

Aug. 8, 1967

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3,334,705

PRIORITY VALVE FOR CLOSED CENTER SYSTEM

Filed Aug. 6, 1965

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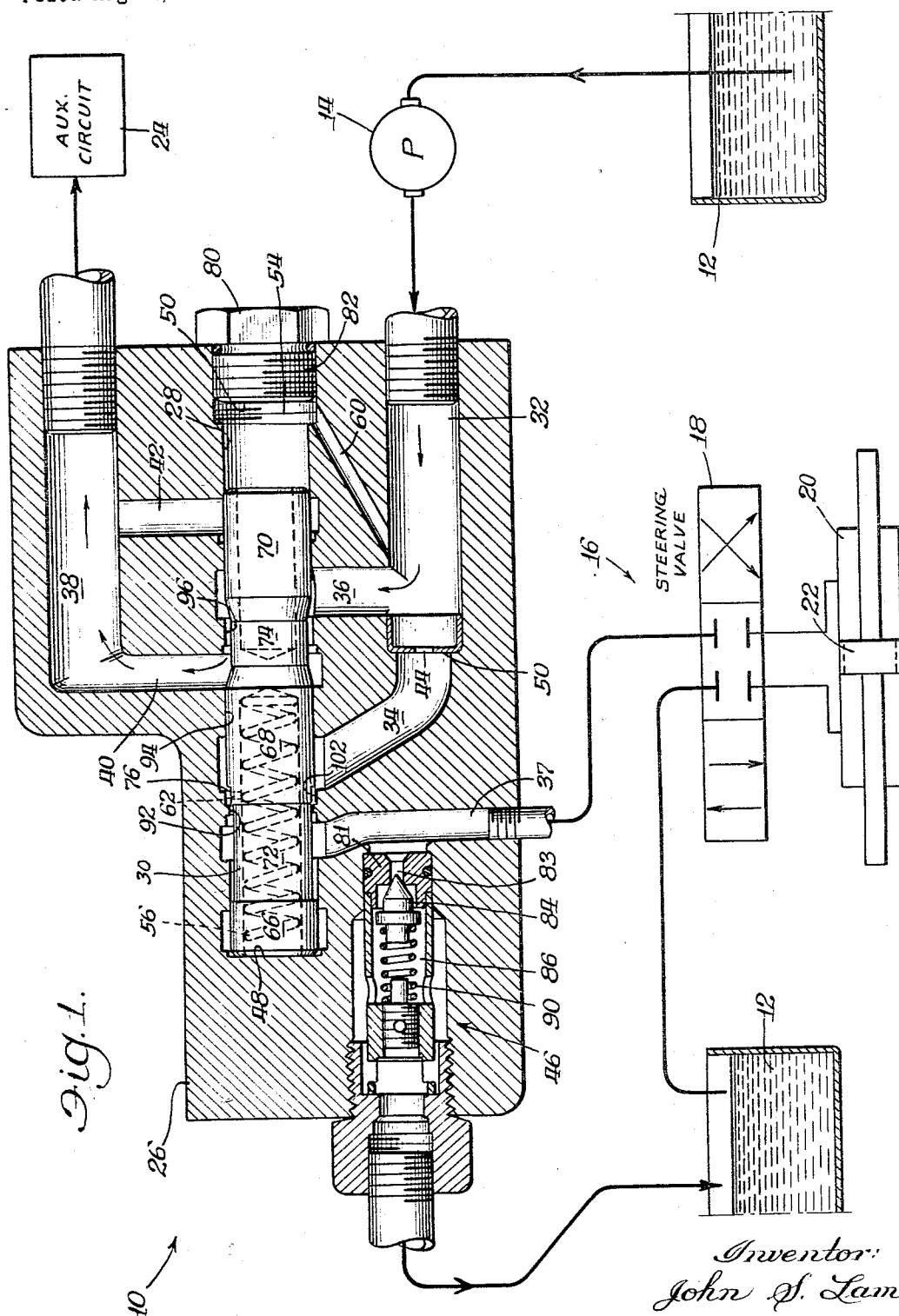


Fig. 1.

