Sept. 4, 1962 J. J. HENRY 3,052,203

SHIP AND TANK THEREON

Filed Nov. 29, 1957 2 Sheets-Sheet 1

Fig. 1

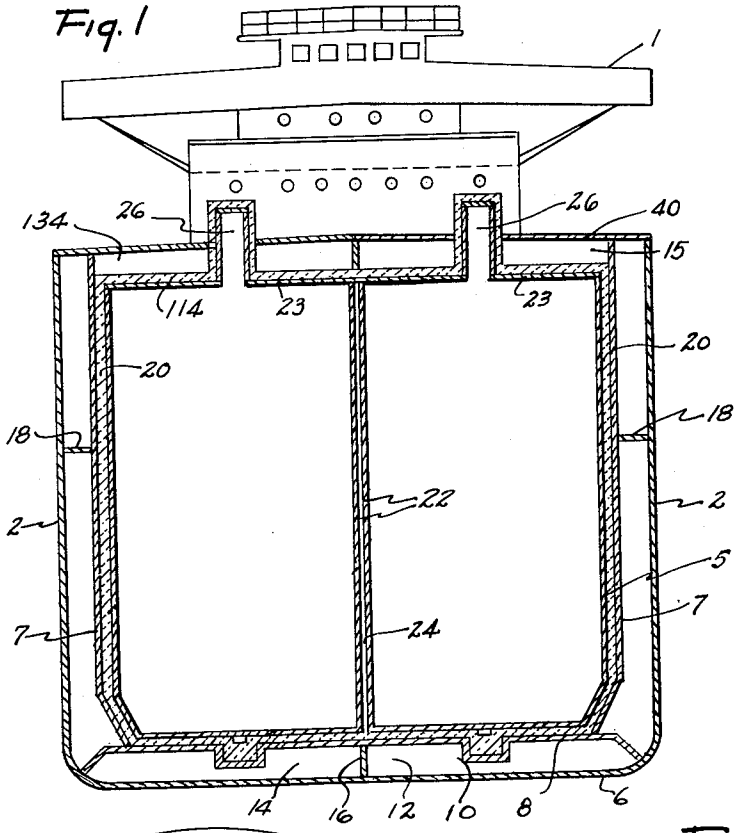


Fig. 2

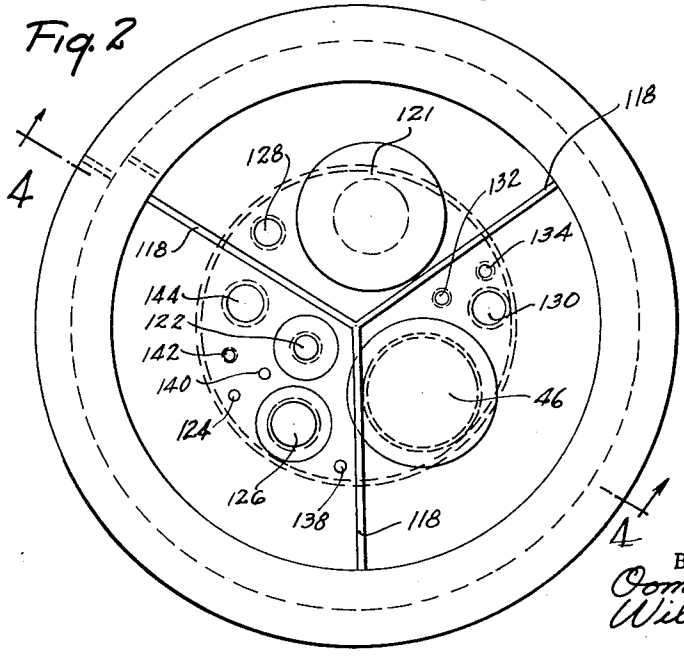
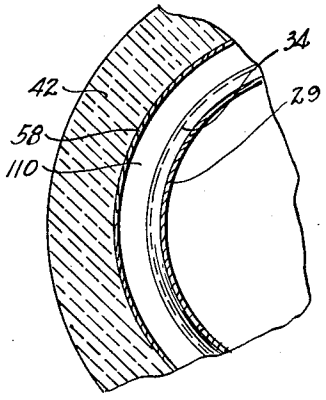


