Nov. 5, 1940. H. O. WALKER 2,220,186

TANK CONSTRUCTION

Filed Dec. 24, 1937

FIG. 1.

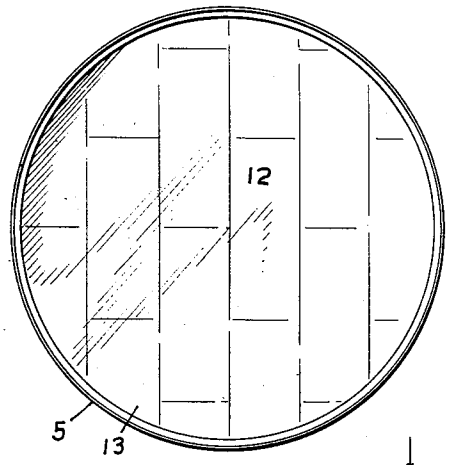


FIG. 2.

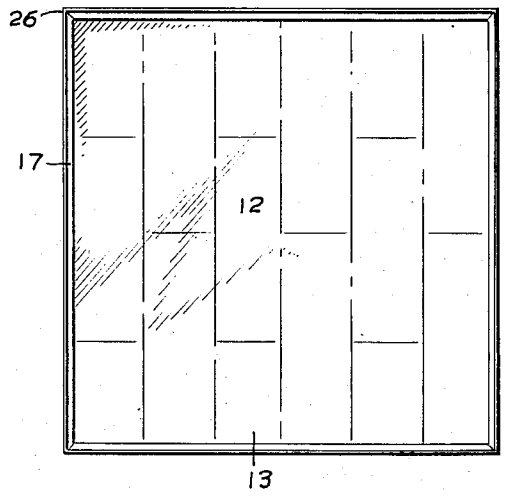


FIG. 3.

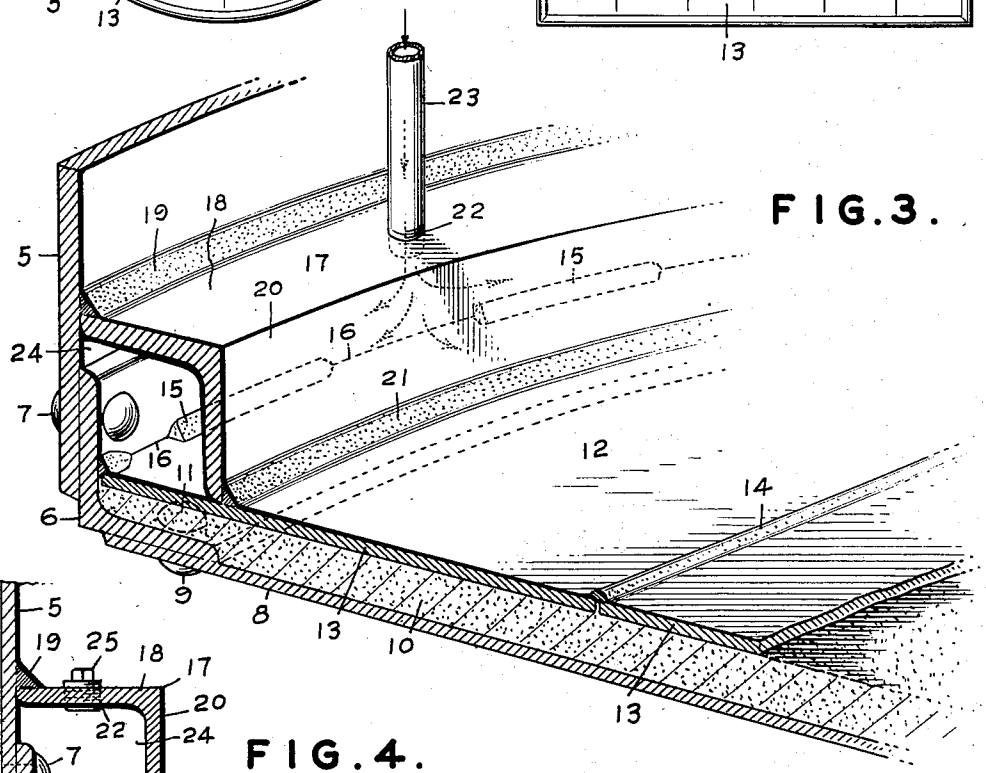
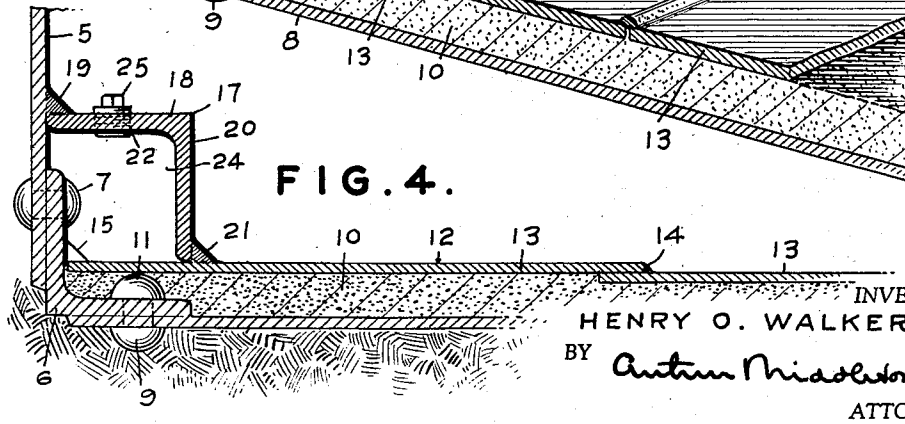


