July 9, 1957 P. URBAN 2,798,639

CONTAINER

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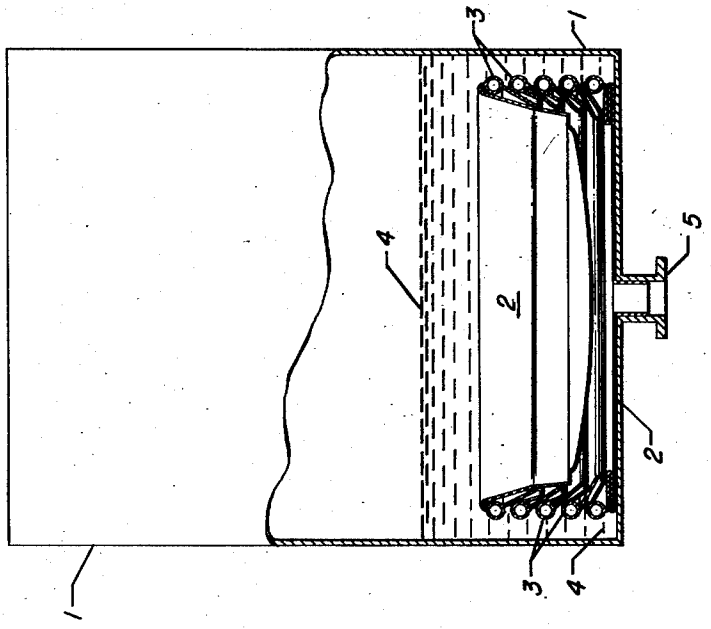


Figure 2

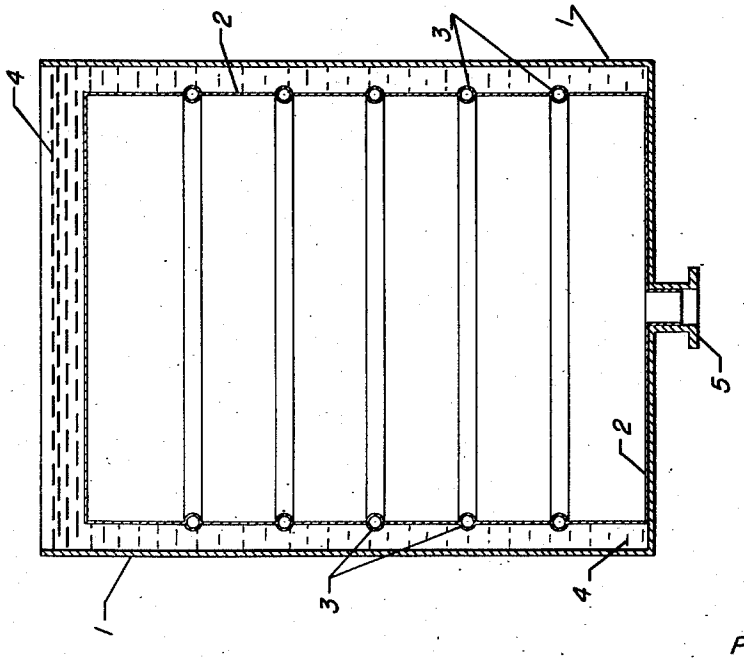


Figure 1

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2 Claims. (Cl. 220—85)

This invention relates to a storage vessel and particularly to a storage vessel lined with a specially formed flexible material.

It is well known to store air-sensitive material in containers having air-tight, flexible linings so that the lining may deform as the stored material is discharged to maintain it out of contact with the air. These applications have, however, been more or less limited to small containers since the difficulties of lining a large container with a flexible material is too great. When lining a large vessel, such as a stationary storage tank for oil or gas, the flexible liner must be of sufficiently heavy material to support its own weight as well as that of many gallons of fluid. This frequently causes tearing of the liner and more frequently ruptures or leaks at weak spots caused by random creasing as the flexible liner collapses upon emptying the vessel or rubbing against the rigid outer wall. Frequently, the liner may be relieved of the burden of supporting the contained material by disposing a heavier fluid between the liner and the rigid vessel wall, however, as the flexible liner is emptied the heavier material causes a lateral collapse of the liner which introduces new strains upon it and limits the container to a top drawoff since the heavier liquid flowing in under the lighter material contained in the liner causes a "bubble" of light fluid to be formed which is sealed from a bottom drawoff by the heavier fluid. It is an object of this invention to provide a large diameter vessel with a flexible liner for the storage of air-sensitive material.