Fig. 3



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Fig. 4

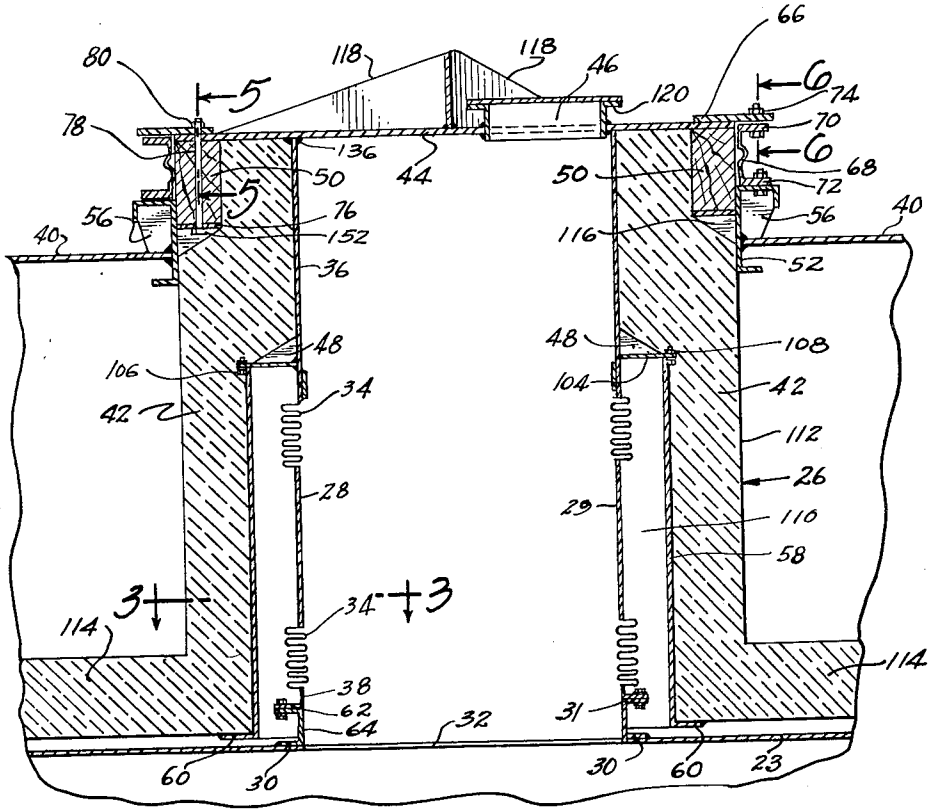


Fig. 5

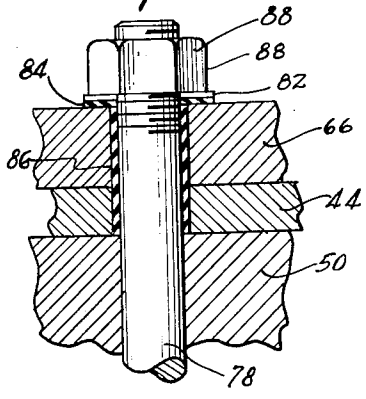
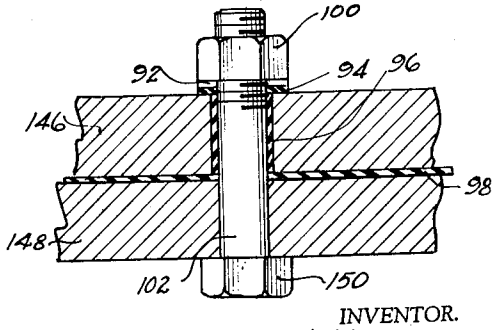


Fig. 6



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3,052,203

SHIP AND TANK THEREON

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Filed Nov. 29, 1957, Ser. No. 699,565
7 Claims. (Cl. 114—74)

This invention relates to an expansible tank dome for a vessel adapted to receive and transport liquids at temperatures of extreme cold.

This application is a continuation-in-part of my copending application Serial No. 582,965, filed on May 7, 1956, entitled "Ship." The present invention belongs to a proliferating art which has responded to an industrial need for means of transporting liquefied gases over long distances, especially over the waterways of the world.

