Aug. 26, 1958 A. E. ROESKE 2,849,143

TANK DESIGN

Filed Feb. 9, 1956 6 Sheets-Sheet 1

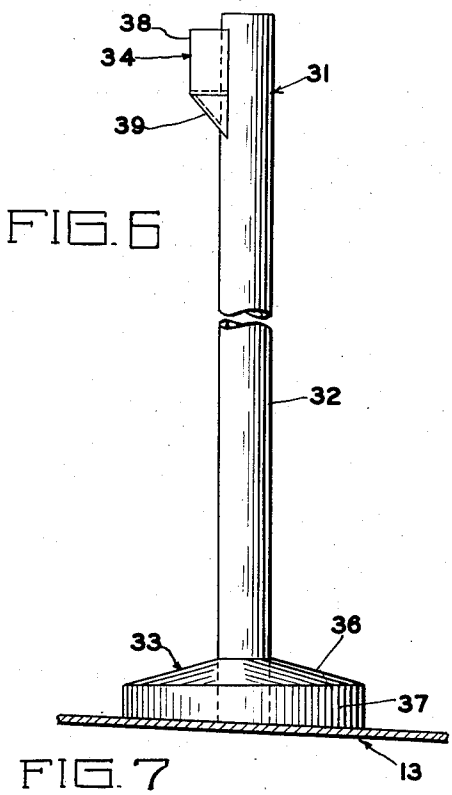


FIG. 6

FIG. 7

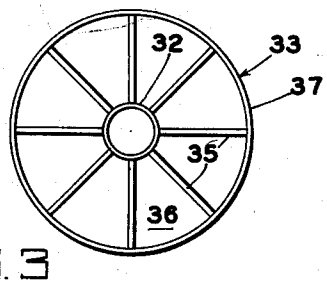
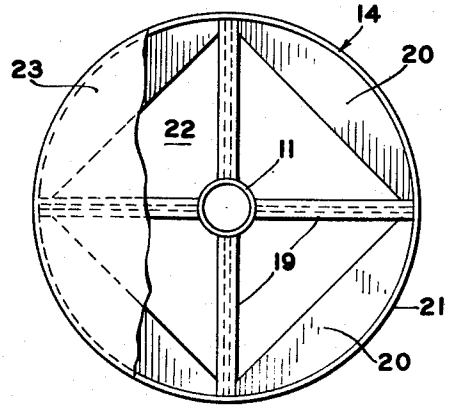


FIG. 3



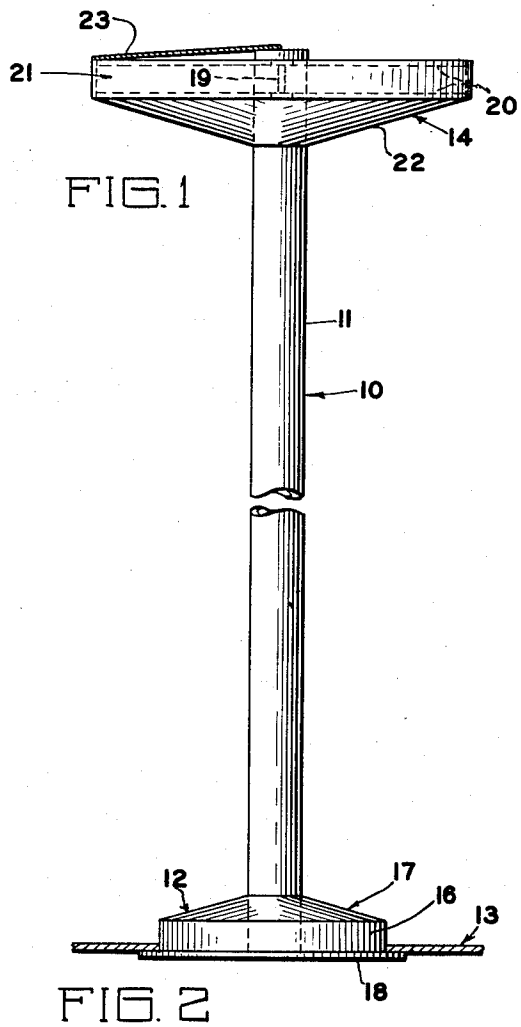
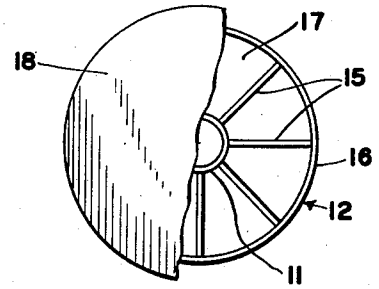


FIG. 1

FIG. 2



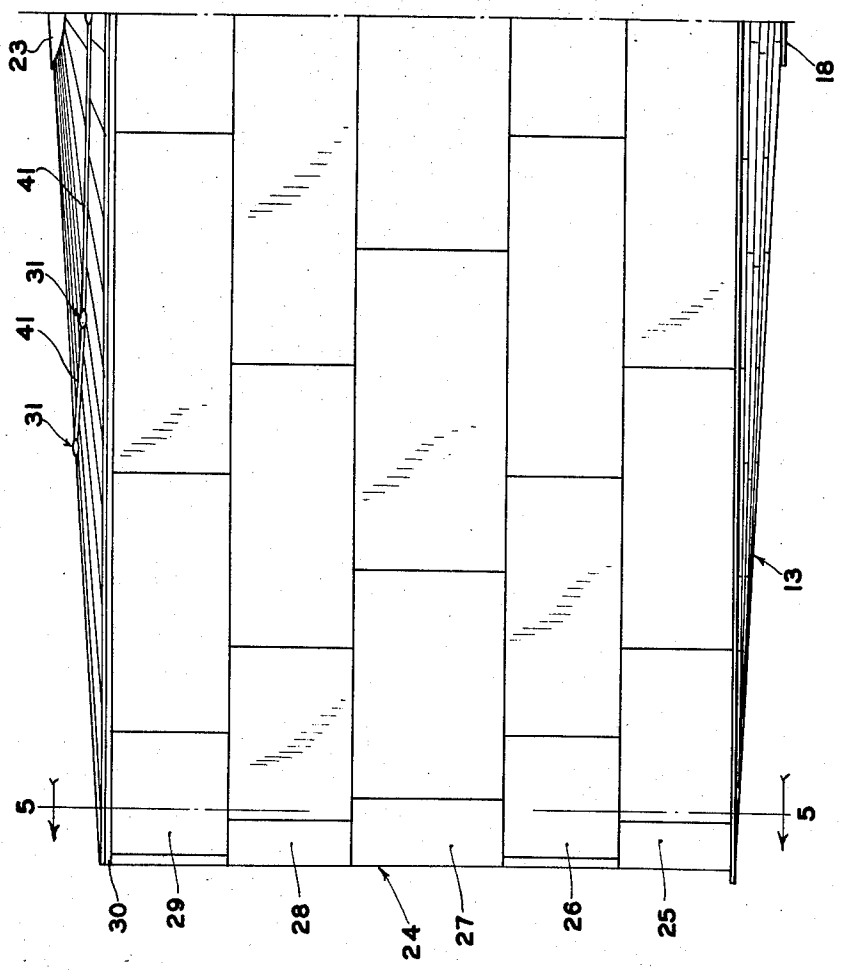
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Aug. 26, 1958 A. E. ROESKE 2,849,143

