Feb. 18, 1969 N. K. BASILE ET AL 3,428,205

ARRANGEMENT FOR MAINTAINING ALIGNMENT OF COLD TANKS WITHIN A SHIP OR THE LIKE

Filed Sept. 16, 1966 Sheet 1 of 4

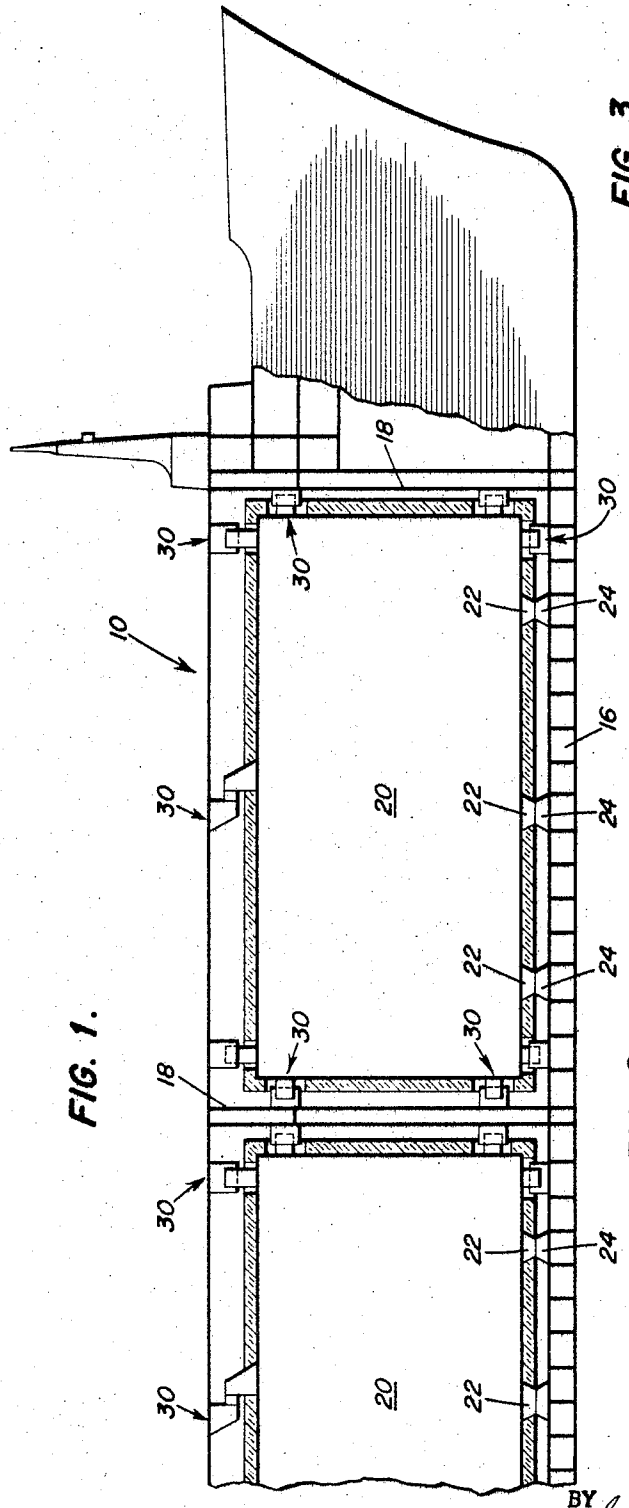


FIG. 1.

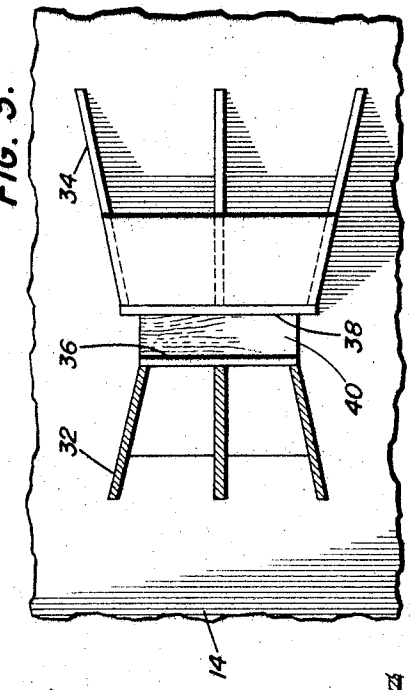


FIG. 3.

