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FLOATING ROOF FOR A HYDROCARBON STORAGE TANK

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2 Sheets-Sheet 1

FIG. 1.

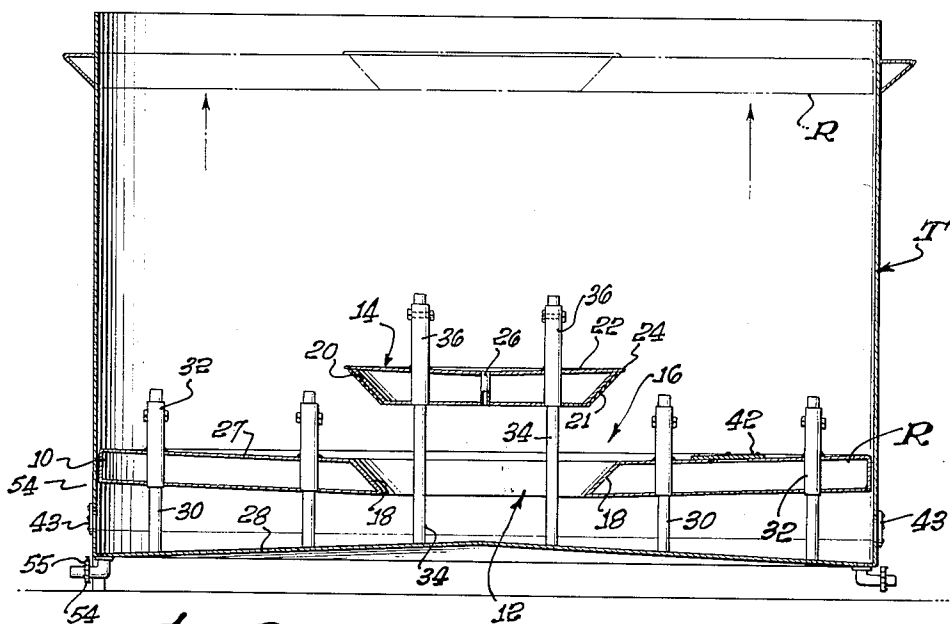
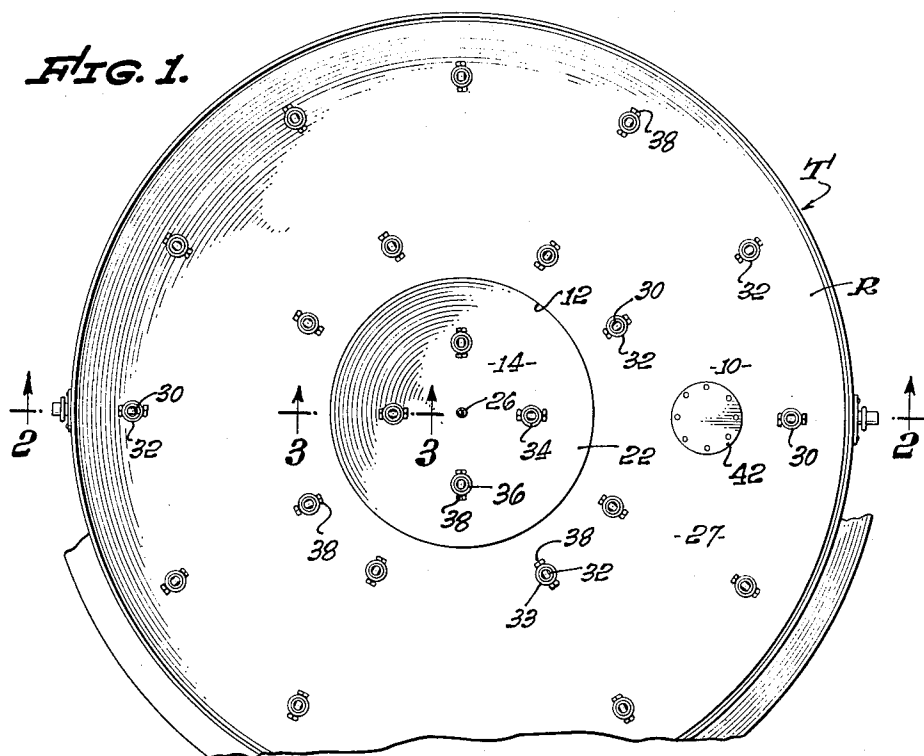


FIG. 2.

