June 30, 1964 J. MERCIER 3,139,113

PRESSURE CONTAINER

Original Filed June 17, 1958

Fig.1

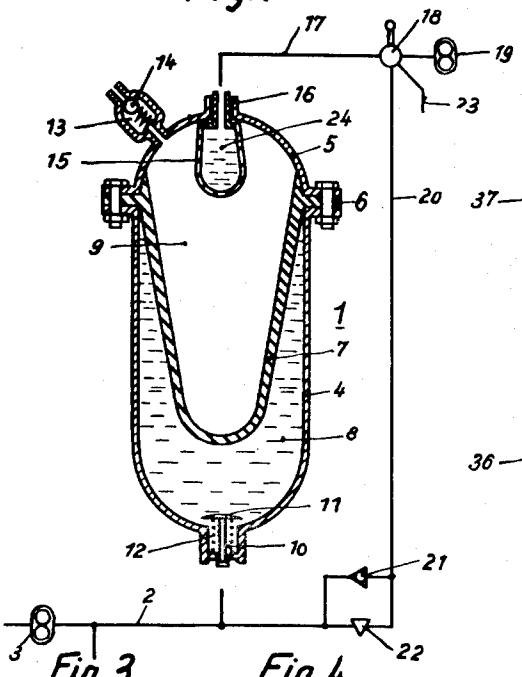


Fig.2

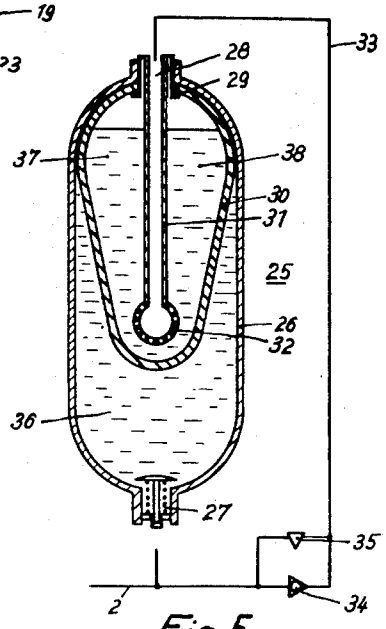


Fig.3

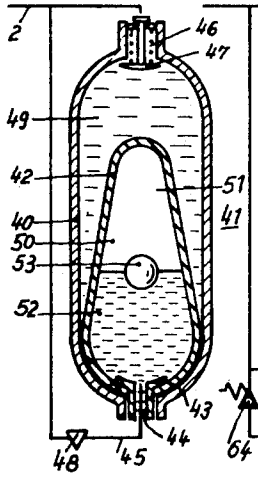


Fig.4

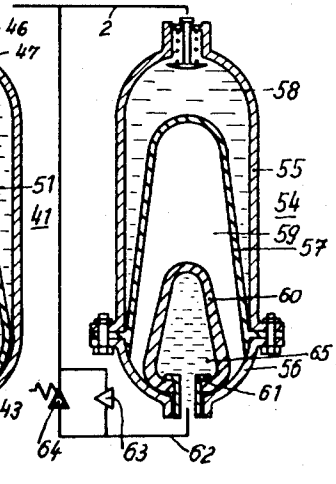
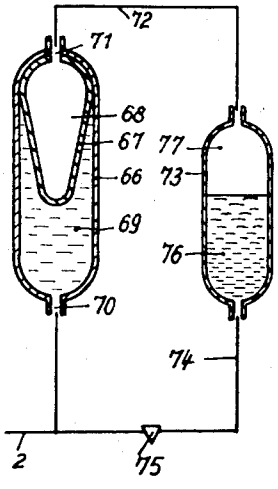


Fig.5



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PRESSURE CONTAINER

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Original application June 17, 1958, Ser. No. 742,670, now Patent No. 3,077,208, dated Feb. 12, 1963. Divided and this application Dec. 18, 1962, Ser. No. 245,528
12 Claims. (Cl. 138—30)

The present invention is concerned with the art of pressure vessels, more particularly of the type having a rigid container with a compressible and expansible medium such as a resilient deformable partition defining a pressure or resilient chamber on one side that is filled with gas and a liquid chamber on the other side.

As conducive to an understanding of the invention, it is noted that where such pressure vessels are associated with hydraulic installations in which long and short variations of pressure may occur, according to the period of time that a pressure elevation exists, the compressible and expansible medium is in different condition, as for instance, a variable compression of gas. If variations of pressure of equal magnitude occur, the medium reacts differently according to whether it is maintained under high or low pressure. This condition is disturbing for hydraulic installations of various types. At higher pressure the compressible and expansible medium may be subjected to pressure impulses beyond the limit of its operativeness, so that the deformable partition itself may be destroyed.

