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[54] **DEVICE FOR SUPPLYING FLUID UNDER PRESSURE TO TWO REVERSIBLE LOAD ELEMENTS**

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[63] Continuation-in-part of Ser. No. 256,324, May 24, 1972, abandoned.

[30] **Foreign Application Priority Data**

Nov. 17, 1972 France 72.40991

[52] **U.S. Cl.** **60/420,** 60/468, 60/484, 60/494

[51] **Int. Cl.** **F15b 11/22**

[58] **Field of Search** ..... 60/97 F, 420, 468, 484, 60/494

[56] **References Cited**

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[57] **ABSTRACT**

This application discloses a device for supplying pressurized fluid to two load elements such as hydraulic motors, comprises two first conduits each connected to one load element and to a source of pressurized fluid, and two second conduits each connected to one load element and to an exhaust reservoir, a first flow divider being disposed in the first conduits, characterized in that the load elements are reversible, the first and second conduits are respectively placed in communication with the fluid source and the exhaust reservoir or vice versa, and a second flow divider is disposed in the second conduits.

13 Claims, 5 Drawing Figures

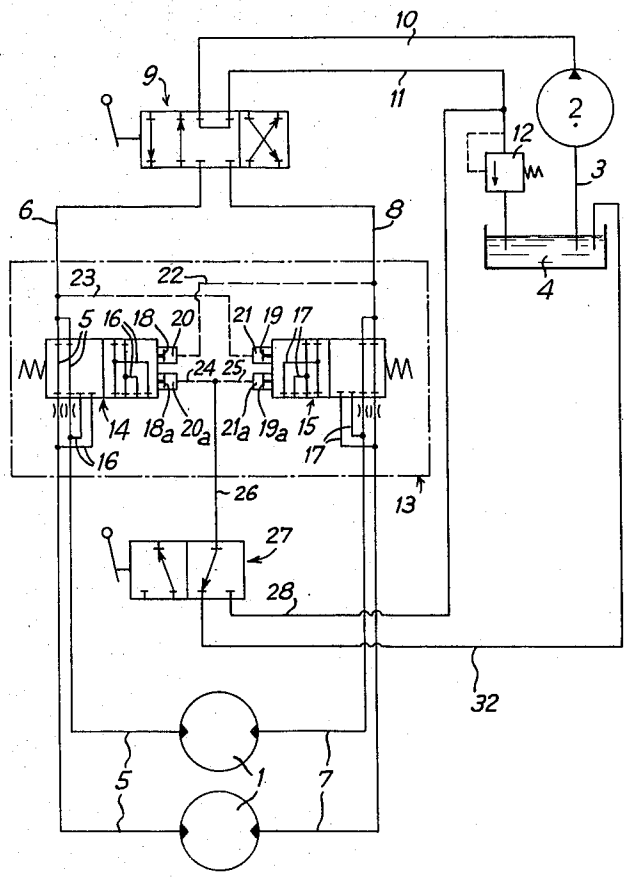


Fig. 1

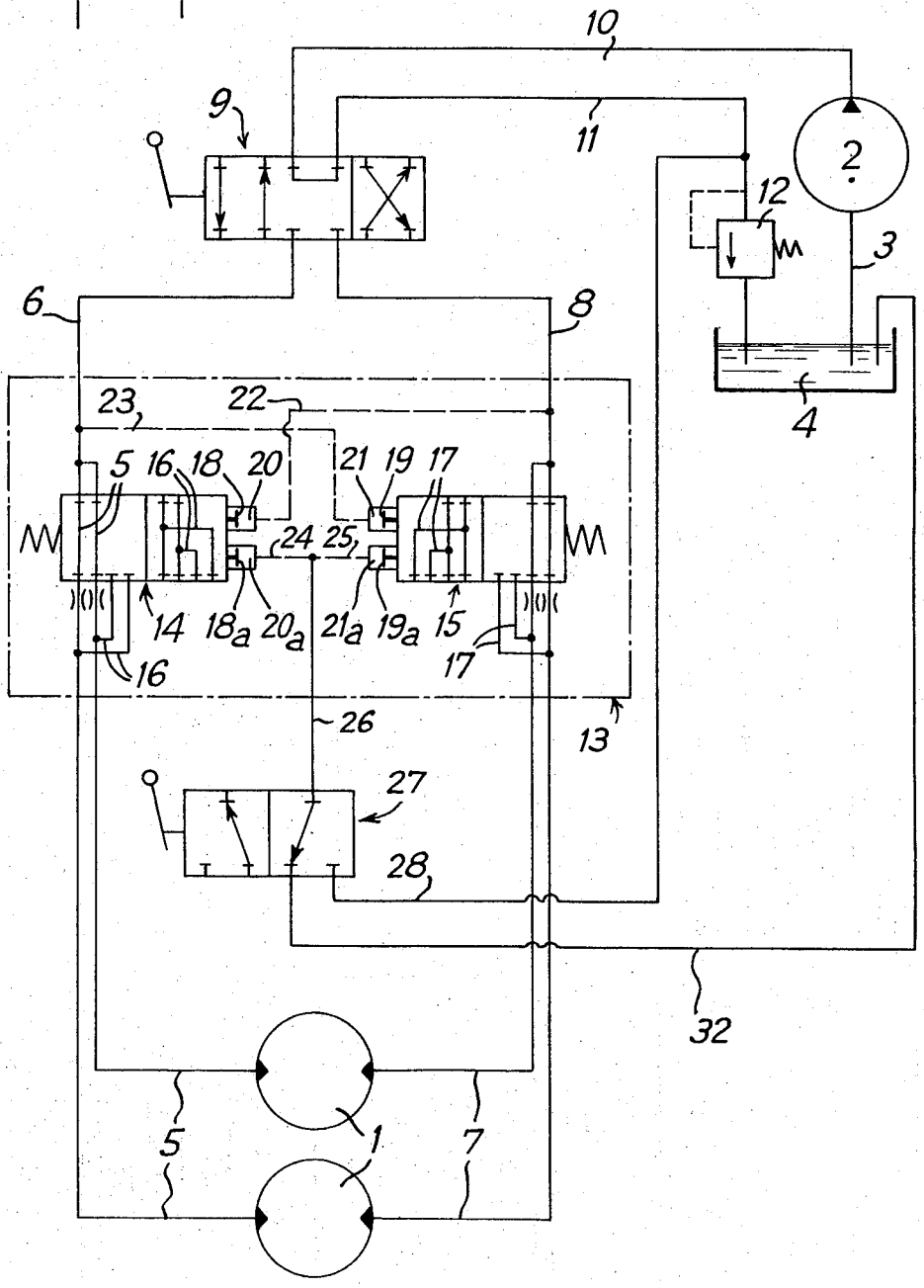

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25
14
18a
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21a
19a
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26
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32
5
1
7

Fig. 2

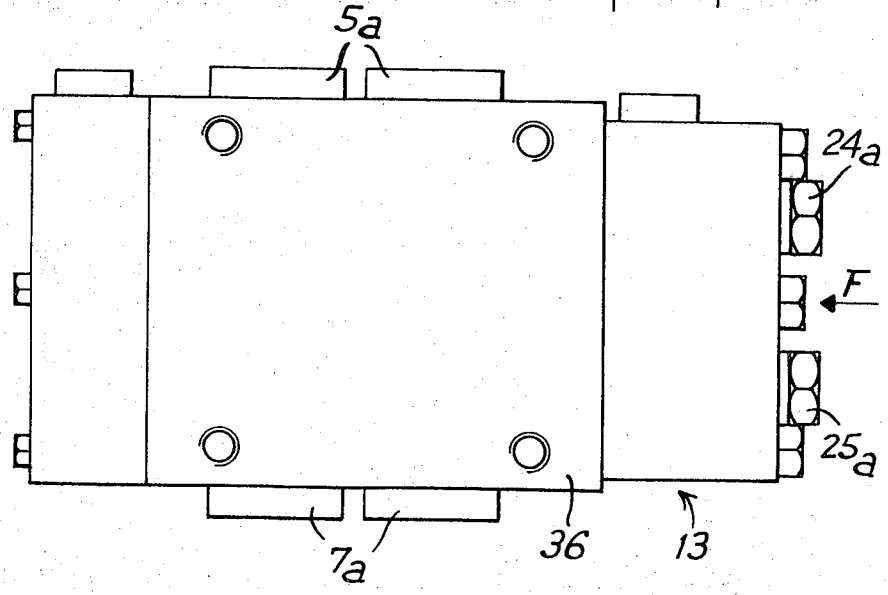


Fig. 3

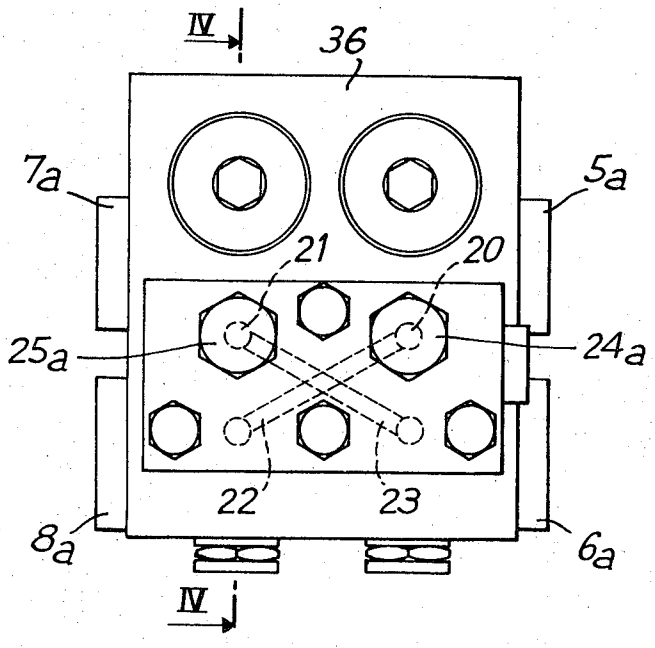
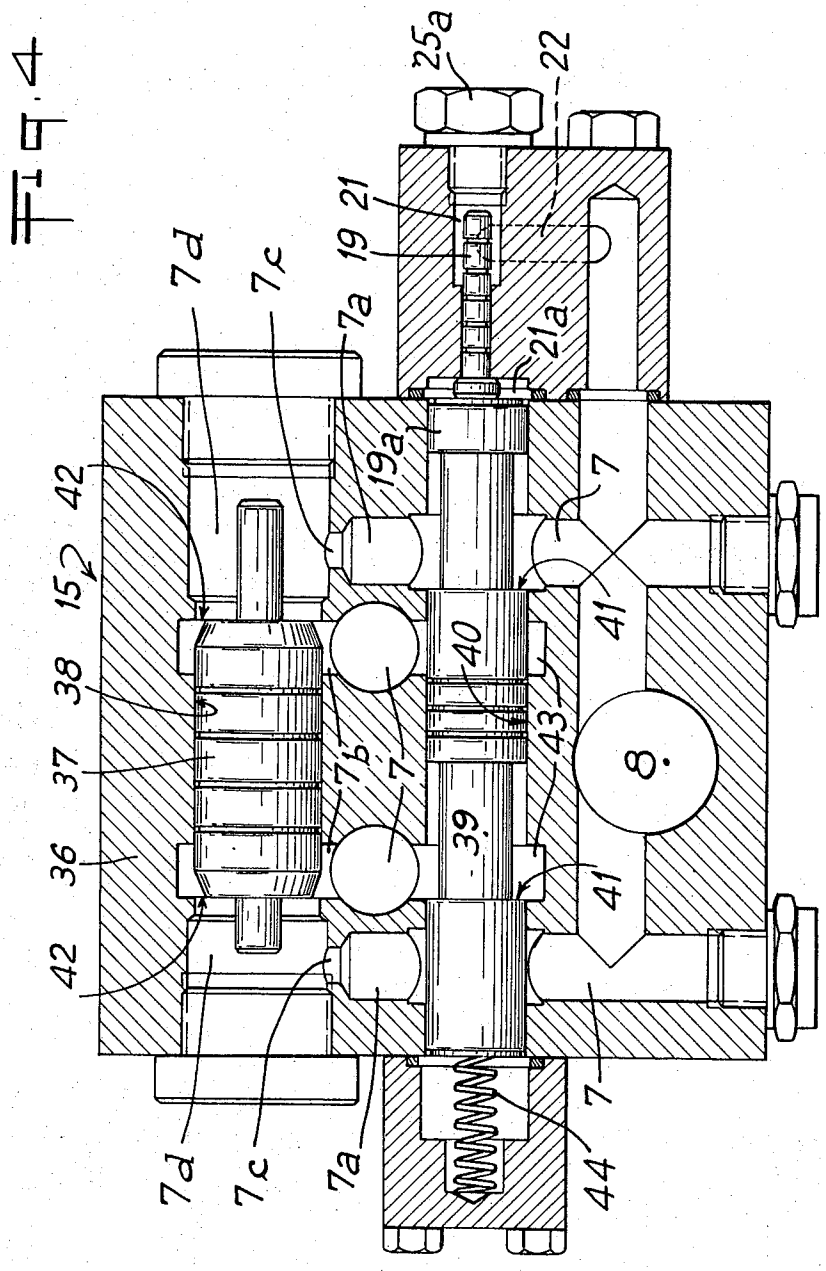


