EXTERNAL HEATING ARRANGEMENT FOR A STORAGE TANK

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This invention relates in general to storage tanks. It deals more particularly with an external heating arrangement for a storage tank.

Cold weather operations involving fluid handling are often severely hampered by low ambient temperatures. With railway or truck tank cars, for example, the transfer of transported liquid such as corn syrup or the like is virtually impossible when the ambient temperature is near or below freezing. The liquid has either solidified or thickened to the point where it will not flow readily. Consequently, heating arrangements of one type or another are frequently used for raising the temperature of the stored liquid sufficiently to achieve suitable flow characteristics.

It is an object of the present invention to provide an improved heating arrangement for a storage tank.

It is another object to provide an improved external heating arrangement for a storage tank.

It is still another object to provide an improved heating arrangement for a railway tank car.

It is still another object to provide an improved external heating arrangement for a tank wherein the tank is comprised of opposed frusto-conical tank sections.

It is yet another object to provide an improved external heating arrangement for a tank comprising opposed frusto-conical tank sections wherein the heating arrangement is simpler, easier to construct, and more economical than generally similar heating arrangements heretofore utilized.

The foregoing and other objects are realized in accord with the present invention through an external tank heating arrangement which takes advantages of the frusto-conical configuration of opposed tank sections to provide an efficient heating structure. The heating arrangement is embodied in a serpentine heating coil secured to the outer surface of the tank shell in such a manner that a substantial portion of its length can be fabricated from standard structural members, such as channels, without any modification being necessary for application to the tank.

The invention, both as to its organization and method of operation, taken with further objects and advantages thereof, will best be understood by reference to the following description taken in connection with the accompanying drawings, in which:

FIGURE 1 is a side elevational view of a railway tank car incorporating a heating arrangement embodying features of the present invention;

FIGURE 2 is an end view of the tank car illustrated in FIGURE 1;

FIGURE 3 is a developed bottom view, looking upwardly, of the heating arrangement and portions of the tank car; and

FIGURE 4 is a sectional view taken along line 4—4 of FIGURE 3.

Referring now to the drawings, and particularly to FIGURE 1, a railway tank car is illustrated generally at 10. The railway tank car 10 includes a double frusto-conical tank 11 supported on diagrammatically illustrated railway trucks 12 by conventional bolsters 13.

The tank 11 is of broadly known construction. The tank 11 comprises opposed half-tank sections 15 and 16. Each tank section 15 and 16 is substantially identical in configuration and includes a shell 18 fabricated of steel plate or the like in the shape of the frustum of a right circular cone.

The frusto-conical shells 18 are joined at their adjacent base edges 20 by welding or the like with the shells suitably rotated upwardly about their base edges so that the upper surface of the tank defines a straight line in side elevation, as seen at 21 in FIGURE 1.

Secured by welding or the like to the outer free edge 24 of each shell 18 is a concave end section 25. The concave end sections 25 are also preferably fabricated of steel plate or the like.

Extending the length of the tank 11 along its bottom is a reinforcing plate 26. The reinforcing plate is preferably fabricated of 3/8 inch steel plate and is suitably welded to the outer surface 29 of each of the shells 18. The plate 28 is slightly V-shaped in side elevation, as will be noticed, to accommodate the sloping bottom of the tank 11.

At opposite ends of the tank 11 a pair of generally rectangular bolster plates 33 are secured to corresponding shells 18 to act as "saddles" for the bolster 32. The bolster plates 33 are preferably fabricated of 1/4 inch steel plate and are secured to the outer surface 29 of each shell 18 by welding or the like. The innermost edge 35 of each bolster plate extends into immediately adjacent relationship with a corresponding longitudinally extending side edge 36 of the reinforcing plate 26.

The jointer of the shells at their base edges 20 defines the center line 38 of the tank 11, of course. Offset from the center line 38 for ease of construction and mounted on top of the tank section 16 is a conventional filler assembly 46 and a breather assembly 41. The filler assembly 40 provides access to the interior of tank 11 for the liquid to be transported. The breather assembly 41 conventionally performs the function its name implies.

