May 5, 1931. J. M. ROHLFING 1,803,407

LINED TANK AND METHOD OF MAKING THE SAME

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Fig. 10.

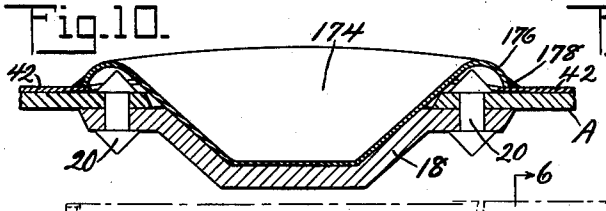


Fig. 1.

Fig. 2.

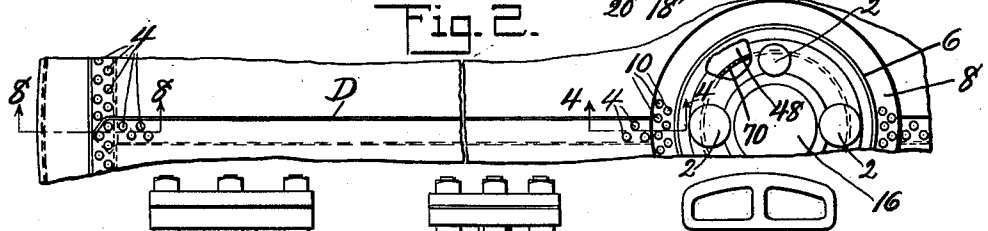
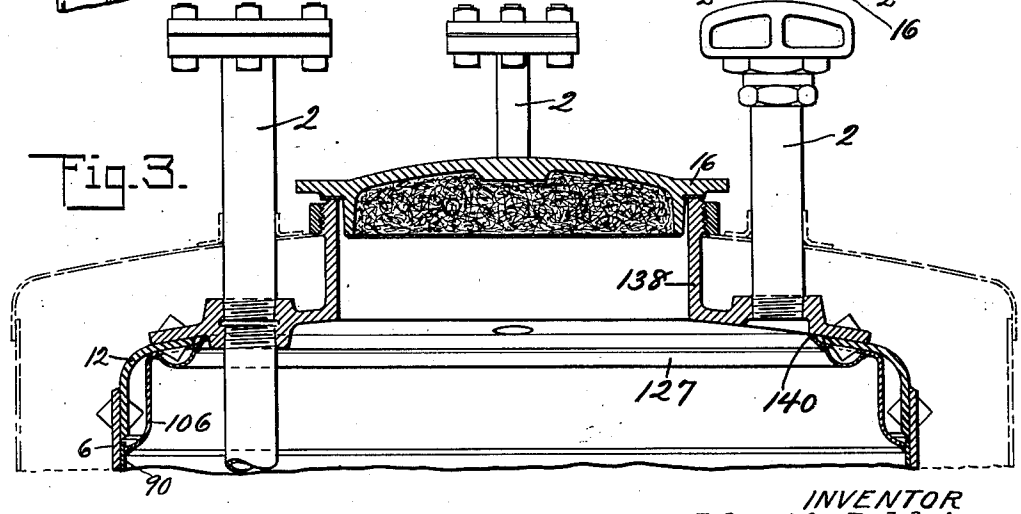


Fig. 3.



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May 5, 1931. J. M. ROHLFING 1,803,407

