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Viron

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[54] **HYDRAULIC JACK**

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[51] **Int. Cl.** **F15b 11/18,** F15b 13/07

[58] **Field of Search** ..... 91/438, 439, 437, 436, 91/411 A, 412

[56] **References Cited**

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[57] **ABSTRACT**

Fluid pressure system comprises a piston which is slidably mounted in a cylinder and divides said cylinder into two variable chambers, said chambers being interconnected through a by-pass, and said piston having two main surfaces, each exposed to the pressure in one of said variable chambers, and a third surface exposed to the pressure in a space other than one of said chambers, and means responsive to a predetermined increase in the pressure in said space to connect one of said chambers to a source of fluid pressure, to close said by-pass, and to connect the other of said chambers to exhaust.

9 Claims, 2 Drawing Figures

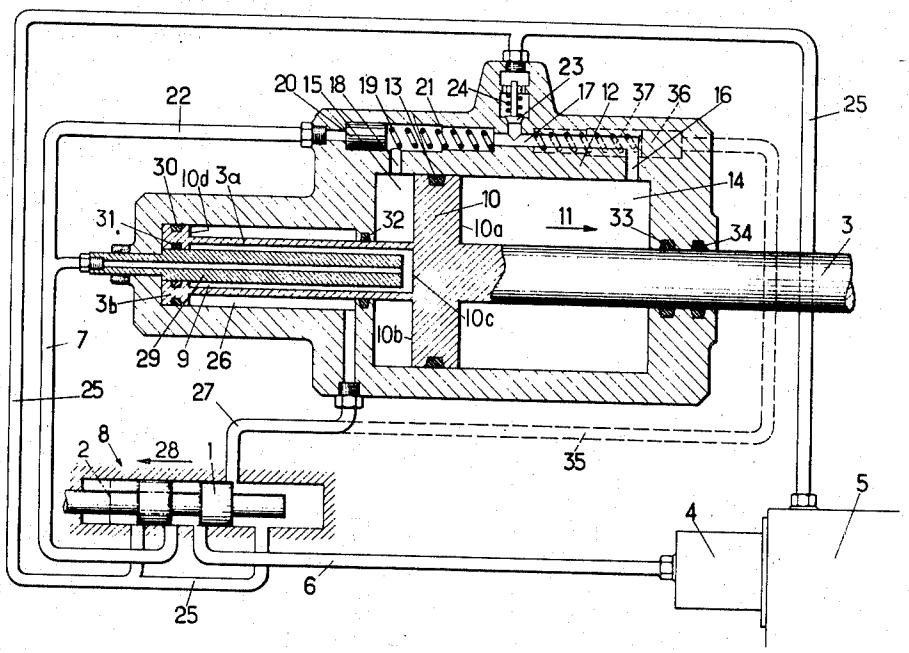

FIG. 1

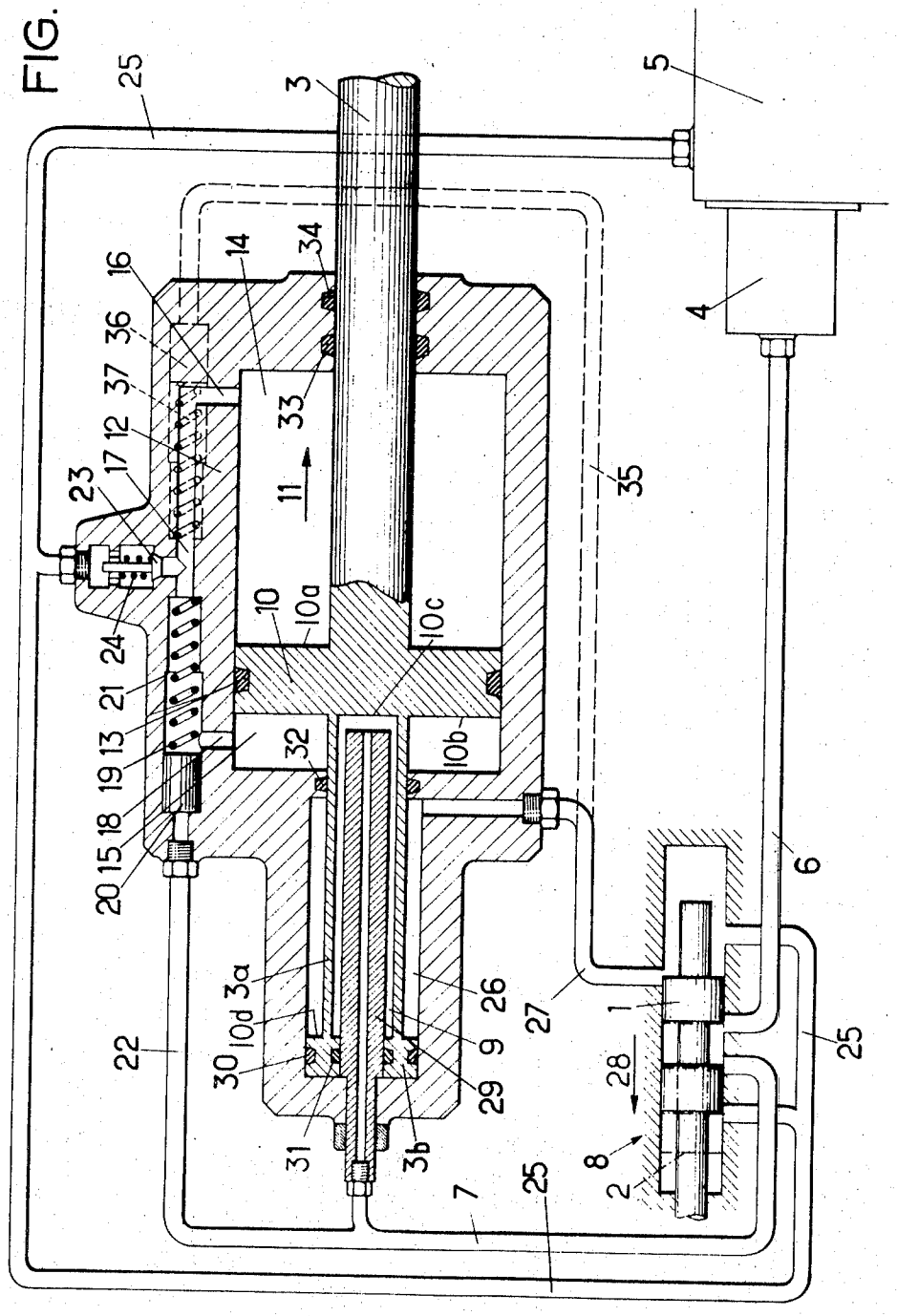
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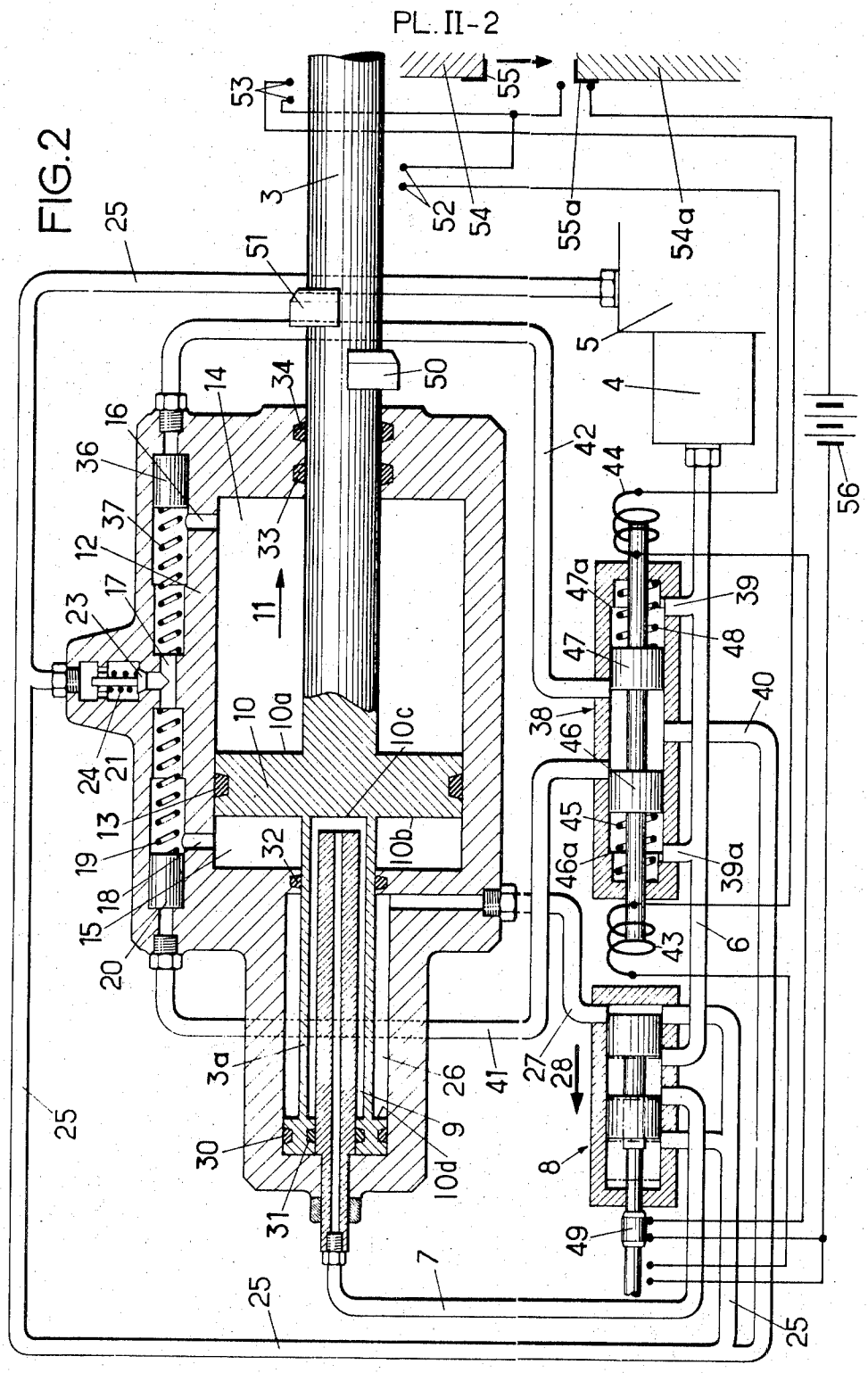
FIG.2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HYDRAULIC JACK

