

June 2, 1964

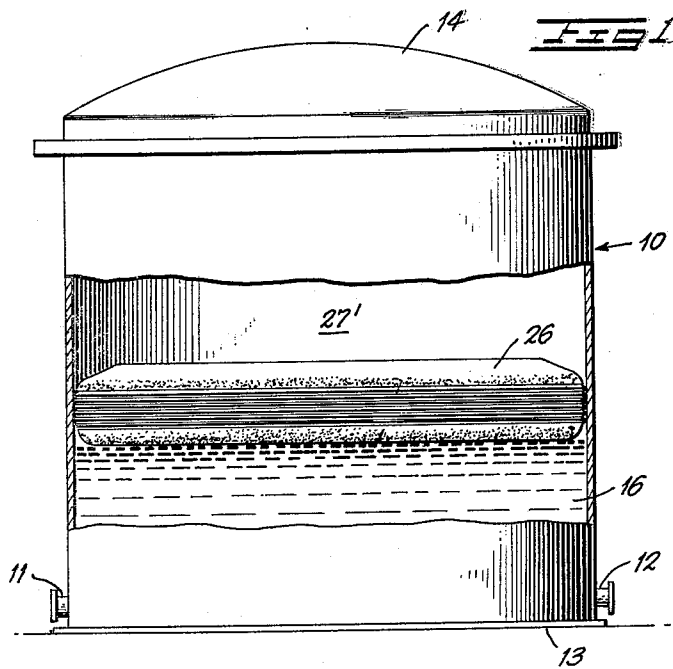
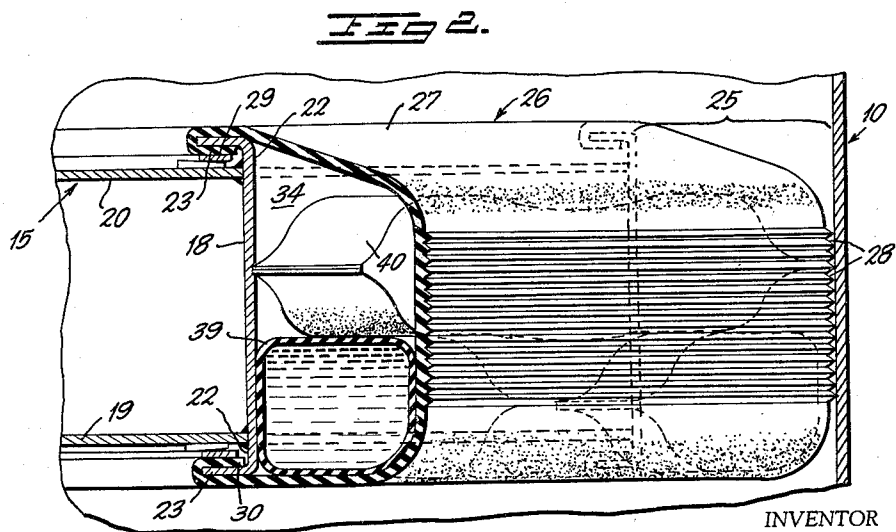
A. F. FINO

