Nov. 17, 1959 J. M. SWICK 2,913,138

FLOATING COVERS FOR TANKS

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FIG.1

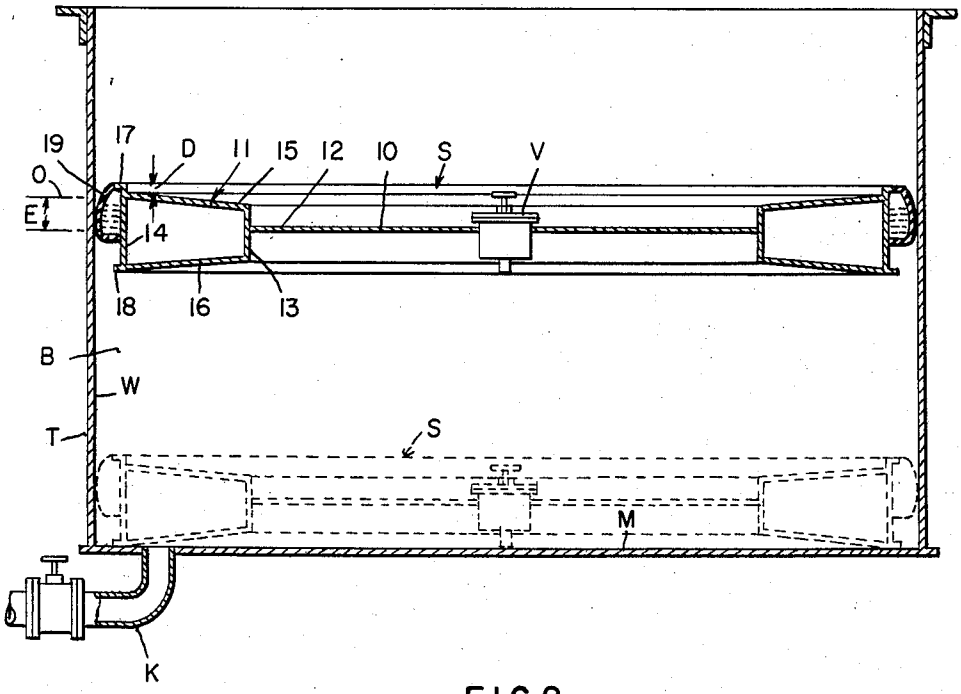

FIG.2

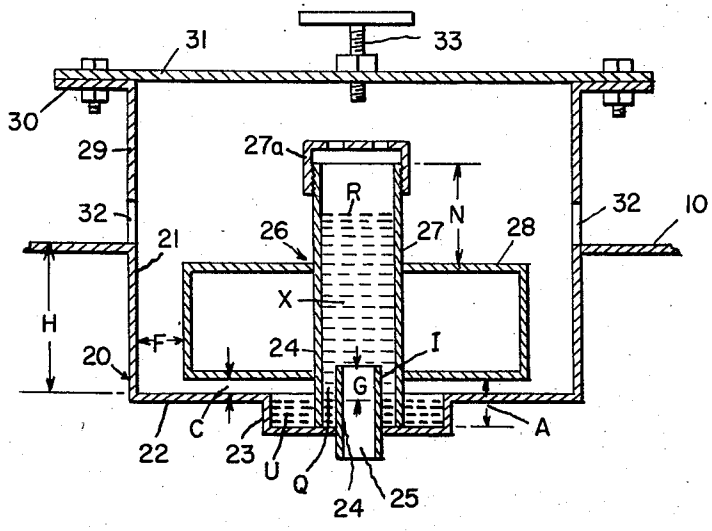

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FIG.3

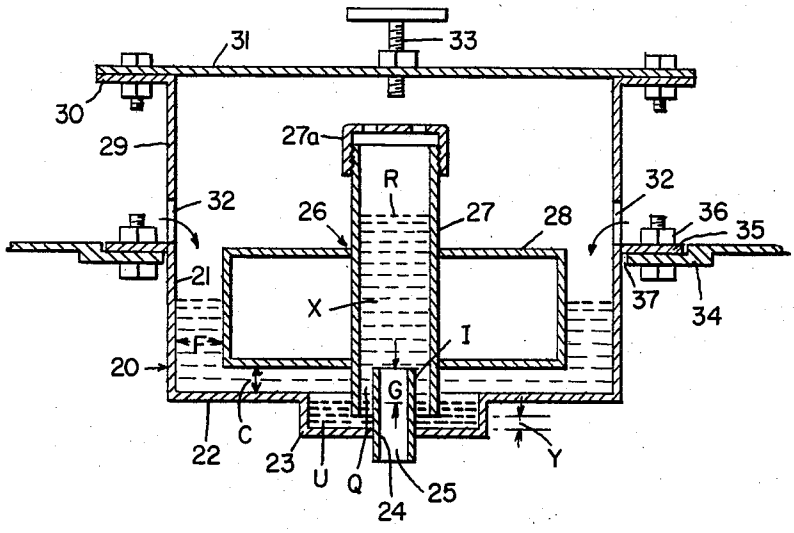
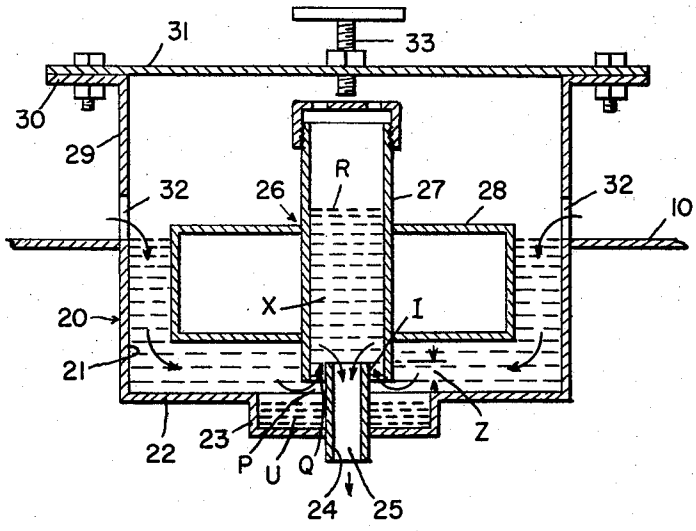


FIG.4



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FLOATING COVERS FOR TANKS

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5 Claims. (Cl. 220—26)

This invention relates to the floating roof structure in storage tanks for liquids such as oil or other liquid fuels, and more particularly to improvements in drainage devices required in such a roof structure to allow rain water to pass therethrough and through the liquid product in the tank down to the bottom for withdrawal, their object also being to provide a liquid seal effective to prevent the oil from backing up onto the top side of the roof at a low point thereof.

Backing up of oil through the drain device may occur especially in the so-called single deck type of pontoon-supported floating roof in which a central circular plate or deck normally has direct contact with the product in the tank, the low drainage point on such a deck being subject to the back pressure of the oil body in the tank. Hence, the invention is here illustrated by its preferred embodiment in a roof structure of that kind.

Known drainage means are disposed centrally of the roof structure as in the form of the inverted siphon type device which in effect is a U-shaped tube with its long leg protruding downwardly from the roof and its short leg directed upwardly to provide the seal. Water on the deck gravitates into the inverted siphon tube displacing an equal amount of water from the siphon discharge end into the product until hydraulic equilibrium in the siphon is restored.

Such a siphon must protrude downwardly from the roof structure a considerable depth sufficient to satisfy practical hydraulic equilibrium requirements. In order that the accumulation of water on the deck may be avoided the length of that protrusion may present an objectionable impediment preventing the roof structure from settling to its lowermost position upon the tank bottom, unless a well or similar kind of depression of sufficient depth were