Jan. 31, 1956 K. L. TREIBER 2,732,873

PRESSURE INDICATING CLOSURE SEAL FOR LIQUID-RECEIVING CONTAINERS

Original Filed Nov. 1, 1948 2 Sheets-Sheet 1

Fig. 1.

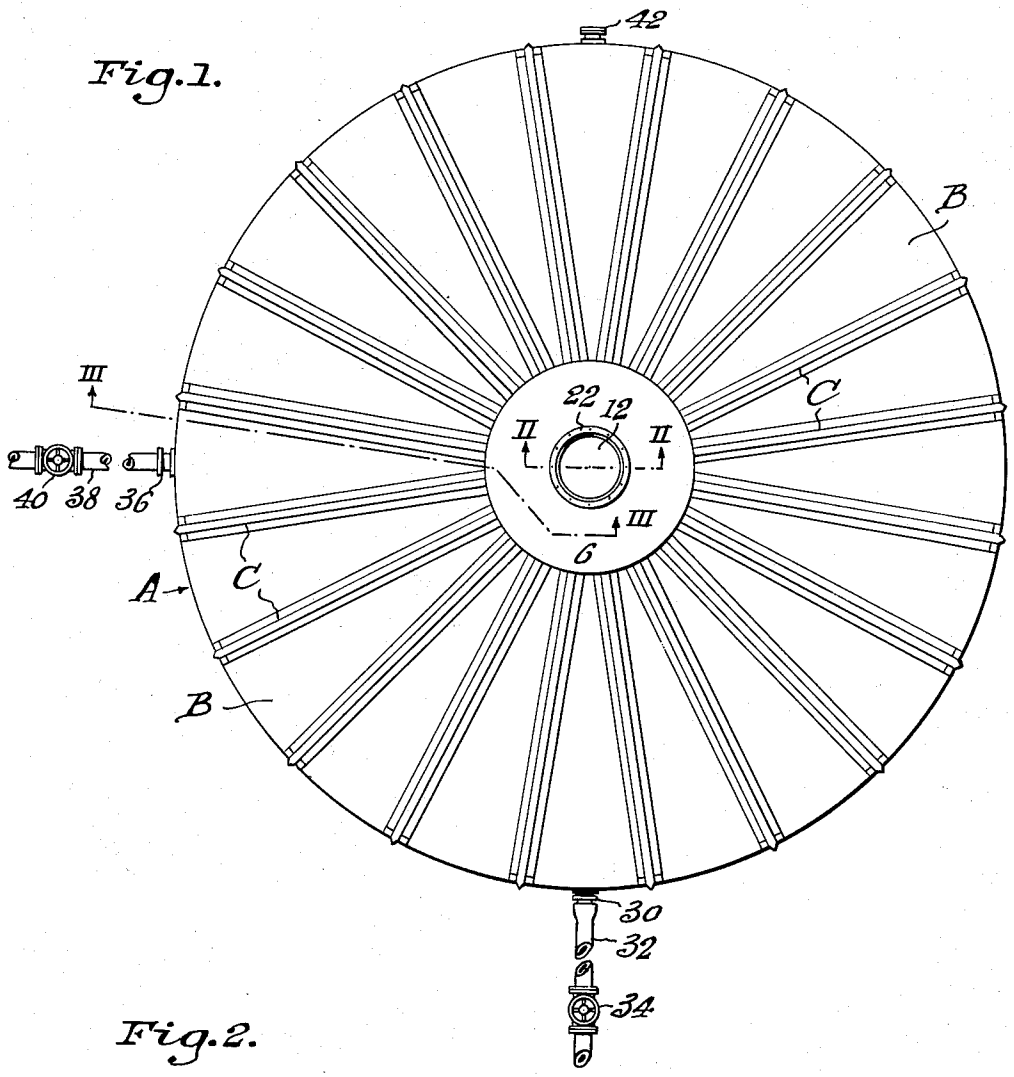
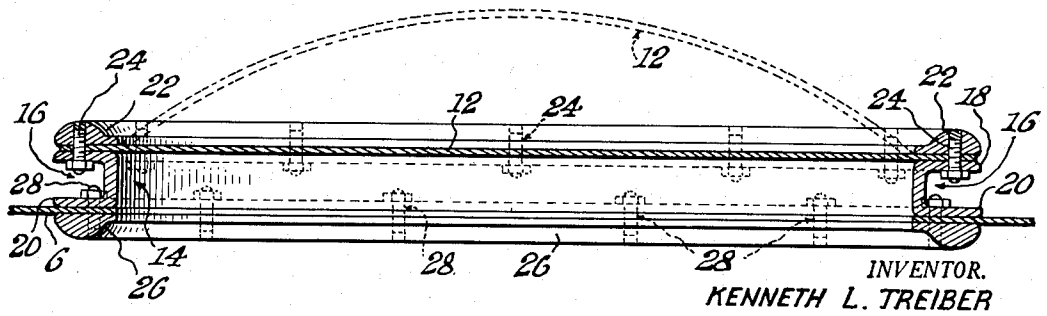


Fig. 2.



