

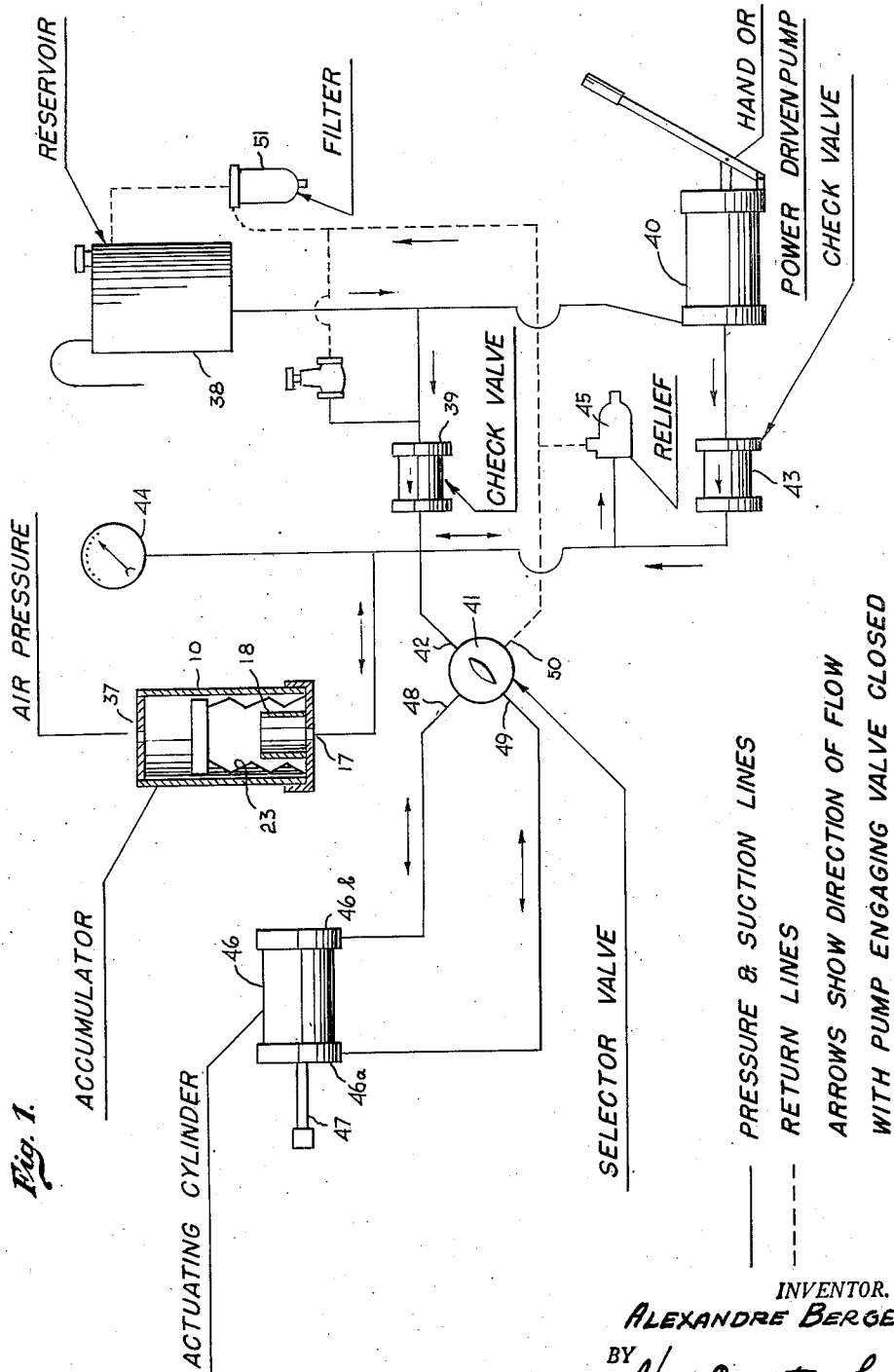
Sept. 28, 1948.

A. BERGER
ACCUMULATOR

2,450,031

Filed Jan. 30, 1945

3 Sheets-Sheet 1



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Fig. 2.

