Nov. 25, 1958 I. L. WISSMILLER ET AL 2,861,715

FLOATING ROOF TANK AND COOLING MEANS THEREFOR

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Fig. 1.

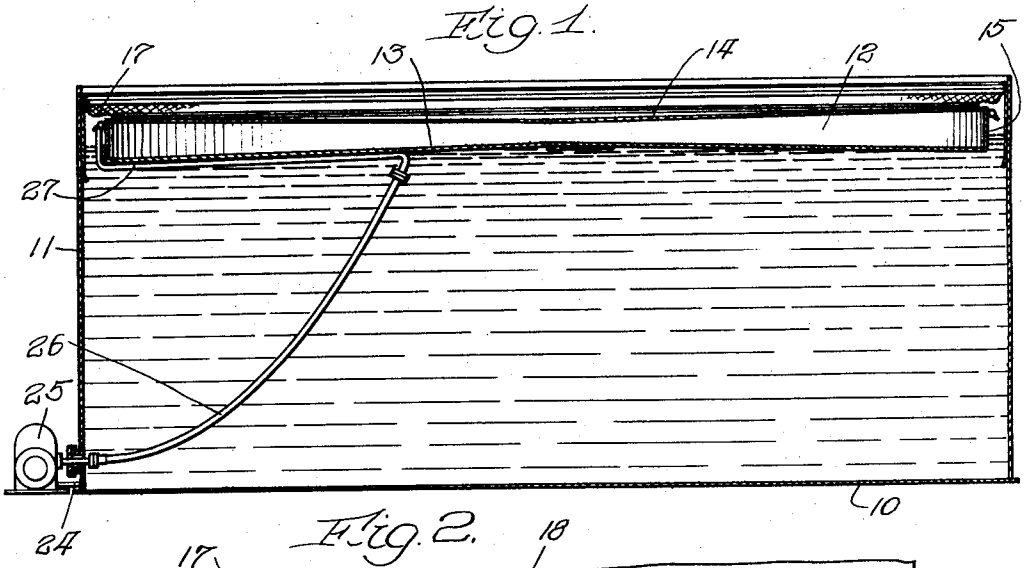
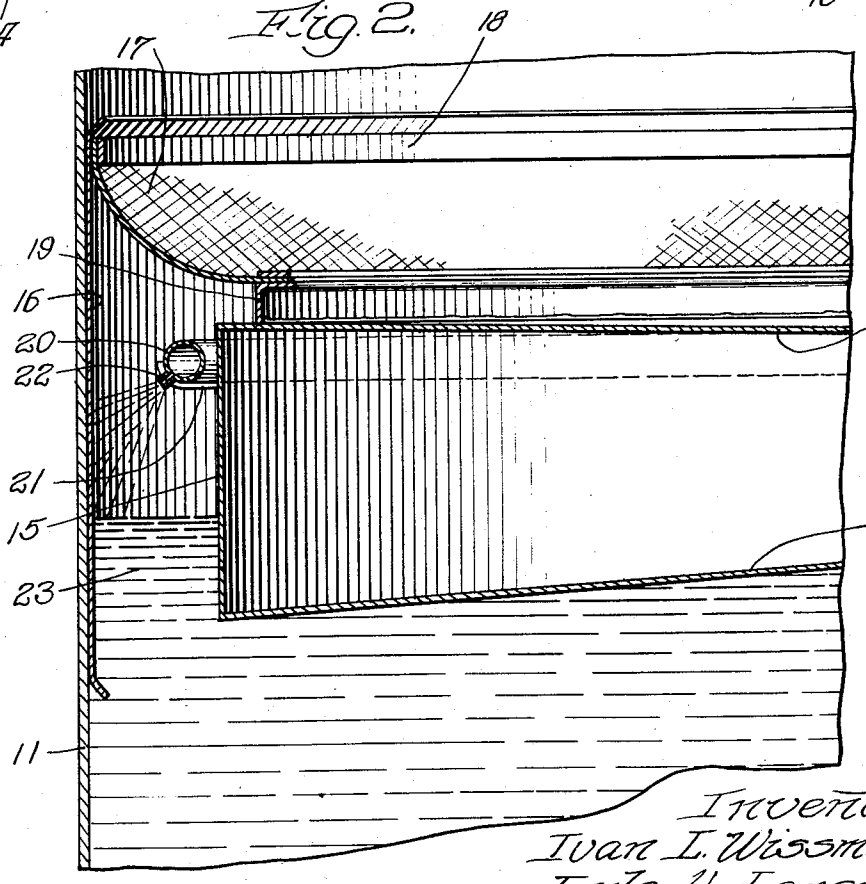


Fig. 2.



