United States Patent

[11] 3,583,351

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[73] Assignee **Esso Research and Engineering Company**

[54] **VESSEL FOR TRANSPORTING LIQUEFIED HYDROCARBON**
11 Claims, 23 Drawing Figs.

[52] **U.S. Cl.** **114/74, 220/15**
[51] **Int. Cl.** **B63b 25/08**
[50] **Field of Search** ..... 114/74, 74 A; 220/15, 9 A'

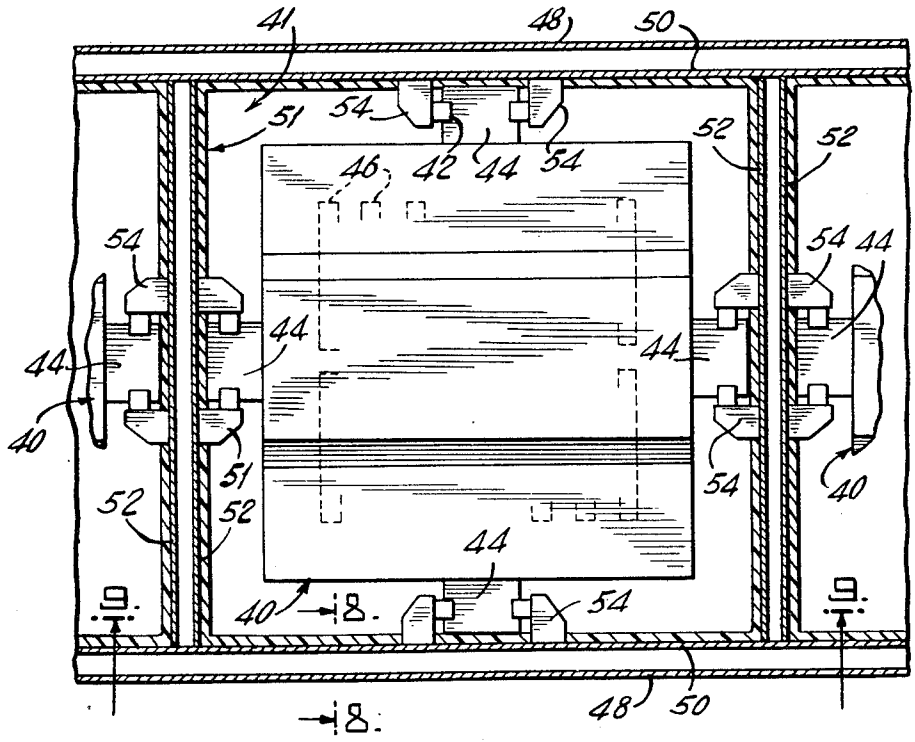
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Primary Examiner—Trygve M. Blix
Attorneys—Manahan and Wright and Donald F. Wohlers

ABSTRACT: A ship for transporting liquids at very low temperatures at about atmospheric pressure, comprising an inner and outer ordinary shipbuilding steel hull and single walled, self-supporting, low temperature material tanks covered with an insulation system which serves to prevent cold from reaching the ordinary shipbuilding steel. The inner walls of the inner steel hull are also insulated as further protection against any leaks which might develop in the primary tanks. The tanks are supported on insulation-bearing blocks and restrained by vertical keys located at the center of the tank sides and ends.



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Fig. 1.

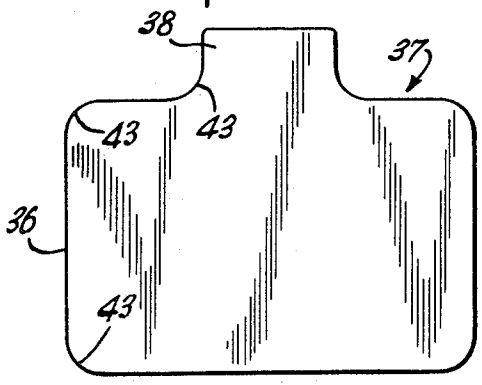


Fig. 2.

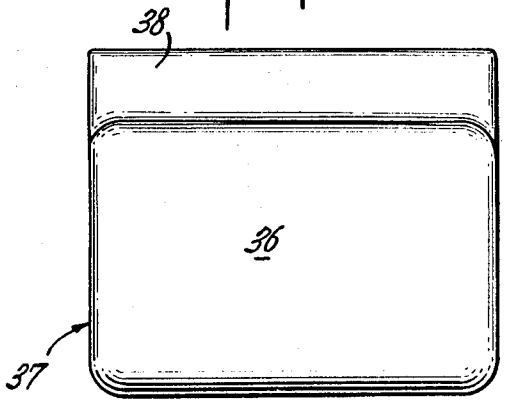


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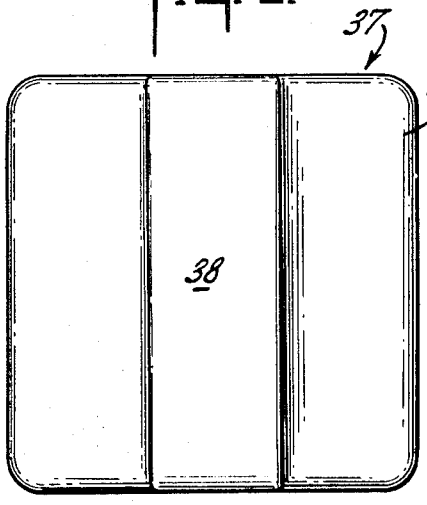


Fig. 4.

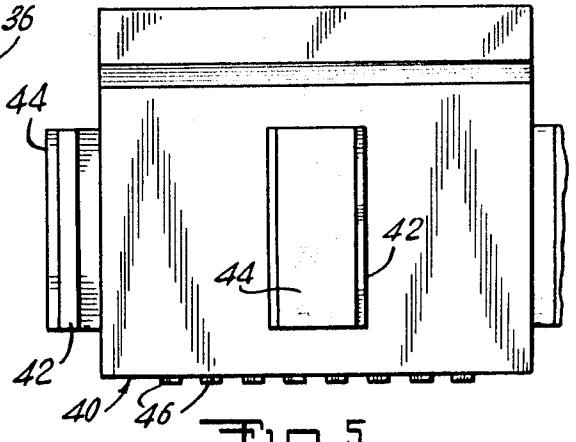


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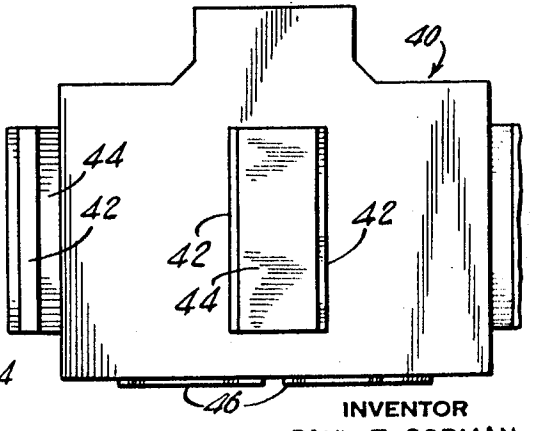
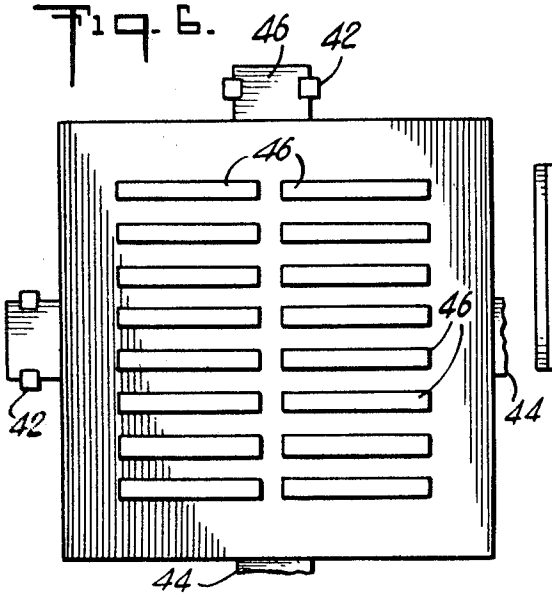


Fig. 6.