3,135,415

FLOATING ROOF SEAL

Filed Jan. 23, 1962

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

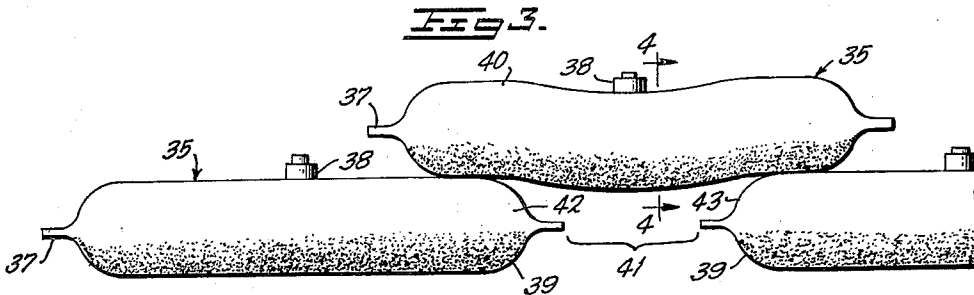
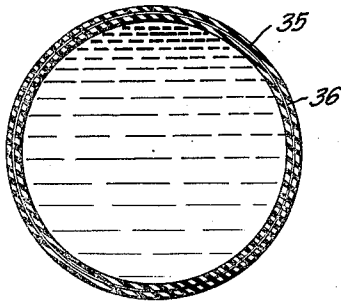
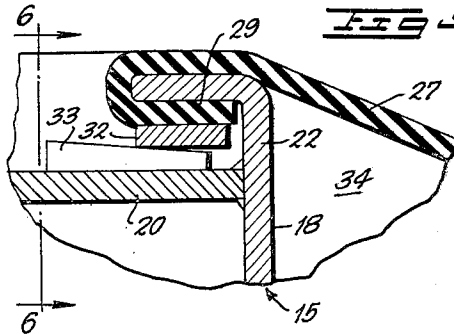
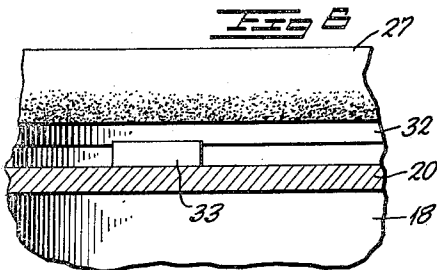
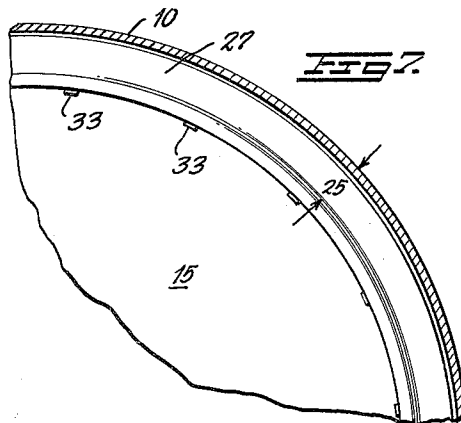
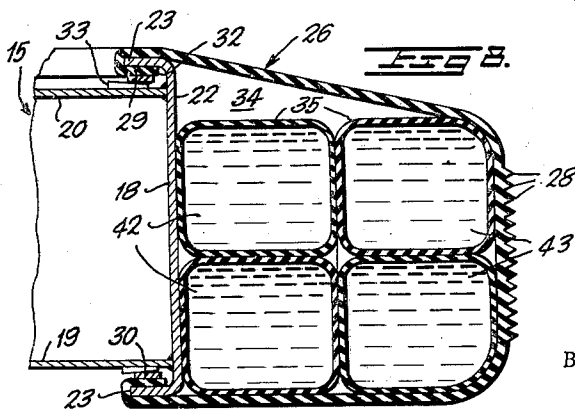


Fig. 4.



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3,135,415

FLOATING ROOF SEAL

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9 Claims. (Cl. 220-26)

The present invention relates to storage tanks for fluids, and more particularly to storage tanks of the type wherein it is desired to store gases or a liquid, such as oil and the like, which tanks employ roofs or covers that are supported by the gas or liquid within the tank and are adapted to rise and fall in accordance with variations in the gas pressure in the tank or the liquid level in the tank.

The present invention incorporates a tank having a cover that is ordinarily of smaller diameter than the inside wall of the tank, and accordingly, it is necessary to provide a sealing means for sealing the annular space between the cover and tank.

It is an object of the present invention to provide a floating roof seal for the cover member of a tank in which the sealing means comprise a plurality of individual or separate members adapted to be filled with a liquid and in which a rupture or puncture of one of the individual members will not prevent loss of the entire seal or ineffectual sealing of the tank.

It is another object of the present invention to provide floating roof seal means which eliminates the need of bolt members and the like for connecting the sealing means along its peripheral edge as commonly used heretofore.