FIG. 4


25a
22
21
19
7d
7c
7a
21a
19a
7
42
15
41
40
38
43
37
7b
7
8
39
36
41
42
7
7d
7c
7a
44

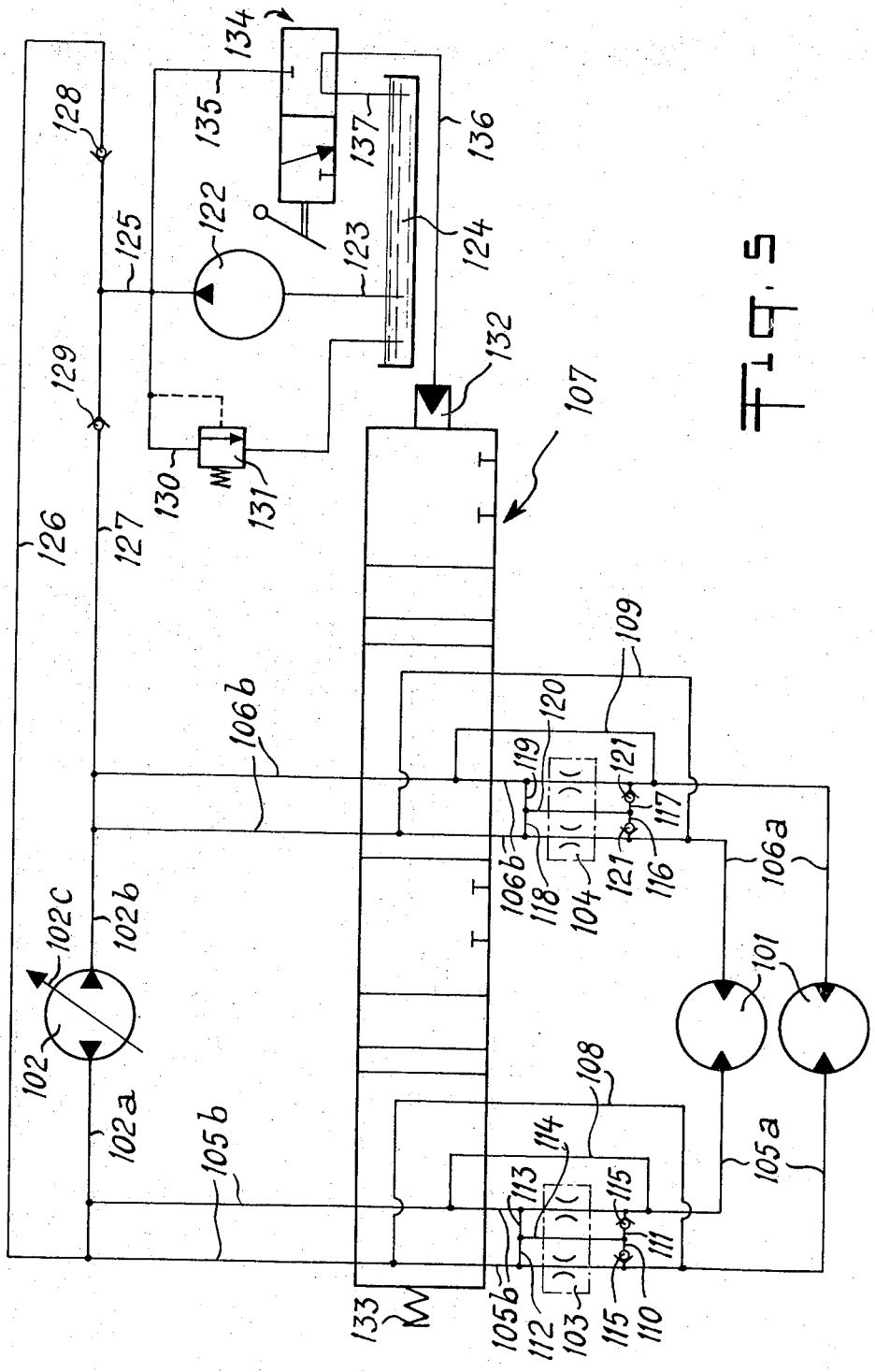

134
135
137
136
128
122
123
124
125
132
129
107
130
131
126
127
109
106b
120
119
121
117
106b
118
104
121
116
106a
102c
102b
101
102
102a
105b
108
114
113
115
105a
111
105b
112
103
115
110
133

FIG. 5

DEVICE FOR SUPPLYING FLUID UNDER PRESSURE TO TWO REVERSIBLE LOAD ELEMENTS

This is a continuation-in-part of copending application Ser. No. 256,324, filed May 24, 1972 now abandoned.