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Fig. 7.

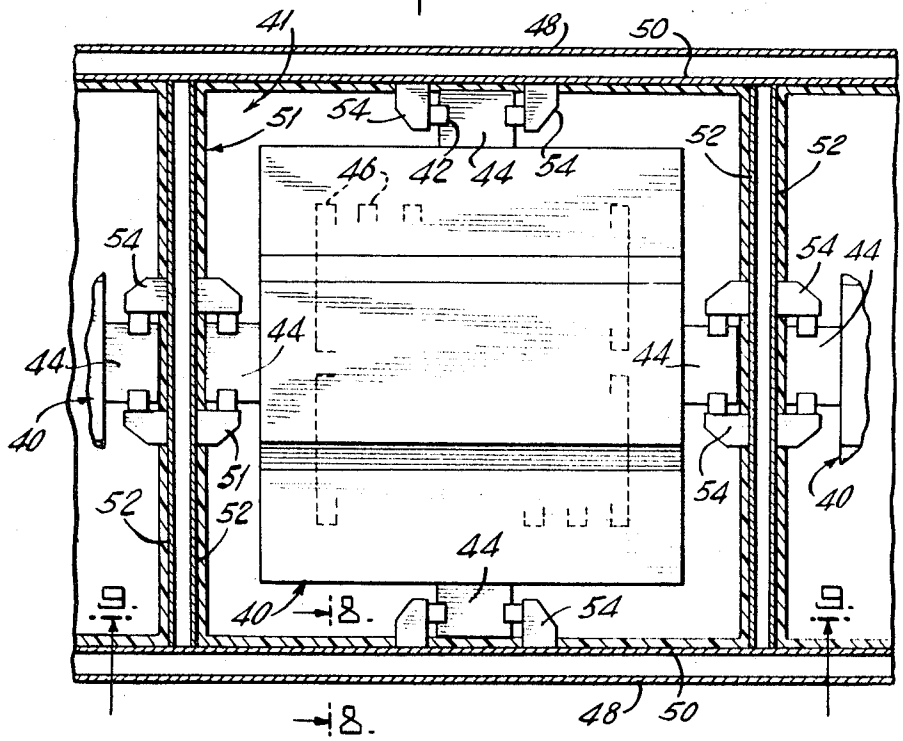
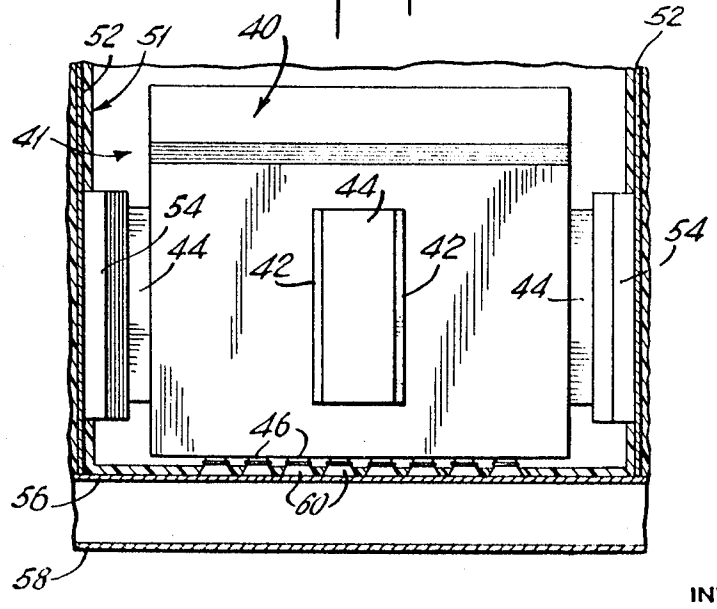


Fig. 9.



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Fig. 8.

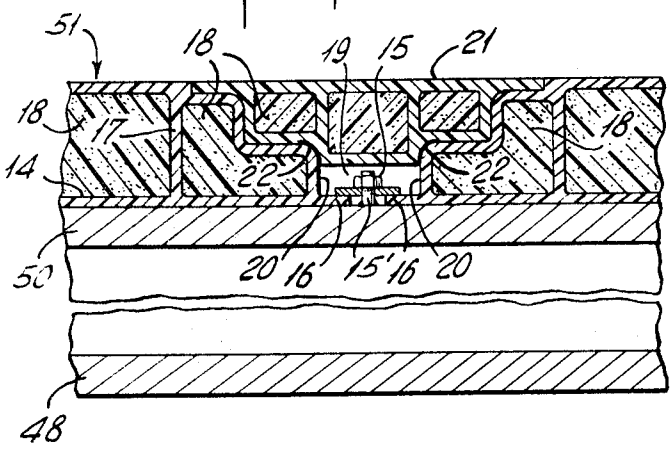


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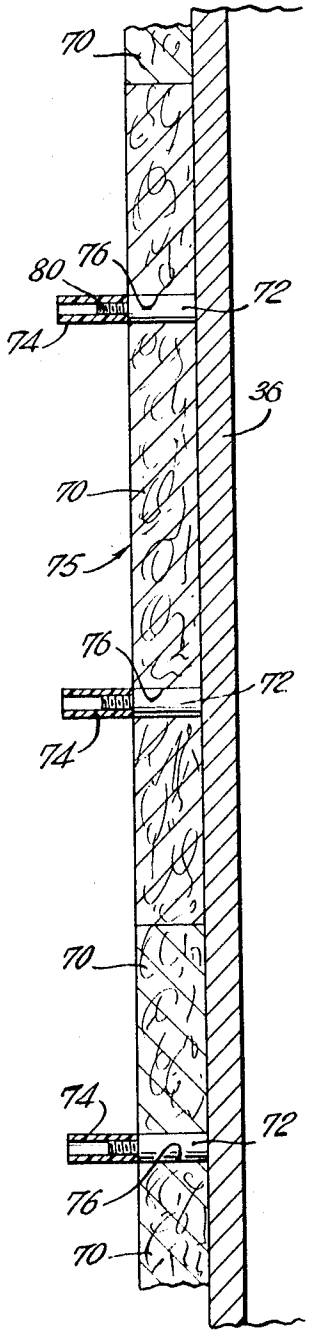


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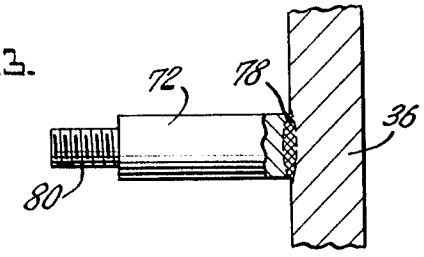
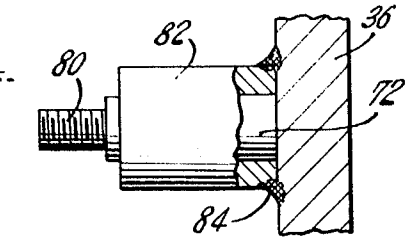


Fig. 14.



