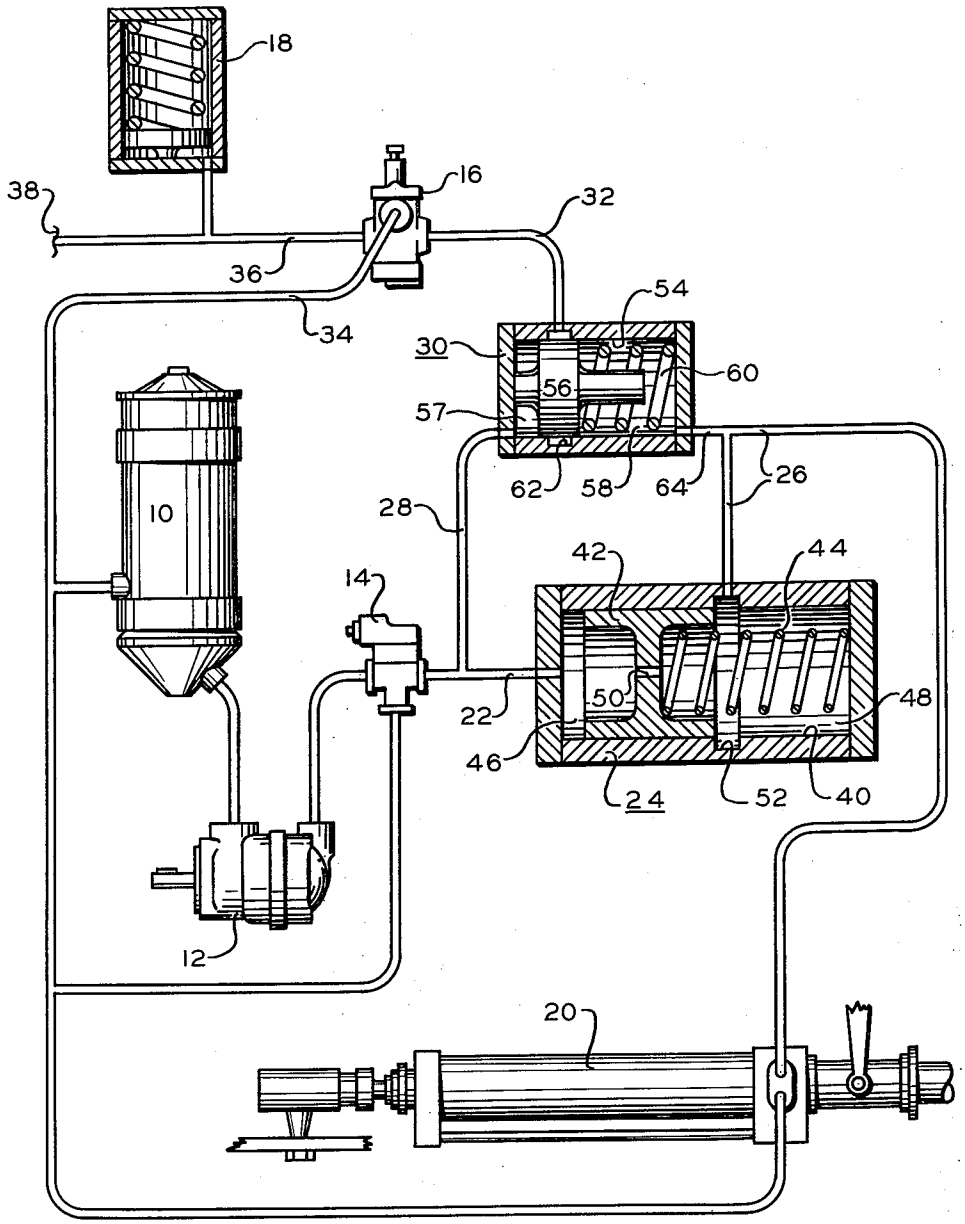
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POWER TRANSMISSION

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POWER TRANSMISSION

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This invention relates to power transmissions, and is particularly applicable to those of the type comprising two or more fluid pressure energy translating devices, one of which may function as a pump and another as a fluid motor.

This invention is more particularly concerned with a system wherein two or more fluid motors of varying requirements may be operated from a single fluid source and particularly to systems wherein one fluid motor has precedence over the other in receiving its normal requirements of operating fluid.

Previous systems of this type have required costly and highly critical valving. This invention has overcome the objections by utilizing a simple, conventional flow control valve placed between the source and the primary load and a second control valve responsive to the pressure drop in the first conduit, thereby providing a low cost and efficient system.

