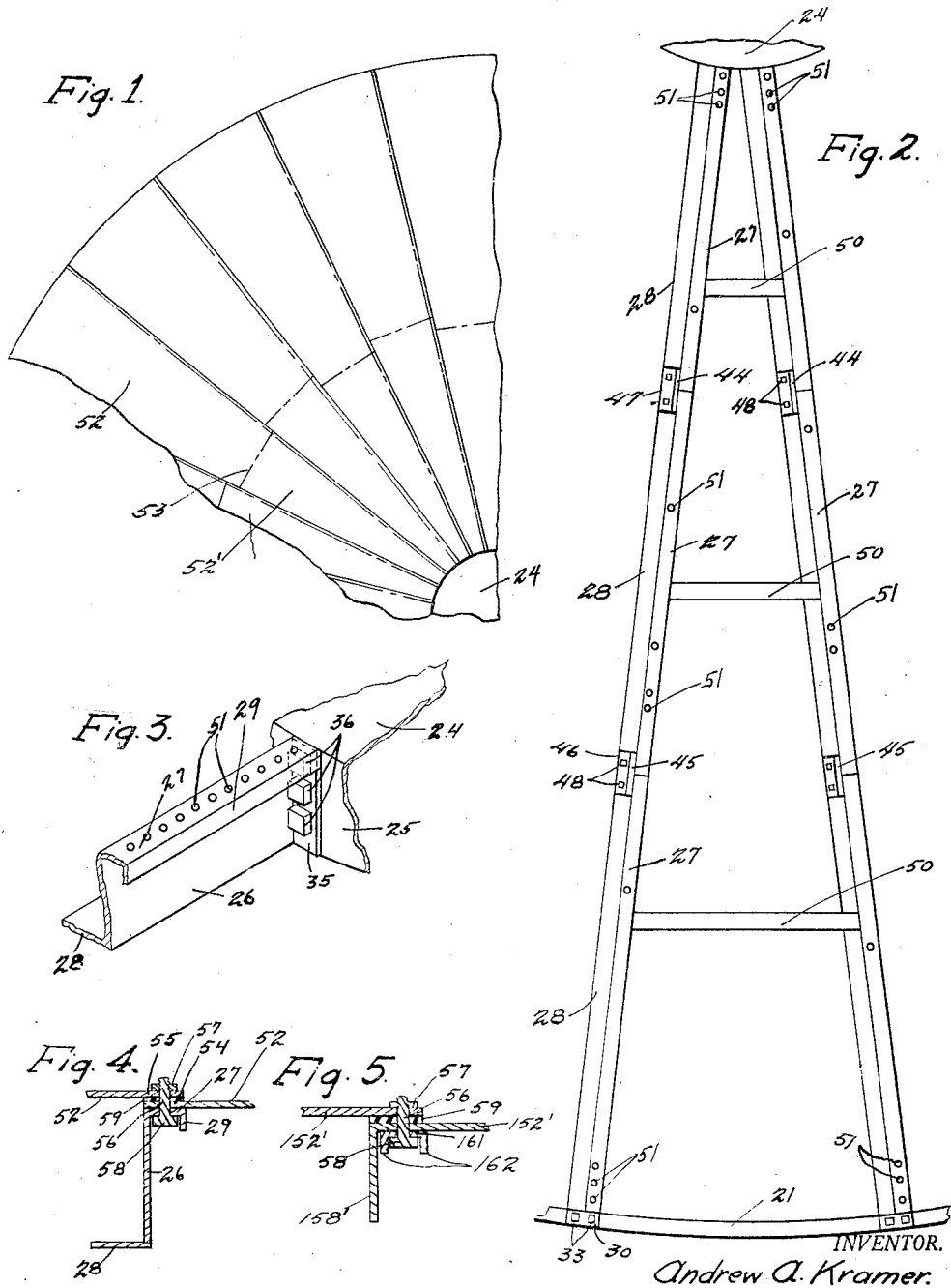


April 5, 1932.

A. A. KRAMER
ROOF CONSTRUCTION
Filed Nov. 6, 1929

1,852,659

2 Sheets-Sheet 1



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April 5, 1932.