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Fig. 10.

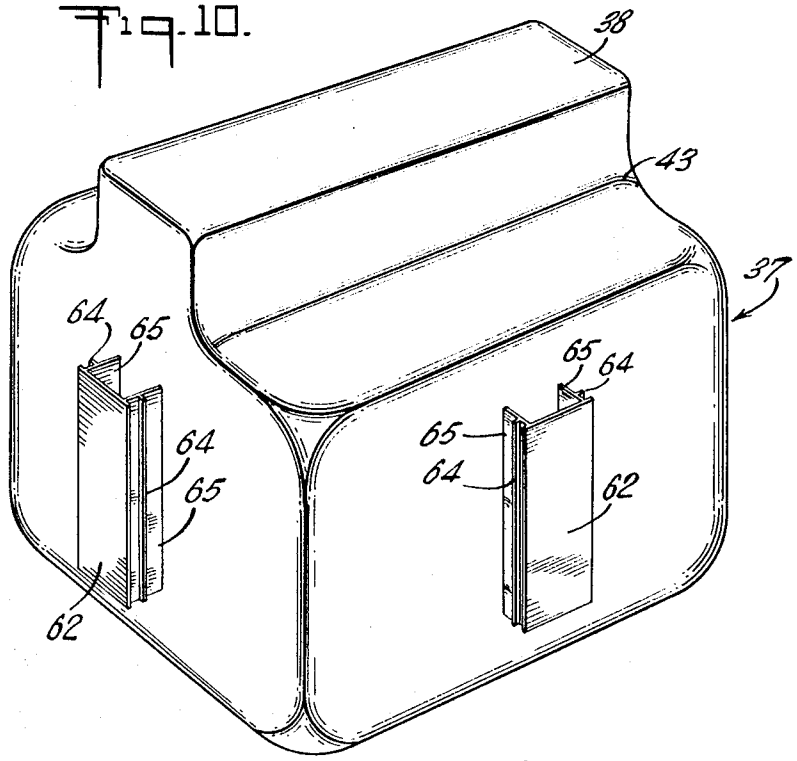
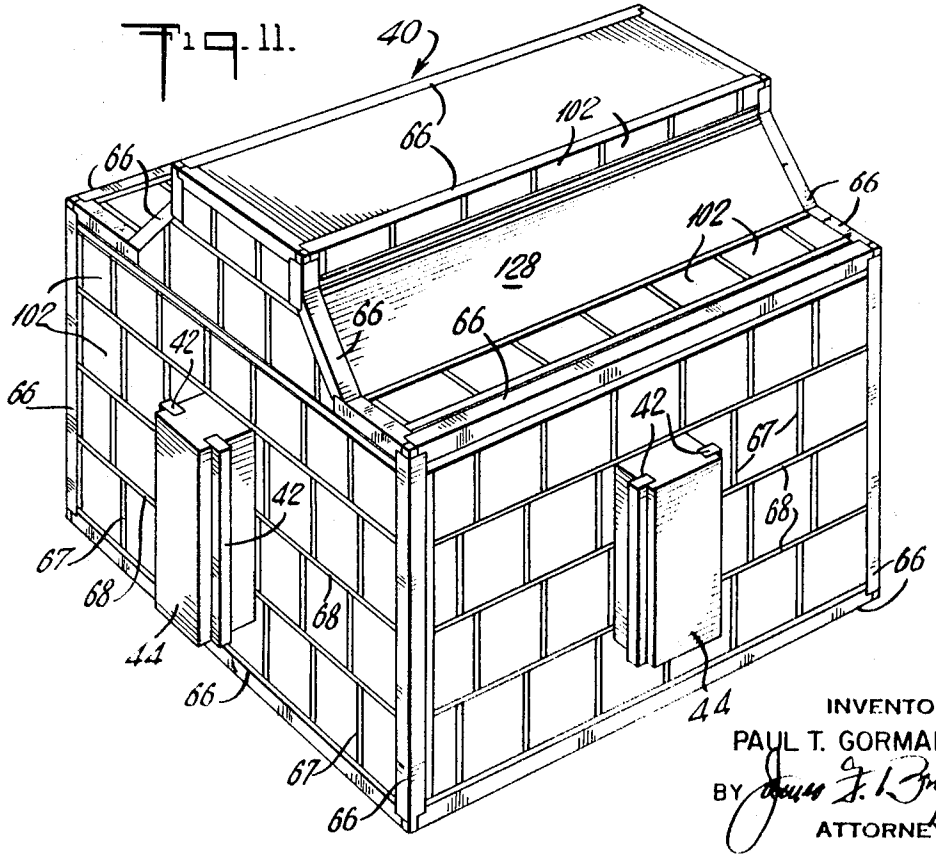


Fig. 11.



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Fig. 15.

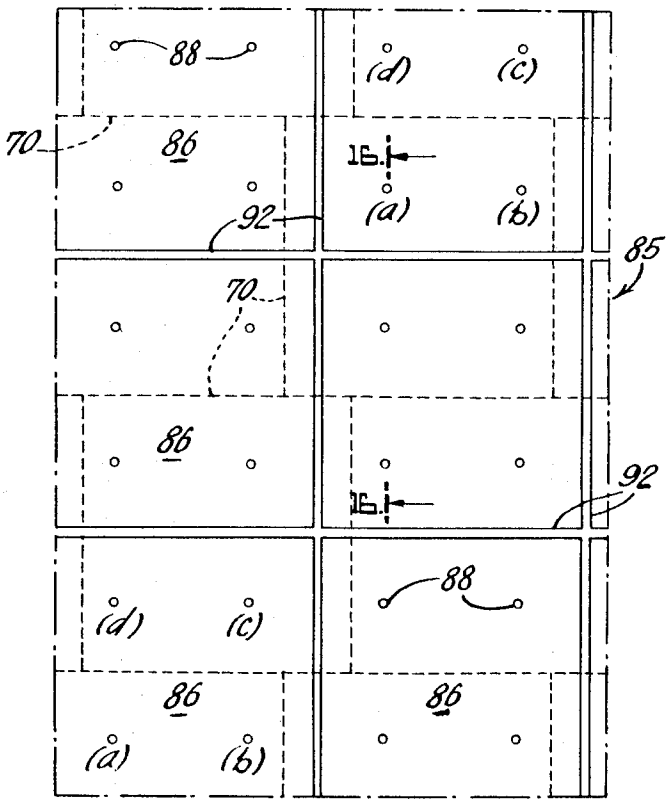


Fig. 16.

