Feb. 28, 1928. 1,661,001

J. P. MADDEN ET AL

TANK CAR

Filed March 15, 1926 5 Sheets-Sheet 1

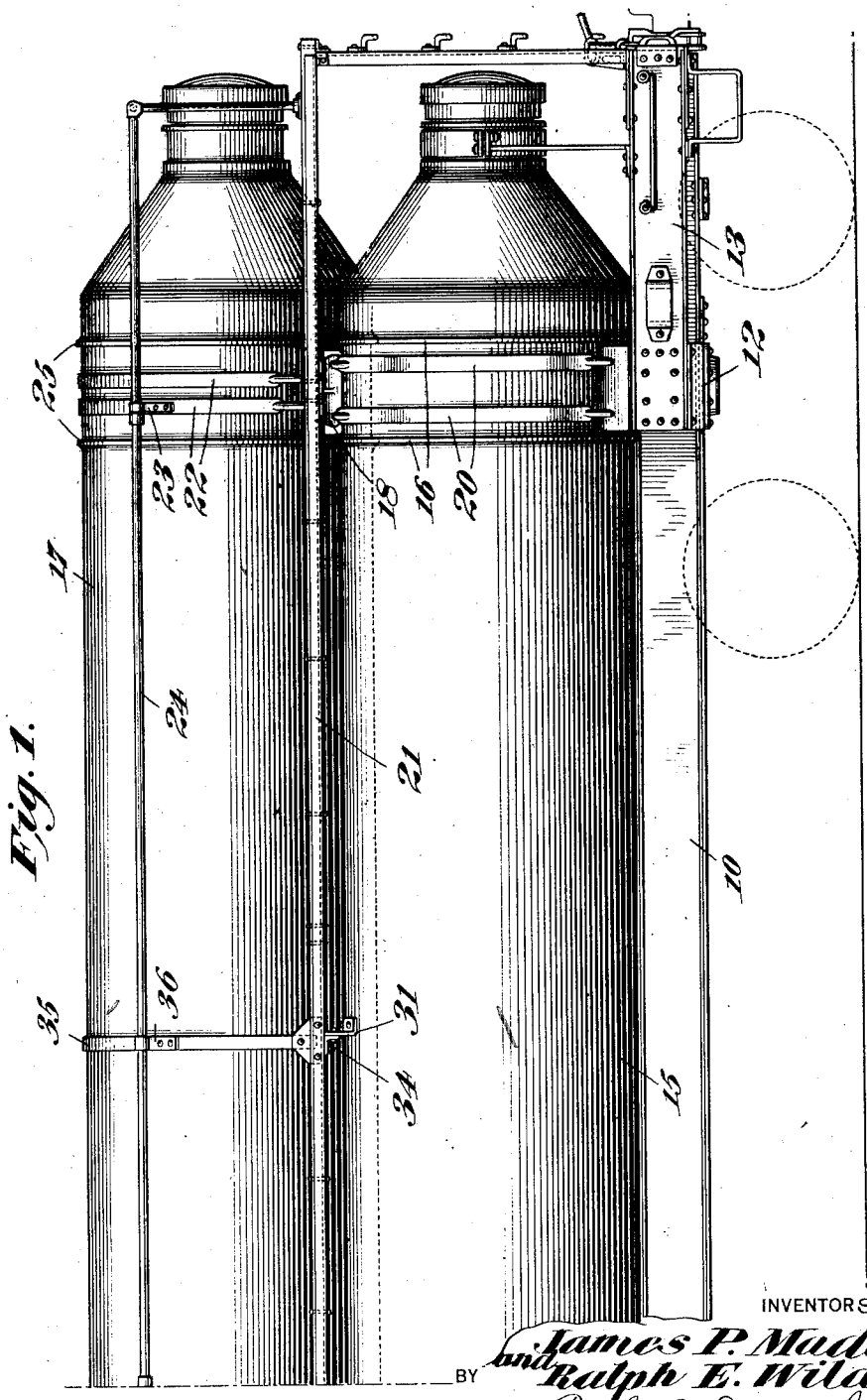


Fig. 1.

