Dec. 26, 1939. A. A. LOWEKE 2,184,501

COMPOUND CYLINDER

Filed Sept. 26, 1936 2 Sheets-Sheet 1

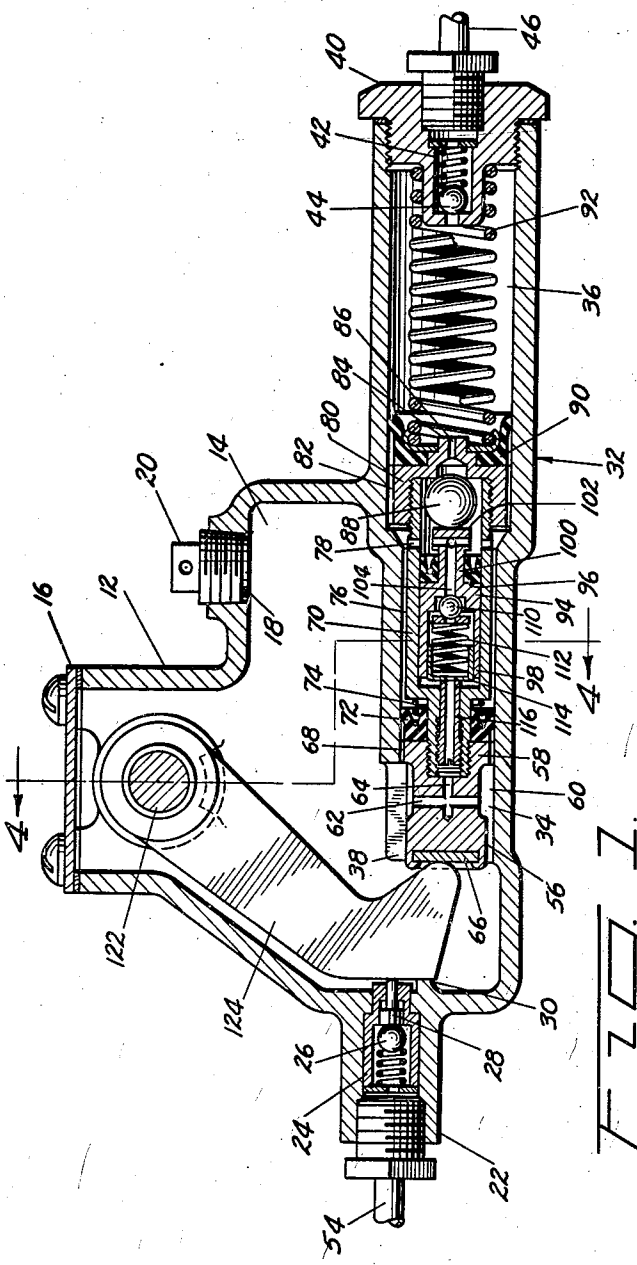


Fig. 1.

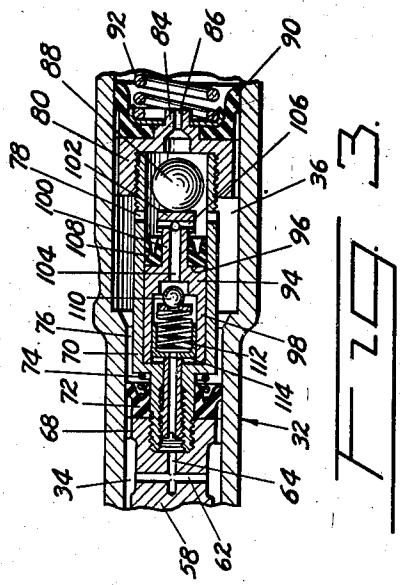


Fig. 3.

