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Knaak

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[54] **REGULATING APPARATUS FOR A HYDRAULIC MACHINE**

[75] Inventor: **Hans Knaak**, Rheydt, Germany

[73] Assignee: **G. L. Reproth GmbH**, Lohr/Main, Germany

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[52] **U.S. Cl.** **91/505**

[51] **Int. Cl.** **F04b 1/26**

[58] **Field of Search** 417/222; 91/505, 506; 60/444

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Primary Examiner—William L. Freeh

Attorney, Agent, or Firm—Michael S. Striker

[57] **ABSTRACT**

A regulating apparatus for a hydraulic machine, such as an axial piston pump with a regulator for adjusting the position of the swash plate for varying the displaced fluid volume, is provided with hydraulic setting means including a piston forming first and second chambers in a cylinder, and being connected with a regulator for operating it. A spring is located at least in the first chamber, acting on the piston. A auxiliary pump supplies pressure fluid to the second chamber at a predetermined pressure, and a regulating valve reduces the pressure of the fluid and supplies fluid at a reduced pressure to the first chamber so that the piston is balanced in a new position determined by the increasing counter force of the spring, and depending on adjustment of the pressure reducing regulating valve. In a modified embodiment, the working pressure of an axial piston pump is used for adjusting the regulating valve.

7 Claims, 4 Drawing Figures

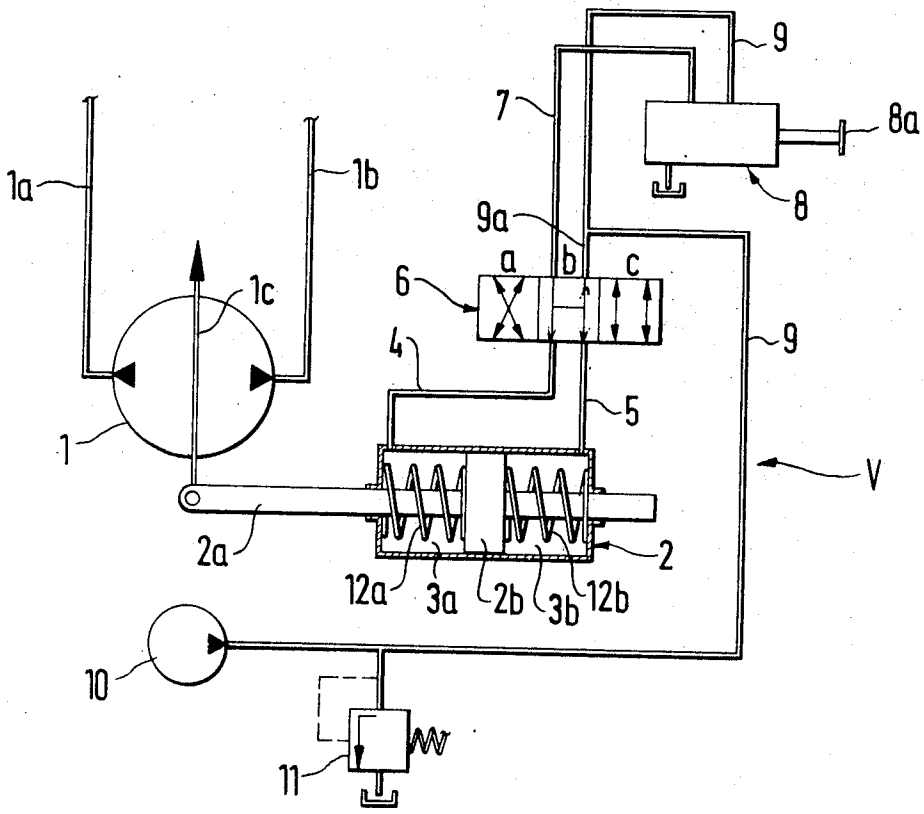


Fig. 1

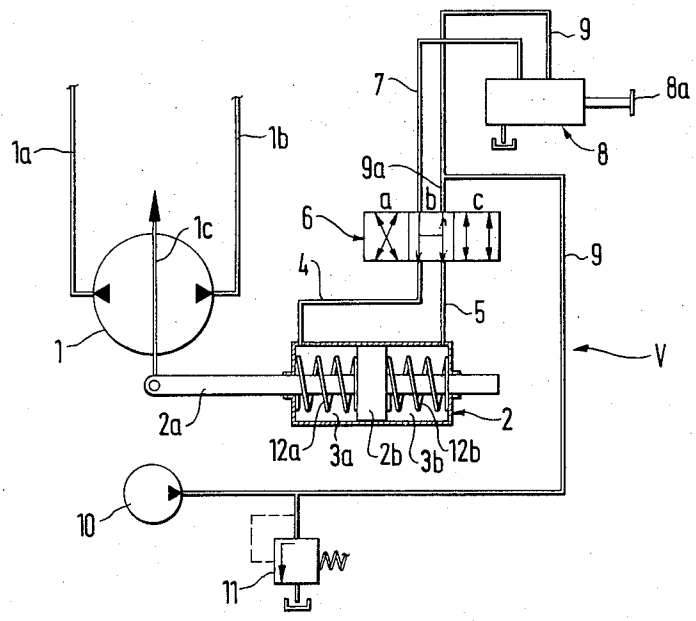

9
7
8a
1a
1b
8
9a
a
b
c
6
1c
9
4
5
1
V
2a
2
12a
3a
2b
3b
12b
10
11

Fig. 2

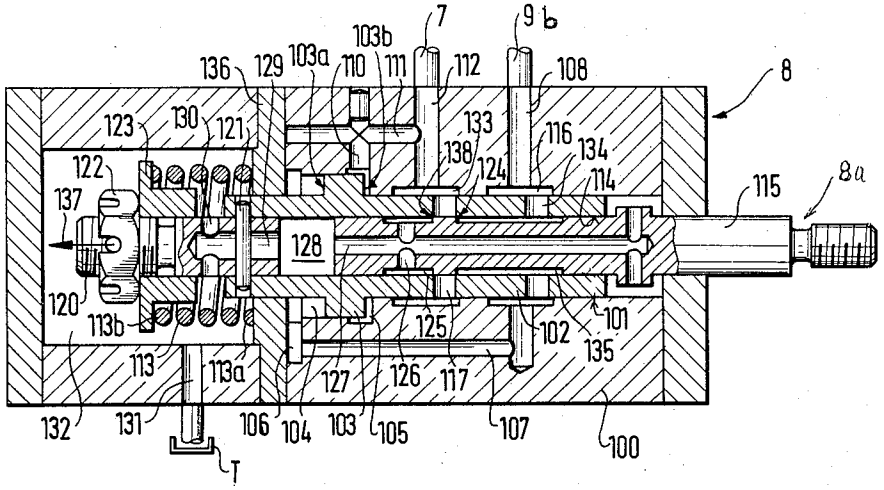

7
9b
103b
136
129
103a
110
111
112
108
8
123
130
121
133
116
134
122
138
124
114
115
8a
137
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113b
125
102
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113a
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126
117
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107
100
T

