

May 4, 1954

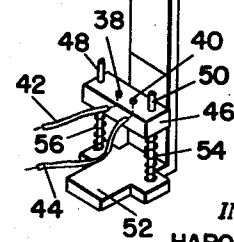
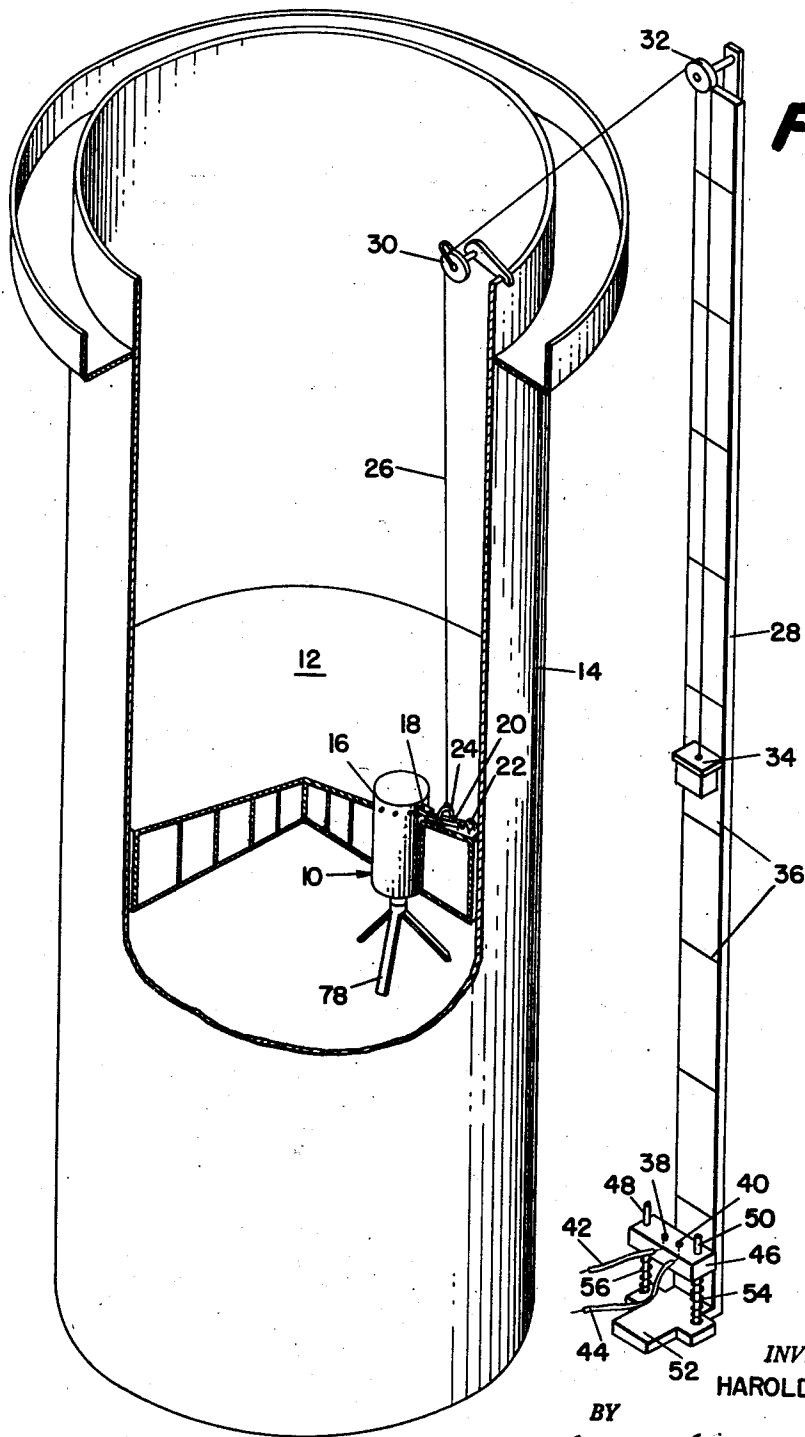
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2,677,816

