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INSULATED TANK CAR

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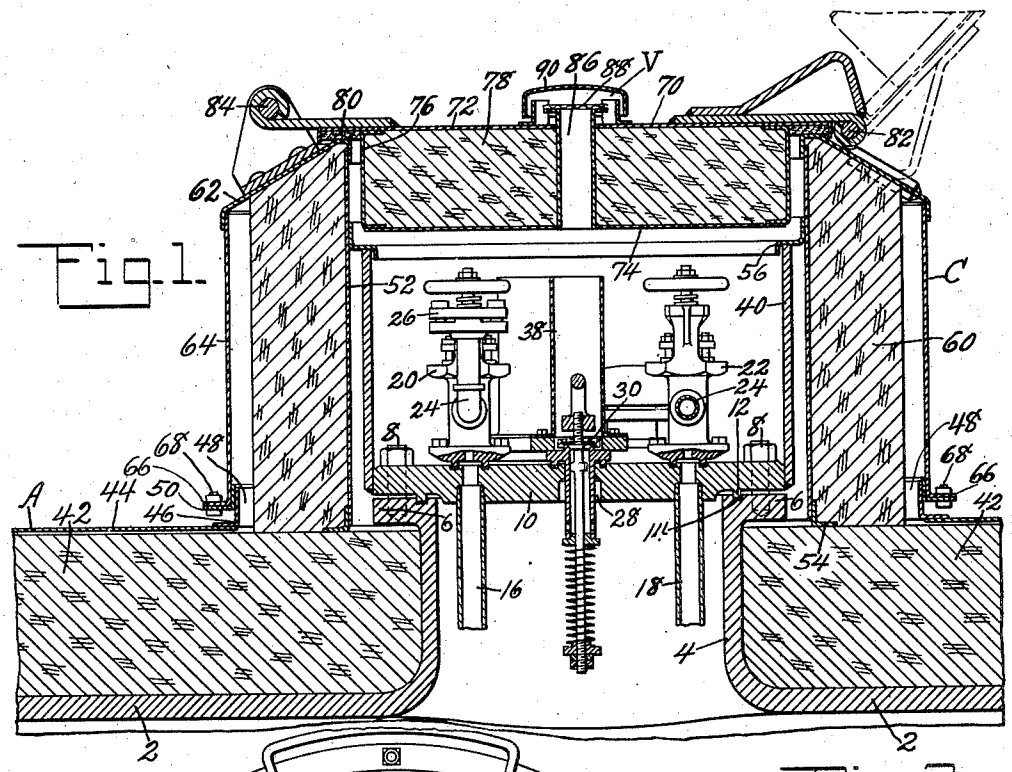

