Dec. 13, 1949 J. W. ALLEN 2,490,767

SEAL FOR FLOATING ROOF TANKS

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Fig. 1.

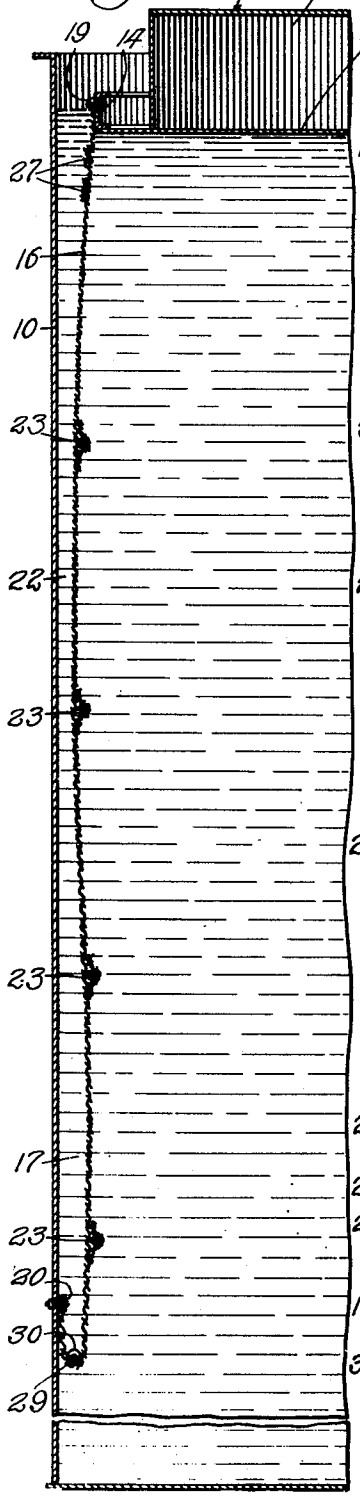


Fig. 2.

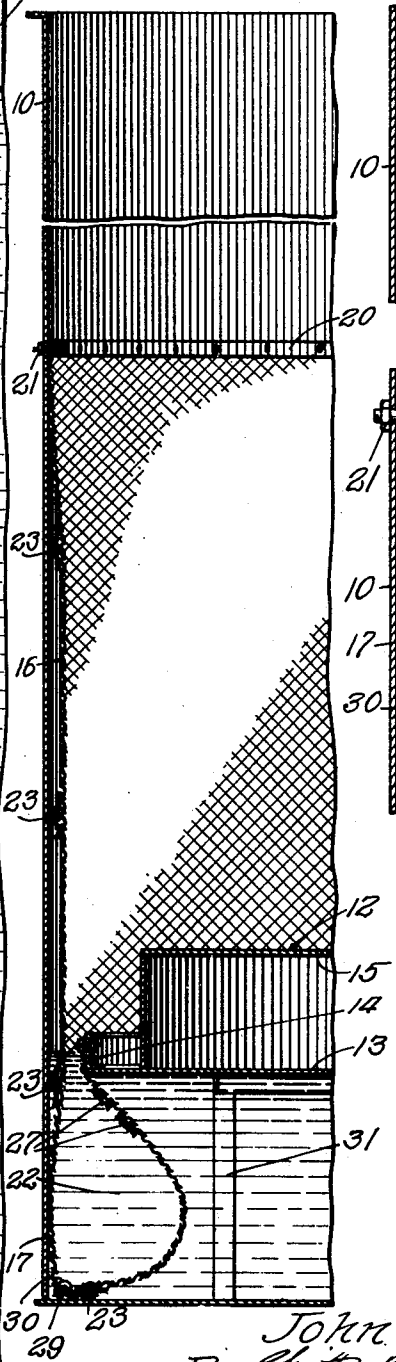


Fig. 3.

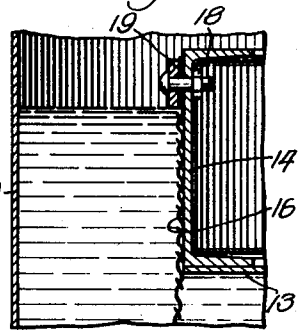
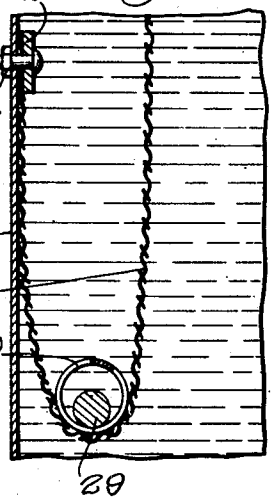


Fig. 4.