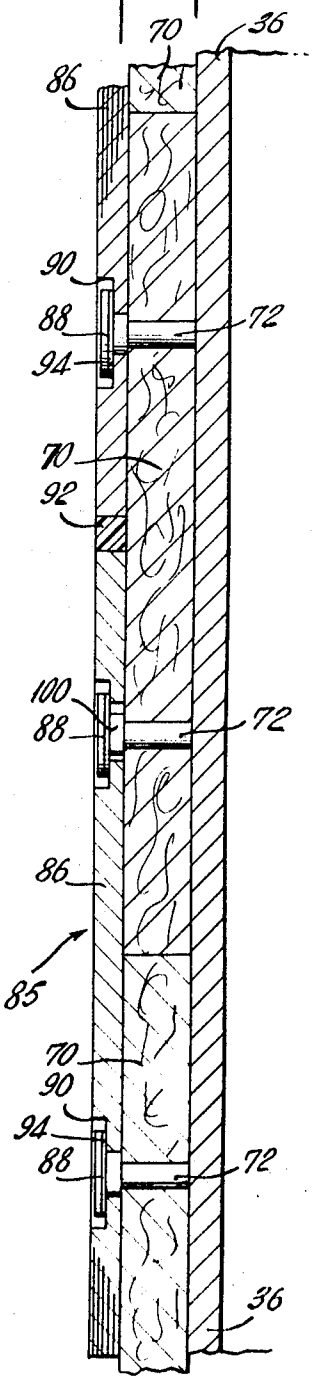


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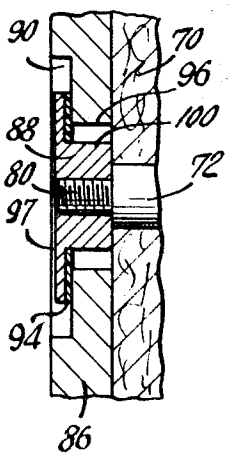
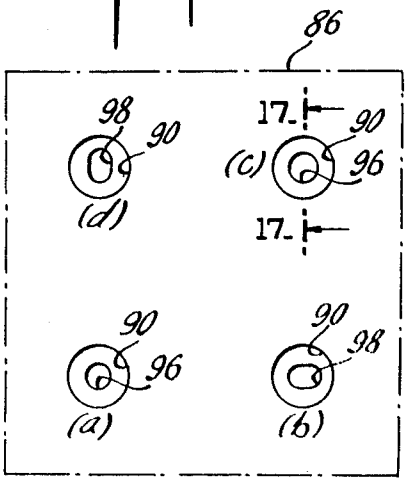


Fig. 18.



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Fig. 19.

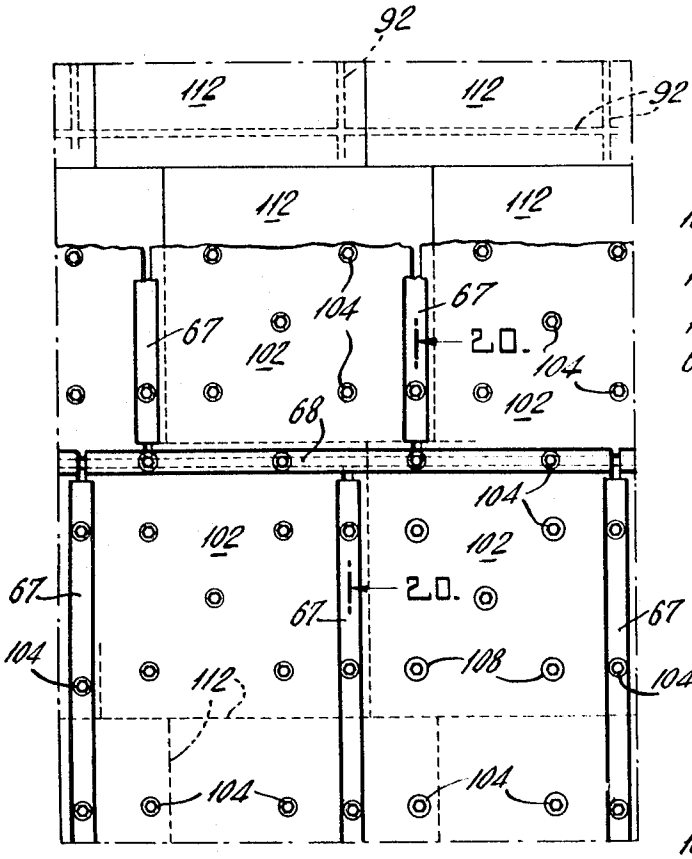


Fig. 20.

