Aug. 18, 1931. O. A. BAILEY 1,819,401

FLOATING ROOF

Filed Dec. 22, 1928 2 Sheets-Sheet 1

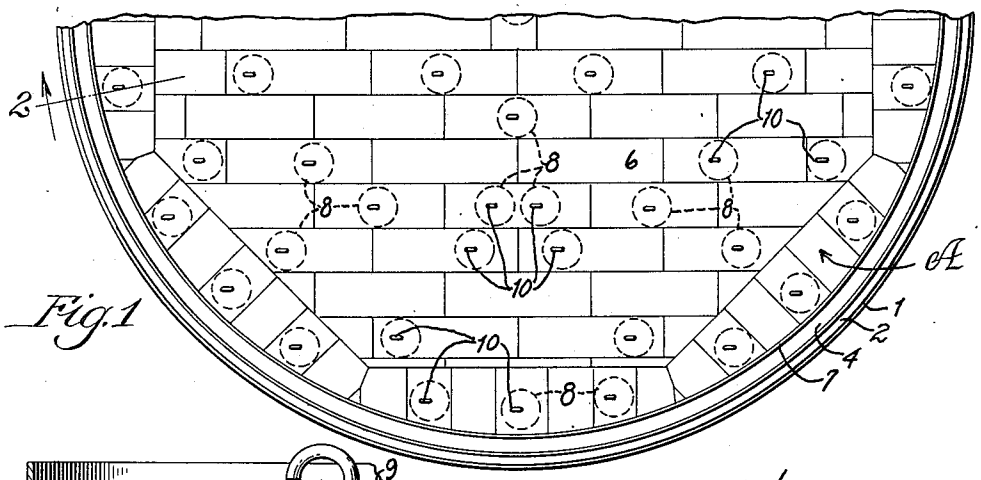


Fig. 1

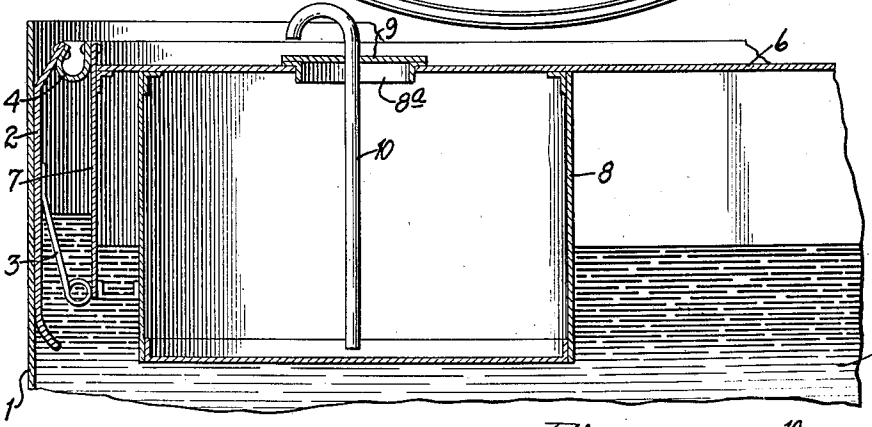


Fig. 2

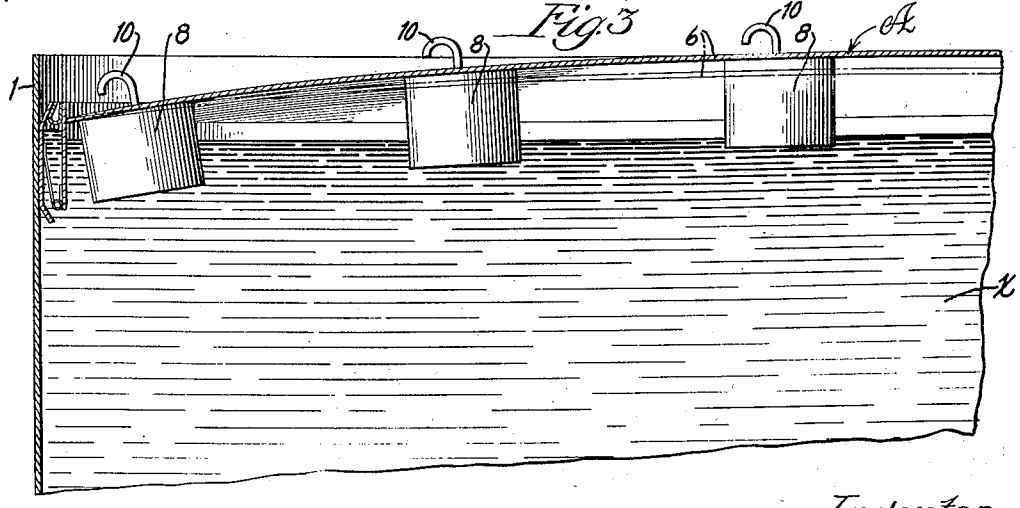


Fig. 3

Inventor:
Otterbein A. Bailey,
By Dyrenforth, Lee, Chritton & Wiles
Attys.

