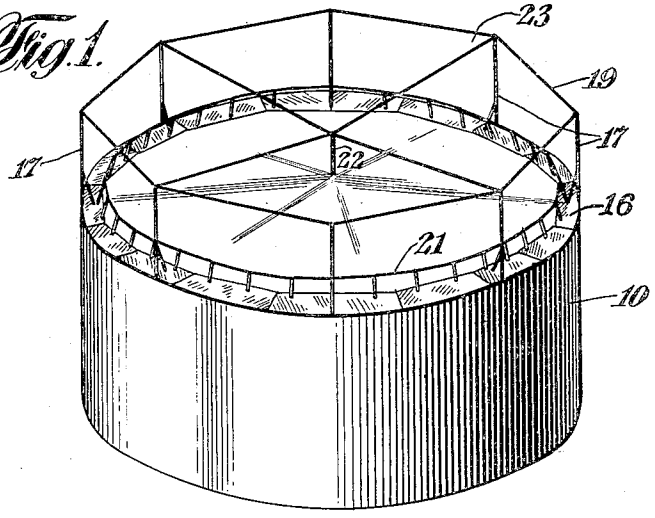
Sept. 18, 1934. E. R. SCHAEFFER 1,974,315

LIGHTNING PROTECTION FOR STORAGE TANKS

Filed March 6, 1930

Fig. 1.



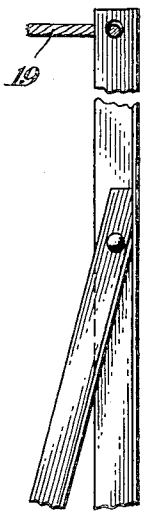
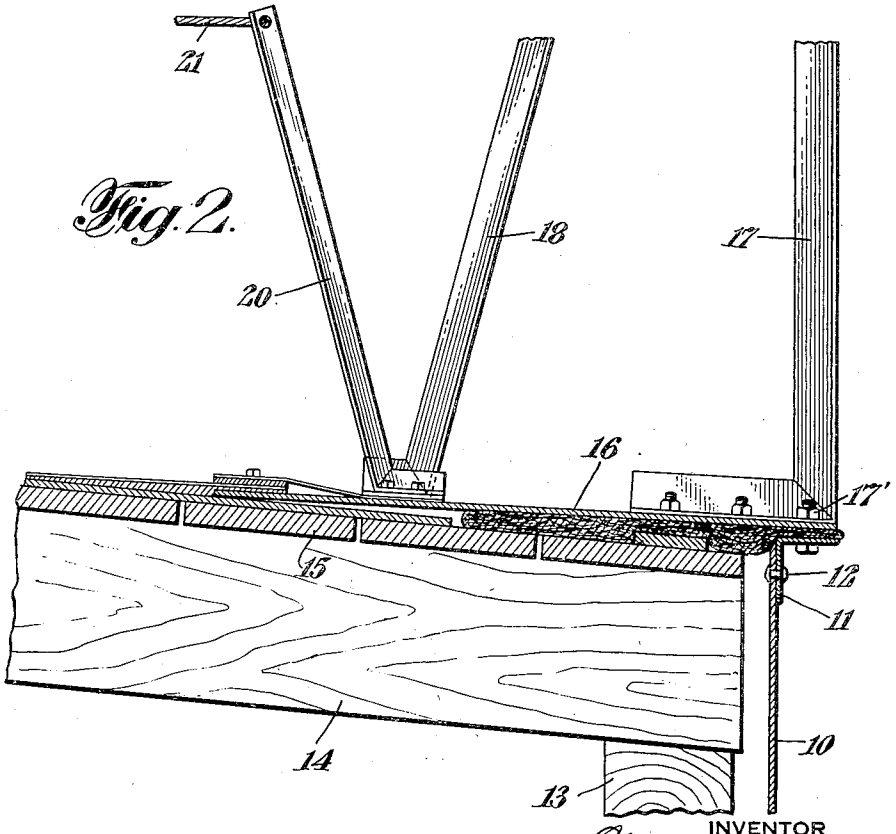


Fig. 2.



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LIGHTNING PROTECTION FOR STORAGE TANKS

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Application March 6, 1930, Serial No. 433,597

9 Claims. (Cl. 173—31)

This invention relates to devices for reducing the fire and explosion risks from electrical ignition of inflammable fluids stored in tanks or the like.

