Sept. 24, 1935. H. C. BOWEN 2,015,511

COMPOUND CYLINDER

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Fig. 1.

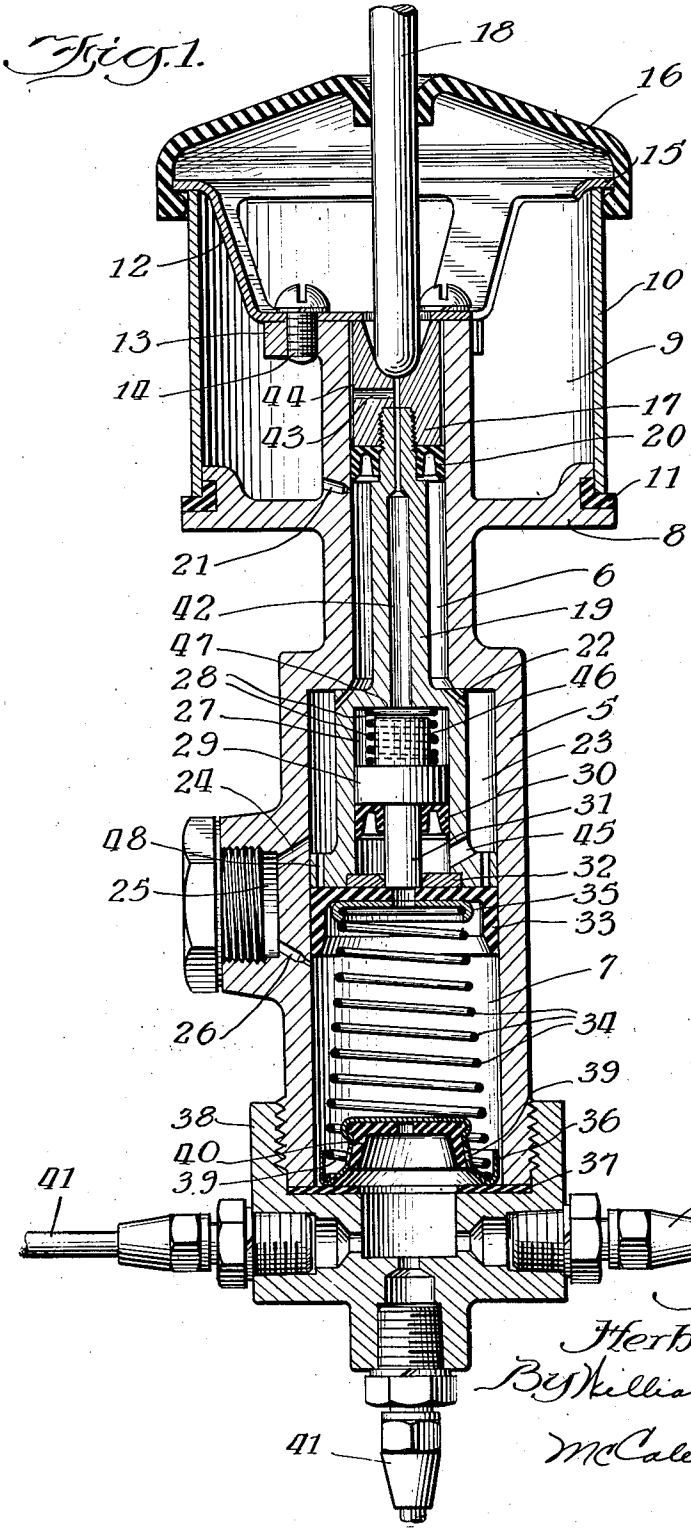


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Fig. 2.