INVENTORS
James P. Madden
and Ralph E. Wilder.
BY R. S. C. Dougherty
ATTORNEY

Feb. 28, 1928. 1,661,001

J. P. MADDEN ET AL

TANK CAR

Filed March 15, 1926 5 Sheets-Sheet 2

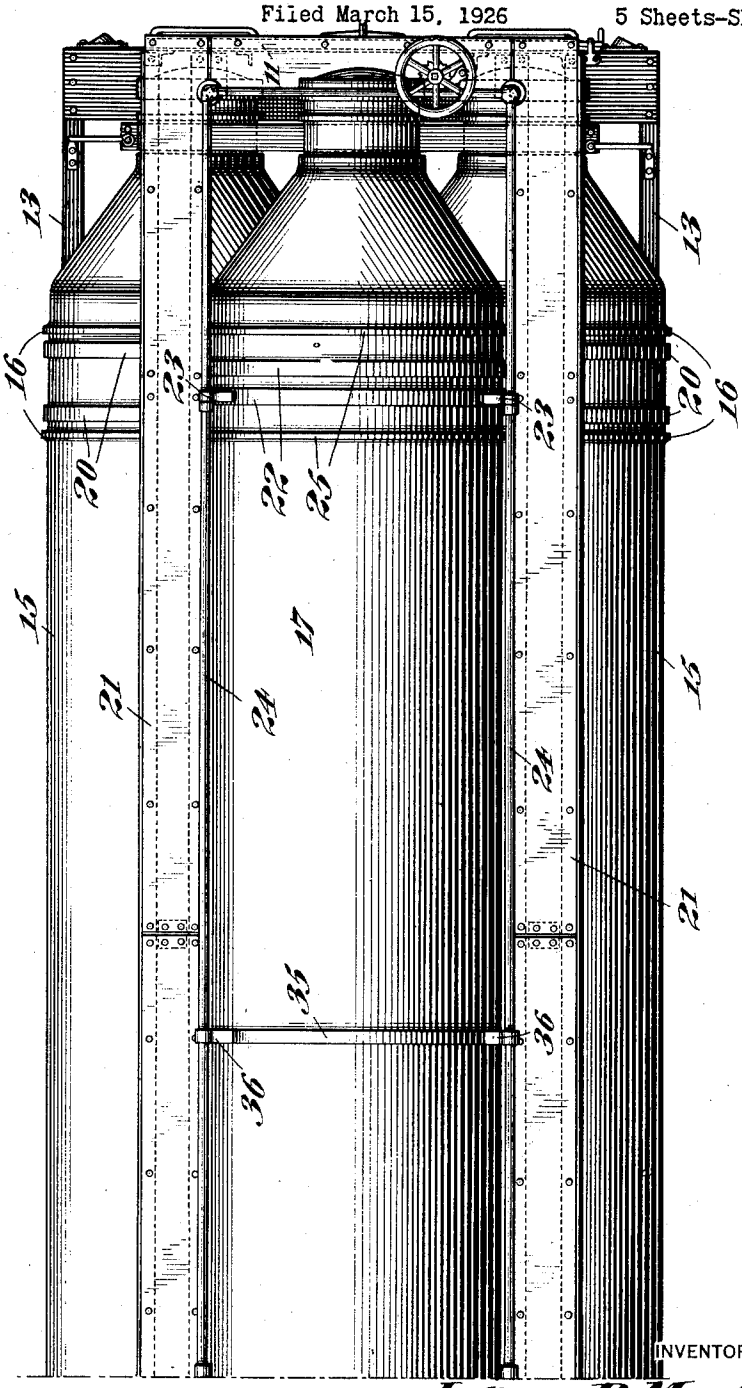


Fig. 2.

INVENTORS

BY James P. Madden and Ralph E. Wilder.

