

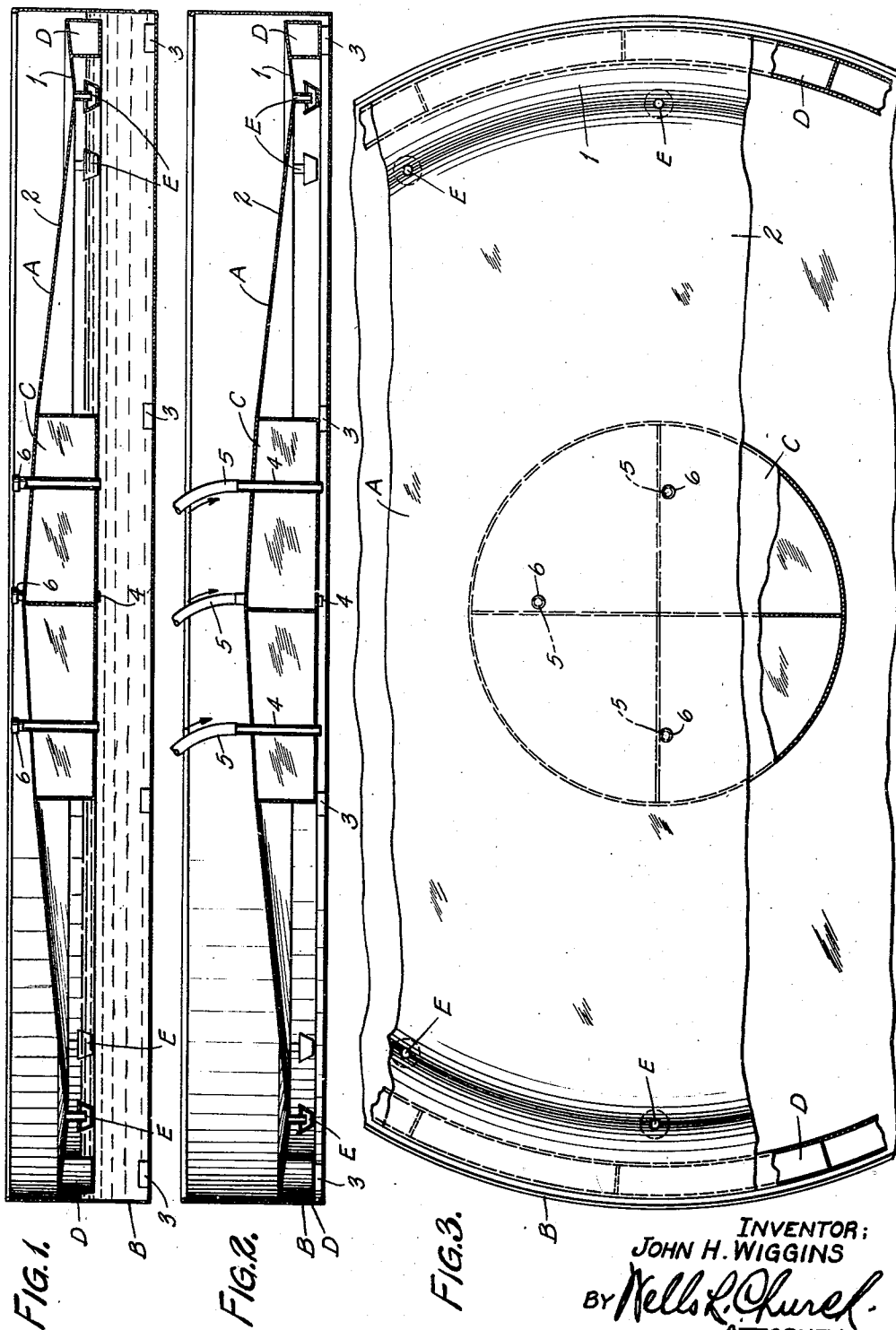
June 23, 1942.

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2,287,213

FLOATING ROOF FOR LIQUID STORAGE APPARATUS

Filed May 10, 1939



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2,287,213

FLOATING ROOF FOR LIQUID STORAGE APPARATUS

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Application May 10, 1939, Serial No. 272,748

1 Claim. (Cl. 220—26)

This invention relates to floating tank roofs of the kind that are used with storage tanks of relatively great diameter, and which consist of a metal deck combined with a metal pontoon or equivalent auxiliary buoyant means that imparts additional buoyancy to the deck.

One object of my present invention is to provide a floating roof for large size storage tanks, for example, a tank having a diameter in excess of 100 feet, that is cheaper to build and which contains considerable less metal and is lighter in weight than metal floating tank roofs of conventional design.