The present invention relates to a device for supplying fluid under pressure to two reversible load elements. In the field of load elements supplied with fluid under pressure, and particularly, but not exclusively, in the field of hydraulic jacks and motors, it is known to use circuits in which two load elements or groups of elements are connected in parallel. It is also known how to maintain a given ratio between the supply rates to the elements or groups, by incorporating a flow divider in the respective supply conduits, for example.

Such supply circuits are highly satisfactory for irreversible elements. Until now, however, no satisfactory arrangements have been proposed for reversible elements. A first aim of the present invention is therefore to fulfill this requirement.

Occasionally it is advantageous to provide a parallel supply to the elements, either without flow division or with flow division for a selected sense of operation of the load elements. It is thus convenient to be able to render the corresponding flow dividers operative or inoperative at will. Another aim of the invention is to propose an arrangement providing for such selection.

The presence of a flow divider in the supply conduits and another in the exhaust conduits may result not only in supply to the load elements in a given ratio but also of an unwanted restriction in the exhaust flows. The invention also proposes an arrangement with which this disadvantage can be avoided.

Further, the invention proposes an advantageous construction for the device, more particularly in that it comprises a monobloc valve actuated by the pressurized fluid.

The invention thus has for its object a device for supplying pressurized fluid to two load elements such as hydraulic motors, comprising two first conduits each connected to one load element and to a source of pressurized fluid, and two second conduits each connected to one load element and to an exhaust reservoir, a first flow divider being disposed in the first conduits, characterized in that the load elements are reversible, the first and second conduits are respectively placed in communication with the fluid source and the exhaust reservoir or vice versa, and a second flow divider is disposed in the second conduits.

Advantageously, each first conduit is connected to a third conduit providing a by-pass for the first flow divider associated with that first conduit, each second conduit is connected to a fourth conduit providing a by-pass for the second flow divider associated with that second conduit, the by-passes are provided with position-controlling elements, being those of the two third and two fourth conduits respectively, and which are so coupled that the two corresponding conduits are always in the same position.

Further, in one preferred embodiment of the invention, the control elements of the third conduits and the fourth conduits are respectively actuated by the pressure of the fluid in the second conduits downstream of the second flow divider with respect to the load elements and by the pressure of the fluid in the first conduits downstream of the first flow divider with respect to the load elements, so that the first and second conduits are respectively placed in communication with the fluid source, the free communication of the first and second conduits with the exhaust reservoir being assured by by-passing the first and second flow dividers respectively.

According to a further embodiment of the invention there are provided additional advantages according to which there is obtained with certitude, the by-pass of the flow divider disposed in the delivery conduits, whatever the instantaneous mode of use of the device, and, of course, when it is desired to obtain the division of the flows in the supply conduits of the two load elements.

This last mentioned embodiment comprises two reversible load elements, a source of pressurised fluid, an exhaust enclosure, two first conduits, two second conduits, each of said first and second conduits being connected, on the one hand to one of the load elements, on the other hand, selectively, the first conduits to the source of fluid and to the exhaust enclosure and the second conduits to the exhaust enclosure and to the fluid source, respectively. A first flow divider is interposed in the two first conduits, a second flow divider in the two second conduits, and four first connecting conduits are connected on the one hand in shunt to the parts of the first conduits connected on either side of the first flow divider, to the first flow divider, and on the other hand together at a first common point. Two non-return valves are each disposed respectively in one of the connecting conduits which are connected to the parts of the first conduits connecting the two load elements to the first flow divider. These two first non-return valves allows the passage of the fluid through said parts of the first conduits towards the first common point, and four second connecting conduits are connected, on the one hand, in shunt to the parts of the second conduits connected on either side of the second flow divider to this second flow divider on the other hand, together at a second common point, and, two second non-return valves are each disposed respectively in one of the connecting conduits which are connected to the parts of the two conduits connecting the two load elements to the second flow divider, these two second non-return valves allowing the passage of the fluid through said parts of said second conduits towards said second common point.

Each of the first conduits is advantageously connected to a third conduit, which constitutes a by-pass to the first flow divider for said corresponding first conduit, each of the second conduits is connected to a fourth conduit, which constitutes a by-pass of the second flow divider of said second corresponding conduit, whilst the by-passes thus constituted are provided with position selecting means.

The selecting members are constituted by a twoway distributor, which is interposed concomitantly in the by-passes of the first and second flow dividers, whilst, in its first position, this distributor ensures the continuity at its level of the said by-passes and, in its second position, said distributor obturates, at its level, said by-passes.

In the above described embodiment, there is provided a variable flow pump connected by two main conduits to the first and second conduits respectively. As a function of the first position of the member adjust-

ing the flow of said pump, one of said main conduits then constitutes the source of pressurised fluid, or the exhaust enclosure, while the other of said conduits constitutes, complementarily, the exhaust enclosure or the source of pressurised fluid.

The invention will be better understood and secondary features and their advantages will emerge from the following description of a number of embodiments of the invention.

The description and the accompanying drawings are given by way of non-limitative example.

Reference will be made to the accompanying drawings in which:

FIG. 1 is a schematic diagram of a supply device according to the invention;

FIG. 2 is a plan view of a valve used in the device of FIG. 1;

FIG. 3 is a view of the valve of FIG. 2 in the direction of the arrow F in that Figure;

FIG. 4 is a section on the line IV—IV of FIG. 3; and

FIG. 5 is a circuit diagram of a supply device forming a further embodiment of the invention.

