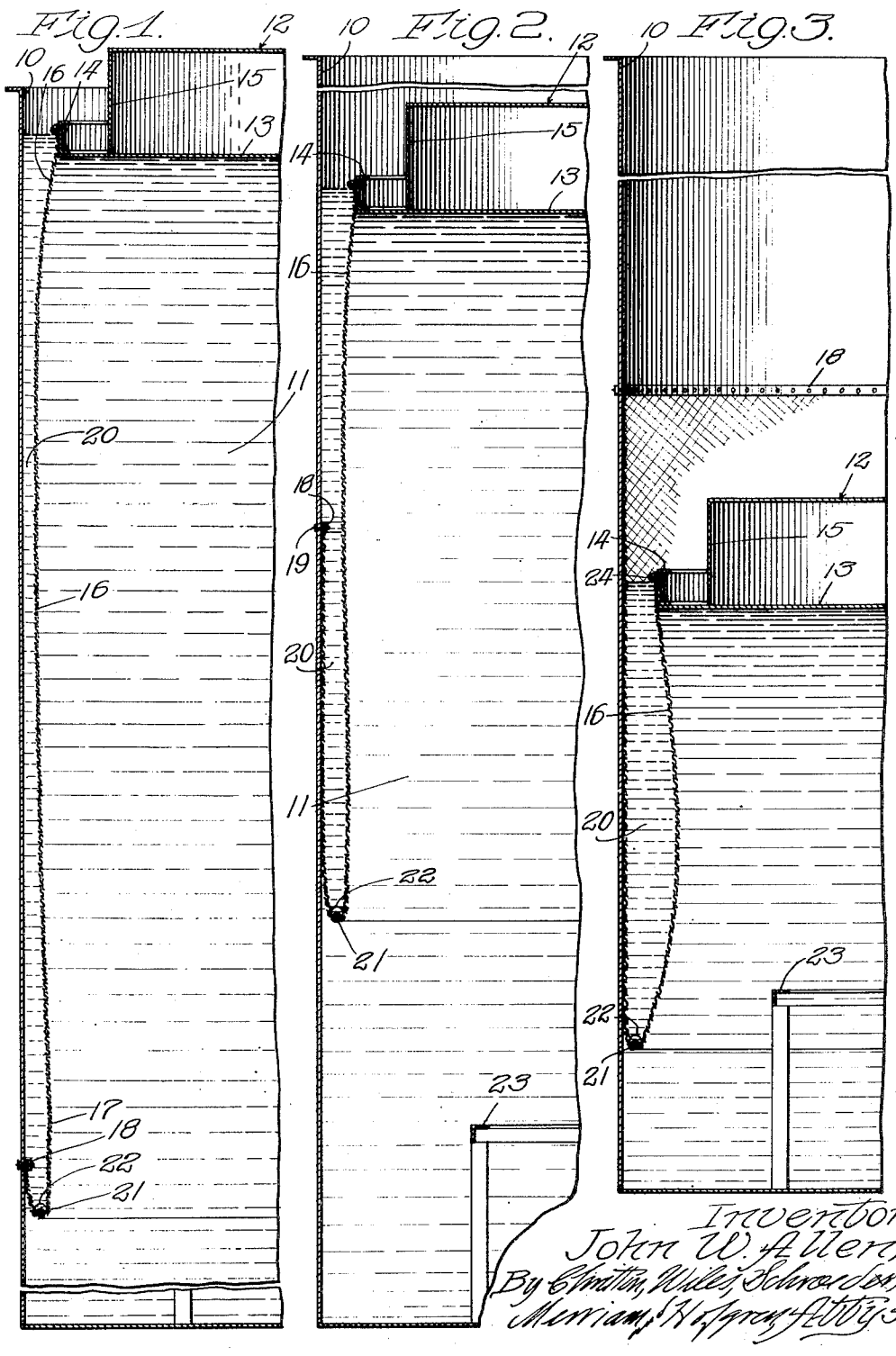
Feb. 21, 1950 J. W. ALLEN 2,497,850

SEAL FOR FLOATING ROOF TANKS

Filed Aug. 6, 1945 2 Sheets-Sheet 1



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Fig. 4.