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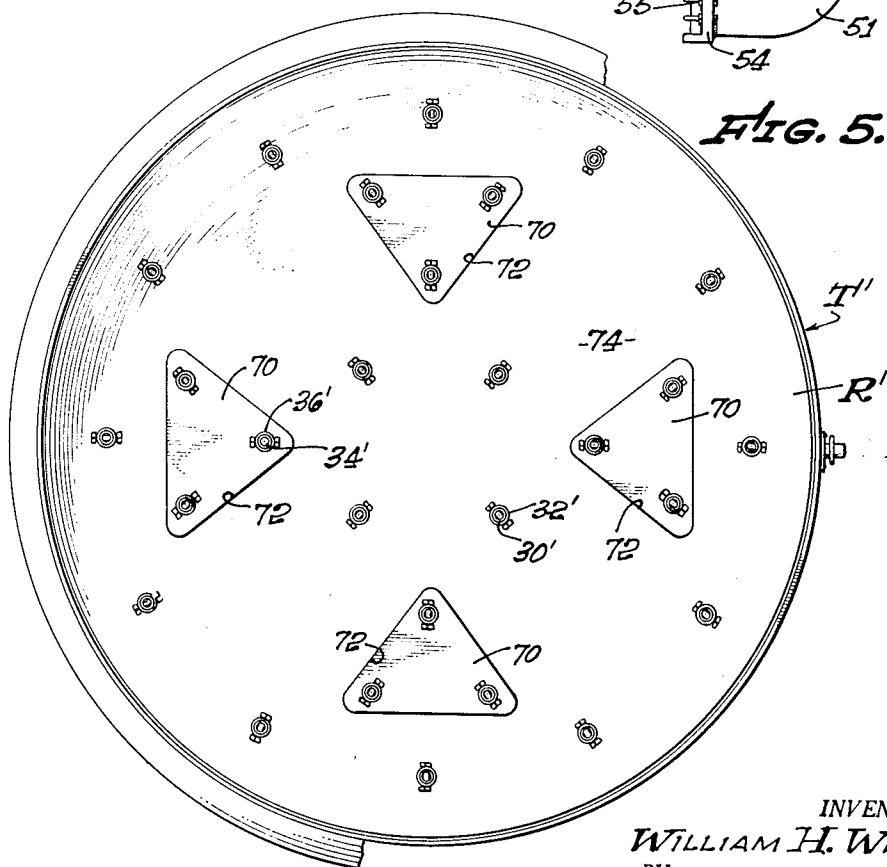
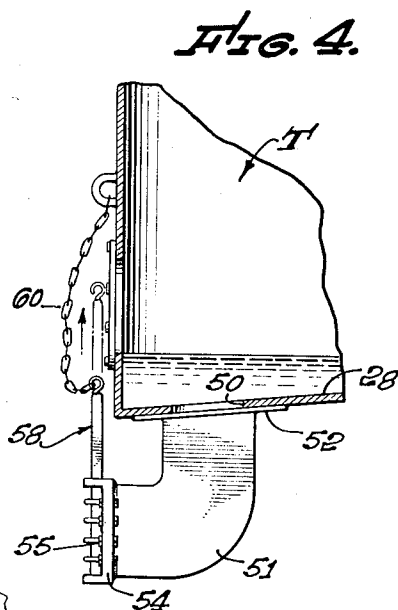
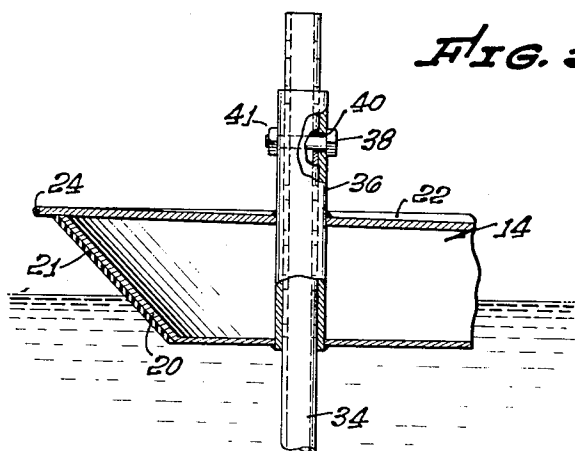
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FLOATING ROOF FOR A HYDROCARBON STORAGE TANK

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9 Claims. (Cl. 220—26)

