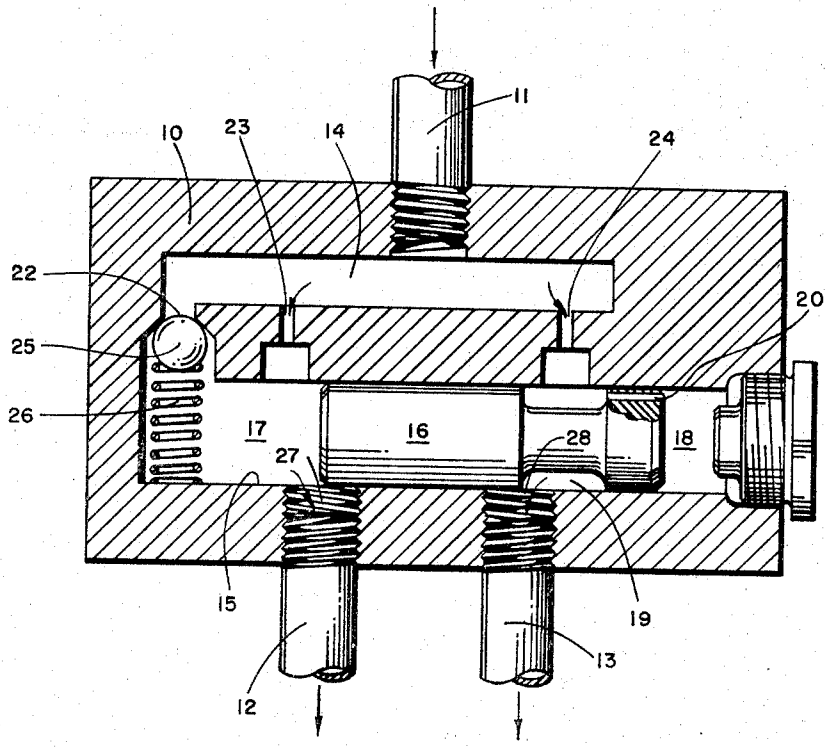
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COMBINATION PROPORTIONAL AND PRIORITY FLOW DIVIDER

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COMBINATION PROPORTIONAL AND PRIORITY FLOW DIVIDER

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ABSTRACT OF THE DISCLOSURE

A pressure responsive device for delivering predetermined proportionate volume flows of fluid from a single pressure fluid supply conduit to two hydraulic circuits of different capacity when the fluid demand from both circuits is low, and for providing a priority large volume flow to the higher capacity circuit when its demand is high, while assuring continuous adequate volume fluid delivery to the lower capacity circuit to assure its proper operation on demand.

This invention relates to a type of hydrodynamically operated valve known as a flow divider, the function of which is to receive fluid under pressure from a single conduit and to divide and regulate the flow of that fluid from the valve into two separate hydraulic circuits, each of which may serve to actuate hydraulic motors or other hydraulic devices.

Some hydraulic systems include a low capacity relatively low pressure circuit, such as a steering circuit, for instance, and also include a large capacity higher pressure circuit. In such systems it is common for the sake of saving power, to keep both circuits continuously charged for instantaneous actuation of their connected hydraulic devices, by means of a low volume source of pressure fluid, and to automatically cut in a large volume source of pressure fluid when the larger capacity circuit, or both circuits, are in use.

With a conventional flow divider in such a system, the volume of fluid required to satisfy the larger capacity circuit may result in starvation or choking off of the smaller capacity circuit.

It is a primary object of this invention to solve the above described problem by providing a flow divider which functions as a proportional flow divider while it is receiving low gallonage from the pressure fluid source, and which functions as a priority flow divider while it is receiving high gallonage from the source. It thus is capable of providing ample fluid to meet the larger volume requirements of the larger capacity circuit, when it is in use, without starving the low capacity circuit.

The invention, together with other objects will be more clearly understood when the following description is read in connection with the accompanying drawing, in which the single drawing figure is a central longitudinal sectional view through a valve embodying my invention.

Referring to the drawing, the valve illustrated includes a body **10** having an inlet **11**, an outlet **12** for a relatively high capacity hydraulic circuit, and an outlet **13** for a relatively low capacity circuit.

Body **10** defines a header or flow distribution chamber **14** in communication with inlet **11**, and a valve spool bore **15** in communication with outlets **12** and **13**, through ports **27** and **28**, the bore being closed at both ends.

A floating valve spool **16** is freely reciprocable in bore **15** and, together with the closed ends of the bore, defines pressure chambers **17** and **18**. Spool **16** is provided with an annular groove **19** intermediate its ends, which in the normal position of the spool, as shown, communicates with one of the outlets **13**. It is also provided with a fluid

metering duct **20** which affords restricted communication between groove **19** and pressure chamber **18**, to slowly equalize pressures in the two spaces.

Body **10** is provided with three flow limiting orifices or ports **22**, **23** and **24**. All three afford flow from distribution chamber **14** through bore **15** and out through outlets **12** and **13**. Port **22** includes a valve seat on which a check valve **25** is normally held seated by a spring **26**.

Operation—low gallonage

When only a low gallonage flow is being delivered from the source into inlet **11**, and assuming that the flow areas of ports **23** and **24** are the same, and neither of the hydraulic circuits connected to outlets **12** and **13** are in use, the pressure drop created by fluid flowing through ports **23** and **24** will be the same, and the fluid pressure in chambers **17** and **18** will be the same. There will consequently be no pressure differential to move spool **16** in either direction from its normal position, and flow outward through outlets **12** and **13** will be at the same rate.

