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FLOATING ROOF SEAL ARRANGEMENT

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Fig. 1.

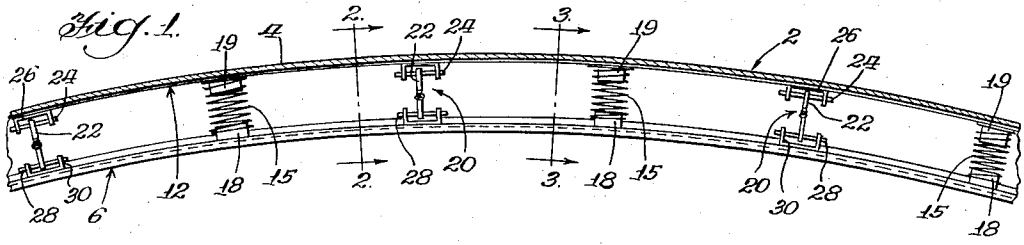


Fig. 2.

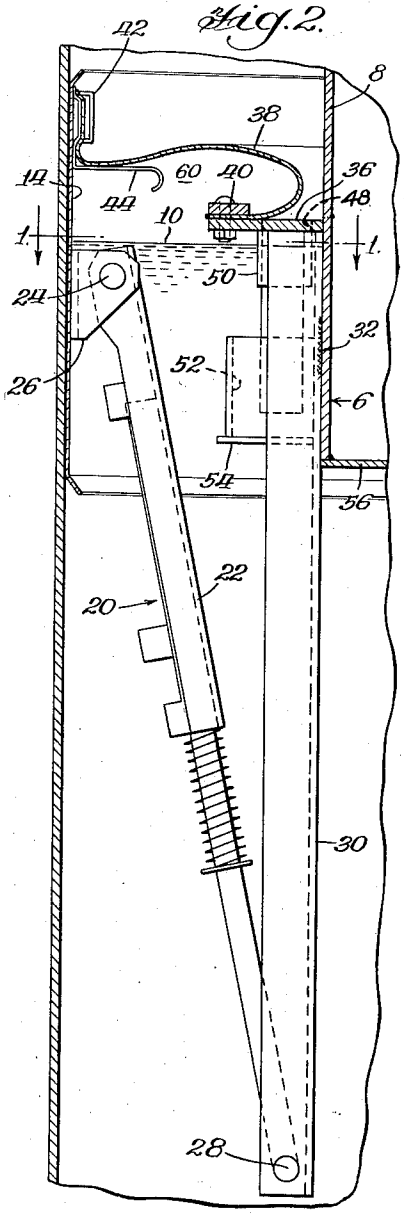
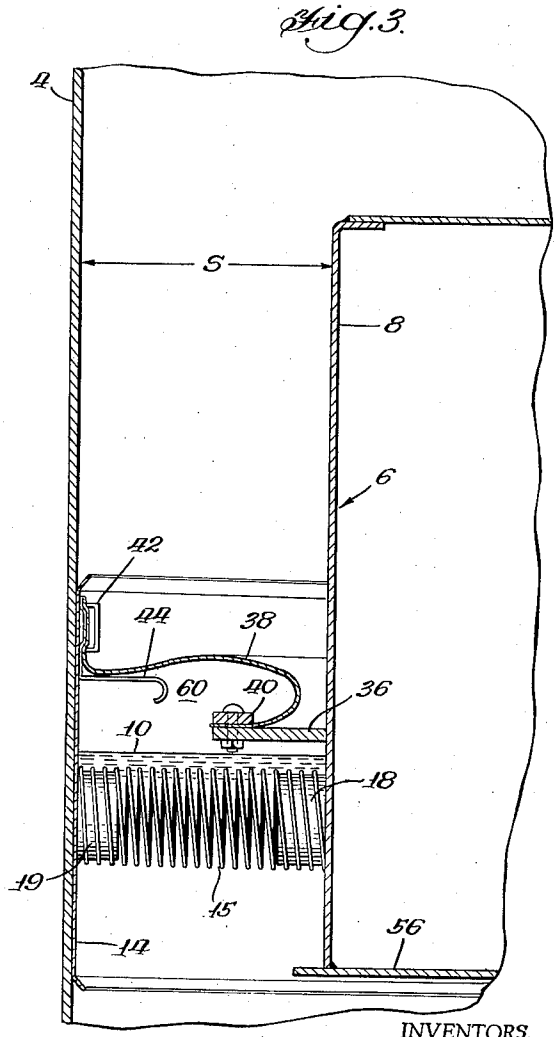


Fig. 3.



