Dec. 8, 1931. E. E. SHANOR 1,835,815

STORAGE TANK

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Fig. 1.

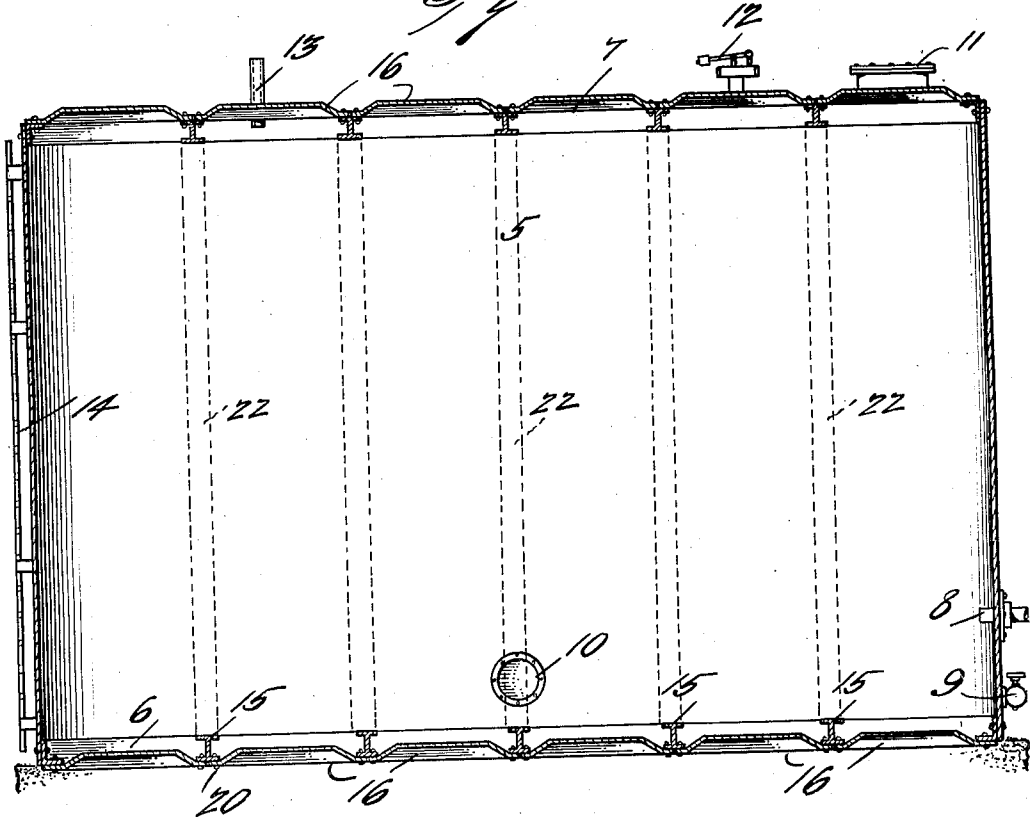


Fig. 3.

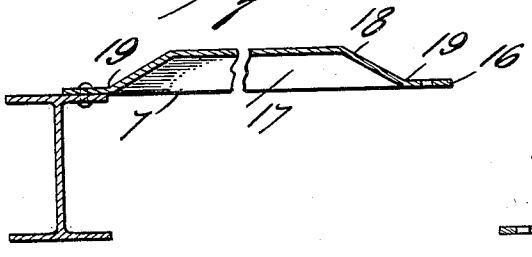
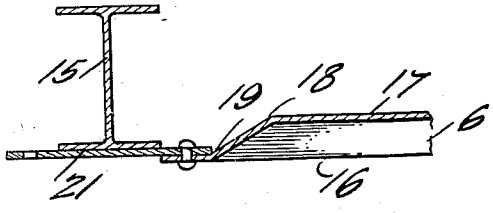


Fig. 4.



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Fig. 2.