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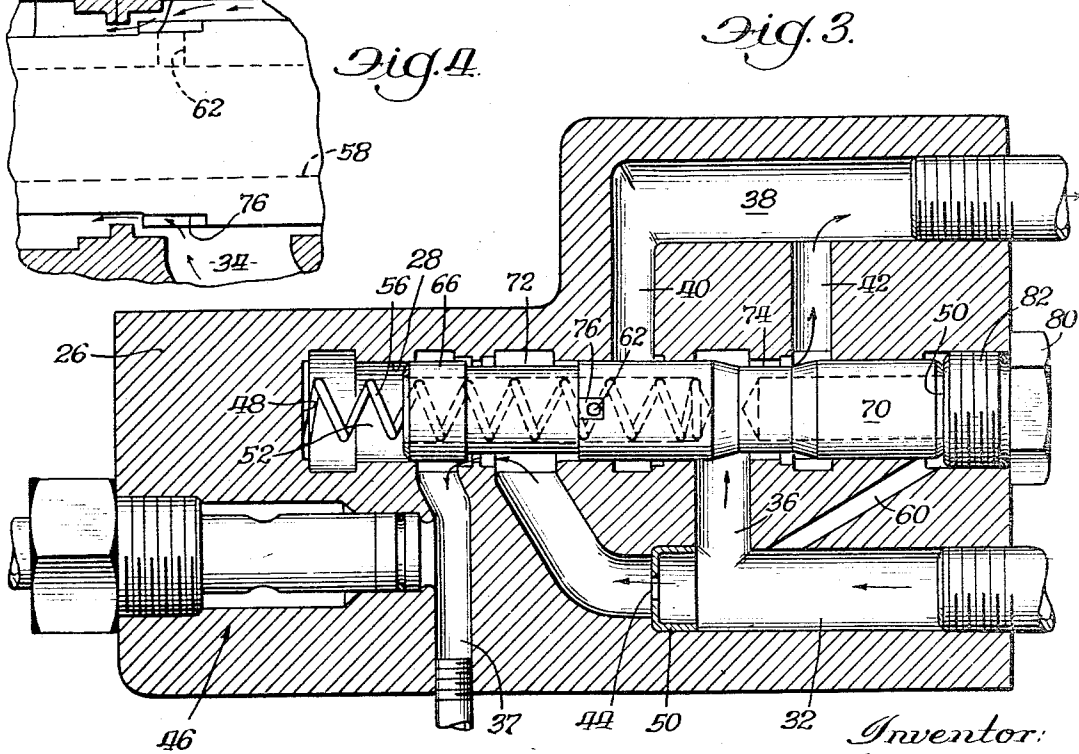
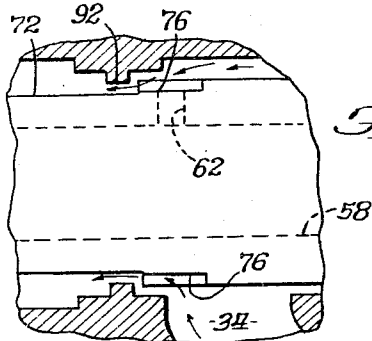
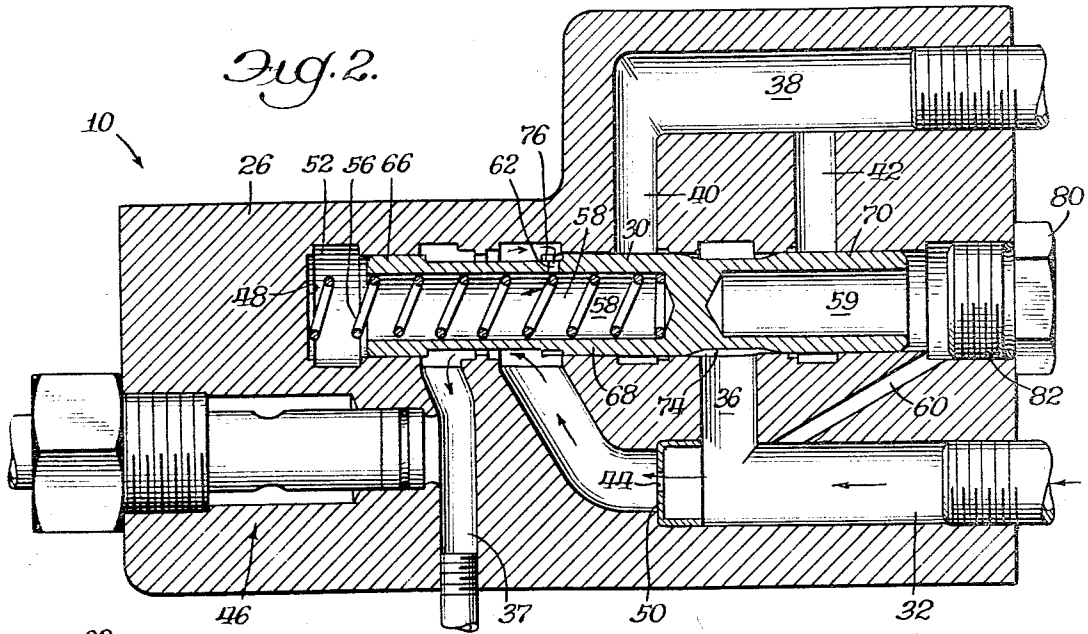
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2 Sheets-Sheet 2



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PRIORITY VALVE FOR CLOSED CENTER SYSTEM

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Filed Aug. 6, 1965, Ser. No. 477,725
10 Claims. (Cl. 180—79.2)

This invention relates generally to hydraulic systems, and more particularly relates to closed center hydraulic systems having fluid pressure responsive priority valves therein operative to provide a divided flow for a plurality of fluid circuits with priority being given to the demands of one of the fluid circuits.

Frequently, for purposes of economy and simplicity of construction in conventional industrial and farm vehicles, it is desirable to operate two hydraulic circuits operating associated hydraulic devices in a single hydraulic system with hydraulic fluid furnished by a single power pump. This is usually accomplished by incorporating a flow divider valve in a pressure supply line leading from a power pump to two hydraulic circuits.

For various safety and operating reasons, it is desirable and indeed necessary that one of the circuits be completely satisfied with a flow of fluid before any fluid is directed to the other circuit. For example, a hydraulic power steering circuit and a hydraulic lift circuit may be operated from a single engine driven power pump. Generally, it is required to provide an instantaneous flow of fluid to the power steering circuit when demanded to ensure the circuit's immediate response when fluid is demanded; and priority must be given to supplying the fluid demands of this circuit. Hence, it is necessary to provide means by which priority is given to supplying fluid for this priority circuit while making additional fluid available for operation of the secondary circuit.

Thus, a general object of this invention is to provide an improved priority valve.

Heretofore, industrial and farm vehicles have utilized predominantly a hydraulic fluid system known as an open center system incorporating a constant flow pump to provide a constant flow of fluid while the vehicle is operating and wherein fluid merely bypasses hydraulic devices operated by the pump returning to reservoir when the devices are not demanding fluid. More recently, the many advantages of using a closed center hydraulic system for industrial and farm vehicles have led manufacturers to seek improved priority valves suitable for use in a closed center hydraulic system.

The closed center system conventionally incorporates a variable flow demand type pump supplying fluid only when demanded by the various hydraulic circuits in the system and wherein the individual circuits block a flow of fluid thereto when there is no demand therefor by the hydraulic devices. Some of the advantages of the closed center system are that it saves power since the pump is not working unless a flow of fluid is required; it permits the use of higher fluid pressures with resultant decreased size of circuit components; it permits use of the relatively more efficient piston pump rather than constant flow gear type pumps heretofore utilized.