A conventional drain valve unit 45 is provided at the bottom of the tank 11 on its center line 38. The tank 11 can be drained through the valve unit 45 in a well-known manner as long as the stored liquid is "fluid" enough and the valve unit 45 is unblocked. In order to assure the requisite fluidity of the stored liquid for withdrawal of the liquid from the tank 11 in low ambient temperature environs, such as winter climates in the northern United States, for example, a heating arrangement 50 embodying features of the present invention is provided on the tank.

The heating arrangement 50 includes two serpentine heater coils 51 and 52 secured to opposite sides of the tank 11 on the lower half thereof. The serpentine coils 51 and 52 are connected at their inlet ends 55 to a heating fluid inlet assembly 56 through which heating fluid is introduced to the coils. The hot fluid courses through each of the coils 51 and 52 and is drawn off at the outlet ends 58 of the coils through an outlet assembly 59 which interconnects them.

Each coil 51 and 52 is preferably fabricated entirely of a series of standard TCBG 6 x 2 channel iron sections. Each of these channel sections comprises a base web 60 and depending legs 61 (see FIGURE 4). It is the lower free edges 62 of the depending legs 61 which are secured to the tank 11; an arrangement hereinafter discussed in greater detail. As will also be hereinafter apparent, however, other structural members of the same general type might readily be utilized in lieu of channel sections.

Since each coil 51 and 52 is substantially identical, it is only necessary to describe the coil 51, for example, in detail. Corresponding reference numerals are applied to corresponding components of the coil 52.

The coil 51 comprises a series of lombardy extending, circumferentially spaced channel sections 65, 66, 67 and 68 secured to the outer surface 29 of the right
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hand shell 18, as seen in FIGURE 1, for example. Channel section 65 is positioned on the tank 11 adjacent the bottom thereof and the remaining channel sections 66, 67 and 68 are circumferentially spaced upwardly from it along the side of the tank, as illustrated. A substantially identical series of longitudinally extending, circumferentially spaced channel sections 70, 71, 72 and 73 are similarly secured to the outer surface 29 of the opposite shell 18.

End plates 77 seal off the open inner ends 55 and 58 of the lowermost channel sections 65 and 70, respectively. The outermost ends 80 and 81 of the channel sections 65, 70, 66, and 67, respectively, are interconnected by welding to circumferentially extending short channel sections 82 at miter joints 83. Similarly, the innermost ends 85 and 86 of the longitudinally extending channel sections 71, 66, and 72, 67, respectively, are joined by welding to circumferentially short channel sections 90 at miter joints 91.

In addition, the outermost ends 93 and 94 of the longitudinally extending channel sections 72, 67, and 73, 68, respectively, are joined by welding to circumferentially extending short channel sections 95 at miter joints 96. The inner ends 100 of the uppermost channel sections 73 and 68 are joined to each other by welding or the like at the miter joint 101 on the center line 38 of the tank 11 out.

The interconnected channel sections provide a fluid tight path through the coil 51, for example, from the inlet end 55 to the outlet end 58 thereof. This is true, of course, since the free edges 62 of the depending legs 61 on each of the channel sections is secured to the outer surface 29 of a corresponding frusto-conical shell 18 by welding or the like. Actually, the inner legs 61 of the lowermost channel sections 65 and 70 are welded to the outer surface 110 of the reinforcing plate 28, as seen in FIGURE 4. Furthermore, suitable cutouts are provided in the legs 61 of the channel sections 70, 65 and 71, 76, at as 111, for example, to accommodate the bolster plates 33. In the area 111, the legs 61 of the channel sections are welded to corresponding bolster plates 33.

According to the present invention, the innermost channel sections 70, 65 and the third channel sections 72, 67 are positioned on the surface 29 of corresponding shells 18 (and the surface 110 of the reinforcing plate 28) on surfaces 115 extending through imaginary vertices of the cones defined in part by the frusto-conical shells 18. As such, these channel sections 70, 65, and 72, 67, seat flush with the outer surface 29 of the shell 18 and the outer surface 110 of the reinforcing plate 28 without being deformed in any way. They can readily be welded in place without being forced into a proper fit.

