April 7, 1936. E. F. LOWEKE 2,036,342

COMPOUND CYLINDER

Filed July 11, 1932 2 Sheets-Sheet 1

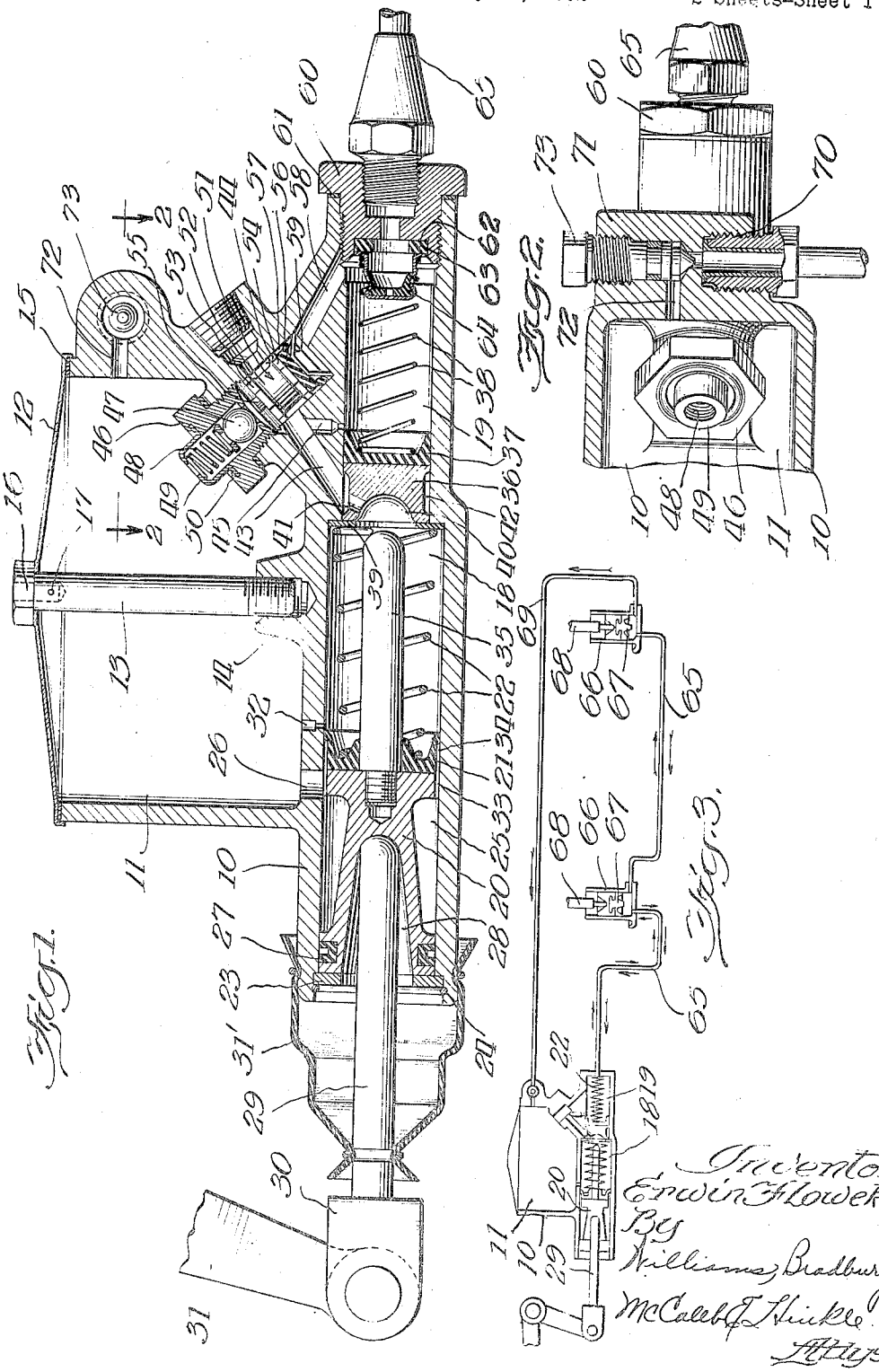

Fig. 1.

Fig. 2.

Fig. 3.

