Aug. 9, 1932. J. H. WIGGINS 1,871,289

FLOATING ROOF FOR LIQUID STORAGE TANKS

Filed May 31, 1930 2 Sheets-Sheet 1

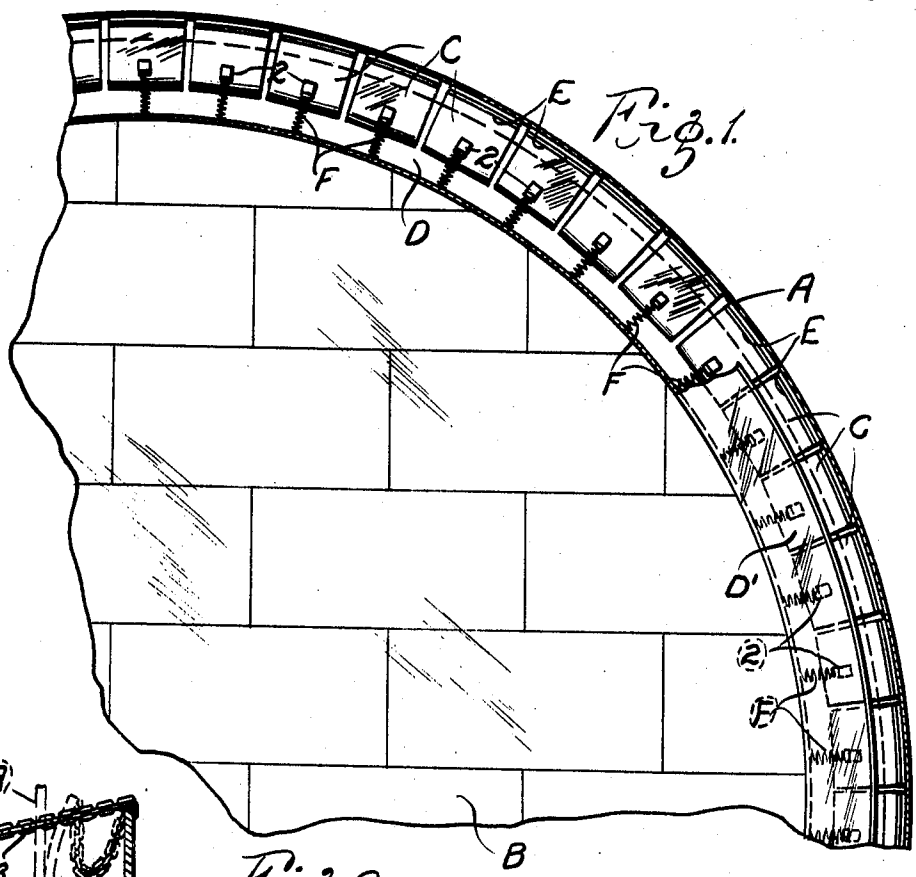


Fig. 1.

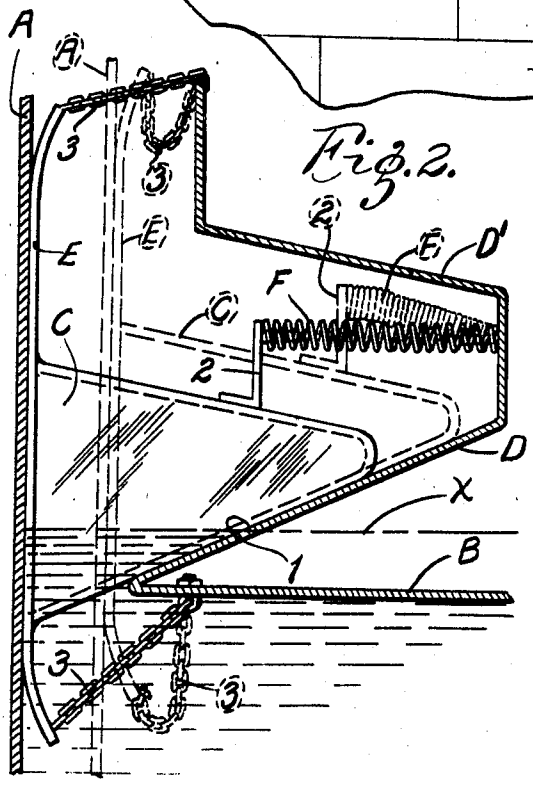


Fig. 2.

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Fig. 3.

