Aug. 29, 1939. H. F. ALLEN 2,170,890

REMOVABLE ACCUMULATOR

Filed April 8, 1937

Fig. 2.

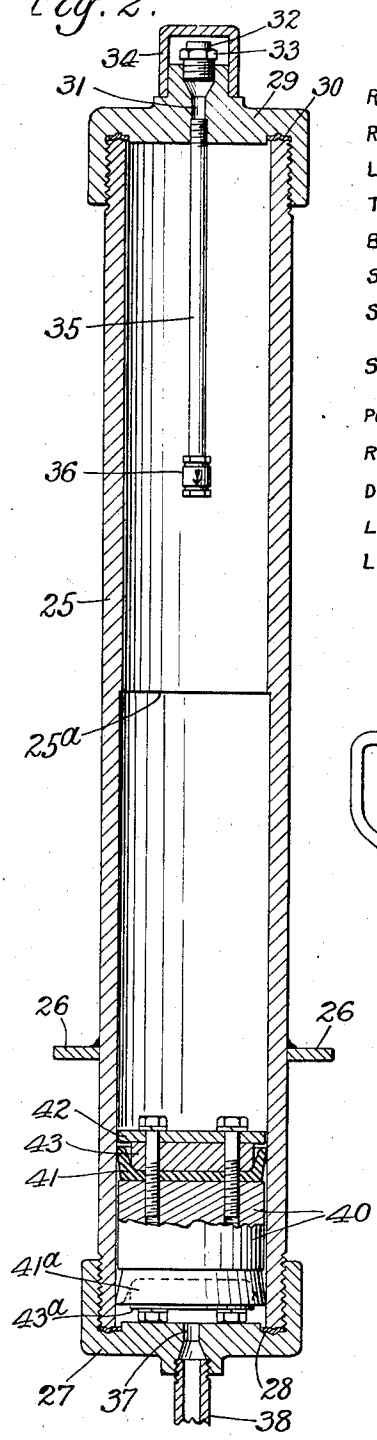
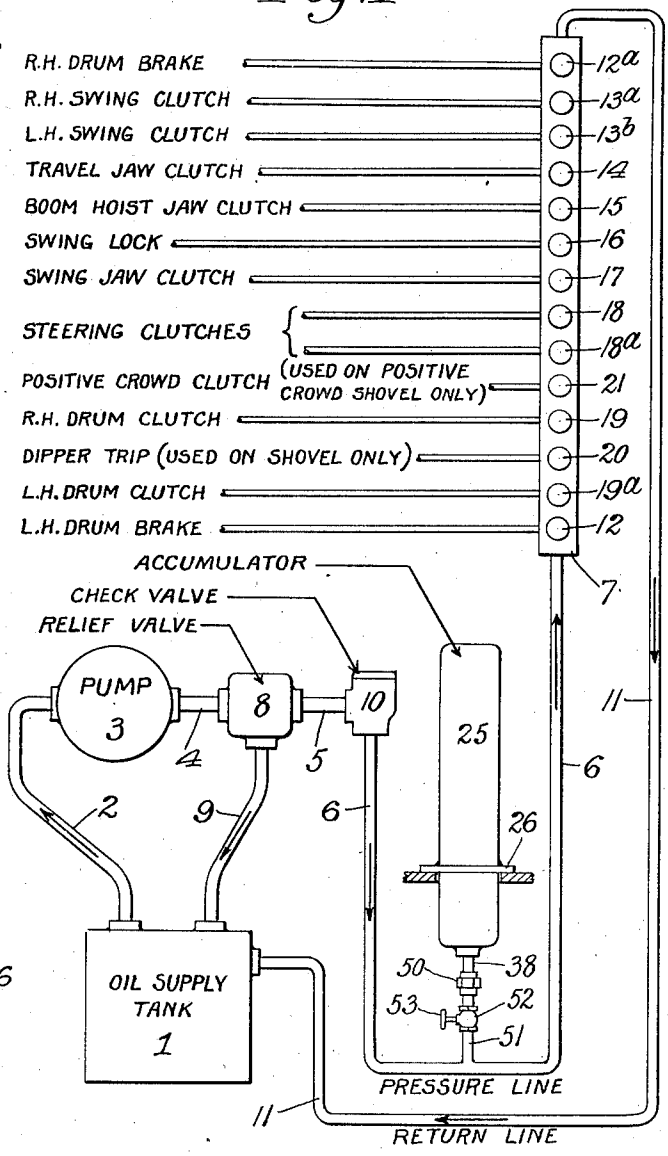


Fig. 1



Inventor
Harold F. Allen
by Parker & Carter
Attorneys.