TANK DESIGN

Filed Feb. 9, 1956 6 Sheets-Sheet 2

FIG 4



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Aug. 26, 1958 A. E. ROESKE 2,849,143

TANK DESIGN

Filed Feb. 9, 1956 6 Sheets-Sheet 3

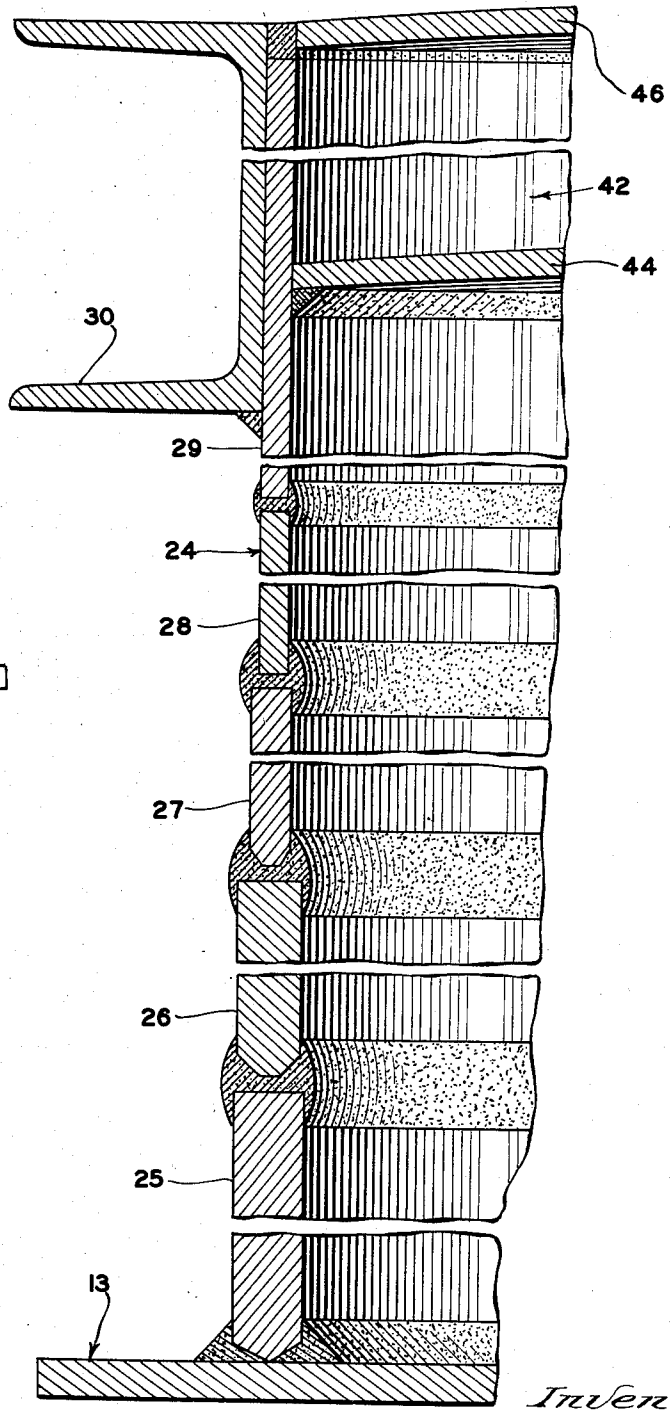


FIG. 5

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Aug. 26, 1958 A. E. ROESKE 2,849,143