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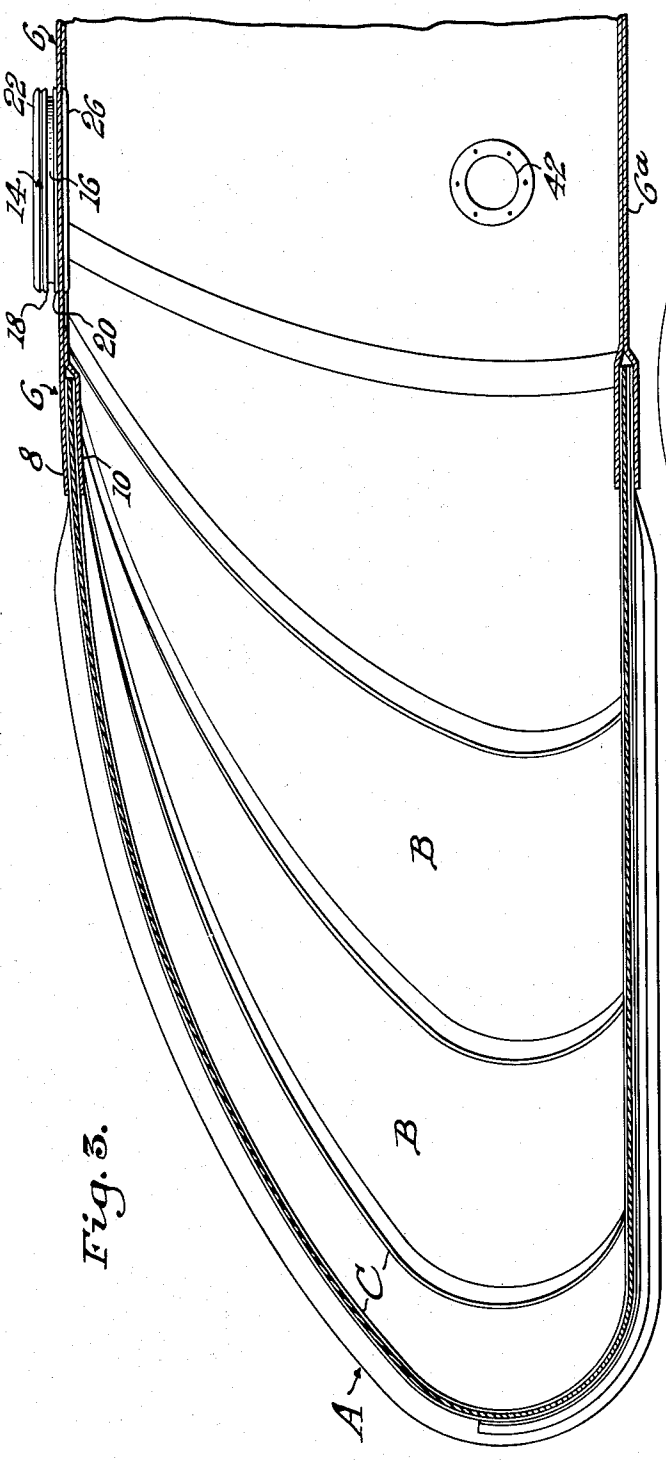


Fig. 5.

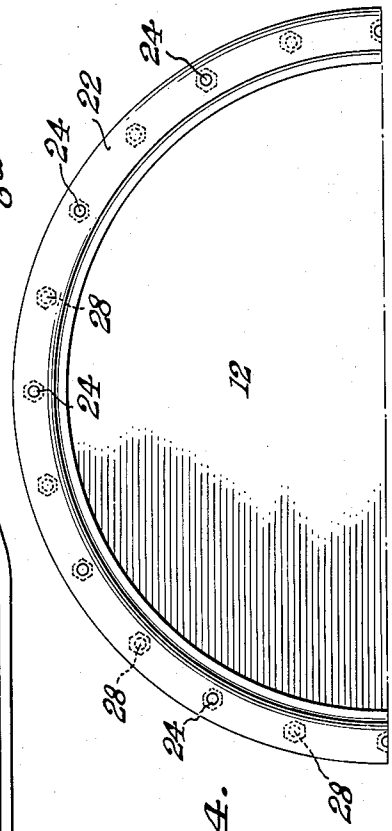


Fig. 4.

