

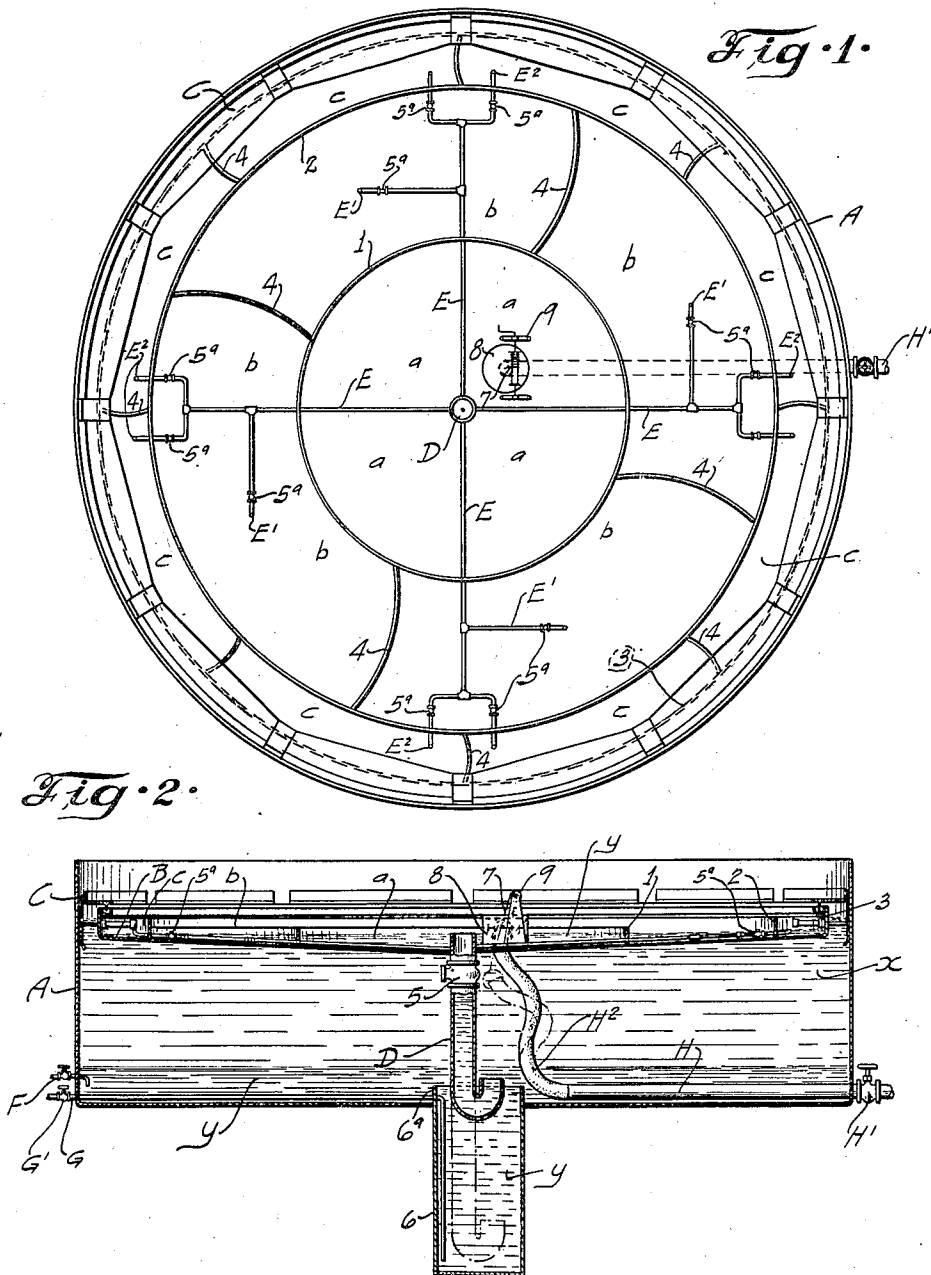
July 13, 1926.

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1,592,244

LIQUID STORAGE TANK

Filed Sept. 20, 1923



Patented July 13, 1926.

1,592,244

UNITED STATES PATENT OFFICE.

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LIQUID-STORAGE TANK.

Application filed September 20, 1923. Serial No. 663,843.

This invention relates to liquid storage tanks of the type that comprise a floating deck or roof provided at its peripheral edge with a portion or portions arranged in sliding engagement with the inner face of the side wall of the tank.

