

# United States Patent

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[54] **FLOATING DECK FOR STORAGE TANK**  
7 Claims, 4 Drawing Figs.

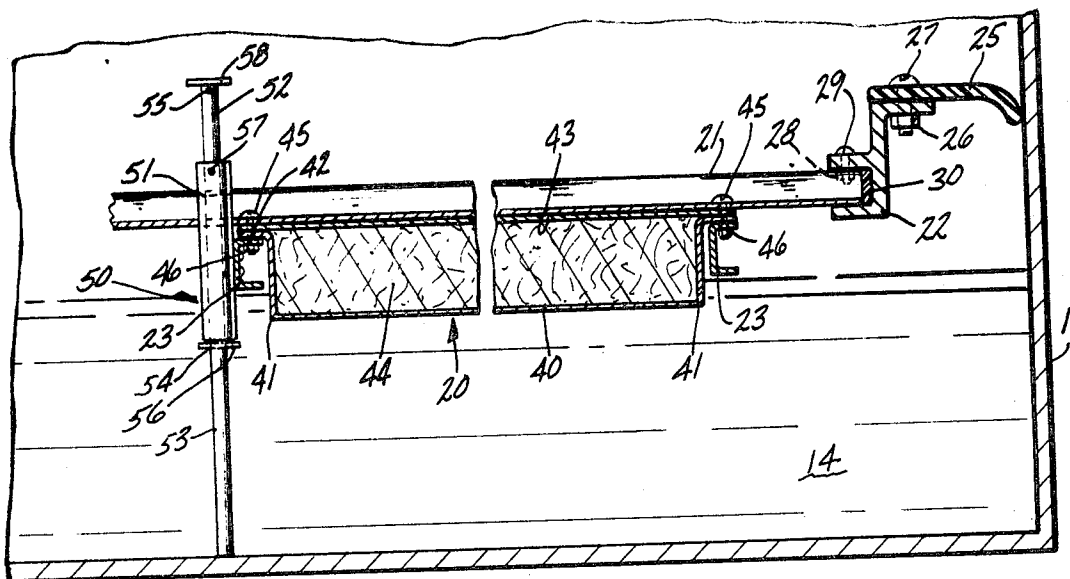
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[51] Int. Cl. .... B65d 87/18  
[50] Field of Search .... 220/26,  
26(S), 26(D), 26(Si)