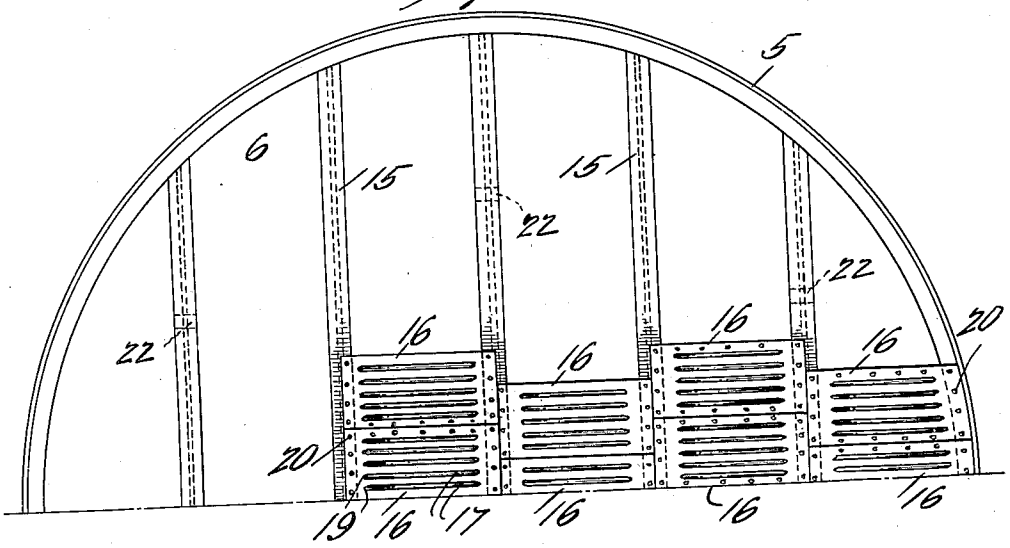


Fig. 5.

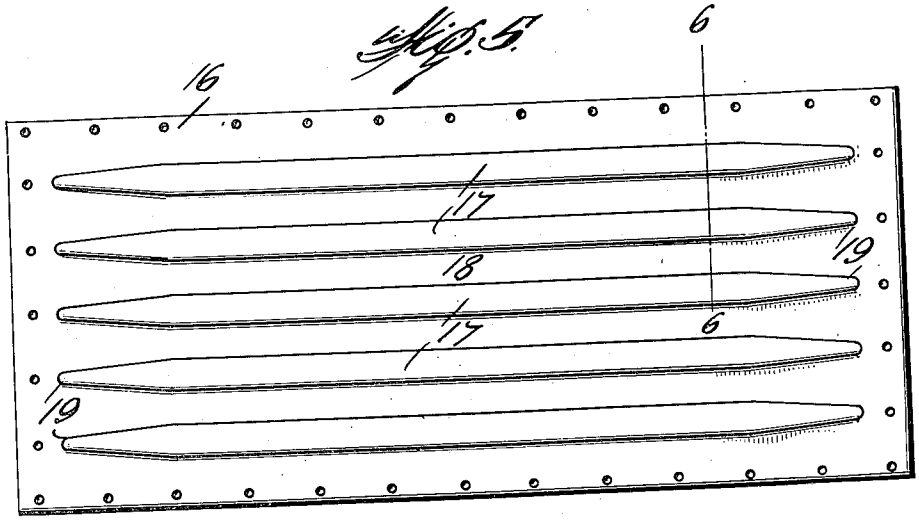


Fig. 6.



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UNITED STATES PATENT OFFICE

EDGAR E. SHANOR, OF SHARON, PENNSYLVANIA, ASSIGNOR TO THE PETROLEUM IRON WORKS CO. OF OHIO, OF SHARON, PENNSYLVANIA, A CORPORATION OF OHIO

STORAGE TANK

Application filed February 14, 1930. Serial No. 428,533.

My invention relates to tanks mainly intended for the storage of crude oils, gasoline or other volatile liquid which evolves or gives off gases or vapors calculated to set up internal pressures; and more particularly to so-called closed tanks as distinguished from tanks equipped with floating deck or roofs.

In the storage of large volumes of liquid the standard practice is to employ vertically disposed cylindrical tanks with flat bottoms. The flat bottom is preferred because of the relatively inexpensive foundation which it requires and because it provides for more or less uniform distribution of the liquid load so that the unit pressure on the soil is not excessive. Such tanks as ordinarily constructed and supported suffer the disadvantage that under the influence of internal gas pressure there is an upward thrust or lifting force on the roof, which force is transmitted to the cylindrical wall or shell and through the latter to the bottom of the tank. The effect of this is to lift the tank bottom from its foundation, open up seams and cause leakage to a more or less degree. Various expedients heretofore have been proposed for the purpose of taking care of excessive gas pressures in the storage of crude petroleum and other volatile liquids; some have taken the form of spherical, elliptical and other special designs but none of them has been commercially satisfactory because of the obvious expense. The problem is to provide for storage of large volumes of liquid in a vertical cylindrical tank of the flat bottom type and having provision for resisting distortion. Manifestly the problem can be met by using properly trussed roofs; by tying the cylindrical wall or shell to the foundation; or by the use of heavy plates reinforced with closely spaced ties; but the use of any of the foregoing or similar expedients, commercially speaking, is impossible because of the prohibitive cost.

Hence, the desideratum and, therefore, the principal object of the invention is to meet the large and constantly increasing demand in the oil industry for a tank capable of storing large volumes of gas producing liquids, which shall meet the specifications of low initial cost and low cost of maintenance, and which shall be capable of successfully resisting dangerous distortion under forces resulting from internal gas or vapor pressures; and the nature of the invention consists in providing a comparatively simple, inexpensive and light-weight construction capable of meeting the specifications aforestated and including, with respect to at least the bottom of the tank and preferably both bottom and roof elements, plates of comparatively light gage or weight inherently constructed successfully to resist dangerous distortion or excessive deflection, that is to say, plates having stiffening integers.