The device shown in FIG. 1 comprises two reversible hydraulic motors 1 and a source of pressurised fluid comprising a pump 2 connected by a conduit 3 to a fluid reservoir 4 providing an exhaust reservoir. The motors 1 are connected in parallel by two first conduits 5, each connected to one of the two chambers of a motor and to a single conduit 6, and by two second conduits 7, each connected to the other chamber of the corresponding motor and to another single conduit 8.

A three-position distributor 9 is linked to the conduits 6 and 8, to a conduit 10 of the pump 2, and to a conduit 11 which returns fluid to the reservoir 4 through a biased discharge valve 12. The first position of the distributor 9 connects together conduits 6 and 10 and conduits 8 and 11. The second position connects together conduits 6 and 11 and conduits 8 and 10. The third position connects together conduits 10 and 11 and shuts off conduits 6 and 8 at the distributor.

A valve 13 is disposed in conduits 5 and 7 to connect conduits 6 and 8. It comprises a first flow divider 14 which connects the conduit 6 to the two conduits 5 and a second flow divider 15 which connects the conduit 8 to the two conduits 7. A first position of each flow divider provides a given ratio between the fluid flow rates in the two conduits 5 (or 7). In the second position third conduits 16 and fourth conduits 17 provide bypasses for conduits 5 and 7 respectively.

The flow dividers 14, 15 comprise respective control elements coupled to the pistons 18, 19 of jacks whose cylinders 20, 21 are linked to conduits 8, 6 by conduits 22, 23. The control elements are also coupled to pistons 18*a*, 19*a* of jacks whose cylinders 20*a*, 21*a* are linked to a common conduit 26 to which is connected a two-position distributor 27.

The distributor 27 is also connected to a conduit 28 connected to the conduit 11 upstream of the valve 12, relative to the reservoir 4, and to a conduit 32 which returns fluid to the reservoir 4. In a first position, the distributor 27 connects conduits 26 and 32 and closes conduit 28 at the distributor. In its second position it connects conduits 26 and 28 and closes conduit 32.

In the valve shown in FIGS. 2 to 4 are provided some of the elements already mentioned. The valve comprises a body 36 to which are coupled the conduits 5,6,7,8, 24 and 25 by means of respective couplings 5*a*, 6*a*, 7*a*, 8*a*, 24*a* and 25*a*. FIG. 4 shows the flow divider 15 in section. The identical flow dividers 14, 15, are disposed in the valve body 36.

Regarding flow divider 15, the two conduits 7 are connected in parallel to conduit 8 in a manner known per se. A double piston 37 slides freely in a housing 38 formed in the valve body 36 and defines a chamber 7*d* at each end of this housing. A shaft 39 slides in a housing 40 in the valve body 36 and has two shoulders 41 which can occupy two positions. In a first position the shaft 39 assures communication between the upstream portion 7*a* and the downstream portion 7*b* with respect to piston 37 of each conduit 7, through a calibrated orifice 7*c* and the passage 42 formed between the end of the piston 37 and the valve body 36. In a second position the shaft 39 assures communication of parts 7*a* and 7*b* of the conduits 7 by grooves 43 from which the shoulders 41 are in this position disengaged. The shaft 39 is coupled to pistons 19 and 19*a* while a spring 44 is located between the shaft 39 and the valve body 36. This spring has an action opposite to those of the fluid contents of cylinders 21 and 21*a*. The conduit 22 is formed in the valve body 36 and connects the conduit 8 to cylinder 20 (not visible in FIG. 4 but similar to cylinder 21).

The supply device which has just been described operates as follows, the operation being described by way of example with reference to a vehicle in which one motor 1 drives a left-hand set of wheels while the other motor 1 drives a right-hand set.

With the distributor 9 in its first position, conduits 6 and 10 and conduit 8 and 11 are in communication. With the distributor 27 in its first position, as shown in FIG. 1, the fluid contained in cylinders 20*a* and 21*a* is returned to the reservoir 4 via conduits 24, 25, 26 and 32 and is not under pressure. The spring of the flow divider 14 pushes back the corresponding shaft 39, since it exerts a greater force than the fluid in cylinder 20 which is that exhausted into conduit 8 by the motors 1. The spring 44 of flow-divider 15, however, exerts less force than the fluid in cylinder 21 which is the pressurised fluid from conduits 6 and 23. The divider 15 is thus brought into its second position in which direct communication is established between parts 7*a* and 7*b* of conduits 7, without flow division, whereas the divider 14 is in its first position and divides the fluid flows in a known manner, as will be outlined below. The two motors 1 are thus supplied by flows in a given ratio, their exhaust being entirely free with no restriction at the divider 15. The vehicle thus has a blocked differential which allows for either left and right wheels driven at the same speed with equal flows, or for left and right wheels driven at different speeds. The first provides a forwarding driving force and the second a turning mechanism.

When the divider 15 is in its first or flow-dividing position as shown in FIG. 4, the fluid reaching conduit 8 also reaches conduits 7*a*. The fluid in each conduit 7*a* pushes back the corresponding end of piston 37, which is thus held in equilibrium, and reaches conduits 7*b* through the orifices 7*c* and passages 42 which generally form restrictions. The flow through orifices 7*c* causes a drop in load and thus a pressure drop between the corresponding conduit 7*a* and the associated chamber 7*d*. The resulting pressures on each side of the piston 37, in chambers 7*d*, cause the admission to conduits 7*b* of flows in a given ratio determined by the orifices 7*c*.

With the distributor **9** kept in its first position and the distributor **27** in its second position, cylinders **20***a* and **21***a* are supplied via conduits **24, 25, 26** and **28** with fluid at the pilot pressure which is that maintained in conduit **11** by biased valve **12.** Whatever pressure subsists in cylinders **20** and **21,** the fluid forces on pistons **18***a* and **19***a* are greater than the spring forces of the corresponding flow dividers **14** and **15.** Thus each flow divider is in its second position with no flow division. The motors **1** of the left hand and right hand wheels are thus supplied in parallel and exhaust in parallel without any intervention by flow dividers **14** and **15,** which in this configuration are by-passed.