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Fig. 3.

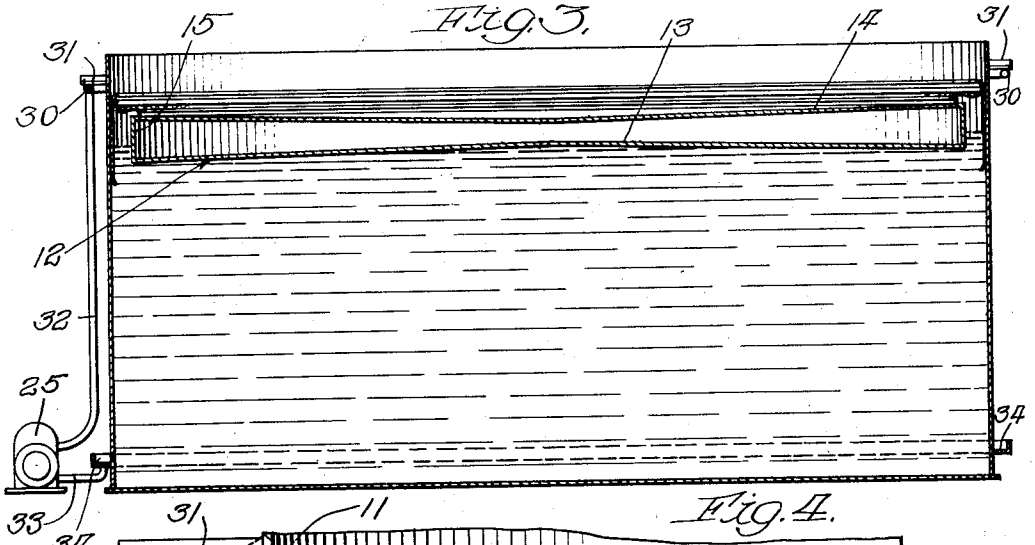
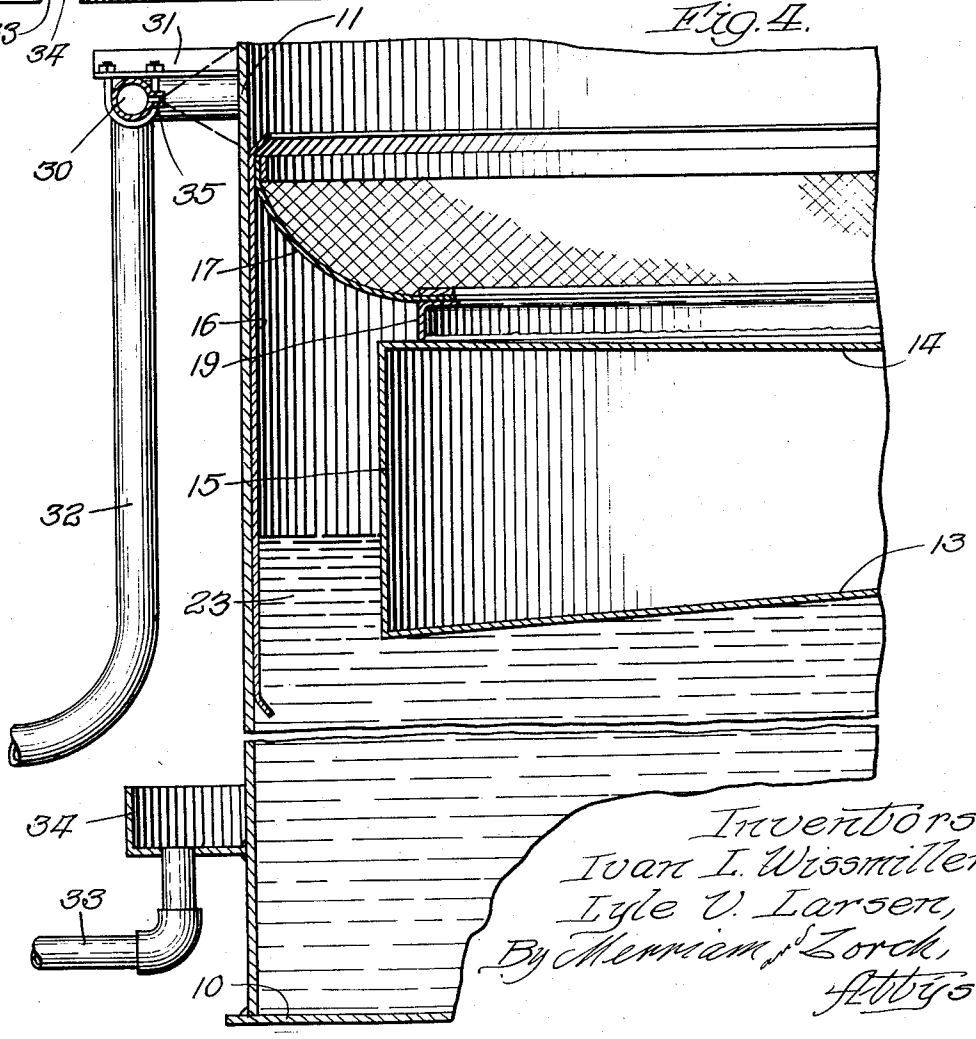


Fig. 4.