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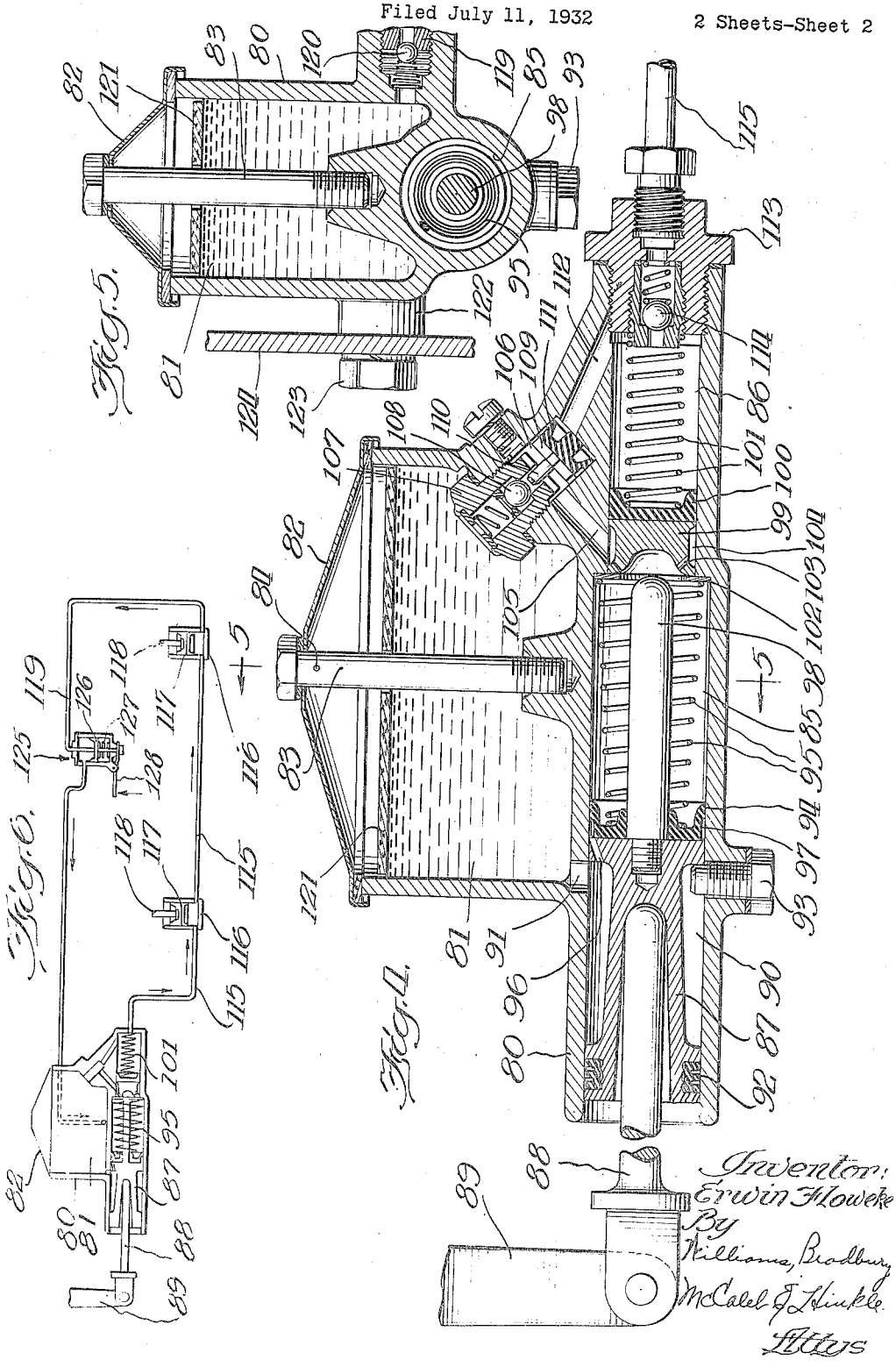

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2,036,342

COMPOUND CYLINDER

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3 Claims. (Cl. 60—54.6)

My invention pertains to compound cylinders and is particularly concerned with compound cylinders especially adapted for use in power transmission systems of the fluid type.

An object of my invention is to provide a compound cylinder having high and low pressure pistons, and means for rendering the low pressure piston ineffective upon the creation of a predetermined pressure.

Another object is to provide a compound cylinder in which there is no back pressure on the low pressure cylinder after it has been rendered ineffective.

Another object is to provide a compound cylinder wherein the pressure at which the low pressure cylinder is rendered ineffective may be accurately predetermined.

Another object is to provide a compound cylinder wherein the pressure at which the low pressure cylinder is rendered ineffective may be changed readily to meet the different conditions.

