

May 29, 1951

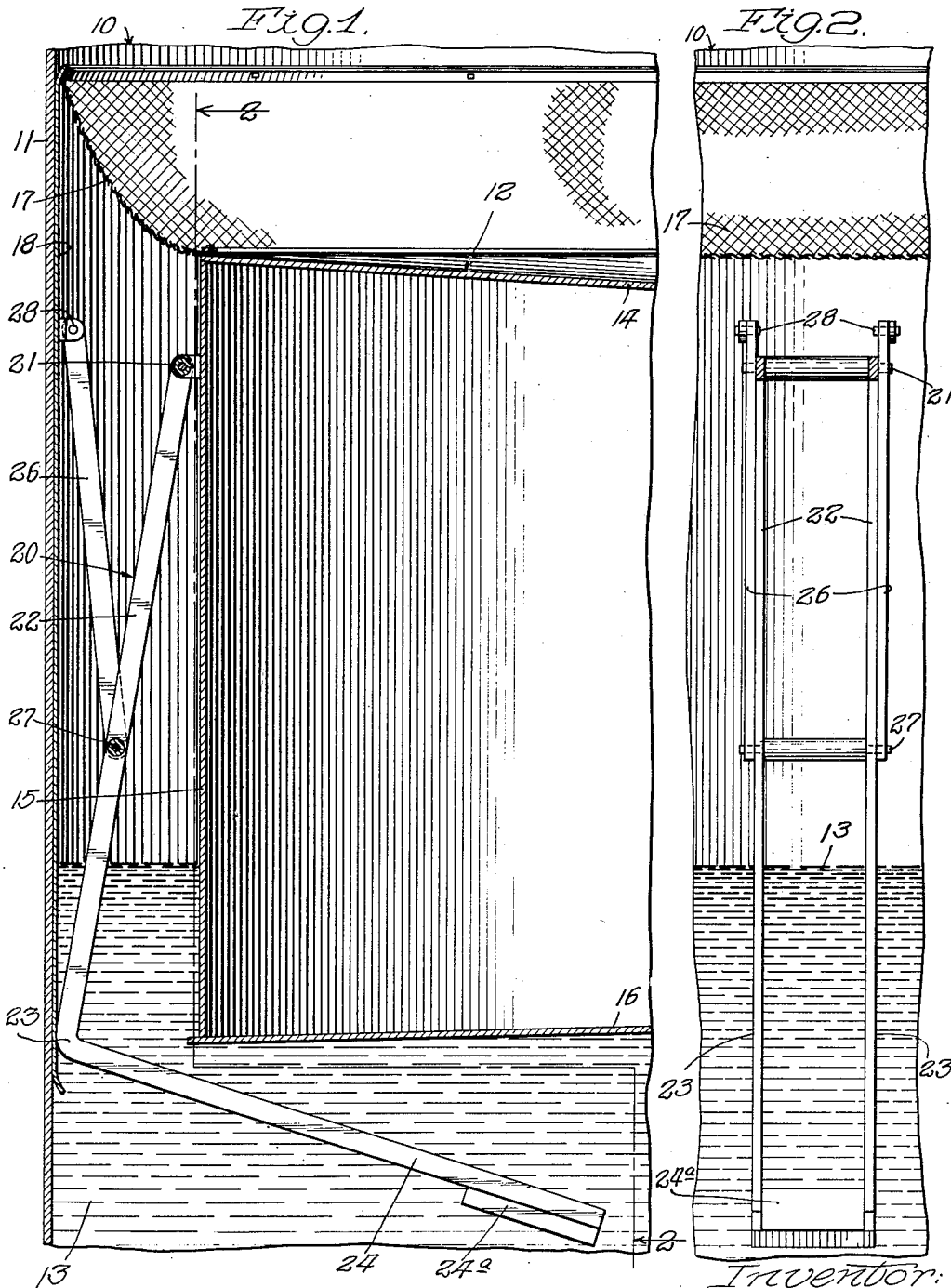
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2,554,497

