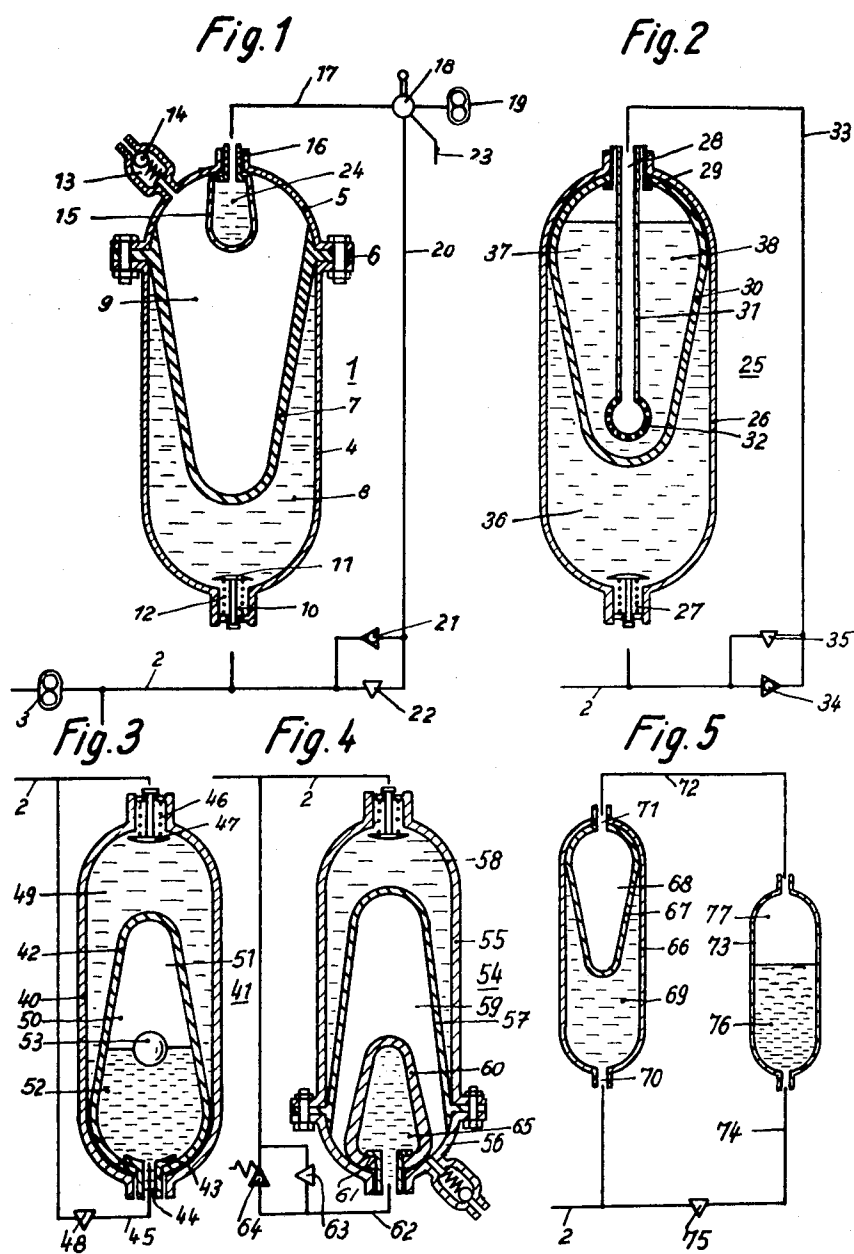


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J. MERCIER

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PRESSURE CONTAINER
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INVENTOR
JEAN MERCIER
BY
Dean, Fairbank & Hensch
ATTORNEYS

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PRESSURE CONTAINER

Jean Mercier, 1185 Park Ave., New York, N.Y.
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No. 3,139,113, dated June 30, 1964, which is a division
of application Ser. No. 742,670, June 17, 1958, now
Patent No. 3,077,208, dated Feb. 12, 1963. Divided and
this application May 19, 1964, Ser. No. 368,680
5 Claims. (Cl. 138—30)

This application is a division of copending application
Serial No. 245,528, filed December 18, 1962, now Patent
No. 3,139,113, dated June 30, 1964, which copending
application was a division of copending application Serial
No. 742,670, filed June 17, 1958, now Patent No.
3,077,208, dated February 12, 1963.

The present invention is connected 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 varia-
tions 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 pres-
sure 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 in-
corporating a pressure vessel of the above type which
will provide for variation in the resilient characteristics
of the compressible and expansible medium in the pres-
sure 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 com-
pared 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.

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 an 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.

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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 installa-
tion 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 re-
tained 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 cham-
ber 9. The pressures in the accumulator are preferably
such that the bladder 7 is normally maintained in dis-
tended, but substantially unstretched condition as shown
in FIG. 1.

A small bladder 15 also of resilient deformable ma-
terial, 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 re-
lation 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 blad-
der 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 con-
duit 2. A rise in pressure will force oil past the re-
verse 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 ac-
cumulator 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 re-
siliant 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

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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 ununiformly 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 release 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.

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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 charged thereto through line 72. According to variation of the volume of this upper portion, the resilient characteristic of the pressure accumulator 66 also varies.

As a result of the variation in the volume and hence pressure of the gas in container 73, the bladder 67 is given a certain percompression, 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 incompressible 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 construction, 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 thereto for charging of said resilient chamber, a resilient deformable bladder positioned in said resilient chamber, said chamber having a port, said bladder having a mouth connected to said port, means connected to said port to introduce varying quantities of a substantially non-elastic regulating medium into said bladder to vary the resilient characteristics of the resilient chamber, said bladder being of wall thickness and stiffness such that upon discharge of the regulating medium therefrom, the bladder will not extrude through said port.

2. The combination set forth in claim 1 in which a conduit is connected between said supply chamber and the mouth of said bladder.

3. The combination set forth in claim 1 in which a conduit is connected between said supply chamber and the mouth of said bladder and a choke is positioned in said conduit to restrict the rate of flow therethrough of said non-elastic medium.

4. The combination set forth in claim 3 in which a one-way spring loaded valve is in parallel with said choke.

5. The combination set forth in claim 3 in which a spring controlled one-way check valve is positioned in parallel with said choke to permit unrestricted flow of

said non-elastic medium from said supply chamber into the bladder when the pressure in said conduit exceeds a predetermined amount.

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LAVERNE D. GEIGER, *Primary Examiner*.

LEWIS J. LENNY, *Examiner*.