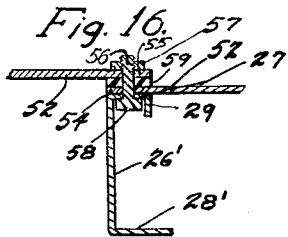
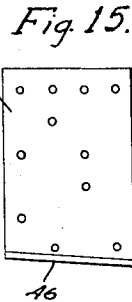
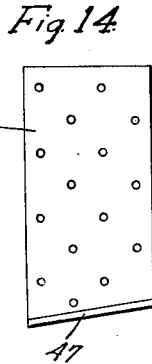
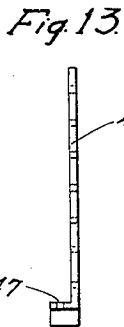
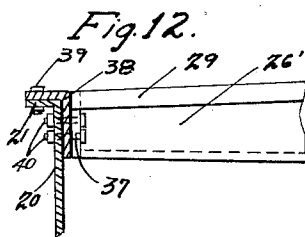
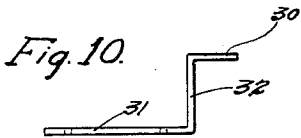
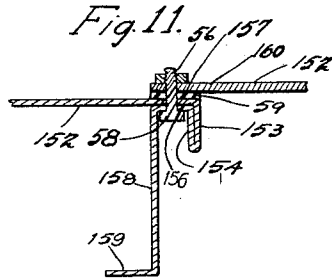
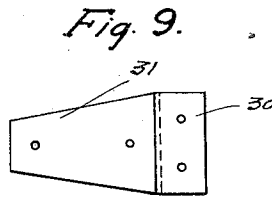
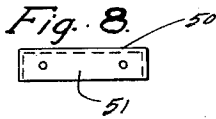
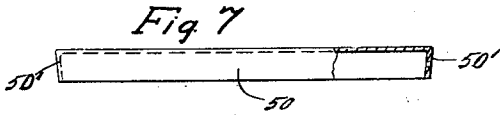
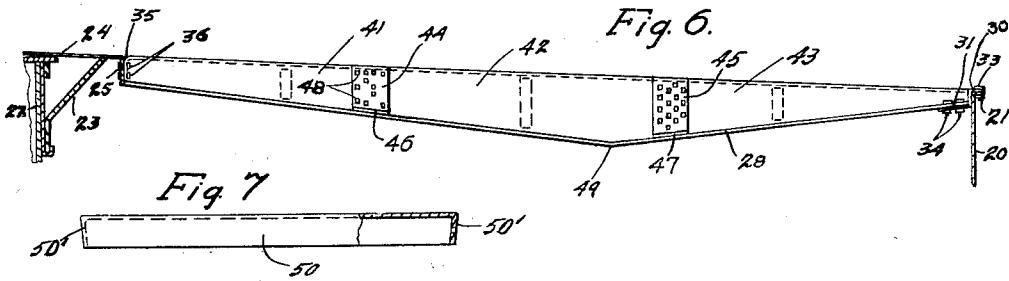
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1,852,659

ROOF CONSTRUCTION

Filed Nov. 6, 1929

2 Sheets-Sheet. 2



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UNITED STATES PATENT OFFICE

ANDREW A. KRAMER, OF KANSAS CITY, MISSOURI

ROOF CONSTRUCTION

Application filed November 6, 1929. Serial No. 405,186.

My invention relates to tanks and more particularly to the roof construction of a tank or similar cylindrical member.

It is a purpose of my invention to provide a new and improved roof construction for tanks and similar members, whereby the said roof can be made of a lighter and stronger construction than has previously been the case and no trusses or braces need be provided for the roof to strengthen the same.

In tanks such as used for the storage of oil the same are frequently of large diameter and the resulting span of the roof is relatively great. In order to provide the proper support for the roof it has been customary to provide trusses or other similar strengthening means or braces for the roof. By my improved roof construction, the necessity of such trusses or bracing means is obviated. This is accomplished by providing a plurality of substantially radially extending beams running from a central dome-like member on the roof to the side wall of the tank. Said beams may be either separate from or integral with the sheets forming the deck or roof, but are preferably made integral therewith where possible, but in any case said beams run along adjacent the radial edges of the sheets, which are of sector shape.

It is an important purpose of the invention to have the sheets or roof sections of a sector shape and the radial beams arranged along and under the overlapping edges of the sheets, as by this arrangement a very rigid strong construction can be obtained and the number of bolts necessary and holes to be punched to receive the bolts can be reduced to a minimum. Furthermore, the sheets are braced at the joints in the roof and the construction of the beams and associated parts is preferably such that a flange is provided on the beam that engages with the bolt heads to keep the same from turning.

