Aug. 9, 1960 R. W. BODLEY ET AL 2,948,432

BREATHER RESERVOIR

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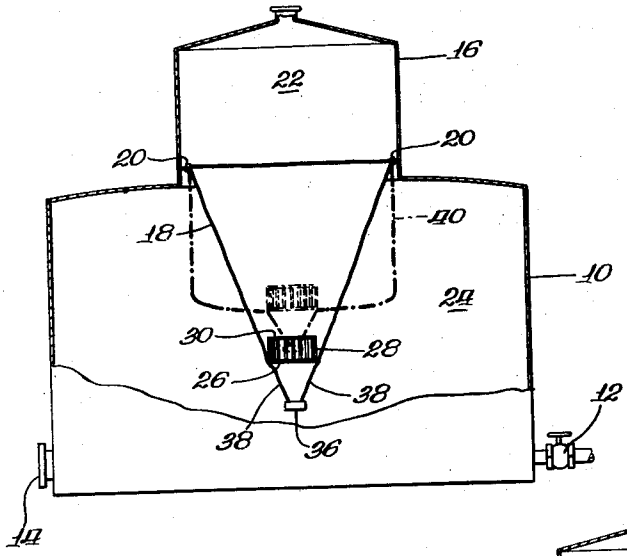

Fig. 1.

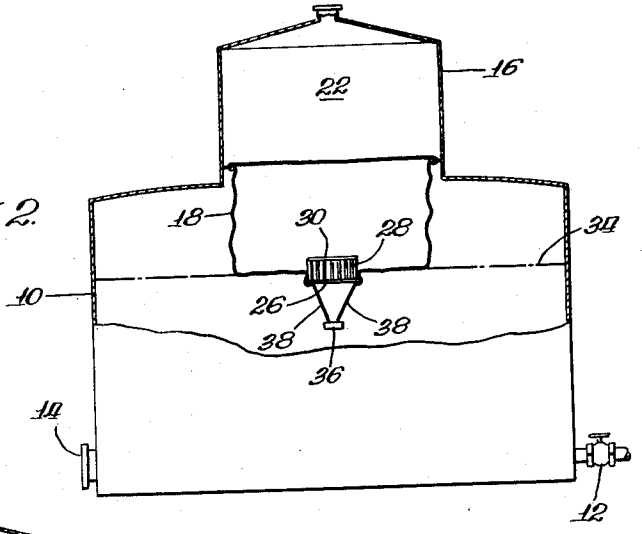

Fig. 2.

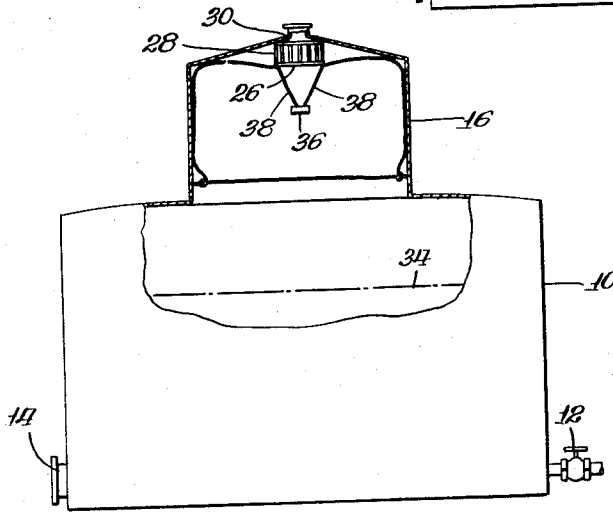

Fig. 3.

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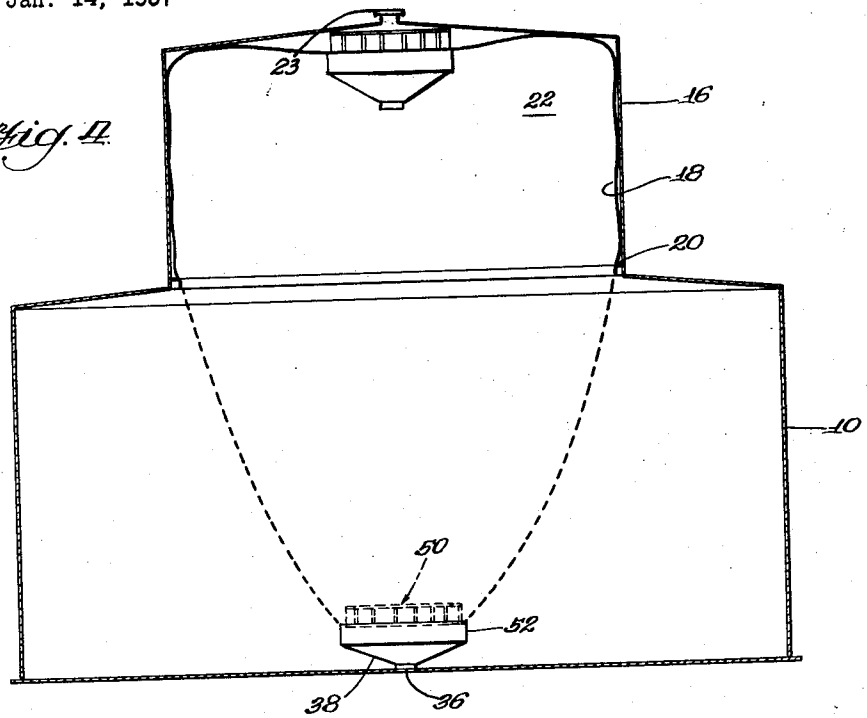
Fig. 4.