If the distributor **9** is now brought into its second position, pressurised fluid is supplied via conduit **8** and exhausted from motors **1** via the conduit **6.** The complete operation, already described in relation to the first position of distributor **9,** will not be described again, but with the distributor **27** in its first position, flow dividers **14** and **15** are in the second and first positions respectively, with no flow division by divider **14** and division by divider **15.** This is evidently the position required, since division of the exhausted fluid is to be avoided in all cases, with the attendant load drop, whether the supply flows are divided in a given ratio or not and whether the reversible motors **1** turn in one sense or the other.

There is thus obtained a hydraulic differential which can be locked but whose operation involves only small load losses. The advantages of using a monobloc for the valve **13** are well known, as are those of adopting hydraulic control for the selection by distributor **27** of the mode of operation of the motors **1.**

The supply device shown FIG. **5** comprises two reversible hydraulic motors **101** and a variable flow pump **102.** The pump **102** is, for example, constituted as a pump with axial pistons and orientable plate, well known per se. It is connected to the rest of the device by two conduits **102***a* and **102***b* which as a function of the position of the rod **102***c* for controlling the orientation of the swash plate of pump **102,** constitute, one, the suction conduit, the other, the delivery conduit, and vice versa, of said pump.

Two flow dividers **103** and **104** are each shown diagramatically by two restrictions and are in fact similar to the combination described in the first modification, with reference to FIG. **4,** of the double acting piston **37** mounted to slide in the housing **38** and making two passages **42,** generally forming restrictions themselves.

The motors **101** are connected to pump **102** by two first conduits, each in two parts **105***a* and **105***b*, and by two second conduits, each likewise in two parts **106***a* and **106***b*. The two parts **105***a* of the first conduits connect one of the two connections of each motor **101** to the flow divider **103,** the two parts **105***b* of these first conduits connecting said flow divider **103** to the conduit **102***a* of the pump **102.** Similarly, the two parts **106***a* of the two conduits connect the other of the two connections of each motor **101** to the flow divider **104,** the two parts **106***b* of these two conduits connecting said flow divider **104** to the conduit **102***b* of the pump **102.**

In addition, it is noted that a two-position distributor **107** is interposed in the conduits **105***b* and **106***b*, and that two third conduits **108** connect conduits **105***a* to this distributor **107,** in the same way as fourth conduits **109** connect conduits **106***a* to said distributor **107.** In its first position, the distributor **107** places the third conduits **108** in communication with the second parts **105***b* of the first conduits on the one hand, and the fourth conduits **109** with the second parts **106***b* of the second conduits, on the other hand. On the contrary, in its second position, the distributor **107** obturates at its level the third conduits **108** and fourth conduits **109.** In its two positions, the distributor **107** maintains in communication the two parts of each of the conduits **105***b* and **106***b*, which are connected thereto.

Furthermore, it is noted that four connecting conduits **110, 111** and **112, 113** are connected in shunt, to each of the first parts **105***a* of the first conduits and to each of the second parts **105***b* of said first conduits, respectively. These four connecting conduits are in addition connected together by means of another conduit **114** forming a junction and common point. Two non-return valves **115** are disposed in the connecting conduits **110** and **111,** so as to permit the passage of the fluid from the first parts **105***a* of the two first conduits towards the conduit **114** forming common point.

In the same way, four other connecting conduits **116,** 117 and **118, 119** are connected in shunt, to each of the first parts **106***a* of the two conduits and to each of the second parts **106***b* of said second conduits respectively. These four connecting conduits are in addition connected together by means of another conduit **120** forming a junction and common point. Two non-return valves **121** are disposed in the connecting conduits **116** and **117** so as to permit the passage of the fluid from the first parts **106***a* and the two second conduits towards the conduit **120** forming common point.

An auxiliary pump **122** is connected by a suction conduit **123** to a fluid tank **124.** To its delivery conduit **125** are connected, in parallel, two conduits **126, 127** respectively connected, furthermore, to the conduits **102***a* and **102***b* of the pump **102.** A first non-return valve **128** is disposed in conduit **126** and a second non-return valve **129** is disposed in conduit **127,** and each allow passage of the fluid of the delivery conduit **125** towards conduits **102***a* and **102***b*, respectively.

A conduit **130** is branched in shunt in known manner to the delivery conduit **125** and is connected to the fluid reservoir **124.** A calibrated discharge valve **131** is disposed in this conduit **130.**

Finally, a single acting jack **132** is coupled to the movable member of the distributor **107.** The effect of the pressurised fluid in the jack **132** is antagonistic of that of a spring **133** which tends to return said movable member of the distributor **107** into its first position. A second two-position distributor **134** which is, for example, manually controlled, is provided, to which are connected on the one hand a conduit **135** connected to the delivery conduit **125,** on the other hand a conduit **136** connected to jack **132,** and a conduit **137** connected to the fluid reservoir **124.** In its first position, the distributor **134** obturates at its level the conduit **135** and places the conduits **136** and **137** in communication, whilst, in its second position, this distributor **134** obturates at its level the conduit **137** and places conduits **135** and **136** in communication.

Of course, the supply device which has just been described may be completed by additions known per se and with their functions. It is thus possible, for example, and it is often in fact done, to provide an extra supply of pressurized fluid to the motors **101.** To this end, it is sufficient to connect in shunt to conduits **105***a* and

106*a* four conduits connected to a source of fluid under low pressure, almost zero, and to dispose in each of these four conduits a non-return valve allowing passage of the fluid of the source under low pressure towards the conduits **105***a* and **106***a*.