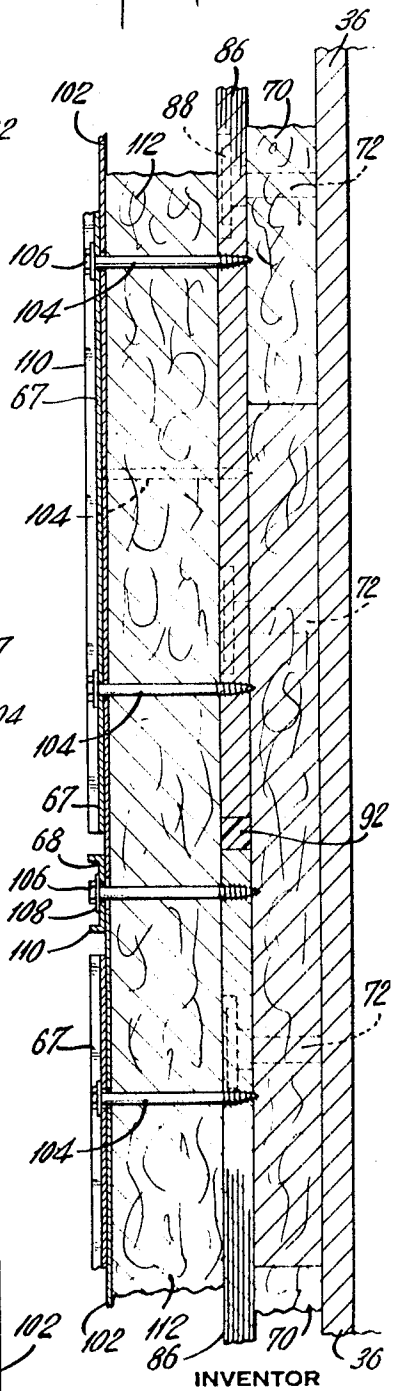


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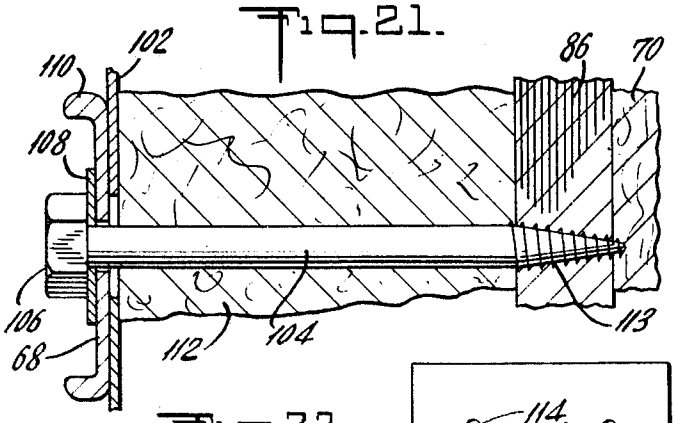
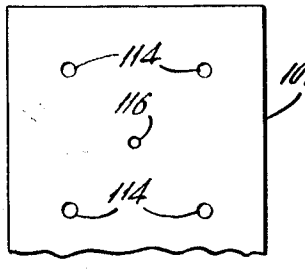
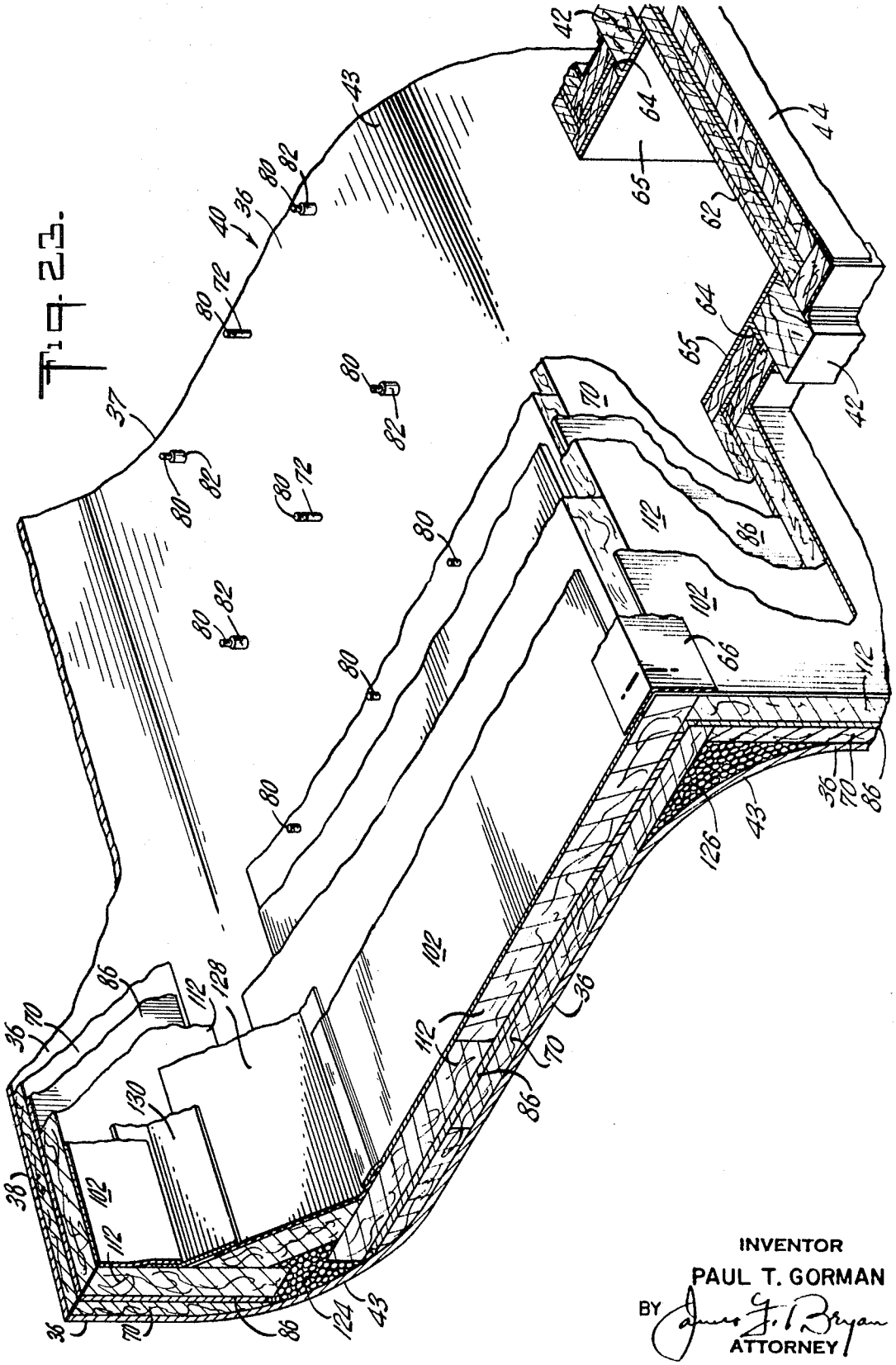


Fig. 22.



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Fig. 23.



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VESSEL FOR TRANSPORTING LIQUEFIED HYDROCARBON

BACKGROUND OF THE INVENTION

This invention relates to the storing and shipping of liquefied hydrocarbons and more particularly, comprises improvements in the construction of those maritime vessels which transport liquefied hydrocarbons at very low temperatures.

It is well known that hydrocarbons which are in a gaseous state in normal conditions of temperature and pressure may be reduced to a liquefied state by high pressure or low temperature, or a combination of both. Regardless of which system is used to store and transport liquefied hydrocarbons, there are a number of difficult problems that are presented. For instance, the tanks used to store the liquefied hydrocarbons under pressure must be strong enough to resist the high pressure needed to liquefy the gas. The weight involved in such tanks is very often objectionable because it comprises a substantial portion of the total weight of the vessel.

If low temperature is to be the medium for transporting the hydrocarbon in a liquefied state, then problems of a different sort are encountered. In the case of methane, a temperature of about −260° C. is required to achieve and maintain liquefaction at atmospheric pressure. At such temperatures, ordinary steel becomes brittle, generally losing its mechanical qualities and rendering it incapable of withstanding the stress and strain to which the structural portions of the vessel are normally subject. The smallest leak can create contact between the transported product and the shell plating of the tanker which is built of ordinary steel, and this, of course, can possibly result in damage and even total loss of the vessel.

Container systems for typical liquified gases must be of sufficient strength and structural integrity to prevent the escape of the gas therefrom since the supercooling effects of the liquefied gas would be extremely deleterious to the ship's structure, which could become embrittled and thereby result in overstressing of the surrounding mild steel ship plate. Accordingly, in order to maintain a high degree of safety, it has been well accepted and statutorily required practice to include at least two liquid and vapor type barriers in cryogenic containers employed in shipboard applications for the isolation of the supercooled cargo from the ship's structure.

Thus, it is the general object of this invention to improve the storing and transporting of liquefied hydrocarbons at low temperatures.

Another object of this invention is to provide a maritime vessel for transporting liquefied hydrocarbons, the vessel having low temperature storage tanks generally following the contours of the vessel and supported in such a fashion as to allow for expansion and contraction of the tanks, as well as flexing of the ship's bulkheads and structural members.

Still another object is to provide a ship for transporting liquefied hydrocarbons which meets safety and reliability requirements in that it has two liquidtight barriers to provide a substantially fail-safe system.