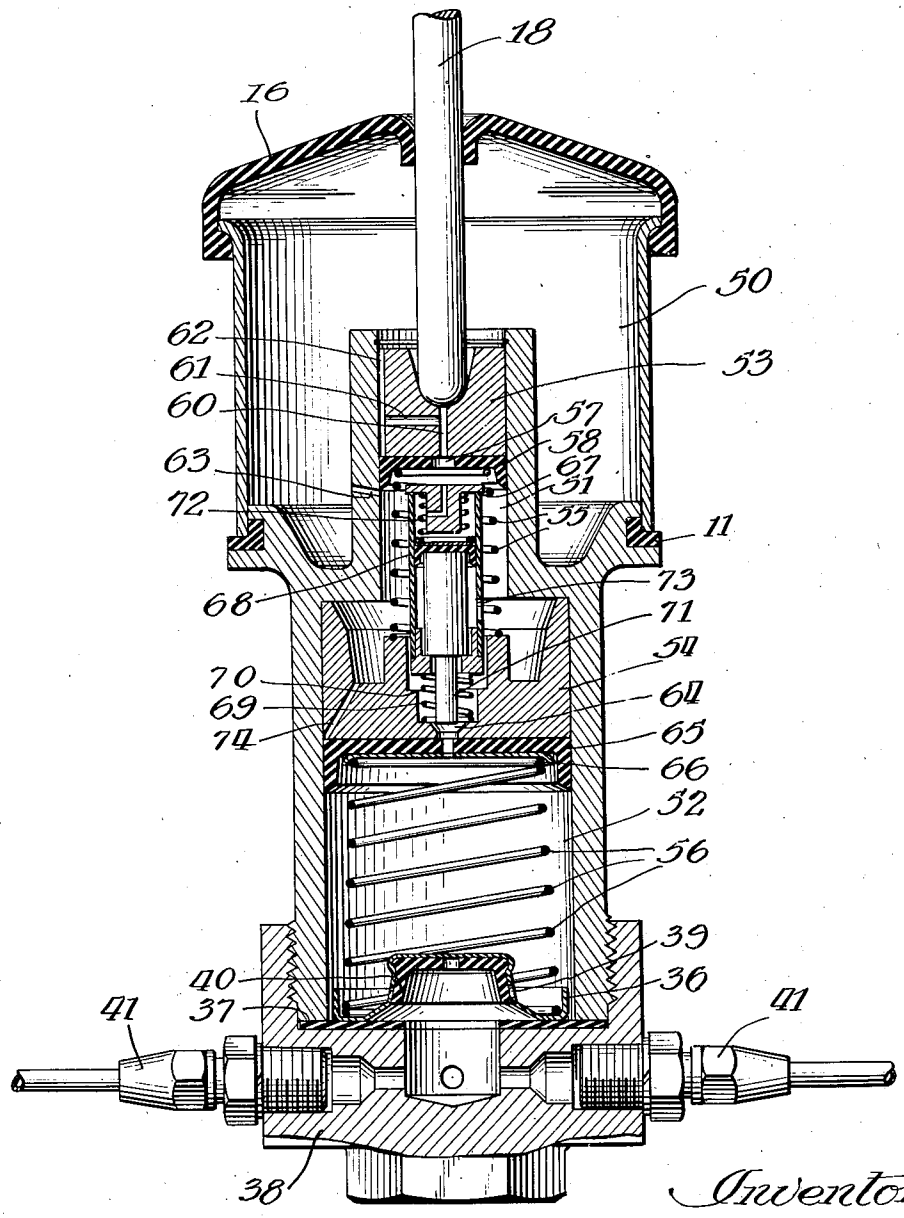


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Fig. 3.

