May 1, 1951 J. H. WIGGINS ET AL 2,551,403

PROTECTING MEANS FOR FLOATING TANK ROOF SEALS

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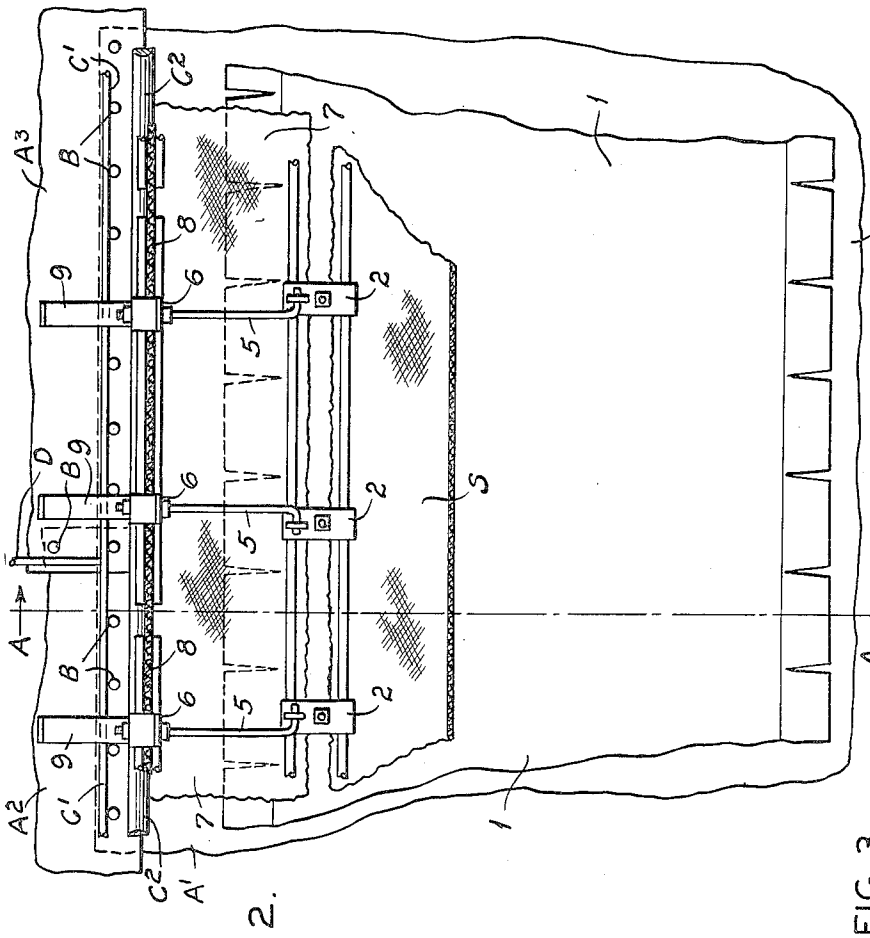


FIG. 2.

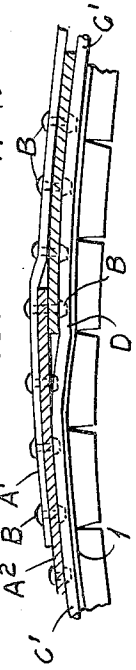


FIG. 3.

