Feb. 10, 1942. H. C. BOWEN 2,272,316

FLUID PRESSURE PRODUCING DEVICE

Filed May 20, 1937 2 Sheets-Sheet 1

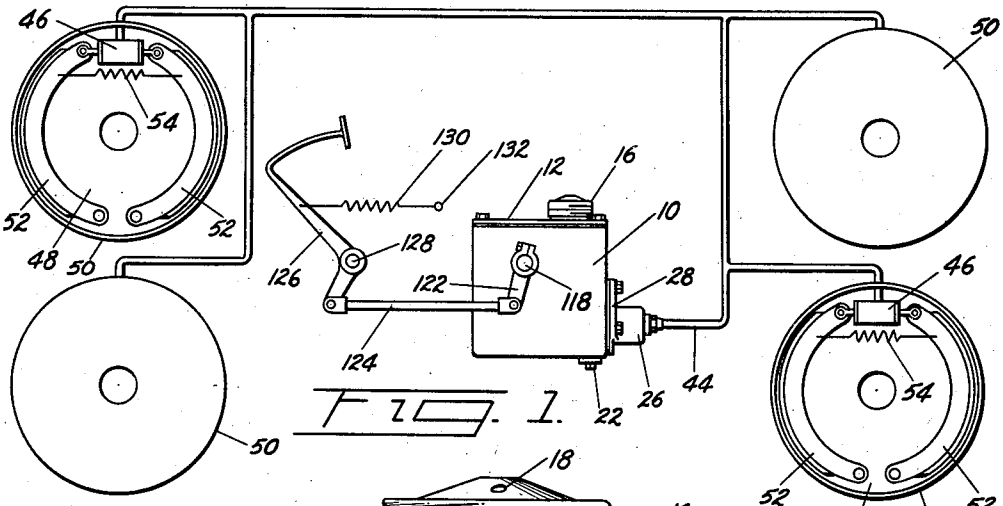


FIG. 1.

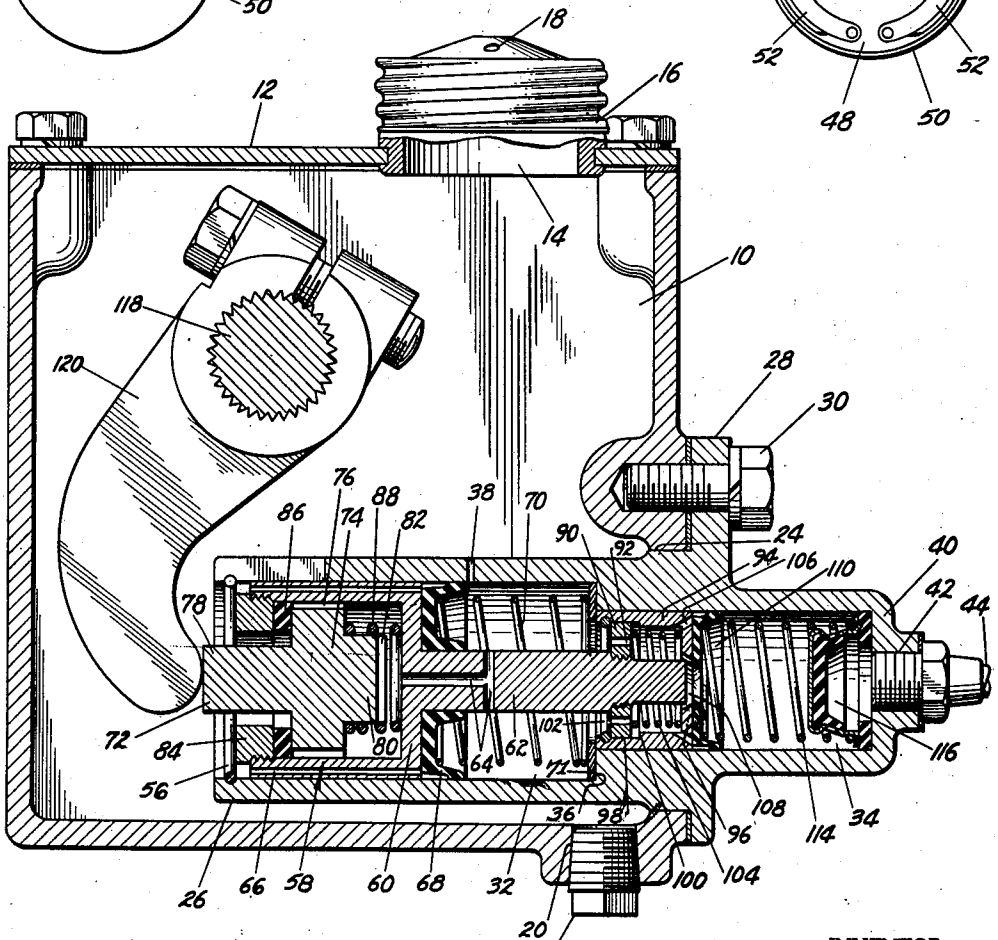


FIG. 2.