FIG. 4.



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Patented Nov. 5, 1940 2,220,186

UNITED STATES PATENT OFFICE

2,220,186

TANK CONSTRUCTION

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Application December 24, 1937, Serial No. 181,549

9 Claims. (Cl. 220—68)

This invention relates to tanks or reservoirs for containing or storing materials such as liquids, and has particular reference to storage tanks of the type adapted to accommodate relatively large bodies of oil, petroleum or other viscous liquids, especially those liquids whose specific gravity is less than that of water.

More specifically the invention relates to the bottom construction of such tanks and to a manner of constructing and the arrangement of a bottom in the tanks to afford a strong, durable and substantially water-tight construction.

The prime object of the invention is to provide a method of rendering fit for utilization again, liquid holding tanks the bottoms and/or lowermost wall portions of which have become leaky and are no longer water-tight as a result of rusting, erosion or corrosion.

Another object is to provide a method of installing, in tanks that have become leaky at the bottom or adjacent thereto, a false or replacement bottom in a manner that will afford a substantially water-tight construction, and at the same time to determine that the structure actually is substantially water-tight.

A further object is to provide a novel bottom construction for liquid holding tanks or the like that is strong, durable and substantially water-tight.

A still further object is to provide a liquid holding tank having a false or re-built bottom constructed in a novel manner and that is strong, durable and substantially water-tight.

Petroleum and its products are usually stored in steel tanks above ground. In most locations the steel tanks are set directly on the ground. These tanks are generally constructed of plates of structural steel, the plates running in thickness from $\frac{3}{16}$ of an inch upwards. The plates forming the bottom are joined together in a water-tight manner by riveting, bolting or welding and the edges of adjoining plates are generally lapped. The walls of the tank are generally constructed of rings made up of a number of plate sections, the lowermost ring being joined to the bottom by means of an annular angle iron, all joints being made water-tight in any suitable manner.

In tanks of this sort corrosion difficulties are encountered most frequently at the bottom and at the joint between the bottom and the walls of the tank and cause considerable annoyance necessitating expensive repairs and in many cases necessitating razing of the tank and erection of a completely new one. The reasons for these corrosion troubles being confined primarily to the bottom portion of the tank are several. First, there is the fact that any water in the tank or body of oil contained therein will gravitate naturally to the bottom and will there attack the bottom plates and cause oxidation and rusting. Furthermore, the bottom is affected on its underside by the humus acids in the soil upon which it rests. To these causes are added the contributing chemical effects of the various acids in the oil itself.