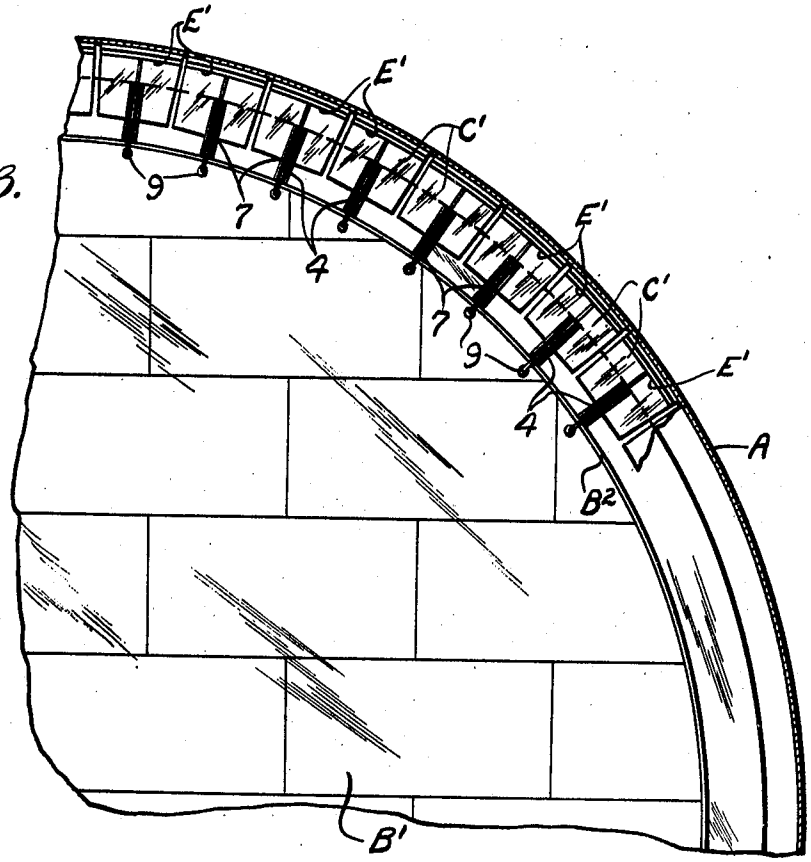
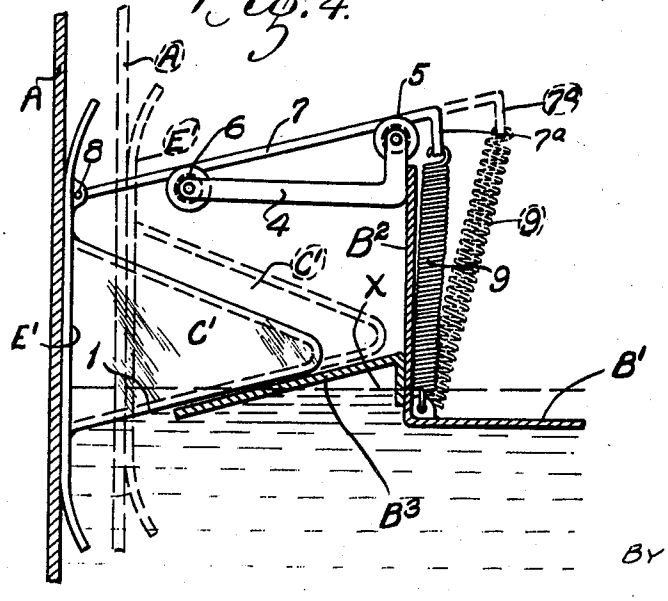


Fig. 4.



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UNITED STATES PATENT OFFICE

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FLOATING ROOF FOR LIQUID STORAGE TANKS

Application filed May 31, 1930. Serial No. 458,009.

This invention relates to floating roofs or decks for liquid storage tanks of the particular type disclosed in my pending application for patent Serial No. 443,326, filed April 11, 1930, i. e., a floating roof that comprises a plurality of relatively movable elements arranged between the side wall of the tank and the peripheral edge of the roof with their lower end portions projecting into the liquid in the tank so as to practically eliminate a liquid surface between the floating roof and the tank side wall.

One object of my present invention is to provide a floating roof of the general type mentioned, in which the relatively movable members or floats relied upon to prevent evaporation from that portion of the liquid in the tank not covered or protected by the roof, are of such design and arrangement that there is no danger of said members binding or wedging when they move radially to take care of the expansion and contraction of the side wall of the tank.

Another object is to provide a floating roof of the general type previously mentioned, in which the floats or similar radially-movable members at the peripheral edge of the roof are rigidly and permanently connected with shoe members that are arranged in sliding engagement with the side wall of the tank.