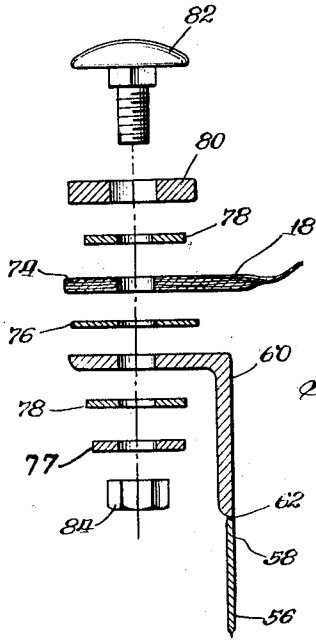


Fig. 6.

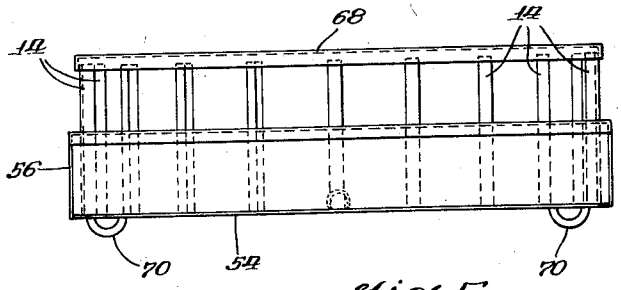


Fig. 5.

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BREATHER RESERVOIR

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2 Claims. (Cl. 220—85)

The invention relates to tanks utilized to store volatile liquids such as gasoline and more particularly to a breather reservoir arrangement associated therewith incorporating a movable diaphragm of flexible material arranged to vary the vapor space in the tank.

The invention comprehends an improved arrangement of that type of breather reservoir as illustrated in the patent to Lester A. Wilkin, No. 2,269,568, issued January 13, 1942. This application is a continuation-in-part of our co-pending application No. 523,471, filed July 21, 1955, and now abandoned. Extensive experience with the type of breather reservoir and flexible bag arrangement illustrated in the mentioned patent has shown that that arrangement presents many difficulties in commercial application. It has been found that when the bag contacts the liquid, as for example when sufficient vapor pressure is not present in tank to inflate the bag, that the buoyancy of the bag on the liquid is lost due to the side portions of the bag laying over the dome portion causing it to sink deeply into the liquid and sometimes in an uneven condition. This sinking action could accentuate any tendency of the bag to leak, thereby shortening its life.

Accordingly, it is a general object to provide a breather arrangement having float and upper limit control means associated therewith.

It is a further general object of the invention to provide a breather reservoir of the type described having novel balancing control means associated therewith thereby providing improved operation as the diaphragm of bag is cycled through its upward and downward movements responsive to a varying vapor pressure within the tank.

It is a particular object of the invention to provide a breather reservoir arrangement of the type described having a centrally located annular rigid member, said member being arranged to provide the impervious diaphragm with float control means when the latter is in contact with the tank-contained liquid.

It is a further specific object of the invention to additionally provide weight control means associated with the rigid member to aid in the maintenance of the diaphragm in proper operating position during all upward and downward movements of the arrangement.

These and other objects of the invention will become apparent in the course of the following description and from an examination of the concerned drawings, wherein:

Figure 1 is a schematic sectional view of a storage tank incorporating the novel breather arrangement and illustrating the arrangement in the tank empty condition,

Figure 2 is a view similar to Figure 1 and illustrating the arrangement with the bag floating on the tank-contained product when no vapor pressure is present,

Figure 3 is a view similar to Figure 1 illustrating the bag in fully inflated position under maximum vapor pressure,

Figure 4 is a sectional view of a tank arrangement,

partly in elevation, and embodying a slightly modified form of the invention,

Figure 5 is a detail view of the central member employed in Figure 4, and

Figure 6 is a detail view of a preferred bag connection employed.

Directing attention to the drawings, it will be seen that the tank may comprise a steel shell **10** having a liquid supply line **12** communicating therewith. The tank may additionally be provided with a manhole arrangement **14**, which accommodates entry into the tank when the latter is empty to provide for inspection of the interior portions thereof.

