Dec. 5, 1944. W. J. HEINRICH 2,364,528

SECTIONAL TANK DECK

Filed Oct. 13, 1943 2 Sheets-Sheet 1

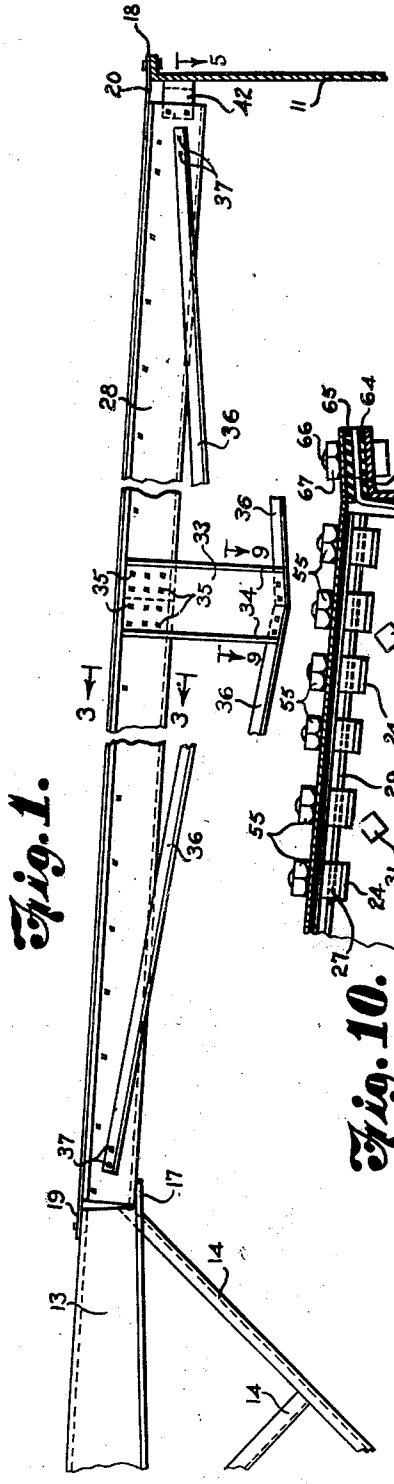


Fig. 1.

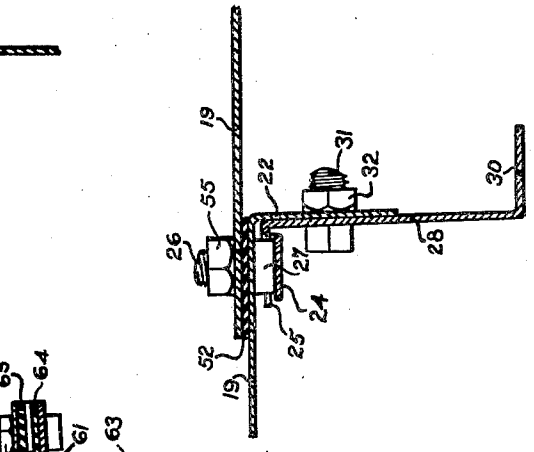


Fig. 3.

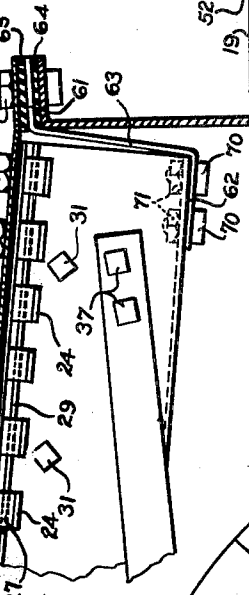


Fig. 10.

