Jan. 16, 1951 C. M. ORR 2,538,033

FLOATING ROOF

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Fig. 1.

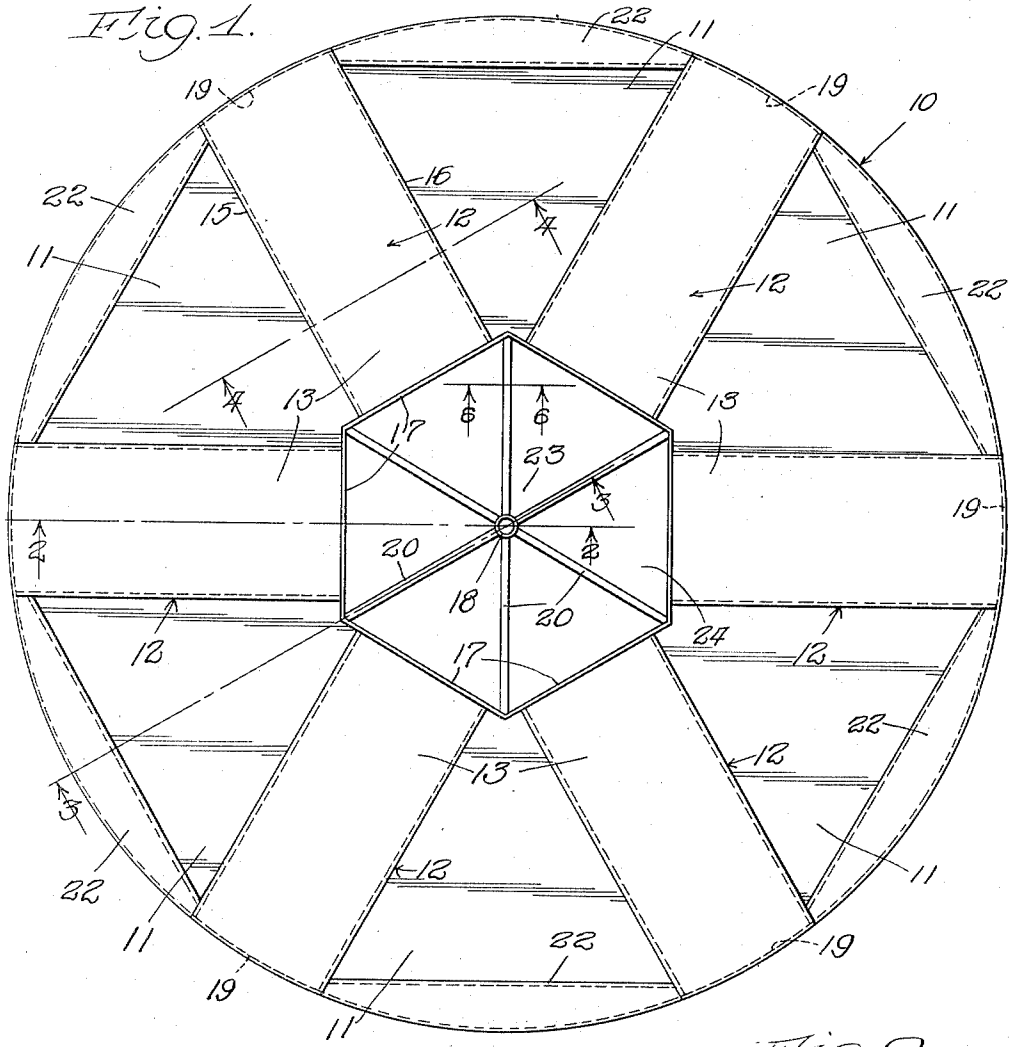


Fig. 2.

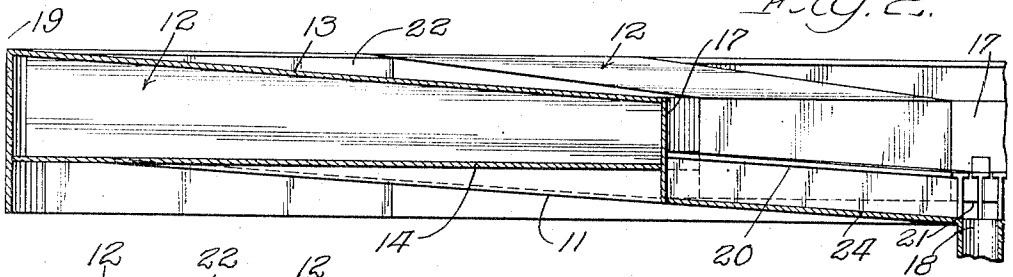
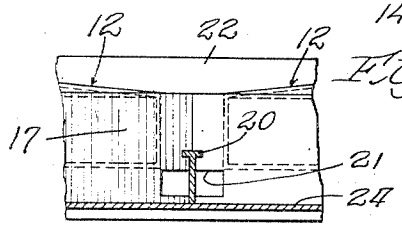


Fig. 6.