It is also a purpose of my invention to provide new and improved means for securing the beams to the tank side wall and to the central dome-like member of the roof, which is supported in any suitable manner by means of a post or similar member, in all large size tanks.

Other objects and advantages of the 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 details shown or described, but that I intend to include as part of my invention, all such obvious changes and modifications as would occur to a person skilled in this art and as would fall within the scope of the claims.

In the drawings:

Fig. 1 is a fragmentary plan view of a tank roof made in accordance with my invention.

Fig. 2 is a fragmentary plan view of the roof on a larger scale with the deck or roof sheets omitted.

Fig. 3 is a fragmentary perspective view of the central dome-like member and the adjoining end of the beam to show the joint between the same.

Fig. 4 is a fragmentary transverse sectional view through one of the overlapping roof joints and the beam associated therewith.

Fig. 5 is a view similar to Fig. 4 of a modification.

Fig. 6 is a substantially radial section of the tank roof with the roof or deck sheets omitted, the inner dome-like member and the side wall of the tank being partly broken away.

Fig. 7 is a top plan view partly in section of one of the cross braces between the beam-like members.

Fig. 8 is an end view thereof.

Fig. 9 is a plan view of the bracket used for connecting the tank side wall and the beam.

Fig. 10 is a side elevation of said bracket.

Fig. 11 is a view similar to Fig. 4 but showing the beam as made integral with the sheet forming a roof section.

Fig. 12 is an enlarged sectional view of a modified joint between the side wall of the tank and the roof.

Fig. 13 is an edge view of one of the plates used for joining the sections of the beams.

Fig. 14 is a face view thereof.

Fig. 15 is a similar view of another of said plates, and

Fig. 16 is a view similar to Fig. 4 of a modified form of beam.

Referring in detail to the drawings, my improved deck or roof is shown as being provided on a tank having a side wall portion 20 which has a laterally outwardly directed flange 21. The tank is further provided with a central post-like member 22 that is used for supporting the central portion of the roof or deck, being preferably provided with a conical bracing member 23 that has the dome-like member 24 secured thereto, said dome-like member 24 having a downturned peripheral flange 25 thereon. My improvements particularly relate to the supporting structure provided for said roof between the said dome-like member and the top of the side wall of the tank, and particularly to such a supporting structure in conjunction with a deck or roof made of sector shaped roof sheets.

In the form of the invention shown in Figs. 2 to 10 inclusive, the supporting structure for the roof or deck comprises beams 26 that are substantially Z shaped in cross section, said beams having an upper transverse flange 27 running along the top thereof and a lower transverse flange 28 extending laterally from the vertical web portion thereof in an opposite direction to the flange 27. The flange 28 is also preferably somewhat wider than the flange 27. From the flange 27 a substantially vertical flange 29 extends downwardly, said flange 29 being substantially parallel to and spaced from the web portion of the beam 26.

Said beams 26 are secured at opposite ends thereof to the side wall of the tank and to the dome-like member at the center of the roof or deck, and in order to secure said beams to said side wall the brackets shown in Figs. 9 and 10 may be provided. Said brackets are provided with a relatively short flange portion 30, and a relatively long tapering flange portion 31 connected together by means of the connecting portion 32 extending substantially at right angles to the said flange portions. The flange portion 30 extends over the lateral circumferential flange 21 at the top edge of the side wall 20 and is secured thereto by means of the bolts 33, while the flange portion 31 extends under the flange 28 on the beam 26 and is secured thereto by means of the bolts 34. Each beam is provided with a vertical end flange 35 at the inner end thereof, which may be welded to the flanges 27 and 29 on said beam. Said end flange 35 fits up against the outer side of the flange 25 and is secured thereto by means of the bolts 36. Thus the beams are firmly anchored at the opposite ends thereof to the central dome-like member and the side wall of the tank.

Instead of using the brackets above referred to for securing the beams to the side wall of the tank, the beams, such as the beam 26' shown in Fig. 12, which is otherwise similar to the beam 26 previously described, may

be each provided with an end flange 37 at their outer ends similar to the flange 35, and the angle 38 may be provided between the end of the beam and the side wall of the tank, one leg of the angle being bolted to the flange 21 by means of the bolts 39 and the other leg of the angle being clamped between the side wall of the tank and the flange 37 by means of the bolts 40 that extend through said flange 37, angle 38 and side wall 20.