SEAL HANGER FOR FLOATING ROOFS

Filed Feb. 3, 1947

4 Sheets-Sheet 1



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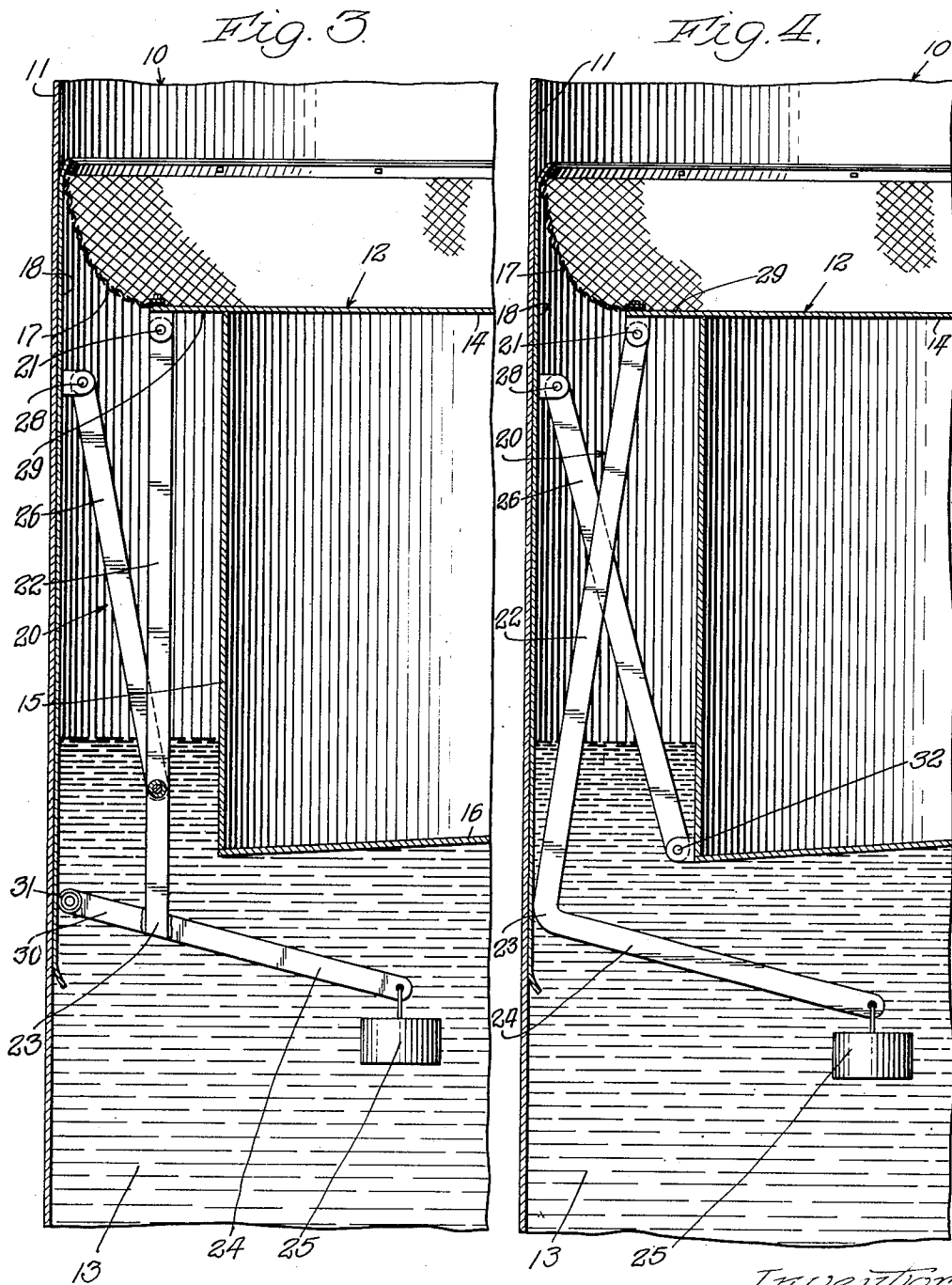
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SEAL HANGER FOR FLOATING ROOFS