TANK DESIGN

Filed Feb. 9, 1956 6 Sheets-Sheet 4

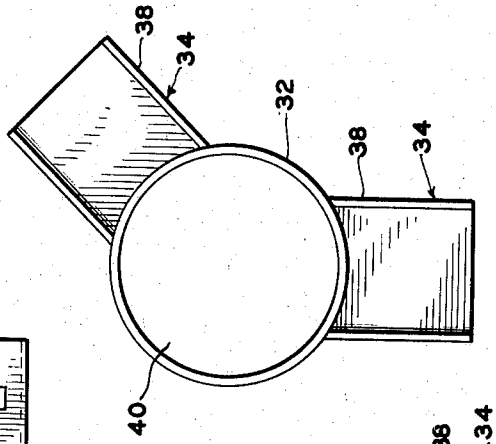


FIG. 8

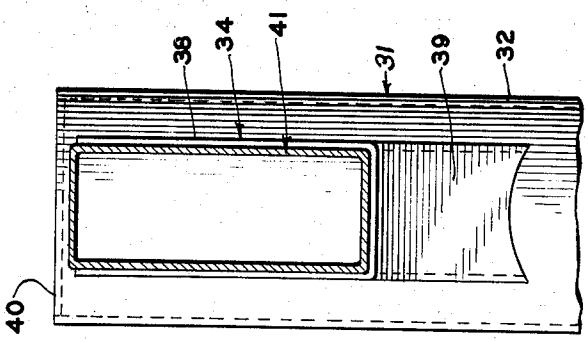


FIG. 10

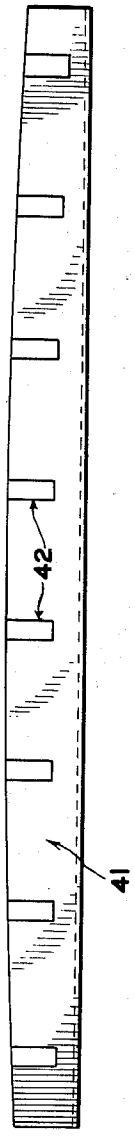


FIG. 13

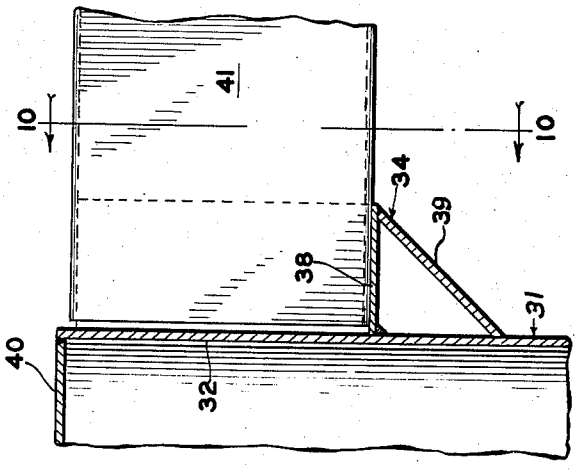


FIG. 9

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Aug. 26, 1958 A. E. ROESKE 2,849,143

TANK DESIGN

Filed Feb. 9, 1956 6 Sheets-Sheet 5

FIG. 11

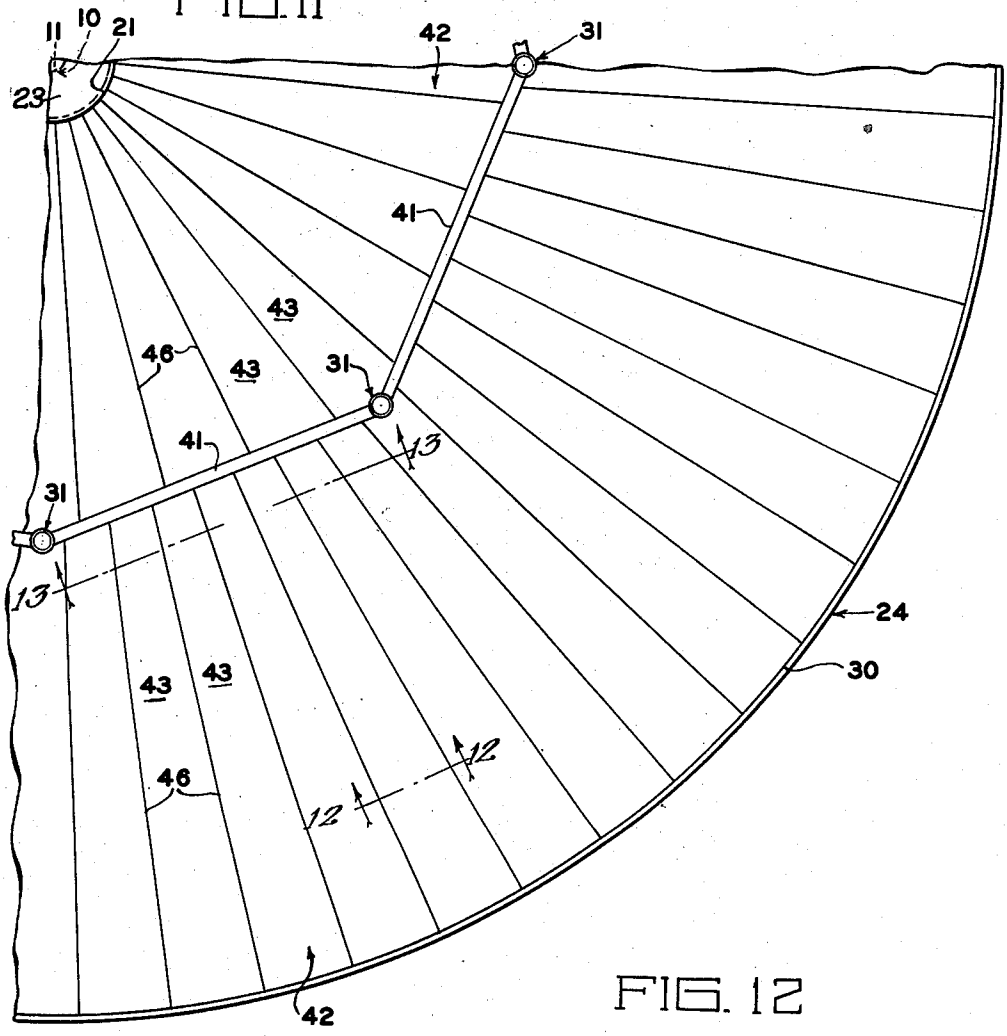
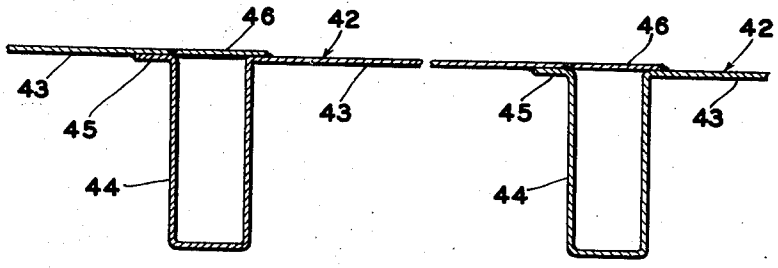