While it is desirable to make the beams in one piece, if possible, the length thereof does not usually permit this, and in Figs. 2 and 6 the beams are shown as being made up of several sections, Fig. 6 showing the same as comprising an inner section 41, a central section 42 and an outer section 43, said sections being secured together by means of the plates 44 and 45, said plates being similar, but the plate 45 being longer than the plate 44. The plate 44 has an inclined flange 46 resting on and secured to the flange 28 on the sections 41 and 42, while the plate 45 has an inclined flange 47 resting on and secured to the flange 28 on the sections 42 and 43, said plates being secured to said flanges 28 and the web portions of the beam sections by means of the bolts 48. It will be noted, upon reference to Fig. 6 that the beam thus formed of the sections 41, 42 and 43 has a web portion that varies in height and that the lower flange 28 thereof is inclined downwardly from the ends thereof to a point indicated at 49 in Fig. 6, which lies somewhat nearer the outer end of the beam than the inner end thereof, whereby said beam is of a truss-like form, to provide the greatest strength thereof where most needed.

In order to maintain the beams in properly spaced relation and to brace the roof transversely of the beams, the transverse connecting members 50 are provided. Any number of these that are desired may be used, three being shown in the drawings, and these varying in length and depth as the beams diverge from each other outwardly and vary in height. One of said members 50 is shown in Figs. 7 and 8, and said members are channel shaped in cross section with end walls or flanges 50' thereon that are inclined to fit against the web portions of the beams 26 to which the same are bolted.

The flanges 27 of the beams are provided with a row of substantially equidistantly spaced bolt holes 51 as shown in Fig. 3, only certain of said holes being shown in Fig. 2 for the sake of simplicity. The deck sheets 52, which are of a sector shape are similarly perforated along the radial edges thereof so that the same can be mounted in overlapping relation on the beams. If the tank is of such diameter that more than one sheet must be used between each pair of beams the sheets 52' may be provided and these have a lap joint at 53 made in a similar manner to the

joint to be described below. The under-lapping edge of the one sheet 52 at the radial joint (see Fig. 4) is designated by the numeral 54 and the over-lapping edge of the adjoining sheet by the numeral 55. The flange 27 underlies the sheets at the lapped portions 54 and 55 thereof and the flange 29 thereon stiffens the same so that the same acts as a bearing member and stiffening means for the sheets at the points where the bolts 56 are passed through the same, so that when the nuts 57 on the same are tightened up there will be no warping or buckling of the edges 54 and 55 of the sheets 52. The heads 58 of the bolts furthermore lie between the flanges 29 and the web portions of the beams and said flanges and web portions are so spaced therefrom that the heads of said bolts will engage the same to prevent said bolts from turning when the nuts are tightened thereon.

A compressible packing 59 is inserted between the two sheets at the joint between the same and the engagement of the bolts therewith at the openings therethrough for said bolts, along with the frictional engagement of the bolts with the edges of the bolt holes in the sheets, will hold the bolts in position for placing the nuts thereon, after the bolts have been pushed through the holes from the inside of the tank. Thus the nuts can be put on the bolts as desired without the necessity of any aid from a person on the under side of the roof, after insertion of the bolts through the holes.

The resulting deck is very strong, due to the beam construction used and is lightened due to the elimination of unnecessary parts, the same means being used for forming the framework for the deck or roof that serve as bracing and stiffening means for the edges of the sheets and the number of bolts necessary being greatly reduced, due to the use of the same bolts for connecting the sheets with each other and the beams and the sheets together.

In Fig. 16 a slightly modified form of beam 26' is shown, said beam 26' being substantially the same as the beam 26 except that the flange 28' thereon extends in the same direction as the flange 27 instead of on the opposite side of the web portion of said beam.

It is very desirable to make the beam integral with the edge of the sheet where the size of the parts does not make the manufacturing problems involved too great to be practical. Such a structure is shown in Fig. 11, in which portions of two sheets 152 similar to the sheets 52, are shown, except that the beams that run radially of the roof or deck are made integral therewith.