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PRESSURE INDICATING CLOSURE SEAL FOR LIQUID-RECEIVING CONTAINERS

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Original application November 1, 1948, Serial No. 57,798. Divided and this application December 8, 1952, Serial No. 324,859

2 Claims. (Cl. 150—3)

(Granted under Title 35, U. S. Code (1952), sec. 266)

The present invention provides improvements in closure constructions for tanks, containers and the like, the closures of the present invention comprising closure assemblies in which improved closure means include improved and highly simplified signalling means which are designed to indicate to an observer at a distance from the tank or similar installation, conditions of pressure existing at a given time within the container.

The closure assembly constructed in accordance with the present invention is applicable particularly to collapsible or flexible storage tanks for liquids such as water, petroleum products, fuels, lubricants, and the like, which tanks are readily portable and which may be assembled readily for field operations. It is well known that such type of tank or container is an important adjunct to military operations, or for other installations where it is desired to store liquids in receivers more or less temporarily installed in a given location, which receivers can be transported readily to a new location and set up anew. The improvements represented by the present contribution find high favor among military authorities as providing readily mobile fuel storage facilities for accompanying rapid movements of mechanized equipment in field operations, and also as readily mobile fuel supplies for aviation operations in connection with rapidly shifting combat fronts where the locale of combat military and aviation forces are in states of flux with rapid fluidity on any given front or sector of operations.

As has been noted above, the improved closure and signaling assemblies of the present invention are applied to collapsible storage tanks for temporary storage of motor fuels, lubricants, and other liquids. Such tanks are composed of segments of fabric which are joined laterally by reinforced stitching to provide liquid- and vapor-tight lateral joints between the segments. The closure assembly of this invention unites the upper ends of the segments also in liquid- and vapor-tight relation and it includes an expansible flexible diaphragm as signalling means to indicate vapor-pressure conditions within the tank as the tank becomes depleted of its liquid contents, or as such liquid contents become vaporized to greater or less extent under the action of solar heat or other vaporizing influences.

The present application is a division of the copending application, Serial No. 57,798, filed November 1, 1948, entitled Flexible Container, now U. S. Patent No. 2,633,172.

It will be understandable readily, however, that for various purposes in addition to military operations and installations, it is highly desirable to have available readily portable storage cells or tanks for various liquids, such as motor fuels, lubricants, normally liquid chemicals of widely diversified compositions and volatility, which cells or tanks combine ready portability with substantial storage capacity; and the advantages of such equipment become enhanced by combining large liquid storage capacity with easy manipulation in assembling or dis-assembling and the occupation of minimum storage space when not

in use or for storage. Also, particularly where such containers are employed for retaining liquids of substantial volatility, it obviously is desirable to have associated with the container visual indicating means which will indicate, at least roughly, the vapor conditions existing in the container.

The present invention will be understood more readily by reference to the accompanying drawings in which—

Fig. 1 is a top view of a collapsible storage tank embodying the improvements of the present invention;

Fig. 2 is a sectional elevation of a portion of Fig. 1, the view being taken on the line II—II of Fig. 1, looking in the direction of the arrows, and showing by way of dotted lines the position of visual vapor-indicating means responsively to accumulations of vapors in the container;

Fig. 3 is a vertical half-section of the showing of Fig. 1, the view being taken on the line III—III of Fig. 1, looking in the direction of the arrows and illustrating the manner of attachment of the flexible envelope of the container to the top structure thereof; and

Fig. 4 is a half-plan view of the visual signal means employed in accordance with the present invention, together with mounting means therefor.

Referring more particularly to the drawings, the construction illustrated therein comprises a flexible envelope or container A, which usually is composed of a heavy fabric such as canvas or duck, which has been treated to render it impervious to liquids which it is intended to contain. This container is composed of the above-indicated or any other suitable fabric and is assembled by joining a plurality of segments B which are joined together by seams C. The fabric assembly of the envelope A is collapsible and foldable into a small and compact space for storage and transport, but which has a substantial capacity and which is self-supporting when containing liquid to be stored, so that no extraneous supporting construction is required. The container A is substantially circular in any horizontal cross section and is adapted to rest either on the ground or on any prepared surface when in service.