FIG. 12



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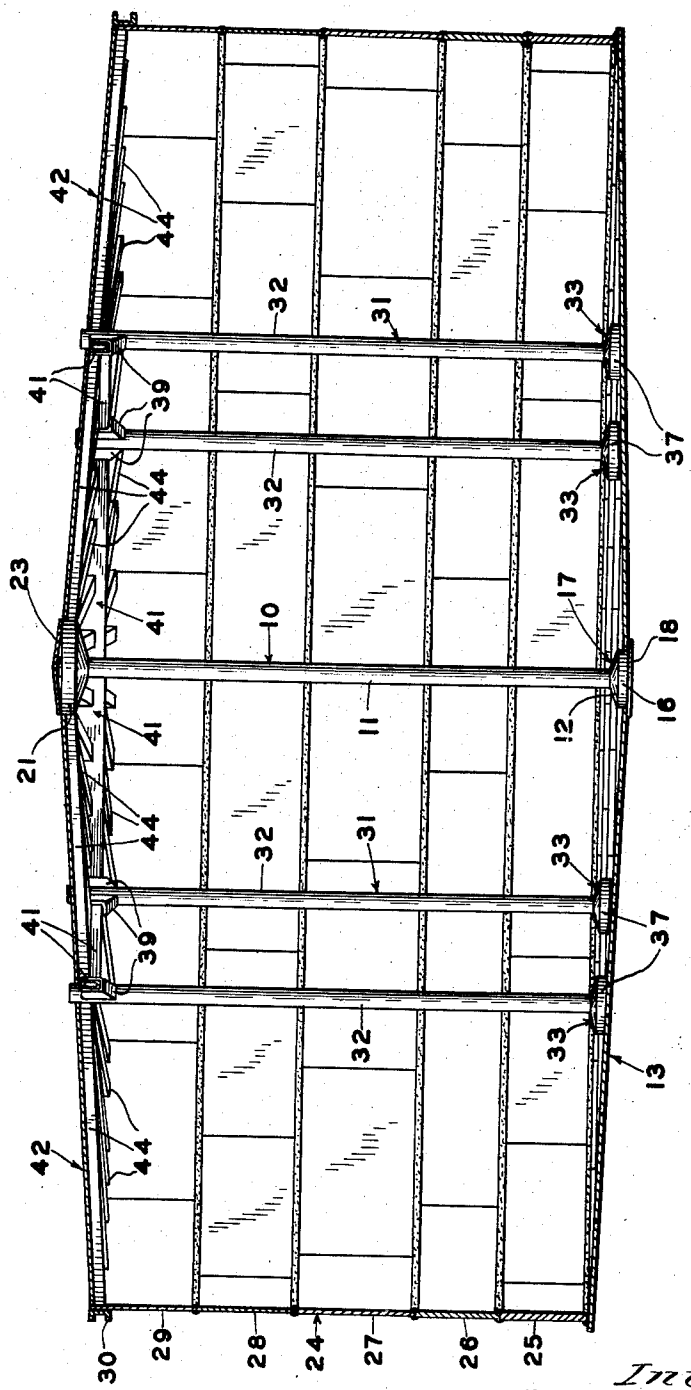
Aug. 26, 1958 A. E. ROESKE 2,849,143

TANK DESIGN

Filed Feb. 9, 1956

6 Sheets-Sheet 6

FIG. 14



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2,849,143

TANK DESIGN

Alfred E. Roeske, San Jose, Calif., assignor to International Minerals & Chemical Corporation, a corporation of New York

Application February 9, 1956, Serial No. 564,425

5 Claims. (Cl. 220—1)

This invention relates to a tank design, and more particularly, to a tank design for the storage of corrosive liquid materials. The invention pertains still more particularly to the design of a metal tank in which rough edges, such as bolts, overlays, exposed I-beams and exposed channels are eliminated, and which provides a substantially continuous interior surface to serve as a base for a corrosion-resisting material.

In the chemical industry it is frequently necessary to use metal storage tanks which have a vertical cylindrical shape and a diameter greater than about 50 feet. These tanks are used to store raw materials as well as intermediate and final products. Tanks of this type which have a diameter greater than about 50 feet frequently utilize a design which includes a central roof supporting column and one or more circles of intermediate supporting columns. Girders are used to connect the tops of the intermediate columns. Additional roof support is obtained by extending radial rafters from the top of the central column to the girders and from the girders to the top of the tank wall. The radial rafters and supporting columns are usually in the form of channels or I-beams.

Although this type of tank design has found wide use among the chemical industry, its use is limited to the storage of non-corrosive materials. Attempts have been made to apply coatings of corrosion-resisting material to the interior surfaces of tanks of this type. It has been found that because of the great number of sharp edges on the channels, I-beams, bolts, clips and overlays, complete coverage of the interior with a corrosion-resisting material cannot be obtained. As a result, storage of corrosive materials in these tanks will eventually cause serious deterioration of the tank structure at the unprotected surfaces.

It is an object of the present invention to provide an improved tank design having a substantially continuous interior surface to serve as a base for a corrosion-resisting material.

It is an another object of this invention to provide an improved tank design which eliminates substantially all of the sharp edges usually found in tank roofs and roof supporting structures.

Additional objects will be apparent to those skilled in the art from the detailed description provided hereinafter.

Briefly, the steel tank comprises a tank bottom member, roof supporting members which include a central roof support member, a wall member, and intermediate roof support members. Roof members are supported at their extremities by attachment to the roof support members. The tank bottom member serves as a closure member for the tank. One of the roof supporting members is a central roof support member which is placed in a vertical position at the center of the tank bottom. The wall member which serves as a roof support member and a closure member, is placed in the vicinity of the outer periphery of the tank bottom member. Intermediate between the central roof support member and the wall member there are placed a multiplicity of intermediate

roof support members. The tops of the intermediate roof support members are joined with the tops of adjacent intermediate roof support members by means of box girders, which are an integral part of the intermediate roof support members. The roof members extend from the wall member to the girders and from the girders to the central roof support member.

The roof members are specially designed sheet metal units, each roof member having a tapering flat plate portion with the longitudinal edges extending at an oblique angle to each other. Adjacent to one of the longitudinal edges a U-shaped gutter and gutter flange are integrally formed in the flat plate of the unit. A closure plate which covers the gutter is secured to the flat plate portion and the gutter flange to form a box-like rafter. The box-like rafter serves as a stiffener means for the roof member. The roof members are positioned so that the longitudinal edges extend in a radial direction from the central support member.

The use of U-shaped gutters as radial rafters, the use of pipe instead of I-beams, or channels in the roof supporting members, and the use of welded joints instead of bolted joints all aid in minimizing the number of sharp edges and permit complete coverage of the interior surfaces with a corrosion-resisting material.

More in detail, the following drawings are used to describe the invention.

Figure 1 is an elevational view of the central roof support member.