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Fig. 5.

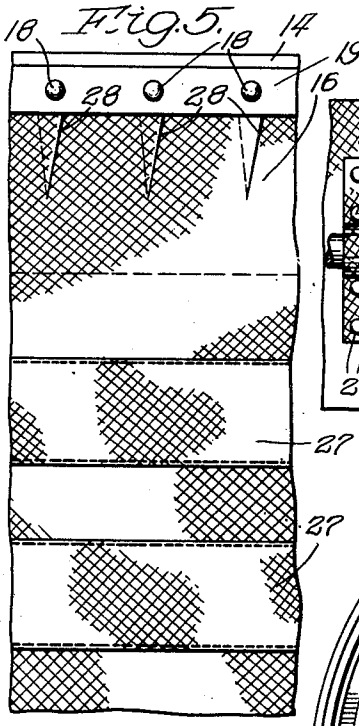


Fig. 6.

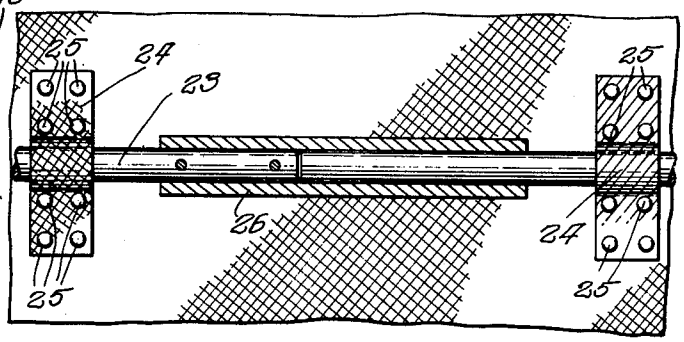


Fig. 7.

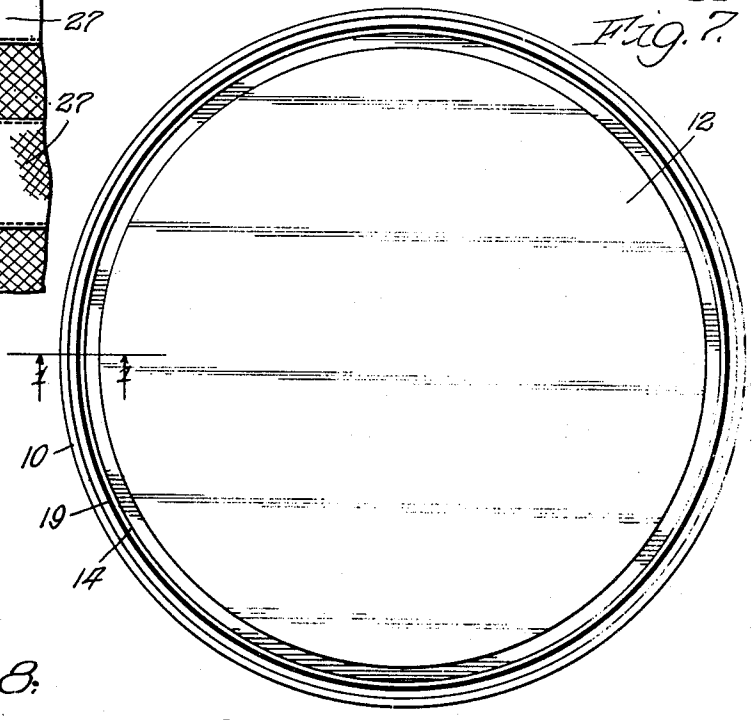
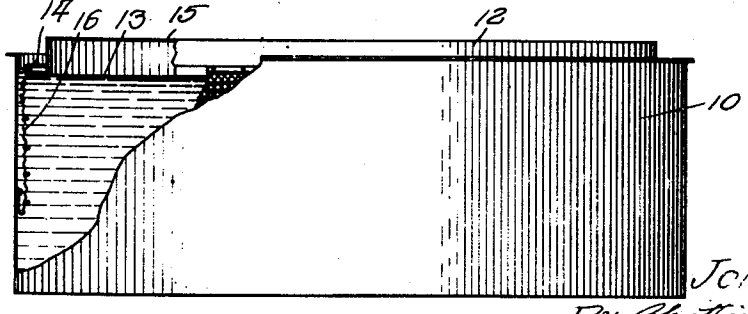


Fig. 8.



