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FLUID PRESSURE PRODUCING DEVICE

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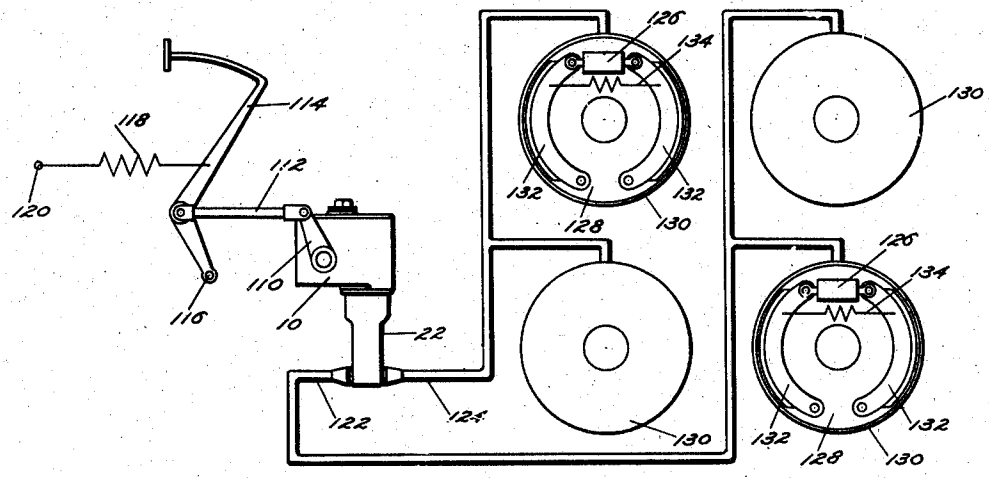


FIG 1

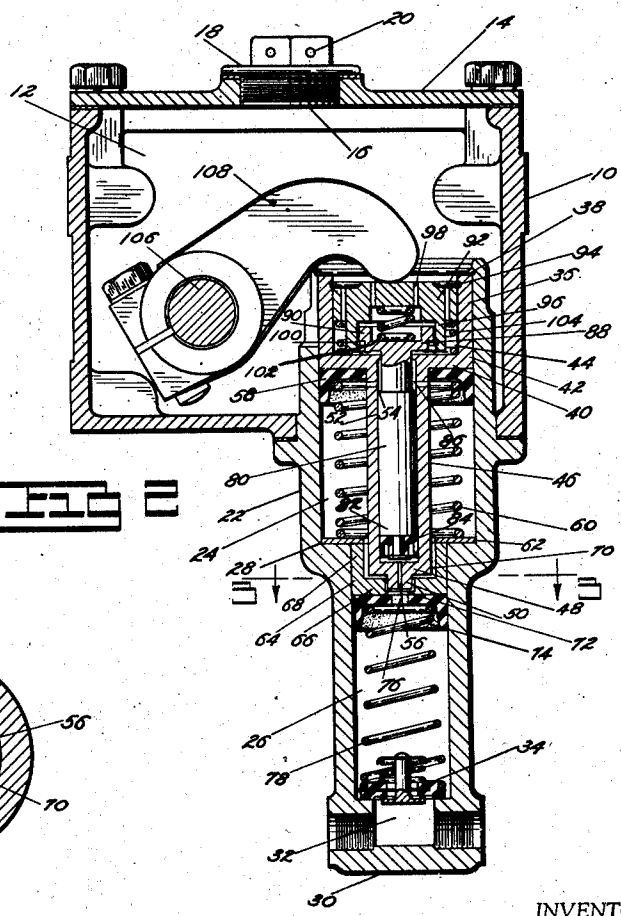


FIG 2

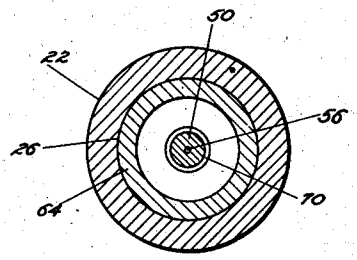


FIG 3

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FLUID PRESSURE PRODUCING DEVICE

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7 Claims. (Cl. 60—54.6)

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

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

Another object of the invention is to provide a fluid pressure producing device operative to effect a gradual transition from low to high pressure without proportionately increasing the applied or actuating force.