It is another object of the present invention to provide a plurality of individual members forming a seal for a floating cover member for a tank, which has equalized hydraulic sealing effect provided by the independent flexible segments providing the seal.

It is another object of the present invention to provide sealing means for a floating roof or cover member made of a plurality of independent flexible members that may be stocked for ready use and hence do not require custom manufacturing thereof to fit odd size or odd diameter tanks.

It is another object of the present invention to provide a plurality of individual flexible sealing members that may be stacked upon one another to assume a fixed position with respect to each other once they are stacked, with the completed structure forming the sealing member.

It is another object of the present invention to provide a plurality of individual flexible sealing members disposed in a staggered arrangement so that they may be readily adjusted with respect to each other to accommodate unusual diameters with the correct number of sealing sections.

It is another object of the present invention to provide a plurality of individual flexible sealing segments in which a damaged section may be readily replaced without removing the tank from service, and in which any damaged section will result only in the loss of a small portion of the seal and not affect the entire seal, as distinguished from sealing means used heretofore which comprise but a single unit.

It is another object of the present invention to provide sealing means for a floating roof member comprising a plurality of independent flexible sections adapted to be readily filled with a liquid and in which the sections may be adjusted laterally of each other to form a circumference of longer or shorter dimensions as desired, so as to thereby be utilized in tanks of varying diameter.

It is another object of the present invention to provide sealing means for a floating roof for a tank in which the members are disposed in stacked relationship or stag-

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gered arrangement with one another, and in which they may also be stacked side by side in pairs, or in double one rows so as to seal a wide gap existing between the deck of the roof cover and the side wall of the tank shell to obtain proper sealing therebetween.

It is another object of the present invention to provide sealing means having a plurality of overlapping arranged independent flexible sections which permits a full hydraulic action throughout the periphery of the seal and which eliminates the necessity of a single endless tube or individual sections interconnected by liquid filled hoses such as used heretofore.

Various other objects and advantages of the present invention will be readily apparent from the following detailed description when considered in connection with the accompanying drawings forming a part thereof, and in which:

FIG. 1 is a side elevational view, partly broken away and in section, of a tank embodying the sealing assembly of the present invention;

FIG. 2 is an enlarged fragmentary perspective view of a portion of the floating roof and sealing means of the present invention;

FIG. 3 is an enlarged fragmentary detail view illustrating the staggered arrangement of the independent flexible members embodied in the present invention;

FIG. 4 is a cross section through an individual sealing segment of the invention;

FIG. 5 is an enlarged detailed view illustrating the method of securing the wearing band of the assembly to the floating roof deck;

FIG. 6 is a detailed view in the direction of the arrows 6-6 of FIG. 5, illustrating the connection of the wearing band to the floating roof deck;

FIG. 7 is a fragmentary top view of a portion of the floating roof deck, wearing band and side wall of the tank; and

FIG. 8 is an enlarged fragmentary sectional view of a modification of the invention illustrating a double row of stacked separate sealing members.

Referring to the drawings, the reference numeral 10 designates a metal cylindrical tank having an inlet connection of pipe 11 and an outlet connection 12 in the bottom thereof. The inlet and outlet connections are provided for filling the storage tank with a gas or liquid and discharging it therefrom to its point of use when desired. The tank is provided with a bottom 13 and a top 14, although, of course, it is obvious that the tank need not necessarily have a top if it is not desired. If the tank is completely sealed, it is generally provided with access openings or doors so that the floating roof hereinafter described may be inspected and any parts may be replaced, if necessary.

The tank is provided with a floating structure, deck or roof member generally designated 15. Member 15 is freely disposed within the vessel so that it may float or rise upwardly and downwardly to confine the liquid in the chamber generally designated 16 that is disposed below the floating deck structure 15. The volume or size of chamber 16 will vary depending upon the amount of gas or liquid introduced into the tank and the amount of it that is removed therefrom through the inlet and discharge connections.