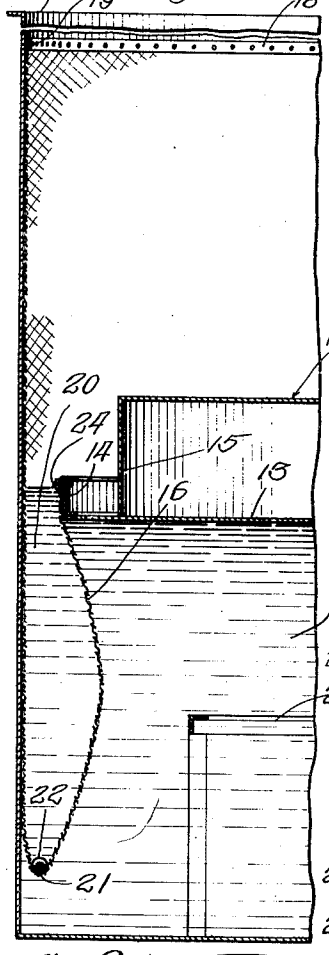


Fig. 5.

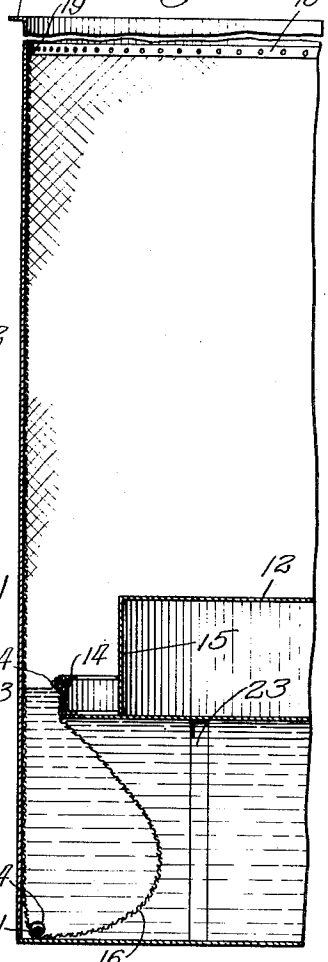


Fig. 6.

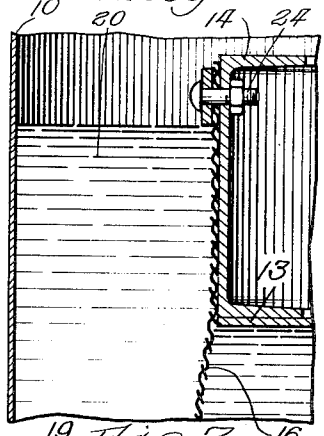


Fig. 7.

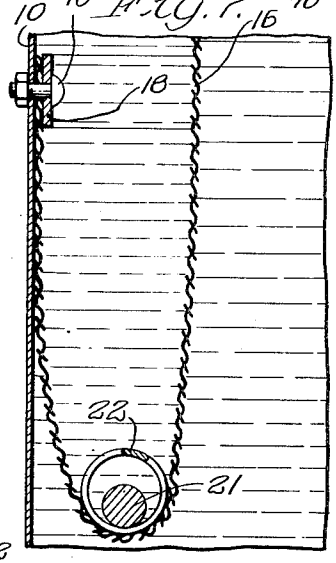


Fig. 8.

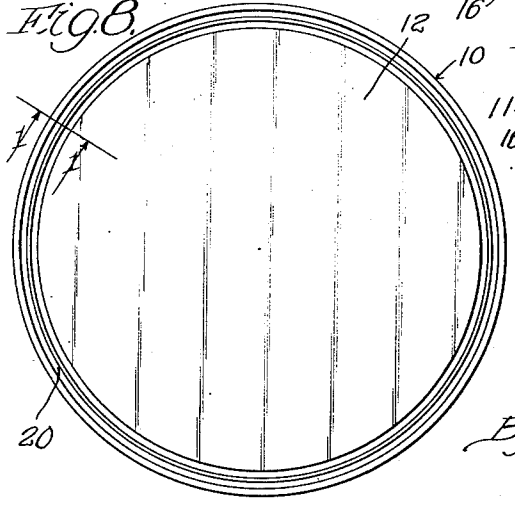
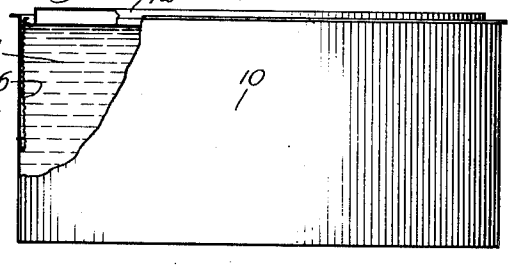


Fig. 9.