Fig. 3

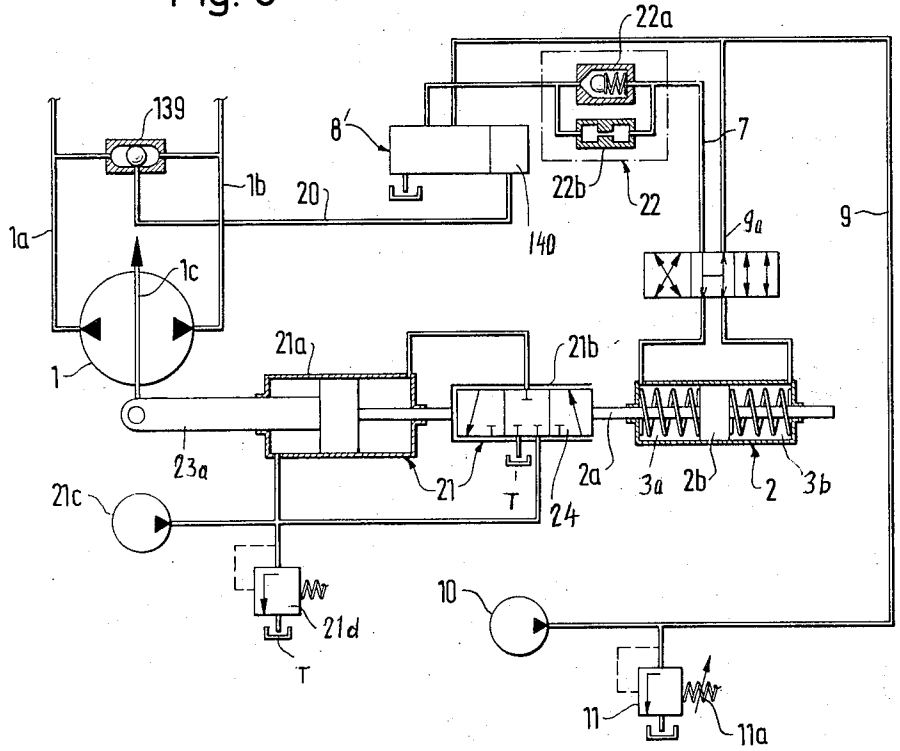
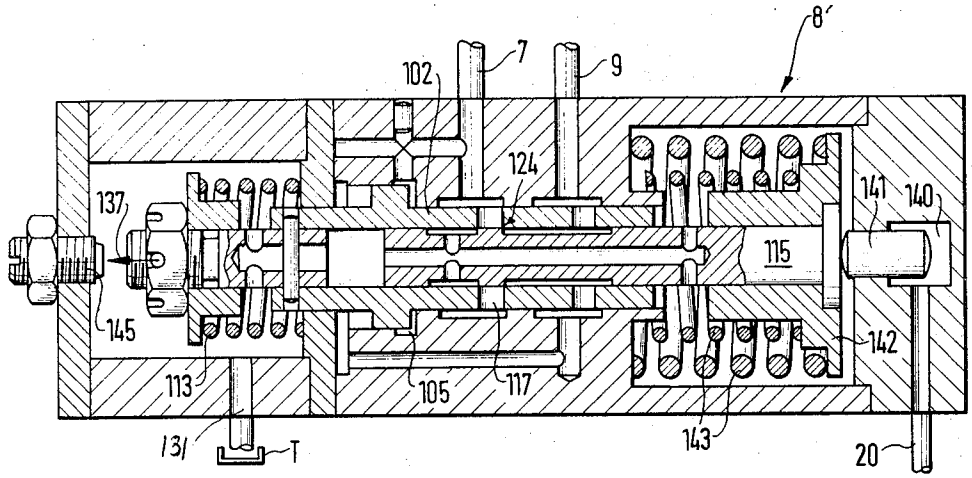

22a
139
8'
7
1b
20
22b
22
9a
9
140
1a
1c
21a
21b
1
23a
21
T
2a
3a
2b
2
3b
24
21c
21d
10
T
11
11a

Fig. 4


8'
102
7
9
124
137
141
140
115
145
142
113
105
117
131
T
143
20

REGULATING APPARATUS FOR A HYDRAULIC MACHINE

BACKGROUND OF THE INVENTION

The present invention relates to an improvement of a regulated pump, particularly an axial piston pump with an adjustable swash plate operated by a setting piston on which a regulating pressure acts.

In a known regulated pump of this type, the setting piston is located in a setting cylinder, forming two chambers therein, one of which is subjected to an adjustable regulating pressure, while the other chamber of the cylinder is connected with a discharge reservoir. The position of the setting piston, which corresponds to the displaced volume of the pump, exclusively depends on the height of the regulating pressure, together with the spring characteristic of the spring means centering the setting piston in a neutral position. The height of the respective regulating pressure is determined by a pressure regulating valve which can be manually, mechanically, or, if the regulated pump is to be regulated to a constant drive torque, operated by the working pressure. If an adjustment which permits any desired setting of the regulated pump, is to be superseded by a regulation to a constant drive torque, in addition to the pressure regulating valve, which determines the desired setting of the regulating means of the pump, another pressure regulating valve controlled by the working pressure of the pump is required, which is built into the conduit for the regulating pressure fluid, and determines the regulating pressure, if adjusted to a lower pressure than the other pressure regulating valve. This is the case, when a predetermined maximum drive torque of the regulated pump is reached.

In a system of this type, particularly for simple regulation of the volume of the regulated pump, it is not possible to connect several independent setting means to a common pressure regulating conduit, since a variation of the displaced volume of the regulated pump is based on a variation of the height of the regulating pressure, so that the other setting means of other hydraulic machines would be influenced. On the other hand, pressure fluctuations in the regulating pressure conduit, as may occur when additional hydraulic consumer motors are connected to the regulating conduit, cause the displaced volume of the regulated pump to fluctuate.

