July 30, 1940. E. W. HALL 2,209,399

TANK ROOF

Filed Dec. 31, 1937

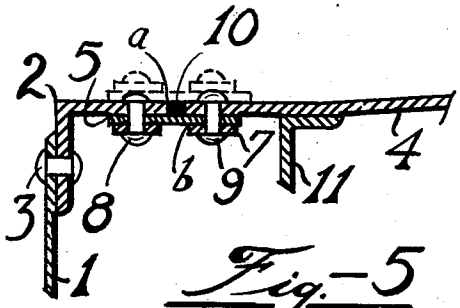

Fig.-5

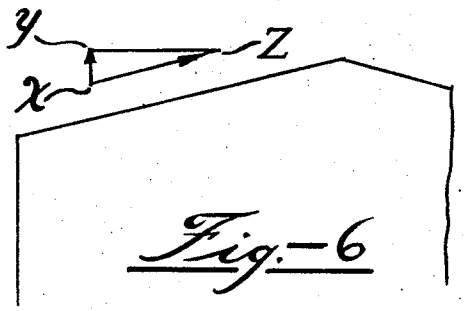

Fig.-6

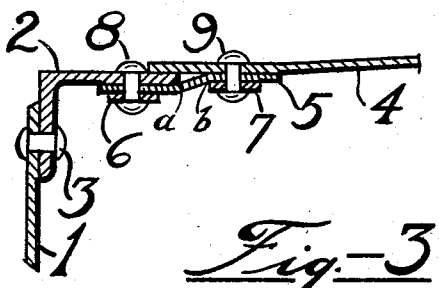

Fig.-3

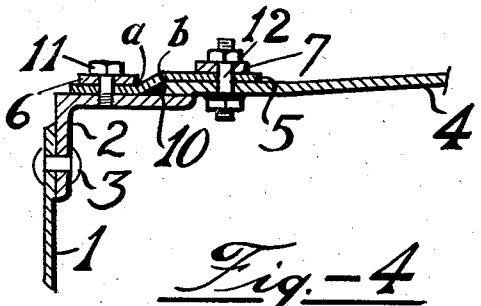

Fig.-4

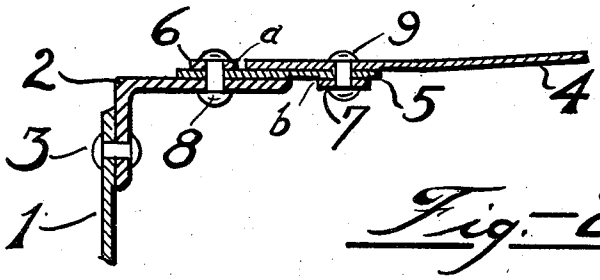

Fig.-2

Fig.-1

Earle W. Hall Inventor

By P. L. Young Attorney

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TANK ROOF

Earle W. Hall, Westfield, N. J., assignor to Standard Oil Development Company, a corporation of Delaware

Application December 31, 1937, Serial No. 182,671

10 Claims. (Cl. 108—32)

The present invention relates to the construction of storage tanks which may be subjected to abnormal or destructive internal pressures generated by the materials within the tank.

More particularly, this invention relates to the construction of storage tanks in which the roof or a portion of it may be secured to the remaining structure in such manner as to accomplish the rapid and automatic release of any abnormal or destructive pressures which may develop within the tank. It is an object of the invention, to provide for such release of pressure without substantial damage to other portions of the tank, and without uncontrolled release of the contents thereof. It is also an object of the invention to provide an improved rip seam for a tank roof. A further object of the invention is to provide for a substantially fluid tight joint between adjacent sections of a tank roof while attaining the objects previously set forth.

These objects and the invention may be fully understood from the following description when read in conjunction with the accompanying drawing in which like parts are similarly designated, and in which:

Fig. 1 is a sectional view of a portion of a storage tank constructed according to the invention.

Figs. 2, 3, 4, and 5 are similar views of alternate forms of construction according to the invention.

Fig. 6 is a diagrammatic view of a portion of a tank showing the resolution of forces exerted in the roof plates.