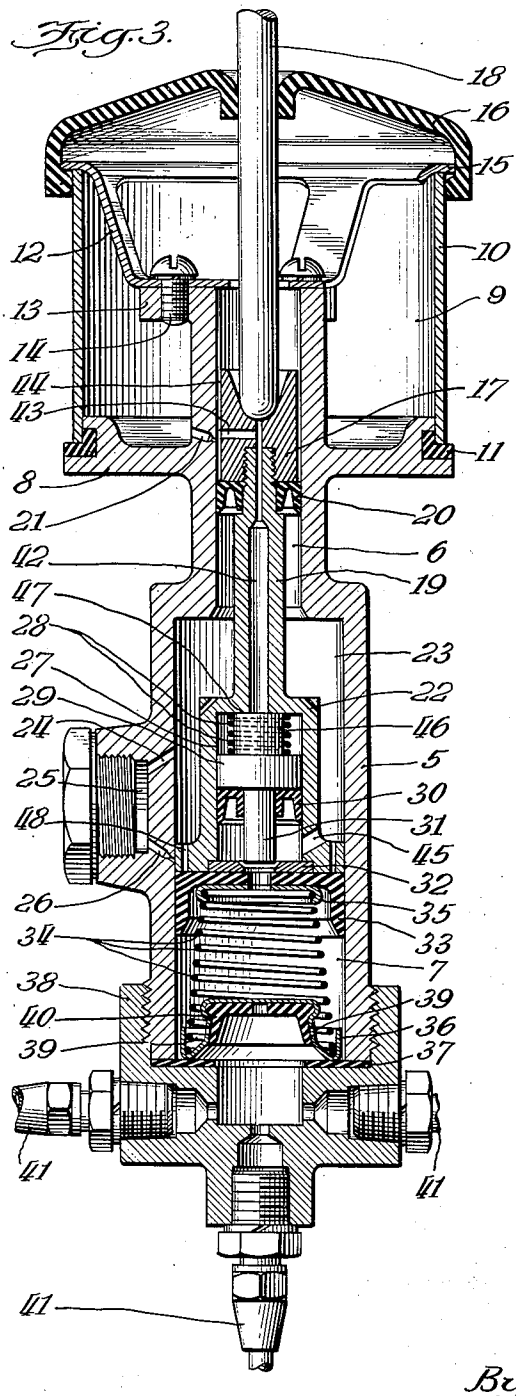
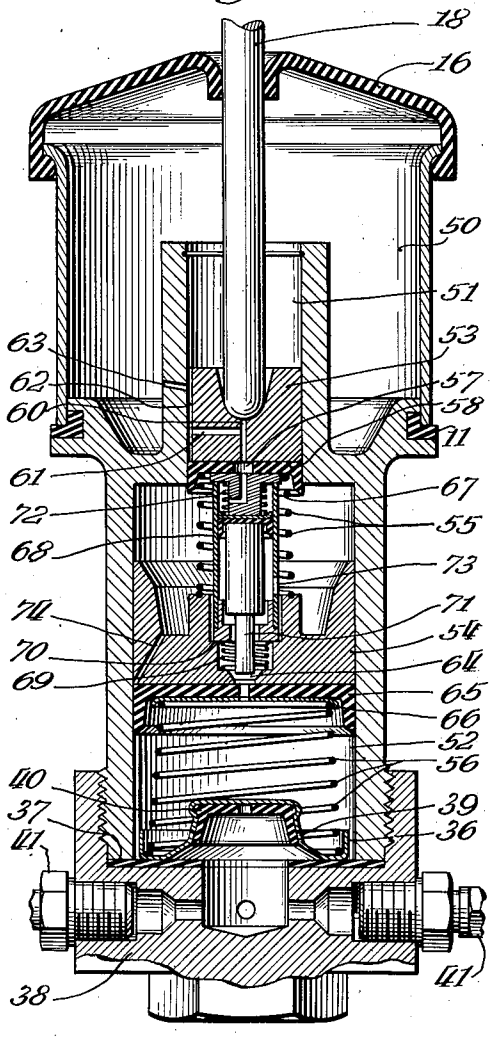



Fig. 4.

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2,015,511

# UNITED STATES PATENT OFFICE

2,015,511

## COMPOUND CYLINDER

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Application April 22, 1932, Serial No. 606,784

12 Claims. (Cl. 60—54.6)

My invention pertains to compound cylinders and is particularly concerned with a type of cylinder especially adapted for hydraulic brake systems and similar fluid systems for transmitting power.

An object of my invention is to provide a compound cylinder wherein the outlet port is connected directly to the large cylinder.

Another object is to provide a compound cylinder wherein no fluid is by-passed back to the reservoir when the low pressure piston becomes inactive.

Another object is to provide a new and improved compound cylinder.

Other objects and advantages will become apparent as the description proceeds.

In the drawings, Fig. 1 is a vertical section of one embodiment of my invention;

Fig. 2 is a similar view of a second embodiment of my invention;

Fig. 3 is a view of the embodiment illustrated in Fig. 1 but shows the parts in the positions they assume when the low pressure cylinder becomes inoperative; and

Fig. 4 is a view of the embodiment illustrated in Fig. 2 but shows the parts in the positions they assume when the low pressure cylinder becomes inoperative.

Referring to Figs. 1 and 3, I have illustrated my invention as having a casting 5 providing a high pressure cylinder 6 and a low pressure cylinder 7. The casting also provides the base 8 of a reservoir 9 having a wall 10 of sheet metal or other suitable material. The wall 10 is clamped between a gasket 11 carried by the base 8 and a spider 12 which is fastened by means of screws 14 to a flange 13 formed by the upper end of the casting 5. The edge 15 of spider 12 overhangs the wall 10 and serves as a retaining means for the rubber boot 16 which covers the upper end of the reservoir.