In the accompanying drawings forming a part hereof

Figure 1 is a vertical sectional view showing a vertically disposed cylindrical tank embodying features of my invention.

Fig. 2 is a plan view of the bottom construction.

Figs. 3 and 4 are details of mounting tank bottom and roof plates.

Fig. 5 is a top or face view of a typical bottom or roof plate embodying my invention.

Fig. 6 is a section on lines 6—6 of Fig. 5.

Referring to the drawings, 5 represents a tank body in the form of a cylindrical shell, the details of which may be as usual or of any approved construction; 6 represents a bottom of the flat type designed to rest directly upon the soil or any usual foundation; 7 represents a roof which may be of the flat type shown or of any conventional type. The tank is or may be equipped with the usual accessories such as inlet and outlet connections 8, water draw-off 9, manhole 10, gage hatches 11, pressure relief valve 12, standpipe 13 and ladder 14.

The bottom 6 embodies parallel I-beams 15 serving as supports for the cylindrical shell and also for the bottom plates 16. It is a merit of my invention that the plates 16 are inherently constructed so as to be stiffened or reinforced against deflection or distortion in a vertical direction under stress transmitted to them from the cylindrical shell. While realizing that this may be ac-

complished in various ways I prefer to embody this part of my inventive thought in a plate of light gage formed with upstanding or vertical integers 17, which are of generally rectangular form 18 intermediate their flaring terminals 19 which latter ultimately vanish in the end margins of the plate. The integers 17 might well be die-formed corrugations thus giving the plate a concavo-convex form. While preferring corrugated plates of the type recited, it is manifest that it would be but a continuation of my inventive thought to employ other types of corrugated plates.

Bottom plates of the nature indicated readily lend themselves to assemblage or mounting with respect to the I-beams or other means of support. For example, the plates may be joined as at 20 by riveting or welding and they may be secured to the beams, as at 21 by welding or otherwise.

The roof construction with respect to individual plates is or may be the same as the bottom except that the margins of the plates are secured to the top flanges of the beams instead of the bottom flanges as is the case with the tank bottom. However, the roof need not be of the flat type as my method of reinforcement against lifting forces may well be incorporated in a conical or other conventional type of roof.

Evidently the provision of bottom and roof plates of the character specified simplifies the closing of the heads of the tank, whether by riveting, welding or other convenient method of closing seams, and the provision of such plates is further meritorious in that it provides for the easy placement of vertical columns or ties 22 ranging between the beams of the respective heads so that without excessive flexure of the corrugated plates they are capable of transmitting their load to the ends of the corrugations at which points the load is reacted by the columns or ties to the opposite heads of the tank, it being understood that the intermediate ties between the roof and the bottom are so constructed and arranged as to constitute columns to support the external roof load. Regardless of the form of the roof, the inclusion therewith of the standpipe 13 has the merit that it takes care of conditions making for so-called "breathing" resulting from varying gas pressures due to expansion and contraction. The "breathing" can be overcome by keeping the tank filled to capacity permitting expansion to take place in the standpipe and taking care of contraction by supplying fluid to the tank from the standpipe.

Having described my invention, I claim:

1. A liquid storage tank of the closed type comprising a shell, a roof and a bottom, I-beams supporting the shell and the bottom, said bottom including a plurality of independent plates afforded marginal support by the I-beams and each having stiffening ribs stopping short of the margins, roof supports, and vertical columns or ties ranging between the bottom and roof supports.

2. A liquid storage tank comprising a cylindrical shell, a bottom and a roof, the latter including I-beams and a plurality of independent plates each formed integrally within its marginal limits with stiffening ribs, said plates being marginally secured to the top flanges of the beams, means for stiffening the bottom, and ties between the roof and bottom and effective as columns to support the external roof load.

3. A liquid storage tank comprising a cylindrical shell, a bottom and a roof, the latter including I-beams and a plurality of independent plates each formed integrally within its marginal limits with stiffening ribs, said plates being marginally secured to the top flanges of the beams, means for stiffening the bottom, and ties between the roof and bottom and effective as columns to support the external roof load, and means for relieving conditions making for "breathing" and resulting from varying gas pressures due to expansion and contraction.

4. A liquid storage tank comprising a shell, a bottom and a roof, bottom and roof supports in substantial alignment and including members ranging crosswise of the shell in parallel order of arrangement and tied to the shell, ties intermediate the bottom and roof supports, and means for completing at least one of said elements namely, the bottom and roof, and comprising ribbed plates spanning the areas between the crosswise ranging supports and marginally secured to said supports, whereby without excessive flexure of the ribbed plates, they are capable of transmitting their load to points at which it is reacted by the ties to the opposite closure of the tank.

In testimony whereof I affix my signature.

EDGAR E. SHANOR.