One radial edge of each sheet 152 is turned downwardly to provide a depending portion 153 thereon, and doubled back and extended upwardly alongside the portion 153, said upwardly extending portion 154 forming with

the portion 153, a doubled flange depending from the sheet 152. The sheet is then bent to provide the portion 156 that underlies the portion 157 of said sheet provided with the row of holes for the bolts, the portions 156 and 157 being provided with aligning apertures for said bolts. From the portion 156 the relatively deep flange 158 depends, said flange terminating in the lateral stiffening flange 159. A beam integral with the sheet 152 is thus formed thereon, and this may be truss-like in form like the beam 26 if desired. The doubled portions 156 and 157 and the doubled flange provided thereon stiffen and brace the sheets at the over-lapping joints thereof to avoid warping or buckling thereof and also constitute part of the beams formed on the sheets whereby the framework for the deck or roof is formed integral therewith. The opposite edge 160 of each sheet overlaps the doubled portions 156—157 of the adjoining sheet and has bolt holes therein aligning with those in the portions 156—157. The bolts 56 have the heads 58 thereof held against turning in a similar manner to that previously described, as will be evident from Fig. 11. The packing 59 is also preferably provided between the sheets and the bolts are inserted in a similar manner to that previously described, and the nuts placed thereon and tightened thereon from the outside of the tank without the necessity of a man on the inside of the tank to hold the same from turning.

In Fig. 5 another modification is shown in which the sheets 152' are provided with a deep flange 158' along the edge thereof and a channel 161 is mounted adjacent the flange 158', the channel and sheets being bolted together by means of the bolts 56 and nuts 57, compressing the packing 59 between the sheets. The heads 58 of the bolts are mounted between the flanges 162 and hold the bolts from turning when the nuts are tightened thereon.

Having thus described my invention, what I claim and desire to secure by United States Letters Patent is:

1. A tank roof comprising a plurality of sector-shaped sheet metal sections having overlapping joints and supporting means therefor comprising a central member and substantially radially extending beams lying under the joints between said sheet metal sections and extending continuously from said central member to the periphery of said roof, each comprising a substantially vertical web portion depending from said roof adjacent each of said joints and stiffening means underlying the overlapping portions of each of said joints adjacent said web portion and comprising a flange spaced from said web portion.

2. A tank roof of the character described comprising a plurality of sheet metal sections having over-lapping substantially radially extending joints and supporting means

for said roof comprising a central member and substantially vertically extending web portions depending from said roof adjacent each of said joints and extending continuously from said central member to the periphery of said roof and channelled stiffening means underlying the overlapping portions of each of said joints.

3. A tank roof of the character described comprising a plurality of sheet metal sections having flat over-lapping joints, and a supporting and stiffening structure for said roof comprising a central member and stiffening means extending lengthwise under said joints continuously from said central member to the periphery of said roof, said stiffening means having a flange depending therefrom on one side thereof and a web portion deeper than said flange depending from the other side thereof to form beams extending lengthwise under the overlapping portions of said joints continuously from said central member to the periphery of said roof.

4. In a tank roof, a plurality of roof sections, each of said roof sections having a web portion depending from one side thereof and constituting a framework member running substantially parallel to the side edge of said sheet and reinforcing means underlying said section adjacent said side edge and having a flange depending therefrom spaced from said web portion.

5. In a tank roof, a plurality of roof sections, each of said roof sections having a web portion depending from one side thereof and constituting a framework member running substantially parallel to the side edge of said sheet and reinforcing means underlying said section adjacent said side edge and having a flange depending therefrom spaced from said web portion and shorter than said web portion.

6. In a tank roof, a plurality of roof sections, each of said roof sections having a web portion depending from one side thereof and constituting a framework member running substantially parallel to the side edge of said sheet and reinforcing means underlying said section adjacent said side edge and having a flange depending therefrom spaced from said web portion, said roof sections having substantially plane upper surfaces.

7. In a tank roof, a plurality of roof sections, each of said roof sections having a truss-like web portion depending from one side thereof and constituting a framework member running substantially parallel to the side edge of said sheet and reinforcing means underlying said section adjacent said web portion in face to face relation thereto and having a stiffening flange thereon extending in spaced relation to said web portion.

8. In a tank roof of the character described, a plurality of roof sections of sheet metal having overlapping joints, supporting means

therefor comprising beams extending lengthwise of the joints between said sections, said beams each comprising a substantially vertically extending web portion running substantially parallel to the side edges of said sections at said joint, a portion underlying the overlapping portion of the joint between the sections, a stiffening flange depending from said last mentioned portion and a lateral flange on said web portion at the bottom thereof, and fastening elements lying between said web portion and said stiffening flange.