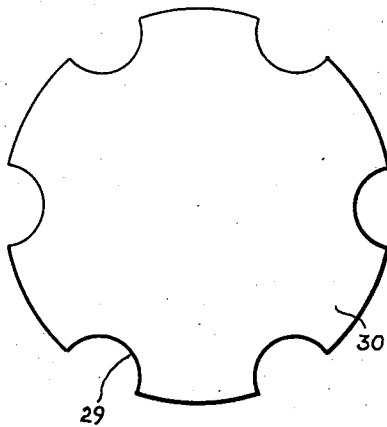
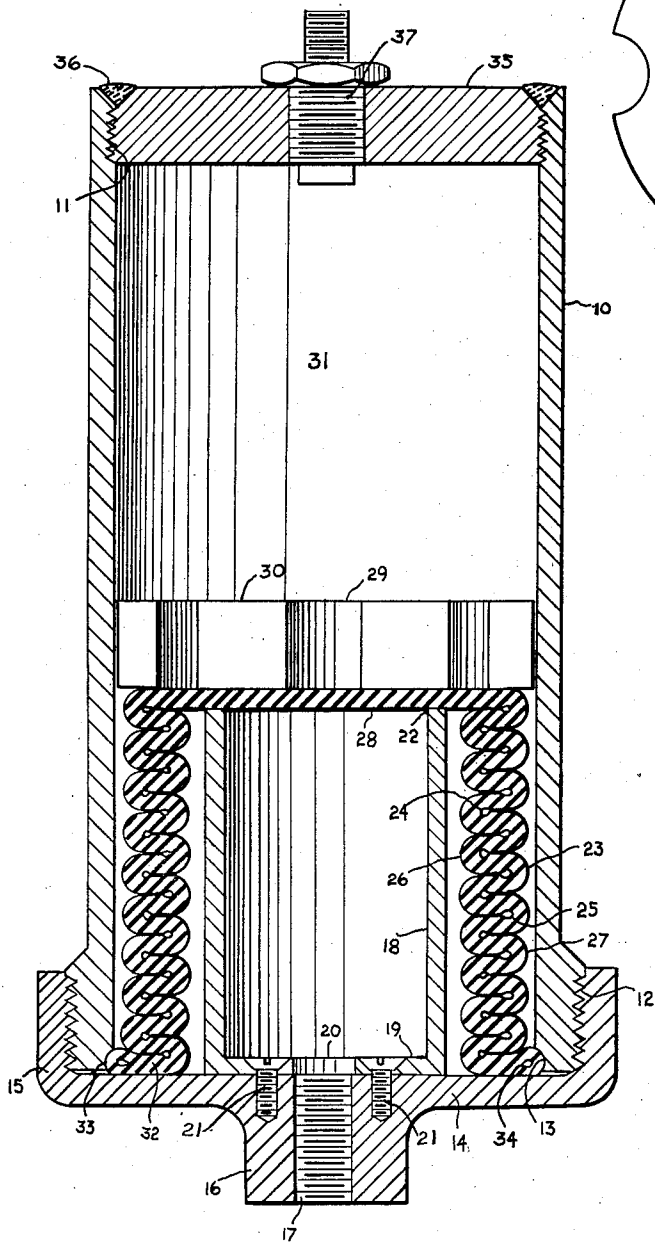


Fig. 3.

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Fig. 4.