Most existing hydrocarbon storage tanks utilize a roof which floats on top of the stored hydrocarbon and rises and falls with the level thereof. After the tank has been in use for a certain period, it is necessary that it be drained whereby its interior may be cleaned. As such draining occurs, the roof drops to the lower portion of the tank where it is supported a few feet above the bottom of the tank. A manhole is opened in the side of the tank, to permit workmen and equipment to enter the lower portion of the tank. In this manner the lower portion of the tank below the roof may be cleaned. This same procedure is followed where the roof must be repaired. It will be apparent that the working conditions below the roof are both disagreeable and dangerous. Because of the absence of light and the existence of an explosive and poisonous atmosphere both artificial light and air must be supplied workmen entering the tank. The danger of an explosion is very great, and considerable care must be exercised in order that sparks are not created. Workmen are therefor loath to engage in such repairing and cleaning activities.

It is a major object of the present invention to provide a novel floating roof for use with a hydrocarbon storage tank.

A more particular object of the invention is to provide such a floating roof having a main section, an auxiliary section, and means to support the auxiliary section at a different elevation than the main section when the roof is in a lowered position whereby an opening will be provided between the two sections for permitting the admission of adequate light and ventilation to the lower portion of the tank.

Another object of the invention is to provide a floating roof of the aforescribed nature which is simple in design and rugged of construction whereby it may have a long and useful service life.

A further object of the invention is to provide a floating roof of the aforescribed nature which is foolproof and entirely automatic in operation.

An additional object is to provide a floating roof of the aforescribed nature which may either be sold as original equipment or may be incorporated in existing floating roofs.

These and other objects and advantages of the present invention will become apparent from the following detailed description, when taken in conjunction with the appended drawings wherein:

Figure 1 is a top plan view of a hydrocarbon storage tank which incorporates a preferred form of floating roof embodying the present invention;

Figure 2 is a vertical sectional view taken on line 2—2 of Figure 1;

Figure 3 is an enlarged vertical sectional view taken on line 3—3 of Figure 1;

Figure 4 is an enlarged vertical sectional view of a detail of said tank; and,

Figure 5 is a top plan view of a hydrocarbon storage

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tank which incorporates another form of floating roof embodying the present invention.

Referring to the drawings, and particularly Figures 1 and 2 thereof, there is shown a conventional cylindrical hydrocarbon storage tank T having a floating roof R telescopically disposed therein. The floating roof R includes a main section 10 formed with an aperture 12 and an auxiliary section 14. As indicated by the dotted lines in Figure 2, when the floating roof R is in its normal floating position at the upper portion of the tank, the auxiliary section 14 covers the aperture 12. When, however, the floating roof drops to its lowered position indicated by the solid lines in Figure 2, the auxiliary section 14 is supported at a different elevation than the main section 10 whereby an opening 16 will be provided therebetween. This opening 16 permits the admission of adequate light and ventilation to the lower portion of the tank by means of the aperture 12.

More particularly, the aperture 12 will preferably be coaxial with the main roof section 10, and the sidewalls 18 thereof will be of downwardly tapered frusto-conical configuration. The auxiliary section 14 is formed with sidewalls 20 that are of complementary downwardly tapered configuration whereby it may be seated within the aperture 12. A rubber-like seal or gasket 21 may be interposed between the sidewalls 18 and 20. The upper wall 22 of the auxiliary section may include a peripheral lip 24. This upper wall 22 may slope downwardly and radially inwardly from the lip 24 so as to conduct rain water, and the like, to a drain tube 26 centrally mounted by the auxiliary section. Preferably, the upper wall 27 of the main section 10 will also slope downwardly and radially inwardly from its outer periphery to assist in disposing of rain water, and the like.

The main roof section 10 is adapted to be supported above the bottom wall 28 of the tank T by means of legs 30 when the floating roof is in its lowered position. The legs 30 depend from sleeves 32 that are rigidly affixed as by welding to the main section. The auxiliary section 14 is adapted to be supported above the tank bottom wall 28 by legs 34, which legs depend from sleeves 36 which are in turn rigidly affixed as by welding to the auxiliary section. As shown in Figure 3, the axial position of the legs 34 relative to the sleeves 36 may be adjusted by means of bolts 38. Bolts 38 are selectively engageable in any one of several bores 40 formed in each of the legs 34. Each of the bolts may be retained within the bores 40 by means of a nut 41. The axial position of the legs 30 relative to the sleeves 32 of the main section 10 may likewise be adjusted in this manner. Access to the interior of the main roof section 10 may be provided by a removable cover 42.

