

May 8, 1928.

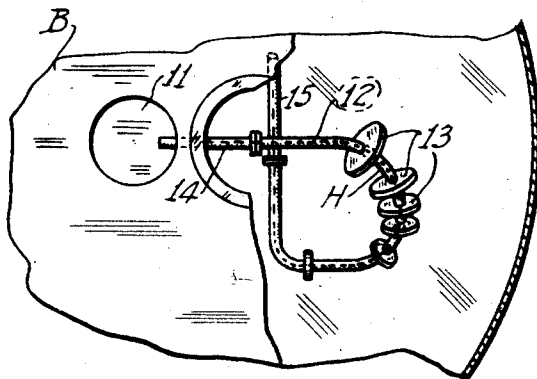
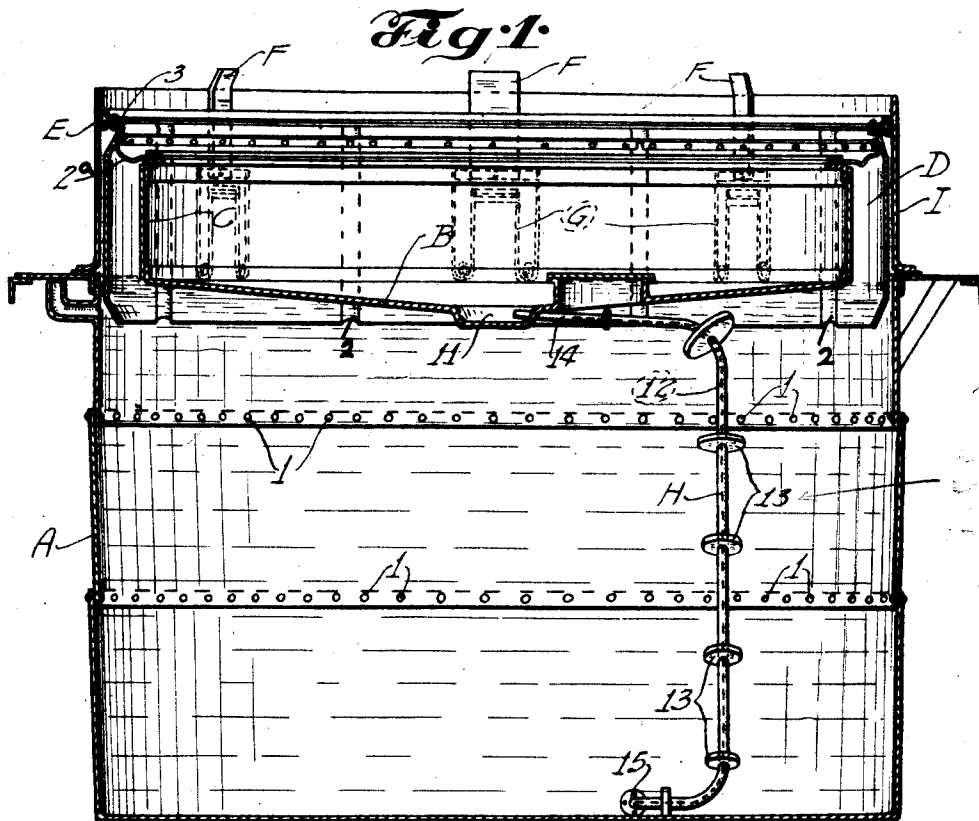
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J. H. WIGGINS

LIQUID STORAGE TANK

Filed Aug. 30, 1926

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 3.