And still another object of my invention is to provide a floating roof of the general design disclosed in my said pending application, that is equipped with a novel means for sustaining or supporting the floats or the like that are used to eliminate a liquid surface at the peripheral edge of the roof. Other objects and desirable features of my invention will be hereinafter pointed out.

Figure 1 is a fragmentary top plan view of a floating roof constructed in accordance with my present invention, partly broken away so as to more clearly illustrate the radially-movable members or floats arranged in the space between the side wall of the tank and the peripheral edge of the roof.

Figure 2 is a vertical sectional view on an enlarged scale, illustrating the action of the floats or radially-movable members at the peripheral edge of the roof.

Figure 3 is a fragmentary top plan view, partly broken away, illustrating another form of my invention; and

Figure 4 is an enlarged vertical sectional view of the structure shown in Figure 3.

In the drawings, A designates the side wall of a tank that is used for storing liquid, and B designates a floating roof or deck sustained by the liquid x in the tank and adapted to move vertically relatively to said side wall as the level of the liquid in the tank varies. The roof B covers the major portion of the surface of the liquid in the tank, and a plurality of members C are arranged between the peripheral edge of the roof B and the tank side wall A, so as to substantially eliminate a liquid surface at the edge of the roof from which vapors might evaporate. The members C may be constructed in various ways without departing from the spirit of my invention, but I prefer to construct said members from metal plates combined in such a way as to produce hollow floats whose bottoms or lower ends 1 are adapted to rest upon or remain in close proximity to an inclined surface at the peripheral edge of the roof B that slopes upwardly and inwardly towards the center of the roof. In the form of my invention shown in Figures 1 and 2 the members C rest upon and are supported by an upwardly and inwardly inclined supporting surface D at the peripheral edge of the roof. Irrespective of how the members C are supported, they are so shaped and proportioned that portions of the lower ends of said members will project downwardly into the liquid between the side wall of the tank and the peripheral edge of the roof, and thus practically fill the liquid space or eliminate a liquid surface between the tank side wall and the floating roof B that covers the major portion of the surface of the liquid in the tank. The members C are made of such length that they are capable of moving radially inwardly and outwardly, as indicated by full lines and broken lines in Figure 2, so as to provide for the expansion and contraction of the side wall A of the tank. When said members C are in their extreme inward position, as indicated in broken lines in Figure 2,

the ends of said members are in abutting or substantially abutting relation, and when said members are in their extreme outward position, as shown in solid lines in Figure 2, there are gaps or spaces between the ends of said members, as shown in Figure 1. Each of the members C is rigidly and permanently attached to a shoe member E disposed vertically in sliding engagement with the inner surface of the side wall of the tank and preferably proportioned so that the bottom edge of said shoe member is submerged in the liquid x in the tank. As shown in Figure 1, the floats or members C are of the same length as the shoe members E.

The supporting surface D on which the floats or members C rest is flat enough or disposed at such an angle as to prevent the members C from wedging or jamming in the space between the side wall of the tank and the roof B when said members C move radially, due to expansion and contraction of the side wall of the tank. In order to insure the shoe members E remaining in snug engagement with the side wall of the tank, springs or some other equivalent means F are employed for exerting pressure on the members C in a direction tending to move them outwardly towards the side wall of the tank. In the form of my invention shown in Figures 1 and 2, the supporting surface D is formed by a portion of an upwardly-projecting rim at the peripheral edge of the roof, and the means that is used to exert an outward thrust on the members C consists of compression springs F interposed between said rim and brackets 2 that project upwardly from the top walls of the floats or members C.

When the side wall of the tank expands, the members C move outwardly and downwardly on the supporting surface D, due to the outward thrust or pressure exerted on said members by the springs F, thereby causing the shoe members E to which the members C are rigidly attached to remain in engagement with the side wall A of the tank. As the members C move outwardly, the friction between said members and the supporting surface D decreases, due, of course, to the fact that the buoyancy of the members C increases as they move outwardly. In other words, the outward movement of the members C causes greater portions of said members to contact with the liquid in the tank, and as the area of contact between the members C and the liquid increases, the weight or load of the members C on the supporting surface D is automatically diminished. This is a very desirable characteristic of my structure, as it practically eliminates the possibility of the members C jamming or binding when said members move radially, due to expansion or contraction of the side wall of the tank. The slope or angle of the supporting surface D is such that the members C will travel freely downwardly over said supporting surface, under the influence of the springs F, when the side wall of the tank expands, and when said side wall contracts, the members C will travel freely upwardly over the supporting surface D. The supporting surface D is preferably so shaped that it maintains its constant slope, at least as far as the liquid level, thereby eliminating a liquid surface at the edge of the roof from which vapors might evaporate.

