

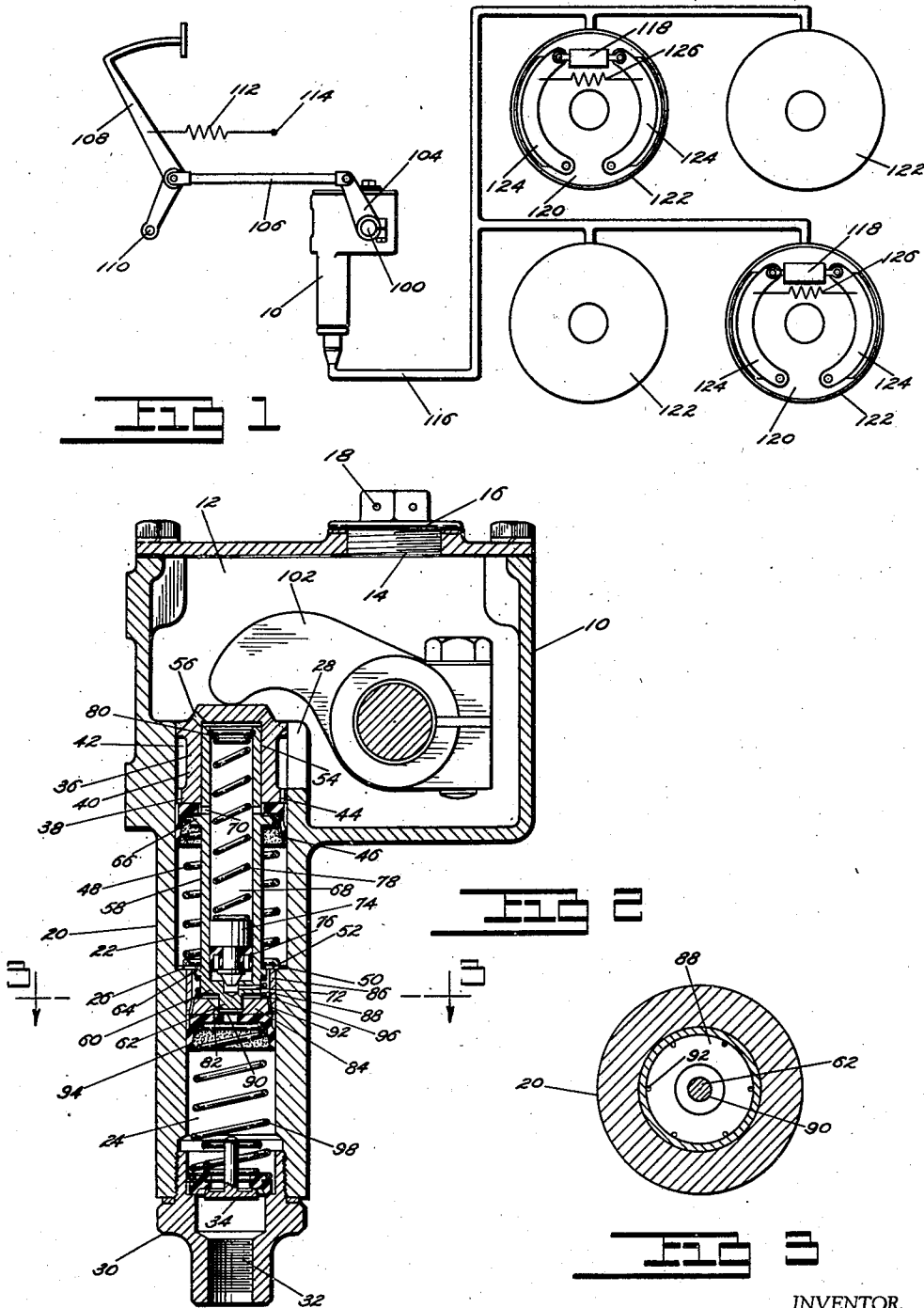
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FLUID PRESSURE SYSTEM

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FLUID PRESSURE SYSTEM

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This invention relates to fluid pressure systems, and more particularly to fluid pressure producing devices for such systems.

Broadly the invention comprehends a fluid pressure system embodying a fluid pressure producing device of the two-phase type operative to effect a transition from a low pressure to a relatively high pressure without proportionately increasing the applied or activating force.