The floating deck 15 is generally cylindrical and has a cylindrical side wall 18, a bottom wall 19 and a top wall 20. The cylindrical wall 18 and the top and bottom 20 and 19 are rigidly secured to one another, such as by welding or the like, so as to form a hollow cylindrical floating member. The side wall 18 extends substantially above and below the top and bottom as indicated at 22,

and terminates in inwardly projecting annular horizontal flanges 23, as clearly shown in the drawings. The diameter of the wall 18 is substantially less than the diameter of the inner surface of the cylindrical tank 10 so as to provide a wide opening or annular gap 25 therebetween as shown in FIG. 2. The provision of the gap permits the floating structure 15 to readily rise and fall in the tank without coming in contact with the inner side wall surface of the tank 10. The space or gap 25 is provided with sealing means 26 disposed therein so as to completely seal off the upper portion of the tank 27' above the floating deck 15 from the portion 16 of the tank below this member so that the tank may properly store liquid and gases therein.

Sealing means generally designated 26 are provided with an annular wear band 27 formed of a flexible material, such as reinforced synthetic rubber having a nylon or equivalent reinforcing core, and in which the synthetic rubber may be butadiene acrylonitrile or the like. The wear band 27 may also be constructed of electricity conducting material in the event that electrically charged liquid is stored that requires positive grounding at all points. A plurality of continuous horizontally extending ribs 28 are provided on the outer surface or circumference of the scuff or wearing band. The ribs 28 tend to ride over sharp edges of rivets or other protuberances and irregularities that may be on the inner surface of the side wall of the tank, while at the same time reducing wear on the wearing band and the tank wall.

The wearing band is connected to the horizontal flanges 23 of the floating deck 15 by taking the upper and the lower free inner ends or edges 29 and 30 respectively of the wearing band and wrapping them around the inner side of flanges 23 so that the ends 29 and 30 overlap the inner edge of the flanges 23 by approximately two to three inches.

A wedge bar 32, as best seen in FIGS. 5 and 6, which is rectangular in cross section, is disposed inwardly of the flanges 23 between the tucked-in or overlapping edges 29 and 30 of the wearing band, and the top and bottom respectively, of the deck member 15. The wedge bar 32 is generally made up of a split ring or may be made of a plurality of arcuate sections, as desired. The ends 29 and 30 of the wearing band are securely connected to the flanges 23 by inserting a plurality of wedges 33 between the top and bottom respectively, of the floating deck and the wedge bars 32 as shown in FIGS. 5 and 6 to thereby eliminate the necessity for using bolt members and the like to properly secure the wearing band to the floating deck. The wedges 33 are preferably spaced apart approximately two feet. Disposed within the annular chamber 34 defined by the wearing band 27, the cylindrical deck side wall 18 and flanges 23 of the floating deck are a plurality of liquid-tight flexible sections or members 35.

The flexible members 35 are generally tubular in cross section as shown in FIG. 4, and preferably consist of synthetic rubber, such as Buna-N in which is disposed a nylon core 36, the thickness of the entire section being preferably 0.040 inch. The individual or separate sections 35 have their opposite ends sealed in a fluid-tight relationship to provide a flat pinch type closure 37 as best shown in FIG. 3. Each individual segment is provided with a filling connection 38 having a removable plug therein for filling the section with a liquid. The flexible sections are approximately ten inches in diameter and approximately ten feet long with the opposite ends of the section being of a pinch type configuration as already described, instead of the usual circular or round configuration. The sections 35 are disposed within chamber 34 in vertical rows comprising a lower row 39 and an upper row 40 with the sections in the upper row 40 being supported on the sections in lower row 39 as best seen in FIGS. 2 and 3. The individual units that make up lower row 39 have their opposite ends disposed in spaced relationship with one another as indicated at 41.

The individual sections 35 forming the upper row 40 are disposed on the two adjacent sections 35 in the lower row 39, so that they are positioned over the space 41, and have their opposite ends overlapping and being supported by the adjacent ends 42 and 43 (see FIG. 3) of two individual sections in the lower row 39 to thus provide a staggered arrangement. The sections are installed in the staggered position as indicated in FIG. 3, with the space 41 being approximately one-third of the length of 35. With such a staggered arrangement, it is apparent that the space 41 may be decreased or increased as desired, by merely positioning two adjacent sections in the lower row 39 closer to one another or moving them apart. This permits the dimension of the circumference of the circle the individual sections form, to be varied to accommodate unusual diameter tanks with the correct number of sealing sections.