SUMMARY OF THE INVENTION

In accordance with the principle of the present invention, an improved insulation system is provided for use with as self-supporting cryogenic tank of the type fabricated from such a low temperature resistant material such as aluminum alloys or 9 percent nickel steel. In a preferred embodiment of the invention, an insulation system is provided which comprises, in part, a first course of insulation which is secured to the exterior surfaces of the self-supporting tank in such a manner as to allow it to contract independently of the cargo tank, thereby minimizing thermal stresses on this first course. A second insulation layer is provided on the interior of an inner hull comprising part of the ship's structure, which second layer is comprised of foam plastic panels encapsulated in fiberglass reinforced plastic. These panels are joined in a manner so that the entire second insulation layer is liquid and vaportight and serves as a container of the cold cargo in the event that a failure occurs in the self-supporting tank.

A significant aspect of this invention is the relatively high temperature of the plastic encapsulated insulation layer during normal service conditions, which reduces the effects of continued exposure to very low temperatures and thermal stress cycling on its integrity.

For a more complete understanding of the present invention and its advantages, reference should be made to the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. **1** is a diagrammatic end view of the cryogenic cargo tank itself.

FIG. **2** is a side elevational view of the tank shown in FIG. **1**.

FIG. **3** is a plan view of the tank shown in FIG. **1**.

FIG. **4** is a diagrammatic side elevation of the tank with insulation, and also shows the key members on the tank.

FIG. **5** presents an end view of FIG. **4**.

FIG. **6** is a bottom view of FIG. **4**.

FIG. **7** is a diagrammatic sectional plan view showing the installation of tank within the hull of a ship.

FIG. **8** is an enlarged sectional view taken along the line **8–8** of FIG. **7**.

FIG. **9** is a sectional view taken along the line **9–9** of FIG. **7**.

FIG. **10** is a perspective view of the tank itself showing the metal keys welded thereto.

FIG. **11** is a perspective view of the tank with its associated insulation completely installed.

FIG. **12** is an enlarged sectional view of a portion of the insulation course associated with the cargo tank.

FIG. **13** is a detail of the studs shown in FIG. **12**.

FIG. **14** is a detail of the studs used at the corners of the tank.

FIG. **15** is a side elevational view depicting the second step of the fabrication and installation of the insulation on the tank.

FIG. **16** is a sectional view taken along the line **16–16** of FIG. **15**.

FIG. **17** is a detail of the fastening nuts shown in FIG. **16**.

FIG. **18** is a detail of the relationship of the holes shown in the plywood sheets of FIG. **15**.

FIG. **19** is a side elevational view depicting the third step in the fabrication and installation of the insulation on the tank.

FIG. **20** is a sectional view taken along the line **20–20** of FIG. **19**.

FIG. **21** is a detail of the stud screws shown in FIG. **20**.

FIG. **22** shows a detail of the holes in the metal sheathing shown in FIG. **19**.

FIG. **23** is a perspective view (with parts broken away) showing installation of the insulation on both inside and outside corners and on one of the keys of the tank.

Referring to the figures in detail, FIGS. **1—3** show respectively an end, side and top view of a cargo tank **37** which is to be utilized in conjunction with the insulation system of the instant invention. Tank **37** is of generally rectilinear prismatic shape and is provided with a trunk section indicated at **38**. The corners **43** of the main portion of the tank, as well as those between the main portion of the tank and its trunk section, are curved so as to avoid any stress buildup in these areas.

FIGS. **4—6** respectively show a side view, end view and bottom view of tank **37** covered with the first insulation course of the system of the instant invention, indicated generally at **40** in FIG. **4**. Tank **37** is also provided with keys (not shown in FIGS. **1—3**) which will be herein subsequently discussed. These keys are shown covered with insulation **44** in FIGS. **4—6**. Key bearing blocks **42**, whose function will also be further described, are installed in the keys. Referring to FIG. **6**, the primary cargo tank rests on bearing blocks **46** which may preferably be fabricated from balsa wood or the like, and will also be discussed subsequently hereto.

FIG. **7** presents a diagrammatic sectional plan view showing the installation of the insulated tank **40** within a ship's cargo hold, indicated generally at **41**. The ship is preferably of dou-

ble hulled construction, having an outer hull 48 and an inner hull 50. Preferably, double walled transverse bulkheads 52 are disposed between the sides of the inner hull 50. Each of the interior walls defining hold 41 are provided with insulated brackets 54 which define keyways to engage the keys 44 and their associated bearing blocks 42 of tank 40. As may clearly be seen in FIG. 7, a second insulation lining 51 is provided on the interior surface of inner hull 50 and on surfaces of transverse bulkheads 52. As hereinbefore indicated, insulation lining 51 is constructed so that it is liquid and gastight and will serve as a container of the cold cargo in the event that a failure occurs in the tank 37.

More specifically, layer 51 is comprised of a plurality of panels which are generally similar to the fiberglass reinforced polyester and polyurethane foam thermal insulating panels first disclosed in U.S. Pat. No. 3,367,492 (Pratt et al.) for "Insulation System." In general, as shown in FIG. 8, the continuous, effectively dimensionally stable, secondary barrier 51 is established by securing stepped insulation panels 14 through integral flanges 16 extending peripherally outwardly from the base portions thereof to the inner hull plating 50 by means of a nut 15 and a Nelson stud 15'. Advantageously, the insulation panels 14 are approximately 5 feet × 25 feet in size, are generally symmetrical in shape, and include glass fiber reinforced polyester shell 17 filled with polyurethane foam 18. Each gap 19, formed between opposing faces 20 of adjacent insulating panels 14, is closed by a mating stepped plug piece 21 constructed similarly to the insulating panels 14 of a fiberglass reinforced polyester shell filled with polyurethane foam and being correspondingly effectively dimensionally stable.

The secondary barrier 51, defined by the end-to-end and side-by-side array of panels and plug pieces, is made continuous and liquidtight by the adherence of the plug pieces 21 to the opposing step faces 20 of adjacent insulating panels by means of a suitable adhesive sealer 22. As set forth in more detail in the before-mentioned Pratt et al. application, the above described insulating barrier 51 is effectively dimensionally stable and will not undergo deleterious contraction when subjected to the extreme temperatures (e.g. about −260° F. for liquefied methane) encountered in the cryogenic environments of liquefied hydrocarbon transportation.

Referring now to FIG. 9, which is taken along the line 9–9 of FIG. 7, it may be seen that the means for supporting tank 40 within the hold 41 includes a plurality of bearing blocks 46 which in turn are supported by a plurality of supporting rails 60, which are affixed to the bottom 56 of the hold 41. Supporting rails 60 may preferably be made from a metal which retains its physical properties at cryogenic temperatures, for example, 9 percent nickel steel.

FIG. 10 shows a perspective schematic view of tank 37 before the first insulating course of the instant invention has been applied thereto. As may be clearly seen, each of the keys 62 define a pair of grooves 64 in their peripheral sides 65. Grooves 64 are adapted to receive the bearing blocks 42 shown in FIG. 4. A diagrammatic perspective view showing tank 37 as it would appear when covered with the first insulating course of the instant invention is shown in FIG. 11. Corners of the insulation are protected by a plurality of metal sheathing angles indicated at 66. A plurality of batten strips generally indicated at 67 are also shown. (The function of these strips will be discussed in conjunction with FIGS. 19—22.)