If desired, the rim at the peripheral edge of the roof, of which the supporting surface D forms a part, may be provided at its upper end with an outwardly-projecting portion D′ that acts as a baffle for any entrained liquids that are carried by gases which escape upwardly through the joints between the members C and the supporting surface D, as described in my pending application for patent previously referred to. Any suitable means may be employed to restrict or limit the outward movement of the floats C and the shoe members E with which said floats are combined. In Figure 2 I have shown chains 3 attached to the upper ends of the shoe members E and to the upper edge of the rim on the floating roof B, and similar chains 3 attached to the peripheral portion of the roof and to the lower ends of the shoe members E.

Figures 3 and 4 of the drawings illustrate another form of my invention, wherein the floats or similar elements that are relied upon to eliminate a liquid surface at the peripheral edge of the roof are sustained or supported in a novel manner. In said figures the reference character C′ designates floats or similar elements that are rigidly and permanently attached to shoe members E′. The bottom walls of said floats C′ slope upwardly and inwardly towards the center of the floating roof B′, so that the area of said floats which contact with the liquid in the tank will increase when said floats move outwardly, due to expansion of the side wall A of the tank, and will decrease when said floats move inwardly, due to contraction of said tank side wall, but said floats and the shoe members with which they are combined are sustained by a structure located some distance above the level of the liquid in the tank. As shown in Figure 4, the floating roof B′ is provided at its peripheral edge with an upwardly-projecting rim B^2. At the upper edge of said rim are outwardly-projecting brackets 4 provided with rollers 5 and 6 on which radially-movable carriers 7 are mounted, said rollers being grooved, and the carriers 7 preferably consisting of bars that are arranged radially with respect to the floating roof B′. The shoe members E′ are pivotally connected at 8 to the outer ends of the carriers 7, and tension springs 9 are attached to depending arms 7^a at the inner ends of the carriers 7 so as to exert pressure on said carriers in a

direction tending to force them outwardly towards the side wall A of the tank. In order that the shoe members E′ will have a natural tendency to remain in engagement with the side wall of the tank, the rollers 5 and 6 are arranged so that the carriers 7 will be disposed in an inclined position and preferably parallel to or at about the same angle as the bottom walls 1 of the floats C′, thereby insuring outward movement of the floats C′ when the side wall of the tank expands. As the floats move outwardly the buoyancy of same increases, due to the greater area of the floats that is brought in contact with the liquid in the tank, and hence, the friction between the carriers 7 and their supporting roller is reduced sufficiently to compensate for the reduction in the force or pressure which the springs 9 exert on the carriers, as they move outwardly. The upwardly-projecting rim B^2 at the peripheral edge of the roof is spaced far enough from the side wall of the tank to provide for the inward movement of the floats C′ when the side wall of the tank fully contracts, and the rim B^2 is provided adjacent its bottom edge with an outwardly-projecting member B^3 that is overlapped by the floats C′ and which is deflected downwardly sufficiently to cause the outer edge of said member B^3 to be submerged in the liquid in the tank. While the member B^3 co-acts with the floats C′ to eliminate a liquid surface at the peripheral edge of the floating roof, the same as in the form of my invention shown in Figures 1 and 2, said member B^3 does not serve as a supporting means for the floats. On the contrary, in the form of my invention illustrated in Figures 3 and 4 the floats C′ and the shoe members E′ with which they are rigidly combined are sustained by a supporting structure located some distance above the level of the liquid in the tank and designed so as to permit the shoe members and the floats to rise bodily and move inwardly towards the center of the roof when the side wall of the tank contracts, and to move outwardly and downwardly when said side wall expands.

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

1. In a liquid storage tank, the combination of a side wall, a roof adapted to float on the liquid in the tank and having its peripheral edge spaced away from said side wall, shoe members arranged in sliding engagement with the inner face of said side wall, floats rigidly combined with said shoe members and projecting inwardly from same towards the peripheral edge of the roof, and a supporting means for said floats and shoe members, constructed so that as the side wall expands, the area of said floats that contact with the liquid in the tank increases.

2. In a liquid storage tank, the combination of a side wall, a roof adapted to float on the liquid in the tank and having its peripheral edge spaced away from said side wall, radially-movable floats in the space between said roof and side wall, arranged so that expansion of said side wall increases the submerged volume of said floats and contraction of the side wall decreases the submerged volume of said floats, and shoe members rigidly combined with said floats and adapted to slide vertically on the side wall of the tank when the roof rises and falls due to variations in the level of the liquid in the tank.