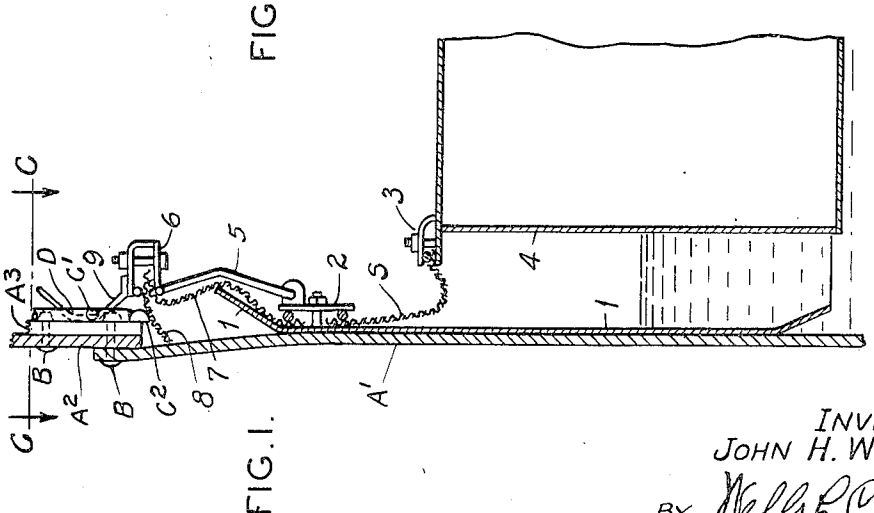


FIG. 1.

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FIG. 4.

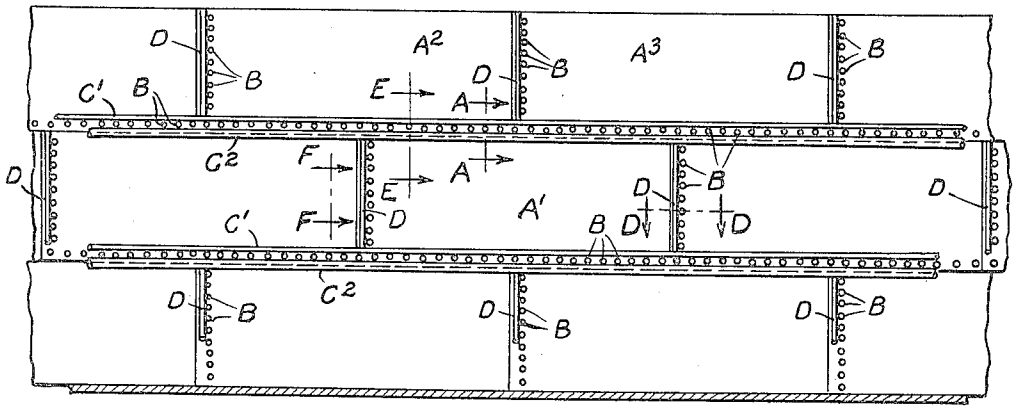


FIG. 5.

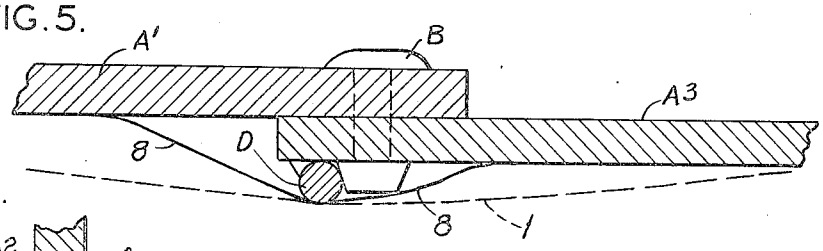


FIG. 6.

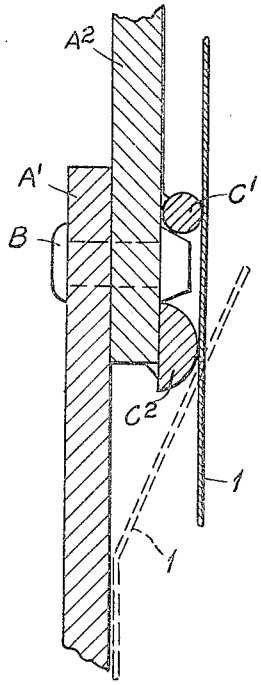
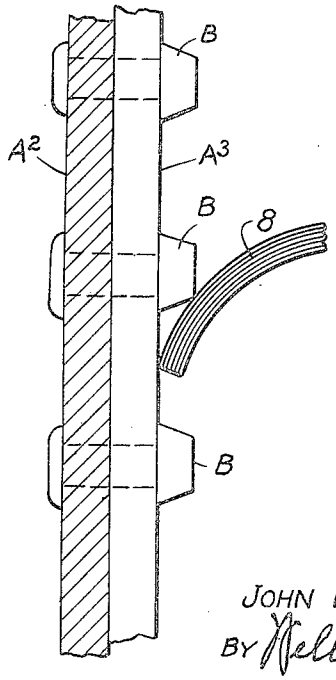


FIG. 7.