One object of my present invention is to provide a novel drainage means for a floating tank deck or roof of the general type above referred to.

Another object is to provide means for automatically maintaining a certain approximate level of water on the top side of a floating tank deck or roof.

Another object is to provide means for insuring the escape of drain water from the floating deck of an oil storage tank into the bottom portion of the tank, even when a large quantity of water resulting from a cloudburst is projected onto the tank deck when the tank is nearly empty.

And still another object is to provide a liquid storage tank that is equipped with a pipe adapted to be used for introducing liquid into the tank or discharging liquid from the tank, arranged in such a way that the end of the same which terminates inside of the tank can be raised to a point above the level of the liquid in the tank, thereby permitting a controlling valve in said pipe to be repaired or replaced, in the event it becomes defective, without the necessity of first removing the liquid from the tank. Other objects and desirable features of my invention will be hereinafter pointed out.

Figure 1 of the drawings is a top plan view of a liquid storage tank constructed in accordance with my invention; and

Figure 2 is a vertical transverse sectional view of said tank.

Referring to the drawings, A designates the cylindrical side wall of a tank that is adapted to be used for storing oil or other liquid, B designates the central body portion of a vertically-movable deck or roof that normally floats upon and is supported by the liquid in the tank and C designates as an entirety a variable peripheral portion of the deck that closes the annular space between the side wall of the tank and the central body portion B of the deck, said variable peripheral portion being of any preferred construction.

The top surface of the body portion B of said deck or roof is divided into a number of open compartments or chambers formed

by upright partitions on the top side of said deck. While the particular shape or form of said compartments is immaterial, so far as my invention is concerned, I prefer to provide the deck with two ring-shaped partitions 1 and 2 arranged in concentric relation with the upwardly-projecting rim 3 at the peripheral edge of the body portion B of the deck, and substantially radially-disposed partitions 4 arranged between the ring-shaped partitions 1 and 2 and between the partition 2 and the rim 3, so as to form a center chamber or compartment *a*, a plurality of segmental-shaped compartments *b* that surround the central compartment and a plurality of segmental-shaped compartments *c* arranged at the periphery of the body portion B of the deck. When rain falls on the deck the partitions above referred to prevent the rain from flowing over the deck and accumulating at a particular point on the deck in such a way as to capsize the deck or destroy the equilibrium of same. In order that a certain approximate quantity of water will be maintained in the compartments or chambers *a*, *b* and *c* so as to absorb heat from the sun's rays, and thus prevent the contents of the tank from being subjected to excessive heat in hot weather, I have provided the deck with a center drain pipe D that leads from the center compartment *a* and which is connected by branch drain pipes with the segmental compartments *b* and *c* in such a way that the said various compartments will normally hold a certain approximate quantity of water, but when the normal level is exceeded the excess water will escape automatically from said compartments. In the form of my invention herein illustrated the upper end of the center drain pipe D terminates at a point several inches above the bottom of the center compartment *a*, so that when the water in said center compartment *a* rises above a certain level, the excess water will overflow into the drain pipe D and escape from the compartment, and said center drain pipe is connected by branch drain pipes E with the compartments *b* and *c*. Thus, as shown in Figure 1, each of the compartments *b* is equipped with a drain pipe E¹ that leads to one of the branch drains E, and each of the compartments *c* is equipped with a drain pipe E² that leads to one of the main branch drains E, the drain pipes E¹ and E² preferably having upturned ends or

vertically-disposed inlet portions into which water escapes from the compartments with which said drain pipes are associated when the water in said compartments rises above a certain approximate level, the upturned portions or inlet portions of the drain pipes E' being so formed that a certain approximate depth of water will be automatically maintained in the compartments *b*, and the upturned portions or inlet portions of the drain pipes E² being so formed that a certain approximate depth of water will be automatically maintained in the compartments *c*. Preferably the center drain pipe D is equipped with a check valve 5 that opens in the direction in which the water escapes through said pipe and the drain pipes E' and E² are also equipped with check valves 5^a that open in the direction in which the water escapes from the compartments *b* and *c*, thereby eliminating the possibility of water passing from one compartment into another compartment or from the drain pipe D back into the center compartment *a*, as might occur in some cases if said drain pipes were not equipped with check valves.