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8 Claims. (Cl. 220—26)

The invention relates to field storage tanks of the floating roof variety and particularly to a seal arrangement therefor.

As is well known in the art, tanks of the type employ a cylindrical shell having an open top, said shell being substantially closed by a roof which is arranged to float on the product in the tank. Of course, tanks of this nature are relatively large and field erected and it is therefore extremely difficult to maintain perfect concentricity between the roof and the shell with the result the roof is constructed somewhat smaller in diameter than the shell so vertical movement of same will be accommodated during filling and evacuation of product from the tank. The difference in diameter between the tank shell and the roof leaves an annular opening therebetween which is usually provided with a movable sealing arrangement to prevent product loss due to evaporation and to aid in avoiding contamination of the product by entrance of foreign material into the annular space.

It is therefore a primary object of the invention to provide a floating roof seal arrangement of new and novel design.

It is a further object of the invention to provide a tight fitting, flexible seal which is effective in minimizing product loss through vaporization.

It is a further object of the invention to provide an arrangement of the type described wherein vapor space is reduced to a practical minimum. The relatively small vapor space provided is so designed that it usually contains vapors of such concentration that they are above the explosive range of stored volatile product. Another feature of the design is that the space above the seal is open and ventilated so escaping vapors will not become trapped therein in explosive concentrations.

It is an additional object of the invention to provide a novel seal arrangement that will effectively maintain the roof in a central position in the tank and further will accommodate maximum roof travel to the top and the tank thereby increasing the effective capacity thereof.

These and other objects of the invention will become apparent in the course of the following description and from an examination of the concerned drawings, wherein:

Figure 1 is a fragmentary sectional view taken along line 1—1 of Figure 2 and illustrating the plan arrangement of supporting structure,

Figure 2 is a fragmentary sectional view in elevation and taken along line 2—2 of Figure 1, and

Figure 3 is a fragmentary sectional view in elevation and taken along line 3—3 of Figure 1.

Describing the invention in detail and directing attention first to Figure 1, it will be seen that the arrangement comprises a cylindrical tank 2, said tank being formed of an upstanding shell 4 having a floating roof indicated generally at 6 disposed therein. The roof 6 is so arranged in the tank that in the central position thereof an annular space S is provided between the rim 8 of the roof and the internal periphery of the shell 4. The roof 6 may be of any conventional variety and may

be arranged to float in the tank on the product 10 stored therein. It will be understood that the roof will rise and fall within the tank in response to intake and evacuation of stored product.

The annular space S must, of course, be effectively sealed to prevent the escape of an unreasonable amount of vaporized volatile product. Additionally, it is desirable to maintain the roof 6 in a central location within the tank both to secure more effective sealing action of the arrangement and to facilitate vertical movement of the roof. It is therefore the purpose of the invention to provide a seal arrangement which will provide a practical and effective seal, maintain the roof centrally located in the tank, and reduces to a practical minimum the fire hazard incident to this type of storage.

It will be noted that a peripheral seal ring 12 may be formed of a plurality of horizontal elongated shoes 14 placed in end to end relationship to each other. In a preferred embodiment the shoes are joined in such a manner as to admit of some relative motion therebetween for reasons that are well understood in the art and not here important.

Directing attention to Figures 1 and 2, it will be seen that a plurality of pusher springs 15 are arranged around the tank and have their opposite ends in pressured engagement with the rim 8 of the roof 6 and the adjacent shoe 14. Connection at the respective ends of the springs 15 may be made by bosses 18 and 19 secured to the rim 8 and the shoe 14 respectively, and telescopically received within the internal diameter of the adjacent ends of the spring.

