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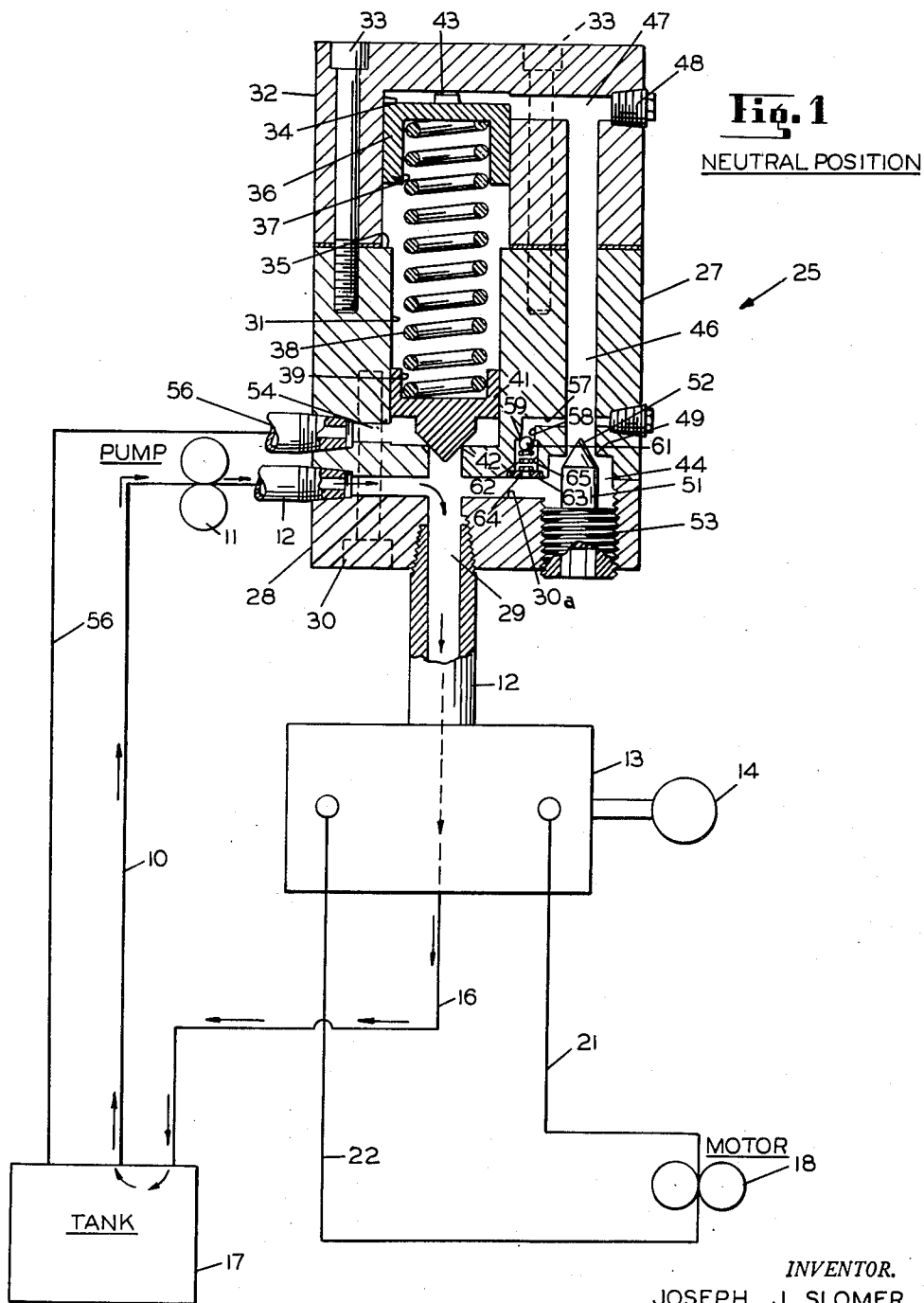
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FEED CONTROL FOR HYDRAULIC MOTORS