Other objects and advantages of the invention will 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 a fluid pressure producing device incorporated in the system; and

Fig. 3 is a sectional view taken on line 3—3 of Fig. 2.

Referring to the drawing for more specific details of the invention, 10 represents a fluid pressure producing device including a reservoir 12 having a removable top 14 provided with a filling opening 16 normally closed as by a plug 18 having openings 20 therethrough for venting the reservoir to the atmosphere.

A cylinder 22 depending from the bottom of the reservoir includes a large chamber 24 opening into the reservoir and a relatively small chamber 26 arranged below, concentrically to, and in direct communication with a large chamber and providing at its juncture therewith an annular shoulder 28, and the small chamber 26 is closed by a head 30 provided with a discharge port 32 controlled as by a two-way valve 34.

A piston 36 reciprocable in the chamber 24 is held against displacement by a retaining ring 38 seated in a groove in the wall of the chamber adjacent its open end. The piston includes a head 40 and a skirt 42 providing a chamber 44 back of the head, and arranged concentrically on the head is an extension 46 projected through the chamber 24 and into the chamber 26, and provided on its head 48 with a cylindrical protrusion 50. The extension is bored to provide a chamber 52 opening into the chamber 44 back of the head of the piston. Arranged in the wall of the chamber 52 is a port 54 providing a communication between the chamber 52 and the large chamber 24. The chamber 52 also has a port 56 extended through the head 48 and protrusion 50 to provide a communication between the chamber 52 and the small chamber 26.

A sealing cup 58 sleeved over the extension 46 and sealed on the head of the piston 36 inhibits seepage of fluid from the chamber 24 past the piston, and a spring 60 interposed between the cup 58 and a washer 62 seated on the annular shoulder 28 serves to retain the cup against displacement and also to return the piston to its retracted position.

A piston 64 reciprocable in the small chamber 26 normally seats on the washer 62. The piston 64 includes a head 66 and a skirt 68 providing a chamber 70 back of the head. The chamber 70 opens into the chamber 24, and a concentric opening 72 through the head of the piston provides a communication between the chamber 70 and the small chamber 26. The opening 72 receives the protrusion 50 on the head of the extension upon movement of the piston 36 to close the communication between the chamber 26 and the chamber 70.

A sealing cup 74 seated on the head of the piston 64 seals the piston in the chamber 26. The cup has a concentric opening 76, and the perimeter defining this opening 76 overhangs the opening 70 in the head of the piston so as to abut and seal the protrusion 50 in the opening 70, and a spring 78 interposed between the cup 74 and the two-way valve 34 serves to retain the cup and valve against displacement and also to return the piston 62 to its retracted position against the stop 62.

A plunger 80 reciprocable in the chamber 52 has on one end a head 82 supporting a sealing cup 84. The other end of the plunger has a reduced portion providing an annular passage 86 communicating with the port 54, also with the chamber 44 and a valve head 88 in the chamber 44 for control of the passage 86 having an upstanding offset flange 90. A pressure block 92 slidable in the chamber 44 is held against displacement by a retaining ring 94 seated in a groove in the wall of the chamber. The block 92 has thereon a concentric sleeve 96 receiving the flange 90, and a plurality of spaced passages 98 therethrough providing communications between the chamber 44 and a reservoir. The flange 90 normally seats on a retaining ring 100 fitted in a groove in the wall of the sleeve 96. A spring 102 interposed between the valve 88 and the block 92 urges the flange 90 on the valve head 88 to its seat, and a spring 104 interposed between the bottom of the chamber 44 and the block 92 urges the block to its retracted position against the

retaining ring 94 so as to normally maintain the valve 88 open.

