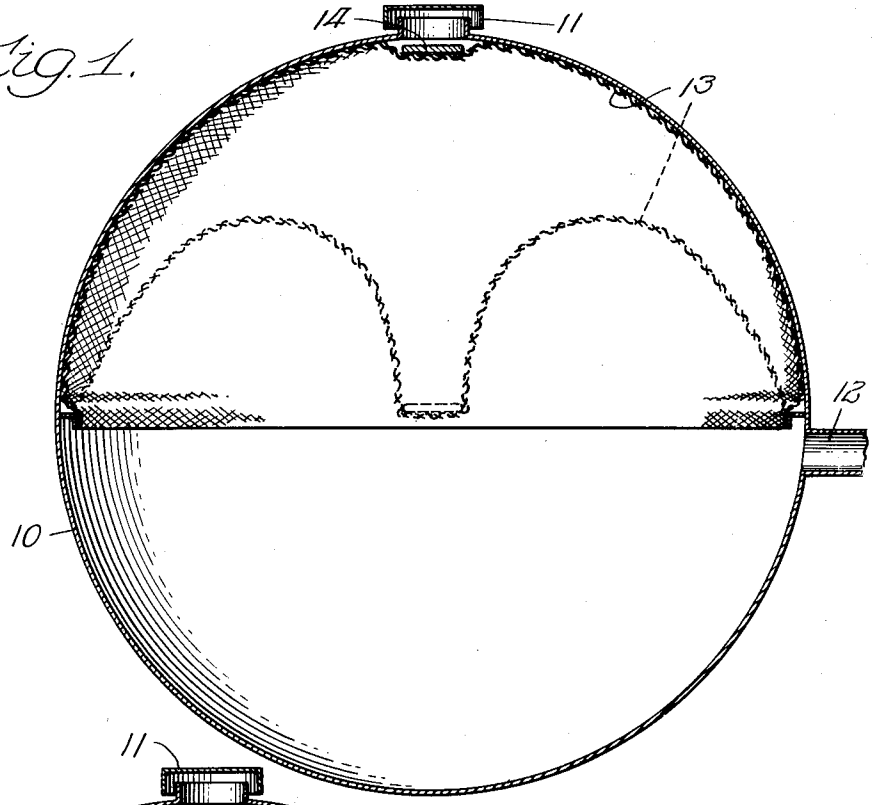
March 6, 1956 L. V. LARSEN 2,737,453

GAS STORAGE APPARATUS

Filed Jan. 27, 1953

Fig. 1.



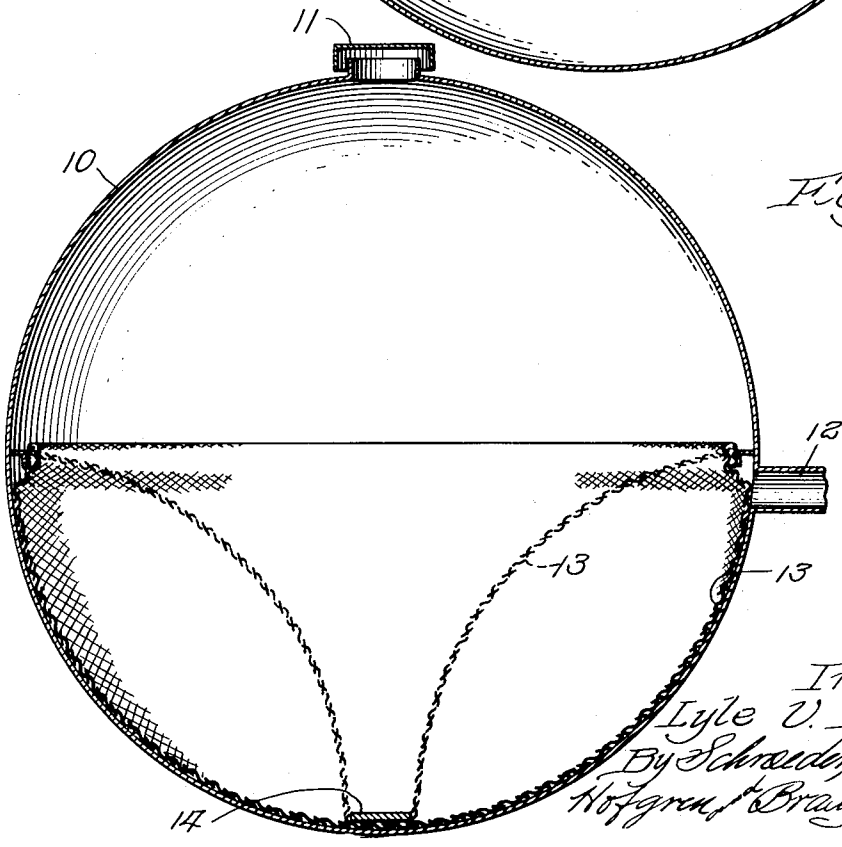


Fig. 2.

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GAS STORAGE APPARATUS

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Application January 27, 1953, Serial No. 333,431

1 Claim. (Cl. 48—178)

This invention relates to fluid storage vessels and more particularly to a control weight for a flexible diaphragm in a breather type fluid storage vessel.

This application is a continuation-in-part of my co-pending application Serial No. 93,987, filed May 18, 1949, now abandoned.