Filed July 24, 1952

3 Sheets-Sheet 1



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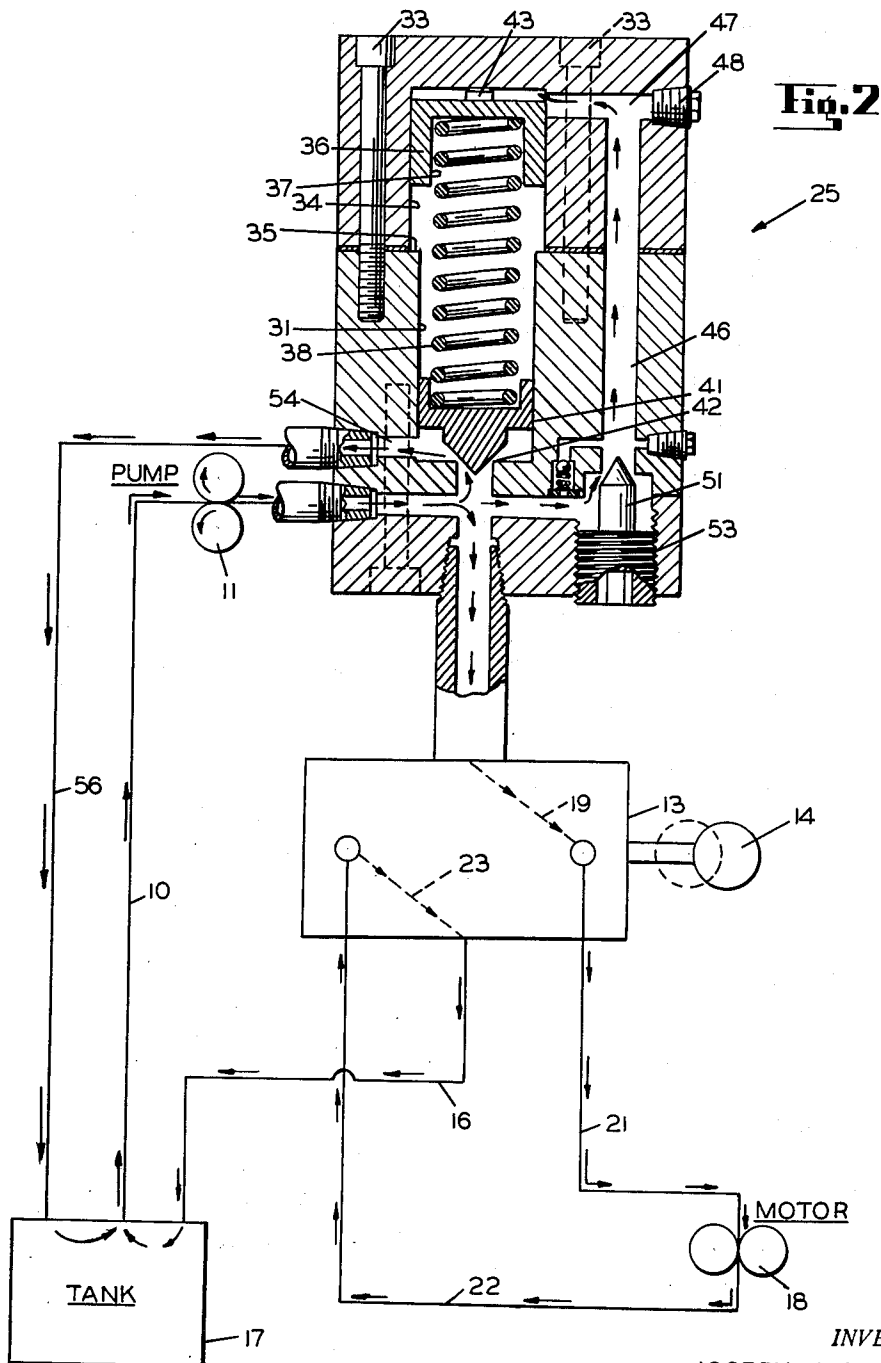
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3 Sheets-Sheet 2



