Oct. 25, 1966 H. E. BREIT, JR 3,280,779

WATERBORNE FREIGHT-CARRYING VEHICLES

Filed Sept. 14, 1964 2 Sheets-Sheet 1

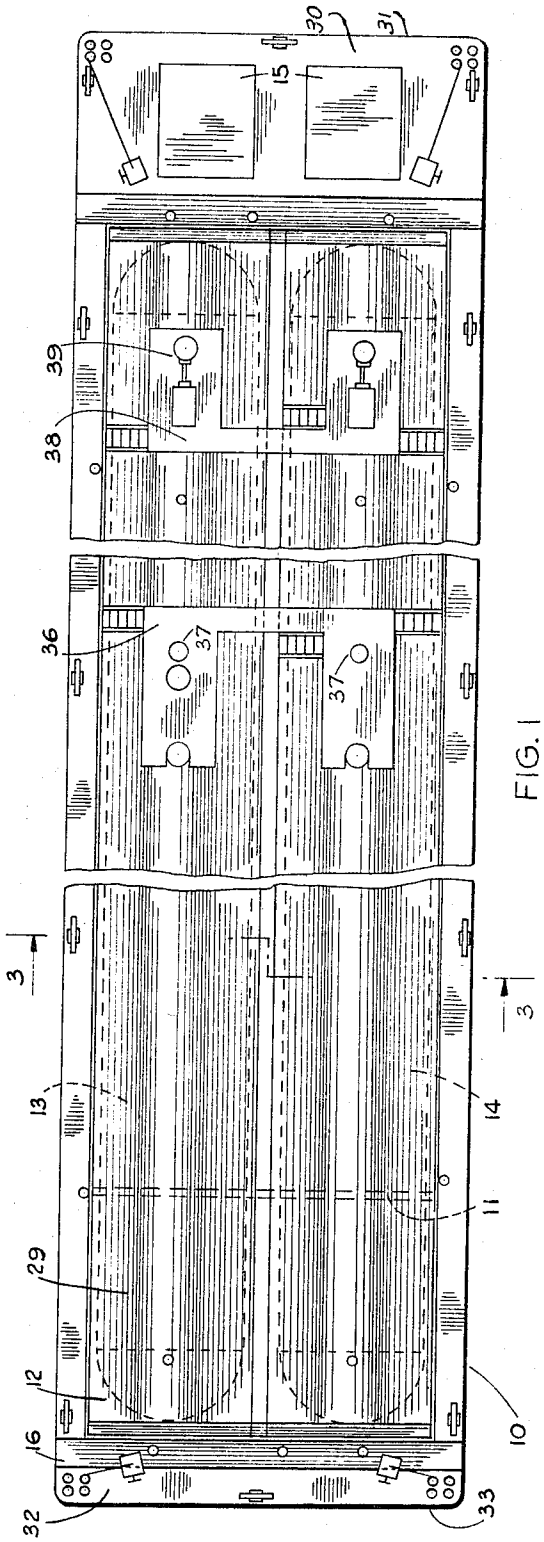

FIG. 1

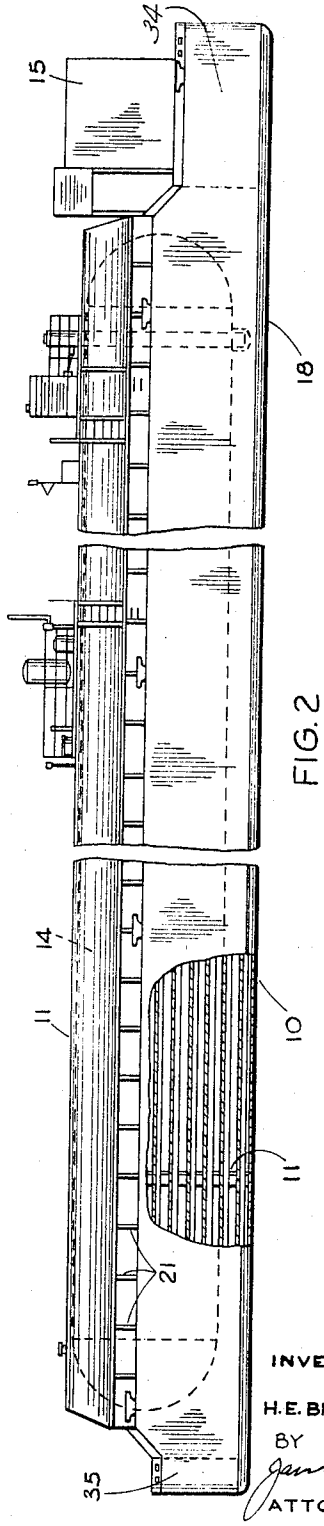

FIG. 2

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FIG. 4

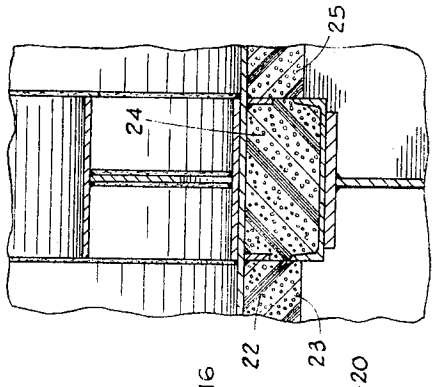
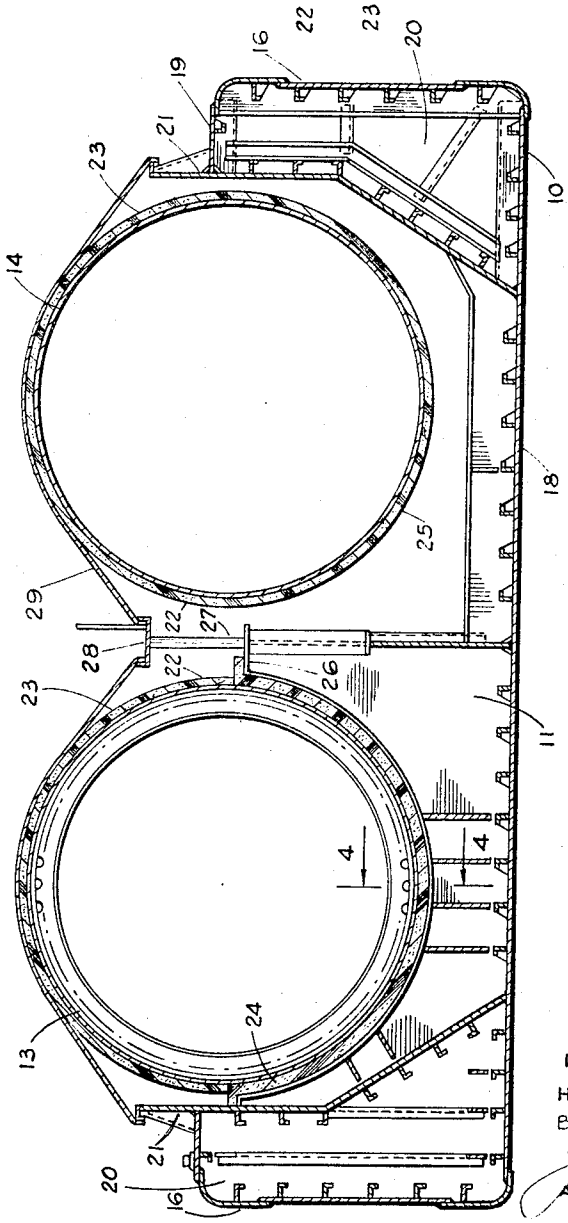


FIG. 3



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WATERBORNE FREIGHT-CARRYING VEHICLES

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6 Claims. (Cl. 114—74)

The invention relates in general to waterborne freight-carrying vehicles and more particularly to barges for the water transportation of liquified gases at near atmospheric pressure and correspondingly low temperatures.

A barge constructed in accordance with the principles of this invention may be used for the purpose of transporting a wide variety of liquid cargoes which need to be maintained at a cold temperature in order to be in the liquid state at atmospheric pressure. The invention will be described in connection with the transportation of liquified anhydrous ammonia, which is a liquid at atmospheric pressure at temperatures below minus 28 degrees F.

Some of the problems and requisites that should be considered for carrying anhydrous ammonia and similar gases as cargo are as follows:

The gas must be maintained in the liquid state at atmospheric pressure because the use of cargo tanks with shells strong enough to maintain the gas under pressures at ambient temperatures (this would be about 250 p.s.i. for anhydrous ammonia) would prohibitively add to the deadweight of the barge and make the barge economically unattractive.