Tanks for storing crude petroleum and oils of low gravity, and other inflammable fluids, usually comprise cylindrical shells with a metal bottom and are frequently capped by non-metallic roofs. The roofs are provided with coverings of asbestos or other fire-proof material of low electrical conductivity, generally a built-up roof covering comprising a plurality of plies of flexible roofing such as asbestos or other felt saturated with a bitumen. During electric storms, electric charges spread over the surface of the earth and over structures on the earth, producing great electric stresses at certain parts of the structures. A considerable electric charge may collect on the roof of a tank during the approach of a highly charged cloud or during the formation of a thunder-cloud above the tank. The electric charge per unit area on the outside of such a metallic tank is large but the stresses are particularly great at the top of the vertical metallic walls or rim of such a structure. Due to frequent relative movements of the tank shell and the roof, unless special precautions are taken, gases from crude petroleum and the like will escape at the junction between the composition roof and the steel shell. Since this is the region of the greatest electrical stresses, during a period of electrical storm, it is necessary to devise a construction which will offer protection against both the sparks from induced charges and from the effect of direct lightning strikes. When a cloud discharges, the bound quantity of electricity on the tank roof passes in a surge to the metallic rim or eaves of the tank, whether the lightning discharge strikes the tank or not, and may cause small sparks in the region where petroleum vapors are most likely to escape from the tank.

By arranging grounded wires above the eaves of the tank, the charge per unit area on the roof can be reduced to any value desired. The electrical effect of a grounded wire, making a closed circle of diameter equal to that of the tank, is to increase the effective height of the metallic shell and therefore to offer greater protection to the roof and to points within the tank. The wires raise the equipotential surfaces over the tank and, if the grounded wires form a horizontal closed figure, the electrical forces are greatly reduced in the space directly below the plane of the ground wire. The electric lines of force then end on grounded wire and greatly reduce the stresses near the eaves of the tank. Direct lightning discharges are also far more likely to end on the elevated grounded wire than on the eaves.

According to the present invention, the roof is provided with a series of segmental metal eaves plates which overlie the outer margin of the non-metallic covering. The electrical forces beneath the eaves plates and adjacent to the top of the shell are very much smaller than on the outside of the tank at the eaves and, although the region of greatest electrical stresses is thus well protected, a part of the difficulty has been transferred from the eaves, or top of the vertical shell of the tank, to the inner edge of the steel eaves plate. Vertical metal members are supported by the metal eaves plates, which are grounded by being secured to the tank shell, and the vertical members support one or more conductors above the periphery of the roof. The conductors which are grounded through the shell prevent lightning striking the eaves.

It is preferable also to provide a second conductor at a lower elevation and above the inner edge of the eaves plates, the junction of the plates and the non-metallic roof. This conductor is also supported by frame members attached to the eaves plates and forms a regular polygon of many sides above the inner edge of the eaves plates. This last mentioned conductor serves two purposes. It reduces very materially the collection of static charges on the roof at the junction between the poorly conducting roof covering and the metallic eaves plates and it prevents lightning from striking the inner edge of the eaves plates.

Other objects, novel features and advantages of this invention will be apparent from the following specification and accompanying drawing, wherein:

Fig. 1 is a perspective view of a tank equipped with lightning protection means in accordance with the invention, and

Fig. 2 is a fragmentary vertical sectional view of the tank.

The tank comprises the usual cylinder steel shell or side wall 10 around the upper rim of which there is provided an angle iron 11 which is secured to the wall by rivets 12. The angle iron is arranged with one of its flanges horizontal and preferably slightly above the upper edge of the shell 10. Within the shell there are provided the usual wooden vertical stanchions or supports 13 which support wooden rafters 14 upon which rests the wooden sheathing 15 which forms a part of the roof of the tank. On the sheathing there is supported a covering of the character fully described

and claimed in applicant's copending application, Serial No. 431,103 filed February 25, 1930. The structure of the covering constitutes no part of this invention and will, therefore, not be described in detail.

A part of the covering comprises a metallic ring 16 having its outer edge overlying and secured to the horizontal flange of the angle iron 11. This ring is preferably made up of sector-shaped plates which are secured to the sheathing in such a way as to be free for such relative movement as takes place in service. The manner in which the plates are secured to the sheathing is fully disclosed in the co-pending application above referred to.