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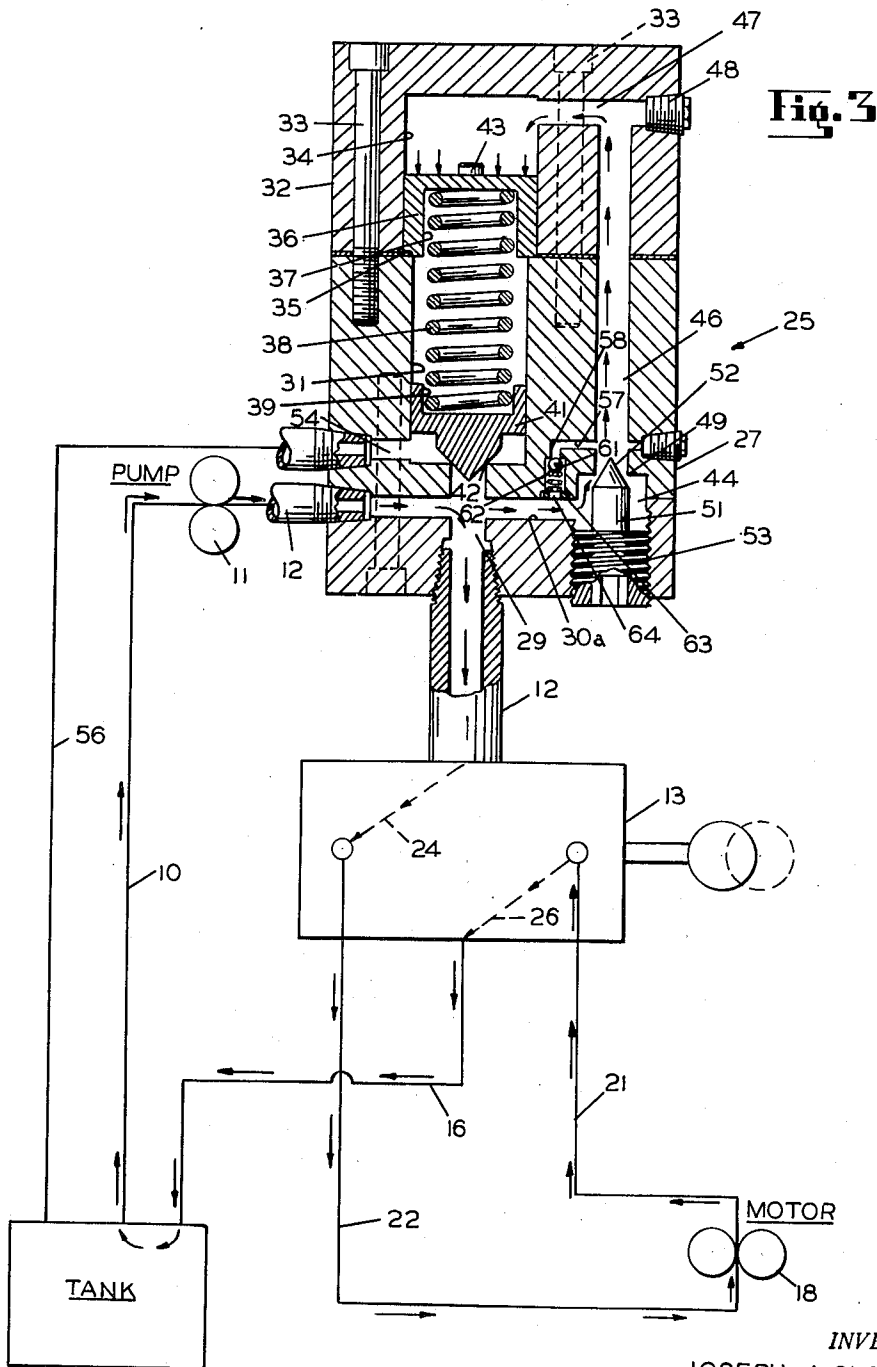
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FEED CONTROL FOR HYDRAULIC MOTORS

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5 Claims. (Cl. 60—52)

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The invention relates generally to fluid pressure systems and more particularly to devices for lessening the shock load on the motive power in hydraulic systems, as may be occasioned by operation of valves controlling hydraulically operated motors connected in the system.

Hydraulic pressure systems are oftentimes arranged so that the pump supplying pressure fluid operates against substantially no back pressure, control valves of such systems being arranged to spill pumped fluid to tank when in the neutral position. Such valves and such systems therefore impose against the pump only the limited back pressures which are functional of the head losses in the system for a pump of a particular capacity.