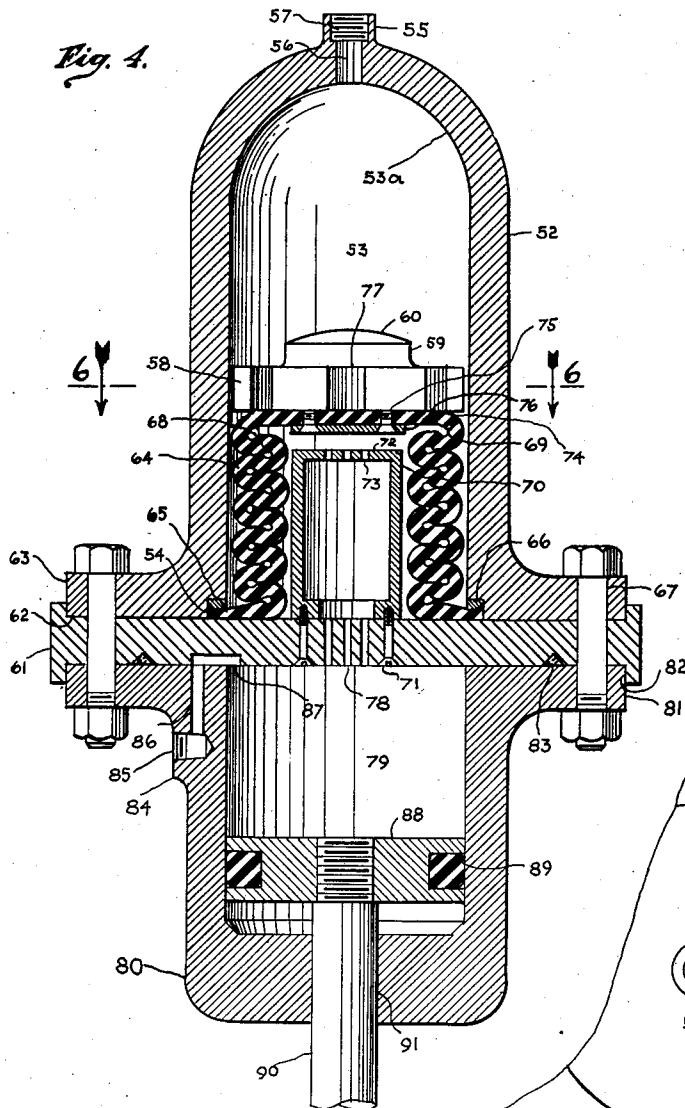


Fig. 5.

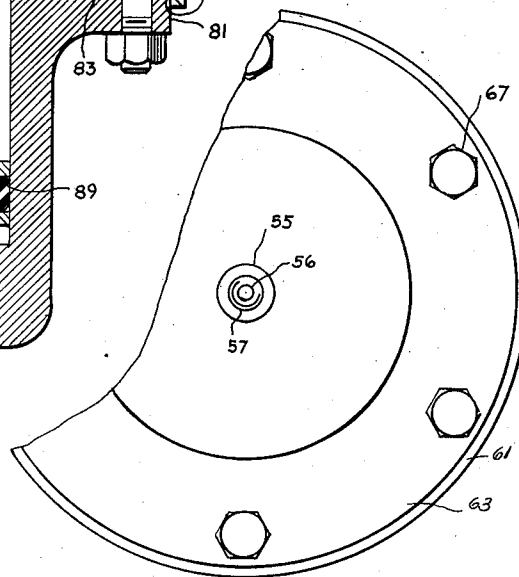
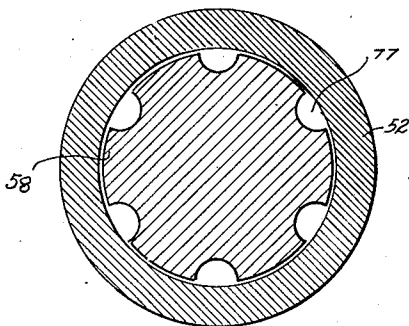


Fig. 6.



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UNITED STATES PATENT OFFICE

2,450,031

ACCUMULATOR

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11 Claims. (Cl. 138—31)

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This invention relates to improvements in accumulators and has for its main object the provision of an accumulator including a piston and a longitudinal expansible member having one end secured to said piston and the other end secured in fluid tight relation to one end of the cylinder in which said piston operates.

Another object of the invention is the provision in an accumulator employing a cylinder having a piston and a longitudinally expansible member between the piston and one end of the cylinder, said expansible member including side walls which are formed of a series of annular plaits, which fold upon one another when said expansible member is collapsed, said expansible member also having in cooperation with the interior thereof a tubular wall secured to a head of the cylinder and serving as a guide for said plaits as they approach the point where the plaits are collapsed upon each other.

Yet another object of the invention is the provision of an accumulator including a cylinder having a piston operable therein and flexibly connected by means of a greatly expansible member in fluid tight relation to one end constituting the head of said cylinder, tubular guide means within said expansible member including a perforate end closure, the perforations of which provide communication between the interior of said expansible means and the interior of said guide means, a second cylinder oppositely disposed on said head substantially in alignment with the first cylinder and including a piston and a connecting rod, and perforations formed in the cylinder head providing communication between the said second mentioned cylinder and the interior of said guide means.

