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FLUID PRESSURE PRODUCING DEVICE

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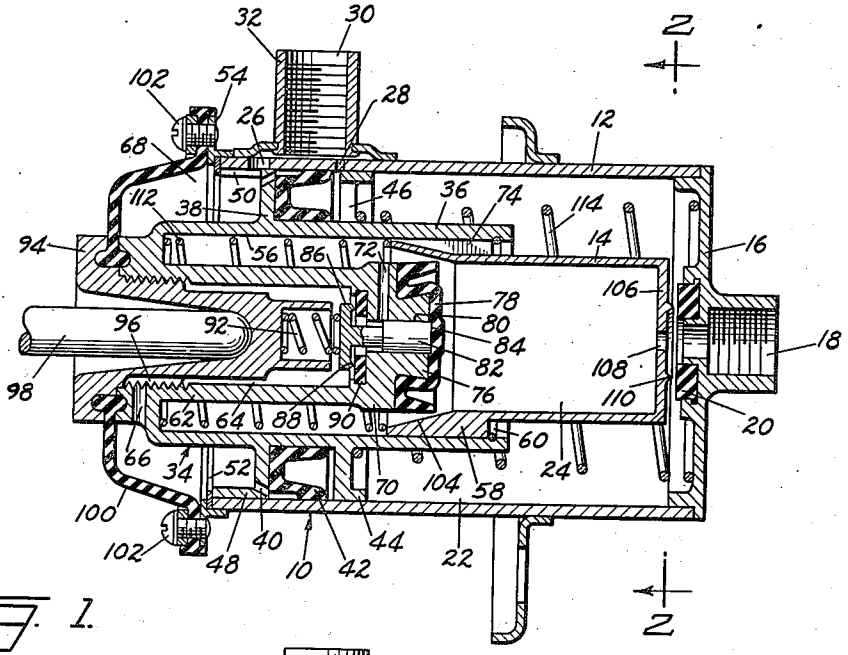


FIG. 1.

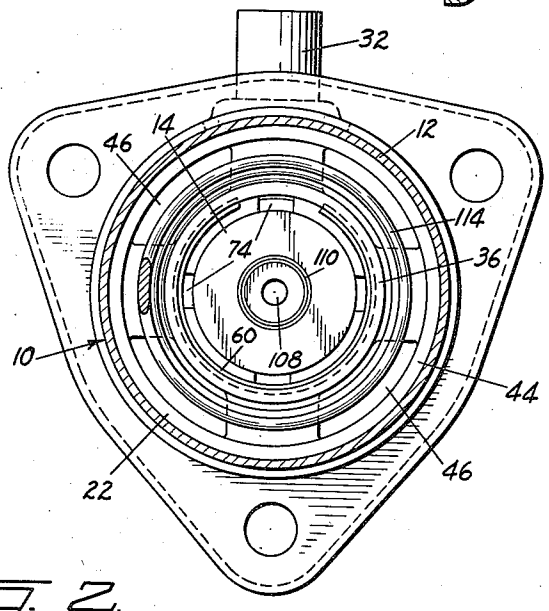


FIG. 2.

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FLUID PRESSURE PRODUCING DEVICE

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12 Claims. (Cl. 60—54.6)

This invention relates to fluid pressure producing devices and more particularly to improvements in construction thereof.

An important object of the invention is the provision of a new and improved form of compound cylinder of light and compact design.

Another object of the invention is to provide a compound cylinder having a fixed cylinder and a movable cylinder.

Another object of the invention is the provision of a compound cylinder comprising a large cylinder and a relatively small cylinder, said cylinders forming therein a large chamber and a small chamber, said small cylinder being free to move within the large chamber.

Another object of this invention is the provision of a fluid pressure producing device comprising a large cylinder and a small cylinder disposed within the large cylinder, said cylinders forming respective large and small chambers and having a communication therebetween forward of the small cylinder, and valve means on the head of said small cylinder for closing the communication.

Another object of the invention is to provide a fluid pressure producing device including a large cylinder and a small cylinder, a piston reciprocable within the cylinders, said piston supporting the small cylinder on a suitable bearing surface.

Another object is the provision in a fluid pressure producing device of a new and improved compound piston assembly functioning within a compound cylinder assembly.

A further object is the provision of a compound piston and cylinder assembly comprising a small cylinder disposed concentrically interiorly of a large cylinder and a small piston operable within the small cylinder and disposed concentrically interiorly of a large piston operable within the large cylinder.