While the invention disclosed and claimed in this application is suitable for use on vessels adapted to transport many different types of liquids refrigerated to extreme cold, the present invention and that disclosed in the parent application will be discussed with specific reference to the transportation of liquefied natural gas or substantially pure methane. Methane exists in a liquid state at substantially atmospheric pressure when maintained at temperatures of —258° F. or below. It will also be observed that although the invention is herein specifically described in relation to vessels for nautical transport, the tanks and their associated domes may also be adapted to other forms of transport, such as railroad tank cars, motor vehicle tankers, or conceivably, aircraft tankers.

It will be helpful to indicate briefly the contemporary economic need which instigated this invention. It is generally known that, in some areas of the United States and in some areas of the world, natural gas suitable for industrial use as heat in the generation of power or methane in the petro-chemical industry are available in abundant supply; in others, such gas is in such scant supply as to be economically prohibitive.

For example, methane is often associated with the production of petroleum. In oil-producing regions, like North and South America and the Gulf States of North American, methane is produced in greater quantities than can be readily utilized in the immediate vicinities of production. Without a practicable method of transporting the excess production of methane in such areas, much of the methane gas is necessarily wasted. In the meantime, other areas, such as the Northeastern or Midwestern United States, the Western European countries, and Japan, which are not so generously endowed with mineral resources, are in acute need of methane and similar gases and power for space heating, power, chemical synthesis and other industrial purposes.

With the development of techniques for liquefying methane and similar gases, it has become possible to save excess production of such gases in areas of plentiful supply and economically to direct and transport such excess production to areas where a deficiency of fuel exists. Methane can thus be reduced to less than 1/600 of its original volume when liquefied for economical transportation in large volume in a liquefied state to distant stations.

However, at atmospheric pressure, methane can be maintained in the liquid state at temperatures only of —258° F. or below. This fact raises certain critical problems in connection with the storage and transportation of liquid methane and like gases. The tanks or chambers in which such gases are stored or transported must be sufficiently sealed and insulated as to prevent or control evaporation because of heat penetrating thereto from the environment, and precautions must be taken to prevent that portion of the gas which does evaporate from combining with the ambient air and moisture into combustible

mixtures. The serious consequences of permitting such combustible mixtures to occur, presenting the danger of an explosion at sea or elsewhere, are too obvious as to require elaboration.

I have previously taught the construction of a ship especially adapted for the transportation of such liquefied gases. Since the present invention relates particularly to the cargo tanks of such a ship, it will be necessary to give only a very brief description of the ship as a whole as disclosed in the parent application hereto.

In brief, such a ship comprises a plurality of tanks fabricated of material capable of resisting deterioration within a wide range of temperature (such as aluminum), and insulated to minimize the transfer of heat from the ambient atmosphere to the cold boiling liquefied gas to minimize the evaporation thereof and to prevent the penetration of cold from the gas to the ship's hull to cause embrittlement thereof. Each of the tanks is equipped with a dome communicating with the interior of the tank through an opening in the roof of the tank. Because of the necessity of maintaining liquefied gases at temperatures and pressures below those at which evaporation occurs, it is essential that the tanks and their domes be sealed as effectively as possible against the entrance of ambient air, water, and other foreign matter. Such sealing is also essential to obviate, for safety purposes, the commingling of methane and foreign matter, such as water, into combustible mixtures.

Furthermore, the tanks, fabricated of aluminum, aluminum alloy, or other suitable metals, are susceptible to a considerable range of expansion and contraction. Because of the variations in temperature to which they may be submitted, such expansion and contraction necessarily cause the tank to move in relation to the overlying deck of the ship during normal operation of the ship. The amount of relative movement is considerable when, after the tank is installed at ambient temperature, it is cooled down to a temperature of about —258° F. upon the introduction of the liquefied natural gas. Tanks of the dimension contemplated in ship construction for transportation of liquefied natural gas may contract as much as 3 to 4 inches upon cooling down and expand an equivalent amount upon heating up. Where the dome of the tank is rigidly connected to the tank and protrudes upwardly through the deck of the ship, some accommodation must be provided to enable such expansion and contraction of the tank relative to the deck and other framework of the ship.