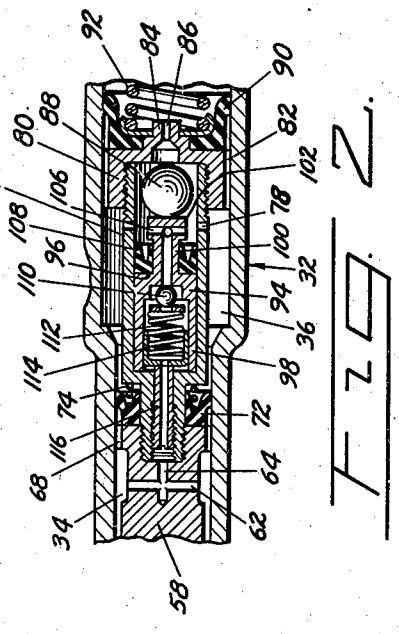


Fig. 2.

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Filed Sept. 26, 1936 2 Sheets-Sheet 2

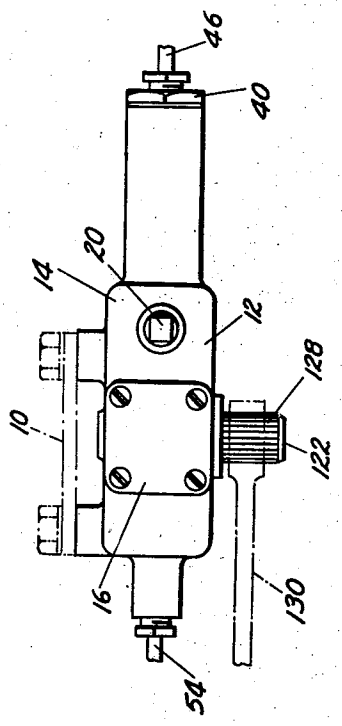


FIG. 5.

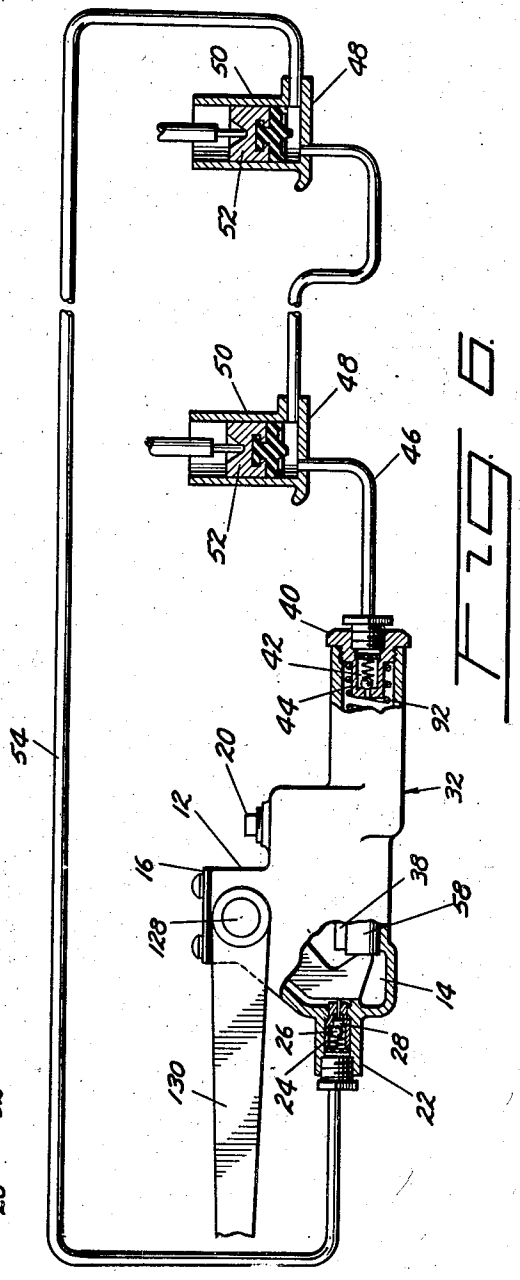


FIG. 6.