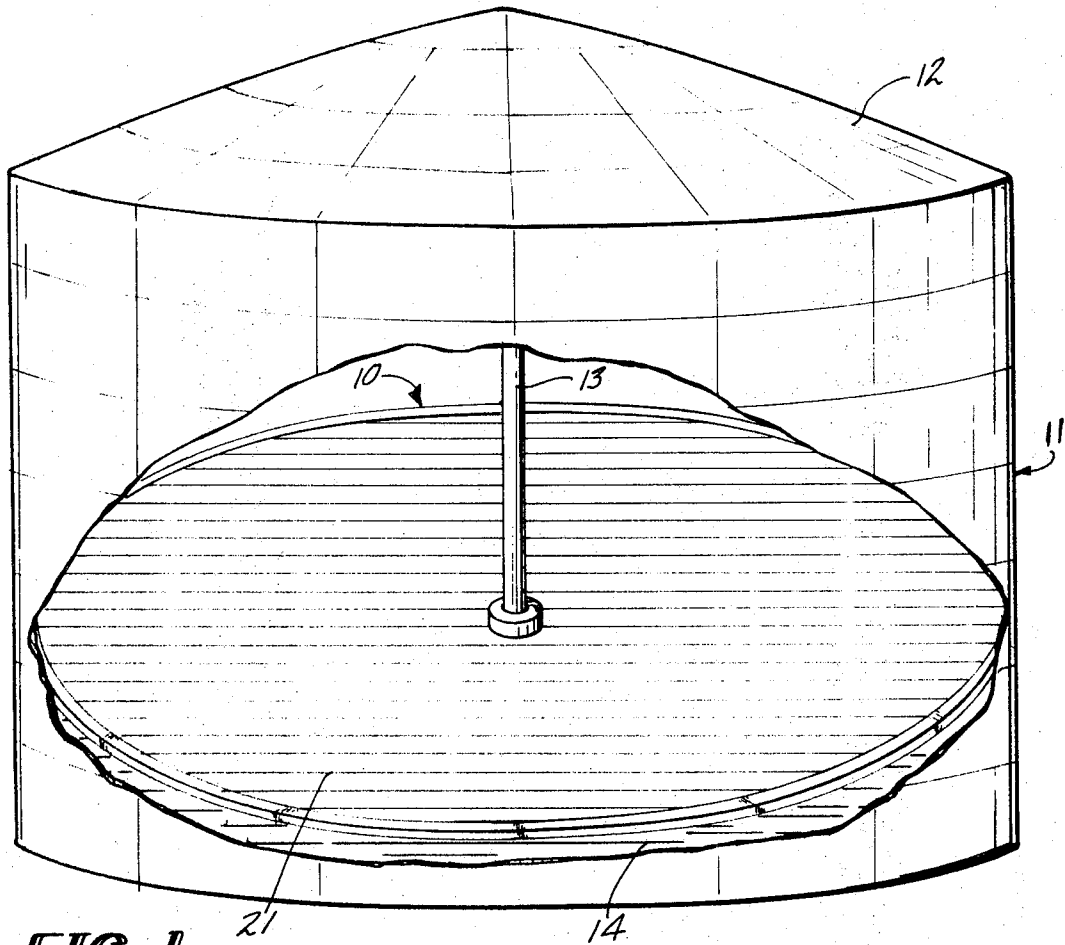
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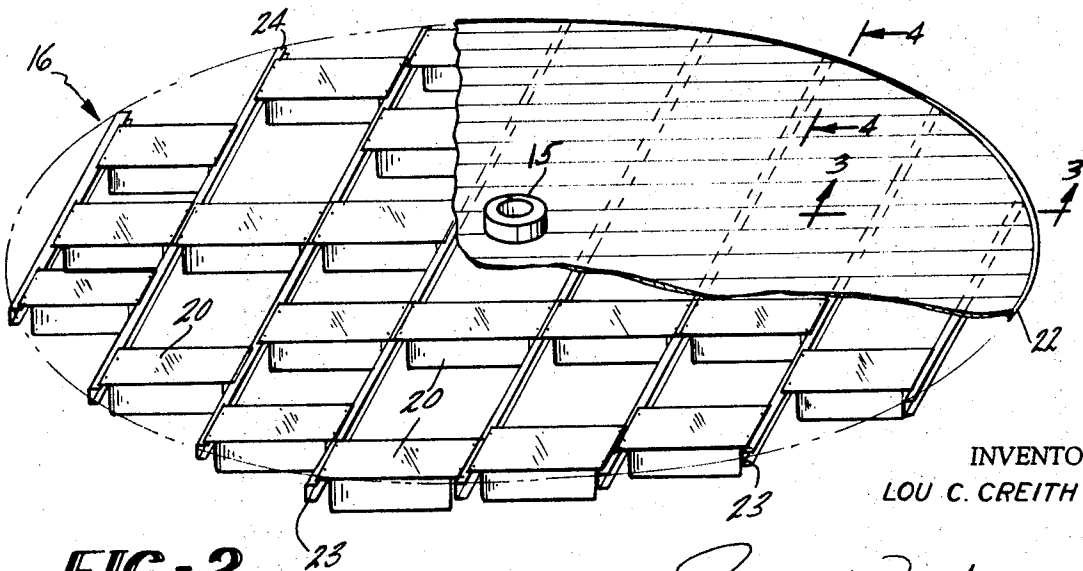
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**ABSTRACT:** A floating deck for use in liquid storage tanks is provided in which a plurality of individually buoyant floats filled with a polymeric material are used to keep the deck afloat.





