

Aug. 5, 1958

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2,846,108

FLOATING ROOF ANTI-TURNING DEVICE

Filed Oct. 7, 1954

2 Sheets-Sheet 1

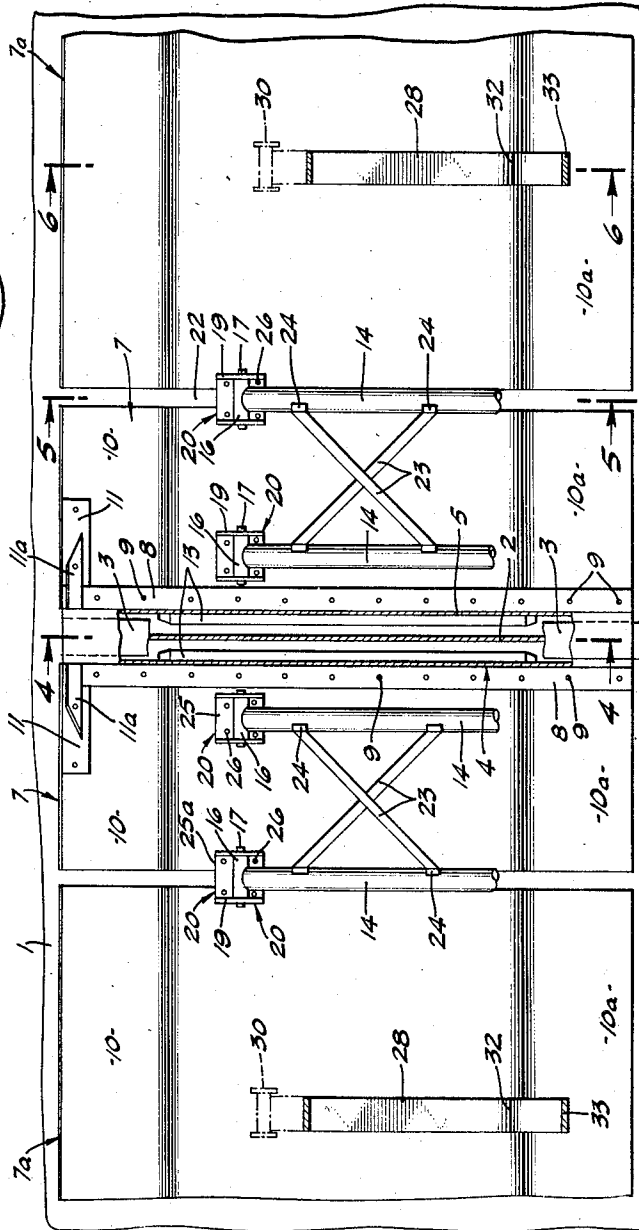
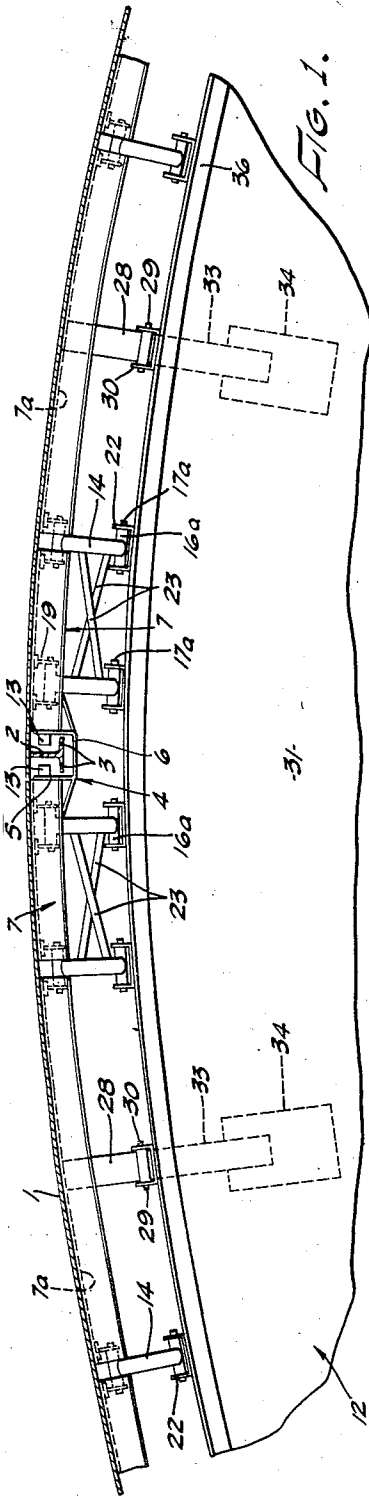


FIG. 2.

