April 9, 1963 H. M. PURCELL 3,084,717

PISTON TYPE ACCUMULATOR WITH FLEXIBLE CYLINDER WALL

Filed Aug. 28, 1957

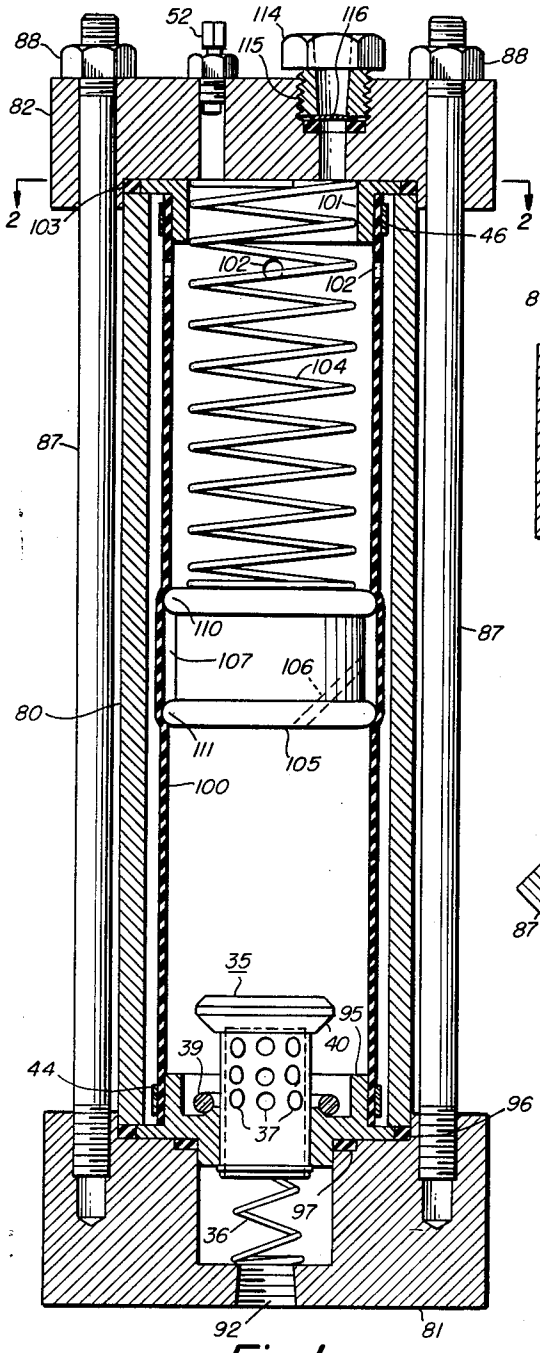

Fig. 1

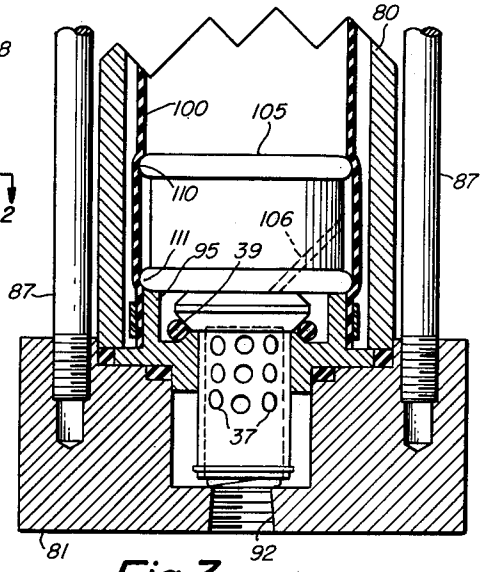

Fig. 3

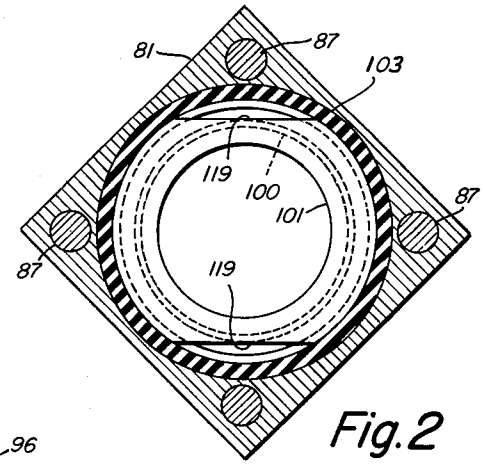

Fig. 2

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PISTON TYPE ACCUMULATOR WITH FLEXIBLE CYLINDER WALL

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The invention relates in general to accumulators and more particularly to hydraulic accumulators which have a new and improved construction resulting in a more efficient and longer lived device.