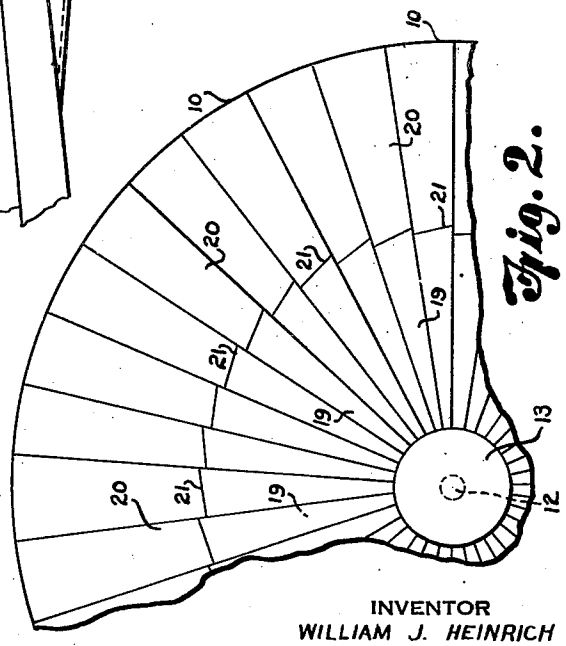


Fig. 2.

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SECTIONAL TANK DECK

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Fig. 4.

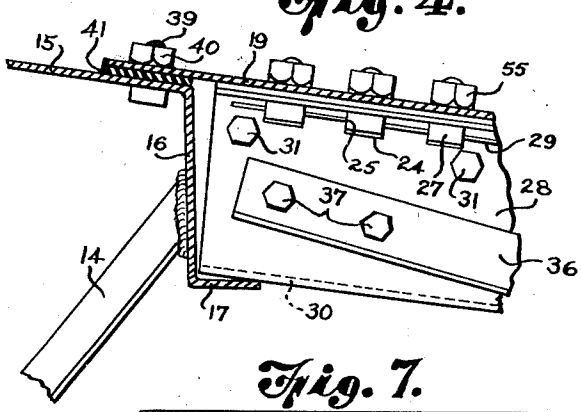


Fig. 5.

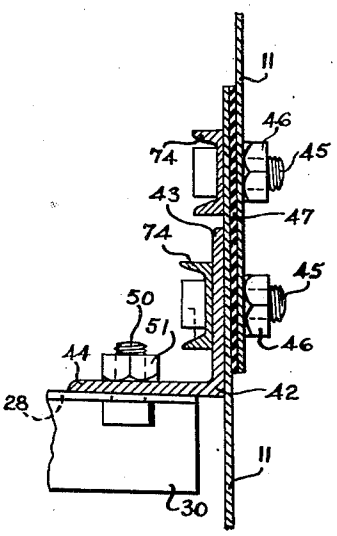


Fig. 7.

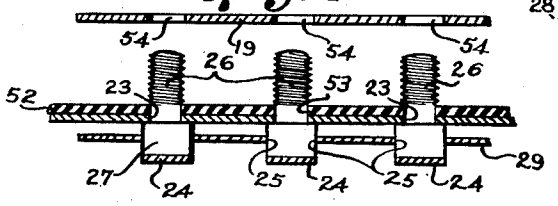
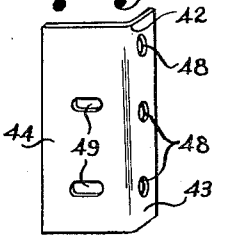


Fig. 6.



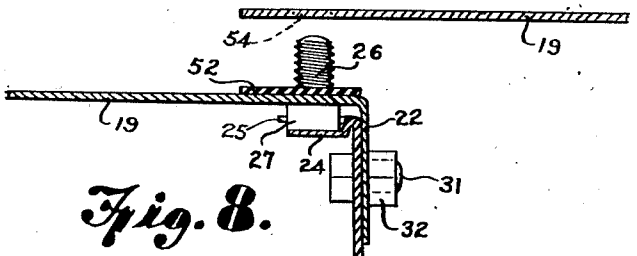
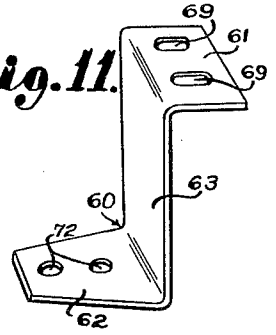


Fig. 8.

Fig. 11.