An object of the invention is to provide a fluid pressure producing device of the two-phase type operative to effect a transition from low to high pressure over a wide range so as to smooth out the operation.

Another object of the invention is to provide a fluid pressure producing device including low and high pressure producing means operative upon attaining a predetermined pressure to relieve the pressure in the low pressure means, to store under pressure fluid discharged from the low pressure means, and to quickly return the fluid to the low pressure means upon drop of pressure in the high pressure means.

Other objects and advantages of the invention will hereinafter appear from the following description taken in connection with the drawing forming a part of this specification, and in which—

Fig. 1 is a schematic view of a fluid pressure braking system embodying the invention;

Fig. 2 is a sectional view of the fluid pressure producing device incorporated in the system; and

Fig. 3 is an enlarged sectional view substantially on line 3—3, Fig. 1.

Referring to the drawing for more specific details of the invention, 10 represents a fluid pressure producing device including a reservoir 12 having a filling opening 14 normally closed as by a plug 16 provided with openings 18 therethrough for venting the reservoir to the atmosphere.

A cylinder 20 depending from the bottom of the reservoir includes a large chamber 22 communicating with the reservoir, and a relatively small chamber 24 arranged forward of, concentrically to, and in direct communication with the large chamber and providing at its juncture with the large chamber an annular shoulder 26. The end of the large chamber communicating with the reservoir extends upwardly from the bottom of the reservoir, and is provided with a longitudinal slot 28, the purpose of which will hereinafter appear; and the small chamber 24 is closed as by a head 30 provided with a discharge port 32 controlled as by a two-way valve 34.

A piston 36 reciprocable in the large chamber

22 includes a head 38, a reduced body portion 40 providing in conjunction with the wall of the chamber 22 an annular chamber 42 communicating with the reservoir 12 by way of the slot 28. A plurality of spaced passages 44 through the head of the piston provides communications between the annular chamber 42 and that portion of the chamber 22 forward of the pistons.

A sealing cup 46 seated on the head of the piston controls the passages 44, and a spring 48 interposed between the cup and a washer 50 seated on the annular shoulder 26 serves to retain the cup against displacement and also to return the piston 36 to its retracted position. As shown, the washer 50 has its inner perimeter radially slotted as at 52 to provide for the free passage of fluid.

The piston 36 has a concentric chamber 54 communicating with the reservoir as by way of spaced ports 56 and opens through the head of the piston directly into the chamber 22. A plunger 58 reciprocable in the chamber 54 extends through the chamber 22 into the chamber 24. The plunger has a head 60 supporting a concentric extension 62, the purpose of which will hereinafter appear, and arranged on the plunger are spaced circumferential flanges 64 and 66, the former normally seated on the washer 50, and the latter adapted to seat on the sealing cup 46 during advance of the plunger.

The plunger 58 also has a chamber 68 opening directly into the chamber 54 in the piston 36. This chamber has a port 70 communicating with the large chamber 22, and a passage 72 through the head of the plunger provides a communication between the chamber 68 and the chamber 24.

A piston 74 movable in the chamber 68 has on its head an extension normally closing the passage 72, and a sealing cup 76 for inhibiting seepage of fluid past the piston 74. A spring 78 interposed between the back of the piston 74 and a retaining ring 80 seated in a groove in the wall of the chamber 68 serves to urge the piston to its normal position and to impose thereon a predetermined load.

A piston 82 reciprocable in the small chamber 24, normally seats on the washer 50. This piston includes a head 84 and a skirt 86 providing a chamber 88 back of the head. The chamber 88 opens into the chamber 22 and receives the plunger 58. The head of the piston 82 has a concentric opening 90 for the reception of the extension on the head of the plunger 58, and a plurality of spaced passages 92 therethrough providing communications between the chamber 88

and that portion of the chamber 24 forward of the piston 82.

A sealing cup 94 seated on the head of the piston 82 controls the passages 92 and also serves to seal the opening 90 during advance of the plunger. A light spring 96 interposed between the back of the head 84 and the flange 64 on the plunger 58 serves to normally retain the plunger in retracted position, and a spring 98 interposed between the sealing cup and the two-way valve 34 serves to retain the cup and valve against displacement and also to return the piston 82 to its retracted position.