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Fig. 5.

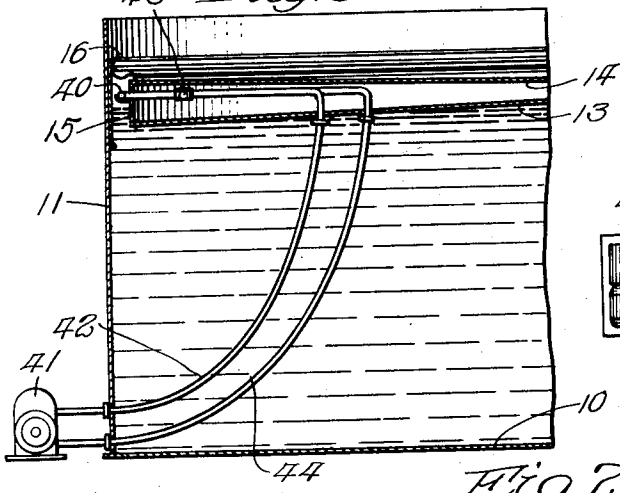


Fig. 6.

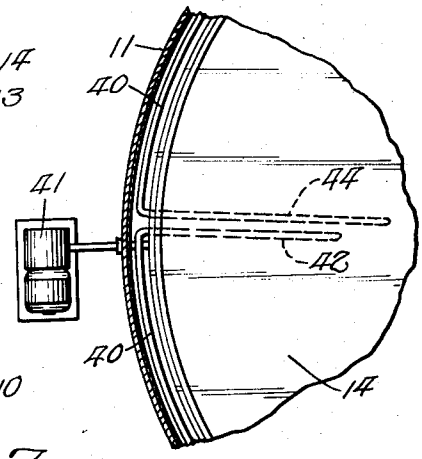
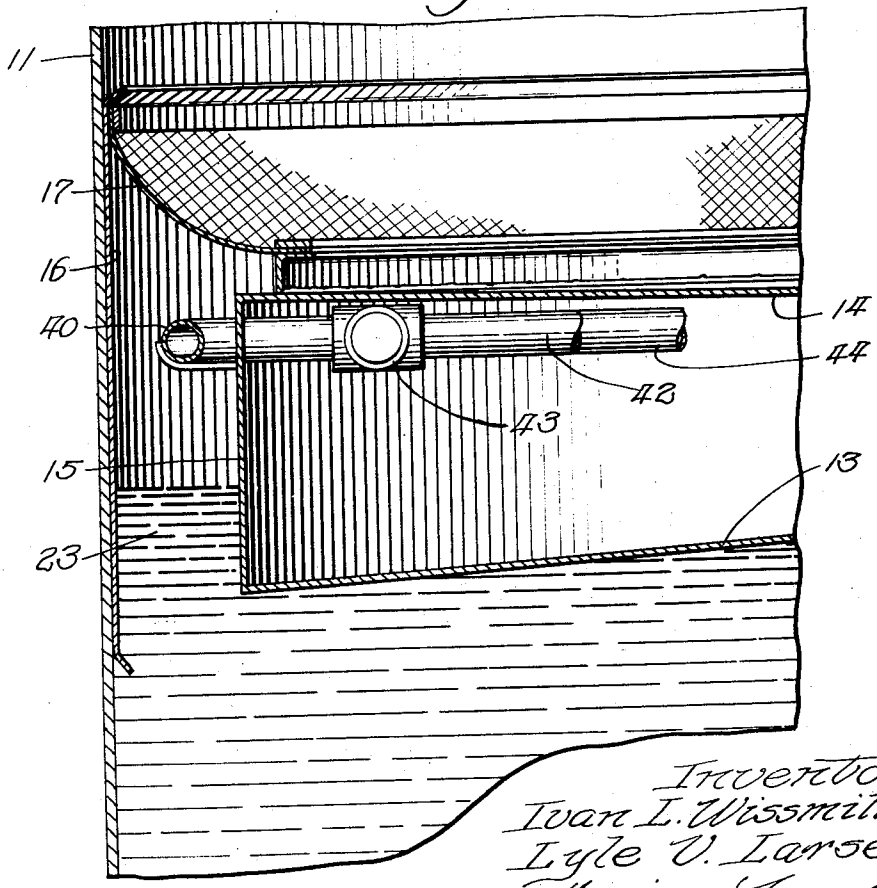


Fig. 7.