Another object is to provide a compound cylinder which is simple in structure, economical to manufacture, durable in use, and automatic in operation.

Another object is to provide a compound cylinder which is equally adapted for use in different kinds of power transmission systems of the fluid type.

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

In the drawings,

Fig. 1 is a vertical section through one embodiment of my invention;

Fig. 2 is a horizontal section taken on the line 2—2 of Fig. 1;

Fig. 3 is a diagrammatic illustration of one type of hydraulic system in which this embodiment of my invention may be incorporated;

Fig. 4 is a view similar to Fig. 1, but showing a different embodiment of my invention;

Fig. 5 is a transverse vertical section taken on the line 5—5 of Fig. 4; and

Fig. 6 is a diagrammatic illustration of a type of hydraulic system in which the embodiment shown in Figs. 4 and 5 may be incorporated.

Referring to the drawings, and particularly to Figs. 1, 2, and 3, I have shown one embodiment of my invention as having a casting 10 providing a chamber 11 which forms a fluid reservoir. The upper end of the chamber is normally closed by a removable cover 12 which is held in place by a bolt 13 threaded into a boss 14 which forms a part of the casting 10.

A gasket 15 of rubber, cork, or other suitable material, is clamped between the cover 12 and the top of the casting to form a fluid-tight seal therebetween. The bolt 13 is provided with a longitudinal bore 16 connecting with a transverse bore 17. These two bores constitute an air vent for the reservoir 11.

The casting 10 has formed therein a large diameter low pressure cylinder 18 and a high pressure cylinder 19 of smaller diameter. In the low pressure cylinder is located a metallic piston 20 having a forward face provided with a rubber gasket 21 which forms an effective seal with the cylinder wall during the forward or right-hand movement of the piston 20. The gasket 21 is held against the forward face of the piston by a return spring 22 which normally maintains the piston 20 in the position shown in Fig. 1. In this position the rear of the piston rests against a stop ring 23 which is clamped between a shoulder provided by the casting 10 and a C spring 24.

The piston 20 has an annular recess 25 which is always maintained in free communication with the interior of the reservoir 11 by means of port 26. The fluid in the annular recess 25 forms a fluid seal which prevents entry of air into the active part of the cylinder during the return stroke of the piston. The rear of the piston is provided with an annular rubber gasket 27 which is C-shaped in cross-section and which functions to prevent leakage of fluid past the rear of the piston.

The piston 20 has a tapered socket 28 which receives one end of a piston rod 29. The piston rod 29 simply rests against the end of the socket and forms a separable abutting connection therewith. The contacting portions of the piston rod and socket are made hemispherical to provide for misalignment of the piston rod and piston without resulting cocking of the piston in the cylinder bore. The left-hand end of the piston rod is yoke-shaped, as indicated at 30, and is pivotally connected to an operating lever 31 which may be operated either manually or by power. A flexible rubber boot 31' is commonly provided to protect the end of the low pressure cylinder against the entry of dirt and moisture.

A small port 32 connects the reservoir 11 with that part of the cylinder 18 in front of the gasket 21 when the piston and gasket are in their retracted position, as shown in the drawings. The piston 20 and gasket 21 are preferably provided with grooves 33 and 34, respectively, to facilitate the flow of fluid past the piston and gasket during the return stroke of these parts. A forwardly extending finger 35 is threadedly attached to the

piston 20 for a purpose to be hereinafter described.

In the high pressure cylinder 19 is located a metallic piston 36 having a cup-shaped gasket 37 of rubber or other suitable material. The gasket 37 is held against the forward face of the piston 36 by return spring 38 which also normally holds the piston 36 against the annular stop member 39 which is held against the shoulder formed at the junction between the high and low pressure cylinders by the spring 22 which is of greater strength than the spring 38.

The piston 36 has a rounded socket 40 for receiving the rounded end of the finger 35. The socket 40 is connected by means of passageway 41 with an annular groove 42 which in turn communicates with bore 43 leading to a valve chamber 44. Bore 43 also communicates with port 45 which leads to that part of the high pressure cylinder immediately in front of the cup-shaped gasket 37 when the piston and cup-shaped gasket are in retracted position.

The upper end of the valve chamber 44 is closed by a threaded plug 46 having a ball valve 47 pressed by a spring 48 against a valve seat formed in the lower end of the plug 46. The spring is held in place by a retainer 49 which is attached to the plug 46 by bending the lip 50 over the outer edge of the lateral flange formed by the lower end of the retainer 49.