Such valves are generally operated from the neutral position described to positions affording full flow of pressure fluid to cylinders or motors controlled by the valve. The inertia of the moving parts of these cylinders or motors, be they load connected pistons or load connected moving vanes creates sudden surges of pressure fluid within the system resulting sometimes in bursting lines or unwanted hammer and shock to the system.

Since the operators are accustomed to actuate the valves from the neutral to the operating positions described rather quickly, the full flow of pressure fluid sometimes operates the associated cylinders or motors in an uncontrolled fashion rather than with a smooth application of the hydraulic fluid.

According to the present invention smooth application of hydraulic pressure fluid to the hydraulic motors or cylinders connected to the hydraulic pump is made possible, an hydraulic motor feed control device being interposed between the hydraulic pump and the control valve for the hydraulic motor, the hydraulic motor feed control being capable of preventing hydraulic hammer and providing for a desired increase in speed of operation of such motor from the start position at rest to the normal speed of operation. The control device is readily adjusted by a metering attachment to vary the application of hydraulic fluid at full pressure, so as to vary the increase in speed of the motor as desired.

It is a principal object of this invention to provide in a hydraulic pressure system an hydraulic motor feed control for regulating the hydraulic pressure fluid to a fluid motor, in such a fashion as to achieve automatic increase in speed of such motor and at the same time prevent excessive hydraulic hammer.

Other objects and important features of the

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invention will be apparent from a study of the description following taken with the drawings which together illustrate a preferred embodiment of the invention and what is now considered to be the best mode of practicing the principles thereof. Other embodiments will be suggested to those having the benefit of the teachings herein, and it is therefore intended that the invention not be limited by the precise embodiment herein shown, the invention being intended to be limited only by the scope of the claims subjoined.

The drawings illustrate a feed control for a hydraulic pressure system, and the separate views illustrate the operations obtaining within such a feed control upon actuation of a control valve connected in the hydraulic pressure system and controlling the operation of an hydraulic motor.

In the drawings:

Fig. 1 shows an hydraulic pressure system having embodied therein a feed control, and showing a control valve for a fluid motor connected in the system, the control valve being shown in neutral position;

Fig. 2 shows the hydraulic system of Fig. 1 but with the condition obtaining within the feed control upon sudden actuation of the control valve; and

Fig. 3 shows the condition obtaining in the feed control after the fluid motor has been brought up to proper speed and the full working pressure is made available for operation thereof.

Referring now to the drawings, the present invention is shown as embodied in an hydraulic pressure system comprising a pump 11 connected by a line 10 to a tank or reservoir 17 and delivering by means of a conduit 12 fluid under pressure to a control valve 13. The control valve 13 is of the substantially no back pressure type and has an operating handle 14, which when in the neutral position shown causes hydraulic pressure fluid to pass by means of fluid line 16 to the tank or reservoir 17 for hydraulic fluid.

The control valve 13 is actuated by the control handle 14 until the control handle 14 occupies the dotted line position seen in Fig. 2, in which position an hydraulic motor 18 is caused to operate in one direction, the supply of pressure fluid for such operation being by way of a passage 19 within the valve 13 and a pressure line 21 exterior of the valve 13. The spent fluid for operation of the motor 18 returns to tank 17 by means of a line 22, a passage 23 within the valve 13, and thence by way of the tank line 16 to the tank 17.

The motor 18 is reversible and the control valve 13 is also adapted to be actuated to a second posi-

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tion to control the flow of hydraulic fluid for such reversal. As seen in Fig. 3, the operating handle 14 is shiftable in an opposite direction to the dotted line position shown, in which position the pressure line 12 is connected to a pressure passageway 24 within the valve 13, which passageway 24 in this position of the valve 13 is connected to the line 22 to the motor 18, to drive same in the reverse direction. Spent fluid from the motor 18 passes by way of line 21 through a passageway 26 within the valve 13 to the line 16 and thence to the tank 17.

The precise form of the control valve 13 forms no part of the present invention, and other forms of control valves which in the neutral or off position afford no substantial back pressure to the pump 11 may be substituted for the form shown herein.

The precise form of the motor 18 likewise forms no part of the present invention, and instead of a vane type motor as shown a piston and cylinder may instead be employed. However, a vane type motor is especially suitable for use with the feed control of the present invention since the speed thereof varies widely.