R. S. & Dougherty

ATTORNEY

Feb. 28, 1928. 1,661,001

J. P. MADDEN ET AL

TANK CAR

Filed March 15, 1926 5 Sheets-Sheet 3

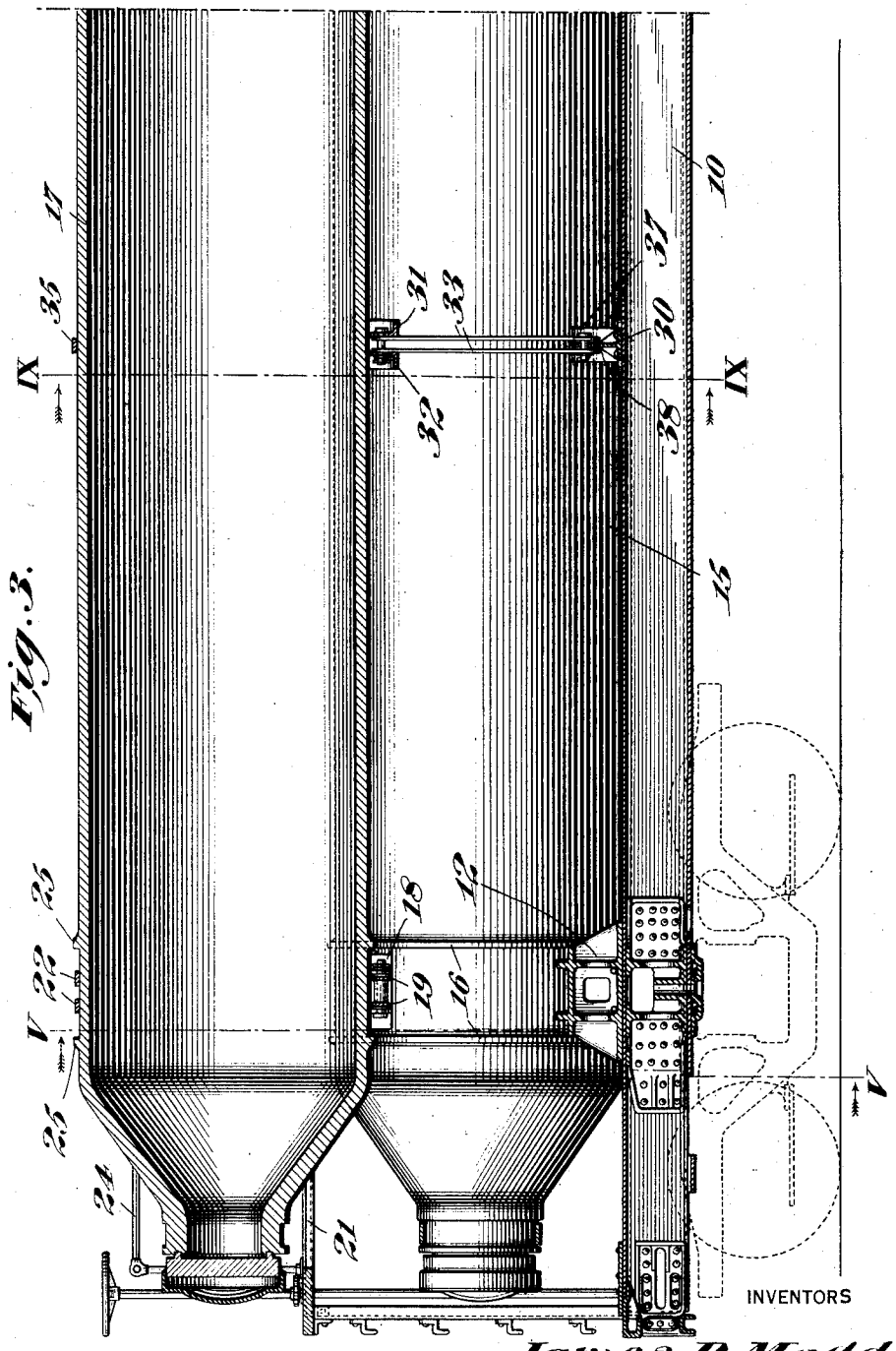


Fig. 3.

INVENTORS

BY James P. Madden and Ralph E. Wilder:

R. S. C. Dougherty ATTORNEY

Feb. 28, 1928. 1,661,001

J. P. MADDEN ET AL

TANK CAR

Filed March 15, 1926 5 Sheets-Sheet 4

Fig. 5.

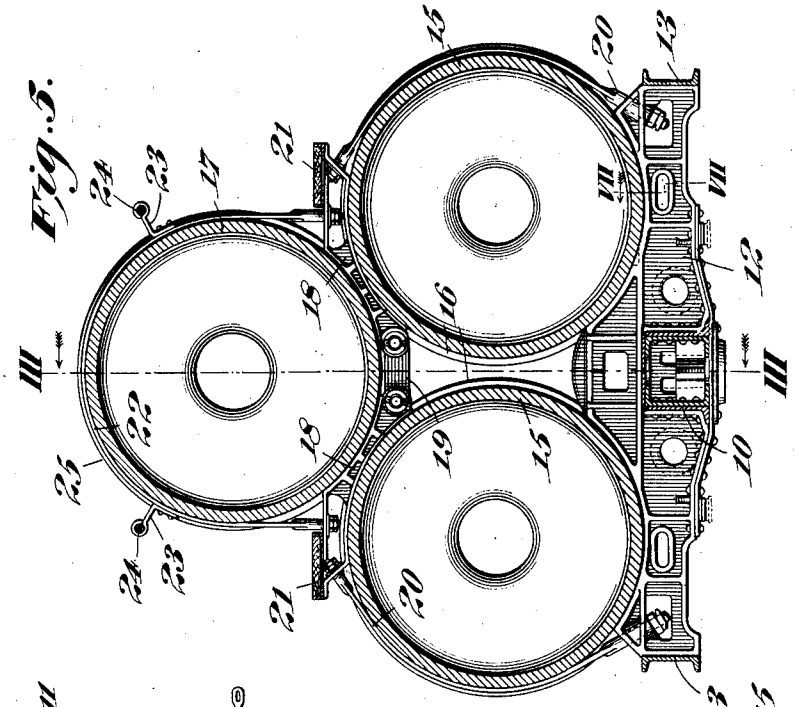


Fig. 4.