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SEAL FOR FLOATING ROOF TANKS

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6 Claims. (Cl. 220—85)

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This invention relates to a storage tank for liquids of the type using a floating roof to cover the liquid and relates particularly to a seal for sealing the edge of the roof to the inner walls of the tank.

Where it is desired to store relatively volatile liquids it has been found that less loss will occur from evaporation if floating roof tanks are used. In these tanks there is substantially no clearance between the top of the liquid and the roof of the tank, as the roof floats on the liquid and rises and falls with the liquid level. These tanks have a maximum volume above which the roof does not rise and have a minimum volume wherein the roof rests on supports at the bottom of the tank when the liquid level falls below the top of the supports.

In storage tanks of the floating roof type it is necessary to provide a seal between the edge of the roof and the inner surface of the tank so as to prevent losses of the stored liquid due to evaporation. The seal must not resist the rising and falling of the roof and must provide a very tight seal, as tanks of this type are used for storing very volatile liquids. If evaporation were permitted to occur the loss of liquid would be very great.

I have invented a new type seal for a floating roof tank wherein the seal does not resist when the roof rises and falls, and yet provides a tight seal between the roof and the tank shell. The new seal comprises a flexible, substantially liquid-impervious member extending around the tank from the floating roof to the inside surface of the tank and forms a trough therebetween at all positions of the roof. This trough is substantially filled with a liquid having a specific gravity substantially equal to that of the liquid within the tank. With such a structure the flexible member is hanging freely in a liquid, and forms a tight, impervious seal.

One embodiment of the invention is set out in the accompanying drawings. Of the drawings Fig. 1 is a vertical section through the floating roof tank with the roof at its topmost position; Fig. 2 is a section similar to Fig. 1 showing the roof in an intermediate position; Fig. 3 is a section similar to Fig. 1 showing the roof still lower in the tank; Fig. 4 is a section similar to Fig. 1 showing the roof in the bottom half of the tank; Fig. 5 is a section similar to Fig. 1 showing the roof at its lowest position in the tank; Fig. 6 is an enlarged fragmentary vertical section of the edge of the roof; Fig. 7 is an enlarged fragmentary vertical section showing the bottom of the

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tank; Fig. 8 is a plan view of a tank embodying this invention wherein Figs. 1 to 5 inclusive are taken along the section lines shown, and Fig. 9 is an elevation of the tank embodying this invention with portions broken away for clarity of illustration.

The floating roof tank embodying this invention comprises an outer cylindrical shell 10 having a liquid 11 stored therein. On top of the stored liquid is located a roof 12 which floats thereon. The floating roof includes a flat base 13 around which is positioned a vertical channel beam 14. On top of the flat base 13 of the floating roof are located sealed air chambers 15.

A fabric curtain 16 is fastened to the floating roof 12 and the shell 10 of the tank so as to extend between them and form a trough 17. The fabric curtain is fastened to the floating roof by bolting it between the channel beam 14 and the flat base 13 of the roof by bolts 24. The other edge of the curtain is fastened to the inner surface of the shell 10 by bolting this edge to the shell and the curtain is held in place by means of a circular metal bar 18 fastened to the tank by means of bolts 19.

The liquid-impervious curtain 16 hangs between the floating roof 12 and the shell 10 to form a trough in all positions of the roof. In a tank 43½ feet high the outer edge of the curtain is fastened approximately 25 feet beneath the top of the tank, and when the tank is full, as shown in Fig. 1, the trough extends substantially 2 feet beneath the line where is is fastened to the shell. Thus, as there is a trough provided when the tank is full, this trough will exist at all lower positions of the roof.

A liquid seal is provided by filling the space between the curtain 16 and the shell 10 with a sealing liquid 20 having substantially the same specific gravity as the liquid 11 within the tank. This means that the curtain 16 hangs freely in a liquid medium and the pressure on each side of the curtain is the same at all positions of the roof.