Consequently, one objective of the present invention is to produce a tank structure of the type described for the safe and economical transportation of a low boiling liquefied gas such as methane or natural gas, and it is a related object to produce a tank having a dome structure which permits expansion and contraction of the tank and elements associated therewith relative to the deck and ship without loss of stability of the tank, without depreciating the sealing relation between the tank and ship, and without introducing stresses in the tank or ship sufficient to interfere with the safe operation thereof.

Another objective is to provide a tank dome around which a layer of insulating material may be built up so that the insulating material may remain in a predetermined relation to the tank.

A further objective of the invention is to provide a tank dome whose weight can be supported from the deck of the ship rather than the roof of the tank.

A still further objective is to provide a dome, as previously described, which is sufficiently sealed to prevent the admission of air, water, and other foreign matter.

Still another objective of the invention is to provide a dome sufficiently sealed so as to enable the circulation within the dome of inert gas for the purpose of reducing

the condensation of moisture and thus reducing the likelihood of accumulation of combustible mixtures.

Other objectives of the invention will appear herein. To achieve the foregoing objections, the invention comprises the features hereinafter set forth in the specification and pointed out in the claims. The specification and claims set forth in detail one particular embodiment of the invention; however, the principles of the invention may be employed in other forms, and the rights to all forms equivalent to that shown in the drawings and described in the specification are reserved.

In the appended drawings—

FIG. 1 is a sectional view of a ship equipped with tanks adapted to transportation of liquefied gases at temperatures of extreme cold, the view being taken in a plane transverse to the longitudinal axis of the ship;

FIG. 2 is a plan view of a form of construction of the dome for one of the storage tanks;

FIG. 3 is a fragmentary sectional view of the tank dome taken along the line 3—3 of FIGURE 4;

FIG. 4 is a sectional view in elevation, taken along the line 4—4 in FIG. 2, of a dome suitable for use in association with the type of storage tank under consideration;

FIG. 5 is a fragmentary sectional view in elevation of the connection between the dome structures and its housing, taken along the line 5—5 in FIG. 4, and

FIG. 6 is a fragmentary sectional view in elevation of another connection between the dome and its housing, taken along the line 6—6 in FIG. 4.

Referring now more particularly to the drawings, FIG. 1 shows a ship (generally designated 1), having a plurality of tanks (generally designated 22) adapted to receive and store liquefied gases for transportation. The tanks 22 may be fabricated of aluminum or alloys which can resist structural damage or decomposition over a wide range of temperatures, more particularly for example, from at least approximately −258° F. to 120° F. (the minimal range of temperatures to which the tanks may be expected to be submitted in the transportation of liquefied natural gases).

Since the construction of such a ship is set forth in detail in the parent application thereto, it will be sufficient to give only a cursory description of the ship as a whole. The ship comprises an outer skin or hull 2 and an inner skin or hull 7 spaced a short distance from the outer hull to provide an open space therebetween. The space 10 between the ship's bottom 6 and the adjacent inner hull 8 is subdivided by girders 16 into ballast tanks 12 and 14 through which water can be circulated for balancing the ship and for conducting heat or cold away from the inner and outer walls of the ship. The space 10 can be further subdivided by means of cofferdams (not shown) disposed transversely to the longitudinal axis of the ship 1.

The hold space 15 defined by the inner hull of the ship and the top deck 40 is usually subdivided by one or more cofferdams extending crosswise of the ship to provide a number of separated compartments spaced lengthwise of the ship. The walls of the compartments are lined with a thick layer 20 of an insulating material of low heat conductivity, and preferably of high structural strength sufficient to support the load of tanks 22 fitted in side by side relation within each of the hold spaces but out of contact one with the other to permit lateral expansion and contraction movements without building up a stressed relation therebetween. It is possible to fit the hold space with a single tank but it is preferred to make use of a number of tanks preferably of rectangular shape for most efficient utilization of the hold space. The layer of insulation built up on the walls of each compartment can thus be used to minimize heat transfer into the hold space. A suitable insulation material with sufficient structural strength can be built up from planks of balsa wood or the like insulating material. This layer of insulating material 20 disposed adjacent to the outer sides of the tanks 22 may extend to the tank roof 23 and overlie the tank roof 23 as at 114. The ship deck overlies the tanks 22, defining therebetween an open space 134 wherein the tanks 22 may move as they contract and expand in response to temperature change.