FLOATING ROOF TANK WARNING DEVICE

Filed March 25, 1952

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

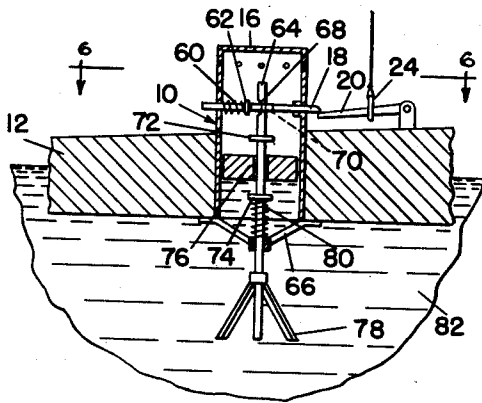


Fig. 2

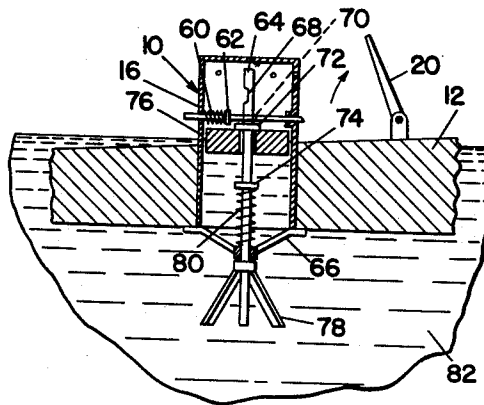


Fig. 3

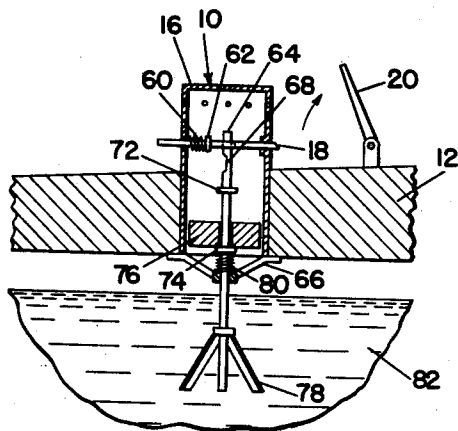


Fig. 4

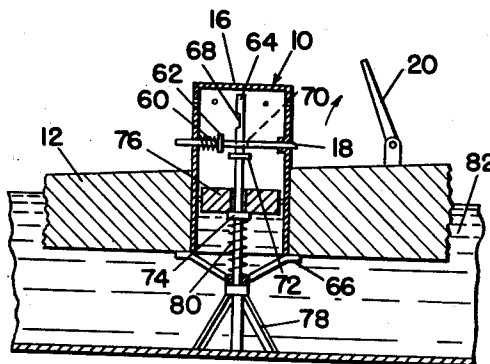


Fig. 5

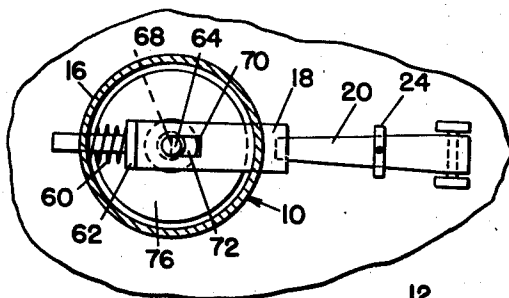


Fig. 6

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FLOATING ROOF TANK WARNING DEVICE

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5 Claims. (Cl. 340-244)

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This invention relates in general to floating roof tanks as used for storage of liquids and more particularly to means for indicating the failure of such roofs to operate properly.

Among the many possible reasons a floating roof in a liquid storage tank may fail to operate properly, there are four of primary importance. They are:

a. Sinking in the stored liquid because of leaks, snow load, freezing, wind pressure.

b. Lifting above the top of the tank because of overflow of the liquid.

c. Accumulation of explosive gases beneath the roof after more than the maximum of liquid is withdrawn from the storage vessel.

d. Sticking at one position in the storage tank because of icing, gumming or obstructions caught in the perimeter seal.

It will be recognized that any of these conditions, in addition to creating a dangerous situation, will give an erroneous measure of the stored contents. Except for the extremes of tank volumes either maximum or minimum, there is no evidence of any unusual condition by mere observance of the roof position or of any visible indicator connected thereto. Where the roof is stuck or is sinking in the liquid it will look and be normally indicated as properly functioning.