LINED TANK AND METHOD OF MAKING THE SAME

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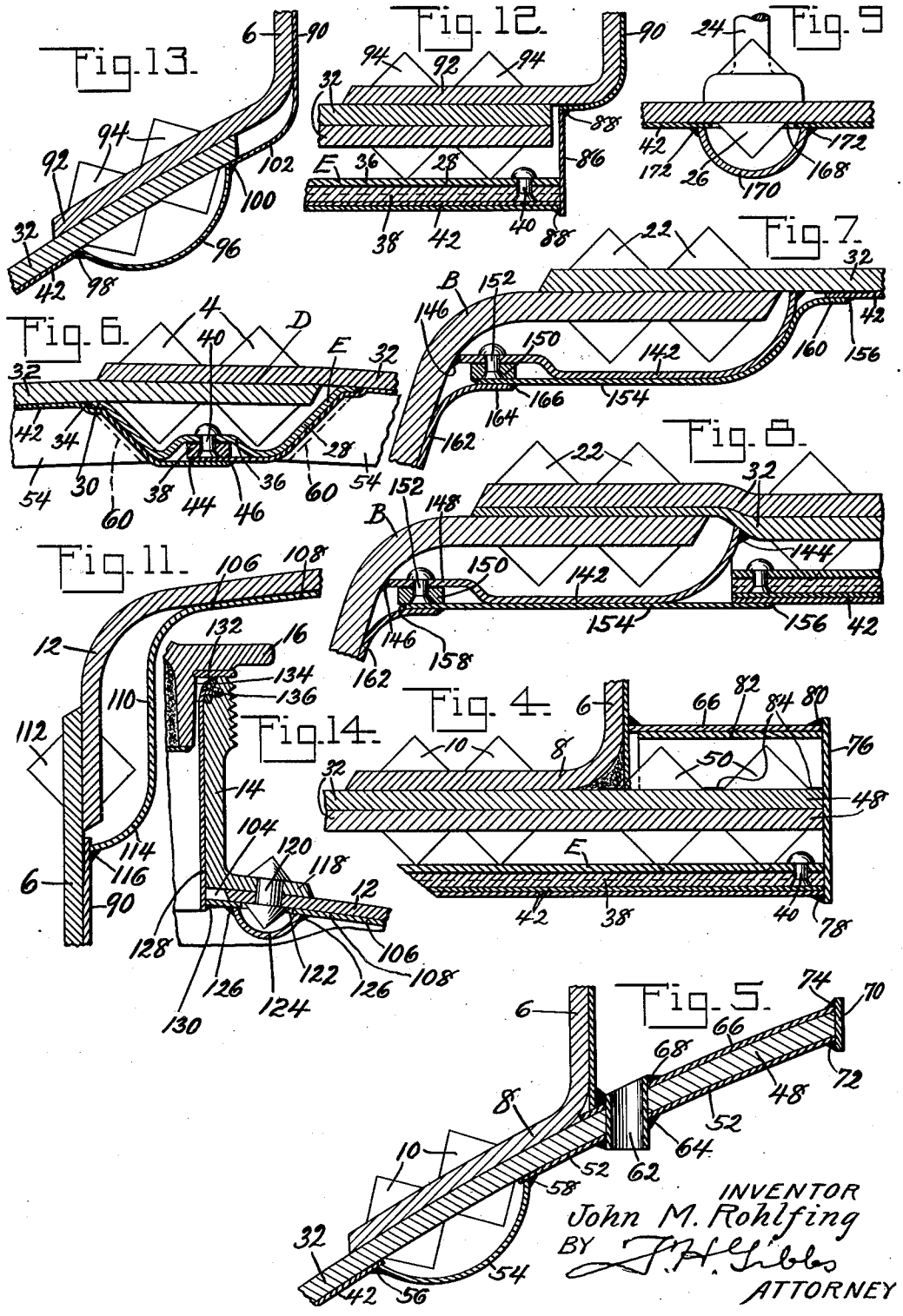

Patented May 5, 1931

1,803,407

UNITED STATES PATENT OFFICE

JOHN M. ROHLFING, OF PLAINFIELD, NEW JERSEY, ASSIGNOR TO AMERICAN CAR AND FOUNDRY COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY

LINED TANK AND METHOD OF MAKING THE SAME

Application filed January 15, 1929. Serial No. 332,590.

This invention relates generally to containers and has particular reference to lined metallic tanks such as car tanks.

At the present time, the transportation of various types of lading in containers, such as car tanks, offers many problems. Car tanks are usually formed of steel, or other ferrous metal, and, as is well known, this type of metal easily corrodes, the corrosion being not only undesirable from the standpoint of deterioration of the tank, but usually having deleterious effects on the tank lading. In fact, it is most undesirable to place certain chemical media into a steel tank, because the lading directly attacks the steel. Petroleum products, such as oil and gasoline, will be discolored by contact with steel or other ferrous metal. Acids will directly attack steel. The large milk industries, and shippers of other food products, will not use ordinary steel tanks, because they hold that formation of bacteria results due to the chemical action of the lading on the steel. The above-mentioned ladings, and many other commodities, are transported in car tanks, and it has been found necessary to either form the tank of metal having high corrosion resistant properties, or to line the tank with such a metal, and, as a tank formed of metal of high corrosion resistant properties is difficult and expensive to manufacture, it has been found most desirable and practical and less expensive to provide a car tank with a lining of metal which will possess high corrosion resistant characteristics.