Having in mind the above enumerated corrosion difficulties, it is a primary purpose of the present invention to provide a method of effecting repair or replacement of a corroded tank bottom in an eminently satisfactory and economical manner and to obviate the necessity for completely rebuilding the bottom or replacing the entire tank structure.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth in the following description. In the accompanying drawing, for the purpose of example there has been illustrated the best embodiment of the invention now known to me, but such embodiment is to be regarded as typical only of many possible embodiments, and the invention is not to be limited thereto.

In the drawing:

Figure 1 is a top plan view of an oil storage tank showing one manner of arranging the individual steel plates comprising the replacement bottom according to a form of the invention.

Figure 2 is a top plan view similar to Figure 1 but showing a storage tank rectangular in cross section.

Figure 3 is an enlarged sectional perspective view through part of the bottom and side wall of an oil storage tank showing the replacement bottom of the present invention in position and illustrating the method of constructing the same.

Figure 4 is a vertical sectional view similar to Figure 3 and showing a modified detail of the construction.

Referring particularly to Fig. 3, the numeral 5 designates the upstanding side wall of an oil storage tank circular in cross-section, the said wall being constructed of a number of steel plates joined together by riveting, welding or other appropriate means. The wall 5 adjacent its lower edge is secured to the upstanding flange of an annular angle iron 6 by means of the rivets 7, and to the horizontal flange of the angle iron 6 is attached the original tank bottom 8 by means of the rivets 9. For convenience in illustration,

the tank bottom 8 has been shown as a one-piece structure. However, as mentioned above, the tank bottom is generally constructed of lap or butt jointed plate sections. Furthermore, the wall 5 and bottom 8 have been shown as riveted to the angle iron 6 but it is understood that they may be secured to the angle iron in any other suitable manner such as by bolting or welding. The joints between the angle iron and the bottom and sides also are generally made water and oil-tight by calking or otherwise, when a riveted or bolted construction is used.

As explained above, the bottom 8 in most instances rests directly upon the ground as will clearly be seen in Fig. 4, and is subjected to various corrosive attacks both from the constituents of the soil on the underside and from the water and possibly other contents of the tank on the upper side.

The useful span of life of storage tanks constructed as above is definitely limited and is generally determined by the condition of the tank bottom. This may sometimes be repaired but such repairs are difficult and expensive and in any event the bottom will eventually become so corroded as to preclude effective repair and thus necessitate complete rebuilding of the tank even though the upper walls may be perfectly satisfactory for continued service. The present invention completely eliminates these difficulties by providing a method and a construction whereby a complete replacement or false bottom may be built into the tank with a minimum of effort and expense and will provide in effect a completely rebuilt bottom that is water-tight, durable and highly efficient.

Referring again to Fig. 3, it is assumed that the bottom 8 of the tank has become so corroded as to render it no longer efficient. The tank is completely drained of its contents and upon the upper side of the bottom 8 is spread a uniform and homogeneous layer or foundation 10 of sand, fine gravel, cinders, or other loose aggregate. The thickness of the layer 10 may be any that is desirable, but in the present embodiment is generally built up so that its top surface is approximately level with the highest point on the upper heads 11 of the rivets 9 so that the heads 11 will serve as steps or foundations upon which the outer periphery of the false bottom may solidly rest.

The foundation 10 having been laid firmly in place, there is now constructed upon the upper surface thereof, a replacement or false bottom 12 which is preferably composed of individual plate sections 13 joined to one another in a water-tight manner by welds 14. These plate sections are preferably lap-welded to one another as shown in Fig. 4, but may, of course, be butt-welded as seen in Fig. 3. The false bottom 12 may, of course, consist of a single unitary steel member. However, a steel shape of that character would be extremely difficult and expensive to obtain so that the bottom 12 is generally constructed, in situ, of the individual plate sections, as just described. Fig. 1 shows the manner in which the plate sections adjacent the outer periphery of the member 12 may be cut or sheared to conform to the contour of the inner wall of the tank.

The thus fabricated false bottom 12 is substantially circular in shape and of a diameter just slightly less than the inside diameter of the tank adjacent its bottom so that the outer peripheral edge of the member 12 lies closely adjacent to and approximately parallels the inner wall of the tank, with the underside of the false bottom 12 adjacent its periphery resting firmly upon the heads 11 of the rivets 9 as hereinbefore explained. The outer edge of the false bottom 12 at its upper side is now intermittently welded to the inside face of the vertical flange of the annular angle iron 6 or the inside of the wall 5 of the tank as the case may be by means of the interrupted fillets 15, leaving an unwelded area 16 of substantial extent between each fillet, for the purpose presently to be described.