Another disadvantage of the prior art system of regulation resides in that in a pump regulation, in which the working pressure of the regulated pump is used for regulating to a constant drive torque, it is not possible to simultaneously regulate several regulated pumps with a single pressure regulating valve providing a desired setting of the regulating means of the adjusted pump, in the event that the several regulated pumps have constant, but different drive torques. The pressure regulating valve which is controlled by the working pressure of the regulated pump, and which is set to the lowest fluid pressure, would determine the height of the regulating pressure, and thereby influence all other setting means.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a regulated pump, whose regulating means can be reliably operated even if a plurality of regulating devices is connected to a common regulating pressure fluid conduit, without mutually influencing each other. For this purpose, the displacement volume of the regulated pump must be settable to any selected value without the requirement for a variation of the height of the regulating fluid pressure, which can be constant for a simple regulation, and may be variable if regulation in accordance with desired set values of the regulated pump is maintained. Furthermore, the volume displaced by the regulated pump by operation of the regulating apparatus of the invention, should not be influenced by fluctuations of the regulating fluid pressure.

With these objects in view, the present invention provides a regulating pressure in a setting cylinder on one side of a setting piston, and a regulating spring and a variable counterpressure on the other side of the setting piston in another chamber of the cylinder. The control of the setting means is effected by the pressure differential between the regulating pressure and the counterpressure which, multiplied by the effective surfaces of the setting piston, result in a force acting on the piston which is balanced by the regulating spring so that the distance of movement of the spring corresponding to this pressure differential, results in an eccentric position of the setting piston, and thereby in operation of the regulating means of the hydraulic displacement pump. Furthermore, the reliable operations of the setting means, are independent of the pressure in the discharge reservoir, and of the position of the reservoir.

The counterpressure acting, together with a spring, in one chamber of the setting cylinder, is advantageously determined by a pressure regulating valve which has an inlet receiving pressure fluid at a predetermined pressure. The pressure regulating valve is constructed so that upon adjustment of the valve slide, the variation of the regulating pressure brings about a variation of the counterpressure in such a manner that the pressure difference between the predetermined regulating pressure and the counterpressure, and thereby the resultant force acting on the setting piston, and the position of the regulating means of the regulated pump remain constant within a range of functions. If the setting means is manually or mechanically operated, the adjusting means of the pressure regulating valve are accordingly operated.

In a further development of the invention, the position of the valve slide of the pressure regulating valve is influenced by the working pressure of the adjusted pump in such a manner that upon an increase of the working pressure in the regulated pump, the counter pressure acting on the piston of the setting means is also increased, or vice versa. Such an arrangement permits advantageously the regulation of the regulated pump in such a manner that the drive torque is maintained constant. This type of regulation can also be used for simple regulation, independently of the working pressure of the regulated pump, particularly if limit valve means are provided for varying the predetermined pressure of a source of regulating fluid. Furthermore, in order to obtain an effecting damping of the adjusting movement of the regulated pump, a combined throttle and check valve can be arranged in the conduit containing the adjusted regulating fluid, and opening toward the setting cylinder.

One embodiment of the invention comprises regulating means for adjusting the displacement volume of a

hydraulic machine, such as an axial piston pump; hydraulic setting means including cylinder means, piston means connected with the regulating means, and forming in the cylinder means first and second chambers, spring means being located at least in the first chamber; and control means for supplying regulating fluid at a predetermined pressure to the second chamber, and at an adjusted reduced pressure to the first chamber. In this manner, the piston is moved to reduce the volume of the first chamber and resumes a balanced position due to the increasing resistance of the spring means in the first chamber so that the regulating means of the hydraulic machine are set dependent on the reduction of the predetermined pressure by the control means.

In the preferred embodiment of the invention, the control means include a source of regulating fluid having a predetermined pressure and including a supply conduit for supplying a regulating fluid at the predetermined pressure to the second chamber, and regulating valve means having an inlet conduit for receiving regulating fluid at the predetermined pressure, adjusting means operable for reducing the predetermined pressure in the regulating valve means, and an outlet conduit for supplying the regulating fluid at the reduced pressure to the first chamber.

In such an arrangement, the predetermined pressure in the second chamber is opposed by the lesser reduced counterpressure of the fluid in the first chamber.