A piston 17 is located in the high pressure cylinder 6 and is moved in fluid discharging direction by a piston rod 18 which may be actuated by a foot pedal, hand lever, or any other suitable manually-operated or power-driven mechanism. The lower end of the piston rod 18 is rounded and simply rests in a socket formed in the upper end of the piston 17 with which the lower end of the piston rod 18 forms a separable connection.

A low pressure piston 19 is threadedly secured to the high pressure piston 17 and the joint between the two is sealed by a rubber gasket 20 which also forms a seal between the high pressure piston and the wall of the high pressure cylinder. A port 21 connects the reservoir with the high pressure cylinder when the high pressure piston is in the retracted position shown in the drawings. When the parts are in the position shown in Fig. 1 of the drawings, the low pressure cylinder 7 is also in communication with the reservoir by way of port 21 formed in the wall of the high pressure cylinder, high pressure cylinder 6, diagonal passageways 22 cutting across a corner formed at the junction of two different diameter portions of the low pressure piston, annular space 23 formed between the wall of the low pressure cylinder and the reduced portion of the low pressure piston immediately in rear of the head thereof, passageway 24 formed in the wall of the low pressure cylinder immediately in rear of the head of the low pressure piston, passageway 25 provided by a boss integral with the wall of the low pressure cylinder, and passageway 26 formed in the wall of the low pressure cylinder at a point immediately in front of the sealing cup associated with the head of the low pressure piston.

The low pressure piston 19 has a cylindrical chamber 27 in which is located a relief valve spring 28 acting on a piston 29 provided with a sealing gasket 30 and a forward extension 31 which functions as a valve to close the opening in an annular washer 32 mounted in the forward end of the low pressure piston.

A rubber cup 33 forms a seal with the wall of cylinder 7 and also prevents leakage between the extension 31 and washer 32. The cup 33 is held against the forward or lower face of the low pressure piston by retractile spring 34 which has one of its ends abutting against a sheet metal cup 35 and its other end resting against a sheet metal valve body 36 which is pressed against a gasket 37 clamped between the end of the casting 5 and a shoulder provided by a cap 38 which is threadedly secured to the lower end of the casting.

The valve body 36 has outlet ports 39 which are normally closed by the flange of a rubber cup 40. This valve mechanism is described and claimed in United States Letters Patent No. 1,985,936, of January 1, 1935, in the name of Erwin F. Loweke.

One or more fluid conduits 41 may be connected to the cap 38. These conduits may lead to brake operating cylinders of the type disclosed in United States Letters Patent No. 1,832,135, of November 17, 1931, or to any other mechanism operated by fluid pressure.

With the parts at rest as shown in Fig. 1 of the drawings, the spring 34 holds the high and low pressure pistons in their elevated or retracted

positions. Both the high and low pressure cylinders are in free communication with the fluid reservoir. The upper part of the cylindrical chamber 27 is in communication with the reservoir 9 by way of passage 42 formed in the low pressure piston, and radial passages 43 formed in the high pressure piston and which lead to longitudinal grooves 44 likewise formed in the high pressure piston. The power end of this chamber 27 is also in communication with the reservoir by way of port 45, annular space 23, passageways 22, high pressure cylinder 6, and port 21.

When force is exerted upon the piston rod 18, the high and low pressure pistons move downwardly, closing the ports 26 and 21, respectively, and cutting off communication between the reservoir and the high and low pressure cylinders. After the low pressure piston has passed the port 26, continued downward movement of this piston forces fluid from the low pressure cylinder through the ports 39 and thence to the conduits 41. As the low pressure piston moves downwardly, the annular space 23 increases in length, and the fluid necessary to fill the increased capacity of this annular chamber is drawn from the reservoir through grooves 44 and past rubber gasket 20, the outer edge of which collapses sufficiently to permit this flow of fluid therepast.

When the pressure in the low pressure cylinder and conduits reaches a predetermined value, the force exerted on the end of extension 31 is sufficient to overcome spring 28, whereupon piston 29, gasket 30 and extension 31 move upwardly relative to the low pressure piston and the lower end of extension 31 is withdrawn from the opening in the washer 32 as shown in Fig. 3. This establishes free communication between the front and rear sides of the low pressure piston by way of the central openings in cup washer 33, washer 32, and port 45.