Where the gas chamber of a pressure vessel is charged with a definite and uniform liquid mass, to prevent the complete collapse of a bladder encompassing the gas chamber, maximum efficiency of operation may not be achieved.

It is accordingly among the objects of the invention to provide a pressure vessel of the above type that has a rigid container with a deformable partition defining a gas chamber on one side and a liquid chamber on the other, the partition and contained gas in the gas chamber forming a compressible and expansible medium, and in which the resilient characteristics of the medium may readily be varied to prevent injury to the partition due to variations in pressure in the pressure vessel.

Another object is to provide a hydraulic circuit incorporating a pressure vessel of the above type which will provide for variation in the resilient characteristics of the compressible and expansible medium in the pressure vessel.

According to the invention from its broadest aspect, the resilient chamber is filled with a gas under pressure and a substantially non-compressible medium as compared to gas, such as a liquid, is provided in the resilient chamber in desired amounts depending upon the pressure in the system so that the condition of the pressure vessel may be varied.

This application is a division of co-pending application Serial No. 742,670, filed June 17, 1958, now Patent No. 3,077,208.

In the accompanying drawings in which are shown one or more of various possible embodiments of the several features of the invention,

FIG. 1 is one embodiment of the invention in cross section with part of a hydraulic installation,

FIG. 2 is another embodiment in cross section,

FIG. 3 is still another embodiment in cross section,

FIG. 4 is a fourth embodiment, and

FIG. 5 is a fifth embodiment shown in simplified form.

Referring now to the drawings, in the embodiment shown in FIG. 1, the port 10 of a pressure vessel such as an accumulator 1 is connected with a hydraulic installation by means of a conduit 2, which is maintained under pressure by a pump 3. The accumulator has a rigid housing 4 with a cover 5, each with a lateral flange at its mouth between which the flange 6 of a bag-like bladder 7 of resilient deformable material is maintained in place. The bladder subdivides the interior of the pressure vessel into a supply chamber 8 in communication with port 10 and a pressure or resilient chamber 9.

The port 10 is controlled by a valve 11 normally retained in open position by means of a spring 12, until the expanding bladder 7 engages the valve to displace the latter thereby closing port 10. The supply chamber 8 is filled with oil under pressure which is conveyed thereto by conduit 2.

The pressure chamber 9 has a gas inlet port 13 in which a check valve 14 is disposed. Through the inlet, gas under pressure is introduced into the resilient chamber 9. The pressures in the accumulator are preferably such that the bladder 7 is normally maintained in distended, but substantially unstretched condition as shown in FIG. 1.

A small bladder 15 also of resilient deformable material is positioned in chamber 9 and is secured to cover 5 with the aid of a holder 16. A conduit 17 is in communication with the interior of the bladder 15, and leads to a valve 18, the latter being connected to a pump 19; to an auxiliary conduit 23; and to a conduit 20 which is connected to conduit 2 by means of a reverse check valve 21 and a choke 22 in parallel thereto.

In the operation of the system shown in FIG. 1, should the pressure in the hydraulic installation and thereby also that in the conduit 2 in advance of the port 10 rise, then the bladder 7 and with it the gas in the pressure chamber 9 will be compressed. With a definite increase in pressure there corresponds a definite decrease in volume of chamber 9. The relation of these two values controls the resilient characteristic of the accumulator. Such relation remains constant as long as the volume of the bladder 15 does not change. This volume is determined by a fluid mass 24 which is contained in the bladder and in the position shown of the valve 18, the bladder 15 is shut off from the exterior.

If the resilient characteristic of the accumulator is to be altered at will, then by corresponding actuation of the valve 18, oil under pressure is introduced from pump 19 into the bladder 15 or oil under pressure may escape from bladder 15 through the auxiliary conduit 23. If oil is forced into the bladder 15 which then becomes enlarged, then the gas in the chamber 9 is compressed to a smaller volume and its pressure increases; if the volume of bladder 15 is decreased the pressure in chamber 9 decreases.

If the valve 18 is actuated so that the conduits 17 and 20 are connected together, then the charge of the bladder 15 is influenced by the pressure maintained in the conduit 2. A rise in pressure will force oil past the reverse check valve 21 and increase the volume of the bladder 15 to correspondingly decrease the volume of chamber 9. Should the pressure decrease, oil from the bladder 15 may escape through the choke 22, thereby decreasing the volume of bladder 15 to correspondingly increase the volume of chamber 9.