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UNITED STATES PATENT OFFICE

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SEAL FOR FLOATING ROOF TANKS

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Application November 1, 1945, Serial No. 625,993

10 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 shell of the tank.

In order to prevent evaporation losses during the storage of volatile liquids, these liquids are often stored in floating roof tanks wherein the roof floats on top of the liquid and rises and falls as the quantity of stored liquid within the tank is increased and decreased. In these tanks there are provided seals between the edge of the roof and the shell of the tank in order to prevent evaporation losses and contamination in this area. These seals must be of the type that will not prevent the roof from rising and falling.

I have invented a new type seal for a floating roof tank wherein the seal does not lift when the roof rises and falls, and yet provides a tight seal between the roof and the tank shell. This new seal comprises a flexible substantially liquid-impervious member extending around the tank from the floating roof to the inside surface of the tank shell and forms a trough therebetween at all positions of the roof. The flexible member is preferably a fabric impregnated with a flexible liquid-impervious material such as a synthetic rubber. One of the best synthetic rubbers for this use is neoprene. The trough formed by the fabric seal is substantially filled with a liquid having a specific gravity greater than that of the liquid within the tank. This liquid will substantially fill the trough at all positions of the roof, as when the roof is in its highest position the trough is long and narrow, and as the roof falls the trough becomes shorter and wider. In a preferred embodiment the fabric seal is provided with expandable stiffening members that serve to prevent the heavier sealing liquid from forcing the seal inward due to its greater specific gravity.

One embodiment of the invention is set out in the accompanying drawings. Of the drawings, Fig. 1 is a partial vertical section through the floating roof tank with the roof at its topmost position; Fig. 2 is a section similar to Fig. 1 with the roof in its lowest position; Fig. 3 is an enlarged fragmentary vertical section of the edge of the roof; Fig. 4 is an enlarged fragmentary vertical section showing the bottom of the trough; Fig. 5 is a fragmentary elevation showing a portion of the edge of the roof with the seal fabric attached thereto; Fig. 6 is a fragmentary elevation showing a portion of the seal fabric with an expandable stiffening member attached thereto; Fig. 7 is a plan view of a tank

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embodying this invention; and Fig. 8 is an elevation of said tank with portions broken away for clarity of illustration.

The floating roof tank shown in the accompanying drawings 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 air chambers 15.

A fabric seal curtain 16 is fastened to the floating roof 12 and the shell 10 of the tank so as to hang down between them and form a trough 17. The fabric curtain is fastened to the floating roof by bolting it on the channel beam 14 by bolts 18 passing through the beam 14, the fabric seal 16, and a circular metal bar 19. The other edge of the fabric 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 second circular metal bar 20 fastened to the tank by means of bolts 21.

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 it 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 22 having a specific gravity greater than that of the liquid 11 within the tank. The volume of the sealing liquid 22 remains constant throughout the travel of the floating roof, and the fabric changes shape as shown in Figs. 1 and 2.

The fabric curtain used to hold the sealing liquid 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 synthetic rubber. One of the best materials for this purpose is neoprene.

Because the sealing liquid has a specific gravity greater than that of the liquid within the tank, stiffening members must be provided for the fabric to prevent the sealing liquid from sinking to the bottom of the trough, thereby permitting the top of the fabric to contact the shell and produce

a rubbing action as the roof rises and falls. These sealing members comprise spaced, horizontal circular pipes 23 attached to the fabric curtain on the side away from the trough. These circular pipes 23 are vertically spaced from each other and are attached to the curtain by means of a plurality of fabric strips 24. The circular pipe nearest the floating roof is spaced therefrom an appreciable distance. The fabric strips 24 that hold the circular pipes in place may be attached to the curtain in any desired manner, such as by means of rivets 25 extending through the strips and the curtain.

As the roof travels from its highest to its lowest position the circular pipes 23 are placed in contact with the shell 10. In order to accomplish this the pipes must be expandable. On one end of each circular pipe there is provided a collar 26 concentric with the end of the pipe and extending therefrom. This collar slidably holds the other end of the pipe with the two ends being in abutting relationship when the roof is in its highest position. Thus as the roof falls the force of the sealing liquid 22 causes each pipe to expand.

At the top of the fabric curtain near the floating roof there are provided tension strips 27 attached to the fabric. These tension strips are horizontal strips of fabric that are attached to the curtain by means of adhesives, rivets, or the like. The strips are preferably of the same impregnated fabric as used for the curtain. As these tension strips are made of flexible fabric they permit the top of the curtain to bow inward at intermediate positions of the roof.