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4 Sheets-Sheet 2



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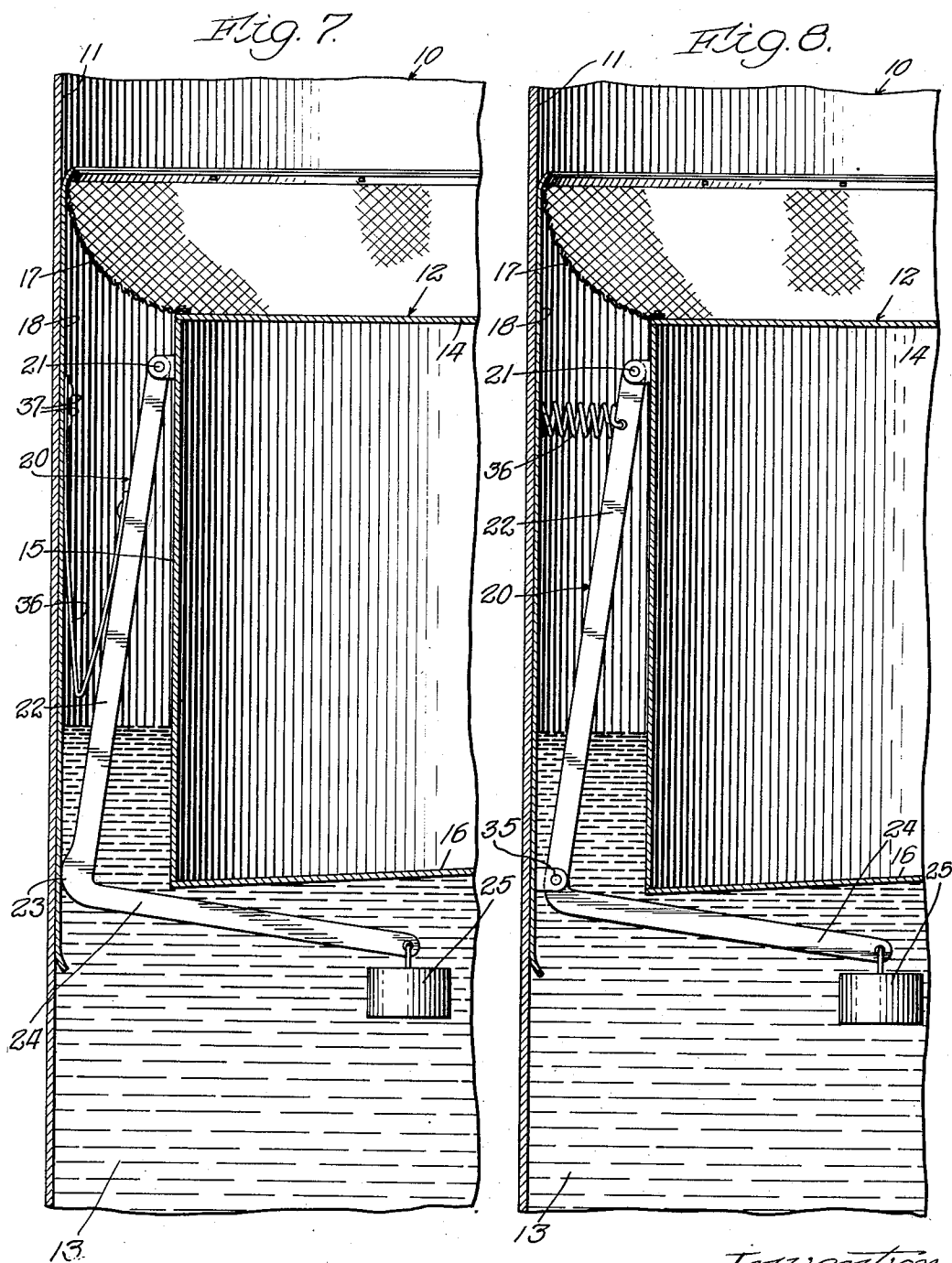
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SEAL HANGER FOR FLOATING ROOFS

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4 Sheets-Sheet 4



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SEAL HANGER FOR FLOATING ROOFS

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11 Claims. (Cl. 220—26)

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This invention relates to an improved seal hanger for use in conjunction with the floating roof of a liquid storage tank.

Storage tanks, especially those designed for the storage of highly volatile liquids, are often provided with a roof adapted to float upon the liquid contained within the tank. As such roofs are constructed with a diameter less than the inside diameter of the tank, means must necessarily be provided between the edge of the floating roof and the inner side walls of the tank to seal that space against liquid loss through evaporation. A common sealing method is to provide a plurality of metallic members supported by the roof and pressed against the side walls. These metallic members are known as "shoes," and in the usual construction a flexible sealing member is provided between the shoes and the floating roof.

In supporting the shoe against the side wall, numerous problems are encountered. For example, a shoe must be held firmly against the wall to prevent vapor loss which would otherwise occur in the space between the shoe and the wall if such space were permitted to exist. The shoe must be slidable freely against the tank wall and must also adapt itself to various deformities or obstructions which commonly exist in the walls. When the tank has been completely filled with liquid and the roof is at its highest point within the tank, the shoes often extend above the edge of the tank wall, and means must be provided for preventing the shoes from bending outwardly over the top edge of the tank. Furthermore, the floating roof should remain centered within the tank in order to function properly, and means must be provided for returning the roof to center in the event that wind or other factors tend to move it against one of the side walls. Again, the supporting means for the shoes should be simple and certain in its operation and contain a minimum of parts susceptible to mechanical failure. There have been numerous seal hangers designed in the past, none of which have completely fulfilled all the requirements for such hanger, and many of which are extremely complicated mechanically.