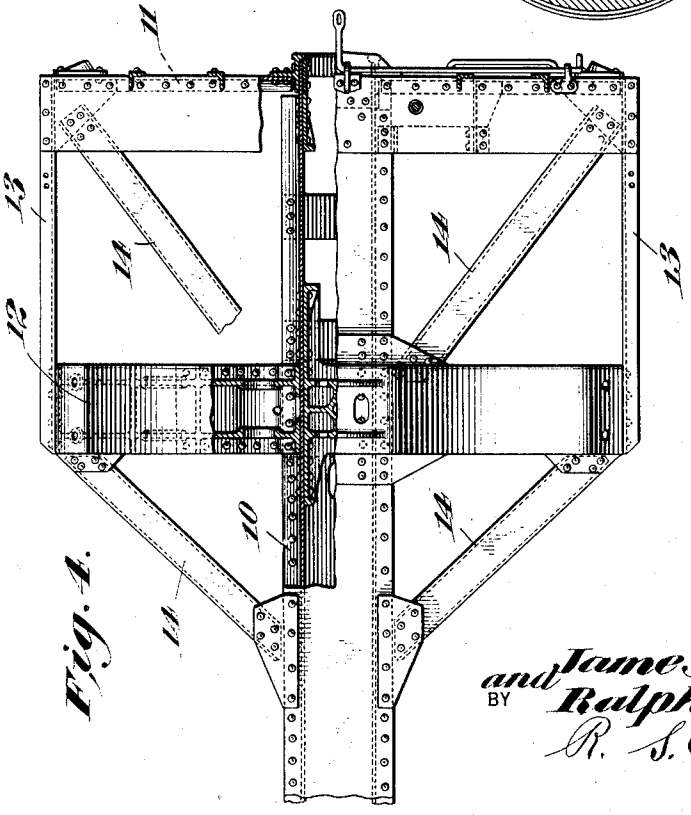


Fig. 7.

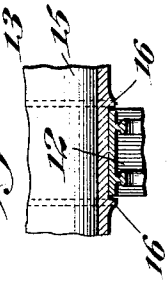
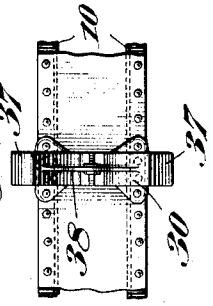


Fig. 6.



INVENTORS

James P. Madden

and Ralph E. Wilder.

BY R. S. C. Dougherty

ATTORNEY

Feb. 28, 1928. 1,661,001

J. P. MADDEN ET AL

TANK CAR

Filed March 15, 1926 5 Sheets-Sheet 5

Fig. 9.

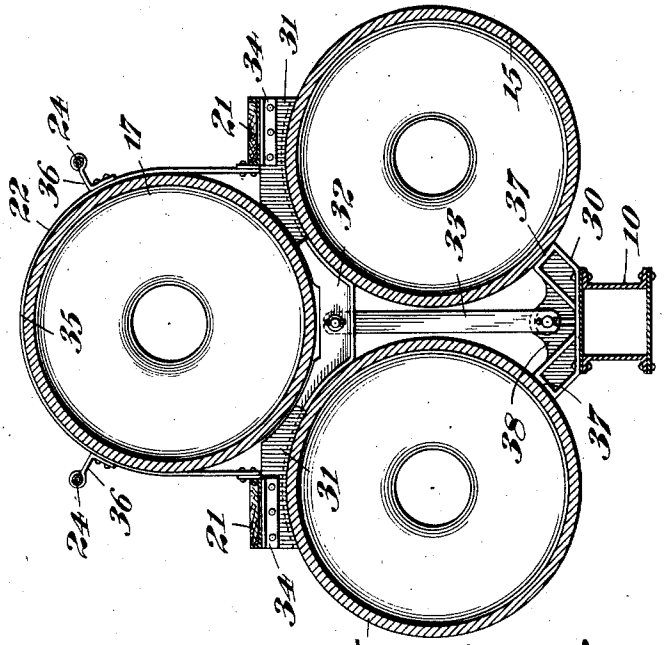
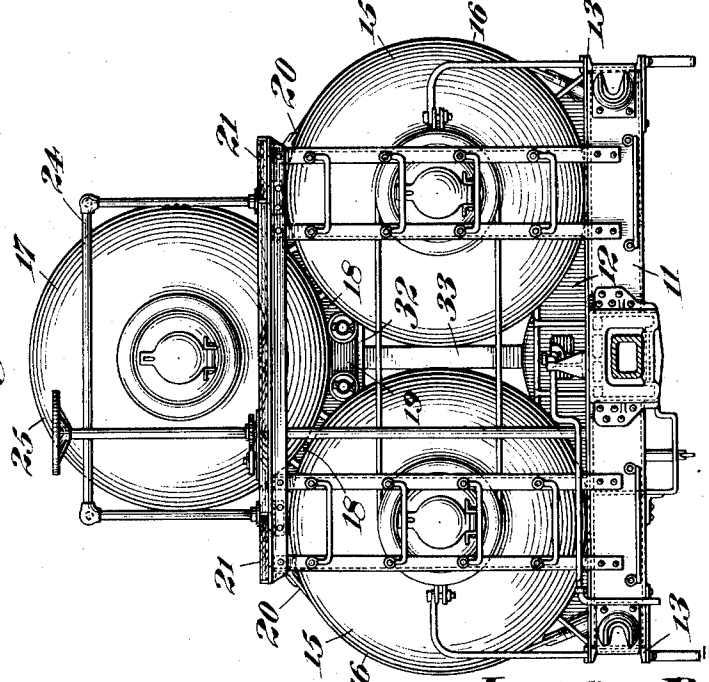