Only the longitudinally extending channel sections 71, 66, and 73, 68 need be deformed, as by twisting, to bring the free edges 62 of the legs 61 into engagement with the surface 29 of corresponding shells 18. The relative ease of securing a coil 51 to the surface of a double frusto-conical tank 11 wherein this minimal amount of deformation of the channel sections is necessary can readily be appreciated. As such, substantial savings in fabrication of a heating arrangement 59 according to the present invention.

The circuitous path which the heating fluid must take from the inlet end 55 to the outlet ends 58 of the heating coil 51 and 52 should now be clearly understood. To introduce this heating fluid, steam in the present instance, to the inlet ends 55 of the coils 51 and 52, a heating fluid inlet assembly 56 is secured to them, as has been pointed out. The assembly 56 includes a jacket 120 mounted on the bottom of the tank 11 at the center line 38 and substantially enclosing the drain valve unit 45 of the tank. An inlet 121 provides means for introducing the steam to the jacket 120 while the arms 122 of an outlet manifold 123 extend from the jacket into communication with corresponding ends 55 of the coils 51 and 52.

The inlet pipe 121 carries a simple screw type cap 125 on its lower end. The cap 125 is removed when heating fluid is to be introduced. Any valve arrangement required for the introduction of steam, for example, is provided at the location where the stored liquid is to be transferred.

When a railway tank car 10, for example, has reached its destination in a relatively cold climate, carrying a liquid such as corn syrup or the like, the stored liquid must be heated to permit ready flow out of the drain valve unit 45. Accordingly, the cap 125 of the inlet pipe 121 is removed and a steam valve (not shown) is inserted. Steam is forced through the pipe 121 into the jacket 120 surrounding the stored liquid drain valve unit 45. The valve 45 is thus heated to assure the smooth and uninterrupted flow of stored liquid through the valve 45 when it is opened and, furthermore, melt any solidified or partially solidified liquid which might be locked in the valve unit. Steam passes through the manifold 123 into the inlet end 55 of the coils 51 and 52 and courses through the channel sections 65-68 and 70-73 (as well as the short channel sections 82, 90 and 95) to the outlet ends 58 of the coils.

The cooled steam and any condensate which might have accumulated is drawn off from the outlet ends 58 of the coils 51 and 52 through the outlet pipe unit 59, as has been pointed out. The outlet pipe unit 59 is manifolded and includes outwardly disposed arms 130 which extend into communication with the outlet ends 58 of the coils 51 and 52. A simple internally threaded cap 131 similar to the cap 125 herebefore discussed in relation to the inlet assembly 56 is provided on the depending leg 132 of the unit 59.

The advantages of the heating arrangement 59 embodying features of the present invention, as applied to a tank car 10, for example, should now be readily apparent. Ease of fabrication with concomitant savings in cost and construction time is paramount. The careful positioning of heating coil sections in a prescribed pattern with a large portion of the coils extending along lines passing through the imaginary vertices of cones defined in part by the frusto-conical sections of the tank makes its ease of fabrication possible.

While the embodiment described herein is at present considered to be preferred, it is understood that various modifications and improvements may be made therein, and it is intended to cover in the appended claims all such modifications and improvements as fall within the true spirit and scope of the invention.

What is claimed is:

1. A storage tank formed of opposed frusto-conical tank sections joined at their bases, the improvement comprising: a heating arrangement for the tank, said heating arrangement including coil means for carrying heating fluid secured to the outer surface of each tank section and arranged circumferentially thereof, said coil means having substantially straight coil sections disposed along straight lines on said tank section extending through the vertex of the cone defined in part by said tank section.

2. In a storage tank formed of opposed frusto-conical tank sections joined at their bases, the improvement comprising: a heating arrangement for the tank, said heating arrangement including coil means for carrying heating fluid secured to the outer surface of each tank section and arranged circumferentially thereof, said coil means having substantially straight coil sections disposed along straight lines on said tank section extending through the vertex of the cone defined in part by said tank section.

3. The improvement in storage tank of claim 2 further characterized in that said substantially straight coil sections embrace approximately one half of the total length of said coil means.

4. In a storage tank formed of opposed frusto-conical tank sections joined at their bases along the center line
of the tank, the improvement comprising: a heating arrangement for the tank, said heating arrangement including a serpentine coil for carrying heating fluid secured to the outer surface of said tank sections and arranged circumferentially thereof, said coil having a first series of coil sections on one of said tank sections and a second series of coil sections on the other of said tank sections, a plurality of said coil sections being disposed along straight lines on corresponding tank sections extending through the vertices of the cones defined in part by said tank sections.