As a result, the piston assumes a balanced position due to the increasing resistance of the spring means so that the regulating means of the hydraulic machine are set in accordance with the adjustment of the regulating valve means by the adjusting means. Preferably, the inlet conduit of the regulating valve means receives the regulating fluid at the predetermined pressure from the source of regulating fluid, and the adjusting means of the regulating valve means is manually operable.

Preferably, a reversing valve means is provided in the supply conduit of the source of fluid having the predetermined pressure and in the outlet conduit of the regulating valve means so that the first and second chambers can be selectively connected with the outlet or inlet conduits, respectively.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a fragmentary schematic view, partially in section, illustrating a first embodiment of a regulating apparatus according to the invention;

FIG. **2** is a sectional view illustrating on an enlarged scale, a pressure regulating valve used in the embodiment of FIG. **1**;

FIG. **3** is a fragmentary schematic sectional view, partially in section, illustrating a second embodiment of the invention in which the working pressure of the regulated pump influences the regulation to obtain a substantially constant drive torque; and

FIG. **4** is a sectional view illustrating on an enlarged scale, a pressure adjusting valve with working pressure controlled adjusting means.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

An adjustable hydraulic machine **1**, shown to be an axial piston pump with a tiltable swash plate, can be adjusted to different displacement volumes by angular displacement of a regulating means **1***c* which is connected with the piston rod **2***a* carrying a setting piston **2***b* in the cylinder of a setting means **2**. Setting piston **2***b* forms in the cylinder a first chamber **3***a* and a second chamber **3***b* which communicate with conduits **4** and **5**, respectively, and contain springs **12***a* and **12***b* which urge setting piston **2***b* to a neutral position. A reversing valve means **6** is located between conduits **4** and **5**, and the corresponding conduits **7** and **9**, **9***a*. The reversing valve is schematically shown and has two control positions *a* and *c*, and an intermediate position *b*. A source of pressure fluid at a predetermined pressure is provided in the form of a pump **10** in whose outlet conduit **9**, a pressure limiting valve **11** is provided which adjusts the pressure in the supply conduit **9** to an exactly predetermined pressure. When valve **6** is shifted to the position *c*, the outlet conduit **7** of a pressure regulating valve **8** is connected with conduit **4** and the first chamber **3***a*, while the supply conduit **9**, **9***a* is connected with conduit **5** and the second chamber **3***b*. In the intermediate illustrated position, the supply conduit **9**, **9***a* is connected with both conduits **4** and **5** and with both chambers **3***a* and **3***b*. In the second control position *a*, the outlet conduit **7** is connected with conduit **5** and the second chamber **3***b*, while the supply conduit **9**, **9***a* is connected with conduit **4** and the first chamber.

Fluid at a predetermined pressure is supplied through supply conduit **9**, **9***b* to the inlet **9***b* of a regulating valve **8** which is shown in detail in FIG. **2**, and when the adjusting means **8***a*, **115** of the pressure regulating valve **8** are operated, the pressure of the fluid in the outlet conduit **7** is adjusted and reduced as compared with the predetermined pressure provided by the source of pressure fluid **10** through the supply conduit **9**. Regulating valve **8** has an outlet conduit **131** opening into an open discharge reservoir T.

In the control position C of the reversing valve **6**, the chamber **3***b* contains fluid at the predetermined pressure maintained by the pressure limiting valve **11**, and the chamber **3***a* is subjected to a counterpressure which is reduced by operation of the regulating valve **8**. In order to displace the setting piston **2***b* from the intermediate position corresponding to no fluid displacement of the regulated pump **1**, the counterpressure is adjusted by operation of the regulating valve **8** and is less than the predetermined pressure at the source of pressure fluid **10**, **11**, the difference corresponding to the desired displacement of piston **2***b* and the corresponding adjustment of the regulating means **1***c*. Due to the pressure differential between the pressure fluid supplied to chamber **3***b*, and the reduced counterpressure in the chamber **3***a*, setting piston **2***b* is displaced to reduce the volume of chamber **3***a*, while the spring **12***a* is compressed. The resilient resistance of the compressed spring **12***a* grows in accordance with a predetermined function depending on the distance of displacement of piston **2***b*. When due to compression of spring **12***a* the resilient resistance has increased to such an extent that it corresponds to the pressure differential of the pressure fluids on opposite sides of the piston **2***b*,

piston 2*b* is in a new position corresponding to angular displacement of the regulating means 1*c*, and to a corresponding displacement volume of the regulated pump 1. As noted above, in the intermediate position *b*, the same pressure prevails in the chambers 3*a* and 3*b* so that piston 2*b* is held in a central position by the springs 12*a* and 12*b*, and the regulating means 1*c* is a neutral position in which no fluid is displaced by the regulated pump 1.