The primary concern in the past, over the conditions enumerated here, has been limited to signalling the position of the floating roof only for the overflow condition. Although this is one of the greatest dangers, its correction does not eliminate the other equally grave situations listed above. It is an object of this invention to provide a floating roof tank with a single means equally responsive to these primary causes of floating roof failure to operate desired signals.

In accordance with the present invention, a float operated lever arm is positioned to extend through the floating roof element and engage a latch adjacent the top thereof. In order to operate the device when the floating roof reaches the minimum allowable liquid depth, the lever arm is extended a predetermined distance below the roofs liquid contact surface. The latch is connected to a cable which is guided over the side of the storage tank and positioned to suspend an electrical connecting element. In the form illustrated, a simple depth indicator is mounted alongside the storage tank and shows the liquid depth in cooperation with the electrical connecting element. The illustrated form of the device indicates the operating condition of the floating roof at the site of the storage tank in addition to

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transmitting a signal of failure to any selected location removed from the tank.

For a more complete understanding of the nature and scope of the invention wherein the above noted object and others will be evident, reference is made to the following detailed description read in connection with the accompanying drawing in which:

Figure 1 is an elevational view, partly broken away showing the device in operating arrangement.

Figures 2, 3, 4, and 5 are sectional elevational views of the float mechanism in four operating positions.

Figure 6 is a sectional plan view of Figure 2 taken on line 6-6.

Referring to Figure 1, the float mechanism generally indicated by the numeral 10 is operably incorporated in the floating roof 12 in storage tank 14. A cover 16 is arranged to protect the mechanism from obstruction by snow and ice. Holes are let into the cover 16 to give access to the atmosphere and prevent gases from accumulating and interfering with the operation of the device. In mild climates or seasons, or under circumstances where the floating roof 12 is not exposed to the elements, the cover 16 may be omitted, although included here.

A signal release means including a latch bar 18 projecting through the cover 16 and the release arm 20 pivotally mounted at 22 on the upper surface of the float 12 holds the cable 26 by engaging the ring 24. These elements indicate a simple means for releasing the liquid level indicator and transmitting any desired signal as later described.

At a convenient location outside the storage tank 14 a depth indicator 28 is placed. Normally indicators of this type are placed adjacent the storage tank facing a direction from which they can easily be read. In Figure 1, it has been set away from the storage tank to better illustrate the cooperative arrangement of the elements. The cable 26 is connected to the ring release 24 and passes up through the interior of the tank 14 over sheaves such as 30 and 32 to reflect movement of the floating roof 12 on the face of the depth indicator 28. A weighted marker 34 arranged to show the depth on the indicator 28 is fashioned to present a regular surface to the foot marks 36 or other indicia for easy reading. This weight 34 may be made of a conducting metal or may be supplied with a conducting band of metal arranged to engage the contacts 38 and 40 of the conductors 42 and 44. By such an arrangement, a conventional electric circuit is closed to excite

a proper signalling system of any desired type and positioned at a selected location. As many such signalling devices are known and form part of the present invention only as a result of the operation of the disclosed mechanism, they are neither claimed nor illustrated.

A means to cushion the impact of the weight 34 as it is dropped to the bottom of the indicator 28 is shown in the form of a contact support 46, guided by rods 48 and 50 positioned in the base 52 and supported by springs 54 and 56. The cushioning and contact means should be arranged to compress within an unmarked or danger indicating zone of the indicator depth board 28 below the last indicated depth measurement. Otherwise, to stop it at the last level mark on the board 28 would indicate a full and properly operating tank, erroneously.

Figure 2 illustrates the neutral or normal position of the operating elements included in the float mechanism previously referred to as numeral 10 in describing Figure 1. This figure will be used to describe these elements and their relative positions prior to discussing the operation of the device. The vented cover 16 is indicated in this disclosed form of the invention as cylindrical in shape. It fits snugly in an opening made completely through the floating roof 12 and is exposed to the body of the stored liquid. A latch bar 18 is passed through the cover 16 and is supported by bearing surfaces therein as indicated. On the end of the latch bar 18 opposed to the end which engages the release arm 20, a spring 60 is compressed between the cover 16 and a flange 62 tending to urge the latch bar into engagement with the release arm. The ring 24 attached to the cable 26 is retained by the pivoted release arm 20.