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PROTECTING MEANS FOR FLOATING TANK ROOF SEALS

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6 Claims. (Cl. 220—26)

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This invention relates to liquid storage apparatus of the kind that consist of a tank provided with a side wall constructed of lapped metal plates joined together by rivets or bolts, a floating roof supported by the liquid in the tank, and a sealing structure for the space between the tank side wall and the peripheral edge of the roof, comprising an annular shoe carried by the roof and arranged in sliding engagement with a tank side wall.

One object of my present invention is to provide a novel means of improved construction for protecting the tank wall contacting elements of a floating roof seal from being injured or subjected to excessive wear, by the rivets or sharp edges of the lapped metal plates of the tank side wall.

Another object is to provide a riveted, lapped plate tank wall, which is of such construction that it is commercially practicable or feasible to construct the annular side wall shoe of a floating tank roof seal from metal plates that are not only exceptionally thin and highly flexible, but also are made of relatively high priced metal, such as stainless steel. Other objects and desirable features of my invention will be hereinafter pointed out.

Figure 1 of the drawings is a fragmentary, vertical sectional view, showing my invention used for protecting a floating tank roof sealing structure that comprises an annular side wall shoe carried by the roof, and also a secondary seal or auxiliary seal mounted on the annular shoe in such a manner that it bears snugly against the tank side wall at a point above the top edge of said shoe, said view being taken on the section A—A of Figures 2 and 4.

Figure 2 is a side elevational view of the parts shown in Figure 1, as viewed from a point looking outwardly from the roof towards the side wall of the tank, the floating roof being broken away so as to show the annular side wall shoe.

Figure 3 is a horizontal sectional view, taken on the line C—C of Figure 1.

Figure 4 is a side elevational view, showing the inner face of the tank side wall.

Figure 5 is an enlarged horizontal sectional view, taken on the section D—D of Figure 4.

Figure 6 is an enlarged vertical sectional view, taken on the section E—E of Figure 4; and

Figure 7 is an enlarged vertical sectional view on the section F—F of Figure 4, with the protecting bar D removed, and showing in end elevation the exposed, vertical plate edge with which the bar D is associated.

Briefly described, my improved floating roof seal protecting means, consists of rubbing bars attached to the inner face of the riveted tank side wall in such relationship with the rows of rivets and the exposed edges of the wall plates, that the wall contacting elements of the roof sealing

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structure are effectively prevented from being cut, scored, or subjected to excessive wear by said rivets or plate edges, when the roof rises and falls, due to changes in level of the liquid confined in the tank. In the preferred form of my invention herein shown, two horizontally-disposed bars that extend circumferentially around the tank wall, are associated with each horizontal row of rivets, said bars being of such height or thickness that when the roof moves vertically in one direction, one of said bars will prevent the wall contacting elements of the roof sealing structure from bearing upon or contacting with said rivets, and when the roof moves vertically in the opposite direction, the other bar will prevent that particular horizontal row of rivets and also the exposed horizontal edges of the wall plates in which said rivets are positioned, from being engaged by the wall contacting elements of the roof sealing structure. Each vertical row of rivets of the tank wall has associated with same, a vertically-disposed rubbing bar that prevents the wall contacting elements of the roof sealing structure from engaging said vertical row of rivets or the exposed vertical edge of the wall plate in which said rivets are positioned.