When the reversing valve 6 is shifted to the position *a*, chamber 3*a* is connected with the supply conduit 9, 9*a* and filled with a pressure fluid from the source 10, 11 at a predetermined pressure, while chamber 3*b* is connected with the counterpressure conduit 7. Consequently, setting piston 2*b* reduces chamber 3*b* in which lesser pressure prevails due to adjustment of the pressure regulating valve 8, and the piston is balanced in a position in which the resilient resistance of the compressed spring 12*b* counteracts the displacement of the piston 2*b* to the right as viewed in FIG. 1. In the balanced piston position the spring force compensates the pressure differential between the fluid at the predetermined pressure, and the fluid at the counterpressure adjusted by operation of the adjusting means 8*a* of the regulating valve 8. The displacement and positioning of the setting piston 2*b* is not effected by a variation of the pressure of the supply pump 10, as in the prior art, but exclusively by a variation of the counterpressure which is obtained by adjustment of the pressure regulating valve 8. Since the pressure of the supply pump 10 is maintained constant by the pressure limiting valve 11, the same supply pump 10 can be used for a great number of other hydraulic devices without mutual interference, which occurs when the pressure of the supply pump 10 is varied for one particular apparatus, in accordance with the prior art.

A preferred embodiment of the pressure regulating valve 8 is shown in FIG. 2. A housing 100 has a longitudinal bore 101 in which a valve slide 102 is guided. Valve slide 102 has an annular flange 103 which separates two spaces 104 and 105. Space 104 is connected by housing bores 106, 107 and 108 with the supply conduit 9, 9*b*. The pressure in the space 105 is determined by the resilient force of a regulating spring 113 which biasses the valve slide 102 toward the space 104.

The adjustment of the regulating spring 113 is carried out by means of a follower arrangement including the valve slide 102, and the adjusting means 115 which is located in the axial bore 114.

When the adjusting means 115 is moved in the direction of the arrow 137, the annular space 116, which is connected by bore 108 and conduit 9*b*, 9 with the supply pump 10, is connected with the annular space 133 which is connected by the bore 112 with the conduit 7 which is connected with the reversing valve 6, specifically by the radial bores 117 and 135 in the valve slide 102, and by the annular recess 135 in the stem of the adjusting means 115. Due to this connection, the predetermined pressure of the supply pump 10 fills the spaces 104 and 105 which are bounded by the annular flange 103 of the valve slide 102. Thereby, the valve slide 2 is pressure balanced, so that only the force of the regulating spring 113 acts on the balanced valve slide 102.

The regulating spring 113, which is a compression spring has one end 113*a* abutting the wall 136 and another end 113*b* abutting the spring plate 123 which abuts on the nut 122 of the threaded bolt 120 which is connected by a transverse pin 121 with the valve slide 102, so that valve slide 102 is biassed and displaced by the regulating spring 113 in the direction of the arrow 137. The valve slide 102 is displaced so far in the direction of the arrow 137, until the connection between the radial bores 117 and the recess 135 on the stem of the adjusting means 115 is interrupted by the control edge 124, and the connection between the radial bores 117 and the recess 125, is obtained. Recess 125 is connected by transverse bores 126 and the longitudinal bore 127 in adjusting means 15 with a space 128, and by the longitudinal bore 129 and the transverse bores 130, the spring space 132, and the housing bore 131 with the discharge reservoir T. When the control edge 138 of adjusting means 115 passes over the radial bores 117 of the valve slide 102, the connection between radial bores 117 and the recess 125 is obtained to such an extent that in space 105 a pressure develops, whose force, acting on the surface 103*b* together with the force of the regulating spring 113, corresponds to the force produced by the constant pressure in space 104 and acting on the surface 103*a*. Since the pressure in space 104 is constant, a displacement of the valve slide 102 in housing 100 causes a variation of the pressure in space 105, depending on the position of the valve slide 102 in housing 100 due to the varying force of the regulating spring 113, the adjusted pressure being the counterpressure of the setting means 2. The farther the adjusting means 115 is displaced in the direction of the arrow 137, together with the following valve slide 102, the more untensioned is the regulating spring 113, and the higher is the pressure in space 105 which constitutes the counterpressure for the setting means 2.