Within the cover 16, the operating rod 64 is positioned by the spider 66. The upper end of this rod 64 is notched as at 68 to cooperate with a slot 70 in the latch bar 18 shown in Figure 6. Flanges 72 and 74 are spaced on the rod to engage the float 76 as it lifts or drops. The float 76 may be made of light metal, solid or hollow, or of impregnated wood, cork, or other like material, as required for proper and efficient operation. Although the cover is vented to permit free passage of air to the latching mechanism, it affords shelter against freezing and gumming and preserves lubricant or similar coating which assist operation.

On the lower end of the operating rod 64, a tripod 78 is fixed. This tripod forms an extension to engage the bottom of the storage tank should the roof 12 be permitted to descend below the desired minimum level. It will be recognized that this feature may be omitted should other means for ascertaining minimum level be presently incorporated in a tank and only the float device be included.

Between the spider 66 and the lower flange 74, a spring 80 is mounted on the operating rod 64. This spring is selected to support the weight of the operating member including the rod and tripod, yet is of sufficient flexibility not to interfere with the operation. The weight of the combined elements is supported to prevent operation of the device except when required.

Disclosure of the operation of the device requires reference to Figure 1 and the group of figures numbered 2 to 5, inclusive. The positions of the several elements as indicated in Figures 1, 2, 6 show the normal operation of the floating roof equipment and the visible indication of

the roof level on the indicating board 28. Continued normal operation within the prescribed maximum and minimum levels allowed for the liquid supported roof will maintain these elements in this relative position.

Should the floating roof either reach the maximum elevation permitted in the tank 14 and be stopped as by the sheave 30 or other like means or be obstructed so that it could not lift within the tank during a "pumping-in" or filling operation, a condition shown in Figure 3 would result. The floating roof 12 is unable to move upward with the rising surface of the liquid 82 and the float 76 is lifted to engage the upper flange 72. The buoyancy of the liquid moves the float upwardly with such force that the operating rod notch 68 is moved out of the slot 70 in the latch bar 18. The lower sloping end of the notch 68 urges the latch bar to further compress the spring 60 and releases the arm 20. As the weighted pointer 34 is supported by the cable 26 and the ring 24, shown in Figure 1, the pivoted movement of the release arm 20 frees the weight. The length of the cable 26 is such as to permit the weight 34 to drop to the bottom of the indicator 28 and into the space below the highest level marking yet not allow the ring to engage the sheave 30. Springs 54 and 56 prevent injury to the apparatus as the weighted marker 34 drops and permits completion of the electrical circuit through the marker 34 and the conductors 42 and 44. As noted above this circuit may be used to ring bells, or operate other well known signals at any location desired.

The operation described in which reference is made to Figure 3 covers the situation of controlling overflow of floating roof tanks and uses the float 76 as the signal actuator. This problem has been recognized and contact devices above the maximum elevation arranged to meet this need. However, the use of the same mechanism to meet all common emergencies experienced in floating roof tank operation is the purpose of this invention. The operation of the above described device as a warning for the remainder of these common emergencies will be described.

Figure 4 illustrates the situation where the stored liquid is being "pumped out" of the tank and the floating roof is stuck and cannot follow the diminishing liquid level. This condition can be met anywhere between the maximum and minimum levels of liquid allowed, and is usually the result of freezing around the roof's peripheral seal. As the liquid level withdraws from support of the roof 12 the float 76 drops down and engages the lower flange 74. Although the float is buoyant and is readily supported by the liquid 82 because of its shape and specific gravity, it has appreciable weight which is enough to compress the spring 80 and move the rod 64 downwardly.

In the downward movement, the upper sloping or bevelled face of the notch 68 in the operating rod 64 engages the latch bar 18 and urges it away from engagement with the release 20. The operation of freeing the retained cable 26 and resultant dropping of the weight 34 to indicate failure and complete the electrical warning signal is as already described. Again, as in the description of Figure 3, the float 76 is the actuator.