A shaft 100 journaled in the walls of the reservoir has thereon an actuator 102 for activating the piston 36. The shaft also has secured thereto a crank 104 connected by a rod 106 to a foot-pedal lever 108 mounted on a stub shaft 110 and connected by a retractile spring 112 to a fixed support 114.

A fluid pressure delivery pipe or conduit 116 suitably connected to the discharge port 32 of the fluid pressure producing device has branches connected respectively to fluid pressure actuated motors 118, preferably arranged in pairs, one pair for actuating brakes associated with the front wheels of a vehicle and another pair for actuating brakes associated with the rear wheels of the vehicle.

The brakes may be of any preferred type. As shown, each of the brakes includes a fixed support or backing plate 120, a rotatable drum 122 associated with the backing plate, a pair of friction elements or shoes 124 pivotally mounted on the backing plate for cooperation with the drum, a retractile spring 126 connecting the shoes, and a motor corresponding to the motors 118 for activating the shoes into engagement with the drum against the resistance of the retractile spring.

In a normal operation, upon depressing the foot pedal lever 108, force is transmitted therefrom through the rod 106, the crank 104 and shaft 100 to the actuator 102, resulting in movement of the actuator and consequent advance of the piston 36 on its compression stroke. During the initial movement of the piston 36 on its compression stroke, the sealing cup 46 engages the flange 66 on the plunger 58 and closes the communication between the chamber 22 and the chamber 68 in the plunger.

Further advancement of the piston 36 advances the plunger 58, and during the initial movement of the plunger, the head 60 thereof abuts the back of the head 84 of the piston 82 with the extension 62 on the head of the plunger in the opening 90 in abutting relation to the sealing cup 94 on the head of the piston 82, and thereafter the pistons 36 and 82 move in unison.

As the pistons 36 and 82 advance on the compression stroke, fluid is displaced from the chamber 22, through the chamber 88 in the piston 82, thence through the passages 92 in the head of the piston 82, past the sealing cup 94 into the chamber 24, thence past the two-way valve 34, through the discharge port 32 and the fluid pressure delivery pipe 116 and branches thereof, into the fluid pressure actuated motors 118, causing energization of the motors with the resultant actuation of the friction elements 124 into engagement with the drums against the resistance of the retractile springs 126, effectively retarding rotation of the drums.

Upon further advance of the pistons 36 and 82 on the compression stroke, the pressure on the fluid in the system builds up rapidly until the

pressure on the fluid in the chambers 22 and 24 reaches a predetermined degree, whereupon the pressure on the fluid acting on the extension of the piston 74 opens the passage 72 so as to admit fluid from the chamber 22 into the chamber 68 in the plunger 58 and according release of pressure on the fluid in the chamber 22.

This release of pressure on the fluid in the chamber 22 results in transition from a low pressure on the fluid to a relatively high pressure on the fluid, and this transition is accomplished over a wide range, due to the gradual displacement of fluid from the chamber 22, through the passage 72, into the chamber 68, introduced by the yielding resistance offered to this flow of the fluid presented by the spring-pressed piston 74.

In instances where the high pressure attained is suddenly released and then quickly recovered, no loss of stroke occurs, due to the storage of fluid in the chamber 68 and the rapid displacement therefrom by the spring-pressed piston 74 into the chamber 22 so that no additional fluid is required to be drawn from the reservoir to completely fill the chamber 22 as in similar operations of fluid pressure producing devices of various types heretofore developed.

Upon conclusion of a braking operation, the foot pedal lever 108 is released, and is returned to its retracted position under the influence of the retractile spring 112. This results in transmitting force through the rod 106, the crank arm 104, and shaft 100 to the actuator 102, with consequent retraction of the actuator and release of the piston 36.

Upon release of the applied operating force, the springs 48, 96 and 98 return the pistons 36 and 82 and the plunger 58 to their respective retracted positions. As the pistons 36 and plunger 58 return to the retracted position, there is relative movement between the piston 36 and the plunger, resulting in establishing communication between the chamber 22 and the reservoir by way of the port 70, the chamber 68 in the plunger, the chamber 54 in the piston 36, and the passages 56. There is also relative movement between the piston 82 and the plunger 58 resulting in withdrawal of the plunger from the opening 90 in the head of the piston 82 thereby establishing communication between the chambers 22 and 24, and during this operation fluid in the chamber 68 is displaced therefrom by the spring-pressed piston 74. Also, during this operation fluid is returning to the chamber 24 from the fluid pressure actuated motors 118 and the fluid pressure delivery lines connecting the motors to the chambers 24, and the fluid received in the chamber 24 flows through the opening 90 in the head of the piston 82 through the chamber 88, thence into the chamber 22 and through the passage 70 into the chamber 68 in the plunger, into the chamber 54, and thence through passages 56 into the reservoir.