Fig. 8.



INVENTORS

James P. Madden

and Ralph E. Wilder.

BY R. S. C. Dougherty

ATTORNEY

Patented Feb. 28, 1928. 1,661,001

UNITED STATES PATENT OFFICE.

JAMES P. MADDEN AND RALPH E. WILDER, OF BETHLEHEM, PENNSYLVANIA, ASSIGNORS TO BETHLEHEM STEEL COMPANY.

TANK CAR.

Application filed March 15, 1926. Serial No. 94,742.

Our invention relates to tank cars suitable for the transportation of fluids under high pressures, and it has for an object to provide apparatus of this character wherein the tanks shall extend for the full length of the car structure and be supported in such a manner that the tanks shall not have stresses imposed thereon due to deformation of the car structure in service.

In order that gases or liquids under high pressure may be transported by railway economically, with a minimum of handling, it is desirable that the tanks shall be made as large as possible, within reason, in order that the tanks shall each have a reasonably large capacity and in order to simplify the tank car construction. In view of the fact that very high pressures may be imposed on tanks of this character, they are made of single pieces of forged steel in order to secure a receptacle, considering the volume, which is strong enough to resist high pressures with safety. However, in view of the fact that a railway car deforms or weaves more or less in service, it is necessary that such a mode of support shall be used as will not impose upon the tanks stresses due to weaving or deformation of the car, otherwise such weaving or deformation might result in the application of concentrated stresses to the tanks with possible rupturing of the latter. To this end, we provide tanks of the character referred to which extend for the full length of the car construction and which have, in effect, two-point supports, each tank having its end portions supported substantially in the planes of the body bolsters. With such a construction, it will be apparent that the tanks may be held in place against longitudinal movement with respect to a car while at the same time relative movements of different parts of the car may take place without resulting in the setting up of stresses, due thereto, in the tanks. A further object of our invention is to provide a tank car construction of the character referred to wherein a pair of lower tanks shall extend longitudinally of the car and be supported on the body bolsters and an upper tank shall extend longitudinally of the car and be supported by and spaced from the lower tanks at the end portions thereof, the vertical plane of the longitudinal axis of the upper tank being disposed substantially midway between the vertical planes of the longitudinal axes of the lower tanks, and means being provided in connection with the bolsters whereby the tanks may be maintained in place with respect to the latter and longitudinal movements of the tanks relatively to the bolsters be resisted.

A further object of our invention is to provide a tank car arrangement having tanks supported on body bolsters together with anchorage means cooperating with intermediate points of the tanks, the anchorage means being of such a character as to permit of relative movements between the tanks and the car construction in service, while affording support for the tanks and restricting lateral movements of the tanks with respect to the construction.

These and other objects are effected by our invention as will be apparent from the following description and claims taken in connection with the accompanying drawings, forming a part of this application, in which:

Fig. 1 is a fragmentary side elevation of our improved tank car construction;

Fig. 2 is a top plan view of the apparatus shown in Fig. 1;

Fig. 3 is a vertical longitudinal sectional view of the apparatus shown in Fig. 1;

Fig. 4 is a fragmentary plan view, with parts shown in section, of the center sill and bolster construction;

Fig. 5 is a sectional view taken along the line V—V of Fig. 3 and viewed in the direction of the arrows;

Fig. 6 is a fragmentary detail view showing the support for the intermediate anchorage device;

Fig. 7 is a detail view showing the relation between one of the bolsters and one of the tanks;

Fig. 8 is an end elevation of the apparatus shown in Figs. 1 and 2; and,

Fig. 9 is a sectional view taken along the line IX—IX of Fig. 3 and viewed in the direction of the arrows.