A further object of the invention is the provision in a piston diaphragm accumulator of a tubular diaphragm formed of natural or artificial rubber compounds and having its walls formed with a series of inwardly extending peaks and outwardly extending peaks alternately disposed, the material in said peaks being thinner than the material joining said peaks, thereby permitting said tubular member to collapse to a shorter length than if the thickness of the material were uniform throughout.

Other objects and advantages of the invention will be apparent to those skilled in the art.

Referring to the drawings:

Figure 1 is a diagrammatic sketch of a system showing one example of the use of my new and improved accumulator;

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Figure 2 is a sectional elevation of one form of my new and improved accumulator;

Figure 3 is a view of the piston employed in the accumulator of Figure 2, showing clearances which permit the air to pass by the piston and contact the expansible element;

Figure 4 is a sectional elevation of a modified form of the accumulator;

Figure 5 is a plan view of the accumulator shown in Figure 4; and

Figure 6 is a cross sectional view as seen along the lines 6—6 of Figure 4.

Referring first to Fig. 2, the accumulator includes a cylinder 10 having its upper end internally threaded at 11 and having external threads 12 formed on the other end. The lower end of the cylinder and arcuate step 13 is formed for a purpose which will presently be described. The lower end of the cylinder is provided with a head 14 by having an annular flange 15, which is internally threaded to match the threads 12, formed on the cylinder. The cylinder head 14 is provided with a boss 16 having a central hole 17 which is threaded to accommodate a pipe, or fitting. Mounted on the cylinder head is a cup member 18, the lower end 19 of which has a hole 20 formed therein communicating with the hole 17. The cup may be secured to the cylinder head in any suitable manner, for example, by means of screws 21. The upper end of the cup is open.

Mounted in the cylinder 10 is a deformable member generally designated by the numeral 23. The side walls of the deformable member 23 are preferably formed of artificial rubber, or the like, and constitute a series of annular plaits or folds, which are thinned in the interiors of the internal apexes 24, and in the interiors of the external apexes 25 so that when the element 23 is entirely collapsed the folds will lie upon one another. The exteriors 26 of the internal apexes lie along a circular line clearing the exterior of the cup member 18. The exteriors of the external apexes 27 lie along a line clearing the interior bore of the cylinder 10. Continuous with, or joining the upper fold or plait is a web 28 to which is secured in any suitable manner a piston 30 which has a series of arcuate slots 29 formed therein to permit air from the chamber 31 in the cylinder above the piston to communicate with the exterior of the deformable element 23. The lower end 32 of the deformable element 23 extends beyond the diameter of the element proper and is finished with an arcuate rim 33 which is engaged by the arcuate groove 13 to form a fluid tight seal between the lower end of the cylinder and the de-

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formable element. A suitable insert 34 may be formed in the material to stiffen the portion 32.

The upper end of the cylinder is provided with a head or plug 35, the outer diameter of which is provided with threads which engage the threads 11. After the plug 35 is screwed into the cylinder it may be soldered or brazed, at 36, to form a fluid tight seal. The plug 35 may have a central threaded hole formed therein to accommodate a fitting such as that shown at 37. The fitting 37 may be connected to a source of air pressure and a pipe or fitting engaging the threaded hole 17 may be connected to and receive oil from any hydraulic system in which the accumulator is to be used.