A further object is the provision of a compound piston and cylinder assembly comprising a small cylinder shiftable axially within a large cylinder to control pressure discharge of fluid from the large cylinder. The small cylinder has one end positioned within and supported by the piston assembly which is reciprocable within the large cylinder, and the piston assembly has an interior high pressure piston portion which reciprocates within the small cylinder.

Another object is the provision of a fluid pressure producing device comprising a low pressure chamber and a high pressure chamber disposed interiorly of the low pressure chamber and including a high pressure cylinder reciprocably receiving the high pressure piston and itself being reciprocable within the low pressure chamber.

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

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

Fig. 2 is a sectional view of the fluid pressure producing device substantially on line 2—2, Fig. 1.

Referring to the drawing for more specific details of the invention, represented generally at 10, is a compound cylinder comprising an assembly of sheet metal tubing, die castings and stampings welded or otherwise suitably secured together to form an integral unit. The compound cylinder 10 includes a small movable cylinder 14 and a large stationary cylinder 12. Cylinder 12 is closed at one end by a head 16 provided with a discharge port 18 and secured therein against displacement, and surrounding the discharge port is a resilient washer 20. Discharge port 18 connects to fluid pressure delivery pipes or conduits, not shown, for the delivery of fluid under pressure to suitable motors, not shown, for the actuation thereof.

As shown, cylinders 12 and 14 provide a large chamber 22 and a small chamber 24. The large chamber 22 has ports 26 and 28 for communication with a reservoir, not shown, by way of a port 30 in connection 32. Reciprocable within the cylinder 12 is a piston structure 34 including a shell 36 provided with a piston head 38 fitted snugly in the large cylinder 12 and having passages 40 therethrough, and a sealing cup 42 disposed on the head 38 of the piston for control of the passages and to provide a compression seal within the large cylinder 12. A radially extended flange 44 on the shell having passages 46 therethrough is provided to furnish a greater bearing surface for the shell on the wall of the cylinder 12. Axially extended from the rear of the piston head 38 is a circumferential flange 48 slotted as at 50, and adapted to engage this flange to retain the piston 34 against displacement is a washer 52 supported on a retaining ring 54 fitted on the open end of cylinder 14.

The shell 36 has a finished inner bore 56 providing a bearing surface for a rim portion 58 of small cylinder 14. A retaining ring 60 is seated in a groove in the wall of the shell and serves to retain the cylinder against displacement.

Piston structure 34 has an inner portion 62 formed concentrically within the shell 36 con-

stituting a high pressure piston which is of smaller diameter than the diameter of the small chamber 24 within which it is adapted to reciprocate. This inner high pressure piston portion is hollowed out interiorly providing a chamber 64 and its wall has a plurality of ports 66 therethrough providing communication between the chamber 64 and a chamber 68 back of the piston. Inner portion 62 has a head 70 fitted thereon for reciprocation within the small chamber 24 formed by the small cylinder 14. The head 70 has a passage 72 therein providing communication between chamber 62 and the large chamber 22 within the cylinder by way of passages 74 in the rimmed portion 58 of cylinder 14. A raised portion 76 on the head 70 serves to seat and firmly hold a sealing cup 78 thereon. This sealing cup forms the pressure seal within the cylinder 14. A bore 80 in the head 70 communicates with the passage 74 and has a plunger 82 reciprocable therein.

Plunger 82 has at one end a head 84 in abutting relation to the sealing cup 78 and thereby is subjected to fluid pressure within the small chamber. The plunger has an annular portion 86 at its opposite end exposed to fluid pressure within the large chamber 22. The plunger 82 is provided with an annular bead 88 defining a valve arranged to seat on a rubber gasket 90 in the chamber 64 for control of communication between chamber 22 and chamber 64 through the passage 72. The valve 88 is normally held against its seat by a spring 92 interposed between the annular portion 68 of the valve and a plug 94 threaded into the piston structure 34.

Plug 94 provides passages 96 through its threaded length and has a recessed back for the reception of a thrust rod 98. A resilient boot 100 is firmly held at one end between the plug and piston and is fastened at its other end by means of bolts 102 to the retaining ring 54 to thereby define the chamber 66 back of the piston 34.