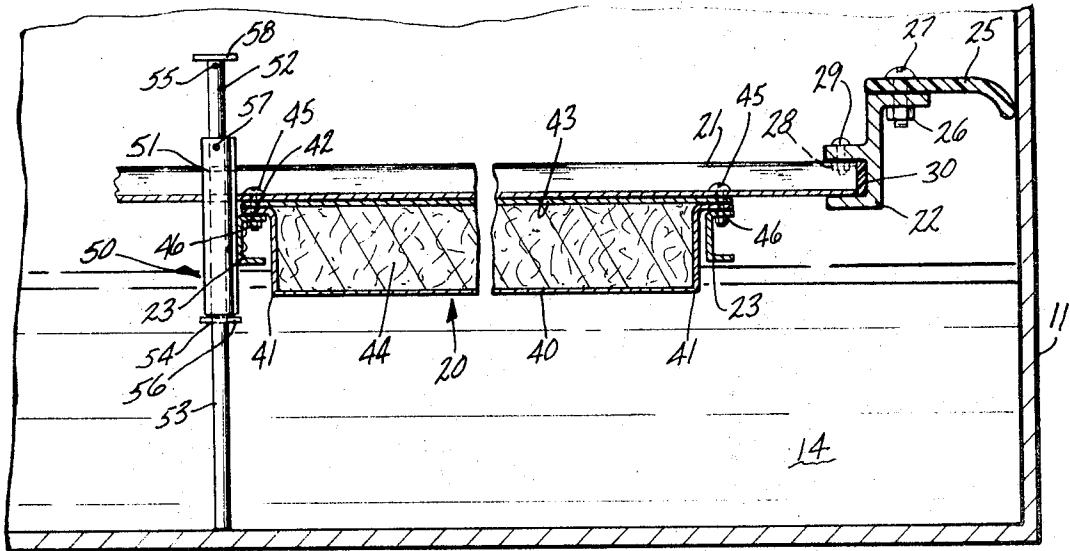
**FIG-1**



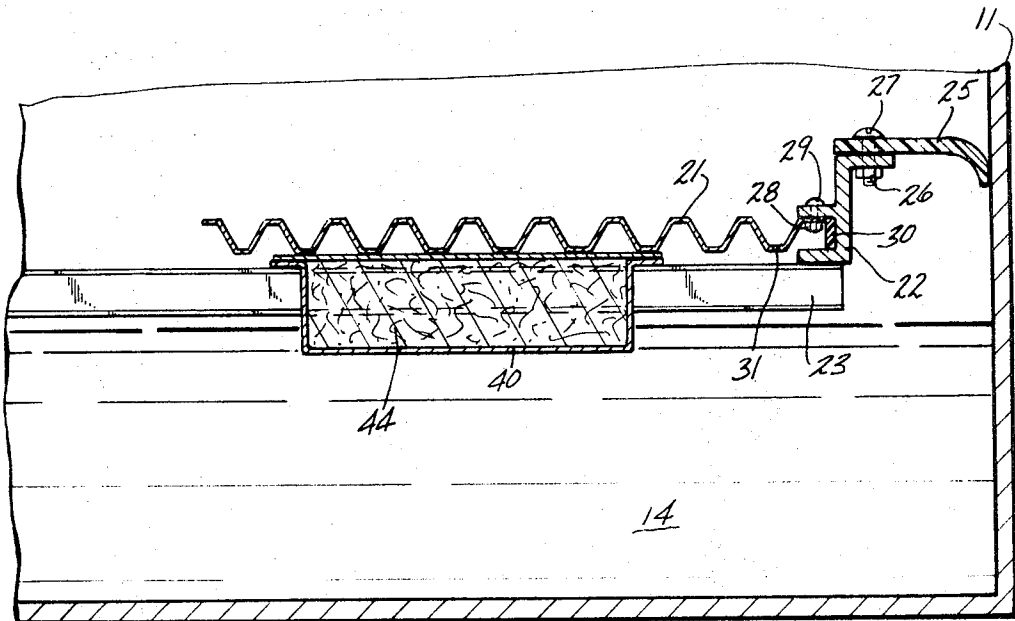
**FIG-2**

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**FIG-3**



**FIG-4**

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## FLOATING DECK FOR STORAGE TANK

This invention relates in general to an improvement in floating decks for use within a liquid storage tank, and more particularly to such a deck having improved floatability apparatus.