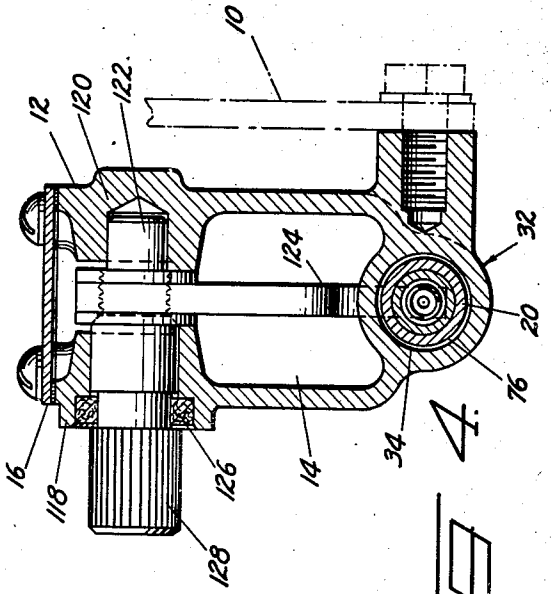


FIG. 4.

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UNITED STATES PATENT OFFICE

2,184,501

COMPOUND CYLINDER

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Application September 26, 1936, Serial No. 102,788

5 Claims. (Cl. 60—54.6)

This invention relates to fluid pressure producing devices, and more particularly to that type of fluid pressure producing device wherein for a given operating force or effort there may be imparted to an apparatus operatively connected to the device relatively small pressure resulting in comparatively large movement and subsequent greater pressure resulting in comparatively small movement.

The present application is a continuation in part of my co-pending application for United States Letters Patent for improvements in Compound cylinders, filed May 27, 1933, Serial No. 673,286 issued May 18, 1937, Patent No. 2,081,056.

An object of the invention is to provide a fluid pressure producing device adaptable for various purposes and particularly where it is desirable to build up high operating pressures.

Another object of the invention is to provide a fluid pressure producing device of the compound or stepped-up type wherein high pressures are attained without an increase in the applied force.

A feature of the invention is a double-diametral piston, and means contained within the piston operable at a predetermined pressure to transfer the load from the large head of the piston to the small head of the piston.

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

Fig. 1 is a vertical sectional view of a fluid pressure producing device;

Fig. 2 is an enlarged, sectional view of a piston and a part of the cylinder, illustrating one of the valves in open position and the other valve in closed position;

Fig. 3 is an enlarged, sectional view of the piston and a part of the cylinder, illustrating both valves in open position;

Fig. 4 is a sectional view substantially on line 4—4, Fig. 1;

Fig. 5 is a top plan view of the fluid pressure producing device; and

Fig. 6 is a diagrammatic illustration of a fluid pressure system embodying the invention.

Referring to the drawings, 10 represents a support having suitably secured thereto a casting 12 including a reservoir 14 provided with a removable cover plate 16 and a filling opening 18 which may be closed as by a plug 20. Formed upon the wall of and communicating with the reservoir 14 is a sleeve 22 having therein a valve cage 24 housing a spring-pressed ball valve 26 controlling communication between the sleeve and the reservoir. As shown, a pin 28 slidable in the valve cage 24 engages the ball valve 26 and extends into the reservoir. The pin is fitted with sufficient clearance to admit of free passage of fluid through the sleeve. Movement of the pin to open the valve is limited by a stop 30 arranged on the wall of the reservoir to arrest an actuator to be hereinafter described.

A cylinder 32 in the bottom of the reservoir has a portion extending beyond the wall thereof. As shown, the cylinder has a small chamber 34 in the reservoir and a large chamber 36 arranged concentrically to and forward of the small chamber. The inner end of the small chamber is slotted as indicated at 38, the purpose of which will hereinafter appear, and threaded in the outer end of the large chamber is a head 40 provided with a discharge port 42 controlled as by a check valve 44.

A fluid pressure delivery pipe or conduit 46 suitably connected to the discharge port 42 has coupled therein in series a plurality of fluid pressure actuated motors 48, each including a cylinder 50 and a piston 52 reciprocable in the cylinder adaptable to be connected to any type of apparatus which it may be desired to actuate. The last motor in the series is connected by a return pipe or conduit 54 to the sleeve 22 communicating with the reservoir, the communication being controlled by the ball valve 26.