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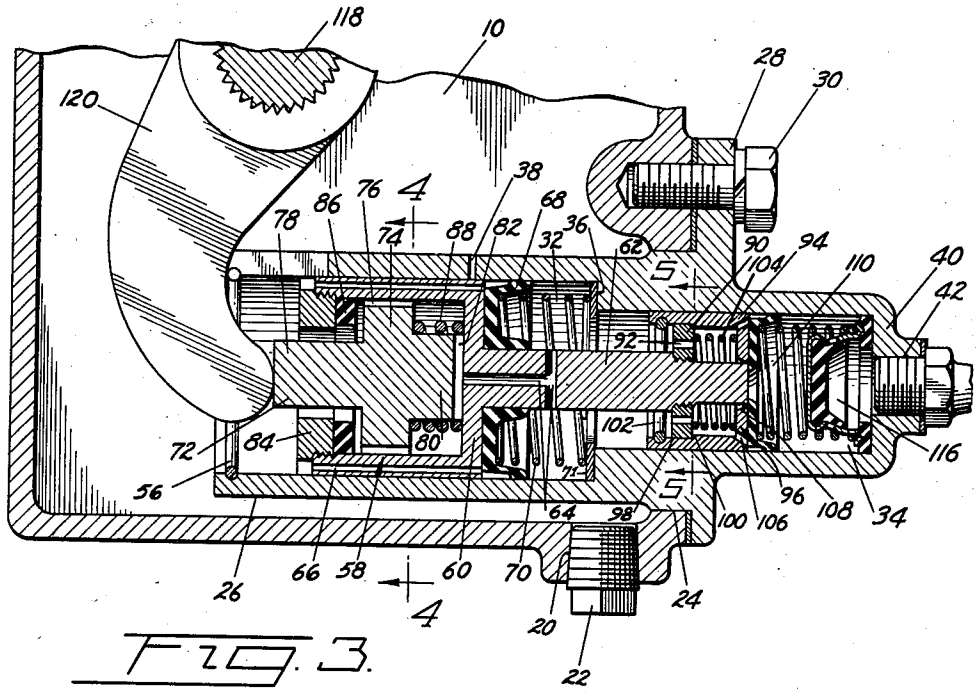


Fig. 3.

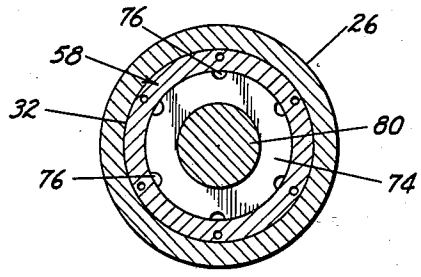


Fig. 4

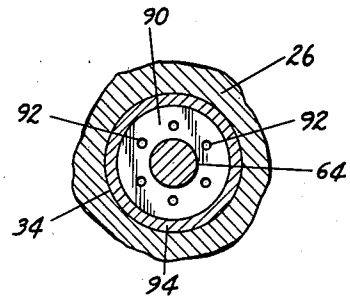


Fig. 5

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UNITED STATES PATENT OFFICE

2,272,316

FLUID PRESSURE PRODUCING DEVICE

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Application May 20, 1937, Serial No. 143,693

4 Claims. (Cl. 60—54.6)

This invention relates to fluid pressure braking 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 operative to effectively increase the pressure on the fluid without proportionately increasing the applied operating force.

Another object of the invention is to provide a fluid pressure producing device operative to effect a transition from low to high pressure without pulsations in the fluid during the operation thereof.

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

Fig. 1 is a diagrammatical illustration of a fluid braking system embodying the invention;

Fig. 2 is a vertical sectional view of the fluid pressure producing device illustrating the piston thereof in retarded position;

Fig. 3 is a vertical sectional view of the fluid pressure producing device partly broken away illustrating the piston in advanced position;

Fig. 4 is a sectional view substantially on line 4—4, Fig. 3; and

Fig. 5 is a sectional view substantially on line 5—5, Fig. 3.