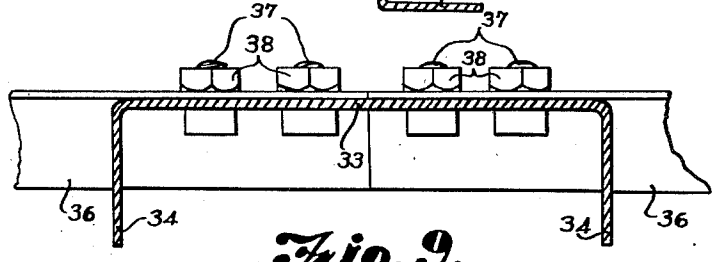


Fig. 9.

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2,364,528

UNITED STATES PATENT OFFICE

2,364,528

SECTIONAL TANK DECK

William J. Heinrich, Englewood, Mo., assignor to Andrew A. Kramer, Kansas City, Mo.

Application October 13, 1943, Serial No. 506,069

12 Claims. (Cl. 108—32)

My invention relates to decks or roofs, and more particularly to a deck for a tank. This is a continuation in part of my co-pending application Serial No. 467,120, filed November 27, 1942, on Tank decks.

My invention particularly relates to decks that are made of a sectional character and that particularly are applicable to bolted tanks, which are also made in a sectional manner, so that the same can be shipped knock-down and erected quickly at the point where the same are desired for liquid storage purposes.

Decks of the type forming the subject matter of my invention are secured together by means of a large number of bolts. The placing of these bolts in position and keeping the same in position until the deck sections are fastened together thereby involves a very large amount of the labor necessary in the assembling of such a deck. Decks or roofs for tanks are ordinarily of a circular character, and for tanks of any appreciable size, require supporting means, or reenforcing means providing a framework, due to the fact that the space spanned by such decks or roofs is much too large that the sheets making up the sections of the deck will support themselves between the side wall of the tank and the center thereof. In order to simplify the assembly and construction of such decks and to avoid an unnecessary amount of framework within the tank itself, the deck sections are, preferably, provided with reenforcing means carried thereby, that provide the framework, or beam structure, for supporting the roof or deck from the side wall of the tank and a central supporting means.

It is a purpose of my invention to provide a deck made up of a central member, which is supported by a post-like member, and a plurality of segmental sections that are duplicates and that collectively form the deck or roof between the central deck section and the side wall of the tank, said segmental sections being provided with reenforcing means adjacent one radial margin thereof depending therefrom so as to provide a beam or rafter that is supported by the central section and by the side wall of the tank, to thus provide a series of radial beam members or rafters, one for each section, underlying the radial joints between the sections, to provide the supporting framework for the roof or deck.

It is another purpose of my invention to provide deck sections of the above mentioned character having such reenforcing members depending therefrom, which are provided with a truss structure to further stiffen and strengthen the roof or deck along radial lines. Said truss structure is, preferably, so constructed as to include a member that serves both as splicing means for the beam-like reenforcing members and as a bracket for carrying the apex of the truss on such beam-like members, and also acting as stiffening means at the transverse joint in each of said sections.

It is a particular purpose of my invention to provide means greatly aiding in the assembly of decks of this general character, comprising means for holding the bolts that secure the sections together at their radial joints from turning, and means for holding the bolts in position, so that the bolts that have been placed in position in the openings in an underlapping section at a joint will project above the top surface of said underlapping section in regularly spaced relation due to the fact that said bolt-like members are mounted in regularly spaced openings arranged in a row adjacent the longitudinal margin of such section, this permitting the placing of the overlapping section in position in overlapping relation to the section having the bolts projecting upwardly therefrom, by passing the section downwardly over the projecting bolts, whereby all of the bolts will be projected through all of the openings in all of the sections simultaneously, or substantially simultaneously.

It is a particular purpose of my invention to provide means on said deck sections whereby all the bolts can be placed in position in the openings along the underlapping edge of each section while in inverted position and held in such position upon turning said deck section over into the position it will have in the deck, comprising means on said reenforcing means for holding said bolts in position after projection through said openings and means for holding said bolts from turning. After the bolts have all been placed in the openings in the inverted section said reenforcing means are assembled with the sections by securing the same in position with detachable securing means, such as bolts, and upon such assembly prevent the bolts from dropping out of the openings upon reversal of the position of the section and turning of said bolts. Thus when a section is ready for assembly in a deck, it is provided with a beam-like member depending therefrom along one radial marginal edge thereof and with bolts projecting upwardly through the openings adjacent said margin, or edge, which are held not only against turning, but against receding back into the openings.