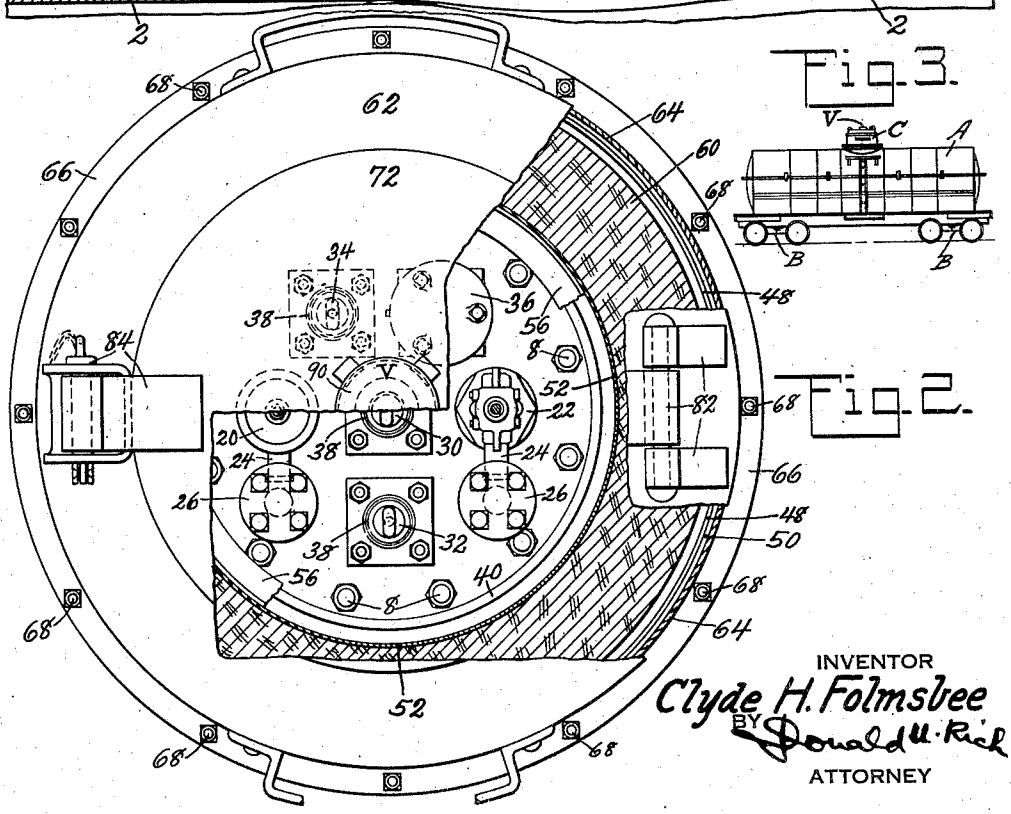

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INSULATED TANK CAR

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8 Claims. (Cl. 62—1)

This invention relates to tank cars in general and in particular to insulated tank cars of the relatively low pressure type for the transmission of liquified gases.

In the past liquified or highly compressed gases have been transported in comparatively small containers of extremely heavy construction capable of withstanding the extreme pressure of the gas regardless of the outside or atmospheric temperature. In certain rare instances large containers for transport of liquified gases or highly compressed gases under the same conditions have been built but such containers in order to comply with I. C. C. regulations must be forged from a single billet. These large containers are extremely expensive to manufacture and of enormous weight, in most instances having steel walls two to three inches thick but in some cases the walls are five to six inches in thickness. It has also been proposed to transport liquified gases in insulated structures whose cost may be but a fraction of the cost of the forged structures, but all of these insulated structures heretofore built have required an excessive wastage of lading in order to maintain the lading at the necessary low temperature to prevent bursting of the container shell. It is an object, therefore, of the present invention to provide a wholly insulated tank car in which liquified gases may be transported for comparatively long periods of time without any loss of lading and with a very slight increase in temperature, in other words, with a minimum loss of energy.

A further object of the invention is the provision of a wholly insulated tank car of the medium pressure type complying fully with I. C. C. regulations and in which all metallic paths for heat loss from the tank shell are reduced to a minimum with the paths of small cross section and great length.

Another object of the invention is the provision of a wholly insulated tank car with a fully insulated dome-like structure protecting all nozzle fittings against heat losses.

These and other objects of the invention will be apparent to persons skilled in the art from a study of the following description and accompanying drawing, in which

Figure 1 is a longitudinal central sectional view taken through the nozzle and dome-like structure;

Fig. 2 is a plan view of the dome-like structure with parts thereof broken away to better disclose the interior construction, and

Fig. 3 is a diagrammatic view of the complete tank car having the improved construction.