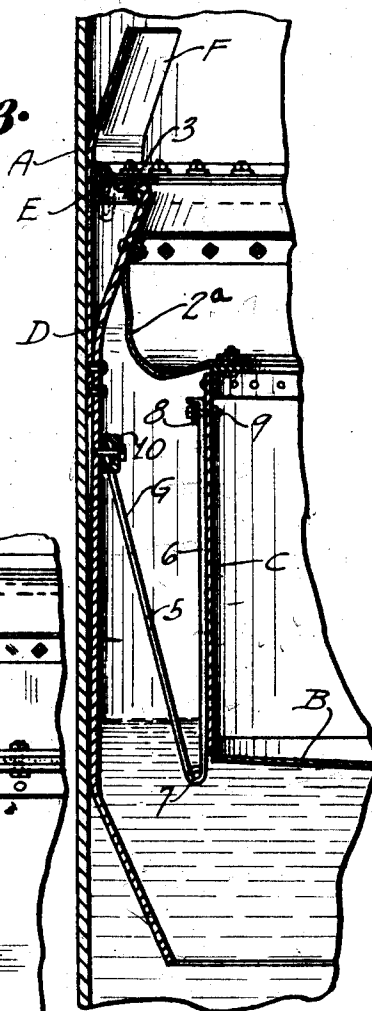
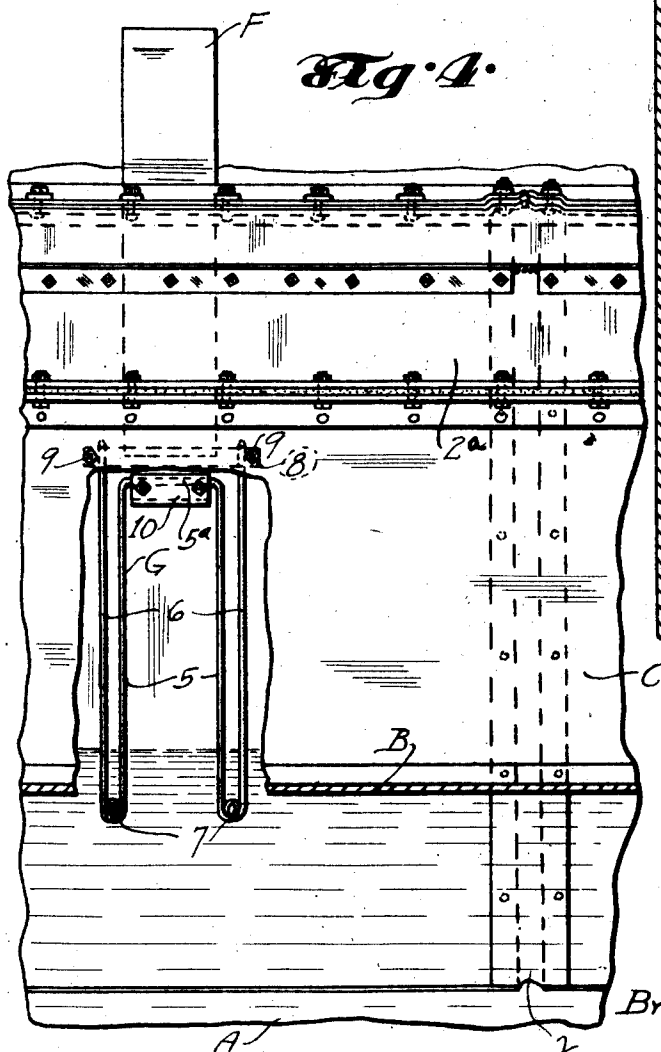


Fig. 4.



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UNITED STATES PATENT OFFICE.

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LIQUID-STORAGE TANK.

Application filed August 30, 1926. Serial No. 132,539.

This invention relates to liquid storage tanks of the type that comprise a floating deck or roof which normally rests upon and is supported by the liquid in the tank.