It is a specific purpose of my invention to provide a deck section of the above mentioned char-

acter, with an integral flange depending from one margin thereof, and with a row of openings for bolts adjacent said margin, and to provide a beam-like member, preferably, Z-shaped in cross section, which is bolted to the depending flange in such position that one of the flanges of said beam-like member engages the bolt heads so as to prevent the bolts from moving out of projected position and from turning.

Other objects and advantages of my invention will appear as the description of the drawings proceeds. I desire to have it understood, however, that I do not intend to limit myself to the particular details shown or described, except as defined in the claims.

In the drawings:

Fig. 1 is a fragmentary vertical sectional view through my improved deck and a portion of the side wall of a tank, portions of the deck being broken away.

Fig. 2 is a fragmentary plan view of a tank deck made in accordance with my invention.

Fig. 3 is a section taken on the line 3—3 of Fig. 1, on an enlarged scale.

Fig. 4 is a fragmentary vertical sectional view of the peripheral portion of the central deck member showing the mounting of one of my deck sections thereon.

Fig. 5 is a fragmentary horizontal sectional view on an enlarged scale, taken on the line 5—5 of Fig. 1.

Fig. 6 is a view slightly in perspective of the bracket used for securing one of my deck sections to the side wall of the tank.

Fig. 7 is a fragmentary sectional view illustrating the method of assembly of the deck sections with each other.

Fig. 8 is a fragmentary sectional view at right angles to Fig. 7.

Fig. 9 is a sectional view on an enlarged scale, taken substantially on the line 9—9 of Fig. 1.

Fig. 10 is a fragmentary view partly in elevation and partly in vertical section, showing the means for supporting a deck section at its outer end where the radial seams of the deck do not align with the vertical seams of the side wall, and

Fig. 11 is a perspective view of the bracket or hanger shown in Fig. 10.

Referring in detail to the drawings, in Figs. 1 and 2 is shown a deck made up of a plurality of duplicate sections 10, which are mounted, so as to be supported thereby, on the side wall 11 of the tank and on a central pole or post 12. The deck sections 10 radiate from a central deck section 13, which is connected with the post-like member 12 by means of a plurality of bracing members 14, so as to form a central support for the annular series of deck sections 10.

Said central section 13 is provided with a sloping top wall 15 and a depending peripheral annular flange 16, to which certain of the supporting members 14 are welded, the same being welded or otherwise fixedly secured to the post-like member 12, and also to each other, if desired, as is evident from Fig. 1. The annular depending peripheral flange 16 is provided with an outwardly directed flange 17 forming an annular shelf or ledge around the entire periphery of the central deck section 13. The side wall 11 is provided with an outwardly directed peripheral flange 18, as shown in Fig. 1.

In the deck illustrated, a plurality of sheet metal sections is required to form one deck section 10, the same being made up of an inner section 19 and an outer section 20. Each deck section 10 is a duplicate of each other deck section 10, and each portion 19 and each portion 20 thereof are duplicates in the different deck sections. The sections 19 and 20 are connected by means of a lapped joint indicated at 21, which does not form a part of this invention.

Each of the deck sections is provided with a depending flange 22, these being provided on both the sheets 19 and 20 and extending into abutting relation at the adjoining ends of the two portions 19 and 20 of each deck section, but terminating short of the outer extremity of the sheet 20 and the inner extremity of the sheet 19, as will be evident from Fig. 1, so that the sheet 19 at its inner end overlaps the top wall 15 of the central member 13, and the sheet 20 overlaps the flange 18 extending around the top of the side wall 11. Rows of bolt openings are provided in both the flanges 22 and the main body portions of the deck sections adjacent the margins thereof that have the flanges 22 provided thereon, as well as along the opposite radial margins thereof and the inner and outer ends of the sections, to permit the sections to be bolted together and to the central deck member 13 and the flange 18 on the side wall of the tank. These openings are, preferably, punched at the proper spacing from each other and from the edge of the section in which the same are provided, before the flange 22 is bent over thereon, the bend where the flange 22 joins the deck section being so located relative to the openings 23 therein that when the reenforcing means to be described below is assembled with the deck sections the bolt holding means thereon will be in proper cooperative relation to the bolts in said openings.

