This invention relates to improvements in control mechanism for hydraulic transmissions and pumps and has for an object to provide improved means for regulating such devices, particularly to prevent overloading.

Another object is to provide pressure regulated means for this purpose in combination with manual setting means.

Another object is to provide such means for hydraulic transmissions in which either the pump member is controlled or the motor member or both.

Other objects will become apparent from the following description taken in connection with the drawing which shows an illustrative embodiment thereof.

In said drawing:

Fig. 1 illustrates more or less schematically a hydraulic transmission;

Fig. 2 represents a modified control means thereof; and

Fig. 3 shows still another modified form of the invention.

In said drawing, P represents generally a variable volume pump of any suitable construction such as the one shown in United States patent to Hans Thoma No. 1,931,969, granted October 24, 1933, although the invention may be used with any other pump having provision for varying its volume.

M represents generally a hydraulic motor of the variable volume type and may be of the same construction as pump P. However, for certain uses of the invention the member M may be any device utilizing fluid in its operation.

Numeral 11 indicates any prime mover, such as an electromotor connected for driving the shaft 12 of the pump, which pump has a body member 13 and, if a pump of the type shown in Thoma Patent No. 1,931,969 is employed, is provided with an oscillatable member 14 which may correspond to the member 2 of said patent.

In the form shown in the drawing, it is assumed that the volume of the pump is decreased when the member 14 is swung downwardly toward the axis of shaft 12 and is increased when swung upwardly. 15 and 16 designate conduits connecting the pump with the motor member which, if it is of the same type as shown in said Thoma patent, has a body member 13', a power delivery shaft 12', and an oscillatable member 14'.

Fig. 1 shows automatic control means for the motor M but it is understood that this may be dispensed with and the volume of the motor be set for a constant amount or that even a constant volume motor be employed, such as a vane or gear motor or a cylinder and piston. Similarly, the pump volume may be kept constant and the motor volume manually and automatically controlled, or, if desired, both may be manually or automatically controlled, as shown in Fig. 1.

The control for the pump will now be described. The member 16 is shown as provided with an extension 17 to which is pivotally attached a rod 18 connected with a hand lever 19 which is pivoted to any suitable abutment 20 and is preferably provided with adjustable holding means such as a toothed segment 21 with which cooperates a latch member 22 which may be manually released by the button 23 extending from the end of the handle 24. Rod 18 is connected to lever 19 by any suitable means providing for at least one way spring biased relative movement. This may be accomplished by attaching a disk or other spring abutment 25 to the end of rod 18 within a cylindrical chamber 26 within which is located the spring 27. The top of the chamber may be closed with a lid 26 which serves as an abutment or stop for the operating connections, as the rod 18 and the disk 25, said lid being provided with a suitable bracket 28 for pivotal connection with the lever 19. It will be noted that such a mechanism provides for a manual adjustment of the member 14 which, in the form shown, is positive in the down (volume reducing) direction but which permits of downward movement of member 14 upon the application of a force sufficiently large to compress spring 27.

In the construction shown, means is provided for applying a downward force (in the volume reducing direction) under control of pressure in conduit 15, or the difference in pressure in the two conduits 15 and 16. This may be accomplished by providing a cylinder 30 having a piston 31 carried by a piston rod 32 pivotally connected in the slot 44 of the extension 17. Spring 33 biases the piston 31 upwardly so that in the absence of pressure above the piston which space communicates with the conduit 15 through tube 34, the piston and extension 17 and member 14 are held upwardly to the maximum volume position determined by the setting of lever 19. It will be noted however, that if a predetermined pressure in conduit 15 is exceeded, as by increase of load on the motor M, the piston 31 will be forced downwardly against the action of springs 34 and 44 and thus move the extension 17 and member 14 downwardly. This movement results in a reduction of volume and therefore in a reduction of the work performed by pump P and consequently a reduction in power input. By properly proportioning the effective area of piston 31, and the strength of springs 34 and 37, the means described will serve to automatically limit the input of the prime mover, under a maximum predetermined by the manual setting means. Since springs 27 and 33 act jointly, one of them may be omitted. If desired, the tension

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of the spring 33 may be made adjustable by providing an adjustable abutment therefor, as the disk 33a and setting screw 33b. Instead of a cylinder and piston any other expandable member, such as a metal bellows or the like, could, of course, be employed.

It will also be seen that as soon as the load on motor M is reduced and the pressure in conduit 15 therefore drops, the springs 33 and 27 will cause the pump volume to be increased.

If desired, a conduit 35 may be provided connecting the cylinder 30 with the conduit 16, in which event, the control means will be responsive to differences in pressure in the two conduits.

