening of the flow control valve and normally isolated during low speed operation from the bypass flow by the flow control valve thereby providing auxiliary flow to the inlet.

DESCRIPTION OF THE DRAWINGS

The single drawing is a partly schematic view of a hydraulic system embodying the invention.

DESCRIPTION

In accordance with the invention as shown in Fig. 1, the hydraulic system comprises a fixed displacement pump 10 driven by a prime mover such as the engine of an automotive vehicle to supply fluid through an orifice 11 to a steering booster 12 such as a linear or rotary hydraulic motor. In a normal system, the return of fluid through a line 13 is to a reservoir 14. Fluid from the reservoir normally flows through a line 15 and a passage 16 to the inlet 17 of the pump. A flow control valve 18 comprising a spool 19 having spaced lands 20, 21 is provided in a bore 22 and is operable in accordance with well known practive to bypass the fluid when the volume exceeds a predetermined rate. A line 23 extends from the outlet of the pump and has an orifice 24 therein to the spring end of the spool. When the volume exceeds a predetermined rate, the land 21 moves to the broken line position causing a portion of the fluid to flow through line 25 between the land 21 and the edge of the bore into the inlet 17. The passage 16 aspirates further hydraulic fluid flow through the inlet thereby supplementing the flow of fluid to the pump at the higher speed. Such systems are old and shown in the aforementioned United States Patents 2,880,674 and 3,207,077 which should be referred to for details of construction.

In accordance with the invention, an auxiliary passage 26 is provided and communicates as shown diagrammatically by a line 27 with the reservoir 14. Passage 26 functions to provide supplemental flow of hydraulic fluid to the inlet 17 at the lower speeds. It is noted that the passage 26 is located upstream from the passage 16 and is

hydraulically isolated from the fluid applied to the flow control valve when the flow control valve is in closed position.

Thus, a hydraulic system embodying the invention provides improved filling at the inlet at the lower speeds before the flow control valve begins to bypass the discharge volume, lowers the sound level, reduces the wear and maintenance that might be caused by vacuum and cavitational damage. The additional passage also functions to increase the pressure at the inlet supplementing the supercharging normally provided by the flow control valve.

WHAT IS CLAIMED IS:

1. In a hydraulic system comprising a fixed displacement pump (10) driven by a prime mover operable at variable speeds wherein it is desired to have a minimum volumetric flow, a flow control valve (18) operable to return a portion of the hydraulic fluid from the outlet of the pump (10) to the inlet of the pump and draw fluid from a reservoir (14) to replenish the fluid at the inlet when the pump is operated at higher speeds, the improvement comprising

a passage (26,27) extending from the reservoir and communicating with the inlet (17) of the pump (10) upstream from the system flow return (16) drawn from the reservoir (14) by the flow control valve and normally isolated during low speed operation from the bypass flow by the flow control valve thereby providing auxiliary flow to the inlet.

2. The hydraulic system set forth in claim 1 wherein said bypass flow passage (25), system flow return passage (16), and auxiliary passage (26) are in said housing of the pump,

said flow control valve (18) being operable when the flow exceeds a predetermined value to permit flow from the bypass flow passage (25) toward the inlet and aspirate flow from the system flow return to the inlet.