Referring to the drawings for more specific details of the invention, 10 represents a fluid reservoir having a removable top 12 provided with a filling opening 14 which may be closed as by a cap 16 having openings 18 for venting the reservoir to the atmosphere. The reservoir also has a drain opening 20 which may be closed as by a plug 22, and arranged on the wall of the reservoir adjacent the bottom thereof is an opening 24.

A cylinder 26 fitted in the opening 24 has a radial flange 28 bearing against a wall of the reservoir and secured thereto as by bolts 30 so as to support the cylinder within the reservoir adjacent the bottom thereof. The cylinder includes a large chamber 32 having one end opening into the reservoir and its other end communicating with a relatively small chamber 34 arranged concentrically to the large chamber and providing at its junction with the large chamber an annular shoulder 36. The large chamber has a port 38 providing a communication between the chamber and the reservoir, and the small chamber has a head 40 provided with a discharge port 42.

A fluid pressure delivery pipe or conduit 44 suitably connected to the discharge port 42 has branches connected respectively to fluid pressure actuated motors 46 arranged in pairs, one pair for actuating the brakes associated with the front wheels of a vehicle and another pair for actuating the brakes associated with the rear wheels of the vehicle.

As shown, the brakes are of conventional type each including a fixed support or backing plate 48, a rotatable drum 50 associated therewith which may be secured to a wheel, a pair of corresponding interchangeable friction elements or shoes 52 pivoted on the backing plate, and a motor corresponding to the motors 46 mounted on the backing plate between the shoes and operative to spread the shoes into engagement with the drum 50 against the resistance of a retractile spring 54 connecting the shoes so as to effectively retard rotation of the drum.

A compound piston reciprocable in the cylinder is held against displacement by a retaining ring 56 seated in a groove in the wall of the cylinder adjacent the open end of the large chamber 32. This retaining ring also serves as a seat for the compound piston when in its fully retracted position. The compound piston includes a large piston 58 reciprocable in the large chamber 32. This piston comprises a shell having one end closed as by a head 60 and its other end open. The head 60 has a concentric extension 62 projecting into the small chamber 34, and the extension is diametrically and axially bored as indicated at 64 to provide a communication between that portion of the chamber 32 forward of the piston 58 and the interior of the piston. A plurality of passages 66 in the wall of the shell provide communications between the reservoir and that portion of the cylinder forward of the piston. A sealing cup 68 seated on the head 62 controls the passages 66, and a spring 70 interposed between the cup and an annular washer 71 seated on the shoulder 36 at the junction of the large and small chambers retains the cup against displacement. The spring 70 also assists in the return of the piston to its retracted position.

A combined thrust block and valve 72 reciprocable in the piston 58 includes a body portion 74 having passages or ports 76 therein and corresponding concentric oppositely disposed end portions 78 and 80. The portion 80 is provided at its free end with a diametral groove 82 adapted to register with the passage 64 in instances where the valve is fully open so as to maintain a free communication between the interior of

the piston 58 and that portion of the chamber 32 forward of the piston 58. A retaining ring 84 suitably secured in the open end of the piston 58 has thereon an annular rubber washer 86 providing a suitable seat for the valve, and a heavy spring 88 sleeved on the end portion 80 between the body portion 74 and the back of the head 60 of the piston 58 urges the valve to its seat on the washer 86. This spring materially resists movement of the valve when an actuating force is applied thereto tending to move the valve to open position.

A collar 90 suitably secured to the extension 62 within the chamber 34 has therein a plurality of spaced ports 92. This collar supports a small piston 94 reciprocable in the small chamber 34. This piston is characterized by a shell, closed at one end as by a head 96 and open at its other end. The open end has an internal slot 98 providing an annular shoulder 100. The slot receives the collar 90 and is of sufficient width to provide for relative movement between the piston and the collar, the movement being limited by the annular shoulder 100. A retaining ring 102 seated in a groove in the wall of the shell adjacent the open end thereof retains the piston against displacement, and a very light spring 104 interposed between the collar and back of the head 96 normally retains the piston in advanced position.

The head 96 of the small piston normally seated on the washer 71 has a plurality of spaced ports 106 and an axial port 108, the latter being adapted to receive the free end of the extension 62 during the compression stroke of the piston. The spaced ports 106 and the axial port 108 provide communications between the large chamber 32 and the small chamber 34. A collapsible sealing cup 110 having a concentric opening registering with the port 108 in the head 96 is seated on the head and is retained against displacement by a return spring 114 interposed between the cup and a two-way valve 116 seated on the head 48 of the cylinder for control of the discharge port 42. The cup 110 controls the spaced ports 106 and also cooperates with the extension 62 to seal the axial port 108 during the compression stroke of the piston.