3. In a liquid storage tank, the combination of a side wall, a roof adapted to float on the liquid in the tank and spaced away from said side wall, hollow elements in the space between said roof and side wall partially submerged in the liquid in the tank and provided with bottoms that slope upwardly and inwardly from said side wall, shoe members rigidly combined with said elements and adapted to contact with the inner surface of said side wall, and means for exerting pressure on said elements in a direction tending to hold said shoe members against said side wall.

4. In a liquid storage tank, the combination of a side wall, a roof adapted to float on the liquid in the tank and having its peripheral edge spaced away from said side wall, radially-movable elements in the space between said roof and side wall partially submerged in the liquid in the tank and having bottoms which slope upwardly and inwardly from said side wall, shoe members combined with said elements so as to partake of the movement of same, and means for restricting the outward movement of said elements relatively to the roof.

5. In a liquid storage tank, the combination of a side wall, a roof adapted to float on the liquid in the tank and having its peripheral edge spaced away from said side wall, radially-movable elements in the space between said roof and side wall partially submerged in the liquid in the tank and having bottoms which slope upwardly and inwardly from said side wall, shoe members combined with said elements so as to partake of the movement of same, means for restricting the outward movement of said elements relatively to the roof, and means for exerting pressure on said elements in a direction tending to hold said shoe members in engagement with said side wall.

6. In a liquid storage tank, the combination of a side wall, a roof adapted to float on the liquid in the tank and having its peripheral edge spaced away from said side wall, hollow elements in the space between said roof and side wall for practically eliminating a liquid surface in said space, provided with sloping bottom portions, shoe members rigid-

ly combined with said elements and adapted to slide on the inner surface of said side wall, and means for causing said elements and shoe members to move bodily downwardly and outwardly when said side wall expands and to move bodily upwardly and inwardly when said side wall contracts.

7. In a liquid storage tank, the combination of a side wall, a roof adapted to float on the liquid in the tank and having its peripheral edge spaced away from said side wall, hollow elements in the space between said roof and side wall for practically eliminating a liquid surface in said space, provided with sloping bottom portions, shoe members rigidly combined with said elements and adapted to slide on the inner surface of said side wall, means for causing said elements and shoe members to move bodily downwardly and outwardly when said side wall expands and to move bodily upwardly and inwardly when said side wall contracts, and means for exerting pressure on said shoe members in a direction tending to hold them in engagement with said side wall.

8. In a liquid storage tank, the combination of a side wall, a roof adapted to float on the liquid in the tank and having its peripheral edge spaced away from said side wall, an upwardly and inwardly inclined supporting surface adjacent the peripheral edge of the roof, hollow members slidingly mounted on said supporting surface and arranged with their lower end portions projecting into the liquid in the tank, and shoe members rigidly combined with said hollow members and adapted to engage the inner face of the side wall of the tank.

9. In a liquid storage tank, the combination of a side wall, a roof adapted to float on the liquid in the tank and having its peripheral edge spaced away from said side wall, an upwardly and inwardly inclined supporting surface adjacent the peripheral edge of the roof, hollow members slidingly mounted on said supporting surface and arranged with their lower end portions projecting into the liquid in the tank, shoe members rigidly combined with said hollow members and adapted to engage the inner face of the side wall of the tank, and springs for exerting pressure on said hollow members in a direction tending to hold said shoe members in engagement with said side wall.

10. In a liquid storage tank, the combination of a side wall, a roof adapted to float on the liquid in the tank and having its peripheral edge spaced away from said side wall, an upwardly and inwardly-inclined supporting surface adjacent the peripheral edge of the roof, hollow members slidingly mounted on said supporting surface and arranged with their lower end portions projecting into the liquid in the tank, shoe members rigidly combined with said hollow members and adapted to engage the inner face of the side wall of the tank, springs for exerting pressure on said hollow members in a direction tending to hold said shoe members in engagement with said side wall, and means for restricting or limiting the outward movement of said hollow members relatively to the roof.

11. In a liquid storage tank, the combination of a side wall, a roof adapted to float on the liquid in the tank and having its peripheral edge spaced away from said side wall, floats in the space between the roof and side wall having bottoms that are inclined upwardly and inwardly relatively to said side wall, shoe members rigidly combined with said floats, and radially-movable carriers from which said shoe members and floats are suspended disposed so as to bodily raise the same when said floats move inwardly due to contraction of the side wall and to bodily lower the same when said floats move outwardly due to expansion of the side wall.

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