Thus, it is an object of the invention to provide an improved priority valve suitable for use with a closed center hydraulic system.

Another object of the invention is to provide a priority valve for a closed center hydraulic system suitable for use in operating two hydraulic circuits including a priority circuit which is given fluid priority in satisfying its demands.

Still another object of the invention is to provide a fluid operated flow divider valve which will provide in-

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stantaneously upon demand a substantially constant rate of flow for a priority circuit regardless of fluctuations or surges in supply of fluid to said valve, the flow divider valve providing upon demand fluid in excess of the requirements of the priority circuit for operation of a secondary circuit.

Still another object of the invention is to provide a priority valve having a valve spool therein responsive to changes in fluid pressure in a priority circuit and a secondary circuit to direct fluid under pressure to said priority and secondary circuits in accordance with their demands while giving priority to the needs of the priority circuit.

Another object of the invention is to provide a flow divider priority valve that is relatively simple in design and relatively simple to manufacture and that is suitable for use with a closed center hydraulic system to direct a divided flow of fluid from a single source to two individual fluid circuits.

Yet another object of the invention is to provide an improved priority valve for a closed center hydraulic system having a priority and a secondary circuit operated from a single source of fluid under pressure and which valve is equally suitable for use with an open center hydraulic system.

These and other objects of the invention will become apparent to one skilled in the art from the following specification and drawings forming a part thereof, wherein:

FIG. 1 is schematic representation of a closed center hydraulic system having a priority and secondary hydraulic circuit operated from a single source of fluid under pressure, showing an enlarged sectional view of a flow divider priority valve with a valve spool shown in a first position adjacent one end of a valve bore to provide a flow of fluids to both the priority and secondary circuit;

FIG. 2 is a sectional view of the priority valve shown in FIG. 1 but with the valve spool shown in section and shifted to an intermediate position within the bore to provide a flow of fluid to the priority circuit while blocking a flow of fluid to the secondary circuit;

FIG. 3 is a sectional view of the priority valve shown in FIG. 1 but with the valve spool rotated 90° within the bore and shifted to a second position adjacent a second end of the valve bore to provide a flow of fluid to the secondary circuit while also providing an unrestricted flow of fluid to the priority circuit.

FIG. 4 is an enlarged fragmentary sectional seen comparable to FIG. 2, illustrating the land arrangement in greater detail.

Referring to the drawings, there is shown in FIG. 1 a closed center hydraulic system incorporating an improved hydraulic flow divider priority valve designated generally by the numeral 10 and constructed in accordance with the invention. The hydraulic system includes a reservoir 12 to contain hydraulic fluid, an engine driven demand type variable flow pump 14 providing the priority valve 10 with a source of hydraulic fluid under pressure, a priority circuit designated generally by the numeral 16 including a closed center directional control steering valve 18 and a reversible hydraulic motor 20 comprising a conventional double acting steering cylinder slidably receiving a piston 22 operatively connected to wheels or other elements to be steered. The hydraulic system also includes a secondary or auxiliary circuit 24 which comprises a conventional closed center lift circuit. As should be clear, the auxiliary circuit may comprise a plurality of individual circuits to operate various hydraulic devices from the same system so long as the capacity of pump 14 is sufficient to handle the individual circuits.

The priority valve 10 includes a valve body 26 having a longitudinally extending bore 28 therein with a valve

spool 30 positioned for movement axially within the bore. The valve body 26 is formed with an inlet port 32 in communication with the bore 28 by means of first and second inlet passages 34, 36. The body 26 includes a priority or primary outlet port 37 being in fluid communication with the bore proximate one end thereof and a secondary or auxiliary outlet port 38 in fluid communication with the bore by means of first and second auxiliary outlet passages 40, 42 respectively proximate another end of the bore and positioned to straddle the second inlet passage 36. A pressure reducing orifice 44 comprising a suitable annular fitting is positioned within an enlarged portion of the first inlet passage 34 at the entrance thereof and defines a flow orifice between inlet port 32 and passage 34 to ensure a relatively constant rate of flow of fluids into first inlet passage 34.

Inlet port 32, FIG. 1, is connected communicatively by suitable fittings, not shown, to a source of fluid under pressure comprising pump 14. Priority outlet port 37 is similarly connected communicatively to priority circuit 16; and auxiliary outlet port 38 is connected communicatively to auxiliary circuit 24. Priority outlet port 37 is also in fluid communication with a pressure relief valve 46 which is shown to be a conventional poppet type pressure relief valve connected communicatively to the reservoir 12. The bore 28, FIG. 2, has first and second ends 48, 50 defining first and second limits of movement of the spool 30 within the bore and, referring to FIG. 2, defining first and second fluid chambers 52, 54 between the ends of the spool and the respective ends of the bore. A conventional coil spring 56, FIG. 2, to bias the spool 30 toward its second limit of movement is positioned at the first end of the bore and extends into a first spool bore or passageway 58 provided at the left end of the spool as best seen in FIG. 2, the spool 30 having a second spool bore 59 at its second end.

Means are provided to furnish fluid under pressure to the first and second chambers 52, 54 respectively, such means comprising a third inlet passage 60 in the valve body axially spaced from the second inlet passage 36 and leading communicatively from inlet port 32 to chamber 54; an opening 62 into bore 58 leads communicatively from an intermediate location on the valve spool through the spool counterbore 58 which extends axially within the spool to the left end of the spool as viewed in the drawings. Fluid within chamber 54 being in communication with inlet port 32 is at the same pressure as fluid flowing into inlet port 32.

The valve spool 30 is formed with first, second and third annular lands 66, 68 and 70 respectively. The spool 30 has a first valve spool groove or undercut portion 72 between the first and second lands 66, 68 with a second valve spool groove or undercut portion 74 provided between the second and third lands 68, 70.