Referring to Fig. 1, the numeral 1 designates the side wall of a tank, to which is secured an angle brace 2 by means of rivets 3, or by other equivalent means. A roof plate 4 is joined to the angle brace 2 by means of a sheet or plate of material 5 which material has a tensile strength less than that of any other portion of the roof or walls of the tank. The sheet or plate of low tensile material may be of aluminum or a similar weak metal or it may be of a heavy fabric, which may or may not be treated with any of a variety of preservative or stiffening materials. The plate 5 is secured to the fixed and separable portions of the tank, as represented by the angle brace 2 and the roof plate 4 respectively, adjacent their adjoining edges, by means of cap plates 6 and 7 and rivets or bolts, as indicated at 8 and 9 respectively. The cap plates 6 and 7 may, one or both, also function as shear plates as will later be described.

As shown in Fig. 1 the sheet of frangible material is secured to the upper surface of the brace 2 and the cap plate 6 extends beyond the edge of the brace. The roof plate 4 bears on the upper surface of the cap plate 6, but extends outwardly a sufficient distance to overlap the end of the brace 2.

As mentioned above, while plates 6 and 7 are primarily designed to aid in providing a fluid tight joint between the sheet or plate 5 and the fixed and separable portions of the tank roof, these members may also act as shear plates to induce failure of the sheet 5 along particular lines rather than haphazardly. In some instances, only one cap plate will function in that manner but in other instances both will so operate. Probable points of failure, or shear points, are indicated in the drawing at *a* and *b*. Both the sheet 5 and cap plates 6 and 7 may be sectional if required.

Whereas in Fig. 1, the plate 6 extends beyond the edge of the angle brace 2, in Fig. 2 the plate 6 terminates in spaced relation to the edge of the brace 2 and roof plate 4 bears upon the sheet 5 directly. In this form of construction the sheet 5 is flat rather than having an offset surface conformation.

In Figs. 3 and 4 are shown two other forms of construction in both of which the roof plate 4 or separable portion, overlaps the angle brace 2 or fixed portion of the roof. In the former, Fig. 3, the offset sheet 5 is disposed entirely within the tank as are the cap plates 6 and 7. In the construction according to Fig. 4, however, the offset sheet 5 and cap plates 6 and 7 are disposed on the upper or outer surface of the tank. Also, in Fig. 4 a supplementary means for sealing the joint between fixed and separable portions is shown at 10. This means may consist of a plastic or semi-plastic adhesive material such as a sealing material containing a polymer of isobutylene, or it may be any other well known caulking or sealing material such as oakum or manganese putty. A particular advantage is derived from the construction according to Fig. 4, in that failure of the sheet 5, without substantial or violent displacement of the separable portions of the tank roof, may be easily remedied without entering the tank or moving the separable portion to insert a new sheet 5 or sections thereof, especially if the rivets 8 and 9 shown in the previous figures are replaced by bolts 12 or studs 11.

In Fig. 5, there is illustrated a form of construction in which the relationship of the fixed and separable portions of the tank roof, as represented by brace 2 and roof plate 4, is edge to edge. In such instances it is assumed that the weight of the separable portion or plate 4 may be suitably and entirely borne by structure such as support 11. In such an arrangement, the sheet 5 will be flat as in Fig. 2 and may be disposed either interiorly of the tank as shown in heavy lines or exteriorly as shown by the dotted line portion. If the sheet 5 be disposed interiorly, a caulking or packing material 13, as previously described, should be used in the space between the adjoining edges of the respective roof sections.

In Fig. 6, the vectors $x—y$ and $x—z$ indicate respectively and in approximate proportion the relation of the forces which tend to cause failure of the joints in a tank roof, under pressure exerted within the tank. It is apparent, therefore, that the nature of the material used for the sheet 5 should be such that it will fail under tension before the force exerted in the direction of vector $x—z$ is such as to shear the rivets, bolts or other means used to join the other portions of the tank roof. In addition, it is necessary that the force required to cause failure of the sheet 5 under tension should be less than that which, when exerted in the direction of the vector $x—z$, will cause buckling of the tank wall, and also, less than that force which, when exerted in the direction of vector $x—y$, will cause even partial separation of the tank walls either at the base or at other joints thereof. The degree of resistance of the sheet 5 to failure may be provided for by the use of such materials as mentioned above, in varying degrees of thickness and by means of cutters or sharpened edge portions on the cap plates 6 and 7, the angle brace 2, or the roof plate 4 so as to facilitate failure of the sheet along the lines indicated at points *a* and *b*.