Cylinder 14 defining chamber 24 has a tapered bore 104 through its rimmed section, the purpose of which will hereinafter appear. The forward end of the cylinder is closed as by a head 106 having an opening 108 therethrough registering with the port 18 in the head 16 of the cylinder 14, and an annular bead 110 on the head 106 of the cylinder 14 is adapted to seat on the resilient washer 20 to close the large chamber off from the discharge port. The cylinder 14 is maintained against displacement upon the retaining ring 60 by a spring 112 interposed between the rimmed end of cylinder 14 and shell 36. A spring 114 interposed between the head 16 of cylinder 12 and the flange 44 on the shell of the piston 36 serves to maintain the piston against displacement and to assist in returning it to its retracted position.

In Fig. 1 the parts of the structure are shown in the idle position with the piston assembly 34 retracted and small cylinder 14 held on retaining ring 60 of the piston assembly by spring 112. In this position the large chamber communicates directly with discharge port 18 as the small cylinder is withdrawn away from the head 16 of the large chamber. In a normal operation upon imparting force from a suitable means not shown to the thrust rod 98, the force thereby transmitted results in movement of the piston structure 34 on its compression stroke.

During the initial movement of the piston on its compression stroke fluid under pressure is displaced from the large chamber 22 past the head of cylinder 12 through the discharge port 18 into fluid delivery pipes not shown, thence to suitable motors also not shown for the actuation thereof. The fluid is capable of displacement past the head of cylinder 14 because of the pressure velocity head at that point being sufficient to resist the pressure acting on the side of the head 106 in chamber 24, until a predetermined pressure is attained on the fluid in the system. As the fluid pressure is increased to a predetermined pressure, which when multiplied by the area of the valve is slightly in excess of the load on the compression spring 92, the plunger is moved to trip the valve 88 and thereby relieve the fluid pressure in the large chamber of the cylinder, a portion of the fluid being returned from the large chamber of the cylinder through the passage 72, the valve 88, the chamber 64, the passages 66, the chamber 68, and thence through port 26, and port 30 into the reservoir. Likewise during the relief of pressure on the fluid in the large chamber, the spring 112 becomes effective to move the cylinder 14 to its seat on the resilient washer 20 and thereby close communication between the large chamber 22 and the discharge port 18. Thereafter, the pressure developed is attributed solely to the movement of the head of the piston 34 within the small or high pressure chamber 24.

Upon release of the applied force, the piston 34 is moved to its retracted position under the influence of spring 114 and fluid is returned under pressure from the fluid pipe lines. With the return of the piston to its retracted position, spring 92 moves the valve to its closed position.

As the piston returns to its retracted position, a partial vacuum is created in the chamber 24 and results in drawing fluid from the reservoir through the port 26 into the chamber 68; thence through the passages 40 in the head 38 of the piston, past the sealing cup 42, the passages 46, thereon through the passages 74, and past the sealing cup 78 into the chamber 24, completely filling the chambers 22 and 24.

With the return of the fluid from the motors and fluid line, the chamber 24 may receive a quantity of fluid in excess of its capacity and under this condition the excessive fluid is displaced therefrom either through the passage forward of the cylinder 14 into chamber 22 or past the sealing cup 78 through the tapered section 104 of cylinder 14 through passages 74 into the chamber 22. The fluid thus returned to chamber 22 is then displaced therefrom through passages 46, the port 28, thence through port 30 into the reservoir. The reason for the tapered section on the cylinder is for the purpose of permitting the free passage of any air that may become trapped in the cylinder 24 and thereby eliminate an undesirable effect produced by air in hydraulic pressure producing devices of this type.

A small pressure producing cylinder 14 is supported within by the shell 36 of the piston structure 34 and held to its seat therein by spring 112. The shell 36 carries the low pressure piston sealing cup 42. The high pressure piston portion 62 which carries on its head sealing cup 78 and reciprocates within the high pressure cylinder 14 is spaced concentrically within the shell 36 to permit the high pressure cylinder 14 to enter the space between the shell 36 and the high pressure piston 62.

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 large cylinder, a concentrically disposed small cylinder enclosed within and movable relative to the large cylinder, and a piston having a part reciprocable within the large cylinder and another part reciprocable within the small cylinder, said small cylinder including a part having an external bearing surface supported in the part of the piston reciprocable in the large cylinder, and means in the piston positioning the small cylinder when the piston is in retracted position so that the part of the piston reciprocable in the small cylinder is withdrawn therefrom.

2. A fluid pressure producing device comprising a large cylinder and a small cylinder, said large cylinder defining a large chamber having a head and a port therethrough, said small cylinder defining a small chamber including a head having an opening therethrough registering with the port of the large cylinder, a piston having a large head and a small head disposed for reciprocation within the respective chambers, means for retracting the piston, and means providing multiple communications between the large chamber and small chamber, said small cylinder and piston movable relative to the large cylinder to close said communications.