5 In my pending application for patent Serial No. 627,835, filed March 26, 1923, I have described a liquid storage tank of the general type referred to, in which the floating deck is provided at its peripheral edge with an expansible and contractible structure that closes the space between said deck and the side wall of the tank and which is designed so as to form a chamber that traps gases which bubble up around the edge of the floating deck, said structure comprising an annular shoe arranged in engagement with the side wall of the tank and composed of segmental shoe members whose end portions are joined together by flexible elements. 10 Said shoe members are constructed of metal and are so proportioned and arranged that a narrow, annular slot of relatively great depth will be formed between the surfaces of said shoe members and the inner surface of the side wall of the tank through which gases and vapors will not circulate readily. The upper end of said narrow, annular slot is open to the atmosphere, and while the tendency of the oil vapors is to remain in said slot, at the lower end of same, due to the fact that oil vapors are about twice as heavy as air, there are times when strong wind currents cause some oil vapors to be drawn upwardly between the shoe and the side wall of the tank. One object of my present invention is to provide an oil storage tank, which, in addition to having the desirable features and characteristics described in my said pending application, is equipped with a secondary seal or auxiliary seal that decreases evaporation losses by preventing vapor from being carried upwardly out of the annular slot between the shoe and the side wall of the tank by wind currents passing over the tank.

Another object is to provide an improved mechanism of simple design for mounting the segmental shoe members on the floating deck and for maintaining said shoe members in proper relationship with the side wall of the tank.

And still another object is to provide a side wall extension for a liquid storage tank of the general type described in my said pending application for patent, which insures the sealing means at the peripheral

edge of the floating deck functioning properly, even when the level of the liquid in the tank is so high that the shoe members project a considerable distance above the side wall proper of the tank.

Figure 1 of the drawings is a vertical sectional view of a liquid storage tank constructed in accordance with my invention.

Figure 2 is a fragmentary top plan view with the floating deck broken away, so as to clearly illustrate the construction and arrangement of the drain pipe that is used to carry off water from the top surface of the deck.

Figure 3 is a perspective sectional view on an enlarged scale, illustrating the secondary seal at the upper edge of the annular shoe, the guides or runners on the shoe members which tend to guide said members properly over rivet heads on the side wall of the tank and also protect the secondary seal from injury when the deck rises and falls, and the improved hangers that are used to support the shoe members and press them outwardly against the side wall of the tank; and

Figure 4 is a fragmentary view, looking from the center of the floating deck towards the rim and shoe members at the peripheral edge of same with the rim partly broken away so as to more clearly illustrate the construction of the shoe member hangers.

Referring to the drawings which illustrate the preferred form of my invention, A designates the side wall of a liquid storage tank made up of metal plates arranged in overlapping relation and joined together by rivets 1, B designates a floating deck or roof that normally rests upon and is supported by the liquid in the tank, C designates an upwardly-projecting rim at the peripheral edge of said floating deck that is spaced away from the side wall of the tank a considerable distance, D designates segmental shoe members joined together at their ends by flexible devices 2 so as to form an expansible and contractible annular shoe that is arranged in sliding engagement with the side wall of the tank, and 2^a designates a flexible member preferably constructed of gas-tight fabric attached to the upper edge of the rim C and to the upper edge portions of the shoe members D so as to co-operate with the annular shoe and with the rim on the floating deck to form a chamber for collecting gases that bubble up around the

edge of the deck, as described in my pending application for patent.

In order to reduce evaporation losses, due to vapor being carried upwardly out of the open upper end of the narrow, tall slot between the side wall A of the tank and the shoe members D, I attach a secondary sealing device or auxiliary sealing device E to the upper edge of the annular shoe formed by the shoe members D. Said sealing device E is constructed of flexible material, preferably fire-proof fabric, and it is attached to the shoe members D in such a manner that it will constantly rub against the inner face of the side wall of the tank. It is immaterial, so far as my broad idea is concerned, how the sealing device E is attached to the shoe members, but I prefer to provide each shoe member adjacent its upper edge with an inwardly-flared portion that terminates in a horizontally-disposed, outwardly-projecting flange 3 to which the sealing device E is connected in any suitable way, thereby forming a recess at the upper edge of the shoe member into which the sealing device E can move, due to flexing of same, when said sealing device passes over the rivet heads on the side wall of the tank, or over the shoulders on said side wall formed by the edges of the overlapping plates from which the side wall is constructed. In a floating tank deck or roof of the kind to which my invention relates the expansible and contractible structure at the peripheral edge of the floating deck that constitutes the primary seal varies the radius of the deck up to about 14 inches, and in normal operation the shoe members D and more especially their upper edges where secondary seal is attached, are maintained at a substantially fixed distance away from the side wall of the tank. Accordingly, the flexible sealing device E at the upper edge of the annular shoe only has to vary the radius from about one-fourth of an inch to one inch, and therefore, it may be said to constitute a secondary seal that is used to close the upper end of the annular slot between the side wall of the tank and the annular shoe of the primary seal.