In view of the statements above, one object of the present invention is to provide a metal tank with a lining of metal of high corrosion resistant properties.

Another object of the invention is to provide a metal tank having a lining of metal which cannot be readily welded directly to the metal of the tank and which possesses corrosion resistant characteristics different, and preferably greater, than those of the tank.

A further object of the invention is the provision of a tank, the interior of which is completely shielded against contact of the lading therewith.

A still further object of the invention is the provision of a car tank, the interior of which is completely lined with metal different than that of the tank and preferably possessing greater corrosion resistant properties than those of the tank, whereby the tank lading does not come into contact with the tank metal and whereby the tank lading is not subjected to a surface which easily corrodes.

Still another objection of the invention is to provide a car tank with a lining of metal of high corrosion resistant characteristics, whereby the tank lading is protected against fouling and which may be easily cleansed when the tank is empty.

Another object of the invention is the provision of a metal lining for a metal tank in which the lining is formed of sections welded to each other, or, in other words, a lining is provided in which like metals are united, preferably by welding.

The invention also contemplates the provision of a new and improved method of lining tanks.

Other objects and advantages of this invention will be apparent from the following description taken in conjunction with the accompanying drawings in which:

Figure 1 is a side elevation of a portion of a car tank;

Fig. 2 is a fragmentary top plan view of the tank shown in Fig. 1, showing the top longitudinal seam and a portion of the tank dome;

Fig. 3 is a sectional view through a portion of one form of tank dome;

Fig. 4 is a sectional view on the line 4—4, Fig. 2;

Fig. 5 is a sectional view on the line 5—5, Fig. 1;

Fig. 6 is a sectional view on the line 6—6, Fig. 1;

Fig. 7 is a sectional view on the line 7—7, Fig. 1;

Fig. 8 is a sectional view on the line 8—8, Fig. 2;

Fig. 9 is a sectional view on the line 9—9, Fig. 1;

Fig. 10 is a sectional view through the sump shown in Fig. 1;

Fig. 11 is a sectional view through a portion of a modified form of tank dome;

Fig. 12 is a sectional view of a portion of a modified form of tank taken at the joint formed by the dome and longitudinal seam, the view being similar to Fig. 4;

Fig. 13 is a sectional view similar to view shown in Fig. 5, but showing a joint of a modified form of tank, and

Fig. 14 is a sectional view showing a portion of the dome head, and dome ring, and a portion of the dome cover; each thereof showing the lining applied thereto.

The conventional car tank comprises a tank body A usually of cylindrical form, having its ends closed by heads B and provided with a dome C. The dome shown in the instant case is provided with tank fittings 2, which extend above the dome, but, obviously, the dome may be so formed that the fittings are concealed therein, if desired.

In practice, the body A is formed in the usual manner by tank sheets overlapped at their ends and fastened together by rivets 4 to form longitudinal seams D, as shown in Figs. 1 and 2, and of which a sectional view is shown in Fig. 6. The seams D extend from end to end of the body except where they are interrupted by the dome C, which latter may assume any preferred form, but which usually comprises a side sheet 6 having a lower annular flange 8 secured to the body A adjacent an opening therein by circumferential rows of rivets 10, as clearly shown in Fig. 2. The dome also includes a dome head 12 and a dome ring 14, the latter having a cover 16 secured thereto in any suitable manner. In practice, the dome cover may be hingedly secured to the dome ring 14, or may be threadedly engaged therewith. The tank body is formed also with an opening at its lower portion adjacent which a sump 18 is secured by rivets 20, as clearly shown in Figs. 1 and 10. After the tank body has been formed in the usual manner, the lining material is placed therein and then the ends or heads B are applied and riveted to the body, as shown in Figs. 7 and 8, the rivets being indicated at 22.