Another object is to provide a large size floating roof of the pontoon type, whose deck and auxiliary buoyant means are combined in a novel manner that insures eccentric loads being carried effectively from one side of the roof to the other, notwithstanding the fact that the roof is not equipped with trusses or with a trussing means.

Another object is to provide a floating metal roof which is of such construction or design that it is incapable of collecting and holding a large load of rainwater, and whose top area is made up of self-draining surfaces of a sufficiently sharp pitch or slope to prevent puddles of water from standing on the top side of the roof and injuring the paint used to protect the roof plates against corrosion, either when the roof is floating on the liquid in the tank, or when the tank is empty, and the roof is supported by the bottom of the tank.

And still another object is to provide a floating tank roof, which, in addition to having the desirable features or characteristics above stated, is of such construction or design that it is not necessary to equip it with adjustable legs or supporting devices for sustaining the weight of the roof when the tank is empty, and for holding the roof spaced far enough above the bottom of the tank to permit workmen to enter the tank and remove sediment that has collected on the bottom of the tank.

To this end I have devised the floating tank roof herein shown and described, which roof comprises the following three main elements, to wit, a deck portion composed of a single thickness of metal plates joined or fastened together by tight joints, a buoyant means at the periphery of the roof, preferably formed by an annular pontoon of stiff construction, attached to said deck portion, and a buoyant means at the center of the roof, preferably formed by a pontoon of substantial diameter and of rigid construction, separated by an annular space from said peripheral pontoon and connected to said deck portion. Said two pontoons are made of such relative height or depth, and the deck portion is combined with or attached to said pontoons in such a way,

that when the roof is floating on the liquid in the tank, the deck plates will be in tension, and sloping upwardly from near the periphery towards the center of the roof, thereby causing an eccentric load imposed on one side of the roof to be transmitted directly across to the other side of the roof, through the deck plates which constitute the sole connection between the two pontoons. By constructing the roof in this manner I overcome the necessity of equipping the roof with a truss or trussing means to transmit eccentric loads from one side of the roof to the other, and hence, I reduce the cost of the roof, I reduce the amount of metal in the roof, and I reduce the weight of the roof.

The pontoons are made of such relative height or depth and the deck portion is combined with said portions in such a way that the entire area of the top side of the roof is self-draining and co-acts with water outlets of sufficient area to rapidly carry off water that falls on the roof, either when the roof is floating on the liquid, or when the roof is supported by the bottom of the tank. By designing or constructing the roof so that it is incapable of collecting and holding an excessive or emergency load of rainwater, I overcome the necessity of building the roof strong enough to take care of an emergency rain load, and thus, I effect an additional saving, both in the cost and in the weight of the roof. Preferably, the pontoons are arranged on the underside of the roof, and the center pontoon is made considerably deeper or higher than the peripheral pontoon, thereby causing the deck portion to slope downwardly and outwardly, at a fairly sharp pitch or angle, from the central portion of the roof to a valley located adjacent the periphery of the roof, and provided with drains of such number, capacity and rate of discharge as to insure rapid disposal of even a heavy cloudburst.

Due to the fact that the pontoons project downwardly from the underside of the deck of the roof, they serve as a supporting means for the deck which holds it spaced away from the bottom of the tank when there is no liquid in the tank, and thus provides a space on the underside of the deck for workmen engaged in removing sediment from the bottom of the tank. By employing the pontoons for this additional purpose, I am able to omit the adjustable supporting legs with which floating roofs of conventional design are usually equipped, and I accordingly effect still another saving in the cost and weight of the roof.

Figure 1 of the drawing is a vertical transverse sectional view of a liquid storage apparatus equipped with a floating roof embodying my present invention, showing the roof floating upon the liquid confined in the container of the apparatus.

Figure 2 is a similar view, showing the tank empty, or practically empty, and the roof supported by the bottom of the tank; and

Figure 3 is a fragmentary top plan view, partly broken away, of the apparatus shown in Figures 1 and 2.