The arrangement is provided with a plurality of hangers, indicated generally at 20, said hangers comprising longitudinal flexible elements 22 having their upper ends pivotally connected as at 24 to a bracket 26 which in turn is securely fastened to the shoe 14. The lower ends of the hangers 20 are pivotally connected as at 28 to a lower end of a hanger support channel 30 which extends upwardly and is secured to the roof 6 preferably by welding to the rim 8 as at 32. A seal mounting plate 36 is annularly arranged on and secured to the rim 8 at a point in upwardly spaced relation to the bottom of the roof 6 and slightly above the normal surface 10 of the stored product, said plate 36 serving as a mounting member for a seal fabric 38 which has its inner edge secured thereto by means of a plurality of clamping bars 40. The other or outer edge of the fabric 38 is secured to the shoes 14 adjacent their upper edges by means of a plurality of fabric clips 42. It will thus be understood that the fabric 38 in combination with the plate 36 is arranged to cover the annular space S around the entire periphery of the roof.

Each fabric clip 42 is provided with an inwardly extending shelf 44 arranged to be in substantially perpendicular relationship to the inner surface of the shoe 14 and immediately below the point of connection between the fabric 38 and the shoe 14. The shelf 44 is spaced slightly above the plate 36, as seen in side elevational view and is arranged to support the fabric 38 and prevent pockets or the like from forming therein which would accommodate the collection of rain water and other foreign material.

At a plurality of points peripherally spaced on the plate 36 and inboardly of the point of connection between the plate 36 and the related edge of the fabric 38 a plurality of holes or apertures 48 may be located. A pipe arrangement 50 is welded to the lower surface of the plate 36 so as to register with each aperture 48. Each pipe arrangement 50 extends downwardly whereat it is telescopically received in a chamber 52 defined by a housing 54 which has an upwardly facing open end. It will be clearly understood that the apertures 48, drain

pipes 50 and housings 54 are peripherally located at convenient intervals around the entire circumference of the roof. It will be noted that the housing 54 is secured to the roof a short distance below the plate 36 and below the product surface 10. The pusher springs 15 are also normally entirely immersed in the product to aid in the prevention of corrosion and deterioration thereof. The shoe 14 normally has its lower portion located in the product and extends only a short distance below the bottom plate or disk 56 of the roof 6. Further, the upper portion of the shoe 14 extends only a short distance above the surface 10 when the roof is in floating position in the tank.

As a result of this structure a relatively shallow vapor space 60 is provided immediately above the surface of the product 10. Because of this smaller vapor space it has been found that the vapor concentration in the space 60 is very rich and therefore considerably above the usual explosive or combustible range. The space S above the fabric 38 is openly vented to atmosphere whereby vapor concentration therein is reduced to an effective minimum and usually below the explosive or combustible range. Thus the disclosed structure is effective to reduce to a practical minimum the possibility of rim fire.

As noted the shelf 44 supports the outer portion fabric 38 a slight distance above the plate 36 thus preventing the collection of water and other foreign material thereon and accommodating drainage thereof to the plate 36 from whence it is carried downwardly via the pipes 50 and to the chambers 52. In the usual circumstance the chamber 52 is partially filled with water so that the lower edge of the pipe 50 is normally covered thereby rendering it impossible for vapors to escape through the pipe 50 to atmosphere. Noting that water has a specific gravity considerably higher than the product stored in the tank, it will upon filling escape from the chamber 52 and into the product whereat it will move downwardly to the bottom of the storage tank and there it may be drained or otherwise disposed of in any conventional manner.

Additionally, should a rim fire occur the space S is such that it readily accommodates the disposition of foam or other fire fighting material to effectively and quickly smother the fire.

Thus it will be seen that we have provided a novel, highly efficient sealing arrangement for tank structures of the type described which provides a tight fitting, flexible seal arrangement which in the first instance reduces vapor loss and secondly reduces the possibility of rim fires and explosions by reducing vapor space to a minimum so that trapped vapors collecting will normally be above the combustible range of the product and further will provide maximum venting from the space above the seal so that vapors in the latter space are normally below the combustible range of the stored product. The arrangement further accommodates maximum roof travel to the top of the tank thereby making available the full utilization of the maximum storage capacity of the tank without the possibility of the seal becoming functionally inoperative. It has been found that in structure of this type the tank can be filled to overflow and still the seal will functionally operate.