In operation, the cover will rise and fall in accordance with variations in the gas pressure stored within the tank, or the quantity of oil or other liquid disposed therein. The wear band 27 will be maintained in engagement with a substantial area of the inner surface of the tank 10 due to the weight and action of the water, oil, other liquid or granular substance within the individual flexible hollow members 35 resiliently forcing it against the wall, and the gas pressure or the liquid in the portion 16 of the tank below the floating structure 15. Also, if desired, the members 35 may be filled with finely divided plastic material that gives the same results as if the members were filled with the aforementioned liquid material. The wearing band will be maintained in efficient sealing engagement with the walls of the tank regardless of any irregularities in the tank walls. It will be noted that the use of a plurality of independent flexible filled sections 35 eliminates the necessity that the connection of the ends 29 and 30 of the wearing band to the flanges 23 be secured thereto, in a liquid or gas tight manner for proper operation since the sections 35 form a complete seal between the side wall 18 of the floating deck and the inner surface of the tank wall 10.

Hence, with the staggered arrangement of the overlapping sections of the liquid filled members 35, there is a full hydraulic action present through the periphery of the seal without necessitating a single endless tube or interconnection of the individual sections by a number of hoses. Complete and uniform pressure is transmitted by the deformable action of the sections as required by the sealing action. Thus, the present invention permits stocking of the sealing sections for ready shipment with any diameter tank. Also, because of the individual sections utilized as the sealing means between the floating deck and the tank wall, any individually damaged section will result only in the loss of a small portion of the seal and not the entire seal around the floating cover. Another advantage of such a structure is that should an individual section become punctured or damaged, it can be readily replaced by a separate section without taking the tank out of operation or without requiring extensive effort to replace it as compared with conventional sealing units of much larger size.

It is also apparent that with the present invention, should a wide gap exist requiring sealing between the deck and the tank shell, the vertical rows 39 and 40 of the sections 35 may also be disposed within the wearing band 27 in a side-by-side relationship or in a double row fashion laterally of each other. Such an embodiment is shown in FIG. 8 with the sections being positioned as described for the embodiment of FIG. 1, except that there are two lateral rows 42 and 43.

Inasmuch as various changes may be made in the form, location and relative arrangement of the several parts without departing from the essential characteristics of the invention, it will be understood that the invention is not to be limited except by the scope of the appended claims.

I claim:

1. A fluid storage tank with a cylindrical wall, a bottom, and a floating cover member for fluids within the tank adapted to rise and fall with a change in the quantity of fluid in the tank, said cover member being of a smaller diameter than the inside of said wall to provide an annular space therebetween, and a flexible hollow sealing member secured to said cover member and disposed in said space, and a plurality of self-contained independently filled and sealed staggered inflatable members carried by said flexible member to provide a seal in said space between said cover member and wall, said self-contained members being so arranged that the facing ends of adjacent ones of said members are spaced from one another with the spaces so formed being closed by still another one of said members.

2. A fluid storage tank with a cylindrical wall, a bottom, and a floating deck member for confining fluids within said tank adapted to rise and fall in accordance with the pressure exerted thereon by the fluid in said tank, said deck member having a diameter substantially less than the inside of said wall to provide an annular space therebetween, a hollow flexible wearing member secured to the periphery of said deck member and disposed in said space adapted to frictionally engage said wall, and a plurality of self-contained flexible independent liquid filled and sealed members disposed in two rows within said hollow wearing member in a staggered arrangement to fill said space and provide a seal in said space between said deck member and wall, each of said self-contained members including means for filling the member with liquid and for sealing the member which is completely independent of the corresponding means for each of the other members.