additionally provided in the tank bottom to accommodate the siphon structure, that in turn requiring drainage means of its own at the low point of the well. Moreover, in such a siphon structure the water is subject to evaporation as well as freezing, either occurrence being fatal to the proper intended functioning of the drain device. Still another obstacle in the use of these siphons is the fact that they must be primed. The problem of evaporation and of priming might be overcome, as it were, by the interposing of a mercury seal in the bottom portion of the inverted siphon structure. Yet to be operable, again a relatively deep siphon would be needed even for such a mercury-sealed siphon structure.

This invention, therefore, proposes to provide novel drainage means which being positively mercury-sealed avoids priming, avoids the hazard of evaporation, yet is highly compact as to depth, with the amount of freezable water therein minimized. To attain these ends, the invention in one embodiment thereof provide in the deck a mercury-sealed drainage device featuring an annular float member disposed in a depression or sump and surrounding a neck upstanding from the bottom of the sump and forming a downward flow passage through the deck. The float member in a lower position when not sufficiently buoyed by water in the sump maintains sealing relationship with a pool of mercury surrounding the neck, but it is buoyed up by an accumulation of water in the sump, to the extent of allowing water to flow radially across the pool and thus through the downward passage in the deck. When the excess water has thus drained through the device, the float member will drop back to sealing relationship with the pool of mercury.

According to one feature, the float member through its central opening provides access from above to reach the neck in order that it may be capped temporarily. With the neck and downward flow passage thus closed the float member can be removed from the sump for inspection, and the sump be cleaned of possible obstructions.

Yet another feature provides for hold-down means operable to secure the float member non-floatable in mercury-sealed positions, whenever it be desired to interrupt or prevent the passage of water into the body of liquid below the roof. Other features and advantages will hereinafter appear.