Reference will now be had to FIGS. 12—23 in discussing a preferred form of the first insulation course which is affixed to the exterior of the primary cargo container 37. Referring first to FIG. 12, reference numeral 36 identifies the wall of the tank 37 to be insulated. Affixed to wall 36 are a plurality of mounting means 72. These mounting means are preferably aluminum studs having a base portion 76 and a threaded portion 80. Studs 72 may be welded to wall 36 as shown at 78 in FIG. 13. In a preferred embodiment these studs have a nominal diameter of five-eighths inch and are disposed on the wall 36 with a 2 feet × 2 feet nominal spacing. The threaded portion 80 of studs 72 may be provided with a removable impaling head 74, whose function will be discussed hereinafter. In a preferred embodiment of the instant invention, the insulation which is applied to the exterior of the tank 37 is preferable constructed in two layers itself. The first layer or inner layer of the primary tank insulation, which is indicated generally at 75 in FIG. 12, is composed of a plurality of individual insulation panels 70. Panels 70 may be fabricated from any suitable insulation material, but foam plastics of the type including polystyrene, polyurethane and polyvinylchloride are particularly suitable. In the preferred embodiment, polyvinylchloride is used to advantage. The inner insulation panels of 70 are preferably 4 feet × 4 feet and about 2 inches thick. These panels are installed by being impaled over the impaling heads 74. The first panel is properly positioned and subsequent panels are then installed tightly against the edges of the panel or panels that are already in place. Impaling heads 74 are removed from the threaded portion of the studs 72 as each panel is in place. It has been found that impaling heads 74 may be constructed in the form of thin walled tubes with sharpened end peripheries. Such a tube will core out a clean hole in the insulation panel without spoiling the surface on breakthrough and without necessitating the rotation of the cutting tube during the piercing operation.

FIG. 14 illustrates the type of mounting means that are used to install the insulation at the corners of the tank 37. Due to higher stress conditions which invariably result at the intersections between sides and bottoms, sides and tops, etc. of tanks, the studs to be used at these locations should be stronger than the studs used at other locations. In a preferred embodiment, additional one-half achieved by utilizing an aluminum collar 82 which is welded about its periphery to the tank 37 as indicated by reference numeral 84 in FIG. 14.

Following the installation of foam panels 70, a structural support layer indicated generally at 85 in FIG. 16 is installed. In the preferred embodiment, this layer is comprised of a plurality of individual plywood panels five-eights inch thick and 3 feet 11½ inches square. As shown in FIG. 15, these panels are installed such that a nominal gap of one-half inch exists between adjacent panels. The plywood panels serve as structural members, and for this reason each panel is to be located symmetrically with respect to the four studs which support it. While the plywood panels primarily do not serve as insulation, the space between panels nevertheless is staggered with respect to the junctions between the blocks of inner insulation to minimize heat leaks. The half-inch gap between the panels are filled with compressed elastic foam gas skimming material, indicated at 92 in FIG. 16, to further minimize heat leaks.

FIG. 18 details the relationship of the predrilled holes which exist in each of the plywood panels 86. Holes 96 [(a) and (c)] in FIG. 18 are drilled such that there exists a clearance of ±⅛ inch with respect to the diameter of studs 72. Holes 98 indicated at (b) and (d) in FIG. 18 are slotted. This configuration of holes allows each panel to be symmetrically located with respect to the four studs which support it. Each of the holes is surrounded by a countersunk hole 90 which is adapted to receive the threaded nut 88 shown in detail in FIG. 17. Teflon washer 94 is interposed between the enlarged head 97 of the nut 88 and that portion of the plywood on which head 97 bears. The nuts 88 are tightened to a predetermined level, and after this tighting operation the head of stud 72 may be peened or spot welded so that nut 88 will not loosen in service. As an important aspect of the instant invention, it is to be noted that the nuts 88 are not tightened to the extent that all spillage between the faces of the insulation panels 70 and the plywood panels 86 would be eliminated. In this regard it may be seen that the holes 96 and the slots 98 of the plywood panels and their associated countersunk holes 90 allow limited displacement of the plywood panels with respect to the studs and, hence, with respect to the individual insulating panels 70. This allows the structural layer composed of the individual plywood panels when subjected to thermal contraction to be free floating within certain defined limits.

The third major step in the fabrication of the insulation system to be applied to the tank **37** is detailed in FIGS. **19**—**22**. Referring to FIG. **20**, after plywood sheathing **86** has been installed, the next step in the construction according to the instant invention consists of securing a second layer of foamed plastic insulation panels to the plywood. This layer composed of panels **112**, which are nominally 4 feet × 4 feet square and which, in the preferred embodiment, may range between 1 and 5 inches thick. The individual panels here again are installed tightly one against another. This layer of insulation is covered by a metal sheathing indicated by the reference numeral **102**. This sheathing is made up of plates which are nominally 3 feet 11 inches square and the 1 inch gaps (reference numeral **114** in FIG. **21**) therebetween are covered by batten strips **67** and **68** which are approximately 3 inches wide and one-eighth inch thick. The long edges **110** of the battens **67** and **68** are turned up approximately one-half inch to prevent buckling under compressive frictional loading during cool-down to resist dynamic forces when the ship is at sea. The outer layer of the insulation and the metal sheathing are secured to the plywood structural layer **86** by means of stud screws **104**. Screws **104** are provided with hexheads and have approximately three-fourths inch of wood screw thread at their ends **113**. Thus, the wood screws extend one-eighth inch beyond the inner surface of the plywood for increased bite. In the preferred embodiment five of these stud screws are used to secure each sheathing plate and the immediately adjacent insulation layer behind it. As may be seen in FIG. **22**, one of these stud screws goes through the hole **116** at the center of the sheathing plate. This center hole is approximately the same nominal diameter as the stud screw and, hence, a snug fit is maintained between the stud screw and the plate at this point. Holes **114** are approximately one-fourth inch in diameter oversized and are located halfway between hole **116** and the respective corner of sheet **102**. Each of the five stud screws used to secure sheet **102** is provided with a washer under its hexhead. Thus, the center stud screws fixes the position of the sheet **102** while the four other stud screws allow for small amounts of thermal movement that may take place in service. The holes through the insulation and into the plywood may advantageously be drilled in the field at the time of installation and, hence, do not involve aligning up with predrilled holes in the insulation or the plywood. This, of course, minimizes installation difficulties and allows for tight positioning of the outer insulating panels against one another. It is also to be pointed out that since stud screws **104** are not affixed to cold tank wall **36**, but to the relatively warmer plywood layer **86**, they do not serve as paths of major heat leaks.

In the preferred embodiment each of the longitudinal batten strips **67** are approximately 7 feet 11½ inches long, which allows for one-half inch clearance between the ends of adjacent longitudinal battens. They are secured by four stud screws, one of which passes through a hole having substantially the same diameter as the diameter of the stud screw and this fixes that point of the batten with respect to the plywood sheathing. The other three holes in the batten are elongated (not shown) to permit some relative movement with temperature changes and other slight movements which will occur in service. The transverse battens **68** are affixed in a similar manner, thus they too are permitted to undergo predetermined axial movement. As with the installation of the metal sheathing layer **102**, all of the holes in the second installation layer in the plywood which must accommodate the screw threads which hold the battens in place are drilled in the field and, hence, therefore, here also no matching up of predrilled holes is necessary.