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2 Sheets-Sheet 2

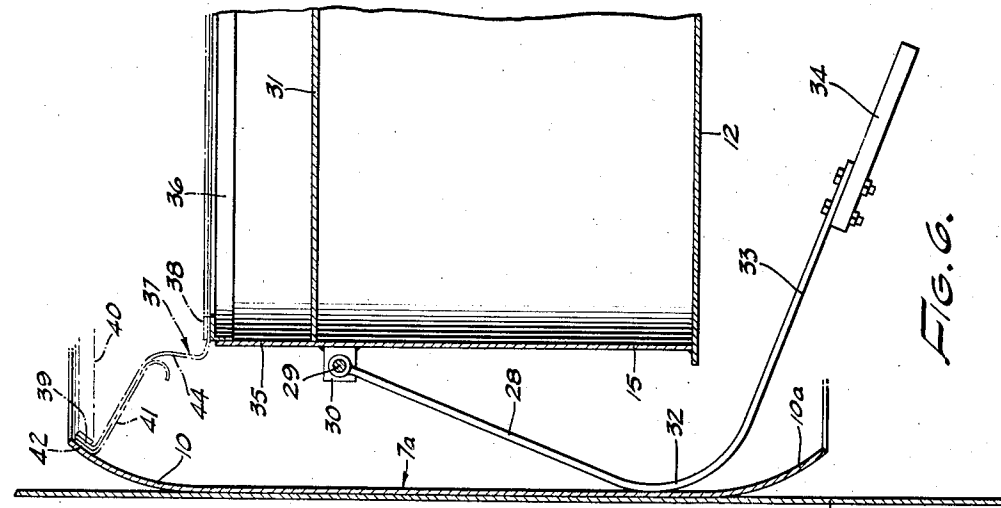


FIG. 6.

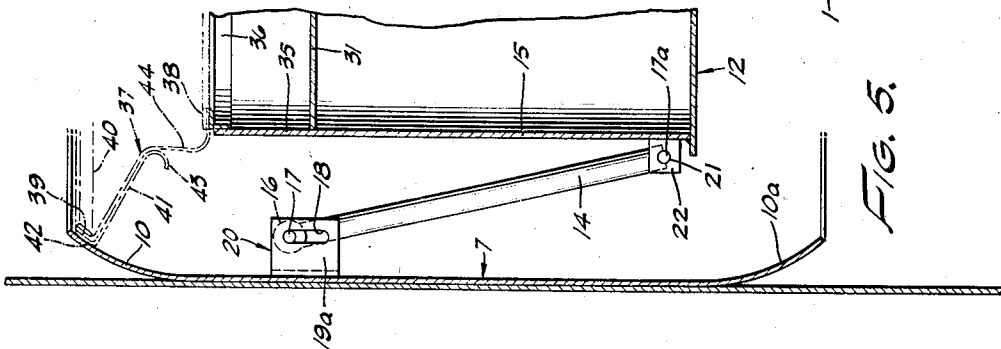


FIG. 5.

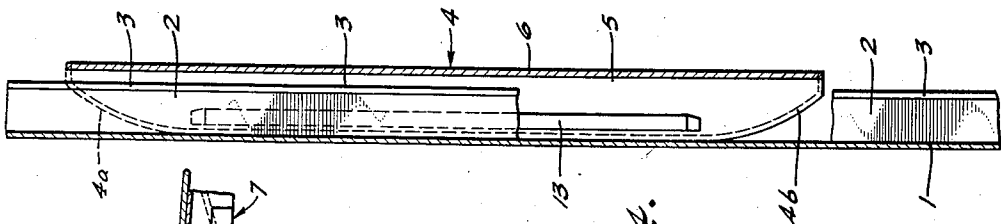


FIG. 4.