In the drawings, the reference characters A' and A^2 designate two adjacent plates of the side wall of the tank, arranged in superimposed relation with the bottom edge portion of the plate A^2, disposed on the inner face of said wall in overlapping relation with the top edge portion of the plate A', and A^3 designates a wall plate connected to the right hand end of the plate A^2 (looking at Figure 4), the plate A^3 being so arranged that its left hand vertical edge is disposed on the inner face or side of the tank wall. A horizontally-disposed rubbing bar C' extends circumferentially around the inner face of the tank side wall at a point above and in close proximity to each horizontal row of rivets B, and a similar rubbing bar C^2 is arranged below each horizontal row of rivets, said bars C' and C^2 being secured to the tank wall by tack welds or in any other suitable way, as shown in Figure 6. The particular cross-sectional shape of said bars is immaterial, so long as the portions of same which are presented to the wall contacting elements of the roof sealing structure are of such form that said wall contacting elements will slide freely over same. In the form of my invention herein shown the bar C' is of round cross-section, and the bar C^2 is of half round cross section. Both of said bars are of a thickness slightly greater than the depth of the rivet heads located between said bars. The bottom bar C^2 is arranged in such relationship with the horizontal wall seam with which said bar is associated, that said bar functions as a fender for the sharp edge of said seam that is exposed on the inner face of the tank wall. Thus, as shown in Figure

6 and other views of the drawings, the sharp, horizontal bottom edges of the wall plates that are disposed on the inner side of the tank, are shielded by the bottom bars C^2 associated with the horizontal rows of rivets, said bars C^2 being so arranged that during the rise or upward movement of the roof, said bars prevent the wall contacting elements of the roof sealing structure from engaging the exposed horizontal edges of the metal plates of which the tank side wall is constructed.

The vertical rows of rivets of the tank wall have associated with same, vertically-disposed rubbing bars D, which are positioned so as to prevent the wall contacting elements of the roof sealing structure from engaging said vertical rows of rivets, and also from engaging the exposed sharp, vertical edges of the tank plates disposed on the inner side of the tank wall adjacent the vertical rows of rivets. Preferably, the vertical rubbing bars D are round in cross section, and are attached to the inner face of the tank wall at points between the vertical rows of rivets and the exposed vertical edges of the wall plates, as shown in Figure 5.

My improved protecting means is adapted for use with various types and kinds of floating tank roof seals. I have herein illustrated it used with a seal that comprises an annular side wall shoe 1, mounted in any suitable way on a floating roof 4, and composed either of a continuous annular wall contacting member, or a plurality of spaced, segmental shoe members combined with fabric sealing elements that bridge the gaps or spaces between the segmental shoe members. The space between the floating roof 4 and the annular side wall shoe 1, is closed by a primary seal S, formed usually from a piece of gas-tight fabric, that is attached by clamping devices 2 to the side wall shoe 1, and attached by clamping devices 3 to the peripheral portion of the roof 4. The annular side wall shoe 1 is provided with an auxiliary seal or secondary seal, that protects the space between said shoe and the tank side wall, and which can be constructed in various ways. The auxiliary seal herein illustrated, comprises rockable supports 5 on the annular shoe 1, that project upwardly above the top edge of said shoe, clamps 6 carried by the supports 5, an annular-shaped sealing device 8 carried by the clamps 6 and arranged so that its outer edge bears against the inner face of the tank side wall, a flexible member 7 for closing the space between the top edge of the annular side wall shoe and the inner edge portion of the sealing device 8, mounted in the clamps 6, and guide devices 9 at the upper ends of the rockable supports 5, that are adapted to bear against the inner face of the tank side wall, the sealing device 8 and the flexible member 7 usually being formed of fabric.