Rearward movement of the piston 29 is limited by the engagement of the upper end of its rearward extension 46 with the shoulder 47. Thereafter the fluid can by-pass the low pressure piston and this piston becomes inoperative. The burden of creating additional pressure is then assumed by the high pressure piston which continues to advance, thereby forcing additional fluid into the conduits 41.

When the desired braking effect has been accomplished, the operator relieves the force exerted on the piston rod 18, whereupon this rod may be returned to initial position independently of the pistons by means of the retractile spring commonly associated with the brake lever or by any other suitable means where my compound cylinder is used in fluid systems other than those associated with hydraulic brakes. The high and low pressure pistons are thereupon returned to their retracted position by the spring 34.

In hydraulic brake systems it frequently happens that the piston of the compression cylinder is returned faster than the pistons of the brake actuating cylinders so that a sub-atmospheric pressure is created in the compression cylinder. In my compound cylinder the creation of such a sub-atmospheric pressure would result in drawing fluid from the reservoir through ducts 44 and past rubber gasket 20 into the high pressure cylinder 6. As soon as the pressure in the low pressure cylinder dropped, due to the withdrawal of force from the piston rod 18, the extension 31 would be returned by spring 28 to the position shown in Fig. 1 of the drawings, thereby closing the by-pass through the low pressure piston. The fluid drawn into the high pressure cylinder during the retractile stroke of the pistons would find its way into the low pressure cylinder through passageways 48 formed in the low pressure piston and thence past the flange of cup washer 33 which would collapse during this retractile stroke.

The embodiment shown in Figs. 2 and 4 of the drawings is generally similar to that illustrated in Figs. 1 and 3 and comprises reservoir 50, high pressure cylinder 51, low pressure cylinder 52, high pressure piston 53 and low pressure piston 54. The pistons are reciprocated on their fluid discharging stroke by piston rod 18, as in the previous embodiment.

In this embodiment the high pressure piston 53 is held in elevated position by a spring 55 which rests on the low pressure piston 54. The latter piston is held in elevated or retracted position by a spring 56 which is somewhat stronger than the spring 55.

In the position of the parts shown in Fig. 2, the high pressure cylinder 51 is in free communication with the reservoir by way of opening 57 formed in the rubber cup 58, passageways 60 and 61, and grooves 62. If desired, a port 63 may also be provided. The low pressure cylinder 52 communicates with the high pressure cylinder 51 by means of passageway 64 formed in the piston 54 and rubber and metal cups 65 and 66.

Initial downward movement of the high pressure piston closes the port 63 and brings the rubber cup 58 into engagement with the base 67 of a cylindrical member 68, thereby cutting off communication between the high pressure cylinder and reservoir 50. Further advance of the high pressure piston causes corresponding advancement of the cylindrical member 68, thereby compressing relatively weak spring 69 until the lower end of this cylindrical member engages shoulder 70, whereupon further advance of the high pressure piston creates equal advance of the low pressure piston.

By the time the lower end of cylindrical member 68 has engaged shoulder 70, valve 71 has entered passageway 64 and sealed against rubber cup 65, thereby closing the opening through the low pressure piston. Further advance of the high and low pressure pistons causes the low pressure piston to discharge fluid into conduits 41 through ports 39 formed in valve member 36. As the low pressure piston advances, it creates a vacuum in back of it which draws additional fluid from the reservoir through grooves 62 and past the collapsed edge of rubber cup 58.

When a predetermined pressure is reached, valve 71 is moved rearwardly against the tension of spring 72, thereby establishing a by-pass through the low pressure cylinder by way of passageway 64, the interior of cylindrical member 68, and port 73 as shown in Fig. 4. Thereafter the fluid may freely by-pass the low pressure piston and the high pressure piston functions as the sole means for creating pressure on the fluid in conduits 41.

During the retractile stroke of the pistons, additional fluid from the reservoir may be sucked into the high and low pressure cylinders by means of grooves 62 and passageways 74.

While I have illustrated and described two embodiments of my invention, it is to be understood that my invention may assume numerous

forms and that the scope of my invention is to be limited solely by the following claims.

I claim:

1. In a hydraulic system of the class described, the combination of a conduit, a low pressure cylinder connected to said conduit for supplying fluid thereto, a high pressure cylinder discharging into said low pressure cylinder and communicating with said conduit only through said low pressure cylinder, pistons in said cylinders, a valved connection between said cylinders, and means for operating said pistons.