Figure 2 is a bottom view of the base assembly of the central roof support member.

Figure 3 is a plan view of the central support roof member showing the roof supporting structure.

Figure 4 is an elevational view of a segment of the tank.

Figure 5 is a sectional view of the tank bottom member and wall member through lines 5—5 of Figure 4.

Figure 6 is an elevational view of an intermediate roof support member.

Figure 7 is a bottom view of the base assembly of an intermediate roof support member.

Figure 8 is a plan view of an intermediate roof support member showing the girder supporting means.

Figure 9 is an elevational view of the girder supporting means of an intermediate roof support member.

Figure 10 is an elevational view of the girder supporting means of an intermediate roof support member, showing a sectional view of a girder through lines 10—10 of Figure 9.

Figure 11 is a plan view of a segment of the tank.

Figure 12 is a sectional view of roof members along line 12—12 of Figure 11.

Figure 13 is a sectional view of a girder along line 13—13 of Figure 11.

Figure 14 is a sectional elevational view of the tank.

Referring to Figure 1 there is illustrated a central roof support member 10 consisting of a vertical central column 11 supported at its lower end by a base assembly 12 which is welded to a tank bottom member 13. Central column 11 has secured to its upper end a roof supporting structure 14 which is illustrated in Figure 3. The central column 11 is a metal pipe of suitable diameter.

The base assembly 12 shown in Figures 1 and 2 is comprised of supporting webs 15, a ring 16, a cover plate 17, and a base plate 18. The base plate 18 is welded to the tank bottom member 13 and to the bottom of the pipe which forms the central column 11. Eight supporting webs 15 extend radially from the central column 11 at equally spaced intervals, and are welded to the base plate 18 and to the central column 11. A ring 16 encircles the outer extremities of the supporting webs 15 and is welded to the webs 15 and the base plate 18. A

conical cover 17 covers the webs and is welded to the top of the ring 16 and the central column 11.

The roof supporting structure 14, shown in Figures 1 and 3 is comprised of four ribs 19, eight gussets 20, a ring 21, a cover plate 22, and a center closure plate 23. The ribs 19 may be I-beams which are welded at one end in an area adjacent to the top of the central column 11, in a horizontal plane perpendicular to the central column 11, each length of I-beam extending radially from the column at equally spaced intervals. Gussets 20 connect the top and bottom of each rib 19 with the top and bottom of each adjacent rib 19 at the outer extremities of the ribs. A ring 21 is placed around the ribs 19 and gussets 20 and is welded to the outer extremities of the ribs 19 and to the edges of gussets 20. A conical shaped cover plate extends from the central column 11 to the bottom of the ring 21. A conical shaped center closure plate 23 extends from the top of the central column 11 to the top of the ring 21. The cover plate 22 and the closure plate 23 are both welded to the central column 11 and the ring 21.

Figure 4 is an elevational view of the tank showing the position of the base plate 18 and the center closure plate 23 of the central support member 10. The tank bottom member 13 is secured to the base plate 18. The wall member 24 is erected in an area adjacent to the outer periphery of tank bottom member 13.

Figure 5 is a sectional view of the wall member 24 through lines 5—5 of Figure 4. The perimeter of the tank bottom member 13 and the perimeter of the wall member 24 have essentially the same form. The form of the perimeter may be that of a circle, square, ellipse, rectangle or other regular or irregular form. Preferably, the perimeter of the tank bottom member 13 is a circle and the wall member 24 forms an upright cylinder. In the event another form is used, such as an ellipse, it may be desirable to include two or more central roof support members 10. The tank bottom member 13 may be fabricated of steel plates which are welded together in any desired pattern. Preferably the plates are placed in parallel courses, each course being staggered so that the junction of two plates in one course does not form a straight line with the junction of two plates in an adjacent course. The tank bottom member 13 may be sloped from the wall member 24 to the base plate 18 of the central roof support member 10, or it may be placed perpendicular to the wall member 24.

As illustrated in Figures 4 and 5, the wall member 24 is fabricated of steel plates which are placed in one or more parallel courses, the first course 25 being secured and hermetically sealed at the bottom in an upright position to the tank bottom member 13. The next course of wall plates 26 is welded to the top of the bottom course of wall plates 25. Other courses of wall plates 27, 28 and 29 may be added in a similar manner to obtain the desired tank height. When the tank is to be in the form of an upright cylinder, the plates are rolled to give a curvature of the desired radius. The thickness of the plates in each course may be decreased as the height of the courses is increased. A stiffening ring 30 is welded to the outer surface of the top of the upper course of wall plates 29. The stiffening ring 30 consists of sections of channel having a curvature which conforms with the curvature of the tank wall.

Intermediate between the central roof support member 10 and the wall member 24, there are erected a multiplicity of intermediate roof support members. Figure 6 is an elevational view of an intermediate roof support member 31, having a vertical central column 32 supported by a base assembly 33 at the lower end. The bottom of the column 32 is secured to the tank bottom member 13. The central column 32 has secured to its upper end a girder supporting means 34. The central column 32 is a metal pipe of suitable diameter.

The base assembly 33 of an intermediate roof support member 31, which is shown in Figures 6 and 7, is comprised of supporting webs 35, a cover plate 36, and a ring 37. Eight supporting webs 35, which are secured to the lower end of the central column 32 and to the tank bottom member 13, extend radially from the column at equally spaced intervals. A ring 37 encircles the outer extremities of the supporting webs 35 and is secured to the webs 35. The bottom of the ring 37 is secured to the tank bottom member 13. When the tank bottom member 13 is sloped, the ring 37 and the webs 35 are fabricated to conform with the slope in order that the central column 32 will be in a vertical position. A conical cover plate 36 covers the webs 35 and is secured to the central column 32 and the top of ring 37. Figure 4 shows the relative position of the intermediate roof support members 31 in the tank.

The girder supporting means 34 shown in Figure 6 is illustrated in detail in Figures 8, 9, and 10. Figure 8 is a plan view of the girder supporting means 34. Figures 9 and 10 are elevational views of the girder supporting means 34. The girder supporting means 34 is comprised of two U-shaped saddles 38 which are welded to the top of each central column 32. The saddles 38 are given additional support by extending a U-shaped gusset 39 from the underside of each saddle 38 to the central column 32. A closure plate 40 is attached to the top of the central column 32.