In Figs. 1 and 5, we show a central sill 10 of box girder construction, an end sill 11, a body bolster 12, side sills 13, and diagonal braces 14. The body bolster 12 supports one end of the lower tier of two tanks 15, being suitably concaved as to its upper bearing surface, so as to correspond with the periphery of the tanks 15. Said tanks are provided with peripheral shoulders 16 spaced in excess of the width of the body bolster 12

so as to limit the longitudinal free movement of the tanks (see Fig. 7).

We also show a single tank body 17, forming the upper tank tier, two cradle castings 18, a link 19 connecting the castings at their inner extremities and tie rods 20 connecting them at their outer extremities with the body bolster 12. The cradle castings 18 are designed so as to provide brackets for the running boards 21 and are furthermore concaved so as to conform with the periphery of both the upper and the lower tank bodies. Straps 22 pass over the upper tank body 17 and are anchored to the cradle castings. One of the straps 22 is provided with a bracket 23 to support a hand rail 24. The tank body 17 is provided with peripheral shoulders or flanges 25 in a manner similar to the shoulders or flanges 16 on the lower tank bodies 15, the flanges or shoulders 16 being disposed laterally of the sides of the body bolster 12 and the flanges or shoulders 16 and 25 being disposed laterally of the sides of the saddles, whereby longitudinal movements of the tanks relatively to the car structure are limited.

Referring to Figs. 1, 3, 6 and 9, we show means for bracing the tanks with respect to the center sill at convenient points between the body bolsters 12. At such points, an anchorage bracket 30 is riveted to the center sill 10, a cross beam 31 is interposed between the upper and lower tanks, a spacing yoke 32 is placed adjacent to the cross beam 31 and a pair of links 33 are inserted to connect the bracket 30 with the cross beam 31 and the spacing yoke 32, respectively. The cross beam is provided with an angle 34 to support the running boards 21. A single strap 35 passes over the upper tank body 17 and is anchored at each end to the running board structure, the strap preferably being provided with a bracket 36 for the hand rail 24.

The anchorage bracket 30 comprises two projections, extending towards the axes of the two lower tanks and having surfaces 37 shaped to conform to the tanks, and a transverse rib 38 drilled for attachment of the links 33, as shown in Figs. 6 and 9.

The cross beam 31 and the spacing yoke 32 have their lower surfaces concaved to bear on the lower tanks 15 while their upper surfaces are shaped to clear the upper tanks 17. The links are intended to have some initial tension when the structure is assembled so that the lower tanks are clamped between the surfaces 37 of the bracket 30 and the lower surfaces of the cross beam 31 and of the yoke 32.

From the foregoing, it will be apparent that we have devised a tank car construction which is characterized by a center sill with bolster structures connected and firmly braced to the end portions of the sill. The tanks 16 and 17 extend for substantially the full length of the car, the lower tier of tanks being supported by the bolsters 12 while the upper tier, shown as consisting of a single tank, rests on the lower tanks. As already pointed out, the arrangement of flanges on the lower tanks 15 laterally of the sides of the bolster seats limits movements of the lower tanks longitudinally of the car with respect to the bolsters. The flanges 25 on the upper tank are disposed laterally of the cradle members 18, the latter members also fitting between the flanges 16 on the lower tanks. Resistance to longitudinal movement of the tanks is essentially frictional, being supported by straps 20 and 22; and, in view of the character of material and length of such straps, large hold-down forces may be exerted, while preserving qualities of yielding, largely due to possible elongation of the straps, so that, in case of extreme stress, the anchorage devices are not broken. Anchorage devices of this character are peculiarly suitable for large tanks of the type herein referred to for the reason that stresses are distributed and not concentrated and for the further reason that no special modification of the tank structure, other than the ribs or flanges is necessary. It will, therefore, be apparent that we have devised a tank car construction in which each tank has a two-point support, the lower tanks being supported by the bolsters and the upper tank being supported by and spaced from the lower tanks. Assuming the car structure to weave or to deform in service, any such deforming movements of the car structure may take place without imposing additional stresses on the tanks; and, in view of the fact that these tanks are likely to be filled with fluids under high pressures, it is important that the tanks are relieved from external stresses as far as possible.