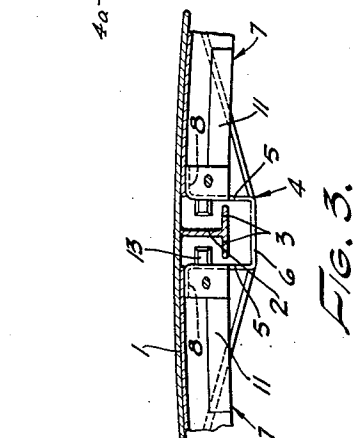


FIG. 3.

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FLOATING ROOF ANTI-TURNING DEVICE

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5 Claims. (Cl. 220—26)

This invention relates to tanks for containing a liquid on which a floating roof rests. Such tanks are usually of great size, and of cylindrical form, and are often in groups referred to usually as "tank farms." The floating roof usually includes centering means for normally maintaining the floating roof concentric with the tank, regardless of wind pressures which exert at times considerable pressure against the windward side of the tank, and the roof if it is located at a high level in the tank. Such high winds, and sometimes earthquakes may set up a rotation of the floating roof on its central axis relative to the tank. Such rotation is objectionable, because, in practice, there are connections to the floating roof such as gauging apparatus with reading boxes on the ground; and also rolling ladders, and flexible drain lines. Hence it is desirable to prevent positively and immediately any rotation of the floating roof; and also any lateral movements of the roof that will move it to an eccentric position with respect to the tank in which it should be centered at all times.

An object of the present invention is to provide anti-rotation means, sometimes referred to as anti-turning means, which is capable of arresting any incipient rotation or oscillation of the floating roof with respect to the tank.

There are several kinds of anti-rotation or anti-turning devices in use at present.

One of the objects of the present invention is to provide simple and inexpensive features of construction applicable to tanks having floating roofs, that will function reliably to eliminate any incipient movements of a rotary character; and which can readily be incorporated with means for maintaining the floating roof in its proper concentric, that is, coaxial position in the tank.

In tanks having floating roofs, that are intended to hold volatile liquids, it is necessary to provide them with sealing means usually in the form of an annular diaphragm or apron that seals off the annular space between the side of the floating roof and the side of the tank. Such a construction includes a plurality of shoes spaced equidistant around the perimeter of the tank, and which are connected with the floating roof so as to rise and fall with the roof as the level of the liquid changes within the tank. One of the objects of this invention is to provide anti-rotation means including features of construction capable of being employed with such plate-form shoes that lie adjacent to the anti-rotation means.

Another object is to provide improved means for supporting the edges of the diaphragm that will facilitate the easy replacement of the diaphragms when they have become worn from use.

Further objects of this invention will be evident from a careful reading of this specification and a study of the accompanying drawing.

The invention resides in the novel parts, and combinations of parts, all of which co-operate to produce an efficient anti-rotation and centering apparatus for floating roof tanks.

A preferred embodiment of the invention is described

in the following specification, while the broad scope of the invention is pointed out in the appended claims.

In the drawing:

Figure 1 is a plan showing a portion of the perimeter of a tank and floating roof showing a concentric portion with relation to the tank which is of cylindrical or circular form.

Figure 2 is a developed view located outwardly against the inner face of the tank wall and shown partially in section, of the anti-rotation construction and also indicating the location of yielding pressure means associated with the plate-form shoe, and that co-operate with the anti-rotation means in maintaining the floating roof normally centered in the tank. In this view the inner portions of means employed for connecting parts of anti-rotation device of the floating roof are broken away.

Figure 3 is a fragmentary view showing a portion of the tank wall in horizontal section at the location of the anti-rotation means. In this view the section also passes through a portion of two plate-form shoes that are held against the inner face of the tank wall. This view also shows in section the anti-rotation member that is carried by the tank wall and shows in plan view, the means carried by the floating roof that co-operates with the anti-rotation member on the tank wall.