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FLOATING ROOF TANK AND COOLING MEANS THEREFOR

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Application September 16, 1954, Serial No. 456,397

1 Claim. (Cl. 220—85)

This invention relates to an apparatus for storing volatile liquids and more particularly to an apparatus for storing natural gasoline in a floating roof storage tank.

Natural gasoline is sufficiently volatile that it will boil at temperatures ordinarily encountered in storage. Since the boiling temperature is often exceeded in the usual storage tanks, particularly in the southern States where the largest volume of natural gasoline is stored, it must be stored in either cooled or pressure containers. The cooled containers are generally insulated, fixed volume, nonpressure tanks. The pressure containers are normally designed to withstand a pressure of about 10 to 20 p. s. i. g. The cooled containers have been more costly than the pressure containers because of the insulation and refrigeration required, so most natural gasoline is now stored in pressure containers.

The present invention provides an apparatus for storing natural gasoline in the usual type of floating roof storage tank now in widespread use for storing less volatile products such as refined motor gasoline. This apparatus has many advantages, the most attractive of which is that the initial cost of a floating roof storage tank is only a little more than one third of that of a pressure vessel of the same capacity designed to withstand a pressure of 10 p. s. i. g. This apparatus has the added advantages of eliminating the filling losses experienced in pressure storage, reducing the fire hazard and providing a container with greater operational flexibility.

The large volume, cooled nonpressure containers that have been used have had cylindrical shells, flat bottoms and low pitch cone or umbrella roofs. The insulation and refrigeration of these containers have been designed not only to prevent boiling, but also to maintain a fairly constant temperature within the container. This has been necessary to prevent the extensive evaporation losses that otherwise would have occurred through daily thermal expansion and contraction of the container's vapor space.

This invention utilizes a proven structure in a novel manner to eliminate the former large vapor space, and thereby disposes of the necessity of maintaining the nearly constant temperature as mentioned above. This permits many economies to be realized. Since the temperature can vary throughout a reasonable range, insulation is not required and the liquid temperature can be allowed to drop as far as desired to take full advantage of the cooling afforded by a minimum atmospheric temperature. The "cold" can be stored efficiently in the lower liquid layers for the peak temperatures. In most climates this will eliminate the need for supplementary cooling except for part of the year, and during only certain days of that part of the year. The supplementary cooling can be provided by relatively small units since the refrigeration can be stored in the liquid itself.

This invention, through the novel use of the floating roof storage tank, also allows a novel means of cooling to be used. Since the floating roof rests on and thereby covers most of the liquid surface, any vapor that is evolved through boiling can only escape around the periphery of the roof; this allows all of the cooling to be concentrated at this one place. The main body of the natural gasoline is self cooled through localized boiling, the vapor so formed would move outward to the edge of the roof where it would be returned to the liquid phase by direct or indirect contact with the cooling medium.

The cooling can be accomplished in several ways and preferred examples of apparatus for carrying out the invention are illustrated in the accompanying drawings in which:

Figure 1 is a vertical cross sectional view through a floating roof storage tank showing a cooling mechanism mounted in the tank;

Figure 2 is a fragmentary enlarged vertical sectional view through a portion of the tank adjacent the periphery of the floating roof and illustrating the spray ring shown in Figure 1;

Figure 3 is a view similar to Figure 1 illustrating another form of apparatus for accomplishing the cooling of the product in the tank;

Figure 4 is a view similar to Figure 2 showing the details of the apparatus illustrated in Figure 3;

Figure 5 is a fragmentary vertical sectional view through a floating roof storage tank showing a third apparatus for accomplishing the cooling;

Figure 6 is a fragmentary plan view partly broken away to illustrate the apparatus shown in Figure 5; and

Figure 7 is a fragmentary vertical sectional view enlarged in scale to illustrate a portion of the apparatus shown in Figure 5.

All of the apparatus illustrated in the various views of the drawings are intended for use in a floating roof liquid storage tank. The tank has a bottom **10** formed of plates placed on a prepared foundation to which sidewalls **11** are secured to form a cylindrical upwardly open tank. A very common size of tank is one of 100,000 barrels so that the tank would be around 120 ft. in diameter and approximately 48 ft. high. The dimensions can vary as to diameter and height within the particular requirements of a user in specifying the size of the tank desired.