2. In a hydraulic system of the class described, the combination of a conduit, a low pressure cylinder discharging into said conduit, a high pressure cylinder communicating with said conduit only by way of said low pressure cylinder, a valved connection between said cylinders adapted to open when the low pressure cylinder attains a predetermined pressure, pistons in said cylinders, and means for reciprocating said pistons.

3. In a fluid system of the class described, the combination of a conduit, a cylinder communicating with said conduit, a piston for creating a relatively low pressure therein, a second piston for creating a higher pressure in said cylinder, a valve for automatically rendering said first-named piston inoperative upon the creation of a predetermined pressure in said cylinder whereby said high pressure is communicated therethrough to the conduit, and means for reciprocating said pistons.

4. In mechanism of the class described, the combination of a large cylinder, a piston reciprocable therein, said cylinder having a fluid outlet, a fluid reservoir for said cylinder, a smaller cylinder interposed between said reservoir and said large cylinder, said large cylinder communicating with said reservoir through said small cylinder, pistons in said cylinders, and means for operating said pistons.

5. In mechanism of the class described, the combination of a fluid reservoir, a high pressure cylinder communicating therewith, a low pressure cylinder communicating with said high pressure cylinder and supplied with fluid therefrom, a conduit connected to said low pressure cylinder, a piston in each of said cylinders, a loaded valve in said low pressure piston, said valve openable to permit fluid to flow from in front of the sealing portion of said piston to the rear thereof, and means for operating said pistons.

6. In a fluid system of the class described, the combination of aligned high and low pressure cylinders, a fluid reservoir communicating with said high pressure cylinder, a piston in each of said cylinders, said pistons being rigidly connected, a fluid receiving conduit connected solely with said low pressure cylinder, means for operating said pistons, and means for connecting the low pressure cylinder with said high pressure cylinder upon the creation of a predetermined pressure in said low pressure cylinder.

7. In a compound cylinder of the class described, the combination of a low pressure cylinder, a high pressure cylinder, pistons in said cylinders, a fluid reservoir, means establishing communication between said cylinders and said reservoir when said pistons are in retracted position, means for advancing said pistons, and means operative upon the creation of a predetermined maximum pressure in said low pressure cylinder to open a passageway through the low pressure piston and establish communication between the parts of said cylinders on the pressure sides of said pistons.

8. In mechanism of the class described, the combination of a low pressure cylinder, a fluid reservoir, a high pressure cylinder located between said low pressure cylinder and reservoir and establishing communication therebetween, a piston in said high pressure cylinder, a piston in said low pressure cylinder for discharging fluid therefrom and for simultaneously drawing additional fluid from the reservoir and into said high pressure cylinder in front of the high pressure piston therein, and a conduit for receiving the discharge from said cylinders.

9. In mechanism of the class described, the combination of a low pressure cylinder, a fluid reservoir therefor, a high pressure cylinder providing communication between said cylinder and reservoir, pistons reciprocably mounted in said cylinders, means establishing communication between said cylinders when said pistons are in retracted position, means for advancing said pistons to cut off communication by way of said last-named means, and other means to reestablish communication between said cylinders upon the creation of a predetermined pressure in one of said cylinders.

10. In a compound cylinder of the class described, the combination of a low pressure cylinder, a high pressure cylinder, a piston in each of said cylinders, the low pressure piston having a port therethrough for establishing communication between those parts of said cylinders which are in advance of said pistons, a loaded valve controlling said port, means for reciprocating said pistons, a fluid reservoir communicating with said high pressure cylinder, and a discharge conduit connected to said low pressure cylinder.

11. In mechanism of the class described, the combination of a high pressure cylinder, a low pressure cylinder, a high pressure piston in the high pressure cylinder, a low pressure piston in the low pressure cylinder, said last-named piston having an opening therethrough, a valve operated by the initial protractile movement of said high pressure piston to close said opening, operating means for said pistons, and a conduit receiving the discharge from said cylinders.

12. In a hydraulic system of the class described, the combination of a conduit, a low pressure cylinder connected to said conduit for supplying fluid thereto, a high pressure cylinder discharging into said low pressure cylinder and communicating with said conduit only through said low pressure cylinder, pistons in said cylinders, a valve subject to outside pressure and the pressure in the low pressure cylinder controlling communication between said cylinders, and means for operating said pistons.

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