3. A fluid storage tank with a cylindrical wall, a bottom, and a floating deck member for containing fluids within said tank adapted to rise and fall in accordance with the quantity of fluid in the tank, said deck being of a smaller diameter than the inside of said wall to provide an annular space therebetween, a hollow flexible wearing member secured to said deck member and disposed in said space to frictionally engage said wall, and a plurality of self-contained independent and separate liquid filled and sealed flexible members disposed within said wearing member positioned therein to engage the periphery of said deck member and to maintain said wearing member in frictional engagement with said wall to provide a seal across said space between said deck member and wall, each of said self-contained members including means for filling the member with liquid and for sealing the member which is completely independent of the corresponding means for each of the other members, said fluid filled members comprising a lower row and an upper row with the members in said lower row being disposed in spaced relationship with one another and the members in said upper row being supported on and overlapping the adjacent ends of two adjacent members in said lower row so as to cover the space between said two adjacent lower row members.

4. A fluid storage tank with a cylindrical wall, a bottom and a circular floating deck member having a top and bottom and vertical side wall for confining liquids within said tank adapted to rise and fall in accordance with the quantity of fluid in the tank, said deck member side wall being of a smaller diameter than the inside of said wall to provide an annular space therebetween, said deck member side wall extending substantially above and below said top and bottom, inwardly turned flanges disposed on the edges of said side wall in spaced relationship with said top and bottom respectively, a flexible wearing member disposed around said vertical side wall and having oppo-

site free ends extending into the spaces provided between said flanges and said top and bottom respectively, said flexible member extending from its free ends away from said vertical deck member side wall toward said cylindrical tank wall and forming a hollow annular configuration in said annular space adapted to contact said cylindrical wall, means securing the free ends of said flexible member to said flanges, and a plurality of self-contained independent and separate liquid filled and sealed flexible members carried in said wearing member adapted to contact said vertical side wall and maintain said wearing member in frictional engagement with said cylindrical wall to effect a seal across said annular space, each of said self-contained members including means for filling the member with liquid and for sealing the member which is completely independent of the corresponding means for each of the other members.

5. The storage tank of claim 4 wherein said means comprises wedge bar means within said spaces and engaging the free ends of said flexible member, and wedge members extending into said spaces and disposed between and engaging said wedge bar means and said top and bottom respectively.

6. The storage tank of claim 4 wherein said liquid filled members are disposed in stacked relationship on one another within said wearing member.

7. The fluid storage tank of claim 4 wherein said liquid filled members comprise a lower row and an upper row with the members in said lower row being disposed in spaced relationship with one another and the members in said upper row being supported on and overlapping the adjacent ends of two adjacent members in said lower row so as to cover the space between said two adjacent lower row members.

8. The storage tank of claim 4 wherein said liquid filled members are disposed in a stacked relationship on one another within said wearing member, and there are two laterally disposed rows in said stacked relationship.

9. A fluid storage tank with a cylindrical wall, a bottom, and a floating deck member for containing fluids within said tank adapted to rise and fall in accordance with the quantity of fluid in the tank, said deck being of a smaller diameter than the inside of said wall to provide an annular space therebetween, a hollow flexible wearing member secured to said deck member and disposed in said space to frictionally engage said wall, and a plurality of self-contained independent and separate liquid filled and sealed flexible members disposed within said wearing member positioned therein to engage the periphery of said deck member and to maintain said wearing member in frictional engagement with said wall to provide a seal across said space between said deck member and wall, each of said self-contained members including means for filling the member with liquid and for sealing the member which is completely independent of the corresponding means for each of the other members, said liquid filled members being disposed in a stacked relationship on one another within said wearing member, and there being two laterally disposed rows in said stacked relationship.

References Cited in the file of this patent

UNITED STATES PATENTS

1,650,340	Glass	Nov. 22, 1927
1,674,038	Glass	June 19, 1928
2,082,194	Wiggins	June 1, 1937
2,085,752	Horton et al.	July 6, 1937
2,735,573	Fino	Feb. 21, 1956
2,981,436	Fino et al.	Apr. 25, 1961
3,002,828	Fino et al.	Oct. 3, 1961
3,014,613	Anderson	Dec. 26, 1961