A piston 56 reciprocable in the cylinder 32 includes a small piston 58 fitted in the small chamber 34 with suitable clearance for the free passage of fluid. This piston 58 has a circumferential groove 60 in its body communicating with the reservoir by way of the slot 38 in the wall of the cylinder. The piston 58 also has a diametral passage 62 communicating with the groove 60, an axial passage 64 communicating with the diametral bore, and a case-hardened insert 66 in its force-applying end providing suitable bearing surface for the actuator. The head of the piston has therein a plurality of spaced passages 68 providing communications between the circumferential groove 60 and that portion of the cylinder forward of the piston.

A double-diametral sleeve 70 threaded in the axial passage 64 in the piston 58 has sleeved thereon a collapsible leak-proof cup 72 for control of the passages 68, and a spring 74 interposed between the cup and a shoulder on the sleeve 70 serves to retain the cup against displacement. The sleeve 70 provides in conjunction with the wall of the cylinder 32 an annular chamber 76,

and a plurality of spaced ports 78 in the wall of the sleeve provide communications between the interior of the sleeve and the annular chamber.

A piston head 80 threaded on the sleeve 70 is fitted for reciprocation in the large chamber 36 of the cylinder. This head has a plurality of passages 82 therethrough providing communications between the annular chamber 76 and that portion of the cylinder forward of the piston head 80. The head 80 has a concentric extension 84, and a passage 86 extending through the extension and the head provides a communication between the sleeve 70 and that portion of the cylinder forward of the head 80. A ball valve 88 in the sleeve 70 controls the passage 80, and a collapsible leak-proof cup 90 sleeved on the extension and seated on the head 80 controls the passages 82. A spring 92 interposed between a spring seat in the bottom of the cup 90 and the head 40 of the cylinder serves to retain the cup 90 against displacement and also to return the piston to its retracted position.

A piston 94 reciprocable in the sleeve 70 includes a head 96, a skirt 98, and a concentric extension 100 having on its free end a knob 102. The head 96 and the extension 100 have an axial passage 104, and the knob 102 has a plurality of diametral passages 106 communicating with the axial passage. The passages 104 and 106 provide communications between the interior of the skirt 98 of the piston 94 and that portion of the sleeve 70 forward of the piston 94. A leak-proof cup 108 sleeved on the extension 100 and seated on the head of the piston 94 inhibits the seepage of fluid past the piston. The cup 108 is held against displacement by the knob 102 which also serves to actuate the ball valve 90.

A ball valve 110 in the skirt of the piston 94 controls the passages 104 and 106. This valve is urged to its closed position by a spring 112 interposed between the ball and a shell 114 slidable in the skirt of the piston. The shell is adjustably supported on a tube 116 threaded in that portion of the sleeve 70 having the smaller diameter. The spring 112 also serves to urge the piston to actuate the ball valve 90 into closed position.

Suitably arranged in the reservoir adjacent its top are oppositely disposed bosses 118 and 120 transversely bored for the reception of an operating shaft 122. As shown, the shaft has a double diameter, and that portion having the smaller diameter is threaded for the reception of a lever or an actuator 124 arranged for the actuation of the piston 58 and the valve 26. When the actuator is in the position of rest, the valve 26 is retained in open position so that fluid may return from the motors through the fluid pressure delivery pipe 54 to the reservoir. Suitable means, such as a leak-proof washer 126 sleeved on the shaft, is provided to inhibit the seepage of fluid from the reservoir past the shaft, and the shaft is suitably knurled as at 128 for the reception of an operating lever 130.