While this invention has been described in connection with certain specific embodiments, the principle involved is susceptible of numerous other applications that will readily occur to persons skilled in the art. The invention is, therefore, to be limited only as indicated by the scope of the appended claims.

Having thus described the various features of the invention, what I claim as new and desire to secure by Letters Patent is:

1. A fluid pressure producing device comprising a reservoir, a cylinder supplied therefrom having a large chamber and a relatively small chamber,

a piston in each of the chambers, a storage chamber within the larger chamber, means providing communication between the storage chamber and the large chamber, means providing communication between the storage chamber and reservoir, means providing communication of the large chamber with the reservoir through the storage chamber, and means in the storage chamber for imposing pressure on the fluid received by the storage chamber.

2. A fluid pressure producing device comprising a reservoir, a cylinder supplied therefrom having a large chamber and a relatively small chamber, a piston movable in each of the chambers for creating pressure, a storage chamber carried by the piston in the large chamber having communication with the large chamber, passages providing communication between the storage chamber and the reservoir and a means providing communication between the large chamber and reservoir by way of the storage chamber, spring-pressed piston in the storage chamber means on the storage chamber cooperating with means on the piston movable in the large chamber for closing off communication between the large chamber and reservoir.

3. A fluid pressure producing device comprising a reservoir, a cylinder associated therewith having a large chamber and a relatively small chamber, a piston movable in each of the chambers for creating pressure, means for by-passing fluid past the pistons, a storage chamber carried by the piston in the large chamber having communication with the large chamber, said reservoir communicating with the storage chamber means providing communication between the large chamber and reservoir by way of the storage chamber, and means in the storage chamber for imposing pressure on fluid received by the storage chamber including means for control of the communication, said means in the storage chamber requiring an initial pressure for the movement thereof of greater magnitude than the pressure required for further movement.

4. A fluid pressure producing device comprising a reservoir, a cylinder depending therefrom having a large chamber and a relatively small chamber, pistons movable in their respective chambers for creating pressure, a storage chamber supported intermediate the pistons, passages providing communication between the storage chamber and reservoir, passages providing communication between the storage chamber and large chamber, and a valve in the storage chamber controlling the communication between the storage chamber and large chamber.

5. A fluid pressure producing device comprising a reservoir, a cylinder associated therewith having a large chamber and a relatively small chamber, a piston movable in each of the chambers, a storage cylinder supported by and relatively movable between the pistons, a piston in the storage cylinder dividing the cylinder into a fluid pressure storage chamber and a fluid passage chamber, a communication between the large chamber and storage chamber, passages providing communication between the large chamber and reservoir through the fluid passage chamber, and means on the piston in the storage cylinder for controlling the communication between the large chamber and storage chamber.

6. A fluid pressure producing device comprising a reservoir, a cylinder supplied therefrom having a large chamber and a relatively small chamber, a piston reciprocable in each chamber for creating pressure, a hollow cylindrical member having a head thereon supported between and relatively movable to the pistons, a storage chamber in the cylindrical member communicating with the large chamber, means for by-passing fluid past the pistons, passages providing communication between the large chamber and reservoir through the cylindrical member, and spring-pressed means in the storage chamber controlling the communications between the large chamber and storage chamber.

7. A fluid pressure producing device comprising a cylinder having a large chamber and a relatively small chamber, a piston movable in each of the chambers for creating pressure, a storage chamber carried by the piston in the large chamber having communication with the large chamber, a spring-pressed piston in the storage chamber, and a part on the piston of lesser area than the piston for controlling the communication between the large chamber and the storage chamber.

8. In a fluid pressure producing device, a cylinder having a large chamber and a relatively small chamber, a piston reciprocable in each of the chambers, a storage chamber supported within and between the pistons, means for by-passing fluid past the pistons, a passage providing communication between the storage chamber and the large chamber diametrically smaller than the storage chamber, a piston commensurate the storage chamber and an extension on the piston having a portion commensurate the passage providing communication between the large chamber and storage chamber for control thereof.

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