Second land 68, FIGS. 2 and 3, is provided with a plurality of flat portions 76 extending from an engagement surface 78 of land 68 with the first groove 72 a distance to the right therefrom as viewed in the figures. Opening 62 into the spool is centrally positioned on at least one of the flat portions 76 to continuously communicatively connect inlet passage 34 with chamber 52 regardless of the position of the spool 30 within the bore thus providing chamber 52 with fluid at the same pressure as fluid in passage 34.

A plug 80 is secured within the bore at its second end 50 to seal the bore at that end, the plug 80 including a valve stop portion 82 defining the second end 50 of the bore.

Relief valve 46, FIG. 1, includes a valve seat 81 providing a passageway 83 in communication with priority outlet port 37 and has a spring biased valve element 84 slidably positioned within a bore 86 formed within the valve body 26, bore 86 being in communication with reservoir 12 with a suitable biasing spring 90 biasing valve element 84 to the right as viewed in the drawings against

valve seat 81 to block a flow of fluid below a predetermined pressure from outlet port 37 through passage 83 to reservoir 12.

The valve bore 28 extends longitudinally with respect to the valve body and has a plurality of axially spaced lands and grooves including lands 91, 92, 94, 96 and 98. Valve land 92 is positioned between priority outlet port 37 and first inlet passage 34 and has a stepped down portion or edge 102 adapted to receive edge 78, FIG. 3, of valve spool land 68 with the valve spool shifted to a first or extreme left position as in FIG. 1 tending to restrict the flow of fluids from passageway 34 about the spool into priority outlet port 37.

For purposes of an easier understanding of the invention, it is advantageous to provide at this time a functional description of the mode in which the priority valve operates. Specifically, consider that the priority valve is connected communicatively as indicated in FIG. 1 in a hydraulic system including a demand type variable flow pump 14 which by way of example comprises a conventional piston type pressure compensated pump including a swash plate, not shown, the angle of which swash plate is varied to vary delivery of hydraulic fluid from the pump, the swash plate being controlled by suitable valves, not shown, to begin its operation to pump fluid to the priority valve 10 whenever pressure in inlet port 32 falls below a predetermined system pressure which by way of example might be 2000 p.s.i.

Spool 30 normally rests against stop 82, FIG. 3, in its second limit of movement with inlet port 32 in fluid communication with both the priority and auxiliary circuits.

The pump 14 is driven off a vehicle engine, not shown, and upon starting the engine, assuming the fluid pressure in the system is below the predetermined system pressure the pump swash plate is moved from neutral position. Relief valve 46 is preset to open at fluid pressures in excess of a predetermined priority circuit pressure within the priority outlet port 37; thus, relief valve 46 relieves excess pressure within the system and permits a flow of fluid to reservoir.

Assuming that both the priority and secondary circuits are in neutral position where a flow of fluid thereto is blocked, there is no demand for fluid from the pump and once pressure within inlet port 32 builds up to a predetermined system pressure, the pump ceases to operate. Since there is no demand for fluid from either of the circuits, bias spring 56 maintains the valve spool in its second position, FIG. 3, at the right hand end of the bore providing fluid communication between inlet passage 34 and priority outlet port 37 and fluid communication between inlet passage 36 and second auxiliary passage 42.

Now, assume, that the priority valve 18, FIG. 1, in the priority circuit is moved from the neutral position shown to an operating position permitting a flow of fluid thereto. Fluid pressure within outlet port 37 drops instantaneously and hydraulic pressure of the entire system falls signalling a demand for fluid to pump 14 which immediately begins to operate, directing a flow of fluid under pressure into inlet port 32. The drop in fluid pressure within outlet port 37 effects a similar decrease in fluid pressure within fluid chamber 52 which is in communication with port 37 by means of opening 62 in the spool and a differential pressure between chamber 52 and chamber 54 effects a shifting of the valve spool to the left to its intermediate position generally indicated in FIG. 2 blocking any fluid flow to auxiliary outlet port 38 so long as fluid flow from pump 14 is below a predetermined priority flow rate. The exact position of the valve spool within the bore depends on the differential pressure acting on the left and right ends of the valve spool, that is, fluid pressure within chamber 52 and the pressure exerted by biasing spring 56 on the left end of the spool and fluid pressure within chamber 54 on the right end of the spool. As soon as flow from pump 14 exceeds the priority flow rate, pressure in chamber 52 drops and the differen-

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tial pressure between chambers 52 and 54 shifts the spool left toward a position between the spool's first and intermediate position opening communication of auxiliary outlet port 38 to inlet port 32 and chamber 54 to provide immediate response to the spool to fluid demands of auxiliary circuit 24.

Orifice 44 at the entrance of the first inlet passage 34 ensures a substantially constant rate of flow of fluid to the priority circuit. Opening 62 in the valve spool ensures that the fluid pressure within chamber 52 at the left hand end of the spool, as viewed in the drawings, is the same as the pressure in inlet passage 34 and priority outlet port 37 regardless of the position of the valve spool. Spool orifice means comprising the flat portions 76 on the spool ensure that fluid flow to the priority circuit 16 remains constant regardless of sudden shifts or surges in fluid pressure within inlet port 32 and independent of pressure differences in the priority and secondary circuits or changes in the flow rate within inlet port 32. Even with the valve spool moved to an extreme left hand position, FIG. 1, with the spool 30 blocking a flow of fluid to priority outlet 37 as it would upon sudden surges of pressure in the inlet port 32 or when flow from pump 14 is at its greatest rate, the flat portions 76 on the spool, best seen in FIG. 3, permit a constant flow of fluid from inlet passage 34 about the spool to outlet port 37 regardless of the position of the spool. As is clear, the spool orifice means is defined by a chamber or passageway between bore land 92 and flat portions 76 and provides a predetermined rate of flow of fluid to port 37 equivalent to the rate of flow of fluid through orifice 44.