The invention as shown and described is by way of illustration and not limitation and may be subject to modifications without departing from the spirit thereof and the scope of the appended claims.

What is claimed is:

1. In a seal arrangement of the type described, a field storage tank having a vertical cylindrical wall, a roof floating on the product in the tank and having a rim generally paralleling the wall and separated therefrom to define an annular space therebetween, a flexible seal shoe abutting the wall and opposite the rim, mounting means on the outer periphery of the rim extending outwardly therefrom and located immediately above the normal level of product in the tank, a flexible fabric arranged to close the annular space, said fabric having its inner edge connected to the mounting means in spaced relation to the rim, fabric clip means connecting the outer edge of the fabric to the shoe at a point vertically above the mounting means, as seen in elevational view, a plurality of liquid drains communicating with said annular space above the fabric, liquid collection means operatively associated with said drains, spring means interposed between and engaging the rim and the shoe, and hanger means having opposed ends operatively connected to the shoe and roof to offer support for the former from the latter.

2. A seal arrangement according to claim 1, wherein said mounting means comprises a peripheral ledge secured to and extending outwardly from the rim, the inner edge of the fabric being connected to the ledge adjacent the outer edge thereof, and said fabric clip means comprises a shelf horizontally extending into the space from said shoe and underlying said fabric, said shelf being slightly vertically above the ledge as seen in elevational view to cause the fabric to assume a downward slope from the shelf to the ledge and whereby foreign matter is prevented from collecting on the fabric.

3. A seal arrangement according to claim 2, wherein each of said hanger means comprises a member secured to the roof and extending downwardly below same, and a hanger arm having its lower end pivoted to the lower extremity of the member and its upper end pivoted to the shoe.

4. A seal arrangement according to claim 3, and including a drain compartment secured to the roof below the ledge, and pipe means secured to the ledge and communicating with the upper surface thereof and extending downwardly into the compartment.

5. In a seal arrangement, a field storage tank having a vertical cylindrical wall, a roof arranged to float on the product in the tank, said roof having a vertical peripheral rim defining with the wall an annular space around the roof, said roof being arranged so that the level of product in the tank when the roof is floating thereon is normally above the lower edge of the rim, a seal arrangement for the annular space arranged to provide a minimum vapor space in said annular space and above the level of said product, said arrangement comprising a ledge horizontally extending from the outer periphery of the rim and immediately above said product level, a sealing shoe having a vertical dimension substantially less than the vertical dimension of said rim and arranged to abut the wall opposite the lower portion of said rim whereby the lower portion of said shoe is normally immersed in the product in said tank and the upper portion of the shoe extends only slightly above the level of said product in said tank, rigid members secured to the roof and extending below the bottom thereof, hangers having their lower ends pivoted to the members adjacent the lower extremities thereof, said hangers extending upwardly and outwardly as seen in elevational view and having their upper ends pivoted to the shoe at points at or slightly below the level of product in the tank, spring means compressively interposed between the rim and the shoe and arranged to engage the latter at the approximate vertical level of said points as seen in elevational view, and a seal fabric of flexible material disposed in said space and having its inner edge connected to the ledge and its outer edge connected to the shoe slightly above the level of the ledge as seen in elevational view.

6. A seal arrangement according to claim 5, and including a shelf horizontally projecting into said space from shoe at a point slightly above the level of said ledge and below said fabric as seen in elevational view.

7. A seal arrangement according to claim 6, and including drain means comprising apertures in said ledge communicating with downwardly extending pipes, and compartments secured to the roof and below the level

of product in the tank, said compartments telescopically receiving said pipes.

8. A seal arrangement of the type described according to claim 2, wherein said drains comprise apertures in said ledge communicating with downwardly extending pipes, and said liquid collection means comprises compartments secured to the roof and below the level of product in the tank, said compartments telescopically receiving said pipes.

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