Floating decks of many types and forms have been proposed and used in tanks designed for the storage of various liquids. Such a deck may form the roof of the particular storage tank, or may be a separate member within a tank having a fixed roof. In either case, the deck floats substantially horizontally on or slightly above the surface of the liquid stored and moves upwardly and downwardly with the surface as the volume of the liquid stored varies. Thus, protection is afforded to the liquid stored from the environment above the deck; additionally, evaporation from the area below the deck is retarded.

Many floating decks suffer from the significant disadvantage of being relatively expensive to fabricate and to erect within the storage tank to be protected.

One form of a deck which has been proposed utilizes a plurality of individually, air-filled buoyant floats to keep the deck afloat. This suffers from the disadvantage that the air-filled buoyant floats are susceptible to collapse at low temperatures. Also, by their nature optimum buoyance requires a great many of these floats.

Accordingly, it is a principal object of the present invention to provide an improved floating deck for use in liquid storage tanks.

A further object of the present invention is to provide an improved floating deck which overcomes the prior disadvantages, some of which are referred to hereinabove.

A still further object of the present invention is to provide a floating deck with improved buoyancy characteristics which is relatively easy to fabricate and relatively easy to install and which provides the numerous advantages referred to in the ensuing specification.

Further objects and advantages of the present invention will appear from the following specification.

In accordance with the present invention it has now been found that the foregoing objects and advantages may be readily obtained and an improved floating deck provided. The floating deck of the present invention comprises:

A. a substantially horizontal framework;

B. a plurality of metal floats supported by said framework and mounted to extend downwardly in the liquid stored, said floats having

1. a bottom portion adapted to extend into the liquid,
2. side portions extending upwardly from said bottom portion,
3. a cover portion affixed to said sides and enclosing a space within said floats, and
4. a polymeric foam, preferably a rigid polyurethane foam, contained within said space,

C. a rigid material substantially impervious to the liquid stored supported by said framework in a substantially horizontal plane to cover said liquid; and

D. said floats having sufficient buoyance to cause said framework and said material to float above the level of the liquid stored.

The present invention also comprises as an additional improvement the provision of a corrugated material as the rigid material impervious to the liquid stored, preferably corrugated metal. This provides numerous advantages in any floating deck, some of which will be seen hereinafter.

The features of the present invention will be more readily apparent by reference to the ensuing specification with particular reference to the drawings which form a part thereof in which:

FIG. 1 is a perspective view of one form of tank in which a deck according to the instant invention may be employed, with a portion of the tank wall shown broken away to expose the deck in the interior thereof;

FIG. 2 is a perspective view of the deck of the present invention removed from the tank with a portion of the upper corru-

gated surface broken away in order to expose the lower surface more clearly;

FIG. 3 is a sectional view through lines 3-3 of FIG. 2; and

FIG. 4 is a sectional view through lines 4-4 of FIG. 2.

While it is to be understood that the instant floating deck may be employed in any type or shape of vertical walled storage tank, FIG. 1 illustrates by way of example a floating deck 10 in use in a cylindrical storage tank 11 having a fixed roof 12 and a center pole 13. Naturally, the floating deck of the present invention may be used in larger storage tanks requiring a plurality of poles 13. The tank 11 contains liquid 14 which may be of any type normally stored in this type of storage tank.