In assembling the deck each deck section is first placed in an inverted position and the bolts 26 are then placed in position by dropping the same through the holes 23. After the bolts have all been placed in position with the threaded shank portions thereof extending downwardly below the top face of the deck section, which is in the inverted position from that shown in Figs. 7 and 8, a Z-bar having a web portion 28 and the laterally extending flanges 29 and 30 is secured in position on the flange 22 by means of the bolts 31 and nuts 32.

The flange 29 of each of said reenforcing members is cut transversely at regular spaced intervals and the portions between two adjacent cuts are bent out of alignment with the body of the flange 29 to provide offset fingers 24 which engage the polygonal heads 27 of the bolts to hold the same in position, shoulders 25 being thus provided on each side of the recess in the flange 29, provided by offsetting said fingers, which are engaged by opposed flat faces on the bolt heads to prevent the bolts from turning.

The spacing of the openings for the bolts 31 in the flange 22 from the bend, where the flange 22 joins the body of the section, is such that the fingers 24 on the flanges 29 will overlie the heads 27 of the bolts when the section is in inverted position to thus hold the bolts 26 in assembled position.

With the parts so assembled the section is turned over into position with the threaded shanks of the bolts projecting upwardly above the top thereof, as shown in Figs. 7 and 8. While some of the bolts might tend to be held in place by friction, if no fingers underlying the

heads thereof were provided, the bolts are not held so firmly in position as to enable the deck sections to be handled in assembling the deck without the bolts dropping out of place, unless the flange 29 or similar means is provided for preventing such dropping of the bolts out of position and most of the bolts that would not drop out in handling would be pushed out of position when an overlapping deck section is assembled with a deck section having such bolts 26 projecting therefrom, if the guard means 24 were not provided.

It will be obvious from the above that by providing the combination of the depending flange 22, and the reenforcing member in the form of a Z-bar, having the fingers 24 on the flange 29 thereof, means is provided for not only holding the bolts from turning when the nuts are applied thereto, but means is also provided for preventing the bolts from moving out of their upwardly projected position with the screw-threaded shanks thereof ready to receive the openings in an overlapped deck section, and at the same time a beam-like member is provided, which stiffens the deck section along its one longitudinal edge, thus providing a beam-like frame member or rafter underlying each radial lapped joint of the duplicate segmental deck sections. It will also be noted that no difficult manufacturing operations are involved, as only a right-angular bend is provided in each sheet 19 and 20 to form the flange 22 thereon, and only two right-angular bends are provided to form the Z-shaped reenforcing bar, and the fingers 24 are formed on the one flange thereof by a relatively simple die. It is not necessary that the openings provided for the bolt heads in the flange 29 by the offset fingers 24 fit the bolt heads closely.

The aligning reenforcing means on the portions 19 and 20 of a deck section 10 are secured together by a gusset member 33, which is provided with a pair of stiffening flanges 34 along the vertical margins thereof, as will be evident from Figs. 1 and 9, the same being secured by means of bolts 35 to the web portion 28 of the Z-bar, certain of said bolts also securing said Z-bars to the flanges 22 adjacent the meeting ends of the flanges 22 at the joint between the members 19 and 20.

At the lower end the gusset member 33, which depends below the Z-bar member 28, so as to form a depending bracket on the beam, has secured thereto the angle members 36, which complete the truss, said angle members 36 being secured by means of bolts 37 and nuts 38 to said gusset member 33 and to the web portions 28, as will be evident from Figs. 1, 4 and 9. One leg of each angle member 36 underlies the bottom edge of the gusset member 33, as will be evident from Figs. 1 and 9, and said bottom edge is inclined away from the center thereof toward the flanges 34 to conform to the position of the underlying legs of the angle members 36 when the same are in position. It will be obvious that a truss is thus formed on each of the sections by means of the beam-like portion provided thereon, made up of the Z-bar and the depending strut, or leg, or bracket, 33, which also serves as a gusset member, and by means of the angle members 36 secured each at one end thereof to said strut or gusset member and at the other end thereof to the Z-bar, said other ends lying adjacent the inner and outer ends of the sections.