The improvements of the present invention are embodied in a top plate **6**, which is composed preferably of the same fabric as the container A, which plate **6** is shown as being formed of two layers indicated at **8** and **10**, which are separated peripherally to form an annular recess therebetween for receiving and joining together the segments B of the envelope A, these segments being secured to the layers **8** and **10** of the plate **6** in any suitable manner which will produce a liquid- and vapor-tight union with the said layers **8** and **10**, as by the interposition of layers of cementitious material, or by stitching, or by a combination thereof, by means of which a liquid-impervious and vapor-tight union is attained between the top end of each segment B and the top plate **6**. A bottom plate **6***a* is provided for joining the bottom ends of the segments B in a manner entirely similar to that shown in Fig. 3, as indicated above, and the bottom plate **6***a* is composed preferably of the same fabric as the envelope A, as is the top plate **6**.

The top plate **6**, however, is provided with a large opening extending therethrough, while the bottom plate **6***a* is continuous throughout its surface.

The large opening in the top plate **6** may serve as a manhole opening that normally is closed by a flexible diaphragm **12**, which constitutes a visual pressure indicator, as will be referred to hereinafter. The flexible diaphragm **12** is composed suitably of any elastomeric material which is inert to vapors and liquid contained in the tank. Thus, the diaphragm **12** may be composed of a suitable rubber-like material, or rubber itself, the choice of specific materials being determined by its inertness towards the material in the tank. With this provision, the diaphragm **12** may be composed of any suitable elas-

tomeric composition, either synthetic or natural in origin.

This flexible diaphragm 12 is held between a manhole ring 14, the periphery of which is channeled, as is indicated at 16, to form similar top and bottom attachment flanges 18 and 20, the diaphragm 12 overlying this top flange 18 and being held between the top flange 18 and a top retaining or clamping ring 22 secured to the said top flange 18 by a series of bolts or equivalent securing means 24, which are spaced sufficiently closely to assure an inseparable peripheral retention of the diaphragm 12 between the flange 18 and the retaining ring 22, it being obvious that the securing means 24 pass through the material of the diaphragm 12.

In a similar manner, the plate 6 is secured between the bottom attaching flange 20 and a bottom retaining or clamping ring 26, through the medium of spaced bolts or equivalent securing means 28, which preferably, although not necessarily, correspond in number and spacing to the top bolts 24 so that the periphery of the manhole opening of the plate 6 is clamped firmly and continuously between the bottom attaching flange 20 and the bottom retaining ring 26.

As is indicated on the drawings, the tank A is provided with a plurality of pipe fittings or couplings. Thus, pipe coupling 30 may receive an intake pipe 32, controlled by a valve 34, through which pipe the tank A is filled. A second pipe coupling 36 has attached to it a drainage pipe 38, controlled by a valve 40, the drainage pipe 38 serving to drain from the tank any water contained therein which may have been included mechanically in the non-aqueous liquid introduced into the tank for storage, a third fitting or coupling 42 serving as the liquid discharge fitting for the tank. These fittings are secured in liquid-tight relation to the fabric of the tank in any suitable manner.

In operation, when the tank A contains liquid, whatever space there may be, or may develop, between the liquid level in the tank and the top of the tank, becomes filled with vapors from the said liquid, the amount and pressure developed thereby being determined by the volatility of the liquid in the tank. As the vapors accumulate and the pressures developed thereby build up, the flexible diaphragm 12 is expanded and caused to bulge or deform outwardly as is indicated by the dotted lines in Fig. 2, this outward deformation being roughly proportional to the pressures exerted on the diaphragm by the vapors, thereby indicating to an observer an approximation of the amount of vapor and also an approximation of the position of the liquid level in the tank A for a particular liquid. As liquid is drained from the tank, or condensation of vapors occurs due to fluctuations in atmospheric temperatures, resulting changes in vapor conditions are reflected in variations in the amount of the bulging or deformation of the diaphragm 12. Thus the amount of deformation of this diaphragm gives a continuous visual indication of the pressure of the vapors in the tank; and if the pressure exerted by such vapors exceeds the breaking strength of the material of the diaphragm 12, the diaphragm will rupture releasing such excess pressure; and the diaphragm, therefore, serves as a safety valve, its thickness and material being selected so that the said rupture of the diaphragm will occur before there is any likelihood or danger of the pressures of the vapors straining open either the seams between the segmental sections of the tank or the interstices of the fabric of the tank to a point where leakage of the liquid contents of the tank would occur.