In view of the length of the tanks and forces to which they would be subjected in service, it is desirable to provide some form of intermediate support or anchorage. At the same time, any such supporting means or anchorage arrangement should permit of relative movements taking place between the car structure and the tanks so that the tanks may readily accommodate themselves to different conditions of deformation of the car structure, or possibly of the tanks, without having stresses imposed on the tanks. To this end, it will be seen that the links 33 may pivot with respect to the bracket 30 and the saddle and spacing members 31 and 32 may pivot with respect to the links, the bracket having concaved supporting portions 37 fitting the tanks and the saddle and spacing members 31 and 32 having concaved surfaces which fit the tanks, the saddle member 31 being longer than the member 32 and having its ends terminating outwardly of the vertical planes of the longitudinal axes of

the lower tanks. This articulated anchorage arrangement, therefore, permits the lower tanks to assume natural positions without being resisted by rigid anchorage structure, while, at the same time, anchorage and support for the lower tanks is secured to the best advantage. To the end of holding the upper tank in place with respect to the center sill 10, the anchorage arrangement is provided with a strap 35 secured in place with respect to the saddle beam 31 and extending over the upper tank 17. The saddle members 31 and 32 rest on the lower tanks but are spaced from the upper tank. Therefore, it will be seen that the anchorage arrangement maintains the tank assembly in position with respect to the center sill 10 while permitting movements of accommodation to take place without subjecting the tanks to external stresses due to the anchorage.

While we have shown our invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications without departing from the spirit thereof, and we desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

Having thus described our invention what we claim as new and desire to secure by Letters Patent is:

1. In a tank car construction, the combination of a pair of body bolsters, a pair of lower tanks extending longitudinally of the car construction and supported on the bolsters, an upper tank extending longitudinally of the car construction and having the vertical plane of its axis arranged substantially midway between the vertical planes of the axes of the lower tanks, means at each end portion of the upper tank for spacing the latter from the lower tanks, and means for securing the tanks in place with respect to the bolsters.

2. In a car construction, the combination of a pair of body bolsters, a center sill connected to the bolsters, a pair of lower tanks extending longitudinally of the car construction and resting on the bolsters, an upper tank extending longitudinally of the car construction and having the vertical plane of its axis arranged substantially midway between the vertical planes of the axes of the lower tanks, means at each end portion of the upper tank for spacing the latter from the lower tanks, means for securing the tanks in place with respect to the bolsters, and means connected to the center sill and cooperating with intermediate portions of the tanks for anchoring the latter while permitting movements thereof with respect to the car construction.

3. In a tank car construction, the combination of a pair of body bolsters, a pair of lower tanks extending longitudinally of the car construction and resting on the body bolsters, a single upper tank extending longitudinally of the car construction and having the vertical plane of its axis arranged intermediately of the vertical planes of the axes of the lower tanks, cradle devices arranged between the upper tank and the lower tanks and disposed vertically above the bolsters, and means for holding the lower tanks in place with respect to the bolsters and for holding the upper tank in place with respect to the cradle devices.

4. In a tank car construction, the combination of a pair of body bolsters, a pair of lower tanks extending longitudinally of the car construction and resting on the body bolsters, an upper tank extending longitudinally of the car construction, articulated cradle devices disposed between the upper tank and each of the lower tanks, said cradle devices being located vertically above the bolsters, means for frictionally anchoring the lower tanks in place with respect to the bolsters including clamping bands anchored to the bolsters and to the cradle devices and the weight of the upper tank cooperating with the cradle devices to maintain the clamping bands taut to hold the lower tanks in place, and means secured in place with respect to the cradle devices for clamping the upper tank relatively thereto.

5. In a tank car construction, the combination of a pair of body bolsters, each having a pair of concave seats, a pair of lower tanks extending longitudinally of the car construction and resting in the seats of the body bolsters, an upper tank extending longitudinally of the car construction, cradle devices arranged between the upper tank and each of the lower tanks and being disposed, respectively, vertically above the body bolsters, clamping straps anchored to the body bolsters and to the cradle devices and extending outside of the lower tanks, and clamping devices secured in place with respect to the cradle devices and extending partially around the upper tank for holding the latter in place with respect to the cradle devices.

6. In a tank car construction, the combination of a pair of body bolsters, each of which is provided with a pair of concave seats, a pair of lower tanks extending longitudinally of the car construction and resting in the seats, an upper tank, cradle devices arranged between the upper tank and each of the lower tanks and disposed, respectively, vertically above the body bolsters, annular ribs carried by the tanks and disposed laterally of the side faces of the body bolsters and of the cradle devices, means cooperating with the cradle devices and with the body bolsters for holding the lower tanks

in place longitudinally with respect to the body bolsters, and means cooperating with the cradle devices and with the upper tank for holding the latter in place longitudinally with respect to the cradle devices.