The tanks 22 are provided with domes (generally designated in FIG. 1 by the numeral 26 and shown in detail in FIG. 4) communicating with the interior of the tanks 22 through an opening 32 in the roof 23 thereof and extending upwardly and through the deck 40.

Referring now to FIGURE 4, the dome structure 26 is formed in part of a cylindrical section 28 having an annular flange 62 at the lower end for attachment, as by bolt members, to a corresponding flange 31 on the upper end of the annular rim 64 fixed in sealing relationship to the tank about the opening 32 in the top wall of the tank. Intermediate its ends, the cylindrical section is provided with at least one and preferably a plurality of axially spaced apart circumferential corrugation 34 which permits change in the lengthwise dimension of the cylindrical section. Thus, the upper end of the cylindrical section can be fixed to the deck of the ship while the other end is fixed to the top wall of the tank while enabling changes to occur in the vertical dimension of the tank responsive to expansions and contractions taking place in the metal walls of the tank due to temperature change. Such changes in the dimension of the tank will be compensated by inverse changes in the dimension of the cylindrical section joining the tank to the deck for support.

A brace plate 104 encircles the outer face of the cylindrical section 28 and extends outwardly substantially perpendicularly therefrom, whereby to provide lateral support. The brace plate may be fastened to the outer wall of the cylindrical section 28 by welding and may be of stainless steel. Bracket members 48 may be seated on the brace plate 104 at spaced intervals thereof to provide additional lateral support to the cylindrical section 28—for example, a bracket may be positioned at every interval of 30 degrees. Throughout the length of that portion of the cylindrical section 28 which includes the corrugations 34, an encasing cylinder 58 encircles the cylindrical section 28. The encasing cylinder 58 of aluminum or other material capable of withstanding wide variation of temperature is provided at its lower end with a foot portion 60 extending perpendicularly therefrom away from the cylindrical section 28 and at its upper end with an annular flange 106 joined to the brace plate 104, as by bolt and nut means. The foot portion 60 underlies the insulation 42, hereinafter described, and gives support thereto.

The encasing cylinder 58 and the concentric cylindrical section 28 define therebetween an open space 110 wherein to house the corrugations or folds 34 in various conditions of expansion or contraction. A layer of insulation material 42 is disposed between the outer wall or housing 112 of the dome on the one side, and the encasing cylinder 58 and the cylindrical section 28 itself on the other side. Since the encasing cylinder 58 is secured to the bracing member 104 and suspended therefrom, and the bracing member 104 is in turn welded to the upper portion 36 of the dome cylinder 28, that portion of the insulation 114 overlying the tank 22 is supported from above and none from tank roof 23. As FIGS. 1 and 4 most clearly show, the layer of insulation 42 built up around the periphery of the cylindrical section 28 and the encasing cylinder 58 is substantially a continuation of the layer of insulation 114 which overlies the storage tank 22 and extends around the tanks as at 20.

The upper end of the cylindrical section 28 is closed by means of a cover plate 44 dimensioned to have a diameter substantially equal to that of the outer wall 112 of the dome 26. Extending around the opening in the deck 40 through which the dome projects, is an annular member generally indicated at 52, which is of substantially

U-shaped cross-section and may be welded to the deck plate and may serve as a coaming. Around the periphery of the member **52** near its upper edge and secured thereto as by welding, is an annular plate or platform **76** which is provided with reinforcing brackets **116** at spaced points, such as every 30 degrees, around the inner periphery of the member **52**. Stiffeners **56**, seated on the deck **40** and abutting the central portion of the member **52**, and embraced by the upper portion thereof, may be spaced at intervals, such as every 60 degrees, around the outer wall **112** of the dome structure.

Seated upon the platform **76** is an annular block of wood **50**, such as cypress, which is held in place by that portion of the annular member **52** which extends above the level of the platform **76**. Resting on top of the annular wood block **50** is the cover plate **44** which is substantially flat but is provided with radially extending, upstanding ribs **118** thereon and most clearly illustrated in FIG. 2. The upstanding ribs **118** provide strength and support for the cover plate **44**. To this cover plate **44**, the uppermost portion **36** of the dome cylinder **26** may be welded as at **136**.