Cargo tanks should be designed independently of the barge hull in order to prevent brittle failure of the tank at the low temperatures of the cargo. The tank should be designed to provide a factor of safety of at least 10 degrees below the lowest cargo temperature which in the case of anhydrous ammonia would be minus 40 degrees F. A special steel or comparable metal that will remain ductile at this low temperature should be used because ordinary steel becomes brittle at its much higher nil ductility transition temperature and then are subject to failure by cracking when little load is applied. The shape of the tanks should be cylindrical to reduce the unknown stresses to a minimum.

An effective thermal barrier should be provided intermediate the tanks and the barge hull in order that the hull may be constructed of conventional structural steel for ships and therefore economically attractive.

Barges are usually typed as deck barges and as hopper barges. A deck barge is so-called because it has a top deck extending the substantial length and width of the barge hull and cargo is carried thereon. The cargo must be restricted in height in the interest of lateral stability and the prevention of capsizing. A hopper barge has an open hopper space within the hull of the barge and cargo is carried therein. It is not as subject to capsizing as the deck barge and is therefore more heavily loaded. Previously built open hopper barges have been more susceptible to swamping because of the resulting lower freeboard due to this heavy loading, and to holing from grounding and collision due to the barge lying deeper in the water.

It is therefore an object of the invention to provide a hopper type barge that will not sink when the hopper space is flooded.

Another object of the invention is to provide a waterborne vehicle that will protect against the uncontrolled release of noxious cargo to the waterways and atmosphere when encountering the hazards of inland waterway navigation.

Another object of the invention is to provide cargo tanks of maximum capacity and minimum weight and shaped to reduced the unknown stresses to a minimum.

Another object of the invention is to provide means for keeping the cargo at atmospheric pressure without releasing any of it, and that said means will continue to function with the hopper space flooded.

Another object of the invention is to provide thermal barrier means between the cargo tanks and the barge hull to prevent the cargo from thermally damaging the hull and vice versa.

Other objects and a fuller understanding of the invention may be had by referring to the following description and claims taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a shortened plan view of the invention showing the location and arrangement of the cargo tanks, vapor dome bridge, pump bridge and refrigerating equipment,

FIGURE 2 is a side view of the subject of FIGURE 1 showing a cutaway portion,

FIGURE 3 is a cross sectional view taken along section line 3—3 of FIGURE 1 and shows the tanks' mounting, insulation and hopper space covering, and,

FIGURE 4 is a sectional view taken along section line 4—4 of FIGURE 3 and shows details of the thermal barrier.

With reference to the drawing, the invention comprises in general the hopper barge **10** constructed with conventional structural steel for ships, ASTM Designation A131, and having a hopper space **12**. A row of tank mounting saddles **11** are secured to the barge structure in the hopper space on each side of the longitudinal centerline thereof. The saddles are arranged in pairs transversely to said longitudinal centerline and form a pair of rows uniformly arranged with respect thereto. Cargo tanks **13** and **14** are respectively mounted in the two rows of saddles, one tank to a row. Dual refrigerating equipment **15** is mounted on one end of the barge and the units comprising it are connected in parallel with each other and the tanks. Each of said units is adapted to keep the gas in both tanks liquefied, so that one unit acts as standby security while the other unit is carrying the load.

The barge may be constructed of steel framing and plates. The slides **16** are double skinned and form with the bottom **18** and the decks **19** watertight spaces **20**. The watertight spaces **20** provide buoyancy to keep the barge afloat with the hopper space flooded. A coaming **21** extends above the decks **19** to surround the hopper space and provide added freeboard and increase the vertical dimension of the hopper space.

The upper half of the tanks are encased in self-extinguishing polyurethane to form a thermal barrier **22** and a thin coating of mastic is applied to form a vapor carrier **23**. The polyurethane may be foamed in place at 100 p.s.i. and two pounds density or applied in the form of sheets.

The tank mounting saddles **11** may be of steel construction and arranged end to end in pairs to also act as cross-strength members of the barge. The respective pairs are mounted athwartships in the hopper space and are equally spaced in succession from a pair of saddles situated approximately at the middle of the tanks to form two parallel longitudinal rows, each row providing support for a tank. Polyurethane is foamed in place between the saddles and the tanks at 500 p.s.i. and 15 pounds density to provide a thermal barrier **24** therebetween. Thermal barrier **22** is for the remainder of the lower half of the tanks. See Figure 4. A coating of mastic is applied to form a vapor barrier **25** similar to vapor barrier **23**. The thermal barrier for the lower half of the tanks may also be applied to the lower part of the tanks in sheets. The mounting saddles are concavely shaped to receive half of the insulated tanks' perimeters

with the saddle tops **26** extending up to the horizontal diameters of their respective tanks.