It will also be obvious upon reference to Fig. 4 that at the inner end of each section the flanged lower end of the Z-bar rests upon the peripheral flange 17 of the annular central deck member 13 to thus support the deck from said flange by means of said Z-bar reenforcement, instead of by means of the body portion of the section, which overlaps the top wall 15 of said central deck member 13. The overlapping portion of each deck section is secured to the top wall 15 by means of bolts 39 and nuts 40, a compressible gasket member 41 being provided between the deck sections at the joint to provide a gas tight joint.

The outer end of each deck section is secured through its beam-like reenforcing means to the side wall 11 in the manner shown in Figs. 1, 5 and 6. A bracket member 42 having the legs 43 and 44 is secured to the side wall 11 by means of bolts 45 and nuts 46. Channel members 14 are also provided for preventing the heads of the bolts 45 from turning. In Fig. 5 the bracket member is shown as being secured by means of bolts that also secure the overlapping sections of the side wall together, although such would not always be the case, as the points at which the joints between the side wall sections occur will not always correspond to the points at which the joints in the deck sections will occur, although such is preferred, if the proportion of the parts can be made such as to obtain such an arrangement.

A gasket 47, to provide a liquid tight joint between the sections of the side wall 11, is provided, as will be obvious from Fig. 5. As will be obvious from Fig. 6, a plurality of bolt openings 48 is provided in the bracket member 42, through each of which a bolt 45 is passed. While the side wall 11 is cylindrical, the curvature of each section is so slight that it would not be apparent when shown on as large a scale as in Fig. 5. It will be noted that the openings 48 are elongated in a vertical direction, thus being of a slot-like character to permit of limited vertical adjustment of the bracket member 42, as may be required in view of the slight discrepancies in size resulting in the manufacture of such large parts as constitute the tank and deck. Similarly the leg 44 of the bracket member 42 is provided with bolt openings 49 that are elongated in a horizontal direction so as to form slot-like openings running generally lengthwise of the web portion of the Z-bar that forms the beam-like reenforcement on the deck section. Thus adjustment in a direction perpendicular to that provided by the slots 48 is provided for the same reason as above referred to. Bolts 50 and nuts 51 extend through the slots 49 to secure the Z-bar to the bracket member 42 and thus to the side wall of the tank.

In case the vertical seams in the side wall sections and the radial seams in the deck do not align, the means shown in Figs. 10 and 11 is provided for connecting the deck sections to the side wall of the tank. Said means comprises the bracket 60 having the flange 61 thereon overlying the flange 18 on the side wall of the tank and having a flange 62 thereon, which underlies the flange 30 on the Z-bar, said flanges 61 and 62 being connected by an inclined portion 63. Gasket members 64 and 65 are provided, respectively, between the flange 61 and the flange 18 and overlapping end of the portion 20 of the deck section.

The flange 61 is secured to the deck section and flange 18 by means of bolts 66 and nuts 67,

said bolts extending through slots 69 in the flange 61 to permit some relative radial adjustment of the deck section and side wall of the tank, and the flange 62 is secured to the under side of the flange 30 by means of bolts 70 and nuts 71, said bolts extending through openings in the flange 62. Said flange 62 tapers, as will be obvious from Fig. 11.