The false bottom 12 having been thus fabricated and resting upon its sand cushion 10 on the heads 11 of the rivets, there is now provided means for sealing the new bottom 12 to the inner side of the wall 5 so as to provide a water-tight and substantially oil-tight construction and provision is made, in connection with this sealing means, for testing the construction and ascertaining that it is water-tight, or of locating the nature and extent of any points of leakage. To this end a sealing ring 17, in the preferred construction taking the form of an inverted angle iron, is placed in position entirely around the inside of the tank adjacent the point of conjunction of the side wall 5 and the bottom 12, one end of the sealing ring being contiguous to the inner face of the side wall and the other edge resting upon the bottom 12. It will be apparent, of course, that the construction is not limited to the specific angle iron shape shown herein, but may take the form of any other suitable metallic shape and may even be a flat strip placed at an angle with one edge resting against the side wall and the other against the bottom. The sealing ring 17 is continuous, of course, and extends completely around the inside of the tank. The horizontal leg 18 of the sealing ring 17, which parallels the inner surface of the wall 5, is now welded to the inner surface of the wall by means of the continuous and uninterrupted fillet 19 which extends completely around the inside of the tank and forms an effectively sealed joint between the leg 18 and the inner surface of the wall 5. To seal the joint between the edge of the vertical leg 20 and the bottom 12, the said leg is welded to the bottom by means of the continuous and uninterrupted fillet 21 which also extends completely around the joint between the bottom and the sealing ring and forms an effective water-tight and substantially oil-tight seal. It will now be apparent that, assuming all of the welds hereinbefore described to have been executed in a satisfactory manner, the tank will now be provided with a new bottom which will be in all respects water-tight and substantially oil-tight. A visual inspection of the various welded areas will generally suffice to assure that all joints are water-tight, particularly if relatively large amounts of weld metal are used throughout the welded areas. However, in order to provide an accurate check on the original inspection, and, particularly if a minimum amount of weld metal is used at the various joints, a method and means are provided for testing the newly fabricated structure in order to determine beyond doubt that it is actually water-tight.

For this purpose one or more relatively small holes or openings 22 are drilled through the horizontal leg 18 of the sealing ring 17. The opening 22 is then screw-threaded internally and into the same is then screwed the pipe or tube 23 having a corresponding externally screw-threaded end. It

is understood, of course, that the opening 22 need not necessarily be screw-threaded and may receive the end of a pipe or any other type of tube without a screw-threaded connection, a screw-threaded connection, however, providing a solid joint more satisfactory for the ensuing test than most other types of connection.

Having now placed the pipe 23 in position so that it communicates with the space 24 between the sealing ring 17 and the wall and bottom of the tank, water or other suitable liquid is now pumped or otherwise forced through the pipe 23 into the space 24. Using a relatively small amount of pressure, the liquid will be forced through the spaces between the outer edge of the bottom 12 and the inner surface of the upstanding leg of the angle iron 6 at the unwelded areas 16. Thus it will eventually permeate and saturate the sand cushion 10 and completely fill the space 24. Thereafter continued pressure on this body of liquid exerted through the pipe 23 will force the liquid through any part of the new construction that is not water-tight and will thus appear on the inside of the tank and apprise the observer of any points or localities of leakage. Any points where such leakage is observed may then be effectively sealed by welding and the structure effectively made completely water-tight.

Upon completion of the foregoing test, and having observed that there are no leaks, or having remedied whatever leaks may have been observed, the pipe 23 is now withdrawn from the opening 22. The opening or openings 22 are then tightly sealed preferably by means of screw-threaded bolt 25 if the opening 22 is internally screw threaded. If not, other suitable plugs or sealing means may be used such as a metal plug which may be welded into the opening.

The new bottom construction and joint having been thus thoroughly tested and examined and the test openings 22 having been effectively plugged and sealed, there is now provided an oil storage tank having a completely new bottom that is water-tight and substantially oil-tight in every particular and that is satisfactory and eminently fit for continuation of its oil storage function.