Figure 11 is a plan view of a segment of the tank showing the relative position of the vertical supporting members, including the central roof support member 10, the wall member 24, and the intermediate roof support members 31. Also shown in Figure 11 are the girders 41 which join adjacent intermediate roof support members 31, and roof members 42 which extend from the wall member 24 to the girders 41 and from the girders 41 to the central support member 10. The central roof support member 10, having ring 21, cover plate 23 and column 11, is in the center of the tank. When the wall member 24 is an upright cylinder as shown in Figures 4, 5 and 11, the intermediate roof support members 31 may be positioned in a circle around the central roof support member 10, said circle having a radius equivalent to about one-half the radius of the cylinder. When the radius of the wall member 24 is greater than about 50 feet, the intermediate roof support members 31 may be positioned in two or more circles around the central support member 10. When two or more circles of intermediate roof support members 31 are used, the radius of the smallest circle is equivalent to about the radius of the tank wall divided by the number of circles plus one. The next circle of intermediate roof support members will have a radius of about twice the radius of the smallest circle and the next circle will have a radius of about three times the radius of the smallest circle. Although it is preferred to construct the tank wall in the form of an upright cylinder, the tank walls may be constructed so that the perimeter of the walls is in the form of an ellipse, rectangle, square or other regular or irregular form. In such cases, the intermediate roof support members 31 may be deployed in any manner to give the necessary support to the roof.

The relative position of the girders in the tank is illustrated in Figures 4 and 11. The girders 41 extend from the intermediate roof support member 31 to adjacent intermediate roof support members 31. The girders form an integral part of the intermediate roof support members. Figures 9 and 10 illustrate the method by which the girders 41 are connected to the saddles 38. Figure 10 shows a sectional view of a girder through lines 10—10 of Figure 9. Since the cross-section of the girders is rectangular, there are no sharp edges which are difficult to cover with a corrosion-resistant material.

Extending between the wall member 24 to the girders 41 and between the girders 41 and the central roof support member 10 are the roof members 42, which are illus-

trated in Figures 11 and 12. Figure 12 is a sectional view of the roof members **42** along line **12—12** of Figure 11. A roof member **42** is comprised of a flat plate **43** having a U-shaped gutter **44** and gutter flange **45** integrally formed adjacent to one of the longitudinal edges of the flat plate. The flat plates **43** are tapered, having the two longitudinal edges extending at an oblique angle to each other. A closure plate **46**, which is the same length as the gutter, covers the gutter and is secured to the flat plate and the gutter flange to form a box-like rafter. The roof members **42** are placed on the tank so that the longitudinal edges extend in a radial direction from the central roof support member **10**. The roof members **42** are positioned so that the longitudinal edge opposite from the gutter **44** of one roof member **42** overlaps and is secured to the gutter flange **45** of the adjacent roof member **42**.

Those roof members **42** having one end secured to the wall member **24** have their opposite end secured to the girders **41**. Those roof members **42** having one end secured to the central roof support member **10**, have their opposite end secured to the girders **41**. In the event two or more circles of intermediate support members **31** are used, additional roof members may be extended from one course of girders **41** to the next course of girders **41**.

In Figure 11, the closure plate **46** is represented by a single line, since the scale of the drawing would not permit the detailed illustration of the closure plate that is shown in Figure 12. The roof may be sloped from the central support member **10** to the wall member **24**, or the roof may be flat.

Figure 13 is a sectional view along lines **13—13** of Figure 11 showing girder **41**. The ends of the roof members **42** are welded flush to the face of the girder **41**. When the roof of the tank is sloped, it may be necessary to fabricate the girders so that the top edge will follow the contour of the roof curve.

Figure 14 is a sectional elevational view showing the general organization of the tank bottom **13**, wall member **24**, roof members **42**, central roof support member **10**, intermediate roof support members **31**, and the girders **41**.

The roof members **42**, having gutter **44** and closure plate **46**, are welded flush to the interior surface of wall member **24**, as illustrated in Figure 5.

The components of the tank may be secured to their related parts by welding and the like. When welding is used, it is important that all internal welds be smoothed off so that corrosion-resisting material may be easily applied. After the interior of the tank has been adequately sandblasted and cleaned, the interior surfaces are sprayed with a corrosion-resisting material. The type of material and number of coats will depend upon the nature of the liquid being stored in the tank. When an acidic sugar beet juice having a pH of about 3.2 is to be stored in the tank, an adequate lining to resist corrosion can be obtained by covering the interior surfaces of the tank with one coat of primer and about five coats of an acid and alkali proof synthetic resin. The exterior surface of the tank bottom member was covered with two coats of mastic.

The tank is fabricated to include openings for inlet pipes, outlet pipes, and manholes.

As illustrative of the character of the instant invention, but in nowise intending to be limited thereby, the following example is described:

Example

A vertical cylindrical steel tank was constructed for the storage of an acidic sugar beet juice having a pH of about 3.2. The inside diameter of the tank was about 90 feet. The tank was comprised of a tank bottom member, wall members, vertical roof supporting members, and roof members.

The tank bottom member of the tank was constructed of ¼″ steel plates of various lengths which were welded together to form a circular base having a diameter of about 90′ 4¼″. The bottom of the wall member and the bases of the intermediate and central roof support members were welded to the tank bottom member. The tank bottom member was sloped downward from the wall member to the center of the tank, at the rate of about 2′ in a radius of 45′.

The wall member of the tank was constructed of steel plates, having a curvature with a radius of about 45′. The base course was comprised of plates that were about 30′ wide, 6′ high and 9/16″ thick. The bottoms of the wall plates in the base course were welded and hermetically sealed to the tank bottom member, the outside surface of the wall plates being positioned about 1½″ from the outer edge of the tank bottom member. The second course of wall plates, which was comprised of plates that are about 30′ wide, 8′ high and ½″ thick were welded to the tops of the plates in the base course. The third course of wall plates which was comprised of plates that were about 30′ wide, 7′ high and ⅜″ thick was welded to the top of the second course of wall plates. The fourth course of wall plates, which was comprised of plates that were about 30′ wide, 6′ high and ¼″ thick, were welded to the tops of the plates in the third course. The fifth course of wall plates, which was comprised of plates that are about 30′ wide, 6′ 2″ high and ¼″ thick, were welded to the tops of the plates in the fourth course. A stiffening ring was welded to the outside surface of the tank wall at the top of the fifth course of wall plates. The stiffening ring was constructed of sections of 10″ channel which weighed 15.3 pounds/foot, having a curvature with a radius of about 45′ ⅜″. The height of the wall member was about 33′ 2″.