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Fig. 3.

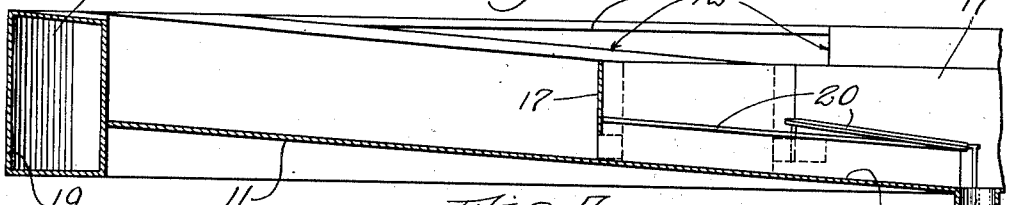


Fig. 4.

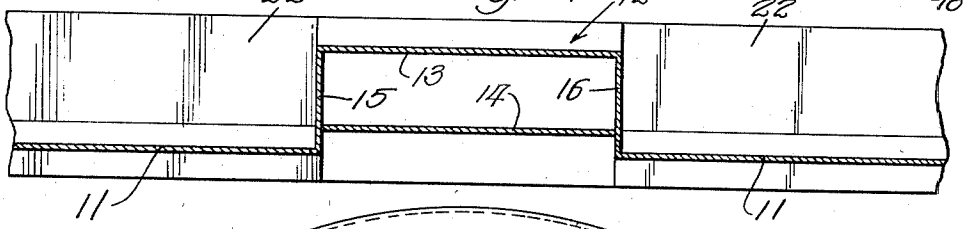
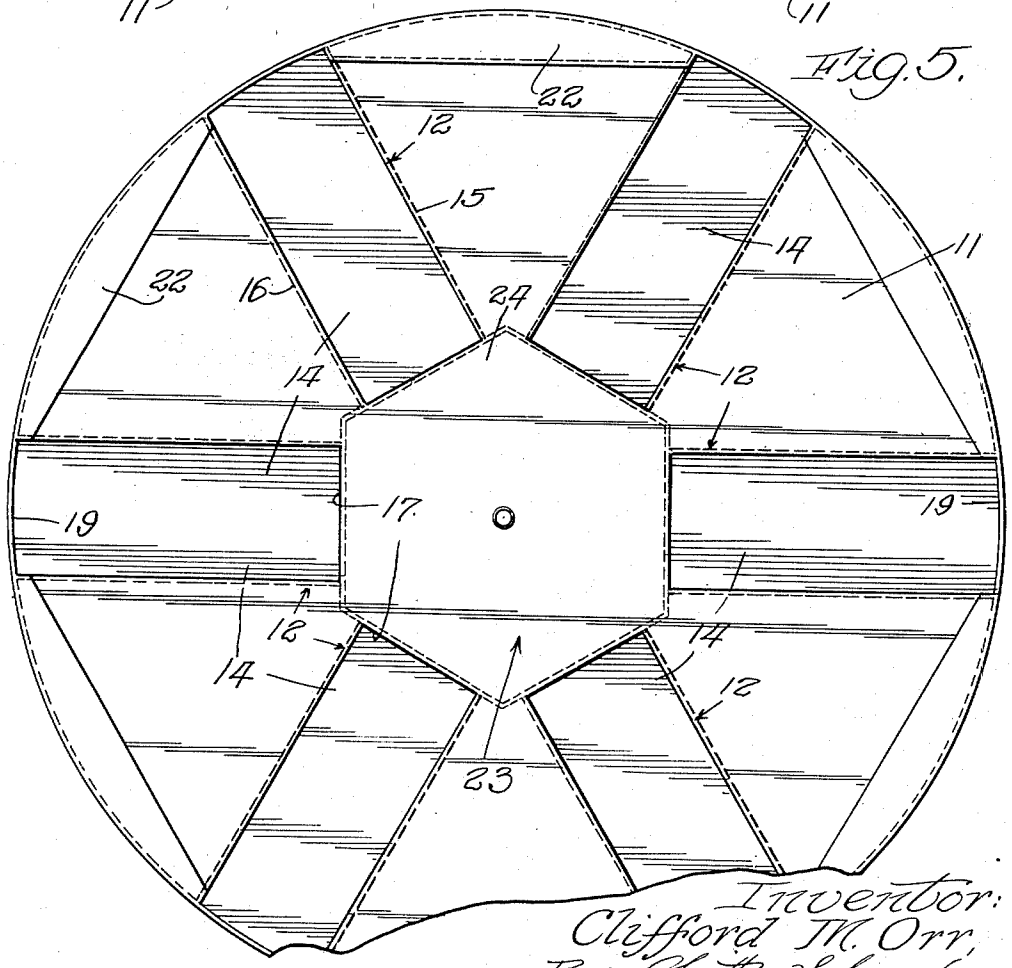