Assuming that the device is properly connected in the system and that the system is filled with suitable liquid or fluid, by applying force to the operating shaft 122, the actuator 124 is moved from the stop 30, resulting in releasing the valve 26, whereupon the valve moves to its closed position. This movement of the actuator also applies force to the piston 56. During the initial movement of the piston on its compression stroke, fluid pressure is received on the piston head 80, and fluid is drawn past the piston 58 and the collapsible leak-proof cup 72 into the cylinder forward of the piston 58.

Upon attaining a predetermined pressure by this movement of the piston 56, the ball valve 88 is urged by the pressure on the fluid in the large chamber 36 from its seat to open the passage 86. As the valve 88 opens, the pressure on the cup 90 is relieved, and the pressure is equalized on both sides of the piston head 80.

The pressure is then received by the cup 72 on the piston 58, also on the cup 108 on the piston 94 and on the ball valve 110. This transfer of pressure is effected without loss. Upon further movement of the piston and upon attaining a second predetermined pressure, the ball valve 110 is opened by the pressure on the fluid in the cylinder forward of the piston 58 to permit the fluid to flow through the passages 104 and 106, the skirt of the piston, the tube 116 and passages 62 and 64 and the circumferential groove 60 and past the body of the piston 58 to the reservoir.

As the piston moves on its retraction stroke, the valve 44 closes and retains the fluid in the system under pressure. This pressure is released when the actuator is moved to its retracted position against the stop 30, in which position the actuator moves the pin 28 to trip the valve 26 so that any excess fluid in the system may be returned to the reservoir. As the piston moves to its retracted position, the cups 72 and 90 collapse, and fluid is drawn from the reservoir, past the cups into the cylinder so as to completely fill the cylinder for subsequent operation.

In a normal operation, the valve 26 is closed so that fluid surges back and forth through the fluid pressure delivery line or conduit 46 connected between the fluid pressure producing device and the fluid pressure actuated motors 48. As shown, when the actuator is moved to its retracted position, the valve 44 is closed and the valve 26 is tripped so that excess fluid in the system may be returned to the reservoir.

Although this invention has been described in connection with certain specific embodiments, the principles involved are susceptible of numerous other applications that may 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 means for producing pressure including spaced pistons each having an orifice, a sleeve connecting the pistons and communicating with the orifices, fluid pressure actuated means in the sleeve for controlling the orifices operative at a predetermined pressure to open the orifice in one of the heads and at a greater pressure to open the orifice in the other head, and means for adjusting the fluid pressure actuated means for opening operation at the pressures determined.

2. A fluid pressure producing device comprising means for producing pressure including spaced pistons each having an orifice, a sleeve connecting the pistons, a valve controlling the orifice in one of the pistons, means movable in the sleeve for control of the valve, said means having a passage therethrough, a valve controlling the passage, a spring in the sleeve urging the valves to close the orifices and the passage, and means for adjusting the load on the spring.

3. A fluid pressure producing device comprising a double diametral cylinder, a piston movable

therein, said piston having spaced heads each provided with an orifice, one movable in that portion of the cylinder having the smaller diameter and the other movable in that portion of the cylinder having the larger diameter, a sleeve connecting the heads and communicating with the orifices, pressure actuated means in the sleeve for controlling the orifices operative at a predetermined pressure to open one of the orifices and at a greater pressure to open the other orifice, and means for adjusting the pressure actuated means for opening operation at the pressures determined.

4. A fluid pressure producing device comprising a piston having an orifice, a sleeve on the piston communicating with the orifice, a piston on the sleeve having an orifice communicating with the sleeve, valves in the sleeve for controlling the orifices, means normally holding the valves closed operative to open the valves successively in response to predetermined pressures, and means for adjusting the opening operation thereof to open the valves at the predetermined pressures.

5. A fluid pressure device comprising a piston having a passage therethrough, a double diametral sleeve supported on the head of the piston in communication with the passage, a head on the sleeve having an orifice communicating with the sleeve, a valve in the sleeve controlling the orifice, a piston movable in the sleeve having a passage therethrough, a valve controlling the passage, a tension member in the sleeve urging the valves to close the orifices and the passage, and means for regulating the load on the tension member.

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