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REMOVABLE ACCUMULATOR

Harold F. Allen, Chicago, Ill., assignor to Link-Belt Company, Chicago, Ill., a corporation of Illinois

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7 Claims. (Cl. 138—31)

My invention relates to an improvement in fluid controlled systems or systems in which a fluid under pressure is employed to do work. An example of the application of my system is to the control and actuation of power shovels, drag scrapers, cranes and the like.

One purpose is the provision of a gas loaded accumulator for use with such systems.

Another purpose is the provision of an accumulator so constructed as to render impossible the escape of the gas from the accumulator as a result of drop in pressure in the balance of the system.

Another purpose is the provision of a removable accumulator which, when exhausted, can easily be removed and replaced by a new and charged accumulator. A useful application of my invention is to the employment of accumulators which may be charged at the factory and delivered for use or held in reserve. This is given merely as an example of a practical use and not as a limitation.

Other purposes will appear from time to time in the course of the specification and claims. I illustrate my invention more or less diagrammatically in the accompanying drawing, wherein:

Figure 1 is a diagram of a fluid or hydraulic controlled system illustrating my invention; and

Figure 2 is a longitudinal axial section through an accumulator embodying my invention.

Like reference characters will be used to indicate like parts throughout the specification and drawing.

Referring to the drawing, I illustrate in Figure 1 a fluid or hydraulic control adapted for example for use with a power shovel or crane. 1 indicates an oil supply tank with an outlet passage 2 in communication with a pump 3 which is adapted to draw fluid from the tank 1 through the passage 2 for expulsion along the fluid pressure line 4, 5 and 6 to a valve manifold 7. 8 is a relief valve which communicates with the oil supply tank 1 by the passage 9 in such fashion that the pump 3 will deliver oil through the valve 8 and along the passage 9 in closed circuit with the supply tank when a predetermined pressure is reached in the pressure line 5, 6 and the manifold 7.

10 is a check valve adapted to prevent return flow from the manifold along the passage 6 in the event that the pressure falls in the line 5 or the parts of the system in communication therewith. 11 is a return line from the valve manifold 7 to the oil supply tank 1. In the particular valve manifold shown, I illustrate a manifold adapted for use with power shovels, drag scrapers, cranes and the like.

It will be understood that the number of outlet ports and their location may be determined to suit the particular problem involved. For instance, the ports 12, 12*a* may be in communication with any suitable hydraulic control means for controlling the drum brakes, 13*a* and 13*b* the swing clutches, 14 the travel jow clutch, 15 the boom hist clutch, 16 the swing lock, 17 the swing jaw clutch, 18 and 18*a* the steering clutches, and 19 and 19*a* the drum clutches. When the manifold is used on a shovel, 20 may be used to control the dipper trip. When used with a positive crowd shovel, 21 may be used to control the positive crowd clutch. The above is indicated as an example of the mechanism or mechanisms with which my system may be used.

25 indicates an accumulator herein shown in the form of an elongated cylinder normally held in vertical position. 26 is any suitable supporting flanges. The low end of the cylinder is closed by the screw threaded cap 27 provided with copper washers 28. The upper end of the cylinder is closed by a corresponding cap or cylinder head 29, also provided with its copper washers or suitable packing means 30. The upper head is provided with an aperture 31 normally closed by any suitable means including a tail piece 32, nut 33 and cylinder head cap 34.

35 is a pipe and 36 generally indicates a vertical check valve through which a gas may be admitted under pressure. The lower plunger or bottom cylinder head 27 is provided with an aperture 37 which may be connected by the passage 38 with the pressure line 6. Any suitable connection may be employed, preferably one permitting ready removal of the accumulator as a whole when exhausted for replacement by another already charged accumulator. 40 generally indicates a cylinder piston having piston cups 41, 41*a*, a piston stop 42, and piston followers 43, 43*a*. The cylinder has a slightly smaller bore in the upper portion, thereby forming the shoulder 25*a*, which is the upper limit for the piston stop 42.

In the employment of the device, the accumulator is first pre-charged through the passage 31 of the upper cylinder head 29 and the check valve 36 with an inert gas, for example nitrogen. As an example of a practical pressure, it may be charged at a minimum pressure of 650 pounds per square inch. The gas pressure forces the piston 40 to the bottom of the cylinder to the position in which it is shown in Figure 2. The

gas is prevented from escaping past the piston by means of a piston seal cup 41. The accumulator can then be shipped or handled in any ordinary manner. Once having been thus precharged, it can be placed in position in relation to the hydraulic control system such as is shown diagrammatically in Figure 1, and may be connected in any suitable manner to the line 38 in communication with the oil or liquid pressure line 6.