The above described method of testing the new bottom construction with water is generally the most convenient where an adequate water supply is available. In addition, other testing methods may be mentioned briefly and these will provide an even more accurate check upon the oil-tight characteristics of the welded seams. Where sufficient oil, petroleum or any of its products is available, a quantity of the same may be forced through the pipe 23 and into the sand bed 10 and the space 24 and a static pressure built up against it sufficient to force the oil through any openings, even very minute ones. This method will, of course, provide a very accurate test since it will reveal any points through which oil could leak. This method also has the further advantage in that it provides the underside of the new or false bottom 12 with a protective coating of oil or petroleum which, of course, will hinder to some extent, the corrosive attacks of water and moisture upon the underside of the false bottom.

Another useful test method, where neither oil nor water are readily available, is to smear or coat all seams or welded areas with a soap solution. Air is then forced or blown through the pipe 23 and beneath the bottom 12 and into the space 24. With a relatively small amount of pressure behind the air, the same will, of course, be forced through any openings or porous points in the welds and will reveal itself in the form of bubbles caused by contact of the air with the coating of soap solution. Wherever the bubbles appear, additional welding can be effected and thus assure air-tight seams which will, of course, be water-tight and substantially oil-tight.

While steel oil storage tanks are most generally constructed with a circular cross-sectional configuration, square or rectangular tanks are sometimes encountered and a plan view of this type of tank is shown in Fig. 2. In that construction it is a relatively simple matter to lay out and fabricate the false bottom 12 as shown since the plates 13 do not have to be sheared to conform with the inner contour of a curved wall. In the construction of Fig. 2, the plates are merely laid upon the sand cushion 10 as previously described and then intermittently welded to the side walls of the tank. In this instance the sealing member 17 will preferably be constructed of four straight sections of angle iron, or other preferred metallic shape, one of which sections will, of course, be laid along each side wall of the tank and continuously welded to the corresponding side wall and to the false bottom 12. These strips will, of course, also be welded to one another at their joints 26 in each corner of the tank and the construction may then be tested for leakage in any of the manners hereinbefore described in connection with the round tank.

It will be appreciated, of course, that, in either shape of tank, the false bottom 12 need not necessarily be welded or joined to the side wall 5 as at 15. In other words, if preferred, the false bottom may be fabricated upon the cushion 10 and the sealing ring 17 may be applied thereafter without any welding or otherwise joining of the peripheral edge of the false bottom to the side wall, the intermittent weld fillets 15 serving merely to provide a more rigid and durable structure. The cushion 10 of loose aggregate material might also in some instances be eliminated without departing from the scope of the invention. In that event it would probably be necessary to place blocks of wood or other material at scattered points over the original bottom 8 to serve as supporting elements for the false bottom 12 and to prevent any tendency of the same to buckle, the continuous cushion of loose filling material, however, being preferred as it supports the false bottom throughout its entire area and eliminates any stress caused by the weight of the contents of the tank.

In either event the present invention provides a method of installing a completely new bottom in an oil tank, the original bottom of which has become so corroded as to be unfit for further service. All fabrication and construction of the false bottom may be effected in the field without resort to prefabricated special shapes or structures and a construction results which is strong, durable and highly efficient for continuation of the function for which the tank is adapted. Furthermore, it will be apparent that, in the event of the false bottom eventually becoming so corroded as to render the tank inefficient, another of these false bottoms identical in practically every respect to the one herein shown and described may easily be built in place upon the corroded false bottom in the same manner as the corroded false bottom was installed over the original bottom of the tank, the additional false bottom merely being laid upon the upper face of the horizontal flange 18 of the sealing ring with a

sand cushion between it and the false bottom 12 and an additional sealing ring placed upon the new or additional false bottom and sealed in place and tested in any of the manners heretofore metioned. This procedure may, of course, be continued indefinitely, depending upon the condition of the side walls 5 and the capacity of the tank desired.

What is claimed is:

1. In a round tank construction, a bottom and an upstanding side wall substantially perpendicular to said bottom, a layer of loose aggregate material covering said bottom, a round false bottom resting upon said material and having its peripheral edge lying adjacent to and paralleling the inside of said upstanding wall, and a sealing ring between the false bottom and the wall and continuously welded to each, said sealing ring, said wall, and said false bottom constituting an annular chamber, which chamber is provided with an opening in the confines thereof, whereby a fluid may be introduced into said chamber to reveal any points of leakage in the welding.