Referring now to Fig. 1, which is a diagrammatic representation of an hydraulic system showing one example of the use of my new and improved accumulator, the threaded hole 17 is connected to the system and the fitting 37 is connected to a source of air under pressure, the pressure of which has a definite relation to the hydraulic pressure in the system. The system includes a reservoir 38 for the oil, and this reservoir is connected both to a check valve 39 and to a pump 40 which may be either a hand pump or a power driven pump. The check valve 39 is connected to the point 42 on a two-way selector valve 41. The outlet of the pump 40 is connected via a check valve 43 to the point 42 and also to the fitting 17 on my accumulator and to a pressure gauge 44. The outlet of the pump 40 is also connected to a pressure relief valve 45. An actuating cylinder 46 has a piston rod 47 which may be operatively connected to any means to be actuated. One end of the actuating cylinder is connected to the point 48 on the selector switch and the other end of the cylinder is connected to the point 49. When the actuating switch is in the position shown in the diagram, oil, under hydraulic pressure, is delivered to the end 46a of the cylinder 46, and this pressure acting upon the piston in the cylinder causes the piston rod to move to the right as seen in Fig. 1. As the piston moves to the right, as just described, oil in the end 46b of the cylinder is forced out and passes via the point 48 on the selector switch to the point 50 and thence via the return line (shown dotted) to a filter 51 and thence into the reservoir 38. When it is desired to move the piston rod 47 in the opposite direction the selector valve 41 is thrown to its other position to supply oil under pressure via the point 48 to the end 46b of the cylinder. As the piston moves to the left the oil in the end 46a is forced out and passes via the points 49 and 50 on the selector valve and thence via the filter 51 to the reservoir 38. The difference between the hydraulic pressure of the air pressure effects the accumulator action. Obviously the accumulator may be used in other systems than the one shown in Fig. 1, and the arrangement shown in Fig. 1 is merely an example.

Referring now to Figs. 4, 5, and 6, a cylinder 52 has an interior bore 53 which has a step 54 formed therein the purpose of which will presently be described. The upper end of the cylinder 52 has a boss 55 formed thereon and this boss has a central hole 56 formed therein the outer end of which is provided with threads 57 to accommodate a fitting.

Within the cylinder 52 is a piston 58 which carries a boss 59 the upper end 60 of which is curved to conform to the dome-shaped end 53a of the interior of the cylinder. A closure plate or head 61 has a counterbore 62 formed therein to accommodate the flange 63 which is formed integral with the cylinder 52. Within the cylinder

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is a deformable member generally designated by the numeral 64. The bottom end 65 of the deformable member is flanged upwardly and lies within the step 54 and includes an upper surface which is beveled. Mounted upon the flange and also lying within the step is an annular pressure ring 66. The thickness of the flange 65 and the ring is greater than the depth of the step 54 so that when the bolts 67 securing the cylinder to the head are tight a fluid tight seal is effected between the flange 65 and the head 61. The side walls of the deformable member 64 constitute a series of annular plaits or folds which are thinned in the interiors of the internal apexes 68 and also in the interiors of the external apexes 69, so that when the element 64 is entirely collapsed the folds will lie substantially upon each other. The apexes 69 lie along a circular line clearing the exterior of a cylindrical member 70 and this cylindrical member, among other things, functions as a guide for the plaits or folds of the member 64 when it is tight and approaches the collapsed position. The cylinder member may be secured to the plate 61 in any suitable manner, for example, by means of screws 71. The upper end 72 of the member 70 is closed except for a plurality of perforations 73 formed therein, the functions of which will presently be described. The deformable member 64 has its upper end closed by means of a web 74 formed integral therewith and this web is in turn secured to the piston 58 in any suitable manner, for example, by means of screws 75, passing through a reinforcing plate 76. The piston 58 may have a plurality of grooves 77 formed therein to permit air to pass from the upper portion of the cylinder to the outer walls of the deformable member 64.

The plate 61 has a plurality of holes 78 formed therein and communicating with the interior of the member 70.

A second cylinder 80 has an interior bore 79 and an annular flange 81 formed integral therewith. The plate or head 61 has a second counterbore 82 formed therein to accommodate the flange 81 so that the cylinder 80 will be properly located thereon. Suitable sealing means 83 in the form, for example, of an annular packing positioned in a groove formed in the plate 61 may be provided. A boss 84 formed on the body of the cylinder 80 has a threaded hole 85 formed therein to accommodate a fitting, and a passage 86 formed in said boss and the flange 81 communicates with a milled passage 87 formed in the plate 61. The passage 87 communicates with the interior 79 of the cylinder.

A piston 88 within the bore 79 carries a suitable packing ring 89 which engages and effects a seal with the wall of the cylinder bore 79. A piston rod 90 is operatively connected to the piston 88 and passes through a hole 91 formed in the cylinder body concentric with the bore 79.