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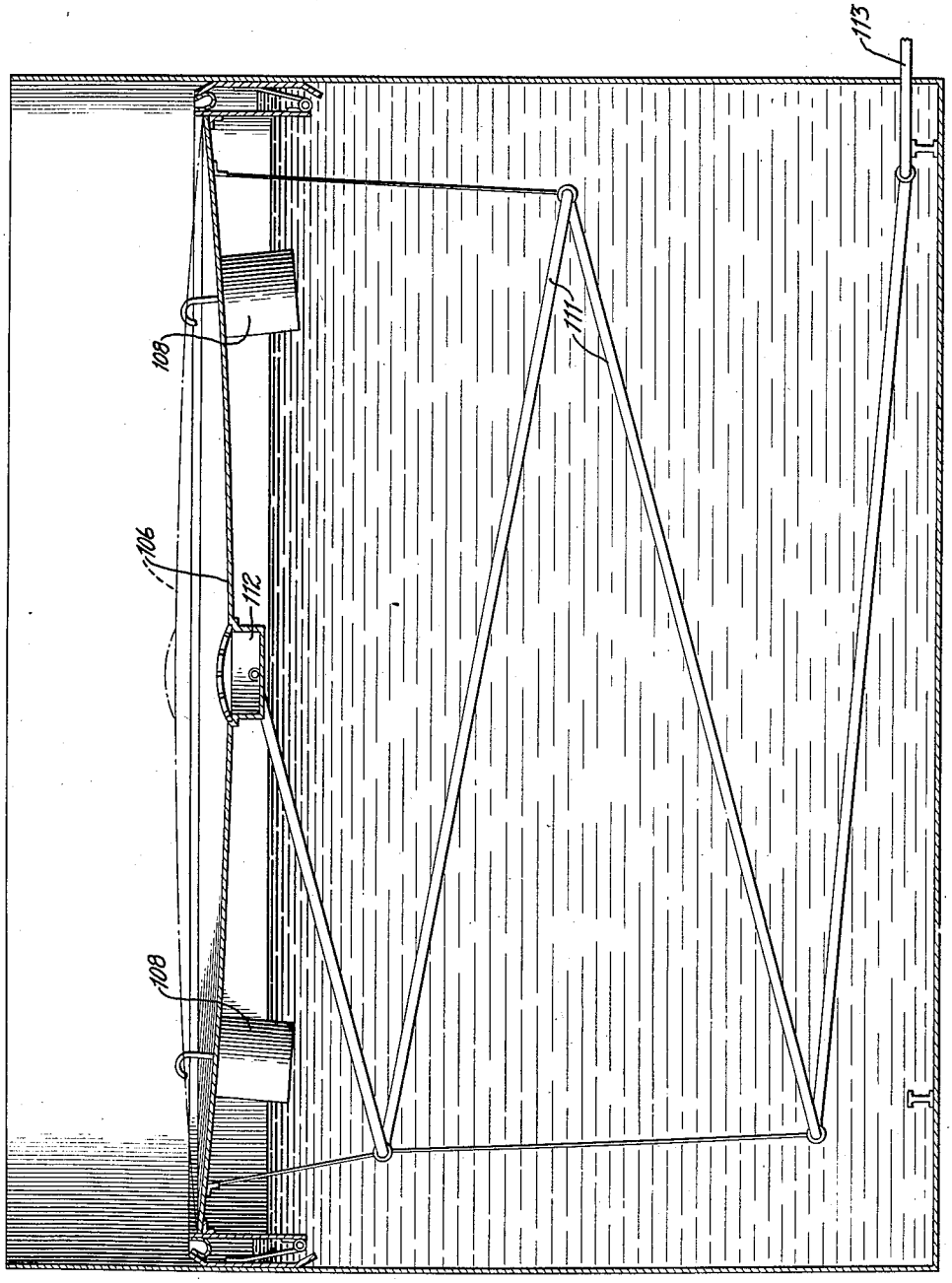


Fig. 4

Inventor:
Otterbein A. Bailey,
By Dyer, Garth, Lee, Chritton & Wiles,
Attys.

Patented Aug. 18, 1931 1,819,401

UNITED STATES PATENT OFFICE

OTTERBEIN A. BAILEY, OF CHICAGO, ILLINOIS, ASSIGNOR TO CHICAGO BRIDGE AND IRON COMPANY, A CORPORATION OF ILLINOIS

FLOATING ROOF

Application filed December 22, 1928. Serial No. 327,956.

This invention relates to floating roofs and more especially floating roofs adapted for use with liquid storage tanks. For example, the invention may be used in connection with metal tanks of the kind that are used in oil fields for storing oil, and particularly, tanks of the type that are equipped with a deck or roof which floats upon and is sustained by the liquid in the tank.

One of the objects of my invention is to provide a flexible deck or roof that is flexed upwardly or downwardly by variations in gas pressure under the same, thus increasing or decreasing the volume of the vapor space in the tank.

Another feature of my invention is the provision of improved buoyant members or supporting means for the roof or deck.

Other features and advantages of my invention will appear more fully as I proceed with my specification.