Now, consider that while the priority hydraulic device 20 in the priority circuit 16 is operating, auxiliary fluid devices, not shown, in the secondary circuit 24 are moved into operational position permitting a flow of fluid thereto and signalling the priority valve a demand for fluid under pressure by a drop in fluid pressure in port 32. Assuming that flow to port 32 is in excess of the predetermined priority flow rate, a flow of fluid is directed from inlet passage 36 around spool groove 74 to auxiliary outlet passage 40.

Assuming valve 18 in priority circuit 16 is positioned in neutral, pressure within chamber 52 and 54 is the same and biasing spring 56 adjusts the valve spool to its second position at the second end 50 of the bore where the valve spool opens fluid communication, as indicated by the arrows in FIG. 3, between second inlet passage 36 and second outlet passage 42; and the spool blocks fluid communication between passage 36 and outlet passage 40.

Since the priority circuit 16 is in neutral position with a flow of fluid thereto blocked by valve 18, there is no flow to outlet port 37; however in this position of the spool, fluid communication of inlet passage 34 with outlet port 37 remains open permitting fluid flow to the priority circuit 16 as required.

Now, referring to FIG. 3 assume that while fluid under pressure is flowing to outlet port 38, priority circuit 16 signals a demand for fluid by a drop in fluid pressure within outlet chamber 37. Instantaneously, the valve spool shifts to the left as viewed in the drawings to the intermediate spool position indicated in FIG. 2 blocking fluid communication between second inlet passage 36 and outlet port 38 and given priority to supplying fluid for priority outlet port 37. As fluid flow rate demands of the priority circuit are met and assuming that the pump 14 is operating at full capacity, valve spool 30 adjusts itself within the bore by moving slightly to the left from the position shown in FIG. 2 opening communication between second inlet passage 36 and outlet passage 40. The valve spool 30 continuously adjusts itself within the bore by reason of pressure differences in the priority and secondary circuit 16, 24 respectively and more specifically by reason of the differences in fluid pressure acting on the first and second ends of the valve spool 30. To ensure that a constant rate of fluid flows to the priority circuit without which an

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oversteering condition would result, that is, an operator's over-compensation for a lack of steering responsiveness when the priority circuit is used to operate a hydraulic steering device, a predetermined constant flow of fluid to the priority circuit is provided; that is provided by the orifice defined by flat portions 76 and the orifice 44 in passage 34. As pump 14 develops fluid rates of flow in excess of that required for the priority circuit, the fluid pressure drop across orifice increases, effecting a corresponding change in pressure differential acting on the ends of the valve spool and effecting a shifting of the valve spool to the left, as viewed in the drawings, by reason of the relatively higher pressure in chamber 54 with respect to chamber 52 and resulting in an increased opening of outlet passage 40 to flow from the inlet passage 36.

The orifice provided by the spool flat portions 76 permits a flow of fluid to the priority circuit under all conditions without interruption. Whenever the priority circuit calls for a flow of fluid by reason of a reduction in pressure, or signals sufficient fluid pressure by increased pressure within priority outlet port 37, fluid pressure within chambers 52 and 54 is adjusted; and spool 30 moves to a correct position to furnish the correct constant amount of flow to priority circuit.

While the manner of operation of the priority valve has thus far been described in conjunction with a closed center hydraulic system, it should be clear that the priority valve of the present invention is equally suitable for use in an opened center hydraulic system. In this case, of course, the priority and secondary circuits 16, 24 would be continuously open to a flow of fluid from priority valve 10 and continuously demanding a flow of fluid from the pump which would be in continuous operation. In this situation, the valve spool would rarely be shifted to its second position at the right end of the bore in the position indicated in FIG. 3 except at start of operation and with momentary surges of high pressure in chamber 52. Otherwise, valve spool 30 would move between its first and intermediate spool positions generally as indicated in FIG. 1 providing fluid continuously and with priority to the priority circuit, but in the usual case providing fluid as required simultaneously to the priority and secondary circuits.

Thus, in accordance with the invention, a flow divider has been provided ensuring a closely controlled rate of flow of fluids to a priority circuit, the divider diverting flow in excess of a predetermined priority flow to an auxiliary circuit with means provided for automatically blocking flow to the secondary circuit in the event that the rate of flow in the overall system drops below a required amount for the priority circuit.

Since modifications of the details of the structure as illustrated in the various figures are contemplated, the invention should be limited only by the scope of the appended claims.

The invention is claimed as follows:

1. A flow divider valve comprising: a valve body having a bore therein, an inlet port in said body having first and second inlet passages communicating with said bore at axially spaced locations, a priority outlet communicating with said bore proximate one end thereof, first and second auxiliary outlets communicating with said bore at axially spaced locations straddling said second inlet passage proximate another end of said bore, said first inlet passage having an orifice therein and communicating with said bore at a position intermediate said priority outlet and said first auxiliary outlet, a valve spool movable in said bore and having first, second and third lands and first and second groove portions intermediate said lands, said valve spool having first passage means therein communicating said first inlet passage with one end of said bore, said valve body having second passage means therein communicating said inlet port with another end of said bore; said orifice establishing a pressure differential between the ends of said bore to shift said spool responsive to said pressure differential: said

valve spool having a first limit of movement wherein said second land restricts communication between said first inlet passage and said priority outlet and establishes communication between said second inlet passage and said first auxiliary outlet around said second groove portion, said valve spool having a second limit of movement wherein said second land portion opens communication between said first inlet passage and said priority outlet and opens communication between said second inlet passage and said second auxiliary outlet, said first land portion having at least one flat portion on the surface thereof communicating said first inlet passage with said priority outlet around said first groove portion when said valve spool is in its first limit of movement, a spring in said bore biasing said valve spool toward its second limit of movement, said spool having an intermediate position wherein said second land opens communication of said first inlet passage with said priority outlet and said second and third land respectively block communication between said second inlet passage and said first and second auxiliary outlets.