3. A fluid pressure producing device comprising a large cylinder and a small cylinder, a piston including a large head and a small head reciprocable within the respective cylinders, a part of the piston providing a bearing surface for the small cylinder, said large cylinder having a head with a discharge port therethrough defining a large chamber, the port being in direct communication with the large chamber, said small cylinder movable within and relative to the large cylinder including a head having an opening therethrough registering with the port of the large cylinder and defining a small chamber therewithin, means on the piston normally holding the small cylinder in spaced relation to the large cylinder head, and means on the head of the small cylinder for closing the communication between the large chamber and discharge port upon actuation of the piston.

4. A fluid pressure producing device comprising a large cylinder defining a large chamber and a small cylinder defining a small chamber, a head on the large cylinder having a discharge port therethrough, said small cylinder movable within and relative to the large cylinder including a head having an opening registering with the port, a piston including heads reciprocable within the respective chambers, a portion of the piston providing a support for the small cylinder and including means for normally spacing the head of the small cylinder with relation to the large cylinder head and thereby affording communication between the large chamber and small chamber, and means between the head of the small cylinder and the head of the large cylinder for closing said communication upon actuation of the piston.

5. A fluid pressure device comprising a large cylinder having a discharge port, a piston assembly reciprocable within the large cylinder, and a small cylinder within the large cylinder shiftable toward and away from the discharge port and controlling communication therethrough, said piston assembly embracing and providing a bearing support for the small cylinder.

6. A fluid pressure producing device comprising a large cylinder, a piston assembly reciprocable as a unit therein and comprising a small piston head and a large piston head, a small cylinder telescoped within and supported by the large piston head of the piston assembly and adapted to receive the small piston head of such assembly.

7. A fluid pressure producing device comprising a large cylinder, a piston assembly reciprocable therein comprising a large piston head and a small piston head, a spring yieldingly urging said piston assembly to the retracted position within the cylinder, a small cylinder receiving the small piston head and supported by the large head of the piston assembly, and a spring yieldingly urging said small cylinder to a determined position upon the piston assembly.

8. A fluid pressure producing device comprising a low pressure chamber having a discharge port, a high pressure chamber having a discharge port, a piston having parts reciprocable in the respective chambers, said high pressure chamber supported by the piston part reciprocable in the low pressure chamber for shiftable movement to establish direct communication between the low pressure chamber through both discharge ports or to dis-establish such communication.

9. A fluid pressure producing device comprising, in combination, a large cylinder, a piston assembly having a large hollow piston portion and a small hollow piston portion, a small cylinder supported by the piston assembly within the large hollow piston portion and itself receiving the small piston portion, and valve means adapted to control communication between the two ends of the large cylinder through the small hollow piston portion.

10. A fluid pressure producing device comprising a large cylinder defining a large chamber and a small cylinder defining a small chamber, heads on the respective cylinders having discharge ports therethrough, a piston including heads reciprocable in the respective cylinders, means for actuating the piston, a passage in the piston providing communication between that portion of the large chamber forward of the large piston head and that portion of the chamber rearward thereof, a normally closed valve controlling the passage, the head of the small cylinder normally spaced apart from the head of the large cylinder, said small cylinder normally resisted from movement, and means providing for the engagement of the head of the small cylinder with the head of the large cylinder upon pressure development due to the actuation of the piston sufficient to open the valve and establish communication between that portion of the large chamber forward and aft of the large piston head.

11. A fluid pressure producing device comprising a large cylinder including a head having a discharge port therethrough and a small cylinder including a head having an opening registering with the port, a piston including heads reciprocable within the respective chamber and a bearing connection between the piston and small cylinder having passages therethrough, said piston including means spacing the head of the small cylinder from the head of the large cylinder when in retracted position, and providing communication between the cylinders aft of the small cylinder by way of the passages in the bearing connection and forward of the small

cylinder by way of the port in the head of the small cylinder.

12. Fluid pressure producing mechanism comprising concentric large and small cylinders each having a discharge port, a piston assembly provided with concentric large and small piston heads reciprocable within the respective cylinders, said small cylinder supported entirely by the piston assembly and projecting therebeyond freely within the large cylinder and reciprocable to establish direct communication of the small cylinder with the discharge port of the large cylinder.

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