The valve 47 controls a passageway extending through the plug 46 and leading back to the reservoir 11. The size of the opening through the valve seat and the strength of the spring 48 are so proportioned that the valve 46 will open under a predetermined pressure. By simply unscrewing the plug 46 and replacing it by another, having a valve set to open at a higher or lower pressure, it is possible to adapt my compound cylinder for different purposes and for uses under widely varying conditions.

A piston valve 51 is located in the valve chamber 44 and has a reduced cylindrical portion 52 of diameter considerably smaller than the diameter of the valve chamber 44. The piston valve 51 has octagonal ends 53 and 54 which guide the piston valve in the valve chamber but permit flow of fluid therepast. The upper or left-hand end of the piston valve 51 has a projection 55 of smaller diameter than the passageway through the seat for the valve 47, and when the piston valve 51 is moved to its upper or left-hand position, as will be hereinafter described, the projection 55 holds the ball valve 47 away from its seat while permitting fluid to flow from the valve chamber back into the reservoir.

A rubber cup washer or gasket 56 is associated with the lower or right-hand end of the piston valve 51, and this cup washer is provided with grooves 57 to facilitate flow of fluid past the cup washer and into passageway 58 which communicates with the forward end of the high pressure cylinder 19. A metal clip 59 acts as a stop to limit movement of the piston valve 51 and rubber cup washer 56 in one direction.

The right-hand or outlet end of the high pressure cylinder is closed by a tubular member 60 which is threadedly engaged therewith, and a suitable gasket 61 is clamped between the end of the casting 10 and the tubular member 60 to provide a fluid-tight seal. A shoulder 62 is formed in the tubular member 60 and a rubber washer 63 is located against this shoulder and forms the valve seat part of the two-way valve mechanism indicated generally by reference numeral 64. This valve mechanism may be of any desired type but is herein shown as being of the kind described and claimed in my copending application for United States Letters Patent, Serial No. 472,666, filed August 2, 1930.

In Fig. 3 I have indicated a form of installation in which the pipe line 65 leads to motor cylinders 66 having pistons 67 for reciprocating piston rods 68 connected with any suitable type of mechanism which is actuated by the power thus transmitted by the fluid system. In the particular type of system illustrated in Fig. 3, I have shown a bleed conduit 69 leading back from one of the motor cylinders 66 to a return connection 70 formed in a boss 71 constituting part of the casting 10 and located at the upper right-hand side of the reservoir 11. The return connection 70 can communicate with the interior of the reservoir 11 by means of an L-shaped passageway 72. In normal operation of the system shown in Fig. 3, this passageway 72 is closed by the tapered inner end of a bleed screw 73, so that the fluid surges back and forth through the pipe line 65 between the compound cylinder and the motor cylinders 66.

In originally filling the system with fluid, or whenever it is desirable to remove air which may have found its way into the pipe line 65 and motor cylinders 66, the bleed screw 73 may be unscrewed sufficiently to open the passageway 72 and the compound cylinder operated to force fluid into the end of the pipe line 65. This operation is continued until all air in the pipe line 65 and motor cylinders 66 has been forced therefrom and forced through the pipe 69 to the reservoir 11, whence this air may escape to atmosphere through vent passageways 16 and 17. As soon as all air has thus been bled from the system, the bleed screw 73 is again screwed into normal position with its tapered end closing the L-shaped passageway 72.

The operation of this embodiment of my invention is as follows. With the parts in the position shown in Fig. 1, actuation of the lever 31 will advance piston 20 and gasket 21 so that the gasket closes port 32 leading from low pressure cylinder 18 back to reservoir 11. Thereafter continued advance of the piston 20 forces fluid through recess 40, port 41, annular groove 42, bore 43, into valve chamber 44. The fluid forced into valve chamber 44 flows past the piston valve 51 and cup washer 56 into passageway 58 and thence into the right-hand or outlet end of the high pressure cylinder. Here the fluid flows through valve 64 and into pipe line 65. This discharge of fluid into the pipe line raises the pressure of the fluid in the pipe line 65, motor cylinder 66 and in the operating parts of the compound cylinder.

When this pressure reaches a predetermined value, ball valve 47 opens and permits fluid forced into the valve chamber 44 by the low pressure piston to flow back into reservoir 11, thereby rendering the low pressure cylinder ineffective.