7. In a tank car construction, the combination of a pair of body bolsters, each of which is provided with a pair of concave seats, a pair of lower tanks extending longitudinally of the car construction and having channels defined by peripheral ribs at the end portions fitting in said bolster seats, cradle devices fitting in the channels of the lower tanks, an upper tank having circumferential channels defined by annular ribs at the end portions thereof for fitting the cradle devices, anchoring bands secured in place with respect to the cradle devices and to the bolsters and fitting the channels of the lower tanks, and anchoring bands secured in place with respect to the cradle devices and fitting the channels of the upper tank.

8. In a tank car construction, the combination of a pair of body bolsters, each of which is provided with a pair of concave seats, a pair of lower tanks extending longitudinally of the car construction and fitting the bolster seats, an upper tank extending longitudinally of the car construction, cradle devices arranged between the upper tank and each of the lower tanks and disposed, respectively, vertically above the body bolsters, clamping bands anchored near to the end portions of the body bolsters, extending partially around the lower tanks, and anchored at the other ends with respect to the cradle devices, clamping bands extending partially around the upper tank and anchored in place with respect to the cradle devices, and means cooperating with ends of said clamping bands in order to place the latter under suitable tension.

9. In a tank car construction, the combination of a pair of body bolsters each of which is provided with a pair of concave seats, a pair of lower tanks extending longitudinally of the car construction and resting in the concave seats of the body bolsters, an upper tank extending longitudinally of the car construction, articulated cradle devices arranged between the upper tank and each of the lower tanks and disposed, respectively, vertically above the bolsters, clamping bands anchored to the body bolsters, extending partially around the lower tanks and anchored to the cradle devices, clamping bands extending partially around the upper tank and anchored in place with respect to the cradle devices, and means cooperating with ends of said bands, whereby the latter may be placed under suitable tension.

10. In a tank car construction, the combination of a pair of body bolsters, each of which is provided with a pair of concave seats, a pair of lower tanks extending longitudinally of the car construction and resting in the seats of the bolsters, an upper tank extending longitudinally of the car construction, spacer members having concave seats fitting each lower tank and the upper tank, means for pivotally connecting the spacer members, said spacer members and their pivotally connecting means being disposed, respectively, vertically above the body bolsters, and means associated with the spacer members and with the bolsters for clamping the tanks in place to resist longitudinal movement thereof.

11. In a tank car construction, the combination of a pair of body bolsters, each of which is provided with a pair of concave seats, a center sill connected to the body bolsters, a pair of lower tanks resting in the bolster seats and having their axes disposed laterally of and above the center sill, an upper tank, cradle devices arranged between the upper tank and each of the lower tanks and disposed, respectively, vertically above the body bolsters, means cooperating with the body bolsters and with the cradle devices for clamping the lower tanks in place with respect to the body bolsters and for clamping the upper tank in place with respect to the cradle devices, and intermediate articulated anchorage means connected to the center sill and cooperating with the tanks at intermediate points of the latter.

12. In a tank car construction, the combination of a pair of body bolsters, a center sill connected to the bolsters, a pair of lower tanks resting on the body bolsters, an upper tank, cradle devices arranged between the upper tank and each of the lower tanks and disposed, respectively, vertically above the body bolsters, means cooperating with the body bolsters and with the cradle devices for holding the tanks in place, a separate bracket member secured to the top of the center sill at a point intermediate the length of the latter and having concave surfaces disposed outwardly and upwardly from the center sill for fitting the exterior of the lower pair of tanks, a pair of members disposed above the axes of the lower tanks and having concave seats fitting the exterior of the lower tanks and spaced from the upper tank, one of said members being of such a length that its concave seats extend outwardly of the vertical planes containing the longitudinal axes of the lower tanks, links pivotally connected to said bracket member and to said members, and strap means secured to the longer of said members and extending partially around and over the upper tank.

13. In a tank car construction, the combination of, a car frame, a pair of lower tanks and an upper tank disposed longitudinally of the car frame, spaced shoulders integral with the tanks disposed at the ex-

tremities thereof, body bolsters freely engaged by the shoulders of the lower tanks, saddles for the upper tank disposed vertically above the bolsters and supported by the lower tanks, said saddles having their upper and lower surfaces freely engaged by the shoulders of the upper and lower tanks respectively, so as to allow limited independent movement of the tanks longitudinally of the car frame, frictional anchoring means associated with the bolsters and the cradles and frictional anchoring means associated with the car frame at points intermediate of the bolsters.

In testimony whereof I hereunto affix my signature this 8th day of March, 1926.

JAMES P. MADDEN.

In testimony whereof I hereunto affix my signature this 8th day of March, 1926.

RALPH E. WILDER.