Each of the rubbing bars C^2 is so arranged that its lower edge is at least as low as the exposed bottom edges of the side wall plates to which said bar is attached. Preferably, the lower edge of the bar C^2 is arranged a trifle lower than the bottom edge of the wall plate A^2, as shown in Figure 6. The upper edge of the bar C^2 is arranged in close proximity to the horizontal row of rivets with which said bar is associated. Each of the bars C' is arranged as close as possible to the horizontal row of rivets with which said bar is associated. Accordingly, the bars C' prevent the annular side wall shoe 1 from being scored or cut by the horizontal rows of rivets, as the

floating roof descends, and said bars also prevent the horizontal rivets from injuring the secondary sealing device 8 as the roof ascends and descends. The bars C^2 effectively prevent the annular side wall shoe from being cut or scored by the horizontal rows of rivets during upward movement of the roof, and they prevent the secondary sealing device 8 from being injured by the horizontal rows of rivets, or by the exposed horizontal edges of the tank wall plates, during either upward or downward movement of the floating roof.

As shown in Figure 5, each of the vertically-disposed rubbing bars D is arranged as close as possible to the vertical row of rivets with which it is associated, between said rivets and the exposed vertical edge of the tank wall plate through which said rivets project, the bar D being preferably of such thickness that the top surface of same that is engaged by the wall contacting elements of the roof sealing structure, is located a greater distance from the inner face of the tank wall than the top surface of the rivet heads. It can be seen that by placing the bars D in this manner, the fabric sealing device 8 never can be cut by the exposed vertical edges of the wall plates. By placing the bars D close to the rivets, it is also seen that a second vertical bar on the other side of the vertical row of rivets is unnecessary. If the bar D is placed between the rivets B and the vertical edge of plate A^3, looking at Figure 5, it will normally be close to the rivets B. In case of several vertical rows of rivets, a second vertical bar similar to bar D may be placed on the other side of the farthest row from B. In case the vertical or horizontal wall seams are reversed as to laps, then the reverse bar construction would be used.

In secondary seals, history shows that the vertical rows of rivets and the circumferential rows of rivets very quickly cut holes in the secondary seal fabric. The practice has been to grind the head of every rivet, so that it will have a bevel, which only decreases the cutting of the rivets; it does not eliminate cutting. Besides, grinding is a very expensive operation. Rivets are generally driven from the outside of the tank wall which makes the flat heads of the rivets on the outside of the wall and the large, sharp-edged heads on the inside of the wall. The backing up bar on the rivet heads often deform the lower or upper edges of the rivets, so as to make knife-like edges. The tank wall plates are sheared, which operation makes a knife-like edge on one side, which half of the time will be in a position to cut and score the annular shoe and the fabric of the secondary seal.

In the past, stiff, short, heavy, segmental shoe members $\frac{1}{8}$ inch thick have been used for the annular side wall shoe. Even with this thickness, the shoe members are cut and grooved so badly that their normal life is much shortened. Improved designs of riveted tank seals contemplate the use of an annular side wall shoe that is circumferentially flexible. Such circumferentially flexible, annular shoes operate better, the thinner they are. The thinner they are, the quicker they will corrode, and hence, stainless steel shoes, which are very expensive per pound, will probably supplant thick, segmental shoe members. A very thin shoe $\frac{1}{32}$ inch or less will be used, and it can be seen that it is absolutely necessary not to wear these shoes out. On account of the high cost of stainless steel, the thinnest sheets possible will be used. Hence, it can be seen that this art has moved into another and advanced phase, and

this feature of a usable means of minimizing the wear-out of shoes is very necessary. Stainless steel is valuable also, because it does not corrode on so-called sour oils, which are increasing in the percentage of total oil produced. My invention makes it commercially practicable or feasible to equip a floating tank roof sealing structure with an exceedingly thin, annular side wall shoe made of stainless steel, due to the fact that it reduces wear on the side wall shoe and prevents the same from being cut or scored by sharp edged projections on the inner surface of the side wall of the tank. Also, when used with a roof sealing structure equipped with a secondary seal made of fabric, it prolongs the life and prevents injury of the fabric, which constitutes the tank wall contacting element, due to the fact that it prevents said fabric from being cut by sharp edged rivets or exposed plate edges on the tank side wall.