Fastened to the periphery of the cover plate **44** is an annular suspending ring **66** of stainless steel which projects radially outwardly of the edge of the cover plate **44** and is thus in overlying relation with the upper leg of the member **52**. Interposed between the thus projecting upper edge of the suspending ring **66** and the upper leg of the member **52** is a U-shaped stainless steel channel, generally indicated at **68**, which has its opposite legs bolted to the members **44** and the upper leg of the member **52** respectively, and intermediately of its end is provided with corrugations to permit flexure as such may occur due to stresses imposed either by load or by ambient temperature changes. The plate **44** is held on the dome by means of circumferentially spaced bolts **78**, preferably formed of stainless steel.

Thus it is seen that in this arrangement, substantially the entire weight or burden of the dome cylinder **26**, the encasing cylinder **58**, and the insulation **114** may be carried by the cover plate **44**, and the tension exerted thereby is distributed therethrough to the annular wood frame member **50**, the platform **76**, the annular U-shaped member **52**, to the deck **40**. As a result, it will be observed that the upper end of the dome is rigid with the deck and incapable of relative movement.

It has previously been observed in this specification that methane can be maintained in a liquid state only at temperatures of approximately —258° F. and below at atmospheric pressure. It therefore becomes important to minimize the penetration of heat into the cargo and to maintain the pressure within the tank **22** and the dome cylinder **28** at a pressure substantially atomspheric. Consequently, at those points where bolt connections are required, these connecting assemblies have been specially designed to effect a sealing relation and to retard the migration of heat or cold through the dome structure, as illustrated in FIG. 4, as between the suspending plate **66** and the upper leg **70** of the stainless steel channel **68**; between the lower leg **72** of the member **68** and the upper extremity of the annular U-shaped member **52**; between the platform **104** and the upper flange **106** of the encasing cylinder **58** (as at **108**); and between the upper radial flange **31** of the member **64** and the flange **62** of the cylinder **28**.

In general, as illustrated in FIG. 6, the hole through the members to be secured together, such as **146** and **148**, will be slightly larger than the threaded shank or stem **102** of the bolt. Surrounding the shank **102** is a bushing **96** of suitable insulating material such as micarta or phenolic resin. The bolt is provided with a mating capscew **150** and a mating nut **100**. Interposed between the nut **100** and the member **146** are a steel washer **92** and a washer **94** of micarta or other suitable insulating material, the steel washer being uppermost. Interposed

between the members to be secured is a gasket **98** of the same material as the bushing **96**. The insulating members—the washer **94**, bushing **96**, and gasket **98**—thus provide a snug, sealing connection and retard the migration of cold from one metal member (such as **146** and **148**) to another, and reduce the hazard of penetration of heat to the refrigerated cargo.

The same principle is applied in the connection, generally designated **80**, between the suspending plate **66** and the cover plate **44**, shown in detail in FIG. 5. The stainless steel bolt **78** extends through openings slightly wider in diameter in the plate **66**, the cover **44**, the annular wooden frame member **50**, and the platform **76**, being secured at its lower extremity against axial movement by a capscrew **152** positioned in an abutting relationship against the lower face of the platform **76**. Throughout that portion of the bolt **78** extending through the members **44** and **66**, the bolt **78** is surrounded by an insulating bushing **86** of micarta or the like. Seated between the nut **88** and the member **66** are the steel washer **82** and the insulating washer **84**, the insulating washer **84** being lowermost.

The sealing relation achieved by the bolt and nut connections previously described not only serves to retain within the cavity of the dome cylinder **28** all vapors resulting from evaporation of the liquid cargo (which may, if desired, be relieved through the opening **128**, reliquefied and returned to the tank through the opening **132**), but also prevents or retards the penetration of moisture and other foreign matter into the dome cylinder **28** and the tank **22**.