A connection is made to the threaded hole 85 so that a fluid medium, oil, for example, may be forced into the cylinder bore 79. The oil passes through the passage 86 and the milled groove 87 and thence into the interior. As the cylinder fills some of the oil then passes via the holes 78 into the interior of the member 70 and thence passes via the holes 73 into the interior of the deformable member 64. When the device is properly charged with oil the hole 85 is sealed with a plug or the like. Air from a source of air under pressure is connected to the upper end of the cylinder 52.

When the piston rod 90 is connected to a device, for example, the shock absorbers on air-

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craft, and said aircraft is going to land, the shock of the wheels meeting the ground forces the piston 88 upwardly. This causes oil to pass from the cylinder 80 via the holes 78 into the interior of the member 70. Due to the sudden tendency of the oil to pass from the cylinder 80 into said interior, the holes 78 (which are small) "wire draw" the oil and its passage therethrough is somewhat retarded. Oil from the interior of the member 70, in passing to the interior of the deformable member 64 is also "wire drawn" as it passes through the hole 73. If the shock is of great extent considerable oil will pass from the cylinder 80 into the deformable member 64 and the piston 75 will be caused to move upwardly against the air pressure which is supplied to the interior of the cylinder 52.

From the above description it will be seen that my method of causing the shock to force oil through several series of small holes or perforations and delivering the overflow of oil (where the shocks are of substantial force) into the interior of the deformable member the exterior of the deformable member being subjected to air pressure, constitutes what I believe to be new and novel in this art.

Although I have herein shown and described by way of example two forms of the invention, it is obvious that many variations may be made in the arrangements herein shown and described without departing from the spirit of the invention as set forth in the following claims.

What is claimed is:

1. In an accumulator, a closed cylinder adapted to have its closed end connected to a source of fluid medium under pressure and having a cylinder head detachably secured to its other end and adapted to be connected to a different source of fluid under pressure, a piston in said cylinder having clearance passages formed therein, and an elongated expansible and contractible non-metallic member having one end flanged and secured in fluid tight relation between said other end of said cylinder and said cylinder head, the other end of said expansible and contractible member being closed and formed integral therewith, said closed end of said member being secured to and guided by said piston, said expansible and contractible member having its exterior subjected to the pressure of fluid from said first mentioned source and having its interior subjected to fluid pressure from said second mentioned source.

2. In an accumulator, a closed cylinder adapted to have one end thereof connected to a source of air under pressure and having its other end adapted to be connected to a source of liquid under pressure, a piston in said cylinder having clearance passages formed therein, a non-metallic expansible and contractible member having one end closed and the other end forming an annular flange, means for securing said flange in fluid tight relation to said second mentioned end of said cylinder, guide means comprised of an open-ended cup within said member concentric with said cylinder, other means securing said closed end to said piston, the walls of said member being circular and formed of a plurality of alternate inwardly and outwardly extending annular folds or pleats, a passage through the bottom of said cup adapted to be connected to said liquid under pressure, said member having its interior subjected to said liquid under pressure and having its exterior under the influence of air under pressure.

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3. In an accumulator, a closed cylinder adapted to have one end thereof connected to a source of air under pressure and having its other end adapted to be connected to a source of liquid under pressure, a piston in said cylinder having clearance passages formed therein, a removable cylinder head forming a closure for said other end of said cylinder, a flexible non-metallic expansible and contractible member having one end closed and the other end forming an annular flange, cooperative means partly on said cylinder head and partly on said other end of said cylinder for securing said flange in fluid tight relation to said second mentioned end of said cylinder and means securing said closed end to said piston, the walls of said member being circular and formed of a plurality of alternate inwardly and outwardly extending annular folds or pleats, said member having its interior subjected to said liquid under pressure and having its exterior under the influence of air under pressure, and an open ended cup positioned in said cylinder and having its closed end secured to said cylinder head, said cup lying within and serving as a guide for the inner folds or pleats of said member as the latter approaches its normal or collapsed position.

4. In an accumulator, a cylinder, a chamber in said cylinder carrying a fluid under pressure, an elongated expansible and contractible member having one end in fluid tight relation to the end of said cylinder and defining said chamber, said member being formed of rubber or the like and having its wall formed of a plurality of alternate inwardly and outwardly extending folds or pleats, the other end of said member being closed and formed integral therewith, a piston in said cylinder secured to the closed end of said member and serving as a guide for said end of said member, an open cup forming interior guide means for said member, said cup being mounted on the end of and concentric with said cylinder, and means for connecting said cylinder to a source of compressed air.