When the adjusting means 115 is displaced in the opposite direction, the radial bores 117 are freed by the control edge 138 of the adjusting means 115 so that the radial bores 117 are connected with the recess 125 which communicates with the discharge outlet 131. Due to the drop of the pressure in the space 105, the constant pressure in space 104 displaces valve slide 102 opposite to the direction of the arrow 137 until the radial bores 117 are again located in the region of the control edges 135 and 124 of the adjusting means 115, and a pressure develops in space 105 which exerts a force on the surface 103*b*, and together with the force of the regulating spring 113, which acts in the same direction, again balances the force acting on the surface 103*a* due to the pressure prevailing in space 104 and acting on the surface 103*a*. Since a displacement of the valve slide 102 opposite to the direction of the arrow 137 increases the force of the regulating spring 113, the pressure in space 105, which corresponds to the counterpressure in the respective chamber of the setting means 2, is reduced to the same extent, acting on the surface 103*b* in the direction of the force of the regulating spring 113.

In the embodiment of FIG. 3, the adjustment of the pressure regulating valve 8′ is carried out under the control of the working pressure of the regulated pump 1 which is supplied to the regulating valve 8′ by a conduit 20 which is connected with an inlet and outlet 1*a*, 1*b* of the regulated pump 1 by a change over check valve 139. The change over valve 139 effects a connection of the conduit 20 with the conduit 1*a* or 1*b* in which the higher working pressure prevails, assuming

that the regulated pump 1 can be operated in opposite directions of rotation. The hydraulic setting means 2 is constructed as described above, and has a piston 2*b* with a piston rod 2*a* connected with the valve slide of a servo valve 21*b* which has three positions. Servo valve 21*b* is a part of a hydraulic amplifier. When the setting piston 2*b* is in the neutral position, the servo valve slide 24 is also in the neutral position illustrated in FIG. 3. The hydraulic amplifier further includes a cylinder 20*a* with a piston 23 whose piston rod 23*a* is connected with the regulating means 1*c* of the regulated pump 1. The hydraulic amplifier further includes an auxiliary pump 21*c* supplying fluid whose pressure is regulated by the limiting valve 21*d*, to the servo valve 21*b*. Another conduit 25 connects the servo valve 21*b* with one end of the cylinder 21*a*.

The chambers 3*a* and 3*b* are connected by conduits 7 and 9*a*, in which a reversing valve 6 is provided, with the regulating valve 8′ which includes operating means comprising, as best seen in FIG. 4, the conduit 20, a pressure chamber 140, and a movable piston 141 acting on the end of the adjusting means 115 for displacing the same in accordance with the maximum working pressure prevailing in the conduits 1*a* and 1*b* of the regulated pump 1. A combined throttle and check valve 22*a*, 22*b* is provided in the reduced pressure conduit 7, check valve 22*a* opening toward the reversing valve 6 and the setting means 2. In the opposite direction, toward the regulating valve 8′, the check valve 22*a* closes so that the pressure fluid flows through the adjustable throttle 22*b* and causes a damping of the setting movement of the setting piston 2*b*. In this embodiment, the limiting valve 11 is provided with manual adjusting means 11*a* which permit the operator of the machine to set the pressure in the supply conduit 9 to a predetermined selected pressure so that independently of the counterpressure produced in the cylinder of the setting means 2, a regulating by means of the predetermined pressure of the supply pump 10 can be carried out.

Depending on the position of the setting piston 2*b*, obtained by adjustment of the regulating valve 8′, and by operation of the reversing valve 6, the servo valve slide 24 is displaced to connect the auxiliary pump 21*c* with the cylinder 21*a*, or with the discharge outlet and reservoir T. Pressure entering through conduit 25 into cylinder 21*a* will displace piston 23 to the left together with piston rod 23*a* so that the regulating means 1*c* is adjusted while fluid is discharged from the left chamber in cylinder 21*a* into the reservoir T. When the movement of the setting piston 2*b* is reversed and the chamber 3*b* is reduced in volume, servo valve slide 24 is displaced in the opposite direction, and the right hand chamber in cylinder 21*a* is relieved of pressure and connected with the reservoir T so that piston rod 23*a* is displaced by the spring acting on the regulating means 1*c*, and the latter assume another position for varying the volume displaced by pump 1. The regulating valve 8′ is best seen in FIG. 4. As compared with the regulating valve 8 of FIG. 3, the regulating valve 8′ has additionally the piston element 141 acting on the adjusting means 115 and being subjected to the working pressure of the regulated pump 1 in the chamber 140. Furthermore, a spring means 143, acting oppositely to the piston 141 on the spring plate 142 of the adjusting means 15, is provided. The spring means 143 has a resilient force following a hyperbolic function, and the greater the working pressure of the regulating pump 1, supplied through conduit 20, the greater is the displacement of the adjusting means in the direction of the arrow 137, and vice versa. At the same time, the counterpressure in the space 105 rises, and therewith also the pressure in the counterpressure conduit 7, so that the regulating means 1*c* of the regulated pump 1 move toward the neutral position.