Very shortly after valve 47 opens, the right-hand end of finger 35 engages and advances high pressure piston 36, thereby closing port 45 and discharging additional fluid from the high pressure cylinder. The fluid discharged from the high pressure cylinder acts on cup washer 56 and piston valve 51 to move them upwardly or toward the left and bring projection 55 into engagement with ball valve 47. Cup washer 56 will not permit fluid to flow from the high pressure cylinder therepast, and thereafter the pressure created by the high pressure piston holds valve 47 open,

thus permitting fluid to flow from the low pressure cylinder back into the reservoir without restriction, so that there is no drag on the low pressure piston.

Upon release of pressure from the actuating lever 31, springs 22 and 38 return the high and low pressure pistons to the positions shown in Fig. 1. Usually an additional spring or similar means is provided to return the lever 31 and piston rod 29 to normal position independently of the return of the pistons.

Pistons 20 and 36 usually return faster than motor cylinder pistons 67, and under these conditions fluid from annular space 25 by-passes the right-hand end of low pressure piston 20 and gasket 21, such by-passing being facilitated by grooves 33 and 34. At the same time fluid can by-pass the high pressure cylinder 36 by passing around through bore 43, valve chamber 44, and passageway 58.

The fluid returned to the compound cylinder by the return movement of the motor cylinder pistons 67 forces valve mechanism 64 away from seat 63, and the excess fluid in the high and low pressure cylinders is returned to the reservoir by way of port 45, bore 43, annular space 42, passageway 41, and port 32.

In Fig. 3 I have illustrated the embodiment of my compound cylinder shown most clearly in Figs. 1 and 2, as being incorporated in a fluid system of power transmission which includes a return line 69 leading directly from one of the motor cylinders to the reservoir. This return line 69 is to be understood as merely an optional and convenient means of bleeding the system and is not necessary to the successful operation of this embodiment of my invention. In fact, this embodiment of my invention is designed for a pulsating type of fluid system in which the fluid surges back and forth in a single conduit or conduit system and is especially designed for use with present forms of hydraulically actuated vehicle brakes and other types of fluid transmission systems in which it is not common and frequently impossible to provide a special return line to the reservoir which would correspond to conduit 69.

Where this form of my invention is used in the hydraulic brake systems of the type now in common use, the system would be bled by means of the bleeder screws now commonly associated with the motor cylinders located at the vehicle wheels. Where my invention is to be used in such systems, the return connection 70, passageway 72, and bleed screw 73, could be eliminated.

That form of my invention shown in Figs. 4, 5, and 6 is generally the same as that previously described. This form of my invention, however, is especially designed for incorporation in a circulating system in which one conduit or conduit system is utilized to connect the motor cylinders with the discharge port of my compound compression cylinder, and a separate conduit or conduit system is utilized to transfer fluid discharged from the motor cylinders back to the fluid reservoir associated with my compression cylinder.

In this embodiment of my invention, as shown most clearly in Figs. 4 and 5, I provide a casting 80 having a reservoir 81 which is normally closed by a removable cover 82 held in place by a bolt 83 which is provided with an atmospheric vent 84. In order to prevent undue splashing of fluid in the reservoir, I preferably provide a cork disk 121 which floats on the surface of the fluid in the reservoir.

The casting 80 also provides a low pressure cylinder 85 and a high pressure cylinder 86. A piston 87 is located in the low pressure cylinder and is actuated by a piston rod 88 connected to a suitable actuating lever 89 which may be manually or power-operated by any suitable means. The piston 87 has an annular recess 90 maintained in communication with the reservoir 81 by port 91. The fluid which fills this recess 90 acts as a fluid seal to prevent leakage of air past the rear of the piston. An annular rubber sealing gasket 92 prevents escape of liquid from the recess 90 past the rear of the piston and also cooperates with the fluid seal in preventing leakage of air past the piston during its return stroke.

Rearward movement of the piston 87 is limited by the upper end of a removable drain plug 93. A rubber gasket 94 is pressed against the forward face of the piston 87 by return spring 95. Piston 87 and gasket 94 are provided with grooves 96 and 97, respectively, to facilitate the flow of fluid therepast during the return stroke of the piston. The low pressure piston also carries a forwardly extending finger 98 for operating the high pressure piston 99 which carries a rubber cup-washer or gasket 100 held thereagainst by a return spring 101. Rearward or return movement of the high pressure piston is limited by the annular stop member 102 held in place by the spring 95 which is of greater strength than the spring 101. The high pressure piston 99 has openings 103 and annular groove 104 for establishing communication between the low pressure cylinder and bore 105 leading to valve chamber 106. The upper end of the valve chamber is closed by a removable plug 107 carrying a ball valve 108 set to release at a predetermined pressure.