In the drawing A designates the deck portion of my improved floating roof, formed preferably from a plurality of metal plates joined together by welding, riveting, or in any other suitable way, so as to form a sheet or diaphragm of single thickness, arranged above the surface of a body of liquid x confined in the tank or container B. As previously stated, the primary purpose of my invention is to provide a highly practicable metal floating roof for large size storage tanks, and accordingly, the container B may be considered as a conventional oil storage tank having a diameter of 100 feet or more. In the preferred form of my invention herein illustrated the roof is of the pontoon type, and is provided with pontoons, or an equivalent buoyant means, so constructed and combined with the deck portion that, irrespective of any load that may be imposed upon the roof (a load of rain water or snow), the deck A will maintain its approximately original shape or form, and any eccentric load imposed on one side of the roof will be carried to the other side of the roof through the deck plates. In the particular form of my invention herein illustrated, the roof is equipped with a center pontoon C, and a peripheral pontoon D, separated from each other by an annular space, the center pontoon being of stiff construction and of greater height or depth than the peripheral pontoon D, so as to insure that the deck of the roof will maintain a substantially dome form;—in other words, will remain in a position with the central portion of the deck disposed in a higher horizontal plane than the peripheral portion of the deck. In the roof herein illustrated the pontoons C and D are arranged on the underside of the deck, and the deck portion A is so constructed that the roof comprises an inclined portion 1 at the peripheral edge of the roof that slopes oppositely to a downwardly and outwardly inclined portion 2 that constitutes the major area of the top side of the roof, said inclined portion 1 sloping downwardly and inwardly and then merging into the downwardly and outwardly inclined portion 2, thus forming in effect a valley near the outer edge of the roof that is provided with numerous drains E of any suitable type or kind, the drains E herein illustrated being of the inverted syphon type, commonly used on Wiggins floating roofs.

When the tank contains sufficient liquid to float the roof, most of the deck portion A remains in a plane considerably higher than the peripheral portion of the roof, due to the greater height or depth of the center pontoon than the peripheral pontoon, and due to the upward pressure exerted on the under side of the deck portion A by the gases confined in the relatively deep space above the surface of the liquid in proximity to the center pontoon C. Under uniform top loading (such as snow) the annular pontoon D sinks as much or more than the stiff center pontoon C, thus maintaining the downward and outward slope of the deck A for drainage. Under a load concentrated at the periphery of the roof (such as a snow drift) the annular pontoon D sinks much lower than the center pontoon, which throws the deck plates into tension, dips the center pontoon, which tightens the opposite side of the deck plates, and thus car-

ries the load to the opposite side of the annular pontoon through the deck plates. From the foregoing it will be understood that in my improved roof, the annular space between the two pontoons is bridged by a plate-like deck portion A, of single thickness, that is always in tension, and which constitutes the sole connecting means between the peripheral pontoon D and the center pontoon C, which exerts a constant upward pressure on the deck portion A and holds it in a downwardly and outwardly sloped position.

By varying the height of the center pontoon, and hence, the pitch of the deck, any desired proportion of the deck and its load may be carried by the center pontoon, thus giving accurate control of the compression set up in the annular pontoon D by the weight of the deck, and any superimposed loads which are carried by the annular pontoon. In other words, the radius of the point of contraflexure of the deck may be controlled by the height of the center pontoon. The drains E, are of course, preferably placed at the lowest point of the deck under normal conditions, and while I prefer to construct the deck so that it is provided at its extreme outer edge with a downwardly and inwardly inclined portion 1, as previously described, this particular shape or form of the deck is not essential.

When the tank B is empty, or substantially so, the floating roof above described is supported by the bottom of the tank, usually by supports 3 on the tank bottom, that hold the pontoons spaced slightly away from the bottom of the tank. In order to facilitate cleaning the tank with steam, the floating roof is provided with a plurality of vertically-disposed, open-ended, tubular members 4, that project upwardly through the center pontoon C, so that steam supply hoses 5 may be attached to same to discharge steam into the tank. Normally, the upper ends of the tubular members 4 are closed by removable caps 6, as shown in Figure 1. Owing to the fact that the pontoons C and D are of considerable height or depth, the space on the underside of the deck C, when the roof is supported by the bottom of the tank, is high enough to permit workmen to enter said space to remove sediment or foreign matter that collects on the bottom of the tank.

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

A floating tank roof of relatively great diameter, composed of a deck portion of a single thickness, made up of metal plates joined together, a stiff annular pontoon at the periphery of the roof attached adjacent its upper end to said deck portion, a relatively large diameter pontoon of stiff construction arranged at the center of the roof and attached adjacent its upper end to said deck portion, said pontoons being separated from each other by an annular space that is bridged by the deck portion and the center pontoon being considerably deeper than the annular pontoon and having its top disposed in a considerably higher horizontal plane than the top of the annular pontoon, said deck portion and pontoons being connected together and disposed in such relative relationship that when the roof is floating on the liquid in the tank said deck portion will always be in tension and will cause eccentric loads to be carried from one side of the roof to the other through the plates of said deck portion.

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