One of the uses of accumulators is in the hydraulic art wherein it is often desirable to supply a large quantity of fluid under pressure to rapidly move a work member a small portion of an entire work cycle. It is generally uneconomical to provide a pump of sufficient capacity to instantaneously supply this large quantity of fluid so a smaller pump is utilized which, during the idle portion of the work cycle, charges an accumulator which stores up a quantity of fluid under pressure until such time during the cycle that it is needed.

Two of the most popular types of accumulators are the piston and bag type. In the piston type, a cylinder is provided in which a piston is located, on opposite sides of which reside hydraulic fluid and a compressible gas, respectively. In this type, the surface finish of the cylinder wall is very critical and has a direct bearing on the life expectancy of the packing which is necessarily carried by the piston. Machine tolerances between the piston and cylinder wall is another factor contributing to the cost of manufacture of the device. Wear between the piston and/or packing and the cylinder is inevitable and as a result of the wear, a very poor division between the fluid and gas is effected by the piston. The high initial friction between the metallic cylinder walls and piston when the device is new is also a factor which contributes to a loss in energy.

In the bag type accumulator, a flexible member is used to divide a chamber into two parts. A gas is placed in one of the parts and fluid is pumped into the other part causing the flexible member to move thereby compressing the gas. This type of accumulator has the disadvantage that the flexible member is subject to high wear and rupturing and is expensive to manufacture. The finish on the chamber walls of this type accumulator is also a factor to be considered in the cost of manufacturing.

It is therefore an object of the present invention to provide an accumulator which obviates the above mentioned disadvantages in prior art devices.

Another object of the invention is to provide a piston type accumulator wherein a piston is adapted to travel in a cylinder of rubber or other suitable flexible or resiliently yieldable material.

Another object of the invention is to provide an accumulator wherein there is little if any wear between the piston and the walls of the tube within which it travels.

Another object of the invention is to provide an accumulator which includes an outer metal shell and an inner flexible or resiliently yieldable tube which define inner and outer annular chambers and a piston in the flexible or resiliently yieldable tube and passageway means providing communication between the upper portion of the flexible or resiliently yieldable tube and the outer annular chamber.

Another object of the invention is to provide an accumulator of the piston type wherein there is no need for packing on the piston.

Another object of the invention is to provide an accumulator wherein the cylinder wall expansion which normally occurs when the device is under pressure does

not affect the seal between the cylinder wall and the piston.

Another object of the invention is to provide an accumulator having a flexible or resiliently yieldable tube with a means for securing both ends of the tube.

Another object of the invention is to provide a new and novel valve construction in an accumulator.

Another object of the invention is to provide a piston for use in a flexible or resiliently yieldable tube of an accumulator which piston has an undercut portion providing first and second annular seal engaging portions.

Another object of the invention is to provide an accumulator which includes a shell with a flexible or resiliently yieldable tube mounted therein which has spring means for locating and tensioning the tube with the shell.

Another object of the invention is to provide an accumulator with a flexible or resiliently yieldable tube within which a piston is adapted to travel wherein the entire length of the tube in effect serves as the packing between the piston and the walls of the container. This distributes the packing wear if any over the entire length of the tube.

Another object of the invention is to provide an accumulator wherein a high finish on the container walls is not necessary as in prior art devices.

Other objects and a fuller understanding of this invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a side elevational view in section of an accumulator constructed in accordance with the teachings of the present invention;

FIGURE 2 is a view taken along the line 2—2 of FIGURE 1; and

FIGURE 3 is a fragmentary view in section of a portion of the accumulator shown in FIGURE 1 and showing the piston in its lowermost position of travel.