3. The hydraulic system set forth in claim 1 wherein said pump housing has a bore (22),

said flow control valve comprising a spool (19) in said

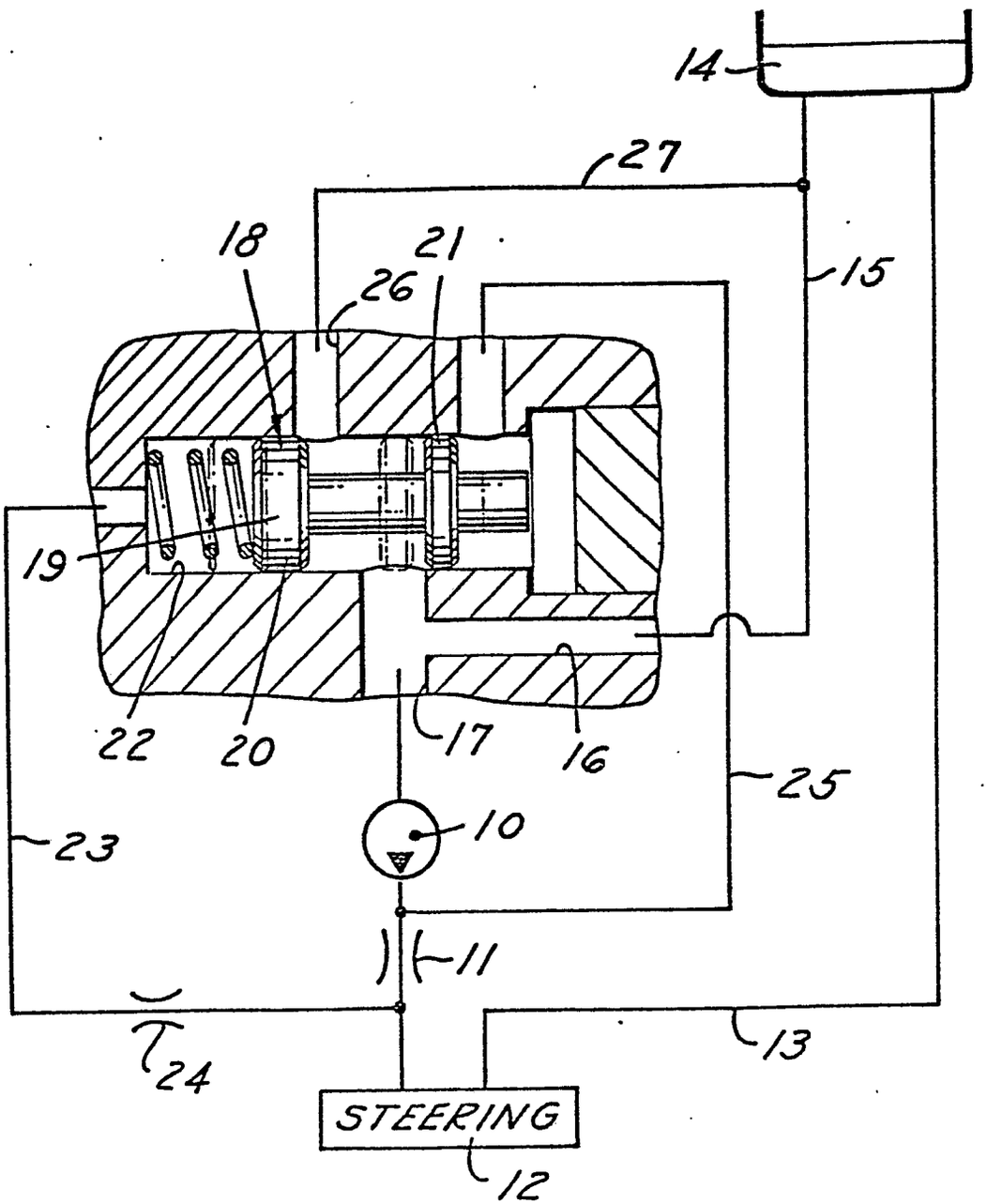
bore having first and second lands (20,21),

said second land controlling the flow from said bypass flow passage (25) to the inlet upstream of the system flow return passage,

said auxiliary passage (26) intersecting said bore (22) between said lands (20,21) and isolated from said bypass flow return by said flow control valve when said flow control valve is in position preventing flow from said bypass flow control passage to said inlet.

4. In a hydraulic system comprising a fixed displacement pump (10) driven by a prime mover operable at variable speeds wherein it is desired to have a minimum volumetric flow, a flow control valve (18) operable to return a portion of the hydraulic fluid from the outlet of the pump to the inlet of the pump (10) and draw fluid from a reservoir (14) to replenish the fluid at the inlet when the pump is operated at higher speeds, the method of supplementing the flow to the inlet at lower speeds which comprises

directing fluid extending from the reservoir (14) to the inlet of the pump (20) upstream from the system flow return (16) drawn from the reservoir (14) by the flow control valve (18) and normally isolating said fluid during low speed operating from the bypass flow by the flow control valve thereby providing auxiliary flow to the inlet.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EUROPEAN SEARCH REPORT

Application number
EP 81 10 6075

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
X	GB - A - 2 019 940 (FORD MOTOR CO) * Page 3, line 86 - the end; page 4, lines 1-9; figures 11A, 11B; page 2, line 88 - the end; figures 1,5,6,7; page 3 - first paragraph; figures 8,9 *	1-4
	US - A - 3 644 065 (LETTENMAYER) * Column 3, lines 18-70; column 4, lines 10-60; figures 1-4 *	2,3,4
	US - A - 3 253 607 (DRUTCHAS) * Column 2, line 46 - column 3, line 65; figures *	2,3,4

CLASSIFICATION OF THE APPLICATION (Int. Cl.³)

F 04 C 15/04

TECHNICAL FIELDS SEARCHED (Int. Cl.³)

F 04 C

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	20-11-1981	KAPOULAS