In assembling the deck sections with each other, one of the deck sections is secured in position on the side wall of the tank and on the central deck member 13, which have been previously erected. A strip of compressible gasket material 52 is then placed in position over the portion of the deck section having the row of openings 23 therein and the flange 22 adjacent said openings, with the bolts 26 projecting through the openings 53 provided in the gasket material therefor. This can, of course, be very readily accomplished, due to the fact that the bolts are held substantially in fixed position projecting above the top face of the deck section that is in place, due to the combined action of the shoulders 25 and fingers 24 on the flange 29 of the Z-bar. The next adjoining deck section is put in position by placing the marginal edge thereof not having any reenforcement thereon over the edge of the section that is in place, which has the bolts 26 projecting therefrom, with the bolt holes 54 therein in alignment with the bolts 26. The overlapping section can then be passed downwardly into position in engagement with the gasket member 52 and with the bolts 26 in the openings 54 without any difficulty, after which the nuts 55 can be applied to the bolts to clamp the gasket member 52 in sealing position in the joint and the deck sections to each other. The deck section thus secured along its marginal edge to another deck section can then be secured in position to the central deck member 13 and to the side wall member 11 in a manner previously described, and the operation repeated for the next adjacent deck section. The assembly of the deck sections with each other is thus greatly simplified and facilitated and much time is saved in the assembly of the deck made in accordance with my invention over one in which each bolt has to be passed through each bolt hole separately. The position of the sections relative to each other just prior to moving the overlapping section into final position is shown in Figs. 7 and 8, and the final secured position thereof in Fig. 3.

One great advantage of my improved bolt holding means is that it offers no obstacles to aligning the openings in edges of overlapping sheets, in case these do not align sufficiently closely to permit the bolts to be passed therethrough, as above described. If, after the sheet that has been provided with a row of upwardly projecting bolts in the manner above described, is to be assembled with another sheet, or section, so provided, and it is found that the overlapping section has openings therein that are misaligned relative to those in the lower section so that some of the bolts will not pass therethrough, this happening infrequently, but occasionally, a bolt or two not lining up properly, the bolt, or bolts, that will not pass through the overlapping section when placed in the position shown in Fig. 8 and moved downwardly into the position shown in Fig. 3, can be driven out of the opening by hammer blows, thus bending the finger 24 that held that bolt in position out of holding position. A drift pin can then be inserted to bring the openings in alignment, a new bolt inserted from below, and the bolt holding finger 24 pounded back into proper holding position by means of hammering, or in a similar manner. This is a great advantage over the method previously employed, of using a channel member for holding the bolts from turning, and a continuous flange on a Z-bar for holding the bolts in projected position, which would not permit any such removal of bolts and insertion of drift pins to align the openings as here described.

What I claim is:

1. A tank deck section having a row of openings therein adjacent a margin thereof, a depending flange on said section at said margin, headed fastening elements projecting through said openings, and a stiffening member having a pair of flanges connected by a web portion on said flange, one of the flanges on said stiffening member having integral means thereon engaging the heads of said elements to hold the same in projected position in said openings and against turning.

2. A tank deck section having a row of openings therein adjacent a margin thereof, a depending integral flange on said section at said margin, headed fastening elements projecting through said openings, and a stiffening member angular in cross section mounted on said depending flange having a leg thereof having integral means thereon embracing and underlying said heads of said elements to hold the same in projected position in said openings and against turning, said depending flange and said stiffening member forming a radial beam for said deck.

3. A tank deck section having a row of openings therein adjacent a margin thereof, a depending integral flange on said section at said margin, headed fastening elements projecting through said openings, and a stiffening member Z-shaped in cross section bolted to said depending flange with the upper flange thereof having integral means thereon embracing and underlying said heads of said elements to hold the same in projected position in said openings and against turning.

4. A tank deck comprising a plurality of duplicate sections each comprising a pair of endwise related deck sheets secured in overlapping relation at the adjoining ends thereof, and each having a beam-like reenforcement along one longitudinal marginal edge thereof comprising a flange integral with each of said sheets and depending therefrom and a reenforcing member angular in section bolted thereto, a depending flanged gusset member underlying the lapped joint of said sheets and securing said reenforcing members together end to end, said gusset member depending below said reenforcing member to provide a depending bracket on said section, members angular in cross section secured to said bracket adjacent the lower end thereof and to said reenforcing members adjacent the ends of said section to provide a truss on said section, said sections each having rows of openings adjacent the longitudinal margins thereof, a bolt mounted in each of the holes of one of said rows of each section with the threaded end thereof projecting from the upper face of said section and means on said reenforcing members holding said bolts against turning and in projected position whereby all the bolts along the margin of one of said sections can be passed simultaneously through the row of openings that

have no bolts therein of another of said sections.