The valve chamber contains a piston valve 109 having a projection 110 for holding open the ball valve 108 while the low pressure cylinder is ineffective. The piston valve 109 is provided with a rubber gasket 111 which seals in one direction only and which, in the present instance, is shown as provided with a centrally located forward projection which serves as a limit stop. A passageway 112 connects the valve chamber 106 with the forward end of the high pressure cylinder 86.

The outlet or right-hand end of the high pressure cylinder is closed by a screw plug 113 containing a ball check valve 114 which permits fluid to flow from the high pressure cylinder into a pipe line 115, but prevents return flow of fluid from the pipe line to the high pressure cylinder.

In the particular hook-up illustrated in Fig. 6, pipe line 115 leads to motor cylinders 116 having pistons 117 for actuating piston rods 118 connected to any suitable mechanism. Since check valve 114 prevents the return of fluid from the motor cylinders 116 by way of conduit 115, a separate conduit 119 is provided to return the fluid from the motor cylinders to the fluid reservoir.

Conduit 119 is normally closed by relief valve 125. This relief valve includes a valve member 126 which is normally held by spring 127 in sealing engagement with the adjacent end of one of the pipes forming the conduit 119. The spring 127 may be of such strength that the valve member 126 will be automatically moved to open position when the pressure in the motor cylinders reaches a predetermined maximum, but in the

ordinary use of the mechanism the relief valve is opened by exerting a pressure on lever 128 in the direction indicated by the arrow. This pressure may be exerted manually or by any suitable means and, in at least one usage of my invention, this pressure is preferably exerted by the return movement of the lever 88 or other means for operating the compound cylinder.

Where the reservoir is located below the motor cylinders and it is desired to maintain the motor cylinders and pipe lines full of fluid, or where for any reason it is desired to maintain a pressure on the fluid in the pipe lines and motor cylinders, a spring pressed check-valve 120 may be provided. This check valve ordinarily operates under very light spring tension but may be given any spring tension desired. In most installations the reservoir can be located above the motor cylinders and the check valve 120 eliminated entirely.

In this latter embodiment of my invention I have shown the casting 80 as provided with one or more bosses 122 for receiving the threaded ends of attaching bolts 123 by means of which my compound cylinder and reservoir unit may be attached to a suitable support such as that indicated at 124.

Having thus described my invention, what I claim is new and desire to secure by United States Letters Patent is:

1. In mechanism of the class described, the combination of a reservoir, a low pressure cylinder, a piston reciprocable therein, means for reciprocating said piston, a forwardly extending projection carried by said piston, a high pressure cylinder, a piston reciprocable therein, said piston being normally spaced from said projection but being adapted for movement thereby, a discharge conduit connected to said high pressure cylinder, a passageway by-passing said high pressure piston, a chamber intercepting the passageway, a valve in said chamber permitting flow through the passageway in one direction only a loaded valve connecting said passageway with said reservoir, and passageways in the high pressure piston providing a communication between the by-pass and the low pressure cylinder.

2. In mechanism of the class described, the combination of a reservoir, a low pressure cylinder, a piston reciprocable therein, means for reciprocating said piston, a high pressure cylinder, a piston reciprocable in the high pressure cylinder, means carried by the piston in the low pressure cylinder for actuating the piston in the high pressure cylinder after an initial movement of the piston in the low pressure cylinder, a valve chamber spaced laterally from said high pressure cylinder, a piston valve in said chamber, said piston valve by-passing fluid in one direction only, a passageway connecting said chamber with each of said cylinders, a loaded valve in said chamber controlling communication between said chamber and said reservoir, a piston valve operable for holding said loaded valve in open position during the compression stroke of the piston in the high pressure cylinder, and valve means at the outlet end of said high pressure cylinder.

3. In a cylinder and reservoir unit of the class described, the combination of a reservoir, a low pressure cylinder supplied therefrom, a high pressure cylinder adapted to receive fluid discharged from said low pressure cylinder, a piston in said low pressure cylinder, a piston in said high pressure cylinder, a port normally connecting said low pressure cylinder with said reservoir, a port normally connecting said high pressure cylinder for two-way communication with said low pressure cylinder, means for advancing said pistons to close said ports, a passageway connecting said cylinders for one-way communication only, a chamber intercepting the passageway and communicating with the reservoir, and a loaded valve in said chamber controlling the communication.

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