Since relative movement between the deck **40** and the tank **22**, resulting from contraction and expansion is accommodated in the flexible corrugations **34** of the dome cylinder **28**, the upper portion of the dome can be rigidly secured to the deck of the ship to be carried by the deck. Pumps and other attachments for the control of fluids and gases into and out of the tank can thus be mounted on the deck thereby to relieve the load when the dome is constructed for movement independent of the deck and therefore adapted to support such fluid handling means. When supported by the deck, the insulating material about the dome can be constructed as stationary elements supported by the top of the dome or ship deck as distinguished from movement with the tank and corrugated portions of the dome. Such stationary construction enables an inert gas to be circulated through the porous insulating material and the space **134** between the deck **40** and the tank **22** to control the atmosphere within that area and generally maintain inert conditions about the tank **22**, the dome **26**, and its attachments. Maintenance of an inert atmosphere within the confined space about the dome and the tank prevents the entrance of moisture which would condense under the cold conditions existing. If such condensation of moisture were allowed continuously to take place, the frozen moisture would interfere with the operation of the equipment. It could lead to the more rapid deterioration of materials and it would, of certainty, reduce the thermal insulating characteristics.

In FIG. 2 are shown the various openings provided in the plate **44** overlying the cylindrical section **28**. With particular reference to FIG. 2, **46** is a manhole formed with a flange **120** attachment of a manhole cover and having a diameter of approximately 18 inches through which the interior of the tank may be inspected and repairs effected, or through which access may be had to the interior of the tank for introduction or removal of process equipment, instrumentalities, insulation or the like.

121 is the opening provided for the lowering into the tank of a deep well pump which will generally rest on the bottom of the tank by which the cargo in the tank may be evacuated. **122** is an opening to accommodate an instrument which will indicate the liquid level in the tank. **124** designates the provision of means for supporting the control by which the deep well pump may be turned on

and off. **126** denotes an opening to which a vapor relief line may be connected in order to insure, as previously indicated, that the pressure within the tank is always substantially atmospheric.

128 denotes an opening through which the vapor generated in the tank because of penetration of heat into the cargo will be carried off either to be used as fuel in the engine propelling the ship. **130** denotes the connection by which the inflow conduit for filling the tank may be connected to the manhole so that the liquid cargo would be charged into the tank at this point. **132** denotes the opening through which vapors which have escaped from the cargo through the reliquefaction outlet **128** and consequently reliquefied may be returned to the cargo space.

134 designates an opening through which refrigerated air or liquid may be charged into the tank for the purpose of cooling down the tank before the introduction of refrigerated liquefied gas, or for the purpose of maintaining the reliquefied gas, once charged, at a temperature below that at which the gas will evaporate. Other openings include a level indicator opening **140**, an opening **142** for a vapor connection to an emergency pump, and a vapor outlet **144**. It will be understood that the openings pattern in the cover forms no part of the inventive concepts described and claimed and that more or less openings may be provided for various purposes.

It will be apparent from the foregoing that I have provided a tank construction for use in the storage or transportation of a cold boiling liquefied gas wherein the tank is supported within a confined space and which is fitted with a dome having one portion rigid with the supporting framework in which the tank is confined while another portion is rigid with the tank with means in between in the trunk for enabling the tank to expand and contract relative to the framework while the tank remains in a predetermined position at rest in the confined space. Thus the tank is relieved of the load of the trunk and elements otherwise carried by the trunk to reduce the stresses existing in use while enabling free expansion and contraction movements to take place in the tank without buildup of stresses or strain or interference with the assembled relation or proper location of the tank.

It will be evident further that I have provided a tank with an associated tank structure adapted to receive and transport liquefied gases in conditions of extreme cold at atmospheric pressures; to promote the maintenance of refrigerated conditions within the tank and dome; retard the penetration of heat; minimize the pressure of moisture, and to hold the tank in a predetermined location free of additional load while permitting the tank to act as a free body.

It will be understood that changes may be made in the details of construction and operation without departing from the spirit of the invention, especially as defined in the following claims.