It is well known that the vapor pressure within a gasoline storage tank increases during the daytime due to the direct rays of the sun on the tank, which causes a heating of the vapor and liquid surface within the tank thus increasing the rate of evaporation and the intensity of the molecular action of the vapors within the tank. During the night the temperature may drop to such an extent that a large portion of the vapors are condensed, thus resulting in a variation of vapor pressure from night to day over a relatively wide limit.

To accommodate this fluctuating vapor pressure the tank **10** is provided with an upwardly extending housing **16**, said chamber acting as a reservoir to provide increased vapor space within the tank. A flexible diaphragm or bag **18** is peripherally secured to the chamber **16** as at **20**, said bag **18** dividing the housing **16** and tank **10** into upper and lower compartments **22** and **24**, respectively. It will be noted that the supply line **12** communicates with the compartment **24**, thus providing for entrance and exit of volatile liquid to that compartment. The bag **18** is made of a suitable flexible material as will withstand the deteriorating action of the volatile liquids or vapors associated therewith. A vent arrangement **23** may be provided at the top of the housing **16** to accommodate entrance and exit of air during bag action and to further provide access means to the compartment **22** for inspection purposes and the like.

A rigid member **26** is secured to the bag **18**, preferably centrally thereof and in spaced relation to the tank **10** and housing **16**. This member **26** is preferably a solid circular plate, however, it may be composed of an annular ring having a portion of the bag **18** stretched across the bottom thereof.

In a preferred embodiment of the invention, the member **26** is provided with a plurality of upstanding elements **28**, said elements **28** being joined adjacent their upper ends by an annular element **30**, thus providing a fence arranged peripherally around the member **26**.

Directing attention to Figure 2, which illustrates the bag in float-position on the liquid, it will be seen that as the member **26** sinks in the liquid **34**, portions of the immediately adjacent bag **18** wrap up and around the upstanding fence-like elements **28** to provide a buoyant pontoon-like arrangement, offering proper support for the bag or diaphragm **18** on the liquid. This pontoon and resulting buoyant effect assures that the bag **18** will float evenly on the liquid, thereby increasing its life. To aid this buoyancy feature and particularly to aid in controlling proper position of the bag, the member **26** has suspended therefrom a weight **36**, which is carried from the member **26** by means of a plurality of flexible members or means **38**. The weight **36** has an additional function in that it aids in balancing the element **26** and maintaining the latter in a substantially horizontal position during vertical movement of the element in response to vapor inflation of the bag.

Further considering Figure 3, it will be seen that the annular element **30**, by virtue of its spaced relation from the member **26** and the interconnecting elements **28**, is

arranged to engage the top of the compartment **22** to limit upward travel of the bag to thereby aid in preventing the bag, during movement thereof, from covering the vent arrangement **23**.

Considering the operation of the novel breather arrangement, it will be understood that the tank **10** as shown in Figure 1 may be considered empty whereby the bag will assume the hanging position illustrated due to the central position of the member **26** and weight **36**. As the tank is filled with cool volatile liquid, the bag assumes the floating position shown in Figure 2 under the above-described pontoon action of the central arrangement. As the vapor pressure in the tank increases, usually in response to climatic heating action, the bag slowly expands and rises evenly to the fully expanded position illustrated in Figure 3. As the vapor in the tank condenses and the pressure decreases, the action is reversed and the bag may evenly return to the position shown in Figure 2. Of course, it will be understood that the action of the bag is responsive to the vapor pressure in the tank, hence the bag may assume any intermediate position between the positions of Figures 2 and 3 as the current pressure may dictate.

In some instances, when the tank **10** is subjected to relatively severe cooling, a vacuum will be produced in the chamber **24**. In these instances the bag **18** will take the position and form as illustrated in phantom at **40** in Figure 1.

Attention is directed to Figures 4 through 6 which illustrate a slightly modified form of the invention. The bag **18** is again peripherally connected, as at **20**, to the chamber **16** as hereinbefore described. A central member **50** comprises a lower pan element **52** consisting of an annular bottom plate or disk **54** having a wall or rim **56** peripherally upstanding therefrom. The rim **56** may comprise a plate **58** having an angle **60** (Figure 6) continuously welded to the upper edge thereof, as at **62**. The wall **56** and the bottom plate **54** together form a pontoon-like pan which will float on the liquid surface **34** to offer buoyancy to the entire arrangement.

Specifically, considering Figure 5, it will be seen that a plurality of upstanding members **64**, **64** are also secured to the bottom plate **54** and extend above the horizontal angle **60** in a fence-like arrangement. The members **64** may be tack welded to the angle **60**. The upper ends of the members **64** are tied together by an annular angle member **68** similar to the earlier described embodiment. Members **70**, **70** may be secured to the lower side of the plate **54** to serve as means to connect the flexible lines **38** and the weight **36** to the assembly.