As clearly shown in FIG. **19**, which is a breakaway plan view, all junctions between the various panels comprising the various layers, which in turn make up the primary tank insulation system, are staggered so as to eliminate breakthrough penetration at any point.

A unique feature of the instant invention, which should be at this point obvious to one skilled in the art, is the fact that the insulation system applied to the primary cargo tank may be dismantled and reassembled without destroying any of the components. Such a feature would have particular significance if regulatory bodies should decide to require periodic inspection of the outer wall of the cargo tank **37**.

For a general, overall view of the various components making up that portion of the installation of the instant invention which is applied directly to the tank **37**, reference should be made to FIG. **23**. This figure shows construction details on both outside type corners, designated **43***a*, and inside corners such as **43***b*. This view also shows a typical construction used at one of the keyways. A significant detail of the installation construction at an outside corner such as **43***a* is that the plywood panel **86** extends over the rounded corners of the tank to provide for attachment in support of the insulation and sheathing. Thus, this construction permits the use of rectilinear insulation panels and eliminates any need for molded insulation to fit the contours of the tank **37**. The void **126** between the curved corner of the tank and the rectangular junction of the insulation extensions is filled with a suitable loose insulation such as foam plastic pellets or the like. The resiliency of the plastic pellets serves to keep the inner insulation panels tight against the underside of the plywood panels. The construction details of the inside corners such as **43***b* may also be readily appreciated by reference to FIG. **26**.

From the foregoing detailed description of the instant invention it is seen that highly efficient and fail-safe system is provided for the transportation of liquefied hydrocarbon cargoes such as liquefied natural gas. The layer of fiberglass encapsulated insulating panels **51** provided on the interior of the inner hull **52** serves as a liquid and gastight secondary barrier for the cold cargo in the event that a failure occurs in tank **37** and the resultant spillage permeates the insulation system which is affixed thereto. A significant aspect of this invention is the relatively high temperature of the layer **51** during normal service conditions due to the insulating effect of the insulation layer on tank **37**. This, of course, reduces the effect of thermal stress cycling and continued exposure to very low temperatures on the integrity of layer **51** so that it remains structurally sound and capable of containing, when called upon to do so, leakage from the primary container **37**.

It should be understood that the specific structures herein illustrated and described are intended to be representative only, as certain changes may obviously be made therein without departing from the clear teachings of the disclosure. For example, while the insulation affixed to tank **37** has been described as being comprised of more than one layer, those skilled in the art will readily appreciate that if desired a single layer could be provided. In the alternative, more than two layers of insulating panels could also be affixed to the tank **37**. Furthermore, while the invention finds particular utility in conjunction with shipboard cryogenic containers, it will also be appreciated that it may be employed to equal advantage for the construction of relatively fail-safe land based storage facilities for cryogenic materials. Accordingly, reference should be had to the following appended claims in determining the full scope of the invention.

What I claim is:

1. In a tanker for carrying liquefied gases maintained at atmospheric pressure and cryogenic temperatures, said tanker having an inner hull and an outer hull and a cargo hold partially defined by said inner hull, the improved system which comprises:

a. a self-supporting cargo tank supported within said cargo hold;

b. a first multilayer insulation system positioned on the exterior of said cargo tank; and

c. a secondary barrier independent of said first multilayer insulation system and comprising a plurality of individual insulation panels affixed on the interior walls of said inner hull and disposed in spaced relation relative to said first multilayer insulation system.

2. The system of claim **1** wherein said multilayer insulation system comprises, a first course of insulation panels, an intermediate thermally nonconductive support wall affixed to the

exterior walls of said cargo tank for holding said first course of panels against the exterior of said cargo tank, and a second insulation course comprising a plurality of individual insulating panels affixed to said intermediate support wall.

3. The system of claim 2 wherein said intermediate support wall comprises a plurality of panels which are affixed to said exterior walls of said cargo tank in a manner which allows slippage between said intermediate support wall panels and said first course of insulation panels.

4. The system of claim 1 wherein the individual panels comprising said secondary barrier comprise fiberglass reinforced plastic shells filled with a foamed plastic insulation material.

5. An improved insulation system for a cryogenic cargo tanker having an inner and outer hull of the type wherein a primary self-supporting cargo tank is positioned within said inner hull, said system comprising, a multilayer insulation panel system affixed to the exterior of said self-supporting cargo tank, and a secondary barrier independent of said multilayer insulation panel system comprising a plurality of insulation panels arrayed in end-to-end and side-by-side configuration on the interior of said inner hull so as to define a liquid and vaportight barrier and being disposed in spaced relation relative to said multilayer insulation panel system, said secondary barrier being normally protected from the extremes of cryogenic temperatures by the insulating effect of said multilayer insulation panel system affixed to the exterior of said cargo tanks.

6. The system of claim 5 wherein said multilayer insulation panel system comprises a first course of insulation panels, and an intermediate thermally nonconductive support wall comprising a plurality of individual panels, which wall is fastened to said cargo tank so as to hold said first course of insulation panels against the exterior of said cargo tank whereby slippage is allowed between said intermediate support wall panels and said first course of insulation panels

7. A tanker for carrying cryogenic cargoes which comprises, an outer hull, a hold defining inner hull positioned within said outer hull, a liquefied gas self-supporting cargo tank positioned within said hold, first insulating means disposed on the

exterior walls of said self-supporting cargo tank, and second insulating means independent of said first insulating means disposed on the interior walls of said hold and disposed in spaced relation relative to said first insulating means, said second insulating means serving as a secondary barrier and being normally protected from the extremes of cryogenic temperatures by the insulating effect of said first insulating means.

8. A tanker according to claim 7 including means for securing said first insulating means to the exterior walls of said self-supporting cargo tank such that such first insulating means is allowed to contract independent of said self-supporting cargo tank, thereby to minimize thermal stresses in said first insulating means.

9. A tanker according to claim 7 wherein said second insulating means comprises a plurality of panels, and including means for joining said panels so as to form a liquid and vapor barrier whereby in the event of a failure in said Self-supporting tank, said second insulating means serves as a container for the cargo.

10. A tanker according to claim 7 wherein the outermost surface of said first insulating means and the innermost surface of said second insulating means are disposed on said exterior walls and said interior walls, respectively, in spaced relation thereby to define an access space therebetween.

11. A tanker for carrying cryogenic cargoes comprising at least one hull which effectively defines a cargo hold, a self-supporting cargo tank positioned within said cargo hold, first insulating means disposed on the exterior walls of said self-supporting cargo tank, and second insulating means separate from said first insulating means disposed on the interior walls of said hold in spaced relation relative to said first insulating means so as to define an access space between said first insulating means and said second insulating means, said second insulating means serving as a secondary barrier and normally being protected from the extremes of cryogenic temperatures by the insulating effect of said first insulating means, whereby said second insulating means serves as a container for the cargo in the event of failure of said self-supporting cargo tank.