It should be evident from the drawing and from the foregoing description that, in general, there are three forms of construction possible under the invention as described:

1. A construction in which the plate 5 is disposed exteriorly of the tank roof;

2. A construction in which the plate 5 is disposed interiorly of the tank roof; and

3. A construction in which the plate 5 is disposed exteriorly of one portion of the roof and interiorly of the other.

Likewise, it is indicated that there are two possible relationships between the fixed and separable portions of the roof:

1. That in which the respective portions overlap; and

2. That in which the respective portions are disposed edge to edge.

In service, regardless of the specific form of construction utilized, it is intended that the generation of excessive pressure below the tank roof will be relieved, before serious damage to the tank occurs, by rupture of the sealing joint provided to permit the entire separable portion of the roof to be displaced, upwardly, to such extent as may be required under the circumstances.

Although, in the foregoing description, the invention has been set forth in considerable detail, it is to be understood that such description is illustrative only, and that various changes may be made within the scope of the appended claims in which it is intended to claim all novelty inherent in the invention as fully as the prior art permits.

I claim:

1. A roof for storage tanks, comprising a roof portion fixedly joined to the tank walls; a separable roof portion supported in substantially free relation to the fixed portion; frangible sheet means disposed in surface contact with each of said roof portions; and connector means disposed in substantially opposed relation marginally of said sheet means, separately joining each roof portion to the sheet means in substantially fluid tight relation.

2. A roof for storage tanks, comprising a roof portion fixedly joined to the tank walls; a separable roof portion supported in substantially free relation to the fixed portion; sheet means of relatively low tensile strength, disposed in surface contact with each of said roof portions; and connector means disposed in substantially opposed relation marginally of said sheet means, separately joining each roof portion to the sheet means in substantially fluid tight relation.

3. A roof for storage tanks comprising a roof portion fixedly joined to the tank walls; a separable roof portion supported in substantially free relation to the fixed portion; frangible sheet means covering the joint between said fixed and separable portions; and connector means disposed in substantially opposed relation marginally of said sheet means, separately joining each roof portion to the sheet means.

4. A roof for storage tanks according to claim 3 in which said sheet of frangible material is disposed exteriorly of the roof.

5. A roof for storage tanks according to claim 3 in which said sheet of frangible material is disposed interiorly of the roof.

6. A roof for storage tanks, comprising a roof portion fixedly joined to the tank walls; a separable roof portion supported in substantially free relation to the fixed portion, said roof portions being disposed in overlapped relation, a sheet of frangible material disposed between the overlapping roof portions; and connector means disposed in substantially opposed relation marginally of said sheet, separately joining each roof portion to the sheet.

7. A roof for storage tanks comprising a separable roof portion and a portion fixedly joined to the tank walls, said portions being disposed in overlapping relation, a sheet of frangible material disposed between the overlapping portions of the roof and extending inwardly beyond the edge of the overlapped portion thereof and outwardly beyond the edge of the overlapping portion, a cap plate for the inner edge of said shet, a cap plate for the outer edge of said sheet, means for securing said outer edge to the upper surface of said overlapped portion and means for securing said inner edge to the lower surface of said overlapping portion.

8. A roof according to claim 7 in which said cap plate for the outer edge of the sheet of frangible material extends inwardly between said sheet and the overlapping portion of said roof, providing a bearing surface for said roof portion.

9. A roof for storage tanks, comprising a roof portion fixedly joined to the tank walls; a separable roof portion supported in substantially free relation to the fixed portion, said roof portions being disposed in overlapped relation; a sheet of frangible material disposed in surface contact with each of said portions and closing the joint therebetween; connector means disposed in substantially opposed relation marginally of said sheet separately uniting each roof portion with said sheet; and a caulking composition in the space formed between said sheet and the overlapped roof portions.

10. A roof for storage tanks, comprising a separable roof portion and a roof portion fixedly joined to the tank walls, a sheet of frangible material closing the joint between said portions, means for separately securing said sheet to each of the fixed and separable portions and means for inducing rupture of the sheet under positive pressure from within the tank.

EARLE W. HALL.