SUMMARY OF THE INVENTION

It is known that the major portion of press piston travel in plastic material molding presses can be obtained by applying much less power to this piston than is required at the end of the stroke of said piston when the latter must overcome the resistance of the product to be molded.

For this reason, it has already been proposed in French Pat. No. 1,583,814, dated Apr. 8, 1968, that pistons be used having a smaller diameter than that of the cylinder barrel in which they move and which, at the end of the compression, fit within a shoulder in one of the end walls of the said cylinder barrel so as to be capable of applying, at the end of the stroke of said piston, increased power to the hydraulic jack rod fixed to this piston, with the major portion of the stroke of the piston being obtained at low power, and with the two compartments on opposite sides of this piston within said cylinder in communication with each other.

One of the main advantages of this system resides in the fact that only a short part of the said cylinder, which cooperates with the perimeter of this piston at the end of the stroke of the piston, needs to be finished, whereas the larger part of this cylinder can remain in the crude foundry state and does not require finishing prior to mounting the said piston.

However, although the advantages consisting of the elimination of a costly finishing step can be of a certain value, it should be noted that the system thus obtained only makes it possible to apply maximum pressure to a piston fixed to such a jack at the end of the stroke of this piston, that is to say at a very specific point.

Now, there are cases in which it is advantageous to provide for the application of maximum pressure at any point in the stroke of said piston, particularly in the case of molding parts of variable volume, when it is advantageous not to have to modify the position of the jack barrel relative to a fixed die in dependence on the value of this volume.

The jack according to this invention also makes it possible to reduce the force to be applied during the major portion of piston travel of the said jack, by bringing the two compartments of the cylinder barrel cooperating with the piston and located on opposite sides of this piston, into temporary communication outside the said cylinder, through a connection which can be terminated at an opportune moment when it is found necessary to increase the force applied to the jack.

In actual fact, this jack is arranged to permit replacement of said temporary connection by a connection between one of the said compartments and the pressurized fluid feed pump of the said jack.

The direct force thus applied to one of the surfaces of the piston of this jack is then added to that obtained by the main actuation pipe of the said jack and the said connection can be effected at will at any predetermined point on the advance or reverse stroke of this jack.