Referring now to the drawing in detail, it will be seen that the tank A is supported upon trucks B of the customary type and that the tank has formed thereon a dome-like structure C. The tank itself is formed, as clearly shown in Figure 1, of a comparatively heavy shell 2 completely closed except for a nozzle 4, which projects upwardly from the shell of the tank as clearly shown in Figure 1. This nozzle or opening terminates in laterally projecting flanges 6 drilled and tapped to receive stud bolts 8, by means of which a nozzle cover or lid 10 may be removably fastened in place. This cover or lid is provided with a projecting rib 12 adapted to fit in a machined groove 14 formed in the nozzle flange, thus forming a tight joint and preventing any leakage of pressure from the tank interior. The lid or cover is drilled and tapped to receive induction and eduction pipes 16 and 18 respectively and above which are securely fastened inlet and outlet valves 20 and 22 respectively. The exterior connection to these valves is made through pipes 24 extending upwardly parallel to the valve stem in spaced relation thereto and terminating in a discharge connection normally capped by a plate or other means 26. In this manner a ready connection for charging or discharging the tank may be made and any leakage past the valve seat becomes impossible when the cap is in place. The cover or lid also is provided with any suitable number of openings 28 in which safety valves may be inserted. In the present instance there are three of these openings and three safety valves indicated at 30, 32 and 34 respectively. These valves are of substantially identical construction and are set to open at various pressures. For example, valve 30 may be set to open at 300 pounds per square inch, valve 32 at 340 pounds pressure and valve 34 at 375 pounds pressure. In addition to these valves and as an added safety feature an approved safety vent 36 is provided and is of the type having a frangible disc designed to rupture at not more than 450 pounds pressure, thus positively protecting the tank shell against rupture. The form of the safety valves is immaterial but they are preferably of the type shown and which are fully disclosed in Willoughby Patent 1,774,690. In order to direct the escaping gases from the safety valves short vertically extending pipes 38 are provided secured to the valve structure and extending upwardly a sufficient distance as to direct

the escaping gases upwardly and away from the charging and discharging valves.

In order to protect the various valve structures as comparatively heavy open ended cylinder **40** is provided, having its lower edge welded or otherwise secured to the nozzle lid or cover and removable therewith. This cylindrical protecting member is of sufficient height as to project slightly above the various valve structures.

The entire tank shell **2** is covered by means of insulation **42** which, in the present case, comprises cork of 10 inch thickness. This insulation is protected against entrance of moisture and destruction by means of a protecting steel housing **44** completely encasing the tank insulation except for a small area adjacent the nozzle. The opening in the outer shell adjacent the nozzle has attached thereto, as by spot welding or similar means, an angle shaped structure **46** having an upstanding flange **48** to which is in turn attached a second angular structure having one leg parallel to leg **48** and secured thereto, while the other leg **50** is directed outwardly substantially parallel to the protective casing of the tank, thus in effect a ledge and upstanding flange is provided extending completely around the opening in the outer protective casing.

In order to fully insulate the tank nozzle cover or lid together with its valve structures, an inner cylindrical casing **52** is provided having attached thereto at its lower edge an angle form member **54** adapted to rest lightly on the tank insulation. This cylindrical inner casing is provided intermediate its length with an inner Z form ring **56** having one leg rigidly secured to the casing and with the other leg disposed inside of the protective cylinder **40**, with the web of the Z shaped ring resting upon the upper edge of the protective housing and supporting the protective inner casing **52**. The inner casing forms a base around which cork or similar insulation **60** may be fitted with the lower edge supported by angle structure **54** and by the insulation of the tank. This insulation is completely housed and protected by means of a top ring structure **62** of substantially inverted channel form attached to an outer casing **64**, having its lower edge terminating in an outwardly directed flange **66** adapted to rest upon and be bolted as at **68** to the flange **50** of the tank protective structure, thus it will be seen that by removal of the bolts or other securing means **68** the entire protective dome like structure may be lifted off of the tank without disturbing the insulation.