A plurality of vertical metallic supports 17 are secured to the ring 16 and are reinforced by oblique braces 18 also supported by the ring 16. The supports 17 are arranged at the edge of the ring 16 and extend a considerable distance above the top of the tank. These supports are spaced uniformly about the periphery of the ring 16 and each support is provided at its upper end with an aperture. A conductor 19 is passed through the apertures in the upper ends of the supports 17 and its ends are joined together, thereby forming an annulus of substantially the same diameter as the tank, but spaced above the top of the tank a distance equal to the height of the supports 17. This conductor is grounded through the support 17, the bolts 17' which fasten the supports 17 to the ring 16 and the ring 16 to the angle iron 11, and thence through the tank itself.

A second set of metal supporting members 20 are attached at their lower ends to the ring 16 at a point slightly removed from its inner edge. These supports are inclined inwardly so that their upper ends lie above the inner edge of the ring 16. A conductor 21 is passed through apertures in the upper ends of the members 20 and has its ends joined together to form an annulus overlying the inner edge of the ring 16. This conductor is grounded through the members 20, ring 16, bolts 17' and angle iron 11 and tank wall 10. The supports 20 are shorter than the supports 17 so that the conductor 19 is at a higher elevation than the conductor 21.

At the center of the roof there is supported a post 22 which is of less height than the supports 17. Conductors 23 lead from the top of the post 22 radially to the supports 17. The conductors 23 are not essential and may be used or not as desired. The upper conductor 19 protects the tank against direct lightning discharges. Instead of the lightning striking the tank at the eaves, it will strike the conductor above the eaves. The conductor 21 also serves to prevent lightning from striking the inner edge of the ring 16 as well as reduces very materially the collection of static charges on the roof at the junction between the poorly conducting roofing and the highly conductive ring 16.

It is, of course, understood that while the preferred embodiment of the invention has been described, modifications within the scope of the appended claims may be made without departing from the spirit of the invention.

I claim:

1. The combination with a metallic storage tank and a roof having a low electrical conductivity of a metal annulus overlying the edge of said roof, a plurality of metal supports carried by said annulus, and a conductor connecting the upper ends of said supports.

2. The combination with a metallic storage tank and a roof having low electrical conductivity, of a metal annulus overlying the edge of said roof, a set of metal supports carried by said annulus at the inner edge thereof, a conductor connecting the upper ends of said supports, a second set of metal supports carried by said annulus at its outer edge, and a conductor connecting the upper ends of said last named supports, said second conductor being at a higher elevation than said first conductor.

3. In combination with a metal storage tank and a roof having low electrical conductivity, of a metal annulus overlying the edge of the roof, a plurality of conductive supports carried by said annulus, and annular conductors carried by said supports above the inner and outer edges of said annulus.

4. In combination with a metal storage tank and a roof having low electrical conductivity, of a metal annulus overlying the edge of the roof, a plurality of conductive supports carried by said annulus, and annular conductors carried by said supports above the inner and outer edges of said annulus, the outer conductor being at a higher elevation than the inner conductor.

5. The combination with a metallic storage tank and a roof having low electrical conductivity, of a metal annulus overlying the edge of the roof, metal supports carried by said annulus and an annular conductor supported by the upper ends of said members, and a second annular conductor supported from said annulus above the inner edge thereof.

6. The combination of a metallic storage tank and a roof having low electrical conductivity, of a plurality of segmental metal plates overlying the edge of the roof and forming an annulus, metallic supports carried by said plates, and an annular conductor supported by and connecting the upper ends of said members.

7. The combination of a metallic storage tank and a roof having low electrical conductivity, of a plurality of segmental metal plates overlying the edge of the roof, metallic supports carried by said plates, and an annular conductor supported by and connecting the upper ends of said supports, additional metallic supports carried by said plates, and an annular conductor carried by said last named supports and overlying the inner edge of said plates.

8. The combination with a metal structure and a roof having low electrical conductivity, of a metal member overlying the edge of the roof, and a pair of conductors supported from said member at different elevations and being differently spaced from the edge of the roof, said conductors being grounded solely through the medium of said structure.

9. In combination with a metal structure having a roof of low electrical conductivity, a metal member overlying the edge of the roof, and a pair of conductors supported from said member substantially above the inner and outer edges thereof, said conductors being grounded solely through the medium of said structure.

ELMER R. SCHAEFFER.