2. A priority valve for a hydraulic system including a priority circuit and a secondary circuit, said priority and secondary circuit each being of the closed center type and each being movable between neutral and operating positions respectively blocking and permitting flow from said priority valve to said respective priority or secondary circuit, said priority valve comprising: a valve body; means providing said body with an inlet port connected communicatively to a source of fluid under pressure, said valve body including means providing a priority outlet port being connected communicatively to said priority circuit; and means providing a secondary outlet port connected communicatively to said secondary circuit; a bore within said body, said bore having first and second ends; a valve spool positioned within said bore and movable therein between said first and second ends of said bore; means providing said inlet port with first and second inlet passages, said first inlet passage being in communication between said inlet port and said bore and having an orifice therein to provide a predetermined rate of flow of fluids from said inlet to said priority outlet through said bore and said first inlet passage; said second inlet passage communicatively connecting said inlet and said bore; means providing said body with first and second axially spaced outlet passages leading communicatively from said bore to said secondary outlet port, said valve spool being movable between first, second, and intermediate positions, said spool in said first position restricting communication of said inlet and priority outlet to said predetermined rate of flow, said spool in said second position communicating said inlet port with said second outlet passage, said valve spool in said intermediate position blocking communication of said inlet port with said first and second outlet passages, said valve spool having means providing a passageway therein communicatively connecting said first inlet passage with said first end of said bore; means in said valve body communicatively connecting said inlet port with said second end of said bore; said orifice with a flow of fluid therethrough from said inlet port into said first inlet passage providing a relatively lower fluid pressure in said first inlet passage and at said first end of said bore than said fluid pressure at said second end of said bore to obtain a differential pressure between said first and second ends of said bore tending to move said spool within said bore; means in said valve spool providing a passageway between said spool and said bore continuously communicating said first inlet passage with said priority outlet to permit said predetermined rate of flow to said priority circuit when in operating position; a spring in said bore biasing said spool toward one end of said bore, said valve spool, being positioned between said first and intermediate spool positions blocking communication between said second inlet passage and

said second outlet passage and opening communication between said inlet port and said first outlet passage and said priority outlet when said priority and secondary circuits are in operating condition; said valve spool with decreases in the rate of flow of fluid to said inlet port below said predetermined rate of flow tending to move from said first position toward said intermediate position to block communication between said inlet port and said secondary outlet, said valve spool with said priority circuit in neutral being in said second spool position opening communication between said inlet port and said priority and secondary outlets, whereby priority is given to fluid communication between said first inlet passage and said priority outlet.

3. A priority valve for priority and auxiliary circuits, said priority circuit having a predetermined priority rate of flow of fluid thereto, said priority valve comprising: a valve body having a bore therein, said bore having first and second axially spaced ends, a valve spool movable within said bore, said valve body having means providing an inlet port to be connected to a source of fluid under pressure and means providing first and second axially spaced inlet passages communicating said inlet port with said bore, said first inlet passage having a pressure reducing orifice therein, said valve body having means providing a primary outlet port proximate said first end of said bore; means in said body providing a secondary outlet port connected communicatively to said priority circuit and being in fluid communication with said bore; means providing first and second outlet passages communicating said secondary outlet port with said bore, said first and second outlet passages being axially spaced and positioned at said second end of said bore straddling said second inlet passage, said primary outlet port being in communication with said bore at a position proximate said first end of said bore; a spring within said bore biasing said spool toward said second end of said bore, said bore having first, second and third axially spaced lands; means in said valve body connecting said primary outlet port communicatively to said second end of said bore; means providing a passage in said spool continuously communicatively connecting said first end of said bore with said inlet port; means in said body communicatively connecting said inlet port to said second end of said bore, said orifice establishing a pressure differential between said first and second ends of said bore to shift said spool within said bore between first and second positions, said orifice restricting rate of flow of fluids through said inlet passage into said bore to a predetermined rate of flow, said spool having first and second positions, said second position being at said second end of said bore with said spool opening communication of said inlet port with said primary outlet port and said second outlet passage; said spool in said first position being at said first end of said bore restricting communication between said first inlet passage and said primary outlet port to said predetermined flow rate and opening communication between said second inlet passage and said first outlet passage; said spool having an intermediate position between said first and second spool position blocking communication of said second inlet passage with said first and second outlet passages and opening communication of said first inlet passages with said primary outlet port until said flow to said primary outlet port approaches said predetermined flow rate whereupon said valve spool tends with demand for fluid pressure from said auxiliary fluid circuit to shift toward said first end of said bore to open communication between said second inlet passage and said first outlet passage.

4. A flow divider valve of the priority type for a hydraulic system for a vehicle, said vehicle including an engine and wheels to be steered, said system including a priority circuit and a secondary circuit, said priority circuit including a closed center spool valve to control direction of a flow of fluid through said valve, said flow of fluid through said spool valve being blocked when said