The storage tanks are field erected and a floating roof **12**, herein illustrated as one of a double deck type, composed of a lower deck **13** and a spaced upper deck **14** jointed at the rim by an upstanding rim plate **15**, constructed in the tank before it is placed in service.

The floating roof is intended to float upon the stored product in the tank as its name implies. A sealing ring **16** extends around the periphery of the roof and is supported by hangers (not shown) secured to the floating roof so that the ring may slide upwardly and downwardly against the inside of the tank walls **11** as the roof rises and falls within the tank. A flexible fabric seal **17** is attached to the sealing ring by a clamp bar **18** and to an angle **19** on the periphery of the roof. The space between the rim **15** of the roof and the sealing ring will ordinarily be of the order of eight inches and the fabric **17** closes this space to avoid evaporation loss from the free liquid surface.

Natural gasoline will boil at temperatures normally encountered in storage. The vapors that are evolved must be condensed or vented and in the latter instance, valuable product would be lost. The floating roof rests in contact with the liquid throughout most, if not all, of its area. The only avenue for escape of vapors is thus between the roof and the sealing ring around the periphery of the tank. The present invention contemplates cooling of the product in this area both to condense any vapor that may be formed and to maintain the temperature of the product sufficiently low to prevent serious boiling, for example to maintain the vapor pressure of the liquid in the rim space at not substantially more than atmospheric pressure.

In the form of the invention illustrated in Figures 1 and 2, the cooling is effected by a spray of water or stored product. A spray ring **20** is supported about the roof by a number of brackets **21** secured to the rim **15**. The ring is provided with a number of orifices **22** at spaced intervals so as to deliver a spray against the sealing ring **16** and into the natural gasoline **23** in the area between the roof and sealing ring. The water or stored product is withdrawn through a connection **24** to the bottom of the tank. A pump **25** discharges through a flexible hose **26** connected to a delivery line **27** on the underside of the roof and in turn connected to the spray ring **20**. Artificial cooling of the water or stored product is provided if desired or needed in the particular locality where used.

The flexible hose permits the roof to rise and fall without disconnecting the pump from the spray ring. If desired, the particular location of the spray ring on the rim **15** of the roof may be varied in elevation. The ring could be immersed in the stored product **23** if desired or located closely to the liquid level.

The form of the apparatus illustrated in Figures 3 and 4 employs a spray ring **30** secured by brackets **31** to the upper course of the sidewall **11**. This ring is connected by a delivery line **32** with the pump **25** which obtains the water through an intake line **33** connected with a sump **34**. This sump takes the form of a collection trough near the bottom of the tank and is intended to collect water draining down the outside of the tank from the spray ring **30** and recirculate that water to the spray ring. Artificial cooling of the water or stored product is provided if desired and needed in the particular locality where used. The spray ring is provided with a number of orifices **35** which spray directly on the sidewall of the tank.

If desired, the spray ring may be mounted in such a way that it follows the rise and fall of the floating roof. Such mounting may be accomplished by cables properly reeved to cause rise and fall of the ring with the roof so that the spray is thus opposite the roof at all times.

The apparatus illustrated in Figures 5–7 employs a refrigeration coil **40** in the place of the previously described spray ring. The operation is substantially the same in that the coil is provided in the area about the roof. A pump and compressor **41** are provided with a

supply line **42** connected through an expansion valve **43** with the ring **40** and a return line **44** to the compressor **41**. The supply and return lines **42** and **44** preferably are flexible hose sections so that they do not interfere with the movement of the roof of the tank.

By providing the cooling in the area around the periphery of the roof, escape of valuable vapors from the natural gasoline can be prevented. The cost of providing the cooling apparatus as described is nominal so that considerable savings are effected on the basis of utilizing a floating roof storage tank construction.

The conduit for cooling fluid may be adapted for controlling only a portion of the periphery of the tank, as for example, that portion exposed to the sun.

The foregoing detailed description has been given for clearness of understanding only, and no unnecessary limitations should be understood therefrom, for some modifications will be obvious to those skilled in the art.

We claim:

Cooling apparatus for a floating roof liquid storage tank having a sealed annular rim space between the floating roof and the tank side walls and an upper seal for said space, said cooling apparatus comprising a conduit ring supported from said floating roof in said annular space for movement vertically in the tank with rise and fall of the floating roof, said conduit ring extending about the tank adjacent the tank side walls, fluid connections to said ring for conducting cooling fluid through said ring, said ring having a plurality of orifices along its length for spraying the cooling fluid into heat exchange relation with said sealed rim space and the surface of the stored liquid.

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