Figure 4 is a vertical section taken about in the plane of the line 4—4 shown in Figure 2, and further illustrates details of the anti-rotation member carried by the tank wall, the lower portion of which is broken away. It also shows the anti-rotation member that is carried by the floating roof.

Figure 5 is a vertical section taken substantially in the plane of the line 5—5 of Figure 2 and further illustrates details of the preferred connection means between the floating roof and the plate-form shoes which move up and down with the rise and fall of the floating roof.

Figure 6 is a vertical section taken in the plane of the line 6—6 on Figure 2 and further illustrating details of the means for maintaining the floating roof in a centered position with respect to the tank.

Referring more particularly to the parts, Figures 1 and 2, illustrates a portion of the wall of a tank such as referred to above, and which is of the usual cylindrical form. At any suitable point on the periphery of this wall and on its inner face an anti-rotation member 2 is provided which projects inwardly from the inner face of the tank wall. This member 2 is preferably in the form of an I-bar the outer edge of which is secured to the tank wall by welds or by riveting. However, any means may be employed to function as the anti-rotation member 2, that projects inwardly from the inner face of the tank wall and which presents flanges 3 projecting laterally to a radial plane passing through the axis of the tank.

In order to provide means to co-operate with the anti-rotation bar 2 I employ means 4 which may be called a tie which includes a construction presenting two side plates 5 that extend in planes normal to the side wall of the tank. In the present instance these sides 5 are vertical walls of plate material that are preferably united by a vertical web 6. In other words, in the present instance a U-shaped channel results, as shown in Figure 1, in plan. The substantially radial side extensions 5 are supported by the roof, but in the present instance they are formed at their outer edges with means for enabling them to be attached to the edge portions of a pair of shoes 7, supported by the floating roof or deck to be presently described. The bodies of these shoes are of plate form; and in order to effect this connection to the shoes, flanges 8 are provided on the edges of the side walls 5. They may be attached by welding or rivets 9 to the shoes. At the upper and lower ends of the tie

member 4 its edge is curved as at 4a and 4b (see Figure 4) to conform to the curved upper and lower edge portions of the shoes 7 as will be presently described. It will be evident that when the floating roof commences to rotate on its axis, one or the other of the side walls 5 of the tie will approach and immediately engage the edge of one of the flanges 3 of the bar 2 to which they are closely adjacent as shown in Figure 1, and as soon as this contact is established the rotation will be arrested.

As shown in Figures 2, 3, 5, and 6, the upper edge portions 10 of these shoe plates 7 are bent inwardly toward the center of the tank, in an arc or curve and laterally extending arms 11 of strap iron or angle-iron form, extend over from the upper ends of the flanges 8, and are connected to the shoe plates and to the tie adjacent their upper ends. These arms 11 may be welded to the upper ends of the flanges 8 or riveted to the same. Short reinforcing brace clips 11a may be used here to connect these parts as shown in Figure 2.

As shown in Figures 1 and 2, the outer faces of the shoe plates lie against the inner face of the tank wall and present a considerable surface area conforming to the cylindrical shape of the tank.

With this anti-rotation construction just described it is evident that if there is a tendency for the floating roof 12 to rotate on its axis, the side members 5 of the tie 4 will engage the side of the anti-rotation bar 2. In the present instance it will be noted that the side plates 5 of the tie are located adjacent to the edges of the flange 3 so that any relative rotary movement of the floating roof 12 with respect to the tank will bring either one of the walls 5 into contact with the flange edge and will arrest any further rotation.

In addition to arresting such rotation, I prefer to provide the side walls 5 of the tie 4 with means for engaging the flanges 3 if the floating roof 12 should be moved away from the adjacent portion of the tank wall. For this purpose I prefer to provide two vertically extending keeper bars 13 that may be welded or otherwise secured to the inner faces of the side walls 5 of the anti-rotation means that is carried by the roof. These are preferably solid steel bars the upper and lower ends of which may be slightly tapered as shown in Figure 2. If the roof moves inwardly at this point the keeper bars 13 engage the flanges 3 to arrest this character of movement.