Fig. 5.



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UNITED STATES PATENT OFFICE

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FLOATING ROOF

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10 Claims. (Cl. 220—26)

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This invention relates to a liquid storage tank and more particularly to a floating roof to form the top closure of a storage tank for volatile liquids.

In the storage of volatile liquids, it has been found that to provide an airspace of any considerable proportion above the surface of the stored liquid results in a considerable loss of the stored product by evaporation and by venting necessitated by fluctuations in pressure and liquid level within the tank. Losses by evaporation and necessary venting are reduced as the vessel approaches a completely filled condition. As it is not feasible to maintain a rigid storage tank completely filled with liquid at all times, the advantage of providing a top closure which floats in the stored liquid is being recognized throughout the petroleum industry.

Foating roofs of various designs and constructions have been suggested, most of such designs have serious disadvantages particularly when used with a highly volatile liquid or with a liquid which, when exposed to air, is corrosive of metal. Many floating roofs are incapable of managing a sudden load such as caused by a torrential downpour of rain or have very little or no stability under unequal loads.

I have invented and am herein disclosing and claiming a floating roof possessing many of the advantages necessary in a properly functioning floating roof.

The invention will be described in conjunction with the embodiment shown in the accompanying drawings in which Figs. 1 and 5 are a top and a bottom plan view of the floating roof, respectively, and Figs. 2, 3, 4 and 6 are vertical sections along lines 2—2, 3—3, 4—4 and 6—6 of Fig. 1, respectively.

Referring now to the drawings, 10 indicates a floating roof adapted to float in the liquid contained within a storage tank with which the roof is used. The roof comprises a plurality of spaced segmental, single deck portions 11, substantially triangular in shape and sloping downwardly from their outer edges near the periphery of the roof toward the central portion of the roof. Between the single deck portions are double deck portions 12, each of the double deck portions having a top 13 which slopes slightly towards the central portion of the roof and a bottom 14 which is substantially level. The double deck portions are substantially rectangular in shape, the tops and bottoms 13 and 14 being secured to the sides 15 and 16 to form boxlike structures each of whose inner end is closed by a plate 17 forming one side of

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a central polygonal structure 23 surrounding a central sump 18. The outer ends of each of the double deck portions are closed by a depending rim 19 which extends downwardly below the level of the bottom 14 of the double deck portion as far as the lowest part of the single deck portions. The sides 17 and the single deck bottom 24 of the polygonal structure are braced by beams 20 radiating outwardly from the sump 18 to the apices of the polygon as shown. The plates 17 which close the inner end of the double deck portions are each provided with an opening 21 at the apices of the polygon to permit drainage to the central sump.

Stabilizing pontoons 22 are provided at the outer edge of each of the single deck portions 11. The lower edge of each pontoon is substantially level with the lower edge of the depending rim 19.