With the aforescribed arrangement, when the tank contains sufficient liquid the main and auxiliary sections of the roof will float thereon. It should be particularly observed that the auxiliary section 14 will have less buoyancy per unit of area than the main roof section in order that the auxiliary section will remain tightly seated within the aperture 12. At such time as the tank T is drained of hydrocarbon liquid stored therein, both roof sections 10 and 14 will move downwardly within the tank. As the floating roof approaches the lower portion of the tank, the lower ends of the legs 34 will engage the tank bottom wall 28 whereby further downward movement of the auxiliary section 14 will stop. The main section 10, however, will continue to move downwardly until the lower ends of its legs 30 engage the bottom wall 28. The floating roof will then appear as shown in Figure 2, and it will be noted that the opening 16 affords ample illumination and ventilation of the portion of the tank between the underside of the floating roof and bottom wall 28. The ventilation may be aided by means of blowers (not

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shown). Once the interior of the tank has been sufficiently ventilated, workmen may enter therein by means of manholes 43 formed in the sides of the tank.

Preferably the bottom of the tank may be provided with one or more drain openings 59 of the type shown in detail in Figure 4 by means of which the residue of a cleaning operation may be disposed. Each of the openings is covered by an elbow 51 having a flange 52 that is rigidly secured to the underside of the bottom wall 28, as by welding. The opposite end of the elbow 51 may be formed with a guide 54 for a cover plate 55. This cover plate 55 is normally bolted to the guide 54 and it includes a rod 58. Rod 58 is secured to the tank as by means of a chain 60, which chain may be urged upwardly so as to pull the cover plate 55 into an open position as indicated by the dotted lines in Figure 4 once it has been unbolted.

Referring now to Figure 5, there is shown a tank T' having a floating roof R', which roof was originally of conventional construction but which has been modified so as to incorporate the present invention. Such modification includes the forming of four generally triangular auxiliary sections 70 at spaced points in the roof. Each of these auxiliary sections 70 normally fit within a complementary aperture 72 formed in the main portion 74 of the roof. The main portion 74 is adapted to be supported, above the bottom wall of the tank T' by legs 30' and sleeves 32', which legs and sleeves are similar in construction to the legs 30 and sleeves 32 described hereinbefore. Likewise the auxiliary sections 70 are adapted to be supported by legs 34' and sleeves 36', which elements are similar to the legs 34 and sleeves 36 described hereinbefore. Accordingly, as such time as the tank T' is drained, the auxiliary sections 70 will each be supported at a higher elevation than the main portion 74 whereby four openings will be formed between the auxiliary section and the main section to permit the introduction of adequate light and ventilation to the lower portion of the tank T'.

It will be apparent to those skilled in the art that various changes and modifications may be made with regard to the foregoing detailed description without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. A floating tank for use with a storage tank having upstanding side walls and a bottom wall, comprising: a main section formed with an aperture; an auxiliary section normally covering said aperture; first support means for holding said main section spaced above said bottom wall when the contents of said tank are drained; and, second support means for holding said auxiliary section spaced above said bottom wall when the contents of said tank are drained, said support means being arranged to hold said auxiliary section at a different elevation than said main section whereby an opening will be defined therebetween.

2. A floating tank for use with a storage tank having upstanding side walls and a bottom wall, comprising: a main section formed with an aperture; an auxiliary section normally covering said aperture; first vertically extending leg means interposed between the underside of said main section and said bottom wall for holding said main section spaced above said bottom wall when the contents of said tank are drained; and, second vertically extending leg means interposed between the underside of said auxiliary section and said bottom wall for holding said auxiliary section spaced above said bottom wall when the contents of said tank are drained, said leg means being arranged to hold said auxiliary section at a different elevation than said main section whereby an opening will be defined therebetween for providing light and ventilation to the lower portion of said tank through said aperture.

3. A floating tank for use with a storage tank having

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upstanding side walls and a bottom wall, comprising: a main section formed with an aperture; an auxiliary section normally covering said aperture; first downwardly extending leg means carried by said main section so as to engage said bottom wall and thereby hold said main section spaced above said bottom wall when the contents of said tank are drained; and, second downwardly extending leg means carried by said auxiliary section so as to engage said bottom wall and thereby hold said auxiliary section spaced above said bottom wall when contents of said tank are drained, said first leg means being of different length than said second leg means so that said auxiliary section will be held at a different elevation than said main section whereby said aperture will be uncovered.