When the pump 3 is started, oil pressure is built up on the opposite side of the piston 40 entering through the inlet aperture 37. The piston seal cup 41*a* prevents penetration of this oil past the piston 40. As oil pressure is built up in the cylinder 25 on the lower side of the piston 40, it forces the piston toward the upper end of the cylinder and continues to compress the gas until the maximum operating pressure is reached and there is a balance in pressure on the two sides of the piston.

As an example, in a typical installation, this pressure may amount to 1000 pounds per square inch, although it will be understood that my system can be run at varying pressures depending upon the mechanism employed and the needs of operation. In any event, one end of the chamber contains gas at the desired pressure and the other end of the chamber within the cylinder 25 contains oil at the same pressure. The piston moves back and forth to adjust itself to changes in pressure of the system. The piston is a practically absolute seal between the gas and the liquid so that the gas does not reach the liquid at all and cannot be absorbed thereby. This is important as the absorption of the gas by the liquid would be a serious defect, one that is found in earlier hydraulic controlled systems.

Should all the oil in the system be drawn off, either through operation or through accidental breakage of the oil line, the piston 40 and its associated parts is merely pushed to the bottom of the chamber and can travel no farther and escape of the gas is prevented. When pressure in the gas loaded accumulator drops below a predetermined limit, it can be removed by the operator without any loss in the gas pressure and can be replaced by a newly charged accumulator, the operator returning the old one to the plant for recharging. Preferably the accumulators are so sealed after charging that they cannot be tampered with by the operator or others and are supplied as complete units for replacement. Also, extra units may be held in reserve so that they can be replaced without loss of time.

It will be understood that whereas I have described and shown a practical and operative device, nevertheless many changes may be made in the size, shape, number and disposition of parts without departing from the spirit of my invention. I therefore wish my description and drawing to be taken as in a broad sense illustrative or diagrammatic, rather than as limiting me to the precise showing.

It will also be understood that my invention is adaptable for systems of hydraulic control applied to a wide variety of mechanisms. It is particularly useful for hydraulic controls such as are used on drag scrapers, cranes and the like. In such systems it is highly desirable that energy storage be employed to smooth out the fluctuations in pressure in the hydraulic system caused by the rapid operation of control valves. As will be clear from Figure 1, ten or more fluid outlets may communicate with the valve manifold 7 and as the user of a shovel or crane actuates one mechanism or another, he controls the boom, hoist, swings the boom, raises or lowers it, actuates the drum, and performs the various complicated functions of such a mechanism. It is important to smooth out fluctuations in pressure so caused. The accumulator herein described and shown is highly effective in smoothing out such fluctuations in pressure due to the operation of the control valves and also serves as a reserve storage of energy over periods of time during which the supply pump 3 may be shut down. The gas loaded accumulator has great storage capacity per pound of weight. In my invention I enjoy the advantage of this great energy storage capacity and avoid any possibility of absorption of the gas by the liquid or oil of the pressure or hydraulic control system. I also prevent loss or escape of the gas in the event that the pressure falls in the pressure line or the fluid system is emptied.

It will be understood that any suitable means may be employed for permitting a ready detachment of the cylinder 25 or the accumulator unit as a whole from the pressure line. Since the details of this connection do not of themselves form part of the present invention, I simply illustrate a connector 50 associated with the line 51 extending to the pressure line 6. 52 indicates any suitable valve or closure which may be controlled for example by the handle 53 whereby the escape of fluid from the pressure line may be cut off to permit removal of the accumulator.

It will be understood that the accumulators can be charged at the plant or at any suitable location.

The removable direct connection between the cylinder and the hydraulic system includes the pipe 38, which is threaded into the boss on the bottom of the cover 27, so that the pipe 38, is in line with the passage 37. This pipe 38 terminates in a union 50, which forms a usual type of convenient disconnector. If the union is detached, then the pipe 38 and one part of the union may be withdrawn with the accumulator 25. If desired, the accumulator 25 may be unscrewed from the pipe 38.

I claim:

1. In an accumulator, a cylinder, a piston movable in said cylinder, a body of inert gas under pressure enclosed by said cylinder and one side of said piston, an inlet passage in communication with the interior of the cylinder on the opposite side of said piston, means for maintaining a fluid under pressure in said passage and in the portion of the cylinder in communication therewith, said piston being free to move longitudinally in said cylinder in response to fluctuations of pressure in the portion of the cylinder in communication with said passage whereby to balance the pressures at opposite sides of the piston, and means for limiting the movement of said piston in said cylinder, including a stop associated with said piston and stop means comprising a shoulder formed in the lateral wall of the cylinder.