The conduit 35 may however be omitted and the space below the piston 31 vented to the atmosphere, in which case the control device will be actuated in accordance with gauge pressure in conduit 16.

The means described therefore provide a combined manual and automatic means for controlling the output of a pump. It is immaterial how the fluid delivery of the pump is employed whether in a motor device such as shown in Fig. 1, a motor cylinder and piston for operating planers, shapers or other tools, or whether the pump delivery is merely to a storage tank or accumulator.

If the fluid receiving member is a motor of variable volume type as shown, it may also (or in the alternative) be desirable to provide the motor with a combined manual and automatic volume varying means. One way to accomplish this is to provide a cylinder 30 containing a piston 31 and having a piston rod 32 connected in the slot 44 of the extension 17 of the oscillatable volume varying device 14 of motor M. Above said piston, a spring 33 is shown. The space below the piston is shown as being connected with the pressure conduit 15 by means of a conduit 35.

If desired, the space above the piston may be connected to the low pressure conduit 16 by means of a conduit 35 although, if desired, this space may simply be vented to the atmosphere.

A spring 21 is shown as being arranged to apply a force to the member 14 in a downward direction. The extension 17 may also be provided with a pin 17′ received in a slot 43 in a rod 18′ connected to the lever 19′. It will be seen therefore that in the absence of pressure in conduit 15 the member 14 will be drawn toward its central (reduced volume) position by means of springs 21 and 33 so that its position is determined by the setting of lever 19′. Since springs 21′ and 33′ act together, one of them may, of course, be omitted.

Assuming the parts to be in the position shown and the motor shaft 12′ delivering a certain torque and that as a result of the application of increased resistance to shaft 12′, the pressure in conduit 15 should rise unduly, the piston 31′ will be moved upwardly and, against the action of springs 33′ and 27′, move the member 14′ upwardly, thus increasing the volume of the motor M whereby the required additional torque can be applied to the shaft 12′ (at lower speed), causing the pressure in conduit 15 to be lower and thus reducing the power input.

It will be noted that in the construction described above, pressure responsive means are provided which upon the occurrence of pressure rise beyond a predetermined point cause the volume of the pump to be decreased and also increase the volume of the motor. Either of these devices may be used alone to secure the desired effect or they may be used together.

If desired, a single means may be provided to cause the pump volume to be decreased at the same time that the motor volume is increased, and vice versa. This could be easily accomplished as shown in Fig. 2 by connecting the arm 17′ with the arm 17′ by any suitable means such as a beam 45 pivoted between its ends to an abutment 46 and suitably connected at its ends by the links 41 and 47′ to the ends of arms 17′ and 17′ respectively. In such an arrangement, of course, only one of the pressure responsive actuating devices would be needed.

With the construction shown in Fig. 1, the reduction of the pressure in cylinder 30 will affect, as case of operation of lever 19. In order to avoid this objection the construction shown in Fig. 3 may be used. Instead of the relatively long extension 17′ a shorter extension 17 may be employed to which is shown connected a link 40 pivoted intermediate its ends to a beam 41, one end of which is connected as by link 42 to the hand lever 19 whereas the other end thereof is pivoted to the connecting rod 32. With this construction the adjustment of lever 19 serves to adjust the fulcrum of lever 41 so that the maximum volume of the pump may be manually varied, while the volume may be automatically reduced below said maximum by the pressure responsive means described. In Fig. 3, M indicates any means for utilizing the fluid pumped by E. A similar arrangement can, of course, also be utilized in connection with the motor control means if a variable volume motor is used such as the one illustrated in Fig. 1.

The invention is not intended to be limited to the three forms shown, which are to be understood as illustrative only and not as limiting, as various changes in construction and arrangement may be made, all coming within the scope of the claims which follow.

1 claim:

1. In a hydraulic transmission system including a variable volume pump, a variable volume motor and connecting conduits therebetween, volume varying controlling means for said pump and said motor, and means responsive to the pressure in said conduits for respectively inversely and simultaneously varying the volume of said pump and of said motor, said last means including a beam pivotally mounted for oscillation about a fixed axis, and links pivotally mounted near each end of the said beam and respectively pivotally interconnected with the control means on said pump and motor.

2. In a hydraulic transmission system including a variable volume pump, a variable volume motor, and connecting conduits, volume varying controlling means for said pump and said motor, and means responsive to the pressure in one of said conduits for respectively inversely and simultaneously varying the volume of said pump and said motor, said last means including a beam pivotally mounted for oscillation about a fixed axis, and links pivotally mounted near each end of the said beam and respectively pivotally interconnected with the control means on said pump and motor.

HANS THOMA.