The tank lining is of metal and may, of course, be any desired metal, but, as before mentioned herein, it is desired to line a tank with a metal of high corrosion resistant characteristics, therefore the lining is preferably nickel, aluminum, copper, chrome iron, chrome nickel or other suitable metal. Of course, chrome iron may be readily welded directly to ferrous tank sheets, but other metals, such as those just indicated for example, are not so easily welded to ferrous metal, or at least it is difficult at the present stage of welding to unite these metals to ferrous metal in such a manner as to form a corrosion resistant union or a joint which is corrosion resistant to any marked degree. As for aluminum, it is impractical at this time to weld it directly to steel. Lining sheets might be riveted, bolted or otherwise mechanically secured to ferrous tank sheets, and, of course, may be directly connected together in this manner; but, in use, the rivet heads or the bolt heads may be sheared off, or, if said heads be not sheared, vibrations, strains, stresses or relative movement between the tank body and lining will eventually elongate the rivet or bolt-holes in the lining and permit penetration of the tank lading between the lining and the tank sheets which, of course, is objectionable. Further, if rivets or bolts are to be used, they must necessarily be of corrosion resistant metal in order to accomplish the results sought for by this invention, and this type of fastening is more expensive than the ordinary rivets which adds to the cost of a tank. In view of the disadvantages attendant upon mechanical connections, welding has been deemed most expedient and practical and less expensive, and this invention can be carried out by any of the well-known methods of welding, such as carbon-arc, electric-arc, gas or atomic-hydrogen. In the description to follow, the lining will be referred to as aluminum, but it is not to be understood that the invention is restricted thereto as, obviously, the invention may be carried out with any preferred type of lining metal.

In forming a tank the rivets at the longitudinal seams are usually of steel and the heads thereof project into the tank. The usual car tank also includes the grab handles 24 riveted to the tank body, as shown at 26 in Figs. 1 and 9. Aside from the protruding rivets, the interior of the tank is substantially smooth, and, in lining a tank, it is impractical to arrange the lining sheets immediately over and in contact with the protruding rivet heads, because said heads will, in all probability, puncture the lining sheets and permit penetration of the tank lading between the lining and the steel tank sheets. Therefore, guards E are provided which are attached to the tank body and cover the rivet heads. The guard for the rivet heads at the longitudinal seams is shown clearly in cross-section in Fig. 6 and comprises in effect a substantial V-shaped channel 28 having laterally extending attaching flanges 30 welded to the overlapping tank sheets 32 as shown at 34. In the present instance, the guard E is formed of metal which can be welded to the steel tank sheets 32, and said guard is provided with a recessed portion 36 extending from end to end thereof in which recess an attaching bar 38 is secured by means of rivets 40. The bar 38 is of the same material, or at least a material to which the lining sheets may be welded. For example, if it

is desired to line the tank with aluminum, an aluminum attaching bar will be employed, and in the present case the bar 38 will be of aluminum. At seams other than the upper longitudinal seam, the guards E extend from end to end of the tank, but at the upper longitudinal seam the guard is, of course, interrupted at the dome, two guards being employed along the upper seam which extend from one end of the tank to a point adjacent the dome, or, to be more exact, to a point adjacent an opening formed in the tank and about which the dome is secured, as clearly indicated in Figs. 4 and 12.

The lining sheets are indicated at 42 and comprise sheets of aluminum arranged circumferentially in the tank with their ends overlapping each other and overlapping the guard E and the attaching bar 38 carried thereby. With a small tank there may be only longitudinal seam, and in this event, a single lining sheet may extend circumferentially in the tank and have the ends of said sheet overlapped, as clearly shown in Fig. 6, or, in other words, a single sheet may extend from the attaching bar completely around the interior of the tank with its other end overlapping the first named end; but in tanks having more than one longitudinal seam, it is apparent that the lining will comprise several sheets extending circumferentially of the tank, each sheet extending from one guard E to another guard E, and so on until a circumferential portion of the tank is lined. In practice, therefore, the tank lining includes a plurality of circumferentially arranged lining sections and the side edges of adjacent circumferential lining sections are either overlapped or butted and welded together; the resultant structure from end to end of the tank being, in effect, a cylindrical member corresponding to the shape of the tank. As before mentioned, the lining sheets 42 overlap the attaching bar 38 and the sheet in direct contact with the attaching bar is welded to said bar, as shown at 44, and the two overlapped lining sheets 42 at the attaching bar are welded to each other as shown at 46. Preferably the welding medium is aluminum in order that a joint or union may be formed which possesses the same corrosion resistant characteristics as those of the lining sheets.