The invention possesses other features of advantage, some of which with the foregoing will be set forth in the following descriptions. In the following descriptions and in the claims, parts will be identified by specific names for convenience, but their functionally conjointly co-operating equivalents are intended to be embraced by the claims. In the accompanying drawings there has been illustrated the best embodiment of the invention known to me, but such embodiment is to be regarded as typical only of other embodiments, and the invention is not to be limited thereto.

The invention is illustrated in the accompanying drawings in which:

Figure 1 is a sectional view of a tank with floating roof structure embodying the drainage device of this invention, while showing in dotted lines the roof when in non-floating position. Fig. 2 is an enlarged vertical sectional view of the drainage device with the sump dry and the drain passage mercury-sealed by the float member. Fig. 3 shows the float member partially buoyed up with the mercury seal still effective; and Fig. 4 shows the float member buoyed up with the mercury-seal interrupted drain passage open.

As shown in Figure 1, the invention is shown as embodied in a roof structure S floating upon a body of liquid B contained in the tank T, having a bottom M and a cylindrical wall W. The floating roof structure as here exemplified to embody the invention is of the single-deck type comprising a central circular deck plate on deck **10** and an annular pontoon structure **11** rigidly connected to the deck peripherally as indicated by a peripheral welding beam **12** disposed about midway of the height of the pontoon structure. The pontoon structure comprises an inner cylindrical wall **13**, an outer cylindrical wall **14**, an annular top plate **15**, having a slightly inward downward slope, and an annular bottom plate **16** having a similarly slight inward upward slope. The outer wall **14** is shown to extend a suitable distance D above the top plate **15**, formed with the top flange **17** and with a lower flange **18**, both flanges serving for the attachment thereto of a resiliently yieldable sealing structure **19** of any suitable known construction sealingly engaging the tank wall as the roof structure rises and falls with the change of liquid level in the tank. A drainage device V according to this invention is located in the deck **10** at a low point of the roof structure where it must provide a seal against an external column of the liquid or oil determined by the reference level O in the tank and for the present purpose definable by its superelevation E above the top face of deck **10**.

Referring more particularly to Figures 2, 3, 4, the

drainage device V comprises a relatively shallow depression or sump 20 and having an effective depth H, formed centrally in the deck 10, comprising a cylindrical wall 21 and a flat bottom 22. Bottom 22 in turn is formed with a secondary shallow depression 23 from the bottom of which rises a neck 24, constituting a downward flow passage 25 through the deck, surrounded by a shallow annular bath or pool of mercury U contained in the secondary depression 23, the neck 24, rising to a height G above the level of the mercury. The neck 24 is provided at the top thereof with external thread I. An annular float member 26 loosely surrounds the neck 24 in telescopically overlapping relationship therewith. In the present embodiment this float member comprises a central tubular open-ended portion 27 carrying an annular float body 28, spaced a distance N from the upper end of the tubular portion 27, and a distance A from the lower end of the tubular portion 27. Thus the tube 27 with its lower end immersed in the pool of mercury in effect represents an upward tubular extension for the neck 24 in which the liquid column X seeks its level R in hydraulic balance with reference level O in the tank, with the mercury seal effective in the manner shown in Figure 1 where the float body in its lowermost position rests upon the bottom of the pool of mercury. In that position the float body 28 has a clearance C with the bottom of the sump and an annular clearance of the width F with the surrounding wall portion of the sump, these clearances representing the water space available in the device for buoyantly operating the float member 26. In the present embodiment, the cylindrical wall of the sump has an upward cylindrical extension 29 terminating in a flange 30 having fastened thereto a cover plate 31. Ports 32 in this extension at the level of the deck 10 allow for the passage of rain water therethrough into the sump.

According to Figure 3, sufficient water has accumulated in the sump to buoy up the float member 26 to a floating position a distance from the bottom of the pool of mercury, but still sealingly immersed therein. Additional accumulation of water in the sump to the extent indicated in Figure 4 buoys up the float member further to where the mercury seal is interrupted, thereby providing a passage P for water to drain across the surface of the pool, then up through the annular space Q defined by overlap Z between neck 24 and tube 27 and thus through the passage 25 of neck 24, down into and through the body of oil in the tank to the bottom from whence it can be tapped off in any suitable accepted manner as indicated by draw-off K in Figure 1.

It will be understood that only a small overlap Z is required, which in turn minimizes the required depth of the receiving sump 20. As long as water keeps on flowing into the sump at a certain rate maintaining the float member disengaged from the mercury, water will keep on draining through the neck 24 into the tank. As the supply of water ceases, the float member will settle down restoring its sealing engagement with the mercury. The amount of water remaining in the sump is relatively small as previously indicated and therefore easily evaporated, while the mercury seal remains effective. The content of freezable water in the device is thus minimized and if present is contained in the shallow accessible depression represented by the sump.