The roof of the tank was supported by the wall member previously described as well as by a central roof support member and other supporting members placed intermediate between the central roof support member and the wall member. The central support member consisted of a 10″ diameter steel pipe which was about 37′ 11⅝″ high, having a base assembly at the bottom and a roof supporting structure at the top. The base assembly of the central roof support member was comprised of a base plate, eight supporting webs, a ring and a cover plate. The base plate was a circular plate 5/16″ thick and about 4′ 3″ in diameter. The base plate was welded to the center of the tank bottom member and to the bottom of the pipe which forms the central column. Eight supporting webs which were made of ⅜″ steel plate extended radially from the central pipe at equally spaced intervals, and were welded to the base plate and to the central pipe. A ring which was about 6″ high, made of 3/16″ steel plate, having an inside diameter of about 3′ 8″ was placed around the supporting webs. The ring was welded to the webs and the base plate. A conical cover, made of ⅜″ plate, having a diameter of about 3′ 8″, and having a slope from the central column of about 15° from the horizontal, covered the webs and was welded to the ring and the central column.

The roof supporting structure at the top of the central column consisted of 4 ribs, 8 gusset plates, a ring, a cover plate, and a center closure plate. The ribs were I-beams which were about 8″ high, 2′ 6″ long, and weighed 18.4 pounds per foot, were welded to the central column. The I-beams were welded to the central column in a horizontal plane perpendicular to the column, at right angles to each other. The top of the beams were placed about 2¼″ below the top of the pipe. A ring made of 3/16″ plate, 8″ high, having an outside diameter of about 6′ was welded to the ends of the four I-beams and the edges of the gusset plates. A conical shaped cover plate, made of 3/16″ plate and having a diameter of about 6′ extended from the central

column to the bottom of the ring. The cover plate sloped downward from the ring to the column at an angle of about 15° from the horizontal. A conical shaped center closure plate made of 3/16" plate and having a diameter of about 6' extended from the top of the central column to the ring. The central closure plate had a slope of about 3½°. The cover plate and the center closure plate were both welded to the central column and to the ring. Roof members were welded to the outside face of the ring in order to obtain support from the central roof support member.

Eight intermediate roof support members were placed in a circle having a radius of about 22' 6" from the center of the tank. Each intermediate roof support member was comprised of a 10" diameter steel pipe which was about 35' 7" high, having a base assembly at the bottom and girder supporting means at the top. The base assembly of an intermediate roof support member was about 3' 8" in diameter and was constructed of 3/8" steel plate in a manner similar to the base of the central roof support member. The base assembly of each intermediate roof support member was fabricated to conform with the slope of the tank bottom member of the tank. The base assembly was welded to the tank bottom member.

The girder supporting means at the top of each intermediate roof support member was comprised of two U-shaped saddles and a U-shaped gusset supporting each saddle. The saddles were made of 3/8" steel plate, about 6" wide, about 14" deep, and extended from the center of the column for a distance of about 11". The saddles were welded to the top of the column. The centerline of one saddle intersected the centerline of the other saddle in the center of the column at an angle of about 135°. A U-shaped gusset made of 3/8" steel plate extended from the column to the lower outer edge of the saddle at an angle of about 45°. The gusset was welded to the column and to the saddle. A closure plate ¼" thick was welded to the top of each intermediate column.

Additional roof support was obtained by extending girders between adjacent intermediate roof support members. Box type girders were used which were constructed of 3/8" steel plate, having a rectangular cross-section which was about 14" high and 6" wide. The ends of each girder were placed in one of the U-shaped saddles of two adjacent intermediate roof support members. Each girder was about 17 feet long. The ends of the girders were welded to the U-shaped saddles.

The roof of the tank was constructed of a multiplicity of roof members which extended from the ring of the center roof support member to the girders and from the girders to the wall member. Each roof member was fabricated from 3/16" steel plate. The plate was bent along one of the longitudinal sides to form a U-shaped gutter having a flange on the side of the gutter opposite from the plate. The flange was about 2" wide and the gutter had a rectangular cross-section which was about 9" high and about 3½" wide. The plates of the roof members were tapered so that one end of the plate was wider than the opposite end. The roof members were about 22' 3" long and were placed so that the longitudinal edges extended radially from the center of the tank. The plates of the roof members which extended from the central roof support member to the girders were about 7" wide at the end attached to the ring and about 4' 6" wide at the end attached to the girders. The plates of the roof members which extended from the girders to the wall member were about 2' 3" wide at the end attached to the girders and about 4' 6" wide at the end attached to the wall member. The roof members were placed side-by-side so that the edge of a plate of one roof member overlapped and was welded to the flange of the U-shaped gutter of the adjacent roof member. Thirty-two roof members were used to cover the annular space between the ring of the central support member and the girders. Sixty-four roof members were used to cover the annular space between the girders and the wall member. The edges of the roof members were welded flush to the ring, the face of the girders and the interior of the wall member. The ends of the plates attached to the wall member and ring were fabricated to conform with the curvature of the wall member and ring. A cover plate made of 3/16" plate, which was about 4" wide and 22' 3" long was used to cover each of the gutters in the roof members. This cover plate was welded to the flange and plate of each roof member to form a box-like rafter with the gutter. The tank roof sloped about ¾" per foot from the center support member to the wall member.

After all of the welds were ground smooth and the interior of the tank was sandblasted and thoroughly cleaned, the interior surfaces of the tank were sprayed with one coat of primer and 5 coats of an acid and alkali proof synthetic resin giving an average thickness of about 1/16". The exterior surface of the tank bottom member was covered with two coats of mastic.

The tank was equipped with a manhole on the top and a manhole on the side. A liquid inlet and a liquid outlet were also provided in the side of the tank. A roof vent was provided in the roof of the tank to prevent pressure from building up in the void space of the tank.