In the embodiment shown in FIG. 2, a pressure accumulator 25 has a rigid housing 26 having a port 27 at one end which is connected with the conduit 2, and at the opposite end a port 28 is provided. In the port 28 there is a holder 29 which retains a bladder 30 of resilient deformable material in position in the housing 26. A tube 31 extends through holder 29 in pressure-tight relation, the lower end of the tube 31 being widened and having apertures 32. The upper end of tube 31 is connected to the conduit 2 by a conduit 33 and by way of a reverse check valve 34 and a choke 35 in parallel therewith.

The storage chamber 36 below the bladder 30 of the accumulator is filled with liquid from the conduit 2. In the chamber 37 defined by the bladder 30 there is gas under pressure which forms a dispersion 38 with the liquid introduced thereto by way of the conduit 33 which fills the major part of the chamber 37. The liquid contains a medium favorable to dispersion, such as for instance, agar-agar. This dispersion effects a division of the liquid over a greater part of the bladder 30, so that it will not collect exclusively at its lower end, which is undesirable as it would stretch the bladder longitudinally and subject it to the danger that in the generally rapid variations of pressure, it would perform non-uniformly and to a dangerous degree.

The amount of fluid present in the resilient chamber 37 depends on the pressure in the conduit 2. If this pressure should rise, further fluid would be pushed into the conduit 33 by way of the choke 35, which would more greatly compress the gas in the chamber 37. Should the pressure in the conduit 2 drop, the gas pressure in chamber 37 would quickly drop since liquid would escape through the reverse check valve 34. We are here concerned with the filling of the hydraulic installation and the supply chamber 36 at all times with small amounts of regulating fluid which flow through the conduit 33. Since the fluid is enriched in the lower part of the chamber 37, substantially no loss of gas occurs. The tube 31 serves at the same time as a prop for the bladder 30.

In the embodiment of FIG. 3, a bladder 42 of resilient deformable material is so disposed in a pressure accumulator 41 that its interior is connected through port 44 to a conduit 45 at the lower part of the housing 40. At the upper end of the housing 40 there is a port 46 with a valve 47 to which is connected the conduit 2 of the hydraulic installation. The conduit 45 is connected by means of a choke 48 to the conduit 2.

In this embodiment, the liquid filled supply chamber 49 is disposed at the upper end of the pressure accumulator. The chamber 50 disposed thereunder is filled in part with gas 51 and in part with regulating fluid 52, the amount of which depends upon the pressure existing in conduit 2. Upon the surface of the regulating fluid 52, there lies a float 53. The accumulator operates in the same manner as the accumulators according to FIGS. 1 and 2. If the pressure in the hydraulic installation has sunk so low that the regulating fluid 52 is completely expelled from the bladder 42, then the float 53 will rest against the inner side of the holder 43 and thereby prevent the escape of gas into the conduit 45.

In the embodiment of FIG. 4, the accumulator 54 has a housing 55 similar to the embodiment shown in FIG. 1, with a cover 56 which in this case is at the lower end of the accumulator. The rim of a bladder 57 is compressed between the flanges of the housing and the cover. The supply chamber 58 above the bladder is connected with the conduit 2 as in the embodiment shown in FIG. 3. In the chamber 59 there is a bladder 60 with relatively thick side walls. It is connected to the cover 56 by means of a holder 61. The conduit 62 leads by way of a choke 63 and a spring loaded reverse check valve 64 in parallel therewith to the conduit 2.

The mode of operation of this accumulator is similar to the embodiment of FIG. 3. Excess pressure from the conduit 2 rises rapidly to a value determined by the strength of the spring in the reverse check valve 64 to the value maintained in the fluid 65 within the bladder 60. The choke 63 permits the slow complete effect of the pressure and the slow discharge of the bladder 60 if the pressure in the conduit 2 should drop further. If the bladder 60 should be empty, it collapses; its walls are so stiff and thick that it cannot extrude into the conduit 62.

In the embodiment of FIG. 5, the interior of the accumulator 66 is again sub-divided by a bladder 67 into a gas chamber 68 and a supply chamber 69. The supply chamber is connected by a port 70 to the conduit 2 and

the resilient chamber by a port 71 and a conduit 72 to the upper end of a container 73. From the lower end of the latter, a conduit 74 leads by way of a choke 75 to the conduit 2.

According to the pressure maintained in the conduit 2, a part of the container 73 is filled with regulating fluid 76. The upper portion of the container encloses a gas 77. According to variation of the volume of this upper portion, the resilient characteristic of the pressure accumulator 66 also varies.