In that form of device embodying the features of my invention shown in the accompanying drawings,

Figure 1 is a fragmentary top plan view,

Fig. 2 is a view taken as indicated by the line 2 of Fig. 1,

Fig. 3 is a fragmentary vertical sectional view, and

Fig. 4 is a vertical sectional view showing a modified form.

As shown in the drawings, 1 indicates the side wall of a cylindrical tank which, for example, may be an oil tank. A designates, in its entirety a deck or roof that floats upon and is sustained by the liquid *x* in the tank. The space between the periphery of said roof A and the side wall 1 of the tank can be closed by any suitable means that will permit the roof to move vertically relatively to the side wall of the tank when the level of the liquid in the tank rises and falls, without danger of undue escape of liquid or gases from the tank through the space between the periphery of the roof and the side wall of the tank. In the tank herein illustrated, the space between the peripheral edge of the roof and the side wall of the tank is sealed by an expansible and contractable gas tight structure carried by the roof and comprising a shoe 2 arranged in sliding engagement with the side wall of the tank, with its lower edge portion submerged in the liquid in the tank, swinging hangers 3 on the peripheral edge of the roof A which carry the segmental shaped members that constitute the shoes 2, and a piece of gas tight fabric 4 attached to the upper edge of the shoe and to a part at the peripheral edge of the roof A that projects upwardly above the surface of the liquid. Any other type of sealing means or closure can be used for the space between the floating roof and the side wall of the tank without departing from the spirit of my invention.

The roof A comprises a flexible diaphragm 6 constituting the central portion of the roof, said diaphragm being preferably constructed from metal plates connected together in such a way as to produce a flexible structure that is capable of moving upwardly and downwardly a limited distance so as to increase and decrease the volume of the vapor space of the tank.

On the underside of the flexible diaphragm 6 are attached a plurality of cylindrical pontoons or floats 8. In the preferred form of device shown in Figs. 1, 2 and 3, these floats have the proper size to give them the proper buoyancy and are so distributed as to give the roof normally a crown as shown in Fig. 3. That is, even when there is no vapor pressure under the deck 6, the same is crowned upwardly or convexly curved so that any rain falling on the same will drain off, such drainage being permitted over the edge of the float, over the upper edges of the shoes, and down between the shoes 2 and the side wall 1 of the tank. Such drainage, of course, will settle in the bottom of the tank, from where it may be removed by any suitable means. Since the deck or roof is supported by a plurality of such floats or pontoons 8, and is made flexible, it will flex upwardly and downwardly with variations in pressure in gases under it.

Each float 8 is preferably provided with a manhole 8^a and cover 9, the same permitting a man to enter the float for inspection purposes and repairs. In each float there is also provided a drain pipe 10 to permit the escape

therefrom of any accumulation of liquid therein, such liquid adapted to be forced out through the pipe 10 by any increasing pressure inside the float 8 of the gases above the liquid that might have accumulated in the float.

In the modified form of the device shown in Fig. 4, there are relatively fewer floats or pontoons near the center of the deck and relatively more near the periphery, as indicated by 108. With this distribution of the floats or pontoons 108, the flexible crown 106 will normally be concaved downwardly as shown in Fig. 4, when there is no gas pressure under the same or a relatively low gas pressure. With an increase of pressure under the roof, however, the flexible diaphragm 106 is adapted to be flexed upwardly into the position indicated by the dotted lines in Fig. 4. In this form of device there is preferably provided some means for draining rain water from the roof when it is in its lower position as shown by the dotted lines in Fig. 4. For example, such draining system may include a drain pipe 111 connecting the sump 112 in the center of the roof with the outlet pipe 113 at the bottom of the tank.

The flexing of the diaphragm 6 or diaphragm 106 permits expansion and contraction of the vapor space in the tank, for so-called "breathing", thus preventing or lessening gas losses. If the upward pressure on the underside of the diaphragm continues to increase, after the diaphragm has flexed upwardly to its extreme elevated position, the entire roof may move bodily upwardly slightly relatively to the surface of the liquid in the tank, thereby causing the floats or pontoons 8 or 108 to float higher in the liquid, with the result that the volume of the vapor space of the tank will be still further increased.

Any suitable type of venting mechanism may be used to vent the vapor space of the tank to avoid injury from any undue vacuum or pressure therein.

The vapor space under the diaphragm also serves to insulate the oil in the tank from outside heat.

7 indicates a depending peripheral rim or edge at the periphery of the flexible diaphragm or central member 6.

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 claims, in which it is my intention to claim all novelty inherent in my invention as broadly as possible in view of the prior art.

I claim:

1. In combination with a liquid storage tank, a roof supported by a plurality of floats under the same adapted to float on liquid in the tank, said roof capable of flexing upwardly and downwardly, and provided with a depending peripheral rim defining a gas space under the same, said floats having the proper buoyancy and weight and so distributed as to permit flexing of said roof with variations in gas pressure under the same.

2. Apparatus as claimed in claim 1, in which the floats are cylindrical in shape.

3. Apparatus as claimed in claim 1, in which the floats have the proper buoyancy and are so distributed as to give the deck normally a crown.

In witness whereof I have hereunto set my hand this 6th day of December, 1928.

OTTERBEIN A. BAILEY.