Having now thus fully described and illustrated the invention, what is desired to be secured by Letters Patent is:

1. A tank for storing liquid material comprising a tank bottom member, a central roof support member positioned in the center of the tank bottom member, a wall member secured to the tank bottom member in an area adjacent to the outer periphery of the tank bottom member, a multiplicity of intermediate roof support members positioned intermediate between the central roof support member and the wall member, a multiplicity of girders extending from the top of the intermediate roof support members to the top of adjacent intermediate roof support members, a multiplicity of roof members supported at the extremities thereof by attachment to roof support members, each of said roof members being a sheet metal unit having a tapering flat plate with the longitudinal edges thereof extending at an oblique angle to each other, said flat plate having a U-shaped gutter integrally formed adjacent to one of said longitudinal edges to serve as a stiffening means, said U-shaped gutter being open in an upwardly direction and having a flange extending from the edge opposite said flat plate in a plane coextensive with said flat plate, portions of said roof member adjacent the oblique longitudinal edges being adapted to overlap and being secured to the adjacent roof members, inlet means for introducing liquid into the tank and outlet means for removing liquid from the tank.

2. A tank for storing liquid material comprising a tank bottom member, a wall member secured to the tank bottom member in an area adjacent to the outer periphery of the tank bottom member, a central roof support member positioned in the center of the tank bottom member, said central roof support member having a vertical central column supported by a base assembly at the lower end and secured to a roof supporting structure at the upper end, said base assembly having a multiplicity of supporting webs secured to the column and extending radially from the column at equally spaced intervals, a ring encircling the outer extremities of the webs and secured to the webs, a cover plate secured to the top of the ring and the column, and a base plate secured to the bottom of the column, the bottom oif the webs, the bottom of the ring and the tank bottom member, said roof supporting structure having a multiplicity of ribs secured in an area adjacent to the top of the column and extending radially from the column at equally spaced intervals, a multiplicity of gussets joining the outer extremities of the ribs, a

ring encircling the outer extremities of the ribs and gussets, and secured to the ribs and gussets, a cover plate secured to the bottom of the ring and the column, a center closure plate secured to the top of the ring and the top of the column, a multiplicity of intermediate roof support members positioned intermediate between said central roof support members and said wall member, a multiplicity of girders extending from the top of the intermediate roof support members to the top of adjacent intermediate support members, a multiplicity of roof members supported at the extremities thereof by attachment to roof support members, said roof members being sheet metal units having a U-shaped channel formed along one longitudinal edge integral with said sheet metal units as stiffener means, inlet means for introducing liquid into the tank and outlet means for removing liquid from the tank.

3. A tank for storing liquid material comprising a tank bottom member, a central roof support member positioned in the center of the tank bottom member, a wall member secured to the tank bottom member in an area adjacent to the outer periphery of the tank bottom member, a multiplicity of intermediate roof support members positioned intermediate between the central roof support member and the wall member, each of said intermediate roof support members having a vertical central column supported by a base assembly at the lower end and girder supporting means secured at the upper end, said base assembly having a multiplicity of supporting webs secured to the column and extending radially from the column at equally spaced intervals, a ring encircling the outer extremities of the webs and secured to the webs, a cover plate secured to the top of the ring and the column, the bottom of said central column, supporting webs, and ring being secured to the tank bottom, said girder supporting means having two U-shaped saddles secured to an area adjacent to the top of the central column, extending radially from the column in the direction of adjacent intermediate roof support members, a multiplicity of girders extending from the U-shaped saddles of intermediate roof support members to the U-shaped saddles of adjacent intermediate roof support members, a multiplicity of roof members supported at the extremities thereof by attachment to the roof support members, said roof members being sheet metal units having a U-shaped channel formed along one longitudinal edge integral with said sheet metal units as stiffener means, inlet means for introducting liquid into the tank and outlet means for removing liquid from the tank.

4. A tank for storing liquid material comprising a tank bottom member, a central roof support member positioned in the center of the tank bottom member, a wall member secured to the tank bottom member in an area adjacent to the outer periphery of the tank bottom member, a multiplicity of intermediate roof support members positioned intermediate between the central roof support member and the wall member, a multiplicity of girders extending from the top of the intermediate roof support members to the top of adjacent intermediate support members, a multiplicity of roof members, each of said roof members having a tapering flat plate portion with the longitudinal edges thereof extending at an oblique

angle to each other, said flat plate portion having a U-shaped gutter open in an upwardly direction and a gutter flange integrally formed adjacent to one of the longitudinal edges, said gutter flange extending from the edge of said gutter opposite said flat plate in a plane coextensive with said flat plate, said gutter having a closure plate secured to the flat plate portion and the gutter flange, those roof members having one end secured to the wall member have their opposite end secured to the girders and those roof members having one end secured to the central roof support member have their opposite end secured to the girders, said roof members being positioned so that the longitudinal edges extend in a radial direction from the central roof support member, the longitudinal edge opposite from the gutter of one roof member overlapping and being secured to the gutter flange of the adjacent roof member, inlet means for introducing liquid into the tank and outlet means for removing liquid from the tank.

5. A tank for storing corrosive materials comprising a tank bottom member, a central roof support member positioned in the center of the tank bottom member, a wall member secured to the tank bottom member in an area adjacent to the outer periphery of the tank bottom member, a multiplicity of intermediate roof support members positioned intermediate between the central roof support member and the wall member, a multiplicity of girders extending from the top of the intermediate roof support members to the top of adjacent intermediate roof support members, a multiplicity of roof members supported at the extremities thereof by attachment to the roof support members, each of said roof members being a sheet metal unit having a tapering flat plate with the longitudinal edges thereof extending at an oblique angle to each other, said flat plate having a U-shaped gutter integrally formed adjacent to one of said longitudinal edges to serve as a stiffening means, said U-shaped gutter being open in an upwardly direction and having a flange extending from the edge opposite said flat plate in a plane coextensive with said flat plate, portions of said roof member adjacent the oblique longitudinal edges being adapted to overlap and being secured to the adjacent roof members, inlet means for introducing corrosive materials into the tank, outlet means for removing corrosive materials from the tank, and a lining of corrosion-resisting material for the interior surfaces of the tank.

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