The bladder 67 is given a certain pre-compression, so that it will not completely collapse under sudden pressure impulses or indeed be compressed into the opening 71.

In each of the accumulator forms shown, the connection between the gas chamber and the conduit 2, that is with the hydraulic installation, may be effected by valves and chokes in the manner shown or any modifications of the same. The part of the pressure chamber which contains the regulating fluid may, instead of being connected to the hydraulic installation, be connected to pressure sources of other types which may, for example, be controlled by the operating condition of a vehicle or motor.

Instead of the liquid, another non-elastic or uncompressible means as for instance a piston may be used which may be introduced to a greater or lesser degree into the resilient chamber or into a container connected with the same.

As many changes could be made in the above constructions, and many apparently widely different embodiments of this invention could be made without departing from the scope of the claims, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

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

1. A hydraulic unit comprising a pressure vessel having a rigid container with a resilient deformable partition therein defining a chamber on each side thereof, one of said chambers defining a supply chamber adapted to be charged with a substantially non-elastic medium and the other a resilient chamber adapted to be charged with an elastic medium under pressure, said resilient chamber having a passageway for gas under pressure leading thereinto for charging of said resilient chamber, and means to introduce varying quantities of a substantially non-elastic regulating medium into said resilient chamber to vary the resilient characteristics thereof, said non-elastic regulating medium comprising a liquid that is introduced into the resilient chamber in direct engagement with the gas therein.

2. The combination set forth in claim 1 in which said resilient chamber has a port and has means therein to prevent escape of gas therefrom but permit introduction of the regulating liquid therein.

3. The combination set forth in claim 2 in which the regulating liquid and the gas form a dispersion.

4. The combination set forth in claim 2 in which the regulating liquid contains a component so that the gas and liquid will form a dispersion.

5. The combination set forth in claim 4 in which the component is agar-agar.

6. The combination set forth in claim 1 in which the supply chamber is at the upper portion of the pressure vessel and the resilient chamber at the lower portion thereof.

7. The combination set forth in claim 1 in which the supply chamber is at the upper portion of the pressure vessel and the resilient chamber is at the lower portion thereof, said resilient chamber has a port and the liquid non-elastic regulating medium is introduced into the resilient chamber through such port, a float lies on the surface of the regulating liquid in the resilient chamber,

said float closing the port leading into the resilient chamber when the regulating fluid is substantially discharged therefrom.

8. The combination set forth in claim 1 in which a bladder of resilient deformable material defines the resilient chamber in the upper portion of the pressure vessel and the supply chamber in the lower portion, a rigid tube is positioned in the bladder extending beyond the upper end thereof, and the liquid regulating medium is introduced through the tube into the bladder.

9. A hydraulic unit comprising a pressure vessel having a rigid container with a resilient deformable partition therein defining a chamber on each side thereof, one of said chambers defining a supply chamber adapted to be charged with a substantially non-elastic medium and the other a resilient chamber adapted to be charged with an elastic medium under pressure, said resilient chamber having a passageway for gas under pressure leading thereinto for charging of said resilient chamber, means to introduce varying quantities of a substantially non-elastic regulating medium into said resilient chamber to vary the resilient characteristics thereof, said substantially non-elastic regulating medium comprising a liquid introduced into the resilient chamber, means to apply a source of liquid under pressure to the supply chamber, the quantity of regulating liquid introduced into the resilient chamber being determined by said liquid pressure, said means to deliver the regulating medium comprising a conduit connected to said supply chamber and a one-way spring loaded valve in said conduit.

10. A hydraulic unit comprising a pressure vessel having a rigid container with a resilient deformable partition therein defining a chamber on each side thereof, one of said chambers defining a supply chamber adapted to be charged with a substantially non-elastic medium and the other a resilient chamber adapted to be charged with an elastic medium under pressure, said resilient chamber having a passageway for gas under pressure leading thereinto for charging of said resilient chamber, means to introduce varying quantities of a substantially non-elastic regulating medium into said resilient chamber to vary the resilient characteristics thereof, said substantially non-elastic regulating medium comprising a liquid introduced into the resilient chamber, means to apply a source of liquid under pressure to the supply chamber, the quantity of regulating liquid introduced into the resilient chamber being determined by said liquid pressure, said means to deliver the regulating medium comprising a conduit connected to said supply chamber and a choke in said conduit.

11. The combination set forth in claim 10 in which a one-way valve is in parallel with said choke.

12. The combination set forth in claim 10 in which a one-way spring loaded valve is in parallel with said choke.

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