Irrespective of the operation of the control valve 13 and the motor 18 controlled thereby hydraulic pressure fluid is made available for operation of the motor in such a manner as to start same smoothly and automatically increase the speed thereof, at the same time eliminating hydraulic hammer. To this end a hydraulic motor feed control indicated generally by the reference numeral 25 is connected in the pressure line 12 between the pump 11 and the control valve 13. It comprises a body 27 and an end cap 28 joined thereto by socket head screws 39 threaded into the body 27. A passageway 30a is routed in the end cap 28 and communicates with the portion of the pressure line 12 leading from the pump 11. A passageway 29 intersects the passageway 30a and communicates with that portion of the pressure line 12 connected to the control valve 13.

The passageway 29 also connects with a bore 31 coaxial therewith. An end cap 32 is held to the body 27 by socket head screws 33 and has a bore 34 therein which is coaxial with the bore 31. A cup shaped piston 36 is slidable within the bore 34 and retains resilient means, namely, a spring 38, within a cup 37 thereof. The piston bore 34 is of larger diameter than bore 31 thus affording a shoulder 35 limiting the movement of the piston 36. The other end of spring 38 is retained in a recess 39 on one side of a piston and needle valve member 41 adapted to seat on a seat 42 formed by the juncture of passageway 29 and bore 31.

The spring 38 is normally extended as seen in Fig. 1 when the control valve is in the neutral position, and the piston 36 is urged by spring 38 against the end cap 32, a stop 43 on the piston head maintaining the piston spaced a slight amount from the end cap 32.

The passageway 30a extends within the end cap 28 to a throttling chamber 44 bored therein. A passageway 46 extends from the throttling chamber 44 on the axis thereof and intersects a passageway 47 in the end cap 32, which passageway 47 leads to the piston bore 34 above the cup-shaped piston 36. A pipe plug 48 closes the passageway 47 where it intersects the end cap 32.

The juncture of the throttling chamber 44 and the passageway 46 provides a seat 49, and a throttling needle valve 51 has a tapered face 52 which

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is adjusted in its spacing from the seat 49 by being threaded, as at 53, towards or away from the seat 49.

A passageway 54 within the body 27 communicates with the bore 31 near the juncture of the bore 31 with the passageway 29, and in turn communicates with the tank 17 by a line 56.

The two passageways 29 and 46 are arranged to be additionally connected so that pressure fluid may, under conditions as will be described as this specification proceeds, flow from passageway 46 to passageway 30a. To this end a passage 57 extends from passageway 46 and is intersected by a passage 58. Said passage is counterbored at 65 to provide a seat 59 for a ball check valve 61 urged against the seat 59 by a spring 62 which is held in position by a nut 63 threaded into the counterbore 65. The nut has openings 64 therein to provide for passage of fluid therethrough.

When the system herein is in the neutral position of the control valve 13 as shown in Fig. 1, the pump 11 will pass hydraulic fluid through the control valve 13 at substantially no back pressure, the fluid returning to tank 17 by way of the line 16. Under such condition of the control valve 13, the force of spring 38 maintains piston and needle valve 41 against seat 42 blocking the passageway 54. Whatever back pressure is against pump 11 under this condition of the control valve 13 is also manifested past the throttling valve 51 in the passageway 46 and in the bore 34 behind the piston 36, such back pressure against piston 36, however, being less than the load of the spring 38, thus maintaining the spring 38 in the extended position shown.

Consider the situation obtaining when the control valve 13 is suddenly actuated to the dotted line position seen in Fig. 2. Under such condition the full pressure of the pump 11 is made available to the motor 18, and since the motor 18 has inherent resistance to being operated, a sudden rise in pressure would ordinarily obtain in all of the pressure lines to the motor 18. Such sudden rise would ordinarily create hydraulic hammer and shock when the motor 18 is commenced to be operated, unless the application of the working pressure fluid thereto is controlled in accordance with the principles outlined above.