The top of the fabric curtain is attached to the floating roof in a series of overlapping puckers 28 positioned about 4 inches apart.

The sealing liquid 22 within the trough 17 will ordinarily be sufficient to hold the fabric curtain down at all times. In order to provide a more positive holding down of the curtain there is provided a weight at the bottom of the trough. This weight may be a circular rod 29 within a coil spring 30 having a diameter larger than the diameter of the rod. As the roof rises and falls the spring 30 will roll and prevent substantial frictional contact between the rod 29 and 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 31 upon which the floating roof rests when in its lowest position (Fig 2).

Having described my invention as related to one embodiment of the same, it is my intention that the invention be not limited by any of the details of the description unless otherwise specified, 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 whereby said curtain forms a trough having a substantially constant volume at all positions of the roof, the trough being substantially filled with liquid at all positions of the roof within the tank and said liquid having a specific gravity greater than that of the liquid within the tank.

2. 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 and a weight located at the bottom of the trough, said trough being substantially filled with a liquid at all positions of the roof within the tank, said liquid having a specific gravity greater than that of the liquid within the tank.

3. The seal of claim 2 wherein the weight is freely movable relative to the said member as the roof rises and falls.

4. 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 therebetween at all positions of said roof, a plurality of substantially horizontal spaced stiffening members attached to the flexible curtain on the side away from the trough and extending around said curtain, said stiffening members comprising circular pipes with each pipe having a collar attached to one end extending therefrom with the other end of the circular pipe slidably held within said collar and with the two ends of the pipe abutting each other when the roof is in its highest position, and a substantially constant volume of a liquid having a specific gravity greater than that of the liquid within the tank substantially filling the trough at all positions of the roof within the tank.

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 substantially constant volume at all positions of said roof, a plurality of spaced substantially horizontal circular pipes

attached to the flexible curtain on the side away from the trough and extending around said flexible member with the circular pipe nearest the floating roof being spaced therefrom a substantial distance, each of said circular pipes having a collar attached to one end and extending therefrom with the other end of the circular pipe slidably held within said collar with the two ends of the pipe abutting each other when the roof is in its highest position, a plurality of spaced horizontal flexible strips attached to the flexible curtain on the trough side near the floating roof and a substantially constant volume of liquid having a specific gravity greater than that of the liquid within the tank substantially filling the trough at all positions of the roof within the tank.

6. The seal of claim 5 wherein the flexible member and the flexible strips are fabric impregnated with a flexible liquid-impervious material and the member is attached to the floating roof in a series of overlapping puckers.

7. 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 room 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 substantially constant volume at all positions of said roof, a plurality of spaced substantially horizontal circular pipes attached to the flexible curtain on the side away from the trough and extending around said flexible member with the circular pipe nearest the floating roof being spaced therefrom a substantial distance, each of said circular pipes having a collar attached to one end and extending therefrom with the other end of the circular pipe slidably held within said collar with the two ends of the pipe abutting each other when the roof is in its highest position, a plurality of spaced horizontal strips of the same material as the curtain attached to the curtain on the trough side near the floating roof, a weight positioned in the bottom of the trough and freely movable as the floating roof rises and falls, and a liquid having a

specific gravity greater than that of the liquid within the tank substantially filling the trough in all positions of the roof within the tank.

8. 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 said roof, a plurality of spaced substantially horizontal stiffening members extending around the flexible curtain and attached thereto on the side away from the trough, and a substantially constant volume of liquid substantially filling the trough at all positions of the roof within the tank.

9. The seal of claim 8 wherein the stiffening members are expandable when the roof moves from its highest position to its lowest position within the tank.

10. The seal of claim 8 wherein the stiffening members are circular pipes with each pipe having a collar attached to one end and extending therefrom with the other end of the pipe slidably held within the collar, said two ends of each pipe being in abutting relationship when the roof is in its highest position.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
135,172	Tiffany	Jan. 21, 1873
2,050,686	Wiggins	Aug. 11, 1936
2,102,299	Wiggins	Dec. 14, 1937
2,330,366	Jayne	Sept. 28, 1943
2,408,538	Wiggins	Oct. 1, 1946

FOREIGN PATENTS

Number	Country	Date
106,097	Australia	Dec. 22, 1938

Certificate of Correction

Patent No. 2,490,767 **December 13, 1949**

JOHN W. ALLEN

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 5, line 26, for the word "room" read *roof*;

and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 25th day of April, A. D. 1950.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.