Column negotiating device 15 is shown schematically and may be of conventional construction or may be of the type shown in U.S. Pat. No. 3,409,165. Naturally, other conventional appurtenances may be provided, not shown in the attached drawings, such as a tank manhole, antistatic cables, gauging funnel, tank inlet pipe, antirotational cables, overflow and air vents.

The floating deck 10 effectively covers the surface of the liquid 14 by a substantially horizontal framework supporting a number of buoyant floats 20 and rigid sheets 21.

The specific construction of the deck will be detailed below. It should be understood that all components of the deck disclosed are of a material impervious and impermeable to the liquid stored. Certain materials may, for example, be a light metal such as aluminum, a plastic material or a fabric coated with suitable material such as a plastic material.

Considering first the construction of the framework which supports all other components, the framework is generally designated by 16. The framework 16 has an annular peripheral ring 22 which is spaced from the tank wall. The framework also has a grid of beams 23. It should be noted that in view of the strength provided by the floats of the present invention, it is not necessary to provide crossbeams in order to give the floating deck structural strength. Naturally, in very large tanks, crossbeams or cross girders or partial crossbeams may be provided if desired in order to obtain still further strength. The peripheral ring 22 conforms in configuration to the perimeter of the tank 11 but is spaced laterally inwardly from the tank walls. Within ring 22 are a plurality of spaced coplanar beams 23. The shape of the beams 23 are not critical and may be either of an L-shape, T-shape, I-shape or C-shape or any other convenient shaped cross section. The beams 23 transverse the entire area enclosed by ring 22 and are interconnected to ring 22 at intersecting points 24 by any suitable means such as bolts or rivets.

The beams 23 and ring 22 should naturally be formed of a metal such as aluminum.

To form a seal between the ring 22 and the interior walls of the tank 11, while allowing for irregularities in the tank walls as the deck moves upwardly or downwardly, a suitable flexible but resilient sealing means 25 is attached about the periphery of a ring 22 as by nut 26 and bolt 27.

As indicated hereinabove, sheets 21 are supported by the framework in a substantially horizontal plane. The sheets 21 should be of a rigid material substantially impervious to the liquid stored, such as aluminum sheet. In the preferred embodiment, as shown in the drawings, the sheets 21 cover the entire area enclosed by ring 22. If desired, the sheets 21 need not cover the floats. The floats are covered themselves and are impervious to the liquid stored. Hence, one may readily provide one row of floats and one row of sheets in an alternating manner. In the preferred embodiment, however, the sheets completely cover the entire area enclosed by ring 22 for simplicity of construction and for additional strength.

Sheets 21 are attached to ring 22 by any convenient method, such as nut 28 and bolt 29. In addition, a sealing means 30 is preferably provided at the juncture of sheets 21 and ring 22, such as a closed cell, flexible sponge.

The material used for sheets 21 may be flat or corrugated. It is preferred in accordance with the present invention to utilize

a corrugated sheet as shown in the drawings. This provides the advantage of additional strength and also improves the efficiency of any floating deck. Hence, a corrugated surface which completely covers both the liquid and the floats would readily provide for water drains, shown schematically in FIG. 3 at 31, in case of a roof leak since drains could be readily provided at the end of each line of corrugations and the surface may readily be drained.

Between certain portions of beams 23 are inserted a plurality of the floats 20. The float 20 is designed to be individually buoyant and has a bottom portion 40 adapted to extend into the liquid, side portions or sidewalls 41 extending upwardly from bottom portion 40 and integral therewith, and integral flanges 42 extending laterally from the upper edges of the sides 41. A cover portion 43 is affixed to flanges 42 enclosing a space within said float 20. The float 20 is filled with a polymeric foam 44 contained within said space. In the preferred embodiment the space is filled with rigid polyurethane foam. A specific illustration of materials which may be used is to provide a rigid polyurethane foam weighing approximately 3 pounds per cubic foot inside a float with a rectangular cross section approximately 4 inches x 18 inches and 8 inches long. A plurality of these floats on the underside surface of the deck would provide the necessary strength to support personnel walking on top of the deck. This foam material has been found to be satisfactory at a temperature of -65° F. and the deck may readily be walked on while floating on gasoline or other similar materials.