9. In a tank roof of the character described, a plurality of roof sections of sheet metal, and supporting means therefor comprising beams integral with said roof sections and extending lengthwise of the joints between said sections, said beams each comprising a substantially vertically extending web portion, a portion underlying the joint between the sections, a stiffening flange depending from said last mentioned portion and a lateral flange on said web portion at the bottom thereof.

10. In a tank roof of the character described, a plurality of roof sections of sheet metal having overlapping joints, and supporting means for said roof comprising a central support and beams underlying said joints each having an upper substantially horizontal flange portion underlying the overlapping portions of each of said joints, a web portion depending therefrom, a lower substantially horizontal flange portion on said web portion, and a flange depending from said upper flange portion substantially parallel to and in spaced relation to said web portion to provide a channeled portion for said beam, said beams extending continuously radially from said central support to the periphery of said roof.

11. In a tank roof of the character described, a plurality of roof sections of sheet metal, and supporting means for said roof integral with said sections and comprising beams each having an upper substantially horizontal flange portion, a web portion depending therefrom, a lower substantially horizontal flange portion on said web portion, and a flange depending from said upper flange portion substantially parallel to and in spaced relation to said web portion to provide a channeled portion for said beam.

12. A tank roof comprising a central member having a depending peripheral flange, beams extending from said central member to the side wall of said tank, and roof sections on said beams, said beams comprising web portions and having horizontal flanges underlying said roof sections, said web portions having end flanges thereon extending laterally from said web portions and securing means extending through said end flanges and said depending flange on said central member to secure said beams to said central member.

13. In a tank roof of the character described, a central member, beams radiating therefrom each comprising a vertical web portion having a horizontal flange on the bottom thereof and means for securing said beams to the side wall of said tank, comprising brackets each having a central portion and flanges extending in opposite directions from opposite ends of said central portion, said side wall having a lateral flange at the top thereof, one of the flanges of said brackets being secured to the horizontal flange of said beam and the other flange thereon being secured to the lateral flange on said side wall.

14. In a tank roof, a beam having a vertical web portion, an upper lateral flange, a lower lateral flange, a depending flange on said upper lateral flange and an end flange on said beam extending substantially perpendicular to said web portion, between said web portion and depending flange.

15. In a roof, a plurality of sheet metal members having over-lapping joints, supporting means therefor comprising beams extending lengthwise of said joints and having web portions depending from said roof, portions underlying said joints and stiffening flanges thereon, and fastening elements extending through the overlapped portions of said sheets and beams, said fastening elements having flattened portions on the heads thereof, said heads lying between said web portions and said stiffening flanges and said stiffening flanges engaging said flattened portions to hold said fastening elements against turning.

16. In a roof, a plurality of sheet metal members having over-lapping joints, supporting means therefor comprising beams extending lengthwise of said joints and having web portions depending from said roof, portions underlying said joints and stiffening flanges thereon, and fastening elements extending through the over-lapped portions of said sheets and beams, said fastening elements having flattened portions on the heads thereof, said heads lying between said web portions and said stiffening flanges and said web portions engaging said flattened portions to hold said fastening elements against turning.

17. In a tank, a side wall portion, a central roof supporting member and a sectional roof for said tank comprising roof sections having overlapping joints and substantially radially extending beams underlying the overlapping portions of the joints between the sections of said roof and radiating from said central roof supporting member to said side wall portion, each of said beams comprising a substantially vertical deep web portion, a shallow stiffening flange spaced from said web portion and a stiffening portion underlying the joint between the sections of said roof between said web portion and said flange.

18. In a tank, a side wall portion, a central roof supporting member and a sectional roof for said tank comprising roof sections having flat overlapping joints and substantially radially extending continuous beams underlying the flat overlapping portion of the joints between the sections of said roof and radiating from said central roof supporting member to said side wall portion, each of said beams comprising a substantially vertical deep web portion, a shallow stiffening flange spaced from said web portion and a stiffening portion underlying said roof between said web portion and said flange, said beams connecting said central member and the side wall of said tank and bracing said flat joints between the sections of said roof.

In testimony whereof, I hereunto subscribe my name this 27th day of September, 1929.

ANDREW A. KRAMER.