An air space existing beneath a floating roof used in the storage of corrosive fluids will give rise to the corrosion of the metal in such space. Accordingly my roof is designed so that no air is trapped beneath it when the roof is floated and all of the bottom plates of the roof are in contact wtih the stored liquid or with the liquid and vapor at all times during normal operation of the roof. One of the problems arising in attempting to design a roof having this characteristic is the difficulty of providing sufficient pitch toward the center of the roof for adequate and speedy drainage. If the roof is pitched too steeply the buoyancy of the central portion of the roof will hold the outer portions thereof above the liquid level with consequent corrosion. In the roof I have just described the double deck portions 12 do not function as pontoons, that is, they do not contribute materially to the buoyancy of the roof except in the emergency of an extremely heavy load. Since the double deck portions normally displace only a small quantity of the stored liquid, they act more in the nature of weights and allow the single deck portions to be pitched steeply for additional displacement as well as better drainage. The double deck portions also serve to shade the roof against the heat of the sun and to prevent accumulation of large water loads on the deck. The highest portions of the single deck areas adjacent the outer portions of the roof and the bottoms of the double deck areas are placed at a common elevation and therefore when the tank is being filled with liquid with the roof standing supports above the bottom of the tank, all of the air trapped beneath the roof can be forced out through a single vent by the incoming

liquid before the liquid has reached a level high enough to float the roof.

The pontoons which are located at the outer ends of the single deck portions extend at least as low as the lowest part of the single deck at the center of the roof. Thus, when the roof is floating, the vapor which forms beneath it due to primary distillation resulting from the sun's rays acting upon the single deck will lift the entire roof. The roof will not tip, however, because of the stabilizing action of the pontoons. This "lifter" action allows the liquid surface to be cooled by the evaporation of some of the liquid and also traps an insulating layer of vapor above the liquid surface which reduces further evaporation. Upon cooling, the vapor recondenses and is not lost. The sides of the double deck portion in conjunction with the polygonal structure at the inner ends of those portions form a framework which reduces the cost of erecting the roof as they eliminate some of the temporary framing required in ordinary construction.

While I have shown and described my invention in its preferred embodiment, 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.

Having described my invention, I claim:

1. In a liquid storage tank, a floating roof comprising a central sump, a plurality of spaced single deck portions, a plurality of double deck portions between the single deck portions and radiating from the central portion of the roof and extending to the outer edge of the roof, the single deck portions being pitched downwardly toward the center of the roof and the bottoms of the double deck portions being horizontal, and a plurality of stabilizing pontoons at the outer end of the single deck portions and spaced by the double deck portions with the single deck portions extending to the central sump and being attached to the stabilizing pontoons intermediate the top and bottom thereof.

2. The floating roof of claim 1 in which the lowest part of the single deck portion is substantially level with the lowest portion of the stabilizing pontoons.

3. The floating roof of claim 1 in which the entire undersurface of the roof is in contact with the stored liquid during normal operation of the roof.

4. The floating roof of claim 1 including a central sump, a polygonal framework about the sump with the sides of the polygon forming closures for the inner ends of the double deck portions.

5. The floating roof of claim 4 in which the single deck portions are substantially triangular in shape with the apices of the polygon being at the interior apices of the single deck portions,

the sides of the polygon being provided with openings at their apices to permit drainage to the central sump.

6. The floating roof of claim 4 including bracing extending from the sump to the apices of the polygon, the braces being under compressional stress during normal operation of the roof.

7. The floating roof of claim 4 in which the bottoms of the double deck portions are at a common elevation with the single deck portions adjacent the outer edge of the roof.

8. In a liquid storage tank, a floating roof comprising a plurality of spaced substantially triangular single deck portions, a plurality of substantially rectangular double deck portions between the single deck portions, the single deck portions being pitched downwardly toward the center of the roof, stabilizing pontoons at the outer edge of the single deck portions, said pontoons being spaced by the double deck portions and extending below the bottoms of the double deck portions, a sump at the center of the roof with the single deck portions extending to the sump and being attached to the stabilizing pontoons intermediate the top and bottom thereof, and a depending rim about the outer edge of the roof with the lower edge of the rim being substantially level with the lower edge of the pontoons and the lowest part of the single deck portions, said roof being so constructed and arranged as to maintain the entire undersurface of the roof in contact with the stored liquid during normal operation of the roof.

9. The floating roof of claim 8 including a polygonal framework about the sump with the sides of the polygon forming closures for the inner ends of the double deck portions, the apices of the polygon being at the interior apices of the single deck portions with openings in the sides of the polygon at their apices to permit drainage to the central sump.

10. The floating roof of claim 8 in which the bottoms of the double deck portions are substantially horizontal and are at a common elevation with the single deck portions adjacent the outer edge of the roof.

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