In use, the bottom 40 of float 20 extends downwardly into the liquid stored with cover 43 and flanges 42 being attached to beams 23 and sheets 21 by any desired means, such as bolts 45 and nuts 46. Naturally, the method of attachment of the floats may be modified to suit the particular deck construction.

Hence, it can be readily seen that the floating deck of the present invention provides numerous advantages. In view of the structural strength of the filled floats of the present invention, it is possible to eliminate many of the crossbeams heretofore required. Furthermore, the floating deck of the present invention is readily fabricated at a reasonable cost. The increased buoyance of the filled floats of the present invention provides an additional added advantage and readily enables the floating deck of the present invention to be walked on by personnel.

Furthermore, the corrugated surface of the deck provides an added advantage against leakage as indicated hereinabove and allows dispersal of fluid in case of accidental submersion of part of the deck.

An additional advantage of the present invention resides in the provision of adjustable legs 50. These are provided to prevent the deck from reaching the bottom of the tank when the tank is empty. As shown in the drawings, a preferred construction for adjustable legs 50 comprises annular sleeve 51 connected to beams 23 by any desired means. Rod or pipe 52 of greater length than sleeve 51 fits inside sleeve 51 and extends downwardly towards the bottom of the tank. Pipe 52 is provided with a plurality of pinholes for adjusting the height of leg portion 53. Two such pinholes are shown in the drawings, pinhole 54 for low position and pinhole 55 for high position. Thus, if the low position is desired, pin 56 may be inserted in

pinhole 54 as shown, with sleeve 51 preventing movement of pipe 52. If the high position is desired, pin 56 is removed from pinhole 54 while the deck is in a higher position, pipe 52 is moved so that pipe pinhole 55 lines up with sleeve pinhole 57 and pin 56 is inserted through pinholes 55 and 57. Flange 58 prevents relative movement of pipe 52. Naturally, more than two such pinholes may be provided.

Further advantages of the present invention will be readily apparent to one skilled in the art especially in view of the simplicity and strength of the present floating deck.

This invention may be embodied in other forms or carried out in other ways without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered as in all respects illustrative and not restrictive, the scope of the invention being indicated by the appended claims, and all changes which come within the meaning and range of equivalency are intended to be embraced therein.

I claim:

1. A floating deck for use in a storage tank containing a liquid, comprising:

A. a substantially horizontal framework, said framework comprising,

1. an annular peripheral ring spaced from the tank wall,
2. a flexible flange affixed to the frame and extending substantially horizontally outwardly therefrom to contact the wall, and
3. a plurality of spaced coplanar beams traversing the area enclosed by said ring, said beams being connected to said ring;

B. a plurality of legs supported by said framework;

C. a plurality of metal floats supported by said framework and mounted to extend downwardly into the liquid stored, said floats having;

1. a bottom portion adapted to extend into the liquid,
2. side portions extending upwardly from said bottom portion,
3. a cover portion affixed to said sides enclosing a space within said floats, and
4. a rigid polymeric foam filling said space;

D. a rigid sheet material substantially impervious to the liquid stored supported upon and covering said framework in a substantially horizontal plane to cover said liquid; and

E. said floats having sufficient buoyancy to cause said framework and said material to float above the level of the liquid stored.

2. A floating deck according to claim 1 wherein said polymeric foam is a rigid polyurethane foam.

3. A floating deck according to claim 1 wherein said rigid material covers said liquid and said floats.

4. A floating deck according to claim 1 wherein said legs are adjustable.

5. A floating deck according to claim 1 wherein said rigid material is metal.

6. A floating deck according to claim 5 wherein said rigid material is corrugated metal.

7. A floating deck according to claim 6 wherein said corrugated material includes drainage means.