A rotatable shaft 106 mounted transversely of the reservoir has thereon an actuator 108 engaging the pressure block 92, and a crank 110 connected by a rod 112 to a foot pedal lever 114 rockable on a stub shaft 116 and connected by a retractile spring 118 to a fixed support 120.

Fluid pressure delivery pipes or conduits 122 and 124 connected to the discharge port 32 have branches connected respectively to fluid pressure actuated motors 126, 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 a vehicle.

The brakes may be of any preferred structure. As shown, each of the brakes includes a fixed support or backing plate 128, a rotatable drum 130 associated therewith, a pair of friction elements or shoes 132 pivoted on the backing plate for cooperation with the drum, a retractile spring 134 connecting the shoes, and a motor mounted on the backing plate and connected to the shoes for actuating the shoes into engagement with the drum against the resistance of the retractile spring.

In a normal operation, upon depressing the foot pedal lever 114, force is transmitted therefrom through the rod 112, the crank 110, the shaft 106 and the actuator 108 to the pressure block 92, resulting in movement of the block against the resistance of the spring 104. This movement of the block results in closing the valve 88, slight compression of the spring 102 to impose a predetermined load on the valve, and thereafter the pressure block 92 and the piston 36 move as a unit.

As the piston 36 advances, the fluid in the chamber 24 is displaced therefrom, through the chamber 70 and port 72 in the small piston 64 into the chamber 26, thence past the two-way valve 34, through the discharge port 32 and fluid pressure delivery lines 122 and 124 and the branches thereof into the fluid pressure actuated motors 126, causing energization of the motors and resultant actuation of the friction elements 132 into engagement with the drums 130 against the resistance of the retractile springs 134 effectively retarding rotation of the drums. Inasmuch as initial movement of the block 92 results in closing of valve 88, chamber 24 is closed to communication with the reservoir, with consequent necessity for displacement of fluid from the chamber as the piston 36 is advanced. As the piston is thus advanced and pressure is developed within the chamber, a velocity head is established, permitting a flow of fluid through the chamber 70 and port 72 into the braking system. The fluid under pressure thus displaced from chamber 24 moves piston 64 relative to moving extension 48—50 so as to provide a passage for the flow of fluid through 70—72.

Upon attaining a predetermined pressure on the fluid in the chambers 24 and 26, the pressure on the fluid acting on the head 82 of the plunger 80 and the valve 88 opens the valve. This establishes communication between the chamber 24 and the reservoir by way of the port 54, the passages 86, the chamber 44 in the piston 34, and the passages 98 through the pressure block 92. Simultaneously with this operation, the protrusion 50 on the head of the extension 46 receives the overhanging perimeter of the sealing cup 74 and effectively closes the port 72.

Upon further movement of the pistons 36 and 64 on the compression stroke, the fluid in the chamber 26 is displaced therefrom, past the two-way valve 34, through the discharge port and the fluid pressure delivery lines into the motors, causing further energization of the motors to increase the activating force of the friction elements without proportionately increasing the applied or operating force.

Upon conclusion of a braking operation, the foot pedal lever 114 is released, and returns to its retracted position under the influence of the retractile spring 118. As the foot pedal lever returns to its retracted position, the rod 112 is retracted, and this movement of the rod transmits force to the crank 110, causing slight rotation of the shaft 106, resulting in retraction of the actuator 108 and release of the pressure block 92.

Upon release of the applied force, the pistons 36 and 64 are returned to their respective retracted positions under the influence of the retractile springs 60 and 78. As the pistons move to their retracted positions, there is relative movement between the pistons, resulting in opening the port 72 and establishing communication between the chambers 24 and 26. Also there is relative movement between the piston 36 and the pressure block 92, resulting in opening the valve 88 and consequent establishment of communication between the chamber 24 and the reservoir.