The neck 24 with the external thread may have a screw cap applied thereto from above by way of access through tube 27 to close the neck, whenever it should become desirable to remove the float member for inspection or to have the sump cleared of possible deposits or obstructions. The top end of tube 27 of the float member has placed thereon a perforated or vented cap 27a removable to gain access to the neck 24 when capping and closing thereof is desired. Otherwise, a hold-down screw 33 in the cover plate 31 can be brought to bear upon the float member to hold the same non-buoyantly in sealing relationship with the mercury whenever it be desired to have the passage of rain water into the tank discontinued or prevented.

According to this invention, with the roof structure settled in its lowermost position upon the tank bottom as indicated by the dot-and-dash line shown in Figure 1, compactness of the drainage device V offers no obstruction below the bottom face of the roof structure, so that the full volume of the tank is utilizable, with no additional well or depression required in the tank bottom to accommodate a protrusion. Whereas the float member 26 in the device of this invention is also operable with the tube 27 sealed at the top to preclude even small or non-critical amounts of evaporation loss from the surface of the oil or liquid column therein, a preferred form herein shown to embody the invention provides for this tube or central column to be vented. Whereas Figure 1 shows the drain device V connected to the deck as by welding, the embodiment indicated in Figure 3 shows the device as a removable sub-assembly unit flange-connected to the deck. That is to say, the deck has an opening 37 dimensioned to receive the device or unit V and its edge position is formed with a downward shallow annular recess 34 dimensioned to receive a flange 35 provided outwardly upon the unit V with bolt connections 36 completing the flange connection of the unit with the deck.

I claim:

1. In a liquid storage tank, a floating roof structure adapted to rise and fall with the liquid level in the tank, the combination of a floatingly supported deck plate with a drain device for water collecting upon the deck plate to pass through the deck plate, said drain device comprising a sump in the deck plate, a neck upstanding from the bottom of the sump providing a downward flow passage through the deck plate and having an open upper end portion, a pool of mercury disposed in surrounding relationship to said neck, the pool of mercury having an upper surface spaced below the level of said upper open end portion of the neck, and annular float means movably mounted with respect to said neck and including a buoyant portion above the pool of mercury and a sealing portion having a closed side wall portion surrounding said neck and spaced therefrom in telescopic relationship therewith, said closed side wall portion surrounding the neck extending upwardly above the upper open end of the neck to at least the level at which the water within the sump buoys the float means in an upward direction upon collection of additional water, said portion of the float means being normally immersed in sealing contact in said pool of mercury when not supported by the buoyant force of water in the sump whereby the float means prevents entrance of water into said neck, said float means being movable upwardly when buoyed up by water draining from said plate and collecting within said sump on said pool of mercury such that said portion of the float means moves upwardly out of sealing contact with the pool of mercury whereby water within the sump passes to and gravitates through said neck until said portion of the float means again is in sealing contact wtih the pool of mercury.

2. Apparatus as defined in claim 1, wherein the bottom of the sump is provided with an annular depression surrounding said neck, said pool of mercury being disposed within said annular depression.

3. Apparatus as defined in claim 1, wherein the sealing portion of said annular float means comprises a tubular member open at the bottom end thereof, and said buoyant portion comprises a sealed annular member disposed in surrounding relationship to said tubular member and mounted upon an intermediate portion thereof.

4. Apparatus as defined in claim 3, wherein the upper end of said tubular member is open, a closure member being mounted upon the upper end of said tubular

member, and hold-down means for engaging said closure member to hold the float member non-floatably in mercury-sealed position.

5. A drainage unit for the deck plate of a floating roof for liquid storage tanks, comprising a container providing a sump having a substantially horizontal bottom portion and an upstanding wall insertable into an opening provided in a deck, said upstanding wall having an outwardly projecting horizontal peripheral flange formed thereon for connection with the associated edge portion of an opening in a deck, said bottom portion having an upstanding neck providing a downward flow passage through the neck, and having an upper end portion, a pool of mercury disposed in surrounding relationship to said neck, the pool of mercury having an upper surface spaced below the level of said upper open end portion of the neck, and annular float means movably mounted with respect to said neck and including a buoyant portion above the pool of mercury and a sealing portion having a closed side wall portion surrounding said neck and spaced therefrom in telescopic relationship therewith, said closed side wall portion surrounding the neck extending upwardly above the upper open end of the neck to at least the level at which water collecting within the sump buoys the floating means in an upward direction upon collection of additional water within the sump, said portion of the float means being normally immersed in sealing contact in said pool of mercury when not supported by the buoyant force of water in the sump whereby the float means prevents entrance of water into said neck, said float means being movable upwardly when buoyed up by water draining from said plate and collecting within said sump on said pool of mercury such that said portion of the float means moves upwardly out of sealing contact with the pool of mercury whereby water within the sump passes to and gravitates through said neck until said portion of the float means again is in sealing contact with the pool of mercury.

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