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

1. A liquid storage apparatus, comprising a tank provided with a side wall made up of lapped metal plates connected together by horizontal and vertical rows of rivets, a floating roof in said tank provided with a sealing structure comprising elements that are adapted to contact the tank side wall, and horizontal and vertically-disposed rubbing bars superimposed upon and attached to the inner face of the tank side wall adjacent said horizontal and vertical rows of rivets for the purpose described, said bars being of sufficient depth or thickness to project beyond the rivet heads, the horizontal bars being arranged parallel to the horizontal rows of rivets and the vertical bars being arranged parallel to the vertical rows of rivets.

2. A liquid storage apparatus, comprising a tank provided with a side wall made up of lapped metal plates connected together by horizontal and vertical rows of rivets, a floating roof in said tank provided with a sealing structure comprising elements that are adapted to contact the tank side wall, and horizontal and vertically-disposed rubbing bars superimposed upon and attached to the inner face of the tank side wall adjacent said horizontal and vertical rows of rivets and having a depth or thickness sufficient to project beyond the rivet heads, some of said horizontally-disposed rubbing bars having portions disposed between the horizontal rows of rivets and the horizontal edges of the wall plates, thereby preventing the wall contacting elements of the roof sealing structure from being injured by the sharp, horizontal edges of the tank wall plates, that are exposed on the inner side of the wall.

3. A liquid storage apparatus, comprising a tank provided with a side wall made up of lapped metal plates connected together by horizontal and vertical rows of rivets, a floating roof in said tank provided with a sealing structure comprising elements that are adapted to contact the tank side wall, and horizontal and vertically-disposed rubbing bars superimposed upon and attached to the inner face of the tank side wall adjacent said horizontal and vertical rows of rivets and having a depth or thickness sufficient to project beyond the rivet heads, some of said horizontal bars being arranged in pairs one of which is disposed above and the other below a horizontal circumferential row of rivets, the two bars of each pair being arranged on the inner face of the tank side wall.

4. A liquid storage apparatus, comprising a tank provided with a side wall made up of lapped metal plates connected together by horizontal and vertical rows of rivets, a floating roof in said tank provided with a sealing structure comprising elements that are adapted to contact the tank side wall, and horizontal and vertically-disposed rubbing bars superimposed upon and attached to the inner face of the tank side wall adjacent said horizontal and vertical rows of rivets and having a depth or thickness sufficient to project beyond the rivet heads, some of said horizontal bars being located directly below the horizontal rows of rivets and extending below the exposed bottom edges of the wall plates in which said horizontal rows of rivets are positioned.

5. A liquid storage apparatus, comprising a tank provided with a side wall made up of lapped metal plates connected together by horizontal and vertical rows of rivets, a floating roof in said tank provided with a sealing structure comprising elements that are adapted to contact the tank side wall, and horizontal and vertically-disposed rubbing bars superimposed upon and attached to the inner face of the tank side wall adjacent said horizontal and vertical rows of rivets and having a depth or thickness sufficient to project beyond the rivet heads, the vertical bars being disposed between the vertical rows of rivets and the exposed vertical edges of the wall plates that are positioned on the inner surface of the tank side wall.

6. A tank provided with a side wall made up of lapped, oblong-shaped, metal plates, joined together by horizontally-disposed rows of rivets that extend circumferentially around said wall and vertically-disposed rows of rivets that lie between the horizontal rows of rivets, the wall plates being so arranged that each horizontal row of rivets is located above and in parallel relation to a circumferential seam or joint in the wall, formed by the bottom edges of a plurality of wall plates that lie in the same horizontal plane and each vertical row of rivets is positioned in the lapped end portions of two adjacent wall plates, circumferentially-disposed rubbing bars superimposed upon and attached to the inner face of the wall at points above and in close proximity to the horizontally-disposed rows of rivets, separate and distinct circumferentially-disposed rubbing bars superimposed upon and attached to the inner face of the wall so that their bottom edges are disposed at least as low as the bottom edges of the wall plates which constitute the circumferential seams, and vertical rubbing bars superimposed upon and attached to the inner face of the wall so as to lie between the vertical rows of rivets and the exposed end edges of the plates which the vertical rows of rivets join together.

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