However, the back pressure in the passageway 29 when the control valve 13 is suddenly operated is effective against the needle valve 41 to raise same from its seat 42, thereby relieving some of the pressure by way of the return line 56 to tank 17. The same back pressure is effective past the throttling member 51 and in the passageways 46 and 47 against the piston 36, gradually to force same against the shoulder 35, during which movement the spring 38 will be compressed. When the pressure behind the piston 36 has increased to a value to close needle valve 41 upon its seat 42, the passageway 54 to tank 17 will be blocked, thus making full pressure from pump 11 available to drive the motor 18, as seen more clearly in Fig. 3. Meanwhile, the motor 18 will have attained operating speed, having moved from rest through successive increases of speed gradually and in a controlled manner.

Fig. 3 also shows the control valve 13 actuated to a position for reversal of the motor 18. The same operation of the feed control 25 also obtains in effecting such reversal of the motor 18, the system being characterized by freedom from hydraulic hammer, and the motor 18 being controllably supplied with pressure fluid as before.

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When the valve 13 is returned to neutral position, the release of pressure from behind the piston 36 will cause the piston 36 and the needle valve 41 to resume the position as seen in Fig. 1, which position will be maintained until the valve 13 is again actuated.

When the control valve 13 is moved to the neutral position shown in Fig. 1, it is desirable, of course, to enable the spring 38 to resume its elongated position seen in Fig. 1, so that there will be no residual load therein preventing the needle valve 41 from moving from its seat 42. The flow of fluid in the passageway 45 is then made substantially unrestricted when the piston 36 returns to the position seen in Fig. 1, the fluid moving past the ball check valve 61, instead of the restricting throttling valve 51, and to the passageway 30a which is connected to tank.

From the foregoing description it will be apparent that there has been provided a novel arrangement for eliminating hydraulic hammer and for controllably supplying pressure fluid to a fluid motor. While the invention has been described in terms of a preferred embodiment thereof, its scope is intended to be defined only by the claims here appended.

I claim:

1. In an hydraulic system having a reservoir, a pump and a motor operated by said pump with a control valve for said motor interposed between said pump and said motor, said control valve being so operable that in a neutral position thereof said pump operates against substantially no back pressure, the combination therewith of a feed control for said motor interposed between said pump and said control valve comprising a body having a first passageway therein connected to said pump, a second passageway intersecting said first passageway and connected to said control valve, a bore coaxial with said second passageway, said bore having a diameter larger than said first passageway so as to form a valve seat at the juncture of said bores, a piston member slidable in said bore and having a needle valve adapted at times to close on said seat, said piston member and said needle valve being movable in response to increase in pressure occurring upon actuation of said control valve to a position supplying pressure fluid to said motor to relieve part of said pressure to said reservoir, a second piston member with resilient means interposed between said first piston member and said second piston member, a passageway connecting said first passageway so as to make the pressure in said first passageway effective against said second

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piston member, and a throttling member in said last named passageway for controllably regulating the pressure against said second piston member while said motor is being supplied with pressure fluid, said last named piston member and its associated resilient means being operable to move said first piston member to a position where it is no longer relieving said pressure.

2. The invention as defined in claim 1 wherein a passageway is connected to said bore and communicates with said reservoir.

3. The invention as defined in claim 1 wherein said second piston member is positioned within a bore of larger diameter than said first named bore, and wherein a shoulder is formed at the juncture of said bores to limit the movement of said second piston member.

4. The invention as defined in claim 1 wherein the fluid behind said second piston moves past a checkvalve bypassing said throttling member during return movement of said second piston member.

5. In an hydraulic system having a reservoir, a pump and a motor operated by said pump with a control valve for said motor interposed between said pump and said motor, said control valve being so operable that in a neutral position thereof said pump operates against substantially no back pressure, the combination therewith of a feed control for said motor interposed between said pump and said control valve comprising a body having a first passageway therein connected to said pump, a second passageway intersecting said first passageway and connected to said control valve, a piston member movable in response to increase in pressure occurring upon actuation of said control valve to a position supplying pressure fluid to said motor to relieve part of said pressure to said reservoir, a second piston member with resilient means interposed between said first piston member and said second piston member, a passageway connecting said first passageway so as to make the pressure in said first passageway effective against said second piston member, and a throttling member in said last named passageway for controllably regulating the pressure against said second piston member while said motor is being supplied with pressure fluid, said last named piston member and its associated resilient means being operable to move said first piston member to a position where it is no longer relieving said pressure.

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