This invention is particularly adapted for use in an automatic hydraulic system wherein a constant supply is required, such as for operation of a power steering booster, while a secondary supply is also needed for the operation of, for example, brakes, windows, doors, and seats.

This invention is especially well adapted for use when continuous operation of only a single motor is required, and where excess power may be stored in an accumulator to permit intermittent operation of other motors, even when the entire pump output is being diverted to the first motor.

An object of this invention is to deliver a constant quantity of fluid to a primary circuit for actuation of a fluid motor regardless of the demand in the secondary circuit.

Another object of this invention is to have one source of supply which can actuate two or more fluid motors of varying requirements.

A still further object is to provide a simple, low cost, hydraulic circuit with appropriate valving for causing the desired operation to automatically take place.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing wherein a preferred form of the present invention is clearly shown.

In the drawing:

The single figure is a diagrammatic view of a hydraulic system incorporating the present invention.

Referring to the drawing, the system includes a reservoir **10**, a pump **12** driven by a variable speed prime mover, not shown, such as a power take-off from the vehicle engine, and relief valve **14**, all of conventional construction. Additional conventional components in the circuit include an unloading valve **16**, an accumulator **18**, and an open-center steering booster **20**. Steering booster **20** may be of the type disclosed in U.S. Patent No. 2,022,698 to Harry F. Vickers. Such steering boosters require a substantially constant rate of fluid supply for proper operation.

Fluid from pump **12** is supplied to steering booster **20** through a primary circuit which includes a conduit **22**, meter-in flow control vlve generally designated **24**, and a conduit **26**.

The unloading valve **16** and the accumulator **18** are supplied with fluid from the pump **12** through a secondary

circuit which includes a conduit **28**, a differential-pressure responsive flow control valve generally designated **30**, and a conduit **32**.

The unloading valve **16** is of the conventional type which is responsive to pressure conditions in the accumulator circuit. When the accumulator is fully charged, unloading valve **16** will divert fluid from conduit **32** back to reservoir **10** through a conduit **34**. When the accumulator pressure is low, unloading valve **16** will direct fluid from conduit **32** through the conduit **36** to recharge the accumulator, and to provide fluid for intermittently operated motors, not shown, which are connected to the conduit **36** beyond the point **38**.

The valve **24** includes a valve bore **40** having a spool **42** slidably mounted therein. Spool **42** is biased to the left in the figure by a spring **44**. The spool **42** divides the bore **40** into a pair of pressure chambers **46** and **48**, and presents equal and opposed areas to the pressures in those two chambers. A metering orifice **50** in spool **42** effects communication between chambers **46** and **48**. The bore **40** includes an annulus **52** which communicates with conduit **26** and, in the spring biased position of spool **42**, is in open communication with the pressure chamber **48**. Valve **24** is of the type termed "normally open" in that it is initially biased to the open position and is shiftable toward its closed position as it performs its control function.

By way of example, spring **44** may be so selected that a pressure differential of 15 p.s.i. between chambers **46** and **48** will cause the spool **42** to shift rightwardly to restrict communication between annulus **52** and chamber **48**. The orifice **50** is of a size such that a 15 p.s.i. pressure drop across it would provide the maximum desired flow to the booster **20**, for example 2 gallons per minute.

The pressure-differential responsive flow control valve **30** includes a valve bore **54** having a valve spool **56** slidably mounted therein. Spool **56** divides the valve bore **54** into a pair of chambers **57** and **58** and presents equal and opposed areas to the pressures in those chambers. A spring **60** normally biases the valve spool **56** to the leftward position illustrated, wherein it blocks communication between the chamber **57** and an annulus **62** in valve bore **54**. Valve **30** is of the type termed "normally closed" in that it is initially biased to the closed position and is shiftable toward its open position as it performs its control function. The conduit **28** communicates with chamber **57** from a point upstream of valve **24** in the primary circuit, and chamber **58** communicates through a conduit **64** with the primary circuit at a point downstream of valve **24**. Spring **60** is so selected as to require a greater pressure differential between chambers **57** and **58** in order to shift spool **56** than is required between chambers **46** and **48** to shift spool **42**. By way of example, we have previously indicated that a 15 p.s.i. differential is required to shift spool **42**, and thus spring **60** might be selected to require a 20 p.s.i. pressure differential between chambers **57** and **58** to shift spool **56**.