During this operation, a partial vacuum is created in the chamber 26, and this results in drawing fluid from the reservoir into the chambers 24 and 26, completely filling the chambers, and simultaneously with this operation fluid is returning to the chamber 26 from the fluid pressure actuated motors 126 and the fluid pressure delivery lines connecting the motors to the chamber 26. This may result in the chamber 26 receiving a quantity of fluid in excess of its capacity, and under this condition the excess fluid is returned to 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.

I claim:

1. A fluid pressure producing device comprising a cylinder having a large chamber and a relatively small chamber, a piston reciprocable in the cylinder having a large piston and a small piston complementary to the chambers, a valve in each of the pistons normally open, the valve in the large piston operative to close upon initial movement of the piston, the valve in the large piston operative to open upon attaining a predetermined pressure in the chambers, and the valve in the small piston closing immediately upon opening of the valve in the large piston.

2. A fluid pressure producing device comprising a cylinder having a large chamber and a relatively small chamber, a piston reciprocable in the cylinder having a large head and a small head complementary to the chambers, a valve in each of the heads normally open, an actuator for the piston operative to close the valve in the large head upon initial movement of the piston, the valve in the large head operative to open as a result of the combined attained predetermined pressure in the chambers resisted by the activating force on the piston, and the valve in the small chamber operative to close concomitantly with the opening of the valve in the large chamber.

3. A fluid pressure producing device comprising a cylinder having a large chamber and a relatively small chamber, a hollow piston reciprocable in the large chamber having an extension provided with a passage therethrough, a valve for control of the passage, means in the hollow piston normally retaining the valve open, a piston in the small chamber, having an opening therethrough, means providing for opening the valve as a result of attaining a combined predetermined pressure in the chambers, and means on the extension for closing the opening at precisely the time the valve opens.

4. A fluid pressure producing device comprising a reservoir, a cylinder depending therefrom and communicating therewith, including a large chamber and a relatively small chamber below the large chamber, a piston reciprocable in the cylinder having a large head and a small head complementary to the chambers, a valve in each of the heads open when the piston is at rest, the valve in the large head operative to close upon initial movement of the piston, the valve in the large head operative to open upon attaining a predetermined pressure in the chambers followed by the closing of the valve in the small head as a result of differential in pressure in the chambers present after the valve opens in the large head.

5. A fluid pressure producing device comprising, a cylinder having a large chamber and a relatively small chamber, a piston reciprocable therein having heads complementary to the chambers, means for actuating the piston, a valve in each head normally open, and means associated with the piston actuating means for closing the valve in the large head upon initial actuation of the piston, said valve operative to open upon attaining a predetermined pressure in the chambers as the piston is further advanced.

6. A fluid pressure producing device comprising a reservoir, a cylinder associated therewith having a large chamber and a relatively small chamber, a piston reciprocable in the cylinder having a large head and a small head complementary to the chamber, a valve in the large head normally open to provide communication between the reservoir and large chamber, a valve in the small head providing communication between the large and small chambers, an actuator for the piston, and resilient means cooperating with the actuator for closing the valve in the large head upon initial movement of the piston, said valve responsive to open against the resistance of the resilient means upon attainment of a predetermined pressure on the fluid in the chambers as the piston is further advanced to provide communication between the large chamber and reservoir.

7. A fluid pressure producing device comprising a reservoir, a cylinder associated therewith having a large chamber and a small chamber, a piston reciprocable in the cylinder having a large head and a small head complementary to the chambers, an actuator for the piston, a chamber in the large head of the piston, passages in the large head providing communication between the large chamber and reservoir, a piston reciprocable in the piston chamber having passages therethrough, a valve intermediate the passages in the large head and the piston reciprocable in the piston chamber normally open, a spring interposed between the valve and piston in the piston chamber, and a valve in the small piston normally open.

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