2. A renewable accumulator for hydraulic systems and the like comprising a cylinder, removable heads closing each end thereof, the interior diameter of the cylinder for a part of its length being greater than for the remainder of its length, a piston free to slide in the large diameter part of the cylinder having packing rings making a tight running fit with the wall of the cylinder and a buffer plate on the front of the piston adapted to contact the shoulder at the point

where the diameter changes, buffer members at the opposed end of the piston adapted to contact the cylinder head, a free and unobstructed passage through the cylinder head associated with the large diameter portion of the cylinder, a passage through the other cylinder head and a closure therefor including a check valve and a gas connection, a cap enclosing and protecting the check valve.

3. A renewable accumulator for hydraulic systems and the like comprising a cylinder, removable heads closing each end thereof, the interior diameter of the cylinder for a part of its length being slightly greater than for the remainder of its length, a piston free to slide in the large diameter part of the cylinder having packing rings making a tight running fit with the wall of the cylinder and a buffer plate on the front of the piston adapted to contact the shoulder at the point where the diameter changes, buffer members at the opposed end of the piston adapted to contact the cylinder head, a free and unobstructed passage through the cylinder head associated with the large diameter portion of the cylinder, a passage through the other cylinder head and a closure therefor including a check valve and a gas connection, a cap enclosing and protecting the check valve, a pipe mounted on the cylinder head extending inwardly toward but terminating short of the point where the diameter increases, the check valve being located at the inner end of said pipe.

4. A gas accumulator for pneumatic systems and the like comprising a cylindrical housing open throughout its length, part of said length being of smaller diameter than the remainder, a piston mounted for free longitudinal movement within the large diameter portion of the cylinder, a stop member on the piston, adapted to engage the shoulder formed at the juncture of the larger and smaller diameter cylinder portions, packing means on the piston in contact with the walls of the cylinder, an aperture closure for each end of the cylinder, open unobstructed connecting means associated with the closure for the large end of the cylinder whereby the cylinder may be removably attached to a hydraulic system, a check valve within the cylinder associated with the opposed cylinder head and a connecting means associated therewith whereby gas under pressure may be introduced into the cylinder past the check valve.

5. A gas accumulator for pneumatic systems and the like comprising a cylindrical housing open throughout its length, part of said length being of smaller diameter than the remainder, a piston mounted for free longitudinal movement within the large diameter portion of the cylinder, a stop member on the piston, adapted to engage the shoulder formed at the juncture of the larger and smaller diameter cylinder portions, packing means on the piston in contact with the wall of the cylinder, said means comprising a flexible cup washer at either end of the piston, a holding member located within each cup of smaller diameter than the piston, means for drawing said holding member against the piston to compress the central portion of the washer, the stop member on the piston comprising a flange associated with one of the holding members overlying the washer and of substantially the same diameter as the piston, an apertured closure for each end of the cylinder, open unobstructed connecting means associated with the closure for the large end of the cylinder whereby the cylinder may be removably attached to a hydraulic system, a check valve within the cylinder associated with the opposed cylinder head and a connecting means associated therewith whereby gas under pressure may be introduced into the cylinder past the check valve.

6. A renewable accumulator for hydraulic systems and the like comprising a cylinder, a piston free to reciprocate therein, a closure head for each end of the cylinder, means associated with one head through which gas under pressure may be introduced therein and means for preventing the escape of such gas, means intermediate the ends of the cylinder and removed from the end thereof for limiting the movement of the piston in a direction toward the gas supply end, the head for the other end of the cylinder being apertured and adapted to be directly connected to a hydraulic system, means interposed between the body of the piston and the last mentioned head for limiting the movement of the piston toward such head whereby there is always maintained a hydraulic chamber between the piston and the head in direct communication with the connection to the hydraulic system.

7. A renewable accumulator for hydraulic systems and the like comprising a cylinder, a piston free to reciprocate therein, a closure head for each end of the cylinder, means associated with one head through which gas under pressure may be introduced therein and means for preventing the escape of such gas, means intermediate the ends of the cylinder and removed from the end thereof for limiting the movement of the piston in a direction toward the gas supply end, the head for the other end of the cylinder being apertured and adapted to be directly connected to a hydraulic system, means interposed between the body of the piston and the last mentioned head for limiting the movement of the piston toward such head whereby there is always maintained a hydraulic chamber between the piston and the head in direct communication with the connection to the hydraulic system, two separate means associated with the piston, one adapted to prevent escape of gas in one direction between the walls of the piston and the cylinder and the other adapted to prevent the escape of liquid in the opposite direction between the walls of the cylinder and piston.

HAROLD F. ALLEN.