In order to close the upper end of the dome like insulating housing, a lid **70** is provided formed on a top plate **72**, bottom plate **74** and ring like connected channel form side structure **76**, thus inclosing a space which may be filled with insulation **78**. As clearly shown, the top plate of the lid overlaps the upper member **62** of the housing and metallic contact between the lid and housing is broken by means of an insulating gasket **80** which also will prevent any leakage of air or gas from the housing. The lid may be directly removable or, as in the present case, it may be hinged as at **82** to the dome like housing and secured in place by locking and sealing means **84**. Since the insulated dome like structure is substantially air tight, it is necessary to vent the same and this is accomplished by means of a high level vent V formed by a pipe **86** extending through the lid and capped by means of a screen **88** and a metallic cap **90**, all of which will prevent entrance of moisture or foreign matter into the interior of the insulated dome like structure while permitting escape of gases liberated by the safety valves. It will be seen that the only direct metallic path for conducting heat from the tank structure to the outside air is established by cylindrical casing **40**, ring **56** and the upper part of inner casing **52**. This path, of course, can be broken if desired by means of a gasket inserted between ring **56** and the upper edge of cylindrical housing **40** but the use of such a gasket is not deemed necessary since the entire cavity in which the valves are located will be at an extremely low temperature. Additional metallic paths formed by the vent pipe and by the sides of the lid are also established between the cavity to the dome like structure and the atmosphere but these paths are of small cross section and comparatively great length and can only transmit heat from the atmosphere to the cavity and not to the tank shell and the rate of transfer will be extremely slow since in many instances, such as with CO_2 gas, the cavity may be considered as filled with a fairly good insulator. It has been found that six inches of cork, or equivalent insulation, is sufficient to economically insulate the dome like structure.

It is believed from the preceding description that the advantages of the construction will be apparent, but these advantages may be better realized from a study of the following: A tank car constructed with ten inches of cork insulation and with the steel nozzle cover and valve fittings exposed when loaded with 60,000 pounds of carbon dioxide at 0° F. and with an outside temperature of 100° will transmit through the cork 2148 B. t. u.'s per hour and through the tank anchors 1260 B. t. u.'s per hour, making a total through the cork and anchors of 3408 B. t. u.'s per hour. The losses through the steel nozzle cover and valve fittings with a 20 inch diameter cover amounts to 30,485 B. t. u.'s per hour, giving a total loss for the entire tank of 33,893 B. t. u.'s with a hundred degree temperature differential; in other words, approximately ten-elevenths of the total losses are through the nozzle cover and fittings. To prevent the lading from developing an excessive pressure, its temperature should not exceed 2° F. and to maintain this low temperature would require the escape of 282 pounds of liquid CO_2 per hour and, further, this loss would begin in 3 hours and 40 minutes after the lading was placed in the tank at 0° F.

When, however, the nozzle and valve fittings are insulated as shown and described the total losses through the insulated dome assembly are only 287 B. t. u.'s per hour. In other words, a saving of over 30,000 B. t. u.'s per hour has been made and the losses through the insulated dome like structure are only approximately one-ninth of the total loss of the tank which is now 3695 B. t. u.'s per hour. To offset this loss and prevent temperature raise beyond 2° F. would require only 30 and $\frac{7}{10}$ pounds of liquid CO_2 per hour and, furthermore, this loss would not begin until nearly 34 hours after the car was loaded with 60,000 pounds of liquid at 0° F. As was previously pointed out, the safety valve **30** is set to operate at 301 pounds pressure, which is the pressure at which liquefied CO_2 at 2° F. must be retained.

By comparison it will be seen that a very great saving is accomplished through the proper insulation of the nozzle and valve fittings and that with the structure shown and described it will

in many cases be possible to transmit liquefied CO_2 in the neighborhood of a thousand miles without any loss of liquid gas whatsoever occurring, in other words, before the temperature of the lading has risen 2° F. It will likewise be seen that there is approximately 30 hours difference in time between a wholly insulated and a partially insulated tank before losses occur and these thirty hours would represent the loss of nearly two tons of liquid or, in other words, one-fifteenth of the lading from the partially insulated tank.