5. The improvement in storage tank of claim 4 further characterized in that said first series of coil sections is joined to said second series of coil sections in fluid tight relationship on the center line of said tank.

6. The improvement in storage tank of claim 4 further characterized in that at least one-half of said coil sections are disposed along said straight lines.

7. In a storage tank formed of opposed frusto-conical tank sections joined at their bases substantially along the center line of the tank wherein a tank drain assembly is mounted on the tank on the bottom thereof at the center line, the improvement comprising: a heating arrangement for the tank, said heating arrangement including a first serpentine coil for carrying heating fluid secured to the outer surface of one side of said tank sections and arranged circumferentially of said tank, a second serpentine coil for carrying heating fluid secured to the outer surface of the other side of said tank sections and arranged circumferentially of said tank, said first and second coils each having a first series of coil sections on one of said tank sections and a second series of coil sections on the other of said tank sections, a plurality of said coil sections being disposed along straight lines on corresponding tank sections extending through the vertices of each cone defined in part by said tank sections.

8. The improvement in storage tank of claim 7 further characterized in that each of said first and second coils is connected to heating fluid inlet means secured to the bottom of the tank, said heating fluid inlet means forming heating enclosure means for said tank drain means.

9. The improvement in storage tank of claim 8 further characterized in that said first series of coil sections and said second series of coil sections in each of said coils are joined together on the center line of the tank.

10. In a storage tank formed of opposed frusto-conical tank sections joined at their bases, the improvement comprising: a heating arrangement for the tank, said heating arrangement including coil means for carrying heating fluids secured to the outer surface of a tank section and arranged circumferentially thereof, said coil means being fabricated of channel sections, said coil means having un twisted channel sections disposed along straight lines on said tank section extending through the vertex of the cone defined in part by said tank section.

11. A storage tank formed of opposed frusto-conical tank sections joined at their bases substantially along the center line of said tank, a heating arrangement on said tank, said heating arrangement including a first serpentine coil for carrying heating fluid secured to the outer surface of said tank sections and arranged circumferentially of said tank, a second serpentine coil for carrying heating fluid secured to the outer surface of said tank sections and arranged circumferentially of said tank, each of said coils having a first series of channel sections on one of said tank sections and a second series of channel sections on the other of said tank sections, a plurality of said channel sections being disposed substantially along straight lines on corresponding tank sections extending through the vertices of cones defined in part by said tank sections.

12. A storage tank formed of opposed frusto-conical tank sections joined at their bases substantially along the center line of said tank, a serpentine heating coil secured to the outer surface of said tank, said coil having a fluid inlet adjacent said center line on one tank section and a fluid outlet adjacent said center line on the other tank section, a plurality of said coil sections interconnected end to end between said inlet and said outlet, a plurality of said coil sections disposed along straight lines on corresponding tank sections extending through the vertices of the cones defined in part by said tank sections.

13. The storage tank of claim 12 further characterized in that each of said substantially straight coil sections comprises a channel member having a base web and depending legs, said depending legs being secured to said outer surface by welding or the like, the channel sections which define coil sections disposed along said straight lines being un twisted with their depending legs in engagement with the tank surface.

14. A railway tank car, comprising: a horizontally disposed tank formed of opposed frusto-conical tank sections joined at their bases substantially along the centerline of said tank, a tank drain assembly mounted on the bottom of the tank at said centerline, truck means supporting said tank at opposite ends thereof, and a heating arrangement for the tank, said heating arrangement including a first serpentine coil for carrying heating fluid secured to the outer surface of one side of said tank sections and arranged circumferentially of said tank, a second serpentine coil for carrying heating fluid secured to the outer surface of the other side of said tank sections and arranged circumferentially of said tank, said first and second coils each having a first series of coil sections on one of said tank sections and a second series of coil sections on the other of said tank sections, a plurality of said coil sections being disposed along straight lines on corresponding tank sections extending through the vertices of each cone defined in part by said tank sections, said heating fluid inlet means forming heating enclosure means for said tank drain means.

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