In case the flow area of port **23** is not equal to the flow area of port **24**, the pressure drop across the two ports will likewise be unequal, which will cause unequal pressures in chambers **17** and **18**, resulting in movement of the spool in the direction of the chamber **17** or **18**, with least pressure. The changed spool position will thus reduce the flow area through opening **27** or opening **28** until the pressures in chambers **17** and **18** have equalized. The volume flow outward through outlets **12** and **13** will then be in direct proportion to the flow areas through the respective ports **23** and **24**. It will thus be understood that the relative volume flow of fluid out of each of the outlets **12** and **13** can be predetermined and regulated by the proper relative sizing of ports **23** and **24**.

This is true even in the case of internal pressure changes due to the operation of one or the other of the hydraulic circuits connected to outlets **12** and **13**. For instance, assuming that ports **23** and **24** are of equal size, if a hydraulic device connected to outlet **12** is actuated, a resistance to flow is created in chamber **17** and the pressure therein rises above the pressure in chamber **18**. Spool **16** is forced to move toward the chamber of least pressure (to the right in the drawing) and reduces the flow area through outlet opening **28** (simultaneously enlarging the flow area of opening **27**), until the pressure in the two chambers is again equalized, and flow to both circuits through outlets **12** and **13** is equalized.

Operation—high gallonage—priority delivery

With high gallonage delivery from the source through inlet **11**, the valve will operate as described above until the flow of fluid through port **23**, due to operation of the high volume hydraulic circuit connected to outlet **12**, causes a pressure differential between chambers **14** and **17** which is sufficient to overcome the compression resistance of spring **26**, and to move check valve **25** off its seat. This permits a considerable volume of fluid (which had previously been flowing through port **23** and causing the pressure differential) to bypass port **23** to reach chamber **17** and to flow out through outlet **12**. Thus the valve has established a priority volume flow of fluid through outlet **12** to meet the requirements of the connected higher capacity circuit.

However, the fluid flow through outlet **13** will not be choked off, because if the flow through opening **27** becomes too great metering will occur at that opening. This will cause a rise in pressure in chamber **17**, which will move spool **16** to the right, reducing the flow area through opening **28**. As this opening is reduced in area, the pressure in groove **19** and chamber **18** will also rise until it

is equal to the pressure in chamber 17 and spool movement ceases.

To those familiar with this art it will be understood that metering duct 20, by minutely restricting fluid flow between groove 19 and chamber 18, serves to slow the speed of travel of spool 16 in both directions, as well as to closely limit over travel of the spool in either direction. It will also be understood that a spring 26 having any desired compression strength may be used to by-pass any desired volume flow of oil around port 23.

From the above it will be seen that my invention provides a flow divider which proportionately regulates the flow of fluid from a single source to two hydraulic circuits when total volume flow is relatively low, and which provides a priority volume flow of fluid to the larger capacity circuit to meet its requirements when total volume flow from the source is relatively large.

Having described the invention with sufficient clarity to enable those familiar with this art to construct and use it, I claim:

1. A fluid flow dividing valve comprising:
a valve body having an inlet and two outlets;
means in the body defining two separate open flow paths between the inlet and the respective outlets;
a floating valve spool in the valve body which meters flow through both outlets and is responsive to disproportionate volume flow of fluid through the two outlets to proportionately regulate such flow;
a third and independent fluid flow path defined by said body, affording communication between said inlet and one of said outlets;
and a normally closed check valve controlling fluid flow through said third flow path, and openable in response to excessive fluid flow through said one outlet to supplement the flow therethrough and afford a continued disproportionate flow through said one outlet as compared to flow through the other outlet.

2. A fluid flow dividing valve comprising:
a valve body having an inlet and two outlets;
a flow distribution chamber in said housing in communication with said inlet;
a closed-ended valve spool bore in said housing in communication with said outlets;
a floating valve spool in said bore defining therewith a pressure chamber at each end thereof, said spool having an annular groove intermediate its ends which normally communicates with one of said outlets;

a duct in said spool affording communication between the groove therein and a pressure chamber at one end of the spool;
three internal flow restricting ports in the valve body affording communication at spaced points between said flow distribution chamber and said spool bore, one port located to afford flow from the distribution chamber through the spool groove through one of said outlets, and the second and third ports located to afford flow from the distribution chamber into the pressure chamber at the other end of said spool and out through the other of said outlets;
and a spring biased pressure opened check valve normally closing one of the two last mentioned ports.

3. A hydrodynamically actuated valve for variably proportioning fluid flow from a single source to two hydraulic circuits having different volume requirements, comprising:
a valve body having
(a) an inlet
(b) a valve spool bore with closed ends
(c) a fluid distribution chamber in communication with the inlet and in communication with said bore at three longitudinally spaced points along the bore, and
(d) two outlets in communication with said bore at spaced points;
a valve spool reciprocable in said bore and responsive to a difference in the pressure at one outlet port and pressure at the other outlet port to proportion the volume flow of fluid outward through said outlets;
and a spring biased check valve normally preventing free flow of fluid from said distribution chamber through one of said points of communication into said bore, and openable in response to a sufficient pressure differential to afford such flow to augment the fluid flowing through one of the other two points of communication.

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