In order to support the anti-rotation tie 4 and the shoe plates 7 on the floating roof 12 so that the shoes and the anti-rotation means will move up and down with the floating roof as it rises and falls with the surface of the liquid in the tank, I provide means including strut-links 14. These links may be made of steel tubing and lie in vertical planes disposed substantially radially to the axis of the tank and floating roof 12.

The ends of these strut-links are articulated respectively to the shoes 7 and to the side wall 15 of the floating roof 12, and this latter connection is preferably located at a low level on the side wall. At one end, preferably the upper end of each strut-link, a lost-motion connection is effected which will permit a limited amount of up-and-down movement of the floating roof without causing any movement of the shoes. This saves a considerable amount of wear on these shoes and is desirable.

In the present instance I prefer to provide a pair of the strut-links 14 corresponding to each of the shoes 7, and their upper ends are provided respectively with short tubular cross-heads 16 which carry centrally disposed pins 17 the ends of which project beyond the ends of the cross-heads 16, and are received in substantially vertical slots 18 formed respectively in side plates 19 of brackets 20 that are disposed in substantially radial planes and are welded to them, or riveted or otherwise secured to the inner face of each shoe plate.

The lower ends of the strut-links 14 are also provided with short cross-heads 16a that are similar to the cross-heads 16 and which are provided with pins 17a that pro-

ject through bearing openings 21 in side bracket plates 22 the inner edges of which are welded to the outer face of the wall of the roof.

It is preferable to brace the two pairs of strut-links 14 that are associated with the two shoes 7 that are located adjacent to the anti-rotation means. This is preferably accomplished by providing diagonal braces 23, see Figures 2, which are illustrated as flat steel bars of substantially rectangular cross-section. The ends of these braces are bent to form end flanges 24 of arcuate cross-section to conform to the sides of the strut-links, to which they are welded.

As indicated most clearly in Figure 2, the brackets 20 that carry the slots 18 in their end plates 19 are preferably provided with backs that are either welded to the backs of the shoes 7 or may be connected to the shoes by rivets 26 which should have countersunk heads in the rubbing faces of the shoes that travel up and down on the inner face of the tank. The use of rivets is an alternate construction but the use of welding method is considered preferable.

Any suitable well-known means may be employed for yieldingly pressing the shoes 7a outwardly against the inner face of the tank. In practice, shoes similar to the shoes 7a are employed attached around the entire periphery of the roof, and spaced equidistant from each other.

In the present instance the means illustrated for this purpose comprises a bar 28 of flat steel the upper end of which has an eye attached to a wrist-pin 29 in a suitable bracket 30 that is welded to the outer side of the roof, preferably near the location of its deck 31. This steel bar 28 extends down in an outwardly inclined direction and the straight portion of this bar merges into an arcuate bearing knuckle 32 that is held yieldingly against the inner face of the shoe 7a. Beyond the knuckle 32 the steel bar has an inwardly and downwardly inclined tail-portion 33 carrying a weight 34 which has a considerable lever-arm measured by the distance of its center of gravity from the side wall of the tank to insure that sufficient pressure is delivered to the shoe to keep it always in contact with the wall of the tank.

The deck 31 is completely surrounded by a coaming 35 the upper edge of which is finished on the inside by a continuous angle-iron ring 36. Its horizontal flange operates as a seat for the lower edge of a flexible sealing hood or diaphragm 37 which extends continuously all around, and above the annular space that separates the side wall of the floating roof from the tank wall.

The inner edge of the diaphragm 37 is held down by a continuous clamping strip 38 that extends around the entire periphery of the roof and makes a vapor tight connection at this point.

The upper edge portion 39 for the diaphragm seats against the inner face of the arcuate upper portion 10 of each shoe and is clamped there by a continuous ring 40 with rivets passing through the ring, the edge of the diaphragm, and the arcuate portion of the shoes 7 and 7a.