A transverse shaft 118 suitably mounted in the wall of the reservoir has keyed thereto within the reservoir an actuator 120 engaging the force applying end of the thrust block 72, and an arm 122 suitably secured to the shaft outside of the reservoir is connected as by a rod 124 to a foot pedal lever 126 pivoted as indicated at 128 and connected by a retractile spring 130 to a fixed support 132.

In a normal operation of the system upon depressing the foot pedal lever 126 force is transmitted from the lever through the rod 124, the arm 122, the shaft 118 and the actuator 120 to the piston, resulting in moving the piston on its compression stroke. During the initial movement of the piston on its compression stroke, the cup 68 on the head 60 of the large piston closes the port 38, and the extension 62 on the head 60 of the large piston is advanced to close the axial port 108 in the head 96 of the small piston.

As the piston advances on its compression stroke the fluid in the chanmber 32 forward of the large piston is displaced therefrom through the ports 92 in the collar 90 of the small piston 94, thence through the ports 106 in the head of the small piston past the cup 110 through the small chamber 34 and past the two-way valve 116, through the fluid pressure delivery pipe or conduit 44 and its respective branches into the fluid pressure actuated motors 46, resulting in actuation of the motors. Upon actuation of the motors the shoes 52 of the respective brakes are moved into engagement with the associated drums 50 and effectively retard rotation of the drums.

Upon further advance of the piston the pressure on the fluid in the large chamber 32 and the small chamber 34 increases the load on the valve 72. This increase of the load on the valve materially assists the heavy spring 88 in retaining the valve 72 in closed position. When the pressure on the fluid in the chambers reaches a predetermined pressure offering substantial resistance to movement of the piston and the valve 72, the applied operating force on the valve overcomes the load on the valve imposed by the pressure on the fluid and the heavy spring 88, resulting in movement of the valve from its seat. Upon opening of this valve, the pressure on the fluid in the chamber 32 is released and a small quantity of fluid is returned from the chamber 32 through the passage 64 in the large piston and the ports 76 to the reservoir.

Simultaneously with this operation the pressure on the fluid in the system is received on the head 96 of the small piston where it does not offer sufficient resistance to movement of the piston to retain the spring 88 compressed. This results in a slight advance of the piston under the influence of the spring 88 accompanied by closing of the valve 72, and as the piston proceeds on its compression stroke pressure is again built up in the chamber 32 until it opposes substantial resistance to the movement of the large piston and materially increases the load on the valve 72. When the total load on the valve 72 becomes insufficient to off-set the operating force applied to the valve 72 through the actuator 120, the valve 72 again opens and establishes communication between the chamber 32 and the reservoir. At this stage the valve opens very slowly so that the fluid is metered from the chamber 32 past the valve and into the reservoir at a rate affording a constantly decreasing resistance to the movement of the large piston and thus accomplishing the transition from low to high pressure without pulsations in the pressure producing means.

As a result of the foregoing transition, the parts assume the position shown in Figure 3 of the drawings wherein the large piston is entirely inoperative and the small piston receives the full force exerted on the foot pedal and translates it into pressure on the fluid in the small cylinder 34, the conduits and the wheel cylinders. Because of the small area of this piston 94 and the leverage provided by the foot pedal and linkage, the operator can create any desired degree of braking action without undue effort by merely continuing to exert force on the foot pedal.

At the conclusion of a braking operation, the foot pedal lever 126 is released and returns to its retracted postion under the influence of the retractile spring 130, and simultaneously therewith the actuator 120 connected to the foot pedal lever by suitable linkage moves to its retracted position. This results in release of the valve 72 and consequently of the piston, whereupon the valve 72 closes under the influence of the spring 88 and the piston moves to its retracted posi-

tion under the influence of the retractile springs 70 and 114. During this movement the small piston is slightly advanced under the influence of the spring 104 as it moves to its seat on the annular washer 71, resulting in opening the port 108 and retaining this port open when the piston is in retracted position.

As the piston moves to its retracted position, a partial vacuum is created in the cylinder resulting in drawing fluid from the reservoir through the passages 66 in the large piston 58 past the cup 68 into the large chamber 32, thence through the ports 92 in the collar 90 and the port 108 in the small piston into the small chamber 34, completely filling the chambers 32 and 34.

During this operation fluid is returning from the motors 46 and the fluid pressure delivery pipe or conduit 44 and its branches to the cylinder, and any excess of fluid over and above the quantity necessary to completely fill the cylinder is returned to the reservoir by way of the port 38.

The subject-matter disclosed herein is claimed more broadly in my copending application, Serial No. 689,715, filed September 16, 1933, and issued as Patent No. 2,196,190, on April 9, 1940.