I have invented, and am herein disclosing and claiming, a means for pressing the shoes against the inner side walls of the tank and for supporting same of greatly improved construction and simplicity of operation.

The invention will be described as embodied in the drawings, in which:

Fig. 1 is a vertical section through a portion of a liquid storage tank and a roof floating therein

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showing the features of one embodiment of the invention;

Fig. 2 is a vertical section along line 2—2 of Fig. 1; and,

Figs. 3 to 8, inclusive, are taken like Fig. 1 and show various other embodiments of the invention.

Referring now to the drawings, 10 indicates a liquid storage tank having a side wall 11. A floating roof 12 is adapted to float upon the liquid 13 contained within the tank, the floating roof having a top portion 14, a side portion 15 and a bottom 16. A flexible seal 17 is provided between the floating roof 12 and the upper portion of a shoe 18. The shoe is adapted to be pressed against the wall 11 to effect a seal therebetween, and may be of any usual construction. My invention embraces a new and novel means for pressing the shoes against the inner side wall of the tank, and comprises a main hanger in the form of a lever 20 having its upper end pivoted at 21 to the side 15 of the floating roof, and having a portion 22 extending downwardly from the point of attachment to the roof to an angle 23, and a further portion 24 extending inwardly from the angle. The member 20 is in the form of a bent lever, and is so positioned and arranged within the storage tank so that the shoes 18, by contact with the angle 23, elevate the lever from a freely hanging position. Outward pressure is created against the lower portion of the shoe by the tendency of the lever to return to a freely hanging position, which pressure may be created solely by the weight of the portion 24 and cross-brace 24a, as illustrated in Fig. 1, or may be augmented by the addition of a weight 25 attached to the portion, as shown in Figs. 3 to 8. In addition, means are provided for supporting the shoe vertically, the means comprising in the embodiment shown in Fig. 1, a shoe supporting member 26 pivoted to the portion 22 at 27, and to the upper portion of the shoe at 28, as shown. I prefer to construct the members 20 and 26 of parallel bars of steel to give increased strength and stability (as shown in Fig. 2).

In the embodiment shown in Fig. 3, the lever 20 is pivoted to an overhanging portion 29 of the roof to permit the lever to rotate past the vertical as the distance between the roof and the shoe decreases. The angle 23 is provided with an inwardly extending member 30, which member has a rolling or sliding contact with the shoe by means of the roller 31. A similar overhang is shown in Fig. 4, however, in that embodiment, the member 26 is pivoted to the lower portion of the roof at 32, as shown, rather than

to the portion 22. Both of these embodiments assure sufficient outward radial push at the top of the shoe when the space between the tank shell and the floating roof is the least. In the embodiment shown in Fig. 5, the member 26 is indirectly pivotally connected to the member 22, being pivoted to an extending arm 33 which is welded at 34 to the portion 22. In the embodiment shown in Figs. 6 and 8, the downwardly extending portion 22 serves to support the shoe vertically by being pivotally connected thereto adjacent its lower end at 35, as shown. In the embodiment shown in Figs. 7 and 8, a spring 36 presses the upper portion of the shoe against the inner tank wall, the spring in Fig. 7 being a leaf spring and in Fig. 8, a coil spring. The leaf spring of Fig. 7 also supports the shoe, being riveted thereto at 37, as shown.

In all the embodiments, little vertical movement of the shoe results from horizontal movement of the roof within the tank. The points 27 and 28, by which the shoe supporting member 26 is pivoted to the main hanger 20 and to the shoe, respectively, swing in compensating arcs about the point of pivot 21 of the main hanger to the roof. The weight 25 creates a positive thrust against the bottom of the shoe horizontally until the roof has travelled the allowed maximum distance from any side wall. As the distance between the roof and the wall increases, the main hanger approaches a freely hanging position until the horizontal force exerted at the angle 23 approaches zero. On the opposite side of the tank, the main hanger will be elevated farther from a freely hanging position with a consequent increase in the horizontal force exerted against the shoe. The moments thus created tend to return the roof to a position in the center of the tank.

A further important feature of my system is the behavior of the hanger when the shoe meets an obstruction in its vertical travel. For example, if a tank is being filled with liquid, and the roof rising therewithin, should the shoe strike an obstruction tending to prevent its further upward travel, the forces created by such obstruction tend to increase the downward force of the member 26 against the main hanger, and thereby to elevate it further from a freely hanging position. Consequently, the horizontal force previously exerted against the shoe is converted into a vertical force tending to overcome the obstruction.