The volume of the sealing liquid 20 remains constant throughout the travel of the floating roof and the fabric curtain changes shape as shown in Figs. 1 to 5 inclusive, as the liquid pressure on each side of the curtain remains constant. When the roof 12 is at its highest point in the tank (Fig. 1) the curtain is bowed outward toward the shell. This same thing holds true at an intermediate position between the highest point of rise of the roof and a middle point (Fig. 2). When the floating roof is down toward the

bottom of the tank the fabric curtain bows inward (Figs. 3 to 5 inclusive). Because the curtain has the effect of hanging freely in a liquid with pressure on both sides of the curtain being the same, the volume enclosed by the curtain and the shell 10 of the tank is the same at all positions of the roof 12.

The fabric curtain used to hold the sealing liquid 20 must be liquid-impervious, so that there can be no leakage through the curtain. A suitable curtain is made from a fabric impregnated with a liquid-impervious flexible solid material such as a synthetic rubber. One of the best materials for this purpose is neoprene.

The dimensions of the fabric curtain are not of vital importance, so long as a trough is formed at all times between the floating roof and the shell of the container. In the embodiment shown, where the tank is 100 feet in diameter, 43½ feet tall, and the outer edge of the curtain is fastened 25 feet from the top of the tank, the curtain will extend down about 2 feet from the line where it is fastened to the shell.

With the dimensions given above and the edge of the floating roof being about 8 inches from the shell of the tank the curtain in Fig. 1 will average about 4½ inches away from the shell. As shown in Fig. 2, this distance will be about 7 inches; in Fig. 3, 12 inches; in Fig. 4, 15 inches; and in Fig. 5, 24 inches. The volume of the liquid contained by the curtain will be the same at all positions of the roof.

It is preferred that the curtain not be permitted to rub against itself or against the shell of the tank during the roof's travel. This will not happen where the specific gravity of the sealing liquid is substantially equal to the specific gravity of the liquid in the tank.

In order to assist in holding the curtain down there is preferably provided a weight at the bottom of the curtain, and this weight may consist of a bar 21 arranged in a circle of smaller diameter than the diameter of the tank and having a circular cross section. Around this bar is located a coil spring 22 of larger diameter than the diameter of the rod 21. As the roof rises and falls the coil spring rolls in the curtain and thereby prevents the rubbing of the rod against the curtain.

In order that the curtain 16 will not be folded upon itself and pressed down by the roof when the tank is substantially empty of liquid, there is provided a framework 23 upon which the floating roof rests when in its lowermost position (Fig. 5).

Having described my invention together with one embodiment of the same, it is my intention that the invention be not limited by any of the details of description but rather be construed broadly within its spirit and scope as set out in the accompanying claims.

I claim:

1. A seal for a floating roof tank or the like comprising a flexible substantially liquid-impervious cylindrical curtain extending around the tank, said curtain having one peripheral edge secured to the floating roof and having the other edge secured to the side of the tank to form a trough therebetween at all positions of the roof, the length of the curtain between its edges being substantially equal to twice the minimum depth of the desired trough plus one half of the vertical travel of the roof within the tank plus the distance between the point of attachment of the curtain to the tank and the midpoint of the roof travel within the tank and a weight located at the bottom of the trough and freely movable relative to said curtain with vertical movement of the roof.

2. The seal of claim 1 in which said weight comprises a liquid substantially filling the trough at all positions of the roof within the tank.

3. The seal of claim 2 in which said liquid has substantially the same specific gravity as that of the liquid within the tank.

4. The seal of claim 1 in which said weight comprises an endless rod of substantially circular cross section surrounded by a coil spring of greater diameter than the rod and normally contacting the rod only at the bottom thereof.

5. A seal for a floating roof tank or the like comprising a flexible substantially liquid-impervious cylindrical curtain extending around the tank, said curtain having one peripheral edge secured to the floating roof and having the other edge secured to the side of the tank to form a trough therebetween at all positions of the roof, the length of the curtain between its edges being substantially equal to twice the minimum depth of the desired trough plus one half of the vertical travel of the roof within the tank plus the distance between the point of attachment of the curtain to the tank and the midpoint of the roof travel within the tank, whereby said curtain forms a trough having a substantially constant volume at all positions of the roof, said trough being substantially filled with a liquid at all positions of the roof within the tank.

6. The seal of claim 5 in which said liquid has substantially the same specific gravity as that of the liquid within the tank.

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