In order to prevent the secondary seal E from becoming jammed between the shoe members and the rivet heads or shoulders on the inner surface of the side wall of the tank, when the deck rises and falls, and to assist the shoe members D to slide properly over the tank side wall, I provide each of the shoe members D with one or more guides or runners F that project upwardly from same, as shown in Figures 1, 2 and 3 of the drawings. Said runners F are flared or inclined inwardly at their upper ends, and they are attached to the outer surfaces of the shoe members D in such a way that they will be interposed between the side wall of the tank and the secondary sealing device E.

Said runners or guides F greatly reduce the initial pressure produced by the rivet heads or shoulders on the tank side wall over which the shoe members D slide when the deck rises and falls, and they effectively prevent the secondary sealing device E from becoming jammed between a rivet or shoulder on the side wall and the outwardly-projecting flanges 3 on the shoe members which carry said sealing device, thereby making it practicable to support said sealing device by portions on the shoe members D, to wit, the flanges 3, that are arranged in close proximity to the inner surface of the side wall of the tank.

The shoe members D are supported on the floating deck and maintained in proper relationship with the side wall of the tank by hangers G of novel design, preferably constructed from a piece of heavy spring wire bent to form two angularly-disposed portions or legs 5 and 6 joined together at one end by coils or loops 7. The portion 6 of each of said hangers, which I will refer to as the vertical leg, is arranged in engagement with the outer surface of the rim C on the floating deck and is connected at its upper end to said rim by any suitable means, as, for example, by a clamping bar 8 arranged transversely of said leg over the outer side of same and attached to the rim C by fastening devices 9. The other portion 5 of the hanger, which I will refer to as its inclined leg, is pivotally connected at its upper end to the shoe member with which it co-operates preferably by means of a horizontally-disposed trunnion portion 5^a on said leg that is embraced by a bearing 10 fastened to the shoe member, as shown in Figures 3 and 4. Assuming that the total throw of the shoe members outwardly away from the rim C is 14 inches, then in an unloaded position of the hangers G they will have a normal throw of, say, about 8 inches, and the added weight of the shoe members will carry said shoe members 6 inches more, or a total of approximately 14 inches from the rim C of the floating deck. As the shoe members close up less than 8 inches, then the spring hangers push the shoe members outwardly. As the shoe members open past the 8 inches, then the spring hangers start to act to help pull the shoe members in against the gravity throw of the weight of the shoe members. Accordingly, hangers of the construction above described help press the shoe members outwardly towards the tank side wall in certain positions of said shoe members, and in other positions of said shoe members the hangers tend to prevent the shoe members from moving outwardly towards the tank side wall.