Such a characteristic is valuable, particularly when it is necessary to overcome the resistance of a viscous material being molded, which material must be placed under maximum compression at the end of the molding operation, and when it is necessary to then retract the piston that serves to compress this material despite the adherence due to the viscosity of the latter.

In this case, this additional pressure must be supplied for the same position of the said jack during its advance and reverse strokes.

However, in other cases not relevant to molding, it is frequently desirable that this connection be made at different positions of the said jack during its advance and reverse movements.

In one embodiment of this invention this connection is made automatically as soon as the piston, which has been actuated by the said jack, encounters resistance in one direction or another and, for this reason, comes to a stop.

This first embodiment utilizes a single two-position distributor making it possible to reverse the jack operating direction and, according to the case, the system is equipped with one or two calibrated springs respectively making it possible to make said connection at any point during the advance of the jack and, possibly, at any point on its reverse travel. However, this automatic alternative has the disadvantage of not making it possible to provide a safety system and is only advantageously applicable in the case of injection molds where it is important to increase the force applied on the jack only after having made sure that the mold is previously closed so as to avoid possible damage to a tool that could have accidentally remained between the two parts of such molds and thus prevents their closing.

In a second embodiment of the invention, said connection can be controlled manually, for example by means of two electro-magnets actuating a second three-position distributor, so as to bring it into one or the other of two end positions making it possible to apply additional force on the piston of the said jack either in the direction of its advance or, on the contrary, to reverse its direction.

It goes without saying that, in such an embodiment, it is only possible to install a two-position distributor as a second distributor that is provided solely to create power makeup at a particular point in the advance of the jack.

It is also possible to render these two manual alternatives automatic by supplying the electro-magnet or electro-magnets through half rings mounted on the piston rod fixed to the jack and which can be longitudinally adjusted independently, thereby making it possible to select, at will, the points at which either of the said electro-magnets is to be supplied according to whether the jack is advancing or reversing.

Furthermore, it should be noted that the respective power supply circuits of these jacks must then pass through contacts cooperating with a ring installed on the first distributor so as not to engender the risk of applying to the piston of the said jack, a force that is opposed to the preceding movement of this jack in response to its main supply.

Whatever the position of this distributor, only the electro-magnet tending to provoke supplemental power can be supplied and, reciprocally, in the opposite position of the said first distributor, it is only the other electro-magnet which can be supplied.

Furthermore, a safety contact could be advantageously installed on the power supply section common to these two electro-magnets.

The characteristics of this invention will be better understood on reading the following description of three jack arrangements according to the invention which

are given purely by way of example, and described with reference to the accompanying drawings, on which:

FIG. 1 is a diagramatic longitudinal diametral sectional view of a first automatic jack arrangement according to the invention, not including a safety contact, and adapted to be used:

either with supplemental power applied at a particular point in the advance of the said jack;

or with supplemental power applied during both the advance and reverse movement of this jack;

and FIG. 2 is a diagramatic longitudinal diametral sectional view of an automatic jack in accordance with the invention that can be easily adapted:

either to substitute manual control means;

or to eliminate any possibility that supplemental power may be applied during the reverse movement of the jack.

FIG. 1 shows that, in the position illustrated on the drawing, the piston rod 3 of a molding press is actuated by pressurized fluid supplied by a pump 4 compressing fluid located in a tank 5. This pressurized fluid is supplied through two pipes 6 and 7 coupled together by a distributor 8.

The fluid entering the first space 9 tends to provoke movement of piston rod 3 toward the right of the figure and drive piston 10 associated therewith in the direction of arrow 11 by exerting pressure against the surface 10*c*. Piston 10 having main surfaces 10*a* and 10*b* moves within a cylinder 12 that has been smoothly finished inside and fluid-tightness is assured between the cylinder and piston by the sealing ring 13.

During the first horizontal movement of piston 10 and rod 3 toward the right, the fluid compressed in cylinder barrel 12 passes freely from the compartment 14 in front of piston 10 to the compartment 15 placed in back of this piston by passing through the three channels 16, 17 and 18.

At a given moment in the movement of piston 10, the pressure piston, (not shown), which is fixed to rod 3, encounters considerable resistance and the fluid entering the space 9 no longer exerts sufficient force to permit the advance of piston 10 to continue; the pressure then increases in pipe 7 and space 9, thereby causing, after a very short time, compression of a calibrated spring 19 by movement of the piston 20 to the right up to shoulder 21.