Although this invention has been described in connection with certain specific embodiments, the principles involved are susceptible of numerous other applications that will readily occur to persons skilled in the art. The invention is, therefore, to be limited only 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 of the class described, comprising a cylinder having a double diametral bore providing a large chamber and a relatively small chamber, a reservoir for supplying fluid to said chambers, a discharge port in the small chamber, a piston reciprocable in each chamber, means connecting said pistons, by-pass means permitting flow of fluid past the smaller piston in one direction only during advancement of said pistons, a chamber in the larger piston, circumferential passages in the larger piston connecting the piston chamber with the reservoir, a passage connecting the larger chamber and piston chamber, a valve normally closing said passage, said passage being opened by movement of said valve in the direction of advancement of said pistons to create pressure in said larger and smaller chambers, a spring interposed between said valve and said larger piston and normally holding said valve closed, said spring together with fluid pressure on the area of the valve being acted upon by the reactions exerted on said pistons by the fluid pressures in said chambers and yielding under a predetermined reaction to permit relative movement between the pistons and said valve to open the valve and relieve the fluid pressure in the larger chamber, and means for applying force to said valve to advance said pistons.

2. A fluid pressure producing device of the class described, comprising a cylinder having a double diametral bore providing a large chamber and a relatively small chamber, a reservoir for supplying fluid to said chambers, a discharge port in the small chamber, a hollow piston reciprocable in each chamber, means connecting said pistons, a port connecting the reservoir with the larger chamber, a cup washer movable with the larger piston to control said port, bypass means in the smaller piston permitting flow of fluid past the smaller piston in one direction only during advancement of said pistons, a passage through the larger piston connecting the larger chamber with the reservoir, a valve normally closing said passage, said valve being opened by movement of said valve in the direction of advancement of said pistons to create pressure in said chambers, a spring interposed between said valve and said pistons and normally holding said valve closed, said spring being acted upon by the reactions exerted on said pistons by the fluid pressures in said chambers less that degree of reaction exerted in the large chamber acting on the inner side of the valve, and yielding under a predetermined reaction to permit relative movement between the pistons and said valve to open the valve and relieve the fluid pressure in the larger chamber and means for applying force to said valve to advance said pistons.

3. A fluid pressure producing device of the class described, comprising a cylinder having a double diametral bore providing a large chamber and a relatively small chamber, a reservoir for supplying fluid to said chambers, a hollow piston reciprocable in the large chamber and having passages through its wall, a cup on the piston for preventing flow of fluid through said passages in one direction, a concentric extension on the piston having a passage therein providing a communication between the large chamber and an interior chamber of the piston, a perforated collar on the extension, a second hollow piston movably mounted on the collar and reciprocable in the small cylinder, said second piston having an axial orifice adapted to be closed by the extension and a plurality of ports, a cup on the second piston for preventing flow of fluid through said ports in one direction, a valve in the first-mentioned piston normally closing the interior chamber of the hollow piston from communication with the reservoir, said interior chamber being intermediate the valve and large chamber, a discharge port in the small cylinder, a spring positioned in the interior chamber interposed between said valve and the larger piston and acted upon by the reactions exerted by the fluid pressures on both of said pistons, said spring being yieldable under a predetermined reaction to permit relative movement between said pistons and said valve for opening of said valve and relief of fluid pressure in the larger chamber, and means for exerting force on said valve to advance said pistons.

4. A fluid pressure producing device of the class described, comprising a cylinder having a double diametral bore providing a large chamber and a relatively small chamber, a reservoir for supplying fluid to said chambers, a piston reciprocable in the large chamber and having passages through its wall, a cup on the piston for preventing flow of fluid through said passages in one direction, a chamber in the piston communicating by way of a passage with the large chamber, a head on the chamber in the piston having a passage therethrough providing communication between the reservoir and the chamber in the piston, a concentric extension on the piston, a second piston mounted on the extension and reciprocable in the small cylinder, an orifice in the small piston controlled by the extension, passages through the small piston, sealing means controlling the flow of fluid through said passages in one direction, a spring-pressed valve

in the piston chamber having a part cooperating with the head on the chamber to normally close the passage through the head and another part adapted to be acted upon by an actuator for advancing the piston, said valve during advance of the piston being acted upon by opposing forces, said force resisting opening of the valve being the spring load plus the fluid pressure in the large chamber acting on the valve, said resistance yieldable under a predetermined reaction of the second piston due to the pressure on the fluid in the small cylinder to permit opening of the valve and relief of pressure from the larger chamber.

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