Figs. 4 and 5, and 12 and 13 disclose two different types of tanks at the dome portion, and now referring to Figs. 4 and 5, it can be seen that the tank sheets 32 extend upwardly beyond the attachment of the dome, thereby defining an extension 48 which, in effect, is an annular ledge. In practice, the tank sheets are provided with an opening which defines the annular ledge 48 when the dome is attached to the tank sheets. As shown in Fig. 4, the guard E extends to the end of the ledge 48 and covers the inner heads of rivets 50, which connect the overlapped tank sheets 32 at this point. In the construction shown in Fig. 12, the dome portion of the tank is devoid of the extension 48 and the guard E terminates at the opening in the tank.

In lining the tank at the dome portion thereof, the lining sheets extend just adjacent the annular rows of rivets 10, as clearly shown in Fig. 5; the rivets 10 being those which secure the dome to the tank. The extension 48 is provided with a liner indicated at 52 which extends from the manhole opening in the dome to the annular rows of rivets 10, said annular rows of rivets at each side of the dome being covered by guard 54 in the form of half rings which are welded to the lining sheets 42 and to the extension liner 52 as shown at 56 and 58, respectively. The ends of the guards 54 are arranged in abutting relation with the guards E at the upper longitudinal seam and the ends of said guards 54 are mitered to fit against guards E and are secured to said guards E by being welded as shown in dotted lines at 60. It is usual to provide the annular ledge 48 with a vent 62 and the vent is welded to the liner sheet 52 as shown at 64. The upper face of the extension 48 is covered by a liner 66 which is welded to the vent 62, as at 68, and which extends to the base or attaching flange 8 of the dome side sheet 6. The edge of the extension 48 is preferably covered by plates 70 which are welded to the liners 52 and 66, as shown at 72 and 74, respectively; said plates 70 extending around the edge of the extension 48 from one guard E to its opposite guard E as will be apparent. At the longitudinal seams D at the dome portion of the tank, plates 76 are employed which are welded to the lining sheets 42 at 78 and to the upper lining sheet 66 as shown at 80; the rivets 50 at the dome portion of the tank being covered by a guard 82 welded to the tank sheets 32 as shown at 84.

At the dome opening of a tank provided with a dome such as shown in Figs. 12 and 13, the open ends of the guards at the upper longitudinal seam are closed by plates 86 which are welded to the lining sheets 42, as shown at 88, and which extend upwardly to be welded at 88 to the lower edge of a dome liner 90; said dome liner and plates being of aluminum. The dome side sheet 6 of the type of tank shown in Figs. 12 and 13 is also flanged at its lower edge, as shown at 92, and said flange is connected with the tank sheet 32 by rivets 94, the inner heads of which are covered by aluminum guards 96 in the form of half rings similar to those heretofore described with reference to Fig. 5 and which are welded, as at 98, to the lining sheets 42 and to the lower edge of the dome liner 90 as shown at 100. The dome liner 90 may be a cylindrical sheet of aluminum having its lower edge outwardly flanged, as shown at 102, and its upper edge terminates adjacent

the lower edge of the dome head 12 as shown in Fig. 11. The dome head is provided with the usual opening 104 (see Fig. 14) and said head 12 is provided with an aluminum liner 106 formed to the desired size and shape and comprising a head portion 108 and side portions 110 spaced from the head 12 to be spaced from rivets 112 which connect the dome head 12 with the said sheet 6, and the lower edge of the liner 106 is outwardly flanged, as at 114, to engage the side sheet liner 90. For connecting the liner 90 with the dome head liner 106, the same are welded together by aluminum as shown at 116.

The dome ring 14 is provided with the usual attaching flange 118 which is riveted to the dome head 12, as shown at 120, and the inner heads of the rivets 120 extend through apertures 122 formed in the dome head liner 106; the said liner 106 having been previously punched to provide suitably spaced openings for receiving the heads of the rivets 120. These rivet heads are preferably covered by individual caps 124 welded to the dome head liner 106 as shown at 126. If desired, instead of individual caps an annular guard 127 may be provided as shown in Fig. 3 which may be welded to the liner 106, as will be obvious. The head 108 of the liner 106 is provided with a central opening, the edge of which is substantially alined with the inner surface of the dome ring 14, and the dome ring 14 is lined with an aluminum tube 128, the lower edge of which is welded to the head portion 108 of the liner 106, as shown at 130, and the upper edge thereof is welded by aluminum, as shown at 132 to an aluminum ring 134 secured by means of screws 136 in a recess formed adjacent the upper edge of the dome ring 14.