5. In an accumulator, a cylinder positioned in contact with one face of a plate forming a cylinder head, a second cylinder secured to the opposite face of said plate and preferably having its bore in alignment with the bore of said first cylinder, a piston in said second cylinder, a non-metallic elongated expansible member mounted in said first cylinder and having its lower end secured in fluid tight relation to said cylinder and having its other end secured to said piston, means for connecting said first cylinder to a source of compressed air, means for filling said second cylinder with a liquid under pressure, and means in said head providing communication between said second cylinder and the interior of said chamber.

6. An accumulator according to claim 5 in which said means in said head providing communication between said second cylinder and the interior of said expansible member comprises a plurality of small holes tending to "wire draw" the liquid passing from said cylinder to said interior.

7. In an accumulator, a cylinder positioned in contact with one face of a plate forming a cylinder head, a second cylinder secured to the opposite face of said plate and preferably having its bore in alignment with the bore of said first cylinder, a piston in said second cylinder, an expansible and contractible member having one end closed and the other end forming an an-

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nular flange which is clamped in fluid tight relation between said first cylinder and said cylinder head, the walls of said member being circular and formed of a plurality of inwardly and outwardly disposed folds or pleats, a piston in said first cylinder secured to the closed end of said member, a closed ended cylindrical guide secured to said head and positioned within said expansible member, a plurality of perforations formed in the closed end thereof, other perforations providing communication between said second cylinder and the interior of said cylindrical member, means for connecting said first cylinder to a source of compressed air, and means for filling said second cylinder, said cylindrical member and the interior of said expansible member with a fluid under pressure and sealing the same therein.

8. An accumulator according to claim 7 in which said cylinders are provided with flanges and in which the cylinder head has annular depressions formed on opposite faces thereof into which said flanges may seat, said cylinder head also having an annular V-shaped groove formed therein to contain packing for effecting a seal between said second cylinder and said head.

9. In an accumulator, a cylinder having a piston reciprocable therein, a piston rod secured to said piston, a head for said cylinder, said head having a groove formed therein providing a passage communicating with the bore thereof, a longitudinal hole in the wall of said cylinder substantially parallel to the bore thereof and a radial hole extending from outside said cylinder into the wall thereof and communicating with one end of said longitudinal hole, the other end of said longitudinal hole registering with said groove, whereby said groove and said holes conjointly provide communication between the exterior of said cylinder and the interior thereof, and threads formed in the outer end of said radial hole to accommodate a fitting for filling said cylinder with fluid under pressure and sealing the same therein.

10. In an accumulator, a cylinder having a piston reciprocable therein, a piston rod secured to said piston, a head for said cylinder, means forming a passage between the exterior of said cylinder and the space between said piston and said cylinder head, a second cylinder secured to the opposite face of said cylinder head, an elongated expansible and contractible member having one end in fluid tight relation to the end

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of said second cylinder and defining a fluid chamber, the other end of said member being closed, a piston in said second cylinder secured to the closed end of said member and serving as a guide for said member, and a plurality of small holes in said cylinder head communicating with the interior of said first cylinder and the interior of said member, said small holes tending to "wire draw" liquid passing from said cylinder to the interior of said member.

11. In an accumulator, a cylinder having a piston reciprocable therein, a piston rod secured to said piston, a head for said cylinder, a radial groove formed in said cylinder head and having one end thereof communicating with the interior of said cylinder, a longitudinal hole formed in the wall of said cylinder and having one end communicating with said groove, a radial hole extending from outside said cylinder into the wall thereof and communicating with said longitudinal hole whereby said groove and said holes conjointly form a passage between the exterior of the cylinder and the interior thereof, a second cylinder secured to the opposite face of said cylinder head, an elongated expansible and contractible member having one end in fluid tight relation to the end of said second cylinder and defining a fluid chamber, the other end of said member being closed, a piston in said second cylinder secured to the closed end of said member and serving as a guide for said member, and a plurality of small holes in said cylinder head communicating with the interior of said first cylinder and the interior of said member, said small holes tending to "wire draw" liquid passing from said cylinder to the interior of said member.

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