Considering Figure 6 which illustrates the manner of connection of the bag to the central member, it will be seen that the horizontal portion of the member **60** may be provided with an aperture **72** and the bag **18** may be provided with a peripherally arranged thickened portion **74**. A sealing strip **76**, preferably of non-metallic material, is interposed between the horizontal portion of the angle **60** and the portion **74** of the bag **18**. Non-metallic washers **78**, **78** may also be arranged in the series and an upper clamping bar **80** may be positioned above the portion **74**. A carriage bolt **82** and cooperating nut **84** and metallic washer **77** serve to tightly and sealingly secure the entire arrangement to the horizontal portion of the angle **60**. It has been found that the arangement described adequately prevents any leakage of product at the connection of the bag and the central member **50**.

Returning to Figure 4, it will be seen that this embodiment also employs the central weight **36** and flexible connections **38** of the previous embodiment and for the same purpose. In operation, the pan **52** formed by the plate **54** and the rim **56** provides initial buoyancy for the bag when same is floating on the liquid. In those cases where due to the action of the bag or the like, as heretofore described the pan arrangement is caused to tip, the bag again folds upward over the fence-like members **54** to form therewith an additional pontoon to prevent sinking of the entire central arrangement. This action, similar to that of the previously described embodiment, affords enough buoyant effect to prevent the undesired immersion of the bag attachment arrangement in the product. Further, the fence-like arrangement **54** again acts as a stopping member as the bag is brought to the fully inflated position in the chamber **16**.

Thus it will be seen that the novel arrangement therein disclosed provides a bag or diaphragm arrangement, which will function in response to the action of the vapor pressure within the storage tank to variably increase or decrease the vapor space within that tank. The arrangement is further provided with a centrally located float control means which insures proper positioning of the bag when it is in contact with the liquid within the tank. The particular fence-like arrangement of both embodiments additionally functions as a limiting stop to engage an upper portion of the tank and prevent the bag from moving to fully inflated position over the vent. The arrangement is further provided with a balancing weight, which aids in maintaining the formed pontoon in a horizontal position when the bag is in contact with the liquid and further aids in controlling the action of the bag as it is urged to move upwardly and downwardly in response to varying vapor pressure within the tank.

The invention as herein disclosed and illustrated by preferred embodiment is susceptible of various changes which will be apparent to those skilled in the art without departing from the spirit thereof or the scope of the appended claims.

What is claimed is:

1. A breather reservoir arrangement comprising a closed tank for storing volatile liquid and including a lower portion and an upper portion having a substantially smaller cross section than the lower portion, said upper portion having a closed top, an inflatable flexible diaphragm of impervious material secured to the tank for dividing the tank into an upper and lower chamber, said diaphragm being inflatable by vapor pressure developed by the volatile liquid, vent means supported by the center part of said closed top for permitting air to pass into and out of the upper chamber in response to deflation and inflation of said diaphragm, said diaphragm being constructed to extend downwardly away from said vent means when deflated and the liquid level is below a predetermined level and to extend upwardly into engagement with substantially all of the center portion of said closed top adjacent said vent means when inflated by vapor pressure, means secured centrally of said diaphragm in spaced relation to said tank and including a floor member and a perforate upstanding wall member, said wall member having an upper rim part for coacting with the center part of the closed top adjacent said vent means, said wall member partially engaging said diaphragm when said diaphragm is deflated and in contact with said liquid to provide a buoyant float arrangement and said upper rim part coacting with that portion of the center part surrounding said valve means when said diaphragm is inflated to prevent the diaphragm from obstructing the operation of said vent means.

2. The combination of a tank for storing volatile liquid and including a lower portion and an upper portion having a substantially smaller cross section than the lower portion, said upper portion having a closed top, an inflatable diaphragm of impervious material located in the tank and secured to the inner tank wall adjacent the juncture of the upper and lower portion, said diaphragm dividing the tank into an upper and lower chamber and being inflatable by vapor pressure developed by the volatile liquid, vent means located in the center portion of said closed top for filling and evacuating the upper chamber in response to deflation and inflation of said dia-

phragm, means secured centrally of said diaphragm in spaced relation to said tank and including a floor member and a perforate wall means, said perforate wall means including a plurality of spaced rod members extending upwardly from said floor member and terminating in an annular member, said diaphragm being configured to hang downwardly in said lower portion when the liquid is below a predetermined level and to lie substantially adjacent to the inner wall and closed top of said upper portion when inflated by vapor pressure, said wall member when said diaphragm is deflated and in contact with said liquid coacting with said diaphragm to provide a float and said annular member when said diaphragm is inflated engaging said center portion of said

closed top surrounding said vent means to prevent the diaphragm from obstructing said vent means.

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