I claim:

1. In a means for the transportation of a liquid having a temperature differing widely from the ambient temperature including a support and a structural element in said transportation means, a metal tank of large dimension for housing the liquid directly in contact with the inner surfaces of the walls thereof whereby the metal tank walls are subject to wide temperature change between the temperature of the liquid and ambient temperature with corresponding change in dimension due to expansion and contraction, means operatively interconnecting the bottom of the tank with the support for supporting the tank at a fixed position crosswise of the bottom wall of the tank from which portions outwardly thereof move in expansion and contraction, means interconnecting the top wall of the tank with a structural element of the transportation means in a manner to permit vertical movement of the top wall relative to the structural element in response to changes in the vertical dimension of the tank while holding the tank in a fixed position in vertical alignment with a fixed position along the bottom wall, said latter means including a vertically disposed cylindrical section having at least one circumferential corrugation intermediate its ends to enable change in the lengthwise dimension of the section, means rigidly fixing the upper end portion of the cylindrical section to the structural element, other means fixing the lower end portion of the cylindrical section to the top wall of the tank about an opening communicating the interior of the tank with the cylindrical section whereby a change in vertical dimension of the tank results in an inverse change in the dimension of the cylindrical section to enable the tank to be fixed in position in the transportation means.

2. A structure as claimed in claim 1 in which a plurality of axially spaced apart circumferential corrugations are provided in the cylindrical section intermediate its ends.

3. A structure as claimed in claim 1 in which the transportation means comprises a ship having a deck forming a part of the structural element of the transportation means and in which the deck has an opening therein dimensioned to enable the cylindrical section to extend axially therethrough and in which the upper end portion of the cylindrical section is secured in a fixed relationship to the ship's deck.

4. In a ship for the transportation of a liquid maintained at a temperature far below ambient temperature including a ship's hold and a deck overlying the hold, a tank of large dimension located within the hold for housing the cold liquid directly in contact with the inner surfaces of the tank walls whereby the metal walls of the tank are subject to wide temperature change with corresponding change in dimension due to expansion and contraction, insulation on the floor of the hold and means for supporting the tank in a fixed position on the insulated floor when measured from one point in a horizontal plane, means interconnecting the top wall of the tank with the deck in a manner to fix the position of the tank when measured in a horizontal plane while permitting vertical movement of the top wall of the tank relative to the deck in response to expansion and contraction due to temperature change including a vertically disposed cylindrical section having at least one circumferential corrugation intermediate its ends to enable change in lengthwise dimension thereof, means fixing the upper end portion of the cylindrical section to the ship's deck for rigid attachment thereto, other means fixing the lower end portion of the cylindrical section to the top wall of the tank about an opening communicating the interior of the tank with the cylindrical section for rigid attachment thereto whereby changes in vertical dimension of the tank result in an inverse change in the lengthwise dimension of the cylindrical section to enable the tank to be fixed in position in the ship.

5. A ship as claimed in claim 4 in which the deck is provided with an opening in vertical alignment with the cylindrical section and in which the cylindrical section extends upwardly through the opening of the deck.

6. A ship as claimed in claim 4 which includes a cover concealing the upper end of the cylindrical section.

7. In a ship for the transportation of a liquid maintained at a temperature far below ambient temperature including a ship's hold and a deck overlying the hold, a tank of large dimension located within the hold for housing the cold liquid directly in contact with the inner surfaces of the tank walls whereby the metal walls of the tank are subject to wide temperature change with corresponding change in dimension due to expansion and contraction, insulation on the floor of the hold and means for supporting the tank in fixed position on the insulated floor when measured from one point in a horizontal plane, means interconnecting the top wall of the tank with the deck in a manner to fix the position of the tank when

measured in a horizontal plane while permitting vertical movement of the top wall of the tank relative to the deck in response to expansion and contraction due to temperature change including a vertically disposed cylindrical section having at least one circumferential corrugation intermediate its ends to enable change in lengthwise dimension thereof, means fixing the upper end portion of the cylindrical section to the ship's deck, other means fixing the lower end portion of the cylindrical section to the top wall of the tank about an opening communicating the interior of the tank with the cylindrical section whereby changes in vertical dimensions of the tank result in an inverse change in the lengthwise dimension of the cylindrical section to enable the tank to be fixed in position in the ship, a concentric encasing member having a diameter greater than the diameter of the cylindrical section and enclosing the cylindrical section through a portion of its length to provide an open annular space therebetween in which the circumferential corrugations

are located, means extending outwardly from the lower end portion of the encasing member, and insulation about the cylindrical section supported by said outwardly extending means.

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