In addition, the device described comprises several variants among which the following two will be mentioned:

The pump **102**, as such is connected to the rest of the device, in fact makes a closed circuit supply. Naturally, an equivalent of this connection, which remains in the domain provided by the present invention, consists in connecting said pump on the one hand to a fluid reservoir and on the other hand to a three-position reversing distributor enabling the delivery conduit of said pump to be placed in communication either with the first conduits **105***a* and **105***b* or with the second conduits **106***a* –**106***b* of the motors **101**. This latter connection is said to be open circuit and is moreover known per se.

The other variant consists in coupling the movable member of the distributor **107**, not to a power-assisted control device but to an ordinary device for manually controlling its position.

The advantages in adopting the device which has just been described will be better seen on reading the following description of the functioning obtained.

It is assumed that the control rod **102***c* of the pump **102** is disposed so that the conduit **102***a* constitutes the delivery conduit, the conduit **102***b* consequently constituting the suction conduit. Moreover, it is obvious that the reverse configuration leads only to reversing the direction of rotation of motors **101**.

It is noted that disposing the distributor **134** in its first position placed conduits **136** and **137** in communication, and consequently places jack **132** in communication with the reservoir **124**. The action of the spring **133** is therefore preponderant and the distributor **107** is maintained or returned to its first position, too. In this first position of the distributor **107**, direct communications are established between the first parts **105***a* and second parts **105***b* of the first conduits by conduits **108**, and in the same way between the first parts **106***a* and second parts **106***b* of the second conduits by conduits **109**. The flow dividers **103** and **104** are thus bypassed by conduits **108** and **109**.

When, on the contrary, the distributor **134** is disposed in its second position, the fluid delivered by the pump **122** reaches, via conduits **135** and **136**, jack **132** and has a preponderant effect over that of the spring **133**. The distributor **107** is then pushed back until it is disposed in its second position. In this position, the only communications which remain are those between the first parts **105***a* and second parts **105***b* of the first conduits and between the first parts **106***a* and second parts **106***b* of the second conduits by means of the flow dividers **103** and **104**, and possibly in one direction only, by connecting conduits **110, 111, 112, 113** and **114** on the one hand, and **116, 117, 118, 119** and **120** on the other hand, since the conduits **108** and **109** are now obturated. It is then said that the flow dividers are not bypassed, it being understood that they are not done so by conduits **108** and **109**.

Finally, by way of example and to specify the materiality of the application made of the supply device, it is indicated that the motors **101** constitute the motors driving the right and left-hand wheels on the same axle of a vehicle, such as a tractor. On the other hand, these motors which are generally sufficiently fed with pressurised fluid to effectively drive the vehicle, may sometimes, when said vehicle goes down a slope, no longer be supplied in sufficient volume. Under these conditions, the motors are in fact driven by the vehicle and the pressure in their inlet conduit drops and becomes practically zero.

The following four situations are then studied:

First situation: the motors **101** effectively drive the loads to which they are coupled, and the flow dividers **103** and **104** are by-passed;

Second situation; the motors **101** are driven by the loads to which they are coupled, and the flow dividers **103** and **104** are by-passed;

Third situation: the motors **101** effectively drive the loads to which they are coupled, and the flow dividers **103** and **104** are not by-passed;

Fourth situation: the motors **101** are driven by the loads to which they are coupled, and the flow dividers **103** and **104** are not by-passed.

Concerning the first and second situations, in which the motors **101** drive the vehicle or are driven by the vehicle, the fluid passes freely between the conduits **105***a* and **105***b* on the one hand, **106***a* and **106***b* on the other hand, by means of conduits **108** and **109** respectively. Consequently, the supplies of the motors **101** by conduits **102***a*, **105***b*, **108** and **105***a* are effected in parallel, in the same way as the motor exhausts are also effected in parallel by conduits **106***a*, **109**, **106***b* and **102***b*. This mode of supply and exhaust is commonplace and well known per se.

When the distributor **134** is then disposed in its second position, the conduits **108** and **109** are closed. The fluid delivered by pump **102** into conduit **102***a*, then into conduits **105***b* must obligatorily pass through the flow divider **103**. In fact, the path through conduits **112, 113** and **114** is obturated at the level of the non-return valves **115**. There therefore remains only the path passing through the flow divider **103**. The flows feeding the two motors **101** are in a fixed ratio, this corresponding to the blocking of the hydraulic "differential." This blocking may be advantageous for moving over poor ground.

If one is in the third or fourth situation, the fluid delivered by the motors **101** in the conduits **106***a* may return directly to the conduit **102***b* by conduits **116, 117**, the non-return valves **121** and the conduits **120, 118**, 119 and **106***b*, since the non-return valves **121** effectively allow the fluid to pass in this direction. In fact, it is noticed that the conduits **116, 117, 118, 119** and **120** and the non-return valves **121** constitute a second bypass path of the flow divider **104**, this path being permanently open, but only in the direction permitting the flow of the fluid from motors **101** by conduits **106***a* towards conduit **102***b*.

Consequently, even if the pressure of the fluid in the supply conduits **105***b* – **105***a* drops, the flow divider disposed in the delivery conduits **106***a*–**106***b* of the motors **101** is efficiently by-passed, contrary to example, to what happened with the device shown in the modification of FIG. **1**. Naturally, it is understood that, in view of the symmetry of the dispositions relative to the supplies and exhausts of the motors **101**, the functioning is conserved, except for the direction of rotation of said motors, when it is the conduit **102***b* which becomes the supply conduit of the pump **102**, and when the suc-

tion conduit of said pump is then constituted by conduit **102***a*.

It is to be noted in addition that the lack of fluid which may occur in the supply conduit of the pump **102**, conduit **102***a* in the present case, when the motors **101** are driven by the vehicle, may be compensated by the extra supply procured from pump **122**, by means of the conduits **125** and **126**, through the non-return valve **128**.