A flexible or resiliently yieldable tube **100** is disposed within the cylinder **80** and at its lower end portion surrounds the retaining ring **95** and is secured in this position by means of a metal band **44**. The upper end portion of the tube **100** surrounds the retaining ring **101** and is secured in this position by means of a metal band **46**. A cylindrical piston **105** is disposed within the tube and is provided with an annular undercut portion between the upper and lower portions thereof which undercut portion provides an annular chamber **107** and which also provides annular sealing engagement portions on the piston, **110** and **111**, respectively. The piston **105** is provided with a hole **106** which provides communication between the annular chamber **107** and the flexible tube beneath the piston **105**. A light spring **104** is disposed within the flexible tube **100** above the piston **105**. The first or upper end portion of the spring **104** bears against the end plate **82** and the second or lower end portion of the spring engages the piston **105**. The purpose of the spring **104** is to move the piston **105** in the tube toward the valve **35** in the event that the accumulator is disposed in a position where gravity is unable to move the piston into engagement with valve **35**. For example, if the accumulator were laid on its side then the effect of gravity or the weight of the piston would not be capable of moving the piston along the tube into engagement with the valve **35** to close the same. When the accumulator is disposed in an upright position, as illustrated in FIGURE 1, then gravity will cause the piston to move downwardly in the tube to close the valve and the spring is not absolutely necessary. However, it may still be utilized to aid in moving the piston. It will also be apparent that this spring may be utilized in the accumulators shown in the other figures of the drawings although it has been specifically shown

in only the accumulator of FIGURE 1. The upper end of the tube is provided with a plurality of openings **102** which provide communication between the tube above the piston **105** and the annular chamber which is formed between the outside of the tube and the inner walls of the cylinder **80**. The cover **82** is provided with a blow-out fuse **114** as a safety feature in the event of excess pressure over that for which the accumulator is specifically designed to handle. This blowout fuse **114** is secured to the cover **82** by means of threads **115** and includes a rupturable diaphragm **116**.

In operation, this accumulator, shown in FIGURES 1, 2 and 3, is as follows. When fluid has been exhausted from this accumulator the piston **105** moves to its lowermost position in the tube **100** causing the valve **35** to move to the closed position as shown in FIGURE 3. When hydraulic or other fluid to be accumulated is pumped through the passageway **92**, this causes the valve **35** to move to the open position (FIGURE 1) and causes the piston **105** to move upwardly in the tube **100** a distance which is dependent upon the pressure of the accumulated fluid. As the piston travels upwardly in the tube, the air or other suitable gas contained in the tube above the piston and in the outside annular chamber is compressed. The openings **102** keep the pressure the same in the annular chamber surrounding the tube and in the tube above the piston. The pressure of the hydraulic fluid beneath the piston is the same as the pressure above the piston and in the annular chamber with the exception that it is slightly higher because of that very small pressure produced by the weight of the piston **105**.

Accumulators made according to the teachings of the present invention have the unique ability to provide an excellent seal between the fluid being accumulated and the pressurizing medium utilized. This is because of the use of the resiliently yieldable tube in combination with the piston member which is adapted to travel therein. The use of the resiliently yieldable tube also enables the high finish on the cylinder walls and manufacturing tolerances to be practically entirely done away with thus reducing the cost of manufacturing to a great extent. The use of the resiliently yieldable tube also enables any wear which may occur to be compensated for. The construction of accumulators made in accordance with the present teachings which embody the use of the resiliently yieldable tube placed within a rigid container thereby forming an annular chamber therebetween and with passageway means between one end portion of the resiliently yieldable tube and the annular chamber insures that a substantially constant pressure is exerted on both sides of the resiliently yieldable tube. The use of the spring in the resiliently yieldable tube which urges the piston toward the valve also permits use of the device when gravity is of no aid.