The center drain pipe D can be formed in various ways, but I prefer to construct said drain pipe so that it forms an inverted siphon of the kind described in my pending application Serial No. 599,904, filed November 4, 1922. As shown in Figure 2, the drain pipe D projects downwardly from the center of the deck or roof of the tank and terminates inside of the tank in such a way that the water which escapes from the lower end of said drain pipe will collect in the bottom of the tank A at a point below the body of liquid in said tank. In order to provide for the rise and fall of the deck B, due to variations in the level of the liquid in the tank, the bottom of the tank is provided with a well 6 that receives the center drain pipe D. Normally, the well 6 contains sufficient drain water to seal the upturned end of the drain pipe D. When rain falls onto the deck or roof of the tank it will collect in the compartments or chambers *a*, *b* and *c* on the top side of the deck, and when the water in said compartments exceeds a certain level, it will escape automatically through the drain pipes E², E' and D, thus increasing the weight of the column of water in the drain pipe D that opposes the column of liquid in the tank A. If the liquid in said tank is oil, as is usually the case, the siphon will become unbalanced, whereupon more water will flow upwardly from the discharge end of the center drain pipe D or from the upper end of the well 6 and collect in the tank A beneath the body of liquid *x* therein. At frequent intervals the drain water *y* that has collected in the bottom of the tank A is removed by opening a valve in a pipe F arranged adjacent the

bottom of the tank A, as shown in Figure 2. Preferably, the well 6 is provided at its upper end with an extension 6^a that projects above the bottom of the tank several inches so as to trap off the drain water on the bottom of the tank from the drain water in the well 6.

A drainage means of the construction above described makes it possible to automatically maintain a certain approximate level of water on the top side of a floating tank deck or roof, owing to the fact that the upper end of the drain pipe D and the portions of the drain pipes E' and E² are so disposed with relation to the bottoms of the compartments *a*, *b* and *c*, respectively, that water will not escape from said compartments unless the level of the water rises high enough to overflow into the upper end of the center drain pipe D and into the inlet portions of the drain pipes E' and E² associated with the branch drains E. In order to take care of a large quantity of water resulting from a cloudburst when the tank is nearly empty, the tank A is equipped with an emergency drain pipe G whose inlet end is arranged in proximity to the bottom of the well 6, as shown in Figure 2, said emergency drain pipe being equipped with a valve G' that is normally closed. The function of this emergency drain pipe G is to provide for the escape of drain water from the well 6 in the event a large quantity of water is projected onto the deck or roof of the tank at a time when the tank contains a relatively small quantity of liquid, and the deck or roof of the tank is arranged in comparatively close proximity to the bottom of the tank.

As previously stated, the valve G' in the emergency drain G is normally closed, but if a cloudburst occurs at a time when the tank is nearly empty, or in other words, when the deck is arranged in such close proximity to the bottom of the tank as to cause the inverted siphon to be cancelled by the water in the well, said valve G' is opened so as to permit the water that collects in the well 6 to escape freely from same through the emergency drain pipe G, thereby preventing drain water from collecting in the bottom of the tank in sufficient quantity as to prevent the inverted siphon from functioning properly, or, in other words, from operating in such a way as to permit the drain water to escape automatically from the discharge end of the center drain pipe D. In such a contingency, namely, when a large quantity of water resulting from a cloudburst is suddenly projected onto the deck, the person who has charge of the tank will open the valve in the emergency drain pipe G before sufficient water has fallen onto the deck to sink it, thereby permitting the drain water that collects in the well 6 to

escape from said well, thus preventing the drain water from rising high enough to shorten the oil leg of the siphon to such an extent as to interfere with the escape of the water from the top side of the deck through the center drain pipe D. If the well 6 were not provided with a projection 6^a, a contingency of the kind above referred to might result in the drain water in the bottom of the tank being forced upwardly onto the deck through the drain pipe D, if, for any reason, the check valve were not operating, thus increasing the load on the deck to such an extent as to cause the deck to sink. The particular form or arrangement of the drain pipes that are associated with the compartments *b* and *c* is immaterial, so long as said compartments are manifolded, but I prefer to arrange the branch drains E and the drain pipes E' and E² on the top side of the deck where they can be gotten at easily for cleaning or for repairs and combine said pipes with the center drain D in such a way that they virtually form a manifold on the top side of the deck that increases the depth of the water towards the center of the deck and normally maintains a certain approximate level of water on the top side of the deck.

The siphon drain pipe D is preferably combined with the deck in such a way that it is removable from the upper side of the deck, and as the branch drain pipes are arranged on the top side of the deck and are detachably connected to the siphon drain pipe, the entire drainage system can be removed and repaired while the tank is still in operation, it, of course, being understood that when the siphon drain pipe D is removed it is necessary to insert a suitable closure in the opening in the deck which receives the siphon drain pipe, so as to prevent the contents of the tank from escaping upwardly through said opening. After the drainage system has been repaired said closure is removed and the center drain pipe and branch drain pipes are restored to their normal position.