4. A floating tank for use with a storage tank having upstanding side walls and a bottom wall, comprising: a main section formed with an aperture; an auxiliary section normally covering said aperture; first vertically extending sleeves carried by said main section; first vertically extending legs telescopically disposed within said first sleeves and extending downwardly therefrom; means to adjust the axial position of said first legs relative to said first sleeves; second vertically extending sleeves carried by said auxiliary section; second vertically extending legs telescopically disposed within said second sleeves and extending downwardly therefrom; means to adjust the axial position of said second legs relative to said second sleeves, said second legs being longer than said first legs whereby said auxiliary section may be held at a higher elevation than said main section when said tank is drained.

5. A floating tank for use with a storage tank having upstanding side walls and a bottom wall, comprising: a main section formed with an aperture; an auxiliary section normally covering said aperture; first vertically extending sleeves carried by said main section; a pair of aligned bores formed in said first sleeves; first vertically extending legs telescopically disposed within said first sleeves and extending downwardly therefrom; a plurality of axially spaced horizontal bores formed in each of said first legs; second vertically extending sleeves carried by said auxiliary section; a pair of aligned bores formed in said second sleeves; second vertically extending legs telescopically disposed within said second sleeves and extending downwardly therefrom; a plurality of axially spaced horizontal bores formed in each of said second legs; and, an elongated lock element selectively insertable through each of said pairs of aligned bores and one of said axially spaced bores so as to adjust the axial position of said legs and said sleeves, said second legs being longer than said first legs whereby said auxiliary section may be held at a higher elevation than said main section when said tank is drained.

6. A floating tank for use with a storage tank having upstanding side walls and a bottom wall, comprising: a main section coaxially formed with an aperture; an annular auxiliary section normally covering said aperture; first support means for holding said main section spaced above said bottom wall when the contents of said tank are drained; and, second support means for holding said auxiliary section spaced above said bottom wall when the contents of said tank are drained, said support means being arranged to hold said auxiliary section at a different elevation than said main section whereby an opening will be defined therebetween for providing light and ventilation to the lower portion of said tank through said aperture.

7. A floating tank for use with a storage tank having upstanding side walls and a bottom wall, comprising: a main section coaxially formed with an aperture; an annular auxiliary section normally covering said aperture; first downwardly extending leg means carried by said main section so as to engage said bottom wall and thereby hold said main section spaced above said bottom wall when the contents of said tank are drained; and, second down-

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wardly extending leg means carried by said auxiliary section so as to engage said bottom wall and thereby hold said auxiliary section spaced above said bottom wall when the contents of said tank are drained, said first leg means being of different length than said second leg means so that said auxiliary section will be held at a different elevation than said main section whereby said aperture will be uncovered.

8. A floating tank for use with a storage tank having upstanding side walls and a bottom wall, comprising: a main section coaxially formed with an aperture having side walls of a downwardly tapering frusto-conical configuration; an annular auxiliary section having complementary side walls of a downwardly tapering frusto-conical configuration, and a downwardly and radially inwardly extending top wall; a rubber-like seal between said side walls; a vertical drain pipe centrally mounted in said auxiliary section; first vertically extending sleeves carried by said main section; a pair of aligned bores formed in said first sleeves; first vertically extending legs telescopically disposed within said first sleeves and extending downwardly therefrom; a plurality of axially spaced horizontal bores formed in each of said first legs; second vertically extending sleeves carried by said auxiliary section; a pair of aligned bores formed in said second sleeves; second vertically extending legs telescopically disposed within said second sleeves and extending downwardly therefrom; a plurality of axially spaced horizontal bores formed in each of said second legs; and, an elongated lock element selec-

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tively insertable through each of said pairs of aligned bores and one of said axially spaced bores so as to adjust the axial position of said legs and said sleeves, said second legs being longer than said first legs whereby said auxiliary section may be held at a higher elevation than said main section when said tank is drained.

9. A floating tank for use with a storage tank having upstanding side walls and a bottom wall, comprising: a main section formed with a plurality of generally triangularly-shaped apertures; a plurality of complementary generally triangularly-shaped auxiliary sections normally encompassed by and closing said apertures; first downwardly extending leg means carried by said main section so as to engage said bottom wall and thereby hold said main section spaced above said bottom wall when the contents of said tank are drained; and, second downwardly extending leg means carried by each of said auxiliary sections so as to engage said bottom wall and thereby hold said auxiliary sections spaced above said bottom wall when the contents of said tank are drained, said second leg means being longer than said second leg means whereby said auxiliary section may be held at a higher elevation than said main section when said tank is drained.

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