If it obvious from the drawings that if the removal of the diaphragm 12 should be desired for any reason, or for replacement with another diaphragm, it is a very simple matter to demount the clamping ring 22 merely by removing the securing bolts 24, thereby releasing the diaphragm 12 for removal or replacement. Similarly, the ring 14 may be removed from the plate 6 by demounting the bottom clamping ring 26 by removing the bolts 28, thereby releasing the ring 14. Also, it is obvious that where the tank envelope A is composed of a flexible material such as a fabric, while the envelope is inherently sufficiently stiff so as to be self-sustaining when filled with liquid, it also will tend to be self-conforming in contour to the depth of the liquid in the tank, and the envelope will tend to collapse until such collapsing is counterbalanced by vapor pressures above the liquid level. However, it will be apparent and self-evident that the improved closure assembly and signaling means of the present invention is not limited necessarily to service in connection with a flexible or collapsible tank, but on the contrary, it is adapted to serve as a closure assembly for any type of tank or liquid container, particularly where a volatile liquid is contained in the tank. In practice, the channel ring 14, together with the top and bottom retaining or clamping rings 22 and 26 may be composed of a light metal such as aluminum or the aluminum-magnesium alloy identified as "magnalium." When the tank is not in service, the top manhole beneath the diaphragm 12 may be closed by a cover plate by removing the top clamping ring 22, thereby releasing the diaphragm which is removed, the diaphragm and top clamping ring being replaced by a cover plate for the manhole opening, which plate is provided with bolt holes corresponding to those in the top flange 18 and replacing the bolts 24 in position for holding the cover plate in place. This cover plate is not shown in the drawings, it forming no part of the present invention; but its use in this connection is noted as it protects the diaphragm from damage during periods of non-service of the container.

It therefore will be seen that the improvements of the present invention constitute a combined signaling means and safety valve for liquid-containing receptacles, the construction of which is extremely simple and which is continuous in its operation. It will be understood, of course, that the embodiment of the improved construction as described herein and illustrated on the accompanying drawings is intended to be an illustrative construction only, and that various changes may be made in structural details without departing from the scope of the present invention so that it will be understood that it is intended and desired to embrace within the scope of the invention such modifications and changes as may be necessary or desirable to adapt it to varying conditions and uses as defined by the appended claims.

Having thus described my invention, what I claim as new and wish to secure by Letters Patent is:

1. A closure for storage tanks for volatile liquids having an opening into the tank, which comprises an elastic closure diaphragm for the opening in direct contact with vapor contents of the tank and covering the opening in the tank, the said diaphragm being continuously and repeatedly visually elastically deformable responsively to varying vapor pressures in the tank between elastic limits of the diaphragm, thereby enabling a continuous indication of vapor-pressure conditions within the tank, and peripheral mounting means for the diaphragm interconnecting the diaphragm and the tank including a pair of complemental clamping rings in clamping engagement with opposite peripheral sides of the diaphragm, one of which rings is an upper ring, the other of which rings is an annular channel having an upper flange and a lower flange, a third clamping ring peripherally underlying the opening in the tank, clamping means extending through the upper flange of the annular channel and into the upper clamping ring, and additional clamping means extending through the lower flange of the channel and into the third clamping ring and maintaining the periphery of the opening in the tank clamped between the lower flange of the channel and the said third clamping ring.

2. A closure structure for flexible storage tanks for volatile liquids and provided with a top manhole opening, which structure comprises a plurality of superposed clamping rings including a top clamping ring, an inter-

mediate clamping ring, and a bottom clamping ring, the intermediate clamping ring being a channel ring having an upper-outwardly extending flange and a bottom outwardly-extending flange, the top clamping ring registering with said outwardly-extending upper flange and the bottom clamping ring registering with the bottom outwardly-extending flange, an elastic closure diaphragm covering the manhole opening in the tank in direct contact with vaporized contents in the tank, the diaphragm being peripherally received between the top clamping ring and the upper flange of the intermediate clamping ring, clamping means for the diaphragm extending through the said upper flange and top clamping ring and securing the diaphragm in vapor-tight relation with the said upper flange and top clamping ring, the manhole opening in the tank being peripherally encircled by and between the bottom flange of the intermediate clamping ring and the bottom clamping ring, and clamping means extending through the said bottom flange and the bottom clamping ring and maintaining these in vapor-tight sealing relation with the periphery of the manhole opening in the tank, the said diaphragm being continuously and repeatedly visually elastically deformable responsively to varying vapor pressures in the tank between elastic limits of the diaphragm, the said diaphragm having a flexibility substantially greater than that of the flexible tank.

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