valve is in neutral position, said hydraulic system including a fluid reservoir, a source of fluid under pressure, a reversible hydraulic steering cylinder in said priority circuit connected to said wheels of said vehicle to be steered, said spool valve controlling the flow of fluid to said hydraulic cylinder, said flow divider valve comprising: a valve body; an axially extending bore within said body, said bore having first and second ends; means providing said body with an inlet port having first, second and third axially spaced inlet passages communicatively connected between said bore and said inlet port, said inlet port being connected communicatively to said source of fluid under pressure, said third inlet passage leading communicatively to said second end of said bore; means providing said valve body with a priority outlet port communicatively between said priority circuit and said bore proximate said first end; means providing first and second outlet passages communicating between said secondary circuit and said bore at first and second axially spaced bore outlet locations straddling in an axial direction said second inlet passage, said first bore outlet location being positioned axially between said first and second inlet passage; a valve spool movable in said bore and having first, second and third land portions, said spool having a first groove portion on said spool intermediate said first and second lands and a second groove portion intermediate said second and third lands, said bore having first and second ends defining first and second limits of movement of said valve spool within said bore; a spring in said bore biasing said valve spool toward its second limit of movement; means providing an orifice in said first inlet passage communicatively connecting said inlet port with said bore, said valve spool when in a first position at said first limit of movement interconnecting communicatively said first inlet passage and said priority outlet port and interconnecting communicatively said second inlet passage and said outlet passage, said spool having means therein providing a minimum predetermined rate of flow from said first inlet passage to said priority outlet port; said valve spool when in a second position at said second limit of movement having said third land opening communication between said second inlet passage and second outlet passage; said valve spool when in a third position intermediate said first and second positions opening communication between said first inlet passage and said priority outlet port and blocking communication between said second inlet passage and said first and second outlet passages, said orifice reducing fluid pressure in said first inlet passage between said orifice and said bore to a pressure relatively less than fluid pressure in said second and third inlet passages, the differential pressure between said first inlet passage in communication with said first end of said bore and said second inlet passage in communication with said second end of said bore tending to move said valve spool toward said third position with said spool tending to block communication of said inlet bore with said first and second outlet passages respectively upon decreases in the rate of flow of fluid into said inlet port giving priority to supplying fluid at said predetermined rate to said priority circuit.

5. A flow divider valve comprising a valve body; a bore in said body having first and second ends; means providing an inlet port in said body having first and second inlet passages communicating with said bore, said inlet port being connected communicatively with a source of fluid under pressure; means providing an orifice in said first inlet passage between said inlet port and said bore; means providing first and second outlet ports in said body communicating with said bore; a valve spool movable in said bore with first and second ends proximate said first and second ends of said bore, means in said valve spool communicating said first inlet passage with said first end of said bore, means in said body communicating said inlet port with said second end of said bore, said valve spool being movable between first and second spool positions at said first and second ends of said bore respectively re-

sponsive to a differential of fluid pressures established by said orifice between said first and second ends of said bore; means providing a passageway in said valve body connecting said first inlet passage communicatively to said first outlet port, said first outlet port being connected communicatively to an associated priority hydraulic circuit; first and second outlet passages connected communicatively between said second outlet port and said bore, said second outlet port being connected communicatively to an associated secondary hydraulic circuit to receive fluid under pressure from said priority valve after predetermined fluid flow demands of said priority circuit have been satisfied, said orifice in said first inlet passage providing a predetermined maximum flow rate through said first inlet passage, said priority circuit being of the closed center type wherein a flow of fluid thereto is blocked with said priority circuit in neutral position wherein a flow of fluid thereto is open in operating position of said priority circuit, said valve spool with said priority circuit in neutral position being positioned in an intermediate spool position between said first and second spool positions, said valve spool in said first position restricting a flow of fluid between said first inlet passage and said first outlet port to said predetermined fluid flow demands of said priority circuit, said valve spool with said priority circuit in neutral being in said second position at said second end of said bore opening communication between said second inlet passage and said second outlet passage and blocking communication between said second inlet passage and said first outlet passage; said valve spool with said priority circuit in operating position and said secondary circuit in neutral position being in said intermediate spool position with said valve spool opening communication between said first inlet passage and said first outlet port and blocking communication of said second inlet passage with said second outlet port, said valve spool with said priority circuit and said secondary circuit in operating position moving between said intermediate position and said first position to open communication between said first and second inlet passages and said first and second outlet ports respectively to permit a flow of fluids to said priority and secondary circuits simultaneously, said spool tending to move to said intermediate position when said flow of fluid from said source of fluid under pressure to said inlet port approaches said predetermined fluid flow to give priority to said priority circuit and to permit a flow of fluid in excess of said predetermined fluid flow to said secondary circuit.

6. A flow divider valve comprising: a valve body having a bore therein having first and second ends; means providing an inlet port in said body having first and second inlet passages communicating said inlet port with said bore at first and second axially spaced locations; a priority outlet port in said body communicating with said bore proximate the first end; means providing a secondary outlet port including first and second auxiliary outlet passages communicating said secondary outlet port with said bore at axially spaced locations proximate said second end of said bore straddling said second inlet passage, said first inlet passage communicating through an orifice with said bore at a location intermediate said priority and secondary outlet ports; a valve spool movable in said bore, said valve spool having a first limit of movement wherein it restricts communication between said first inlet passage and said priority outlet port and establishes communication between said second inlet passage and said first auxiliary outlet passage, said valve spool having a second limit of movement wherein it opens communication between said first inlet and said priority outlet and opens communication between said second inlet and said second auxiliary outlet, said spool having at least one flat portion on the surface thereof providing a passageway communicating said first inlet passage with said priority outlet port at a predetermined restricted rate of flow when said valve spool is in its first limit of movement, said

valve spool having passage means therein communicating said first inlet passage with said first end of said bore; means in said body communicating said inlet port with said second end of said bore; a spring in said bore biasing said valve spool toward one of its limits of movement, said valve spool having intermediate positions between said first and second limits of movement wherein priority is given to communication between said first inlet passage and said priority outlet port and wherein said spool blocks communication between said inlet port and said first and second auxiliary outlet passages and wherein said first land opens communication between said first inlet passage and said priority outlet port, said spool tending to move toward its said first limit of movement after priority of fluid flow is given to said priority outlet.