The floating deck B is provided with a sump 11 for collecting rain water that falls on the deck, and a drainage means of novel

construction is provided for carrying off water from said sump. Said drainage means comprises a flexible hose H, that is provided with a spring steel wire 12 that extends through said hose H its entire length, and a plurality of substantially disk-shaped supporting devices 13 of different diameters attached to said hose H, as shown in Figure 1. The upper end of the hose H is attached to a metal pipe 14 that leads from the sump 11, and the lower end of said hose is attached to a metal pipe 15 arranged at substantially right angles to the pipe 14 and leading outwardly to the side wall of the tank adjacent the bottom of the tank. The wire 12 inside of the drain hose H projects into the discharge pipe 14 on the deck that leads from the sump, and as said wire is practically fixed to said pipe, said wire supports the hose H and prevents it from kinking when the deck rises and falls. The disk-shaped devices 13 on the hose H insure said hose being maintained in an hydraulic gradient when the deck moves downwardly, said members 13 being arranged on the hose so that the smallest member is located at the lower end of the hose, the next largest member is located at a point higher up on the hose, etc. A drainage means of the construction above described is inexpensive to manufacture, it insures the drain hose coiling and uncoiling properly during the rise and fall of the deck and it insures the drain hose being maintained in an hydraulic gradient as the deck moves downwardly towards the bottom of the tank.

In order to insure the sealing means of the deck operating efficiently at times when the tank is full or practically full, I propose to connect an extension I to the upper edge of the side wall A of the tank, so as to serve as a support for the shoe members D at times when the tank contains sufficient liquid to cause the shoe members to project upwardly a considerable distance above the side wall proper of the tank. The side wall extension I need not be liquid tight, but as it forms a continuation of the side wall proper of the tank, it preserves the tall, narrow slot surrounding the annular shoe of the sealing means and forms a surface on which the secondary sealing device E can slide when the tank is full or substantially full of liquid.

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

1. A liquid storage tank provided with a floating deck or roof, a closure for the space between said deck and the side wall of the tank comprising an expansible and contractible shoe arranged in sliding engagement with said side wall and composed of a plurality of segmental members joined together at the ends by flexible devices, and

means for sealing the space between the outer face of said shoe and the inner face of said side wall.

2. A liquid storage tank provided with a floating deck or roof, a closure for the space between said deck and the side wall of the tank constructed so as to form an inverted trough between the side wall of the tank and the periphery of the deck that is adapted to trap gases which bubble up around the peripheral edge of said deck, said closure comprising an expansible and contractible annular shoe that slides on said side wall, and means carried by said shoe for sealing the space between the outer face of the shoe and the inner face of the side wall of the tank.

3. A liquid storage tank provided with a floating deck or roof, a primary sealing means at the peripheral edge of said deck comprising an expansible and contractible shoe adapted to slide on the side wall of the tank and arranged with its lower edge portion submerged in the liquid on which the deck floats, and a secondary sealing means for the space between the inner face of the tank side wall and the portion of said shoe that slides on said inner face.

4. A liquid storage tank provided with a floating deck or roof, a closure for the space between said deck and the side wall of the tank comprising a sealing chamber of inverted trough form provided with a primary sealing means comprising an expansible and contractible portion arranged in sliding engagement with said wall and projecting downwardly into the liquid in the tank on which the deck floats, and a secondary seal for the space between the inner face of said side wall and the portion of the primary sealing means that slides on said inner face.

5. A liquid storage tank provided with a floating deck or roof, a primary sealing means at the peripheral edge of said deck comprising an expansible and contractible shoe arranged in sliding engagement with the side wall of the tank, swinging hangers on said deck that carry said shoe and a wiper on said shoe constructed so as to provide for inequalities in the inner surface of said side wall and remain in snug engagement with said inner surface.

6. A liquid storage tank provided with a floating deck or roof, an upwardly-projecting rim on said deck that is spaced away from the side wall of the tank, an expansible and contractible shoe surrounding said rim and adapted to slide over said side wall, means for supporting said shoe from said deck, a piece of gas-tight fabric attached to the upper edge of said shoe and rim to co-operate with the same to form a primary seal for the deck, and a secondary seal for the space between said shoe and the side wall of the tank.