The stop screw 145 in the housing end wall, limits the displacement of the valve slide 102 in the direction of the arrow 137, so that during a further rise of the working pressure, and the consequent displacement of the adjusting means 15 in the direction of the arrow, the control edge 124 opens the flow to the radial bores 117, without permitting the valve slide 102 to follow up. Since in this manner the counterpressure reaches the height of the regulating pressure, pressure equalization takes substantially place at the setting piston 2*b*, so that piston 2*b* moves toward its neutral central position determined by the springs in chambers 3*a* and 3*b*, so that the regulating means 1*c* of the regulated pump are adjusted to a displaced volume which is required for maintaining the limit of the working pressure at which the regulation takes place.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of regulating apparatus for hydraulic machines differing from the types described above.

While the invention has been illustrated and described as embodied in a regulating apparatus, for a pump whose displacement volume is adjustable, having a source of pressure fluid whose pressure is maintained constant, while a required counterpressure is obtained by a regulating valve, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

I claim:

1. Regulating apparatus for a hydraulic machine, comprising, in combination, regulating means for adjusting the displacement volume of a hydraulic machine; hydraulic setting means including cylinder means, piston means movable in said cylinder means and connected with said regulating means for operating said regulating means, said piston means forming in said cylinder means first and second chambers on opposite sides thereof, and spring means located at least in said first chamber; and control means for supplying regulated fluid at a predetermined pressure to said second chamber, and at an adjusted reduced pressure to said first chamber, said control means including a source of regulating fluid having a predetermined pressure, including a supply conduit for supplying said regulating fluid at said predetermined pressure to said second chamber, and regulating valve means having an

inlet conduit for receiving regulating fluid at said predetermined pressure, adjusting means operable for reducing said predetermined pressure of said regulating fluid in said regulating valve means, and an outlet conduit for supplying said regulating fluid at the reduced pressure to said first chamber so that said predetermined pressure in said second chamber is opposed by the lesser reduced counter pressure of the fluid in said first chamber and by said spring means whereby the piston means is moved to reduce said first chamber, and assumes a balanced position due to the increasing resistance of said spring means so that said regulating means of said hydraulic machine are set in accordance with the adjustment of said regulating valve means by said adjusting means.

2. Regulating apparatus as claimed in claim **1** including an other spring means in said second chamber; wherein said control means further include reversing valve means in said supply conduit of said source and in said outlet conduit of said regulating valve means and having a first control position for connecting said supply and outlet conduits with said second and first chambers, respectively, and a second control position for connecting said supply conduit with the first chamber and said outlet conduit with said second chamber, respectively.

3. Regulating apparatus as claimed in claim **1** comprising hydraulic force amplifier means connecting said piston means with said regulating means of said hydraulic machine, and including a separate source of pressure fluid and a low pressure discharge conduit.

4. Regulating apparatus as claimed in claim **1** wherein said inlet conduit of said regulating valve means receives said regulating fluid at said predetermined pressure from said source of regulating fluid.

5. Regulating apparatus as claimed in claim **4** wherein said adjusting means of said regulating valve means is manually operable.

6. Regulating apparatus as claimed in claim **1** comprising operating means responsive to the working pressure in said hydraulic machine and connected with said adjusting means of said regulating valve means for reducing said predetermined pressure depending on said working pressure of said hydraulic machine so that when working pressure rises, said reduced counterpressure also rises, and when said working pressure drops, said reduced counterpressure also drops.

7. Regulating apparatus as claimed in claim **6** comprising a combined throttle and check valve in said outlet conduit of said regulating valve means opening only toward said cylinder means of said hydraulic setting means.

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