The fluid arriving through pipe 22 can then enter compartment 15, thereby increasing the power applied to the jack and making it possible for rod 3 to advance a small additional distance.

However, the movement of this piston 20 compresses the fluid located in channel 17 thereby lifting a poppet valve 23 against the resistance of a spring 24 so that the excess fluid returns to tank 5 through exhaust pipe 25.

It will be noted that, during the advance of piston 10, the fluid in second space 26 surrounding a hollow rod 3*a* fixed to piston 10 is returned to the tank 5 through a pipe 27 and the said exhaust pipe 25.

When the distributor 8 is reversed by operating it in the direction of arrow 28, this distributor assumes position 2 illustrated by the broken lines on FIG. 1.

In this second position, pump 4 is connected to pipe 27 and space 26, which provokes the return of piston 10 by exerting pressure against the surface 10*d* of piston 3*b* fixed to the hollow rod 3*a*. Sealing contact between this piston and the jack barrel, on the one hand and the pipe 29 fixed to this jack barrel, on the other hand, is assured by two sealing rings 30 and 31.

In the same manner, sealing contact between the other end of rod 3*a* and the jack barrel is assured by a sealing ring 32.

Finally, sealing contact between rod 3 and the jack barrel is assured by two sealing rings 33 and 34.

A pipe 35, a piston 36 and a spring 37 are shown in broken lines and can be optionally installed when the return stroke also requires provision for supplemental power at a certain point when the pressure of the fluid introduced into space 26 by pipe 27 is no longer sufficient to overcome the resistance to the reverse movement of the said jack.

In the alternative embodiment that has just been described, it is, therefore, possible, at will, to provide for supplemental power either regardless of the direction of movement of piston 10, or only in the direction of advance of this piston.

As stated above, the disadvantage of this arrangement is that it does not ensure safety, since if the pressure applied either in space 9 or in concentric space 26 becomes insufficient to actuate piston 10, one of the two pistons 20 or 36 is actuated, which could be disadvantageous in certain cases.

If reference is now made to FIG. 2, the same distributor 8 is shown, which can be reversed by actuating it in the direction of the arrow 28, as well as pipes 6 and 7, exhaust pipes 25, and various sealing rings, as well as valve 23, its spring 24 and compartments 14 and 15.

However, instead of using the pressure of the pump to actuate pistons 20 and 36, a second three-position distributor 38 is used which is connected to pump 4 by ducts 39 and 39*a* and which is connected to the drainage pipe 25 by a duct 40.

This connection results at the moment at which the supply to one or the other of the two electro-magnets 43 and 44 ceases, in making it possible to direct the output of distributor 38 either to the left, by compressing a spring 45 until slide valve 46 of distributor 38 encounters a shoulder 46*a* limiting the compression of the said spring 45, or to the right by compressing a spring 48 until slide valve 47 of the same distributor encounters a shoulder 47*a*.

On the other hand, in the central position of distributor 38, the pump is not connected to either pipe 41 or pipe 42.

When distributor 38 is moved to the left by energizing electro-magnet 43, pipe 42 is then connected to the pump, whereas pipe 41 is connected to exhaust pipe 25.

When, on the contrary, the energization of electro-magnet 44 moves the distributor to the right against the resistance of spring 48, pipe 41 is connected to the pump and pipe 42 is connected to the exhaust.

In the automatic alternative illustrated on FIG. 2, the electro-magnet 44 is energized in position 1 of distributor 8, with its electrical circuit being completed through ring 49.

In the left hand position 2 of distributor 8, corresponding to reverse movement of rod 3 in the direction opposite to that of arrow 11, electro-magnet 43 is energized through ring 49.

However, these electro-magnets are automatically supplied only when one of the two half rings 50 and 51 closes one of two electrical contacts 52 and 53, and when the mold, diagrammatically illustrated at 54 and

54*a* is closed, electrical contacts 55 and 55*a* then connect the power supply source 56 to the two contacts 52 and 53.

According to which of the two half rings 50 and 51 closes one of the two electrical contacts 52 and 53, either electro-magnet 43 or electro-magnet 44, is energized.

The respective positions of two half rings 50 and 51 are longitudinally adjustable independently on rod 3 in such a manner that it is possible to select any two different positions of piston 10 to supply electro-magnet 44 during jack advance in the direction of arrow 11 and electro-magnet 43 during reverse of the rod of the said jack.