2. In a round tank construction, a bottom and an upstanding side wall substantially perpendicular to said bottom, a layer of loose aggregate material covering said bottom, a round false bottom resting upon said material, said false bottom having its peripheral edge lying adjacent to and paralleling the inside of said upstanding wall and intermittently welded thereto, and a sealing ring between the false bottom and the wall and continuously welded to each, said sealing ring, said wall, and said false bottom constituting an annular chamber, which chamber is provided with an opening in the confines thereof, whereby a fluid may be introduced into said chamber to reveal any points of leakage in the welding.

3. In a round tank construction, a bottom and an upstanding side wall substantially perpendicular to said bottom, a layer of loose aggregate material covering said bottom, a round false bottom constructed of plate sections welded together resting upon said material and having its peripheral edge lying adjacent to and paralleling the inside of said upstanding wall and a sealing ring between the false bottom and the wall and continuously welded to each, said sealing ring, said wall, and said false bottom constituting an annular chamber, which chamber is provided with an opening in the confines thereof, whereby a fluid may be introduced into said chamber to reveal any points of leakage in the welding.

4. A stationary metallic storage tank of large capacity, having a supplemental bottom member within the tank and having an approximate fit around its periphery with the upstanding substantially perpendicular side wall of the tank, a sealing ring having its lower peripheral edge resting upon the top of the supplemental bottom member inwardly from the peripheral edge thereof and welded thereto in liquid-tight sealed relation throughout the length of the periphery of the ring, the upper peripheral edge of the ring resting against the inner face of the peripheral side wall of the tank above the supplemental bottom member and welded to the said side wall throughout the peripheral length of the ring and in liquid-tight relation with said tank wall, the supplemental bottom member, the sealing ring and a portion of the tank side wall defining an annular chamber along the periphery of the supplemental bottom member, and a tubular element leading into said chamber through an opening in the confines thereof, whereby a fluid may be conducted into said chamber and underneath said supplemental bottom to reveal any points of leakage in the welding.

5. A stationary metallic storage tank of large capacity having a supplemental bottom member within the tank and having an approximate fit around its periphery with the upstanding side wall of the tank, means supporting the supplemental bottom above the main bottom of the tank, and a sealing ring having its lower peripheral edge resting upon the top of the supplemental bottom member inwardly from the peripheral edge thereof and welded thereto in liquid-tight sealed relation throughout the length of the periphery of the ring, the upper peripheral edge of the ring resting against the inner face of the peripheral side wall of the tank above the supplemental bottom and welded to the said side wall throughout the peripheral length of the ring and in liquid-tight relation with said tank wall, the supplemental bottom member, the sealing ring and a portion of the tank side wall defining an annular chamber around the periphery of the supplemental bottom member, and a tubular element leading into said chamber through an opening in the confines thereof, whereby a fluid may be conducted into said chamber and underneath said supplemental bottom to reveal any points of leakage in the welding.

6. A stationary metallic storage tank of large capacity, having a supplemental bottom member within the tank and having an approximate fit around its periphery with the upstanding substantially perpendicular side wall of the tank, a sealing ring having its lower peripheral edge resting upon the top of the supplemental bottom member inwardly from the peripheral edge thereof and welded thereto in liquid-tight sealed relation throughout the length of the periphery of the ring, the upper peripheral edge of the ring resting against the inner face of the peripheral side wall of the tank above the supplemental bottom member and welded to the said side wall throughout the peripheral length of the ring and in liquid-tight relation with said tank wall, the supplemental bottom member, the sealing ring and a portion of the tank side wall defining an annular chamber along the periphery of the supplemental bottom member, said annular chamber having an opening in the confines thereof whereby a fluid may be introduced into said chamber to reveal any points of leakage in the welding.

7. A tank according to claim 6, with the addition of closure means for said opening.

8. A tank according to claim 6, in which said opening is provided in said sealing ring.

9. A tank according to claim 6, in which said opening is tapped, with the addition of a closure member therefor in the way of a screw element.

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