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ABSTRACT
This invention relates to a hydro-pneumatic pressure reservoir of the type comprising a hollow container having a gas port and an oil port, with a deformable partition intervening therebetween defining a gas chamber and an oil chamber. A magnetic switch is mounted externally of the container, and actuating means internally of the container causes actuation of said magnetic switch to give an alarm signal when the volume of gas in the gas chamber falls below a predetermined amount.

5 Claims, 2 Drawing Figures
PRESSURE VESSEL WITH SENSING DEVICE

As conducive to an understanding of the invention, in pressure reservoirs of the above type, it is essential that the volume of gas in the gas chamber be sufficient to provide for effective operation of the device, such as to expel a desired volume of oil from the oil chamber to the system to which the device is connected. If there should be leakage of gas from the gas chamber and hence undue loss of volume, it is essential that automatic monitoring of this condition be provided.

It is accordingly among the objects of this invention to provide a hydro-pneumatic pressure reservoir with a gas volume sensing device which may readily be assembled and which will operate dependably with no manual supervision to indicate when the volume of gas in the chamber has fallen below a predetermined amount.

According to the invention there is provided at the end of the path of movement of the separator or partition in the pressure reservoir which defines the oil and gas chamber, a switch which is actuated when the partition has reached the end of its movement, to actuate an alarm signal.

The switch is located so that when the gas volume has fallen below a predetermined amount required for safe operation, it will be actuated to give such alarm signal.

In the accompanying drawings, in which are shown various embodiments of the several features of the invention:

FIG. 1 is a longitudinal schematic view of a pressure reservoir according to one embodiment of the invention, and

FIG. 2 is a view similar to FIG. 1 of another embodiment of the invention.

Referring now to the drawings, the pressure reservoir shown in FIG. 1 comprises a container of rigid material, such as steel or aluminum, capable of withstanding the pressure to which the device is subjected in use.

In the illustrative embodiment shown, the container is formed from a central cylindrical sleeve 1, to the opposed rims of which are secured as by welding at W, W', the rims of two cup-shaped end portions 2 and 3, each having an axial opening 2' and 3', respectively. If desired, the central sleeve 1 and end portion 2 could be formed integrally.

Positioned in the container is a movable partition 5, illustratively a bladder of deformable material such as natural or synthetic rubber, which divides the container into an oil chamber C in communication with opening 3', and a gas chamber G in communication with opening 2'.

The bladder 5 is closed at one end and has an enlarged mouth, the rim of which is secured in the container by means of a clamp ring 4, in the form of a metal sleeve which is secured in the container by the weld W.

Secured as by welding in opening 3' is a tubular fitting 6, the bore of which defines an oil port 6', by means of which a conduit connected to a source of oil under pressure may be connected to the oil chamber C. In order to close the port 6' to prevent extrusion of the bladder 5, a valve member in the form of a metal disc 8 is axially mounted in the closed end of bladder 5 and is designed to move against the seat S formed at the inner end of fitting 6.

Secured as by welding in opening 2' is a metal plug 7 having an axial bore 7' therethrough and a cylindrical internally threaded recess 7'' in its outer surface, through the floor of which the outer end of axial bore 7'' extends.

Mounted in recess 7'' is the externally threaded lower end of a cylindrical switch housing 9. The housing 9 has a bore 10 axially aligned with bore 7'' in plug 7.

Axially movable in bore 10 is a cylindrical actuating member or stem 11, which has an annular groove in its periphery to mount a resilient stop ring 12. More particularly, as shown in FIG. 1, the bore 7'' in plug 7 is of smaller diameter than the outer diameter of stop ring 12 so that the stop ring 12 will abut against the edge 7a of bore 7'' to limit the inward movement of stem 11, the inner end of which is rounded as at 11'.

In order to provide free communication of gas between chamber G and bore 10, the lower end of cylindrical housing 9 and the bore 7'' of plug 7 are provided with a plurality of longitudinal grooves 10a, as shown.

Mounted on a bolt 16 extending axially from the outer end 11' of actuating stem 11 are two anular permanent magnets 13 positioned between two washers 14 and 15 of nonmagnetic material the magnets 13 and washers 14 and 15 being retained in clamped position by a nut 17 screwed on the end of bolt 16.

It is to be noted that adequate radial clearance is provided between the magnets 13, washers 14, 15 and the wall of bore 10 so that gas under pressure may readily flow through a gas charging valve 19 screwed in the reduced diameter outer end of bore 10 into the gas chamber G with substantially no pressure drop.

Mounted on the exterior of housing 9, substantially aligned with magnets 13 is a magnetic switch 18 which co-operates with said magnets 13 in the manner to be described, to activate an alarm signal (not shown).

In the embodiment shown, the housing 9, the actuating stem 11, the washers 14, 15 and the bolt 16 and nut 17 are of non-magnetic material.

In the operation of the device in upright position, when gas under pressure is forced through valve 19 it will flow through bore 10, past the magnets 13 and stem 11 into the gas chamber G.

As a result, the bladder 5 will expand and the valve member 8 will move against its seat S to close port 6', as shown in broken lines in FIG. 1.

Due to the fact that the force exerted by the gas in bore 10 and chamber G against both ends of the magnet and actuating assembly is substantially equal, the weight of such assembly will normally retain it in its lowermost position with the rounded end 11' of the stem protruding from bore 7''.