7. A flow divider valve for a hydraulic fluid system including means providing a source of fluid under pressure, a closed center priority circuit, a closed center auxiliary circuit and a reservoir, said valve comprising: a body,

a bore extending axially within said body and having first and second ends;

a valve spool having first, second and third axially spaced lands, said spool being movable in said bore responsive to fluid pressure on said spool at first and second ends of said bore, said spool having an axially extending passageway at one end of said spool; an inlet port being connected communicatively to said source of fluid under pressure, said inlet port having first, second, and third inlet passages communicating with said bore at axially spaced locations, a priority outlet port to receive fluid at a predetermined flow rate being connected communicatively to said priority circuit and communicating with said bore at a position intermediate said first end of said bore and said first inlet passage;

an auxiliary outlet port connected communicatively to said auxiliary circuit, said auxiliary outlet port having first and second auxiliary outlet passages communicating with said bore at positions straddling said second inlet passage, said first auxiliary outlet passage being positioned between said first and second inlet passages, said second auxiliary outlet passage being positioned between said second and third inlet passages;

a first pressure reducing orifice positioned within said first inlet passage to provide a predetermined rate of flow of fluid from said first inlet passage to said bore;

means providing an opening in said second spool land leading from an exterior surface thereof to said spool passageway, said opening continuously communicatively connecting said first inlet passage to said first end of said bore,

said spool having at least one flat portion on said second spool land providing a fluid passageway between said first inlet passage and said priority outlet port whereby fluid communication is continuously established between said first inlet passage and said priority outlet, said second inlet passage being positioned to communicate with said first and second auxiliary passages when said spool is in predetermined positions, said third inlet passage being in communication with said second end of said bore;

pressure relief means in said valve body communicating said priority outlet port with said reservoir when fluid pressure within said priority outlet port exceeds a predetermined pressure,

said spool being movable within said bore to divide flow from said source of fluid to said circuits responsive to demand of said priority and auxiliary circuits giving priority of said predetermined flow rate to said priority circuit,

said spool being movable between a first position at said first end of said bore and a second position at said second end of said bore, said spool having an

intermediate position between said first and second positions,

said spool with said priority circuit in operating position and said auxiliary circuit in neutral being in said intermediate position blocking a flow of fluid to said auxiliary port and opening communication between said first inlet passage and said priority port, said spool with said auxiliary circuit in operating position and said priority circuit in neutral position being in said second position opening communication between said second inlet passage and said auxiliary port,

said spool with said priority and auxiliary circuits in operating position moving responsive to the inlet flow of fluid from said source of fluid between said first and intermediate positions, said spool being in said intermediate position when said inlet flow is below said predetermined priority rate of flow, said spool in said first position restricting flow from said first inlet passage to said priority outlet and opening communication between said inlet port and said auxiliary port,

said spool with said inlet flow increasing above said predetermined flow moving to a position between said intermediate position and said first spool position giving priority to permitting a flow of fluid at said predetermined flow rate to said priority circuit and permitting inlet fluid in excess of said predetermined flow rate to flow to said auxiliary port.

8. A flow divider valve comprising a valve body having a bore therein, an inlet port having first and second inlet passages communicating with said bore at axially spaced locations, a priority outlet communicating with said bore proximate one end thereof, first and second auxiliary outlets communicating with said bore at axially spaced locations proximate the other end thereof straddling said second inlet passage, said first inlet passage having an orifice therein communicating with said bore at a position intermediate said priority outlet and said first auxiliary outlet, said orifice reducing pressure of fluid flowing through said inlet passage to said bore; a valve spool movable in said bore and having first, second and third lands and first and second groove portions intermediate said lands, said valve spool having a first limit of movement wherein said second land restricts communications between said first inlet passage and said priority outlet and establishes communication between said second inlet passage and said first auxiliary outlet around said second groove portion, said valve spool having a second limit of movement wherein said second land portion opens communication between said first inlet passage and said priority outlet and opens communication between said second inlet passage and said second auxiliary outlet; spool means continuously communicating said first inlet passage with said priority outlet when said valve spool is in its first limit of movement; spool means communicating said first inlet passage with said one end of said bore, said valve body having passage means therein communicating said inlet port with said other end of said valve bore; a spring in said bore biasing said valve spool toward its second limit of movement, said spool having an intermediate position wherein said second land opens communication of said first inlet passage with said priority outlet and said second and third lands respectively block communication between said second inlet passage and said first and second auxiliary outlets.

9. The flow divider valve of claim 8 including pressure relief means within said valve body connected communicatively to said priority outlet to exhaust fluid pressure in excess of a predetermined pressure from said priority outlet.

10. A priority valve for use for a hydraulic system including a priority circuit and an auxiliary circuit, said system including an engine driven pump supplying said

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valve with fluid under pressure, said priority valve comprising: a body;

means providing a bore in said body, said bore having first and second ends;

a valve spool positioned in said bore movable between 5
a first position at said first end of said bore,

and a second position at said second end of said bore, said spool having an intermediate position between said first and second ends of said bore,

biasing means within said bore biasing said spool toward said second position, 10

said body having means providing an inlet port connected to said pump; a priority port in said body connected to said priority circuit and an auxiliary port in said body connected to said auxiliary circuit; 15

spool means providing a first fluid passageway communicatively connecting said inlet port continuously to said priority port through said bore; a pressure reducing orifice in said first fluid passageway restricting flow from said pump through said first fluid passageway to said predetermined rate of flow; 20

means on said spool communicatively connecting said first fluid passageway continuously to said first end of said bore;

means in said body communicatively connecting said inlet port to said second end of said bore; 25

said valve spool moving within said bore responsive to a fluid pressure differential between fluid pressure established by said orifice at said first end of said bore and fluid pressure at said second end of said bore, 30

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said priority and secondary circuits respectively signaling a demand for a flow of fluid under pressure to said valve by a drop in pressure of fluid within said priority and auxiliary ports in communication respectively with said first and second ends of said bore,

said valve spool in said first position connecting said inlet port communicatively to said auxiliary port and restricting communication of said inlet port with said priority port to a predetermined rate of flow, said valve spool in said second position connecting said inlet port communicatively to said priority and auxiliary ports;

said valve spool in said intermediate position communicatively connecting said inlet port to said priority port and blocking communication of said inlet port to said auxiliary port;

said spool in normal operating position with said priority and auxiliary circuits demanding fluid moving between said first and intermediate positions,

said spool tending to shift from said intermediate position to said first position as the rate of flow of fluid into said inlet port exceeds said predetermined flow.

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