7. A liquid storage tank provided with a floating deck or roof, a closure for the space between said deck and the side wall of the tank comprising segmental shoe members adapted to slide on said wall and provided adjacent their upper ends with laterally-projecting portions that terminate in close proximity to said wall, flexible devices that join the ends of said shoe members together, a piece of gas tight fabric attached to the deck and to the shoe members so as to bridge the space between said elements, a wiper or sealing device attached to the laterally-projecting portions of said shoe members, and spaces or recesses in said shoe members below said sealing device, for the purpose described.

8. A floating deck or roof for liquid storage tanks provided with shoe members that are adapted to contact with the side wall of the tank, and runners attached to said shoe members and projecting upwardly above the top edges of the same so as to assist them to slide over said wall.

9. A liquid storage tank provided with a floating deck or roof, a closure for the space between said deck and the side wall of the tank comprising an expansible and contractible shoe made up of segmental shoe members that slide on said side wall, and guides or runners on said shoe members projecting upwardly above the upper edges of same and disposed so as to guide them properly over horizontally-disposed shoulders on the side wall of the tank.

10. A liquid storage tank provided with a floating deck or roof, a closure for the space between said deck and the side wall of the tank comprising an expansible and contractible shoe made up of segmental shoe members that slide on said side wall, a flexible sealing device carried by said shoe members and adapted to bear snugly against said side wall, and runners or guides on said shoe members for preventing said sealing device from becoming jammed between said shoe members and projections on the inner surface of said side wall.

11. A liquid storage tank provided with a floating deck or roof, a closure for the space between said deck and the side wall of the tank comprising shoe members that slide on said wall, and hangers on said deck for supporting said shoe members constructed of spring wire bent so as to cause the inherent resiliency of said hangers to press said shoe members against the side wall of the tank.

12. A liquid storage tank provided with a floating deck or roof, a closure for the space between said deck and the side wall of the tank comprising shoe members that slide on said wall, and spring wire hangers for said shoe members carried by said deck and pivotally connected to said shoe members, said

hangers having sufficient inherent resiliency to press the shoe members firmly against the side wall of the tank.

13. A liquid storage tank provided with a floating deck or roof, a closure for the space between said deck and the side wall of the tank comprising shoe members that slide on said wall, and hangers for supporting said shoe members combined with said deck and shoe members and constructed so as to have sufficient inherent resiliency to cause said shoe members to be maintained in substantially parallel relationship with the side wall of the tank.

14. A liquid storage tank provided with a floating deck or roof, shoe members surrounding said deck and adapted to bear against the side wall of the tank, and hangers on the deck for supporting said shoe members constructed from spring wire bent to form two angularly-disposed legs joined together at one end by a part of a coil or one or more coils.

15. A liquid storage tank provided with a floating deck or roof, a rim adjacent the peripheral edge of said deck, shoe members surrounding said rim and adapted to slide on the side wall of the tank, and hangers for supporting said shoe members, each of which comprises a part attached to said rim, a part pivotally connected to the shoe member, and a coil or loop that joins said parts together.

16. A liquid storage tank provided with a floating deck or roof, a seal for collecting gases that bubble up around the edge of said deck comprising an expansible and contractible shoe arranged in sliding engagement with the side wall of the tank and disposed so as to produce a tall, narrow slot between the outer surface of same and the side wall of the tank, and an extension at the upper edge of the side wall of the tank for maintaining said tall, narrow slot when the tank is full or substantially full of liquid.

17. A liquid storage tank provided with a floating deck or roof, a seal for collecting gases that bubble up around the edge of said deck comprising an expansible and contractible shoe arranged in sliding engagement with the side wall of the tank and disposed so as to produce a tall, narrow slot between the outer surface of same and the side wall of the tank, an extension at the upper edge of the side wall of the tank for maintaining said tall, narrow slot when the tank is full or substantially full of liquid, and a flexible sealing device carried by said shoe and adapted to press against said extension when the shoe moves upwardly above the upper edge of the side wall proper of the tank.

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