The dome ring shown in Fig. 14 is of the conventional type, being formed of ferrous metal, and hence requiring a lining, whereas Fig. 3 discloses a modified form of dome ring, the same being indicated as 138, and being formed of cast aluminum, and, therefore, it is unnecessary to line this dome ring. The dome side sheet and dome head are lined in the manner indicated in Figs. 11 and 14, but the upper edge of the dome head liner in the dome shown in Fig. 3 is welded directly to the dome ring as shown at 140.

The rivets 22 at the heads of the tank are covered by an annular guard 142 which is of the form shown clearly in Figs. 7 and 8, the edges of which are welded to the tank sheets 32 and the head B, as shown at 144 and 146, respectively; one edge of the guard being offset, as shown at 148 to carry an attaching bar 150, of aluminum or the like, riveted thereto as shown at 152. The guard 142 is preferably of metal which may be readily welded to the steel tank sheets and said guard is covered by a liner 154 which is welded at its ends, as at 156, to the lining sheets 42 and the attaching bar 150 at 158. At the longitudinal seams in the tank, the liner assumes the form shown in Fig. 8 and at the other portions of the tank the liner 154 assumes the form shown in Fig. 7, the same having a flanged inner edge 160 to overlie the end lining sheet 42. The head liners are indicated at 162, being pre-formed to shape including a circumferential flange 164 which overlaps the adjacent end of the liner 154 and is welded thereto as shown at 166.

At places in the tank where individual rivets have their heads protruding thereinto, the lining sheets 42 are provided with openings 168 through which the protruding rivets extend such as shown in Fig. 9 at 26, and said heads are covered by caps 170 welded to the lining sheets 42 as shown at 172. The sump 18 is also protected by lining the same with a liner formed to the contour of the sump including a body portion 174 and a depending flange 176 arranged over the rivets 20 with the edge of said liner supported in contact with the lining sheets 42, and welded thereto as shown at 178.

This invention also contemplates the provision of a new and improved method of forming a tank and comprises, broadly, the fabrication of a steel tank complete in the usual manner with lining materials loose and unapplied inside of the tank. The next step in the method of the present invention comprises attaching rivet guards E over the longitudinal seams to cover the rivets used to connect the steel tank sheets, the guards being welded to the tank sheets, and, consequently, being of material which may be easily welded to the steel tank sheets. Following this, the tank lining sheets are then arranged circumferentially in the tank with the ends thereof overlapping the rivet guards and overlapping each other, one thereof being welded to the attaching bar carried by the guard and the other being welded directly to the first named sheet. This is carried out until the entire interior of the tank is lined. Of course, provision is made for an opening through the lining corresponding to the manhole opening about which the tank dome is secured. In the present method it is the intention to use, as a welding medium, a material of substantially the same character of that of the tank lining so as to provide an inside surface for a tank which is of uniform character throughout. The heads of the tank may be applied either before or after lining the tank body as desired, and after they are riveted to the tank body, rivet guards are welded to the tank sheet and to the heads to cover the head securing rivets, whereupon a lining ring is secured to the tank lining sheets and to the rivet guards at the ends of the tank, and then the head liners are arranged adjacent the heads and welded to the rivet guard liner. The tank dome may be secured to the tank

body either before or after lining the tank body and it may be lined prior to its attachment to the tank body, or subsequent thereto, as desired; the thought being to provide a lined dome, the lining of which is connected to the tank lining so as to prevent penetration of the tank lading to the tank body.

It will be apparent to those skilled in the art that a tank has been provided which is lined with a material possessing corrosion resistant properties different and greater than those of the tank body; the entire interior of the tank being so lined and being devoid of useless and needless obstructions whereby to provide a substantially smooth interior which may be easily cleansed. It will further be apparent that a tank lining has been provided formed of sections united by welding, the joints at the sections being of a material possessing the same corrosion resistant properties as those of the lining, whereby penetration of the tank lading to the tank shell is prevented.

The drawings and description herein present one embodiment of the invention, but it is to be understood that the invention is not restricted thereto, as the drawings are for illustrative purposes only, and that various changes in the form and proportions of the scheme outlined herein may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

1. In a tank, riveted tank sheets, guards secured to the tank sheets and covering the inner heads of the rivets, and a metallic lining in said tank connected to and covering the guards.