Thus, as stated above, any possibility of jack actuation at increased power is avoided as long as mold 54 – 54*a* is open.

It goes without saying that it is possible to provide such a safety system for applications other than injection molding when it is found necessary to trigger the pressurized fluid supply from either of pipes 41 and 42 only when such a safety contact has been previously closed.

Of course, it is also possible to replace distributor 38 with a distributor having only two positions and to provide, for example, only a single electro-magnet 44 designed simply to procure a power increase during advance of piston 10.

It is well understood that it is possible to introduce into the arrangements that have just been described various other changes, improvements or additions and that it is possible to replace certain components with equivalent components without, for this reason, departing from the basic principles of the invention.

It is possible, for example, to install, on distributor 38, a single pipe connecting it to pump 4, replacing the two pipes 39 and 39*a*, and two ducts connected to pipe 25, replacing pipe 40.

What is claimed:

1. Fluid pressure system comprising a piston member (10) which is slidably mounted in a cylinder (12) and divides said cylinder into two variable volume chambers (14, 15), said chambers being connected through a by-pass (17), and said piston member having two main surfaces (10*a*, 10*b*), having substantially identical areas each exposed to the pressure in one of said variable-volume chambers, and a third surface (10*c*) exposed to the pressure in a first space (9) other than either of said chambers, and means (6, 7, 8) for actuating said piston member, said actuating means comprising means for connecting said space to a source of pressure fluid (4) thus applying pressure to said third surface (10*c*) to advance said piston member in one direction while driving fluid from one of said chambers (14) to the other (15) through said by-pass until the advance of said piston produces a predetermined effect, and means (22, 20, 23) responsive to the attainment of said predetermined effect for automatically increasing the pressure on said piston member by connecting said other chamber to a source of fluid under pressure, closing said by-pass, and connecting said one chamber (14) to exhaust when said predetermined effect is attained.

2. A fluid pressure system as claimed in claim 1 in which said piston member has a fourth surface (10*d*) facing in a direction opposite to that faced by said third surface (10*c*) and subject to the pressure in a second space (26) outside said cylinder, said actuating means comprises a first reversible pressure fluid distributor (8) movable between a first position connecting said first space (9) to said pressure source and said second space (26) to exhaust, and said pressure increasing means comprises a second, reversible electrically actuated fluid distributor (38) movable between a first position connecting said one chamber (14) to said pressure source (4) and said other chamber (15) to exhaust, a second position in which neither chamber is connected to said pressure source (4) and a third position in which said other chamber (15) is connected to said pressure source and said one chamber (14) is connected to exhaust.

3. A fluid pressure system as claimed in claim 6 comprising electrical means for actuating said second distributor and responsive to the position of said rod.

4. A fluid pressure system as claimed in claim 3 in which said electrical means for actuating said second distributor is also responsive to the position of a device to which the pressure on said piston is to be applied.

5. Fluid pressure system as claimed in claim 1 in which said piston member is connected to a rod which actuates apparatus offering a varying resistance to the movement of said piston.

6. Fluid pressure system as claimed in claim 5 in which pressure increasing means is responsive to the pressure in said first space.

7. Fluid pressure system as claimed in claim 1 in which said means for connecting one of said chambers to a source of fluid pressure and for closing said by-pass is a single spring-loaded valve responsive to the pressure in said space, and movable between a first position in which it closes a connection between said other chamber and said pressure source and a second position in which it closes said by-pass but opens said connection.

8. A fluid pressure system as claimed in claim 1 in which said piston member has a fourth surface facing in a direction opposite to that faced by said third surface and subject to the pressure in a second space outside said cylinder, and said actuating means comprises reversible pressure fluid distributor means movable between a first position in which it is connected upon operation of said pressure increasing means to simultaneously supply pressure fluid to one of said spaces and one of said variable chambers while connecting the other of said spaces and the other of said variable chambers to exhaust, and a second position in which pressure fluid is supplied to said other space and variable chamber while said one space and variable chamber are connected to exhaust.

9. A fluid pressure system as claimed in claim 8 in which said pressure increasing means comprises two spring-loaded valves in said by-pass, one of which is responsive to the pressure in each of said spaces, and each of which is movable between a first position in which it closes a connection between a different one of said chambers and said pressure source and a second position in which it closes said by-pass but opens said connection.

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