When oil under pressure is forced into port 6', it will charge oil chamber C and compress the bladder 5 and the gas in chamber G.

So long as sufficient quantity of gas remains in chamber G, the actuator stem 11 will not be affected. However, if the volume of gas is too greatly reduced, either by excessive compression or by leakage from chamber G, the bladder 5 will be moved to the position shown in dotted and dash lines in FIG. 1 so that valve member 8 will abut against the end 11' of actuator stem 11, moving the latter outwardly.

As a result, the magnets 13 carried by the actuator stem 11 will be moved axially, causing actuation of the magnetic switch and thereby giving an alarm.

If the pressure reservoir is to be installed in a position other than vertical or substantially vertical, in which the actuating stem 11 does not assume the position
3,929,163

shown in the drawing by its own weight, a spring (SP) may be provided to normally urge the actuating stem 11 to such position. Such spring may be a coil spring positioned in bore 10 between the shoulder formed by the reduced diameter portion thereof and the washer 15.

It is important that the force exerted by such spring not be sufficient to prevent ready movement of actuator stem 11 by valve members 9a if the gas volume in chamber G falls below a predetermined amount.

Although the invention is illustratively shown incorporated in a pressure reservoir using an open mouth bladder and in which the mouth of the bladder is secured to the wall of the container, the invention could as well be incorporated in a standard pressure reservoir in which the plug 7 could be bonded in the relatively smaller mouth of such bladder and the plug 7 secured in the gas port of such standard device, as by welding.

In the embodiment shown in FIG. 2, parts corresponding to those in FIG. 1 have the same reference numbers, modifications being marked by the addition of a lower case letter.

In the embodiment if FIG. 2, the container comprises a cup-shaped lower end portion 1a having an axial opening to receive a fitting 6; an upper cup-shaped end portion 2a with an axial opening 22'; and a closure plate 22 of non-magnetic material.

Adjacent rims of end portions 1a and 2a are connected by welding as at W. The closure plate 22 is secured in opening 22' as by welding at W'.

The plate 22 has a port 19 in which a gas charging valve 19 is mounted and a magnetic switch 18 is secured to plate 22 so that a portion of the switch 18 will be axially aligned with the container.

The closed end of bladder 5a carries an axially mounted valve member 8 on its outer surface and an axially mounted permanent magnet 13a on its inner surface, the valve member 8 and magnet 13a preferably being moulded integrally with the bladder.

In the operation of the device shown in FIG. 2, when the gas volume in chamber G falls below a predetermined amount, the permanent magnet will move to the position shown in dot and dash lines in FIG. 2, i.e. in proximity to plate 22, and hence the magnetic switch 18 will be actuated to give an alarm signal.

The invention above described may also be incorporated in a piston type pressure reservoir in which a movable piston defines the separation between the gas and oil chambers.

In such embodiment, the piston may support on its side adjacent the gas chamber, a rod shaped, non-magnetic magnet carrier corresponding to actuating member 11 and its associated magnets. The magnets and magnet carrier may engage with adequate clearance a non-magnetic housing corresponding to the switch housing 9 when the piston has arrived on the gas cham-

ber side in the vicinity of its end position, and actuate a magnetic switch mounted on the outside of the switch housing. The chamber in which the magnets and magnet carrier will be accommodated must provide sufficient clearance for free movement of the movable elements to prevent compression.

Having thus described the invention and illustrated its use, what is claimed as new and is desired to be secured by Letters Patent is:

1. A pressure vessel comprising a rigid container having a gas port and an oil port and a flexible partition intervening between said ports and defining a gas chamber and a liquid chamber, a magnetic switch positioned exteriorly of said container, a permanent magnet slidably mounted on said container, means protruding into said gas chamber operatively connected to said permanent magnet to move the latter, said means being in the path of movement of said flexible partition, said magnetic switch being substantially aligned with said permanent magnet to be actuated upon movement of the latter when the volume of gas in said gas chamber has fallen below a predetermined amount.

2. The combination set forth in claim 1 in which the gas port of said container has a cylindrical housing of non-magnetic material rising axially therefrom, said housing having at one end an axial bore in which an actuating assembly is slidably mounted, said assembly comprising an actuating stem having one end protruding into said gas chamber, a non-magnetic support extending axially from the other end of said stem, permanent magnet means mounted on said support, a gas charging valve mounted at the other end of said housing for charging of said gas chamber, said magnetic switch being mounted on said housing aligned with said permanent magnet means, said flexible partition being designed to abut against the protruding end of said stem.

3. The combination set forth in claim 2 in which stop means are provided to limit the inward movement into said gas chamber of the protruding end of said stem.

4. The combination set forth in claim 2 in which spring means are provided reacting against said actuating assembly to urge the protruding end of said stem into said gas chamber.

5. A pressure vessel comprising a rigid container having a gas port and an oil port and a flexible partition intervening between said ports and defining a gas chamber and a liquid chamber, a magnetic switch mounted at one end of the container substantially aligned with the path of movement of the flexible partition toward said gas port and a permanent magnet carried by said flexible partition designed to be moved into juxtaposition with said magnetic switch when the gas volume in said gas chamber has fallen below a predetermined amount to actuate said magnetic switch.

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