2. In a tank, steel sheets overlapped to form longitudinal seams, rivets connecting the sheets at the seams, guards welded to the tank sheets to cover the inner heads of the rivets, and a lining of corrosion resistant properties greater than those of the steel sheets arranged in the tank and covering said sheets and connected to and covering the guards.

3. In a tank, steel sheets overlapped to form longitudinal seams, rivets connecting the sheets at the seams, guards welded to the tank sheets and covering the inner heads of the rivets, an attaching bar secured to the guards, and a lining of high corrosion resistant metal in said tank secured to the attaching bar.

4. In a tank, steel sheets riveted together to form longitudinal seams, guards welded to the tank sheets for covering the rivet heads and an attaching bar of high corrosion resistant properties secured to the guards, and lining sheets of a metal having substantially the same corrosion resistant properties as those of the bar arranged in the tank and welded together and to the attaching bar.

5. In a riveted tank, means for lining the same comprising guards welded to the interior of the tank to cover the rivet heads, attaching bars secured to the guards, and lining sheets arranged circumferentially in the tank with adjacent ends overlapped and welded together, one of said ends being welded to the attaching bar.

6. A tank comprising a body formed of sheets overlapped at their ends and riveted together to form longitudinal seams, heads riveted in the ends of said body, guards welded to the sheets over the inner rivet heads at the longitudinal seams, an annular guard at each end of the tank for covering the head securing rivets and a lining for the tank comprising metal sheets arranged circumferentially in the tank and connected to the guards at the longitudinal seams, an annular lining sheet at each end of the tank connected to the annular guards, and head lining sheets connected to the annular lining sheets.

7. A tank comprising a body formed of sheets overlapped at their ends and riveted together to form longitudinal seams, heads riveted in the ends of said body, guards welded to the tank sheets at the longitudinal seams for covering the body securing rivets, an annular guard at each end of the body covering the head securing rivets and connected to said heads and the tank body, and a lining for the tank comprising circumferentially arranged lining sections in the tank body with the ends thereof welded to each other at the guards and with adjacent circumferential sections overlapped at their side edges and welded together, an annular lining sheet at each end of the tank connected to the annular guard and to the body lining, and head lining sections welded to the annular lining sheets.

8. In a tank, a head riveted thereto, a guard welded to the tank and head and covering the rivet heads, a lining sheet of metal of greater corrosion resistant properties than those of the tank connected to said guard, and a head liner engaging the head and overlapping the lining sheet and welded thereto.

9. In a tank, a head riveted thereto, a guard of substantially the same metal as that of the tank welded to the tank and head and covering the head securing rivets, an attaching bar secured to the guard adjacent the head, an annular lining sheet secured to the attaching bar and covering the guard, and a head lining sheet arranged adjacent the head and overlapping the guard liner and welded thereto.

10. In a tank, a body formed of connected steel sheets riveted together to form longitudinal seams, and means for lining said body whereby to present an interior surface formed entirely of metal of high corrosion resistant properties comprising metallic guards arranged over the rivet heads at the longitudinal seams and welded to the body, an attaching bar of high corrosion resistant metal secured to the guard, and tank lining sheets

of substantially the same metal as that of the attaching bars arranged in the tank and overlapping the guards and the attaching bars carried thereby and welded to each other and to the attaching bars with metal possessing the properties of the lining sheets.

11. In a tank, steel sheets riveted together to form longitudinal seams, a dome secured thereto, heads riveted at each end of the tank, guards covering the rivet heads in the interior of the tank and each having an attaching bar secured thereto, lining sheets arranged in the tank and covering the guards and welded to the attaching bars, a dome lining sheet welded to the tank lining sheets, annular lining sheets connected to the guards at the ends of the tank and welded to the tank lining sheets, and lining sheets arranged in the heads of the tank and welded to the annular lining sheets.

12. In a tank, steel sheets riveted together to form joints, heads riveted in the ends of the tank, a dome secured to the tank and provided with a dome ring, guards covering the rivets in the tank and welded thereto, lining sheets of high corrosion resistant metal secured to the guards, a dome lining sheet welded to the tank lining sheets, a lining tube in the interior of the dome ring welded to the dome liner, and an attaching ring adjacent the upper edge of the dome ring to which the dome ring liner is welded.