The inboard saddle tops **26** provide foundations for vertical extensions **27**. A horizontal walkway **28** between the tanks is supported by the vertical extensions **27**. The walkway extends between the tanks and along the longitudinal centerline of the hopper space. Tank covers **29** are respectively secured to the near edges of the walkway and the adjacent deck coaming. These covers prevent the entrance of water, weather, trash and any chance sparks from falling into the hopper space, thereby providing security against swamping and possible destruction of the heat barrier by burning.

A longer deck **30** is provided at one end **31** of the barge than the deck **32** at the other end **33**. These decks **30** and **32** form, with sides **16** and bottom **18**, two end watertight spaces **34** and **35** to provide additional buoyancy. The units of the dual refrigerating equipment are mounted on deck **30**, which is above the water level of the barge when the hopper space is flooded. Thus the units will be able to continue to function in spite of casualty to the hull, and one unit will be able to function if a casualty occurs to the other. These units are essentially compressors and are unique in that they use part of the cargo as the refrigerant for the rest. As some of the ammonia in the cargo vaporizes thereby cooling the rest, the vapors are continuously drawn off and compressed by a compressor unit of the refrigerating equipment **15** to the liquid state and returned to the tanks. A vapor dome bridge **36** is secured amidships supporting a vapor dome **37** connected to the tanks **13** and **14** and to the units of the refrigerating equipment **15**. The vapors from the tanks collect in the vapor dome and are drawn off to one of the units and returned to the tanks as liquid.

A pump bridge **38** is mounted intermediate the vapor dome bridge **36** and the deck **30**. Deepwell suction pumps **39** are mounted on this bridge and provide the necessary pumping requirement for discharging the liquid-gas cargo. As these pumps are located above the water level when the hopper space **12** is flooded they will continue to function in spite of hull casualty to allow controlled discharge of the cargo.

Although the invention has been described in its preferred form with a cartain degree of particularity, it is understood that the present disclosure has been made only by way of example and that numerous changes in details and construction of the invention and arrangement of parts may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

What is claimed is:

1. A waterborne freight carrying vehicle of the hopper-type category comprising a hull having a hopper space therein, a series of cross-strength members extending laterally across the hull and providing substantial transverse bracing for the hull, said cross-strength members being mounted in and athwartship of said hopper space, said cross-strength members further including supporting saddle portions, at least one cargo tank suitable for storing liquified gas positioned in said hopper space and supported therein by the supporting saddle portions of said cross-strength members, machinery for operating on said liquified gas mounted on said hull, said machinery including refrigerating equipment for keeping the bulk of the gas liquified and pump means for discharging the liquified gas, said hull including double-skin portions which are water-tight to provide buoyancy, part of the water-tight portions extending along the sides of the hopper-type vehicle and part of the water-tight portions located at each end of the hopper-type vehicle, the total volume of said water-tight portions being designed to maintain the hopper-type vehicle afloat even when said hopper space is flooded with water, and end portions located at either end of the hopper-type vehicle and defining the ends of said hopper space, one of said end portions being longer than the other, the longer portion including an area which is located above the water-line of said hull when said hopper space is flooded, all of said machinery being mounted above said water-line and at least part of said machinery being mounted in said area; whereby, when the hopper space is flooded, the hopper-type vehicle retains its strength and rigidity, does not sink and can continue to function.

2. The waterborne freight carrying vehicle of claim **1** which further includes cover means removable mounted over said hopper space for keeping out undesirable elements such as trash, water and sparks from said hopper space.

3. The waterborne freight carrying vehicle of claim **1** wherein there are a multiple number of cargo tanks, each of which are substantially as long as said hopper space and which substantially fill the bulk of said hopper space.

4. The waterborne freight carrying vehicle of claim **3** wherein there are two extended cargo tanks, said two cargo tanks being horizontally mounted in said hopper space and arranged parallel to and on either side of the longitudinal centerline of said hopper space.

5. The waterborne freight carrying vehicle of claim **1** wherein each cargo tank is enclosed by a homogeneous thermal barrier, sad thermal barrier including a first portion located between said cargo tank and said supporting saddle portions, said first portion having a density adapted to support the weight of said tank without deformation and at least a substantial portion of the remainder of said thermal barrier having a lesser density.

6. The waterborne freight carrying vehicle of claim **5** wherein said thermal barrier is composed of foamed polyurethane and said thermal barrier is coated with mastic.

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