The final emergency considered in this invention and for which the disclosed apparatus will also operate is the condition of too much liquid being withdrawn from the storage tank. In this

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instance the float 76 does not actuate the rod 64 but the extension shown here as the tripod 78 urges the rod to release the latch. Supports are normally spaced to keep the floating roof level and prevent serious damage to the equipment when more than the allowed quantities of liquid are withdrawn from these tanks. Under such conditions there is a hazard of volatile constituents accumulating beneath the roof in the liquid-vacated space. When this occurs the risk of explosion and fire or both are imminent. Consequently a device which will warn of the downward movement of a floating roof when it has reached the minimum positional depth is very desirable. Reference to Figure 5 will show the disclosed warning device to be responsive to this condition as well as the other circumstances requiring warning described above.

As the liquid 82 is withdrawn from the tank 14 the weighted marker or pointer 34 rises on the indicator 28 to indicate the liquid level. Normally a minimum depth is marked for attention of the operators, but failure to pump-in at the right time permits the roof 12 to descend to the bottom of the tank. At the desired minimum level the tripod 78 engages the bottom of the tank 14 and lifts the rod 64 without the operation of the float 76. The latch bar 18 is moved from engagement with the release arm 20 as above described and the signal circuit and the visible position of the weighted marker 34 show a warning.

It will be understood that the combination of working elements shown here may be rearranged and replaced with many equivalent structures and still be within the scope of the invention. The primary elements are a simple latch releasable by a float operated rod extended for contact at the lowest depth arranged to release a warning signal. Levers, rods, gears, and cables readily suggest themselves for the transmission of the float and contact rod movement to various forms of latch mechanisms. These elements, together with compressed air, hydraulic devices and electrical assemblies responsive to the float operated-contact rod movements indicate a wide range of equivalents for the elements of this warning device.

I claim:

1. A signalling device for use with floating roof storage tanks comprising a floating roof having an aperture therethrough into the stored liquid, a vertically movable rod supported in the aperture of the floating roof and extending there- 50 through for a determined distance above and below said roof, a separate float movable in the aperture and adapted to engage the rod in vertical movement, latching means mounted on the top of the floating roof in operating engagement with the rod, and means to indicate inoperability 60 of the floating roof in response to the latch release on the vertical movement of said rod.

2. A signalling device for use with floating roof liquid storage tanks comprising in combination with the floating roof, a latch means operatively positioned adjacent an aperture through said floating roof, an operating rod supported to extend through the aperture a predetermined dis- 65

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tance below the floating roof and into operating engagement with the latch means, separate float means positioned to engage and operate the operating rod in response to the elevation of the stored liquid relative to the floating roof, and means to indicate the position and operability of the floating roof releasably engaged by said latch means.

3. A signalling device for use with a floating roof liquid storage tank comprising a floating roof having an aperture therethrough opening into the stored liquid, a covered housing for said aperture, a latch pivotally mounted on the floating roof adjacent the housing covering the aperture therein, a bar slidably mounted in the housing to releasably engage the latch, an operating rod extending from beneath the floating roof upwardly in the housing to operatively engage the slidable bar, a float adapted to lift and lower the operating rod in response to the relative position of the liquid level and the floating roof, and means to indicate the elevation of the floating roof retained by the latch and releasable by movement of the operating rod to indicate operating failure.

4. The device defined in claim 3 further characterized by the means to indicate elevation and operating failure of the floating roof including a graduated member in vertical position adjacent the storage tank and marked with suitable measuring divisions, a marker slidably movable along the length thereof, a cable connecting said marker with the latch, and an alarm circuit at the bottom of said indicator electrically operated 30 when engaged by the marker.

5. A signalling device for use with floating roof liquid storage tanks, comprising the combination with the floating roof, of a housing inserted in an orifice in the roof and in fixed relation therewith, an operating rod connected with said roof and extending from below said orifice into said housing and having a limited vertical movement relative to the roof, a separate float means positioned to float on the tank liquid when the same is at normal or above normal level and free to fall when the liquid is below normal level, said rod being operable by said float member in the movement of the latter a predetermined distance above or below the position it occupies when the tank liquid is at normal level, a lever 45 mounted on the floating roof, latch mechanism controlled by the rod to normally hold said lever in latched position but movable upon the rise or fall of the rod to unlatch said lever, and signalling means connected to, and held inoperative by, said lever when the same is in latched position but operable when the lever is unlatched as specified.

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