While the control weight shown and described in this application is adaptable for use in connection with a flexible diaphragm in any breather type liquid storage vessel, it has been found to be particularly useful to control the operation of a hemispherical or substantially hemispherical flexible diaphragm such as shown and described in Wissmiller applications, Serial No. 638,302, filed December 29, 1945, and Serial No. 702,625, filed October 11, 1946, both of which are now abandoned.

In the operation of hemispherical breather diaphragms of the type disclosed in said applications the deflation pattern of the diaphragm from its fully inflated condition is quite irregular. The diaphragm starts downward on one side, pivoting about the opposite side. During the latter stages of the deflation this causes a sweeping action in the bottom of the vessel which tends to decrease the life of the diaphragm. In addition the off-side loop has a tendency to collect and hold water which because of its weight is retained in the loop inasmuch as the weight of the water prevents the diaphragm from becoming fully inflated and thus eliminating the loop containing the water.

I have found that by placing a weight at the pole of a hemispherical diaphragm to force the pole to precede the outer edge of the diaphragm during deflation the weight will travel straight downward and the deflation pattern of the diaphragm is quite regular. By a regular deflation pattern I mean that the diaphragm will assume a regular and predetermined configuration at each position in the vessel. Inasmuch as the weight eliminates the sweeping action, the life of the diaphragm is increased and if water is trapped on the upper surface of the diaphragm it will be located at the center and readily accessible for removal either manually or mechanically.

The weight necessary to control the configurations is but a fraction of the total weight of the whole diaphragm. Atmospheric air pressure is always present above the diaphragm and the pressure of the stored gas is only slightly above atmospheric.

In the accompanying drawings Figs. 1 and 2 are vertical sections through a breather type vessel substantially of the type disclosed in the said application, Serial No. 638,302, modified in accordance with this invention and showing the flexible breather diaphragm at various positions during the operation of the vessel.

Referring now to the drawings, the fluid storage vessel comprises a substantially spherical tank **10** open at its top to the atmosphere through a covered vent **11** and being provided with a combination inlet and outlet **12** located below the equator of the vessel. Secured across the interior of the vessel along the equator thereof is a flexible diaphragm **13**. The diaphragm is constructed

of nylon impregnated with a vaporproof material such as synthetic rubber, and has substantially the same shape as that portion of the vessel above the equator, that is, is substantially hemispherical in shape so that in its extreme upward and downward positions, as shown by the solid lines in Figs. 1 and 2 respectively, the diaphragm is substantially entirely backed up by the vessel and hence is not subject to strain because of pressures or vacuums therein. Located in the center of the diaphragm, that is, at its pole is a weight **14**. In the particular embodiment shown the weight is a disc-like member secured to the diaphragm by any suitable means. As a specific example of the invention in a spherical tank, such as shown in the drawings, having a diameter of 27 feet, the weight consisted of a metal disc of 14 inches in diameter and weighing 30 pounds. The fabric of a 27 foot diameter tank will weigh about 47 ounces per square yard whereas the weight of that portion under the weight **14** is 30 pounds or 480 ounces on an area of just slightly more than one square foot. The diaphragm has a surface area of about 127.3 square yards and a total weight of about 375 pounds whereas the control weight is 30 pounds, which is less than 10% of the total weight of the diaphragm.

It should be understood that the breather vessel as shown in the drawings is adapted to be connected to a liquid storage tank by means of the connection **12**. During periods of evaporation in the tank, vapors such as gasoline vapors are directed into the interior of the vessel **10** where they may be accumulated. Upon contraction of the vapors within the storage tank, vapors are withdrawn from the vessel **10** and returned thereto. Thus, it is not necessary to vent such expanding vapors to the atmosphere with a consequent loss thereof. The pressure of the vapor under the diaphragm is generally one-eighth inch of water which is sufficient to move the diaphragm upwardly to admit more vapor. The downward force over the area of the control weight greatly exceeds the upward force of the vapor on that same area. The control weight is supported by the diaphragm and thus controls the configuration of the diaphragm.

When the vessel is full of vapors the diaphragm **13** assumes the position shown in the solid lines of Fig. 1. As contraction of vapors occurs in the liquid storage tank the diaphragm moves downwardly assuming the configuration shown in the dotted lines. It will be noted that the configuration is quite regular with the pole bearing the weight preceding the rest of the diaphragm in its downward movement. As contraction continues the diaphragm continues to move downward to the position shown in the dotted lines of Fig. 2. Any further contraction will result in the diaphragm collapsing against the sides of the vessel **10** to assume the position shown in the solid lines of Fig. 2.

While I have shown and described certain embodiments of my invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as disclosed in the appended claim.

I claim:

A gas storage apparatus comprising a shell, a flexible diaphragm secured at its periphery across the interior of the shell along a substantially horizontal plane, said diaphragm forming with the portion of the shell below said plane a gas tight expansible chamber, the portion of the shell above the diaphragm having open communication with the atmosphere, said diaphragm being preformed to have substantially the same size and shape as the portion of the shell above said plane and being substantially completely backed up by said last mentioned portion in its extreme upward position without stressing the

diaphragm and a control weight carried by the diaphragm and having a total weight exceeding the total upward force exerted by stored gas on the area under the weight so that the weight may lead the rest of the diaphragm in downward movement and may lag behind the rest of the diaphragm in upward movement, said control weight being substantially centrally located on the diaphragm for movement along a substantially vertical path within the shell so that the diaphragm assumes a regular predetermined configuration at all positions thereof within the shell avoiding sweeping of the diaphragm against the shell.

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