In order to support the body portion of the hood or diaphragm 37 I prefer to provide an inclined shelf 41 indicated in dotted lines, the upper edge of which is formed into an up-turned flange 42 against which the upper edge of the apron seats, and the lower edge of this shelf is bent around into a hook formed roll 43 from the convex face of which the lower portion 44 of the apron is suspended. This organization of parts at this point is desirable because it avoids any tendency of the movements of the floating roof with respect to the shoe to form creases and develop cracks in this apron.

As indicated in Figures 5 and 6 the lower edge of each shoe is preferably formed with inwardly turned arcuate portions 10a similar to the curved portions 10 already described that are associated with their upper ends.

Many other embodiments of the invention may be resorted to without departing from the spirit of the invention.

I claim as my invention and desire to secure by Letters Patent:

1. In an anti-rotation construction for a floating roof resting on a liquid in a tank, the combination of an anti-rotation bar secured in a vertical position to the inner side of the tank wall, and extending downward, said bar having laterally extending flanges at its inner edge with respect to the vertical axis of the tank and floating roof, two plate-form shoes supported by the roof, and located one at each side of said anti-rotation bar, means carried on the roof for holding the shoes pressed against the inner face of the tank wall, a tie of U-form cross section surrounding the bar, having side walls lying adjacent the sides of said bar for engaging directly with the same when a rotation of the roof occurs, the side walls of said tie having flanges at their outer edges secured rigidly to the adjacent edges of the said plate-form shoes, the inner faces of the side walls of said tie having vertical keeper bars rigidly secured to the same, and extending down the same to engage the flanges at the inner edge of said anti-rotation bar to prevent a movement of the said U-form tie in a radial direction with respect to the tank wall.

2. In an anti-rotation construction for a floating roof in a tank containing a liquid, the combination of a tank having a cylindrical side wall, an anti-rotation bar extending in a vertical position on the inner face of the cylindrical side wall of the tank, and secured to the same, said bar having a web disposed in a vertical radial plane with respect to the vertical central axis of the tank, and having laterally extending flanges at the inner end of its cross-section, a floating roof having a cylindrical side wall disposed concentrically in the tank, an anti-rotation tie extending in a vertical position, said tie having a channel form horizontal cross-section with side plates disposed on each side and adjacent to the edges of said flanges of the anti-rotation bar, a pair of concavo-convex plate-form shoes with means for supporting the same from the side of the roof so as to rise and fall with the liquid level in the tank, said shoes spaced about equidistant from said anti-rotation bar, and fitting, and conforming to, the inner face of the tank wall, the said side plates of said tie having flanges at their outer edges with means securing the same to the exposed faces of said shoes so that the said tie is supported from the said shoes.

3. An anti-rotation construction, according to claim 2, in which the anti-rotation bar has a horizontal cross-section in the form of a T, and in which the outer edge of its web is welded to the inner face of the tank wall.

4. An anti-rotation construction according to claim 3, including means for yieldingly pressing the two shoes against the wall of the tank.

5. In an anti-rotation construction for a floating roof, in a cylindrical tank containing a liquid, the combination of an anti-rotation bar of T-form in horizontal cross-section, disposed in a vertical plane with its web disposed in a radial plane from the central vertical axis of the tank, and with the outer edge of said web welded to the inner face of the tank wall, a pair of plate-form shoes with means for supporting the same from the side of the roof, said shoes spaced about equidistant from said anti-rotation bar, and fitting, and conforming to, the inner face of the tank wall, an anti-rotation tie of channel form in horizontal cross-section having side plates the inner faces whereof lie adjacent to the sides of the flanges of said anti-rotation bar, and means for attaching the side plates of said tie to the exposed faces of said shoes to support the tie on said shoes, the upper ends of said shoes disposed in extensions inclining upwardly and inwardly toward the floating roof, an inclined shelf having an upwardly and inwardly turned flange along its upper edge, secured to the shoes, a sealing hood of flexible material resting on the upper face of the shelf with its upper edge turned upwardly and secured against the inner face of the inwardly inclined extensions of said shoes, the lower edge of said shelf having the form of a roll curving away from the side of the roof, and said sealing hood hanging down over the convex faces of said roll, and with its lower portion lying on the floating roof, and means for securing the same to the roof.

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