In operation, assume that with the vehicle engine idling the output of pump **12** is something less than 2 gallons per minute. Under these conditions, all the fluid pumped will pass through the primary circuit to the steering booster since a flow rate of 2 gallons per mintue is necessary before a 15 p.s.i. pressure differential is created across the orifice **50**, and a 15 p.s.i. pressure differential is required before spool **42** will shift to restrict communication between chamber **48** and the annulus **52**. No fluid will be supplied to the secondary circuit since valve **56** will remain closed due to the pressure differential between chambers **57** and **58** being less than the 20 p.s.i. required to compress spring **60**.

When the vehicle engine speed is increased to a point where the output of pump **12** exceeds 2 gallons per

minute, the pressure differential between chambers **46** and **48** will tend to exceed 15 p.s.i. causing spool **42** to shift rightwardly, restricting communication between chamber **48** and annulus **52**, thus limiting flow in the primary circuit. The additional restriction to flow in the primary circuit introduced by the shifting of spool **42** will create a pressure drop between primary circuit conduits **22** and **26** which is in excess of the 20 p.s.i. required to shift spool **56**. This differential is imposed across spool **56** of valve **30**, causing it to shift and open communication between conduits **28** and **32** of the secondary circuit. Thus, any output of pump **12** in excess of 2 gallons per minute will be available to the secondary circuit for use in charging accumulator **18**, when needed. In the event that accumulator **18** is fully charged, the excess fluid is returned to reservoir **10** through conduit **34** at minimum pressure, thus conserving power.

It should be noted that when the pump output exceeds 2 gallons per minute, in the cited example, pump outlet pressure is dictated by whichever circuit has the higher pressure requirement at any given time. However, during the lengthy intervals of no demand in the secondary circuit, the usually low pressure requirement of the steering booster is the controlling factor. It will be seen from the foregoing that there has been provided an efficient, low cost system for supplying a plurality of fluid motors having varying requirements from a single source.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. In a hydraulic power transmission for controlling the division of flow from a single source, the combination of: primary and secondary circuits; a first delivery conduit leading to said primary circuit and a second delivery conduit leading to said secondary circuit, said conduits having a point of common communication with said source; an orifice in said first conduit; and a pair of separately shiftable valves for regulating the flow between said circuits comprising, a first flow control valve in said first conduit having means to normally bias said valve to an open position and having opposed areas connected respectively to points upstream and downstream of said orifice so as to be shiftable in response to a predetermined pressure drop across said orifice to restrict said first conduit, and a second flow control valve in said second conduit having means to normally bias said second valve to a closed position and having opposed areas connected respectively to points in said first conduit upstream and down stream of said first valve so as to be shiftable in response to the pressure drop created by the shifting of said first valve, thereby opening said second conduit only after said first valve has shifted to restrict said first conduit.

2. In a hydraulic power transmission for controlling the division of flow from a single source, the combination of: primary and secondary circuits; a first delivery conduit leading to said primary circuit and a second delivery conduit leading to said secondary circuit, said conduits having a point of common communication with said source; an orifice in said first conduit; and a pair of separately shiftable valves for regulating the flow between said circuits comprising, a first flow control valve in said first conduit having means to normally bias said valve to an open position and having opposed areas connected respectively to points upstream and downstream of said orifice so as to be shiftable in response to a predetermined pressure drop across said orifice to restrict said first conduit, and a second flow control valve in said second conduit having means to bias said second valve to a closed position and having opposed areas connected respectively to points in said first conduit upstream and downstream of both said orifice and said first valve so as to be shiftable in response to a predetermined pressure drop across both said orifice and said first valve to open said second conduit.

3. In a hydraulic power transmission for controlling the division of flow from a single source, the combination of: primary and secondary circuits; an accumulator and unloading valve in said secondary circuit; a first delivery conduit leading to said primary circuit and a second delivery conduit leading to said secondary circuit, said conduits having a point of common communication with said source; an orifice in said first conduit; and a pair of separately shiftable valves for regulating the flow between said circuits comprising, a first flow control valve in said first conduit having means to normally bias said valve to an open position and having opposed areas connected respectively to points upstream and downstream of said orifice so as to be shiftable in response to a predetermined pressure drop across said orifice to restrict said first conduit, and a second flow control valve in said second conduit having means to normally bias said second valve to a closed position and having opposed areas connected respectively to points in said first conduit upstream and downstream of said first valve so as to be shiftable in response to the pressure drop created by the shifting of said first valve, thereby opening said second conduit only after said first valve has shifted to restrict said first conduit.

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