What is claimed is:

1. A device for supplying pressurized fluid to two load elements such as hydraulic motors, comprising two first conduits each connected to one load element and to a source of pressurized fluid, and two second conduits each connected to one load element and to an exhaust reservoir, a first flow divider being disposed in the first conduits, characterized in that the load elements are reversible, the first and second conduits are respectively placed in communication with the fluid source and the exhaust reservoir or vice versa, and a second flow divider is disposed in the second conduits, a third conduit connected to each first conduit and providing a by-pass for the first flow divider associated with the first conduits, a fourth conduit connected to each second conduit and providing a by-pass for the second flow divider associated with the second conduits, said by-passes being provided with position-controlling elements and so coupled as to maintain the two corresponding conduits in the same position, the control elements of the third and fourth conduits being respectively actuated by the pressure of the fluid in the second conduits downstream of the second flow divider with respect to the load elements and by the pressure of the fluid in the first conduits downstream of the first flow divider with respect to the load elements, so that the first and second conduits are respectively placed in communication with the fluid source, the free communication of the first and second conduits with the exhaust reservoir being assured by by-passing the first and second flow dividers, respectively.

2. A device for supplying pressurized fluid to two load elements such as hydraulic motors, comprising two reversible load elements, a source of pressurized fluid, an exhaust enclosure, two first conduits, two second conduits, each of said first and second conduits being connected, on the one hand to one of the load elements, on the other hand, selectively, the first conduits to the source of fluid and to the exhaust enclosure and the second conduits to the exhaust enclosure and to the fluid source, respectively, a first flow divider interposed in the two first conduits, a second flow divider interposed in the two second conduits, four first connecting conduits which are connected on the one hand in shunt to the parts of the first conduits connected on either side of the first flow divider, to the first flow divider, on the other hand together at a first common point, two first non-return valves which are each disposed respectively in one of the connecting conduits which are connected to the parts of the first conduits connecting the two load elements to the first flow divider, these two first non-return valves allowing the passage of the fluid of said parts of the first conduits towards the first common point, four second connecting conduits which are connected, on the one hand, in shunt to the parts of the second conduits connected on either side of the second flow divider to this second flow divider on the other hand, together at a second common point, and, two second non-return valves which are each disposed respectively in one of the connecting conduits which are connected to the parts of the two conduits connecting the two load elements to the second flow divider, these two second non-return valves allowing the passage of the fluid of said parts of said second conduits towards said second common point.

3. A supply device as claimed in claim **2**, characterized in that each of the first conduits is connected to a third conduit, which constitutes a by-pass of the first flow divider for said corresponding first conduits, in that each of the second conduits is connected to a fourth conduit, which constitutes a by-pass of the second flow divider for said second corresponding conduits, and in that the by-passes thus constituted are provided with position selecting means.

4. A supply device as claimed in claim **3**, characterized in that said selecting members are constituted as a two-way distributor, which is interposed concomitantly in the by-passes of the first and second flow dividers, whilst, in its first position, this distributor ensures the continuity of the said by-passes and, in its second position, said distributor obturates, said by-passes.

5. A supply device as claimed in claim **2**, characterized in that it comprises a variable flow pump connected by two main conduits to the first and second conduits respectively and in that, as a function of the position of the member adjusting the flow of said pump, one of said main conduits constitutes the source of pressurized fluid, or the exhaust enclosure, the other of said conduits constitutes complementarily the exhaust enclosure or the source of pressurized fluid.

6. A device for supplying pressurized hydraulic fluid to two load elements such as hydraulic motors, comprising two first conduits each connected to a different load element and to a first single conduit and two second conduits each connected to a different load element and to a second single conduit, a first flow divider having restrictive flow paths capable of producing a selected appointment of flow from said first single conduit to said first two conduits, said first flow divider being switchable into and out of fluid communication with said first single conduit and said first two conduits, a second flow divider having restrictive flow paths capable of producing a selected apportionment of flow from said second single conduit to said second two conduits, said second flow divider being switchable into and out of fluid communication with said second single conduit and said second two conduits, a distributor arranged for connecting said first and second single conduits to a source of pressure and to a reservoir respectively and vice versa, first control means responsive to application of pressurized fluid to said first single conduit to prevent switching of said second flow divider into communication with said second single conduit and with said second two conduits and second control means responsive to application of pressized fluid to said second single conduit to prevent switching of said first flow divider into communication with said first single conduit and with said first two conduits.

7. A device according to claim **6** wherein said device further includes a second distributor operable subject to the operation of said first and second control means to switch said first and second flow dividers into communication with their respective conduits.

8. A device according to claim 6 wherein said first and second flow divider means include hydraulic valves and wherein said control means comprise pressure operated pilot systems connected to operate said valves in response to changes in pressure in said first and second single conduits.

9. A device according to claim 8 wherein said device includes further pressure operated pilot systems connected to operate said valves, a second distributor and means associated with said second distributor for supplying different fluid pressures to said further pressure operated pilot systems, said pilot systems and said means associated with said second distributor being of a size to provide less valve operating force than said pressure operated pilot systems.

10. A device according to claim 6 wherein said first and second control means comprise bypass lines bypassing said flow dividers and check valves in said bypass lines permitting free fluid flow in a direction away from said load elements.

11. A device according to claim 10 wherein said first and second single conduits are connected respectively to opposite terminals of a reversible hydraulic pump.

12. A device according to claim 11 wherein said first and second single conduits are further connected, via associated check valves, to a reservoir, said check valves allowing free fluid flow in a direction away from said reservoir and toward said hydraulic pump and said load elements.

13. A device according to claim 12 wherein said device includes means for maintaining a continuous circulating flow of hydraulic fluid past a junction at a given pressure, a fluid operated, pressure responsive pilot system for switching said first and second flow divider means and a second distributor switchable to connect said junction and said reservoir alternately to said pilot system.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,864,910 Dated February 11, 1975

Inventor(s) Gerard H. Mechin

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 35, "allows" should read --allow--;

Column 7, line 15, after "distributor" insert --,--;

Column 7, line 35, "placed" should read --places--;

Column 10, line 42, "appointment" should read --apportionment--.

Signed and sealed this 22nd day of April 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks

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