The liquid that is stored in the tank A is introduced into said tank and withdrawn from same through a combined inlet and discharge pipe H equipped with a controlling valve H' and provided at its inner end with a flexible portion H² whose terminal or end is adapted to be raised above the level of the liquid in the tank A in the event it becomes necessary to replace or repair the valve H', thereby overcoming the necessity of emptying the tank at such times, namely, when it becomes necessary to remove or repair the controlling valve H' in the pipe H. As shown in Figure 2, the flexible portion H² of the pipe H is formed by a flexible rubber or metal hose and is connected to a cable or other suitable operating

device 7 that extends upwardly through a manhole 8 in the central body portion B of the deck, said cable being connected to a reel or other winding apparatus, designated as an entirety by the reference character 9, that can be manipulated in such a way as to raise the terminal portion of the flexible part H² of the pipe H above the level of the liquid in the tank. When said flexible part H² is arranged in this manner, as shown in full lines in Figure 2, it is possible to take off or dismantle the valve H' in the pipe H without liability of the liquid escaping from the tank through said pipe.

In a liquid storage tank of the construction above described sufficient water will be maintained on the surface of the deck of the tank to partially protect the contents of the tank from excessive heat in hot weather, and when additional rain falls on the deck, the excess water will drain off and collect in the bottom of the tank, from which point it can be removed at frequent intervals by opening the valve in the outlet pipe F. The drain that leads from the center compartment *a* of the deck is preferably so arranged that the water in said center compartment will be maintained at a greater depth than the water in the compartments *b* and *c*, so as to increase the load at the center of the deck to such an extent as to normally maintain the central portion of the deck in a slightly deflected condition, as shown in Figure 2, thus producing a hydraulic gradient from the outer compartments *c* and *b* to the center drain pipe D, and insuring the escape of the excess drain water from said outer compartments through the branch pipes E that lead to the center drain pipe D. If a cloudburst occurs when the deck is in close proximity to the bottom of the tank, say, four or five feet above the bottom of the tank, the person in charge of the tank opens the valve G' in the emergency drain G before the deck becomes overloaded, so as to permit the drain water which is discharged into the lower portion of the tank from the center drain D to escape from the tank before said drain water can rise high enough in the tank to interfere with the operation of the inverted siphon through which the water is conducted off the top side of the deck. In addition to the desirable features above pointed out, my present invention overcomes the necessity of emptying a liquid storage tank whenever repair or replacement of the controlling valve in the combined inlet and discharge pipe of the tank becomes necessary, due to the fact that the terminal portion of said pipe which is arranged inside of the tank can be raised to a point above the level of the liquid in the tank, thereby preventing the liquid from escaping through said pipe when said terminal portion is in its raised position.

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

1. A floating deck or roof for liquid storage tanks provided on its top side with open chambers or pockets for receiving water, a center drain pipe through which water escapes from one of said chambers automatically when the water in said chamber rises above a certain approximate level, a drain pipe associated with each of the other chambers and having an inlet portion that automatically maintains a certain approximate level of water in the chamber, branch drains leading from the center drain and connected with said additional drain pipes, and check valves for preventing water which escapes from any of said chambers from returning to same or from entering one of the other chambers.
2. A floating deck or roof for liquid storage tanks having its top surface divided into a number of open chambers or compartments for holding water, and means for automatically draining water from said compartments and for maintaining a sufficient depth of water in the various compartments so as to impose a greater load on the central portion of the deck than on the peripheral portion, thereby causing the central portion of the deck to be maintained in a downwardly deflected condition.
3. A tank for storing oil or other liquid of less specific gravity than water provided with a floating deck, a drain pipe projecting downwardly from said deck, a well projecting downwardly from the bottom of the tank that is adapted to receive said drain pipe under certain conditions, and an emergency drain pipe leading from said well.
4. A liquid storage tank provided with a floating deck, open chambers or pockets on the top side of said deck for holding water, a drain pipe projecting downwardly from the center of said deck, a well projecting downwardly from the bottom of the tank that is adapted to receive said drain pipe under certain conditions, overflow drain pipes leading from various chambers on the top side of the deck to said center drain pipe, and an emergency drain pipe leading from the bottom of said well.

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