5. In a tank having a side wall provided with an outwardly directed marginal flange at the top thereof, a center pole, a deck comprising a central circular section supported by said pole and a plurality of segmental sections radiating from said central section to said side wall, each having bracing means depending therefrom providing radial frame members extending from said central section to adjacent said side wall, said segmental sections overlapping said marginal flange and said central section, said central section having a depending annular marginal flange thereon provided with an outwardly directed substantially horizontal flange at its lower end, said frame members resting at their inner ends on said outwardly directed flange, and angular brackets connecting said frame members with said side wall.

6. In a tank having a side wall provided with an outwardly directed marginal flange at the top thereof, a center pole, a deck comprising a central circular section supported by said pole and a plurality of segmental sections radiating from said central section to said side wall, each having bracing means slightly shorter than said sections depending therefrom providing radial frame members extending from said central section to adjacent said side wall, said segmental sections overlapping said marginal flange and said central section, said central section having a depending annular marginal flange thereon provided with an outwardly directed substantially horizontal flange at its lower end, said frame members resting at their inner ends on said outwardly directed flange, and brackets angular in cross section adjustably connecting said frame members with said side wall, one leg thereof being secured to the vertical wall of said frame member and the other leg thereof to said side wall.

7. In a tank having a side wall provided with an outwardly directed marginal flange at the top thereof, a center pole, a deck comprising a central circular section supported by said pole and a plurality of segmental sections radiating from said central section to said side wall, each having bracing means depending therefrom providing radial frame members extending from said central section to adjacent said side wall, said segmental sections overlapping said marginal flange and said central section, said central section having a depending annular marginal flange thereon provided with an outwardly directed substantially horizontal flange at its lower end, said frame members resting at their inner ends on said outwardly directed flange, and angular brackets connecting said frame members with said side wall, one leg of said brackets having slots therein to permit adjustment of said frame members relative to said wall.

8. A deck or roof section having a row of openings therein adjacent a margin thereof, a depending flange on said section at said margin, headed fastening elements projecting through said openings, and stiffening means on said flange having offset fingers struck therefrom engaging the heads of said elements to hold the same in projected position in said openings.

9. A deck or roof section having a row of openings therein adjacent a margin thereof, a depending flange on said section at said margin, headed fastening elements projecting through said openings, and a stiffening member having a pair of flanges connected by a web portion on said flange, one of the flanges on said stiffening member having offset fingers struck therefrom engaging the heads of said fastening elements to hold the same in projected position in said openings and providing sockets therein having flat walls engaging said heads to hold said elements against turning.

10. A tank deck section having a row of openings therein adjacent a margin thereof, a depending integral flange on said section at said margin, headed fastening elements projecting through said openings, and a stiffening member angular in cross section mounted on said depending flange having a leg thereof provided with offset fingers struck therefrom to provide means embracing and underlying said heads of said elements to hold the same in projected position in said openings and against turning, said depending flange and said stiffening member forming a radial beam for said deck.

11. A tank deck section having a row of openings therein adjacent a margin thereof, a depending integral flange on said section at said margin, headed fastening elements projecting through said openings, and a stiffening member Z-shaped in cross section bolted to said depending flange with the upper flange thereof provided with offset fingers struck therefrom to provide means embracing and underlying said heads of said elements to hold the same in projected position in said openings and against turning.

12. A tank deck comprising a plurality of duplicate sections each comprising a pair of endwise related deck sheets secured in overlapping relation at the adjoining ends thereof, and each having a beam-like reenforcement along one longitudinal marginal edge thereof comprising a flange integral with each of said sheets and depending therefrom and a reenforcing member angular in section bolted thereto, a depending flanged gusset member underlying the lapped joint of said sheets and securing said reenforcing members together end to end, said gusset member depending below said reenforcing members to provide a depending bracket on said section, members angular in cross section secured to said bracket adjacent the lower end thereof and to said reenforcing members adjacent the ends of said section to provide a truss on said section, said sections each having rows of openings adjacent the longitudinal margins thereof, a bolt mounted in each of the holes of one of said rows of each section with the threaded end thereof projecting from the upper face of said section and means on said reenforcing members holding said bolts in projected position whereby all the bolts along the margin of one of said sections can be passed simultaneously through the row of openings that have no bolts therein of another of said sections.

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