Although this invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

What is claimed is:

1. A hydraulic accumulator comprising a base, wall means defining a fluid passageway in said base, a cylindrical container having upper and lower end portions, a cover plate, said base covering said lower end portion of said container and said cover plate covering said upper end portion of said container, tie bolts extending between said base and said cover plate for securing same and said container together, said base including a retaining ring secured in place at the lower end of said cylindrical container, a cylindrical rubber member having upper and lower end portions, said lower end portion of said rubber member surrounding said base retaining ring, a band securing said lower end portion of said rubber member to said base retaining ring, valve means in said base providing communication between said fluid passageway and said lower end portion of said rubber member, said cover plate including a retaining ring secured in place at the upper end of said cylindrical container, said upper end portion of said rubber member surrounding said cover plate retaining ring, a band securing said upper end portion of said rubber member to said cover plate retaining ring, said rubber member and said cylindrical container forming an annular chamber therebetween, a cylindrical piston located in said cylindrical rubber member and having its largest dimension greater in the direction of the diameter of the rubber member than the inside diameter of said rubber member, said piston having an undercut portion between the ends thereof forming first and second annular engagement portions, an opening providing communication between said undercut portion and one of the ends of said piston, wall means providing communication between said annular chamber and said rubber member above said piston, and valve means for introducing a gas into said cylindrical container.

2. A hydraulic accumulator comprising a base, wall means defining a fluid passageway in said base, a cylindrical container having upper and lower end portions, a cover plate, said base covering said lower end portion of said container and said cover plate covering said upper end portion of said container, said base including a retaining ring secured in place at the lower end of said cylindrical container, an elongated cylindrical rubber member having upper and lower end portions, said lower end portion of said rubber member surrounding said base retaining ring, a band securing said lower end portion of said rubber member to said base retaining ring, valve means in said base providing communication between said fluid passageway and said lower end portion of said rubber member, said cover plate including a retaining ring secured in place at the upper end of said cylindrical container, said upper end portion of said rubber member surrounding said cover plate retaining ring, a band securing said upper end portion of said rubber member to said cover plate retaining ring, said rubber member and said cylindrical container forming an annular chamber therebetween, a cylindrical piston located in said cylindrical rubber member and having its largest dimension greater in the direction of the diameter of the rubber member than the inside diameter of said rubber member, said piston having an undercut portion between the ends thereof, a spring disposed within said cylindrical rubber member above said piston, said spring having the upper end portion engaging said cover plate and the lower end portion of said spring engaging said piston, means comprising an opening providing communication between said annular chamber and said rubber member above said piston, and valve means for introducing a gas into said cylindrical container.

3. A hydraulic accumulator comprising an elongated container, said container having upper end and lower end portions for closing said container, an elongated cylindrical member composed of flexible plastic which is oil resistant, means for securing the upper end of said cylindrical member to said upper end portion of said container, means for securing the lower end of said cylindrical member ot said lower end portion of said container, said elongated cylindrical member being of less diameter than the width of said container and forming an annular chamber therebetween, a cylindrical piston located in said cylindrical member, said piston having a diameter greater than the inside diameter of said cylindrical member, a light spring disposed above said piston and lightly pressing against said piston to aid in moving the piston toward the lower end of said cylindrical member, means comprising an opening for providing communication between said annular chamber and said elongated cylindrical mem-

ber above said piston, means comprising a fluid passageway extending through said upper end portion of said container and into said elongated cylindrical member, and means comprising a fluid passageway extending through said lower end portion of said container and into said elongated cylindrical member whereby to provide fluid communication with said elongated cylindrical member above and below said piston.

References Cited in the file of this patent

UNITED STATES PATENTS

1,621,858	Sherwood	Mar. 22, 1927
2,259,019	Carr et al.	Oct. 14, 1941
2,731,038	Purcell	Jan. 17, 1956
2,734,531	Bizak	Feb. 14, 1956
2,742,929	Treseder	Apr. 24, 1956
2,752,754	Joseph	July 3, 1956
2,775,255	Snyder	Dec. 25, 1956
2,801,067	Mercier	July 30, 1957
2,828,148	Griswold	Mar. 25, 1958
2,954,675	Reynolds	Oct. 4, 1960

FOREIGN PATENTS

848,441	Germany	Sept. 4, 1952