13. A tank comprising a body formed of steel sheets riveted together, steel heads secured to the ends of the body and a dome secured to the said body, guards covering the rivet heads in the interior of the tank and having attaching bars secured thereto of metal possessing corrosion resistant characteristics greater than those of the tank, and a metallic lining for the tank possessing substantially the same characteristics as those of the attaching bars secured to said attaching bars.

14. A tank comprising a body formed of steel sheets riveted together, steel heads secured to the ends of the body and a dome secured to the said body, guards welded to the tank and covering the rivet heads in the interior of the tank and having attaching bars mechanically secured thereto and a metallic lining for the tank possessing substantially the same characteristics as those of the attaching bars welded to said attaching bars.

15. The method of forming a lined tank body which comprises riveting tank sheets together to form a tank body, forming channel shaped guards, mechanically securing attaching bars to said guards, welding the guards to the interior of the tank to cover the rivet heads therein, arranging lining sheets circumferentially in the tank body to overlap the rivet guards, welding one of said sheets to the attaching bar and then welding the adjacent sheet to the first named sheet, lining a tank dome, and welding the dome liner with the tank body liner.

16. The method of forming a lined tubular body which comprises riveting sheets together to form a tubular body, attaching guards to the tank sheets to cover the rivet heads, arranging lining sheets circumferentially in the tank body to overlap the rivet guards, connecting one of said lining sheets to the guard, and then connecting the lining sheets together.

17. The method of forming a lined tubular body which comprises forming a tubular body by riveting overlapping sheets together, welding guards to the tank sheets to cover the rivets, and then arranging lining sheets circumferentially in the body with the edges thereof overlapping the guards and overlapping each other and secured to the guards, and then welding the lining sheets together.

18. The method of connecting a lining of high corrosion resistant metal to the interior of a riveted steel tank which comprises mechanically securing an attaching bar of the same character as the lining to a ferrous metal guard member, welding the guard member to the tank sheets to cover the rivets therein, arranging metal lining sheets of high corrosion resistant metal circumferentially in the tank with the end edge of one thereof overlapping the attaching bar, welding the overlapping sheet to the attaching bar by metal of substantially the same properties as those of the lining sheet and bar, the other lining sheet having its end overlapping the guard and the welded end of said first named sheet, and finally welding the said lining sheets together.

19. The method of lining a steel riveted tank having a body and heads at the ends thereof with a metal of high corrosion resistant properties which comprises forming rivet guards of metal which can be welded to the tank body, mechanically securing to the guard an attaching bar of metal possessing substantially the same characteristics as those of the lining to be applied, welding the guards to the tank body to cover the rivets therein, arranging lining sheets of high corrosion resistant character circumferentially in the tank, welding the lining sheets to the attaching bars and to each other, then annularly lining the rivet guards at the ends of the tank and finally applying lining sheets to said tank heads and welding the same to the annular lining sheets.

20. The method of forming a lined tubular body which comprises riveting metal sheets together to form a tubular body, forming metallic guards, securing said guards to said sheets to cover the rivet heads, arranging lining sheets in said body with adjacent edges in overlapping relation with respect to each other and to the guards, securing one edge of each lining sheet to the adjacent

guard and then connecting the lining sheets together at their overlapping portions.

21. The method of forming a lined tubular body which comprises riveting metal sheets together to form a tubular body, forming metallic guards, securing said guards to said sheets to cover the rivet heads, arranging lining sheets circumferentially in said body with adjacent edges in overlapping relation with respect to each other and to the guards, securing one edge of each lining sheet to the adjacent guard and then connecting the lining sheets together at their overlapping portions.

22. In a tank, metal tank sheets overlapped to form longitudinal seams, means connecting the metal sheets at the seams, guards secured to the sheets at the seams and covering the said connecting means, and a metallic lining for the sheets connected to and covering the guards.

23. In a tank, metal tank sheets overlapped to form longitudinal seams, means connecting the metal sheets at the seams, guards secured to the sheets at the seams and covering the said connecting means, and a metallic lining for the sheets connected to and covering the guards, said metallic lining being free of direct attachment to the tank sheets.

24. In a tank, metal tank sheets riveted together to form seams, guards secured to the sheets at the seams and covering the inner heads of the rivets, and a lining for the tank formed of a plurality of metal sheets arranged in said tank and connected to the rivet guards, said lining sheets being free of direct connection to the tank sheets.

In witness whereof I have hereunto set my hand.

JOHN M. ROHLFING.