In one embodiment, this invention relates to a storage vessel comprising in combination a rigid shell and a flexible liner having inflated horizontal circumferential segments therein.

In another embodiment, this invention relates to a storage vessel comprising in combination a rigid shell and a flexible liner having inflated horizontal circumferential segments therein with liquid disposed between said shell and said liner.

This invention can be best described with reference to the accompanying drawing which is intended to be illustrative rather than limiting on the broad scope of this invention. Figure 1 of the drawing illustrates one embodiment of this invention, wherein the flexible liner is filled wtih air-sensitive material and Figure 2 illustrates the same vessel and liner as it appears when substantially emptied of the air-sensitive material.

Referring to Figure 1, a rigid cylindrical open topped shell 1 which contains a lower outlet conduit 5 has connected thereto a flexible liner 2. The flexible liner may be connected to the shell in any suitable manner either at the periphery of the liner or by a suitable means disposed in outlet conduit 5. The connection between liner 2 and shell 1 must, however, be fluid tight so that the fluid surrounding the liner which is disposed between it and the outer shell, cannot enter the interior of flexible liner 2. The air-sensitive material maintained within

liner 2 may be fluid such as gasoline, oil, oxidizable chemicals, etc. which may be either liquid or vapor, however, it is intended that this invention should cover all flowable materials which it is desired to store in the absence of air.

Flexible liner 2 has disposed therein circular, circumferential, horizontal inflated segments 3 which are filled with a fluid such as compressed air so that they are rigid and preferably buoyant. Surrounding liner 2, between it and shell 1 is a liquid 4 which supports liner 2 laterally to prevent it from rubbing against the hard shell thereby causing leaks in the flexible liner. It is preferred that liquid 4 be more dense than the fluid within liner 2 so that the folds in liner 2 will collapse towards the center of the vessel rather than towards the wall. A typical suitable fluid 4 and the preferred one of this invention is water.

Figure 2 illustrates the utility of the liner of this invention. In Figure 2 the air-sensitive material contained within flexible liner 2 has been substantially withdrawn and it may be seen that flexible liner 2 has collapsed vertically so that it occupies a much lesser volume than when it is filled thereby eliminating the need for venting as the vessel is emptied. It may also be seen that the circumferential inflated segments of liner 2 cause it to have lateral strength, so that it does not collapse forming a light fluid "bubble" at the top of vessel 1 with drawoff pipe 5 pinched off by the pressure of the heavy fluid laterally collapsing liner 2. The lateral structural strength of inflated segments 3 not only causes this flexible liner 2 to collapse only in a vertical direction but they cause the flat segments of the liner between the inflated segments to neatly fold in an inwardly direction without creasing, so that the liner collapses in a regular manner without the tearing or weakening effect due to random creasing as hereinbefore described.

The flexible liner of this invention may be of any suitable flexible material. It should have sufficient structural strength to withstand tearing when filled and it, of course, must be fluid tight and inert to both the contained fluid and the surrounding liquid. Suitable materials for use are flexible plastics, rubber, fabric or treated fabric, etc. The inflated segments are preferably made of the same material as the liner but may be made of different material and may be mechanically attached to the liner or constructed as an integral part thereof. The inflated segments may be inflated with any suitable fluid such as air, nitrogen, methane, hydrogen, carbon dioxide, helium, etc. The inflated segments may also be inflated with a liquid when it is desired to adjust the buoyancy of these segments to minimize the strain on the flexible liner. Therefore, when storing oil the inflated segments may contain gasoline or naphtha as the inflating fluid which will reduce the buoyancy of the liner to minimize the tensile strain upon it and at the same time maintain it rigid in a horizontal direction. The inflated segments may contain light solid volume-occupying material such as Fiberglas, foam rubber when such is desired so that rigidity may be imparted to the liner without using compressed fluid in these segments.

I claim as my invention:

1. A storage vessel for air-sensitive fluids comprising a rigid shell having a horizontal bottom wall and a vertical side wall portion, a closed, fluid-tight container within the shell having a bottom wall secured to the bottom wall of the shell, a top closure wall and a flexible side wall portion connecting between its top and bottom walls to permit the container to collapse in the lower portion of said shell, said side wall portion of the contained being spaced from the vertical side wall portion of the shell and being provided with vertically spaced, inflated hori-

zontal circumferential segments, and means for introducing air-sensitive fluid to and removing the same from said closed container through the bottom walls of the container and said shell.

2. The storage vessel of claim 1 further characterized in that said shell contains a liquid in the space between the side wall portions of said container and shell and above the top closure wall of the container.

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