The total weight of the shoe and all operating elements, plus or minus (depending on whether the roof is rising or falling) the friction of the shoe on the shell and less the weight of the liquid displaced by the elements, is carried by the floating roof. The weight of the shoe tends to move the top of the shoe radially outward. The weight of the inwardly extending portion 24 tends to exert a radially outward horizontal force against the bottom of the shoe. The shoe will remain essentially vertical, even though projecting above the shell when the tank is full or nearly full of liquid.

While, in the embodiments shown in Figs. 1, 3 and 5, the point of connection of the shoe supporting member 26 to the shoe at 28, and the point of connection of the member 20 to the roof at 21 are indicated as pivotal connections, it is only necessary that one of those connections be pivotal, and the other may be fixed, so long as the connection at 27 between members 26 and 20 is a pivotal connection.

Furthermore, all vertical movement of the shoe, during horizontal movement of the roof, may be prevented by making the length of the member 26 equal to the distance along portion 22 from the point 26 to the point 27.

While I have shown and described certain embodiments of my invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as disclosed in the appended claims.

I claim:

1. In a liquid storage tank having a floating roof and one or more shoes adapted to slidably contact the inner side walls of the tank, means for pressing each shoe against the side walls including a lever swingably attached to the roof, said lever having an angular portion, a portion extending downwardly between the roof and side walls from the point of attachment to the roof to the angular portion, and a portion extending inwardly beneath the roof from said angle and being normally immersed in the liquid in the tank, said lever being elevated from a freely hanging position when the roof is centered in the tank by inward pressure of the shoe thereagainst, said downwardly extending portion having a length greater than the distance from the roof to the side walls at any position of the roof within the tank.

2. The apparatus of claim 1 in which the angular portion of the lever is in sliding contact with the shoe.

3. The apparatus of claim 1 including shoe supporting means connected to the downwardly extending portion of the lever, and attached to the shoe, said supporting means transferring the weight of the shoe to the lever.

4. The apparatus of claim 1 including shoe supporting means pivotally connected to the downwardly extending portion of the lever, and extending upwardly therefrom and pivoted to the shoe adjacent the upper portion thereof, said supporting means transferring the weight of the shoe to the lever.

5. In a liquid storage tank having a floating roof and a plurality of shoes adapted to slidably contact the inner side walls of the tank, means for pressing the shoes against the side walls including a lever swingably attached to the roof, said lever having an angular portion, a portion extending downwardly between the roof and side walls from the point of attachment to the roof to the angular portion, and a portion extending inwardly and beneath the roof from said angle, means for exerting a downward force on said inwardly extending portion, said lever being elevated from a freely hanging position by inward pressure of the lower portion of the shoes thereagainst when the roof is centered in the tank, and shoe supporting means attached to the downwardly extending portion of the lever and to the upper portion of the shoe, said shoe supporting means carrying substantially the entire weight of the shoe.

6. The apparatus of claim 5 in which the means for exerting a downward force on the inwardly extending portion of the lever comprises the weight of that portion itself.

7. The apparatus of claim 5 in which said lever is attached to a portion of the roof overhanging the sides thereof whereby said downwardly extending portion may rotate past the vertical in response to said inward pressure.

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8. The apparatus of claim 5 including spring means attached to said downwardly extending portion adapted to urge the upper portion of the shoe against the side wall.

9. In a liquid storage tank having a floating roof and a plurality of shoes adapted to slidably contact the inner side walls of the tank, means for pressing the shoes against the side walls including a lever swingably attached to the roof, said lever having an angular portion immersed in the liquid, a portion extending downwardly to the angular portion, and a portion extending inwardly from said angle and beneath the roof, a weight on the inner end of said inwardly extending portion said lever being elevated from a freely hanging position when the roof is centered in the tank by inward pressure of the shoes thereagainst, and shoe supporting means attached to the downwardly extending portion of the lever and to the shoe, said shoe supporting means transferring the weight of the shoe to the lever.

10. In a liquid storage tank having a floating roof and one or more shoes adapted to slidably contact the inner side walls of the tank, means for pressing the shoe against the side walls including a lever swingably attached to the upper portion of the roof, said lever having an angular portion, a portion extending downwardly between the roof and side walls from the point of attachment to the roof to the angular portion and having a length greater than the

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height of the roof and a portion extending inwardly beneath the roof from said angle and being normally immersed in the liquid in the tank, said lever being elevated from a free hanging position when the roof is centered by inward pressure in the shoe thereagainst, and said downwardly extending portion having a length greater than the distance from the roof to the side walls at any position of the roof within the tank.

11. The apparatus of claim 10 in which said angular portion is in sliding contact with the lower portion of the shoe.

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