While the invention has been described more or less in detail and with particular emphasis on the transportation of liquid CO_2, it will be obvious to persons skilled in the art that various modifications and rearrangements may be made and that the construction is equally applicable to transportation of liquids or gases other than CO_2 and all modifications and rearrangements of parts and uses of the structure are contemplated as will fall within the scope of the appended claims which define my invention.

What is claimed is:

1. In a railway car tank for the low temperature transportation of liquid lading under pressure, a pressure retaining body, body insulation covering the body, nozzle means carried by said body and projecting through said body insulation, a cover plate for said nozzle, control valves for the liquid lading carried by said cover plate, and an insulated dome-like structure completely covering said control valves and nozzle and substantially preventing heat losses therefrom, said dome-like structure being supported at least in part upon said cover plate by relatively thin metal means.

2. In a railway car tank for the low temperature transportation of liquid lading under pressure, a pressure retaining body, body insulation covering the body, nozzle means carried by said body and projecting through said body insulation, protective means covering said insulation and terminating in spaced relation to said nozzle means, and an insulated dome-like structure secured to said protective means and completely housing said nozzle means to thereby substantially prevent heat losses therefrom, said dome-like structure being supported at least in part upon the nozzle structure but free of connection thereto whereby movements of the protective housing will not be transmitted to the nozzle structure.

3. In a railway car tank for the low temperature transportation of liquid lading under pressure, a pressure retaining body having a nozzle projecting outwardly therefrom, body insulation covering the entire body to a depth substantially equal to the nozzle projection, a lid secured to said nozzle, control valves for the liquid lading secured to the lid, protective means secured to said lid and extending upwardly therefrom, and a dome-like structure supported on said protective means and completely housing said lid, control valves and protective means, said dome-like structure being fully insulated to prevent loss of heat from the control valves and lid.

4. In a railway car tank for the low temperature transportation of liquid lading under pressure, a pressure retaining body having a nozzle projecting outwardly therefrom, body insulation covering the entire body to a depth substantially equal to the nozzle projection, a lid secured to said nozzle, control valves for the liquid lading secured to the lid, protective casing secured to said lid and extending upwardly therefrom, and a dome-like structure supported on said protective casing and completely housing said lid, control valves and protective casing, said dome-like structure being fully insulated to prevent loss of heat from the control valves and lid, and said dome-like structure being formed with a hinged cover permitting access to the control valves.

5. In a railway car tank for the low temperature transportation of liquid lading under pressure, a pressure retaining body, body insulation covering the body, nozzle means carried by said body and projecting through said body insulation, and a dome-like structure completely covering said nozzle means to substantially prevent heat loss therefrom, said structure comprising an inner casing supported on said nozzle structure in spaced relation thereto, insulation covering said inner casing, an outer casing connected to said inner casing and protecting said insulation, and a movable insulated lid carried by said casings.

6. In a railway tank car including a body, insulation covering said body, a nozzle carried by said body and extending through said insulation, a cover plate for sealing said nozzle, control valves carried by said cover plate, a protective casing enclosing said control valves and carried by said cover plate, an insulated covering enclosing said casing and spaced therefrom, said insulated covering being supported in direct contact with the insulation of said car body, and a closure for said insulated covering adapted in its closed position to overlie said protective casing in substantially axial alignment.

7. In a railway tank car including a tank body having an insulated covering, a nozzle extending from said body through said covering, a cover plate for said nozzle, control valves carried by said cover plate, a protective casing fixed to the marginal edge of said cover plate and enclosing said control valves, an insulated cover including a closure member enclosing said protective casing, said insulated cover forming a unit removably connected to the car body structure, and said closure member being adapted to immediately overlie said protective casing.

8. In a railway tank car including a body having an insulated covering and a nozzle, a plate for sealing said nozzle, control valves carried by said plate, a wall member fixed to the plate and extending about said control valves, and a dome-like structure formed of relatively thick insulating material and including a removable wall portion arranged about said wall member and being detachably connected to the car body for removal as a unit.

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