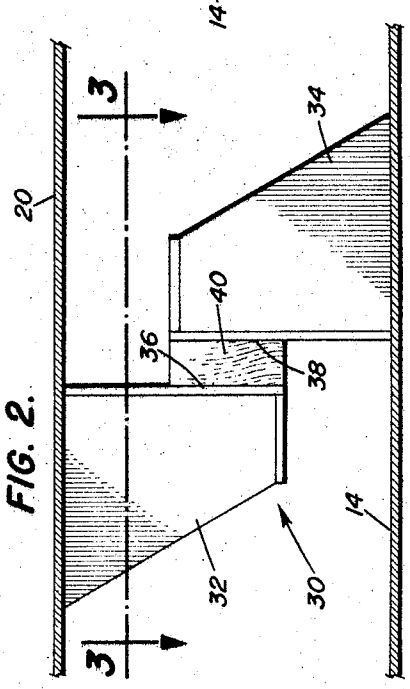


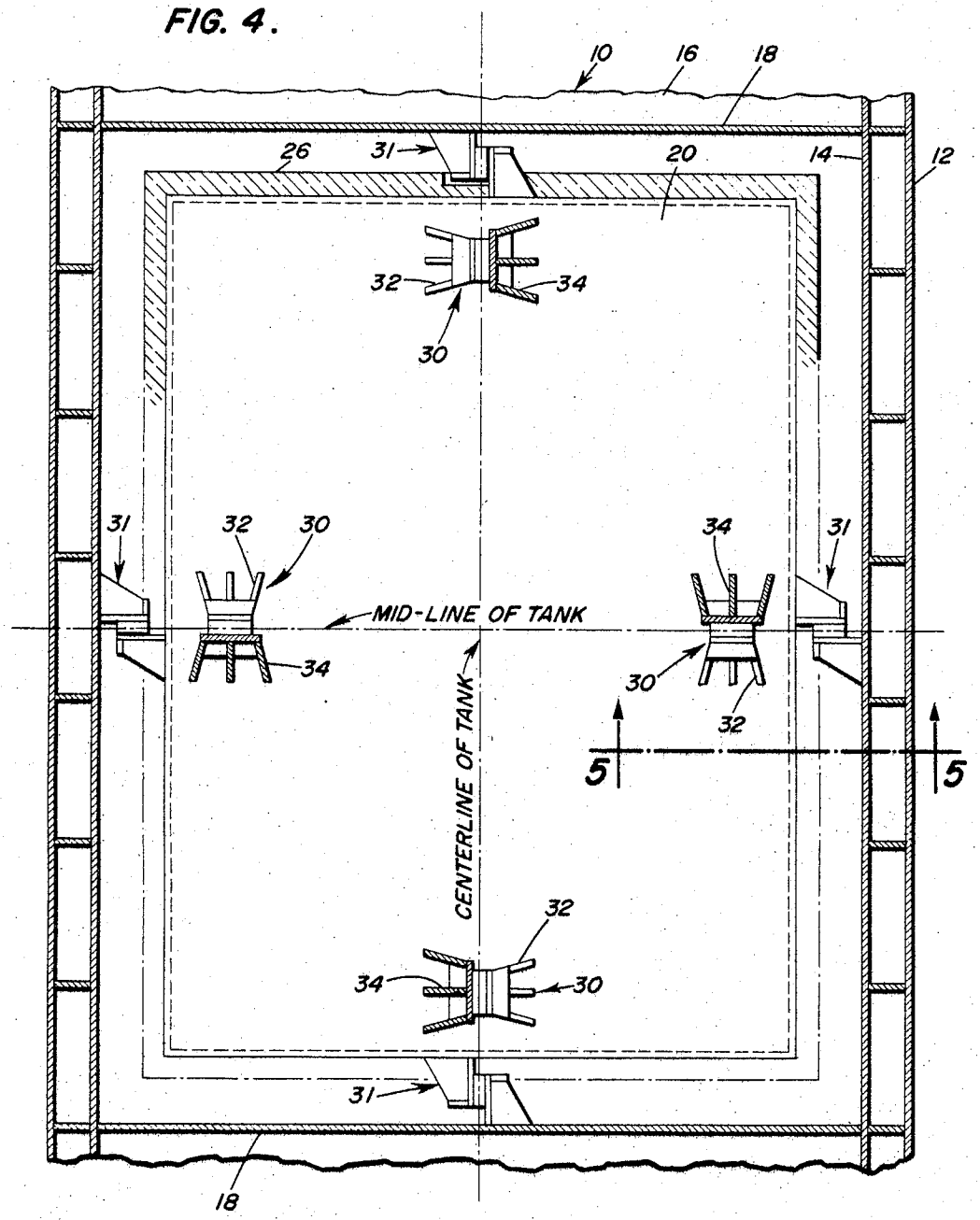
FIG. 2.

INVENTORS
Thomas F. Bridges
Norman K. Basile

BY Stevens, Davis, Miller & Mosher
ATTORNEYS

Feb. 18, 1969 N. K. BASILE ET AL 3,428,205
ARRANGEMENT FOR MAINTAINING ALIGNMENT OF COLD TANKS WITHIN A SHIP OR THE LIKE
Filed Sept. 16, 1966 Sheet 2 of 4

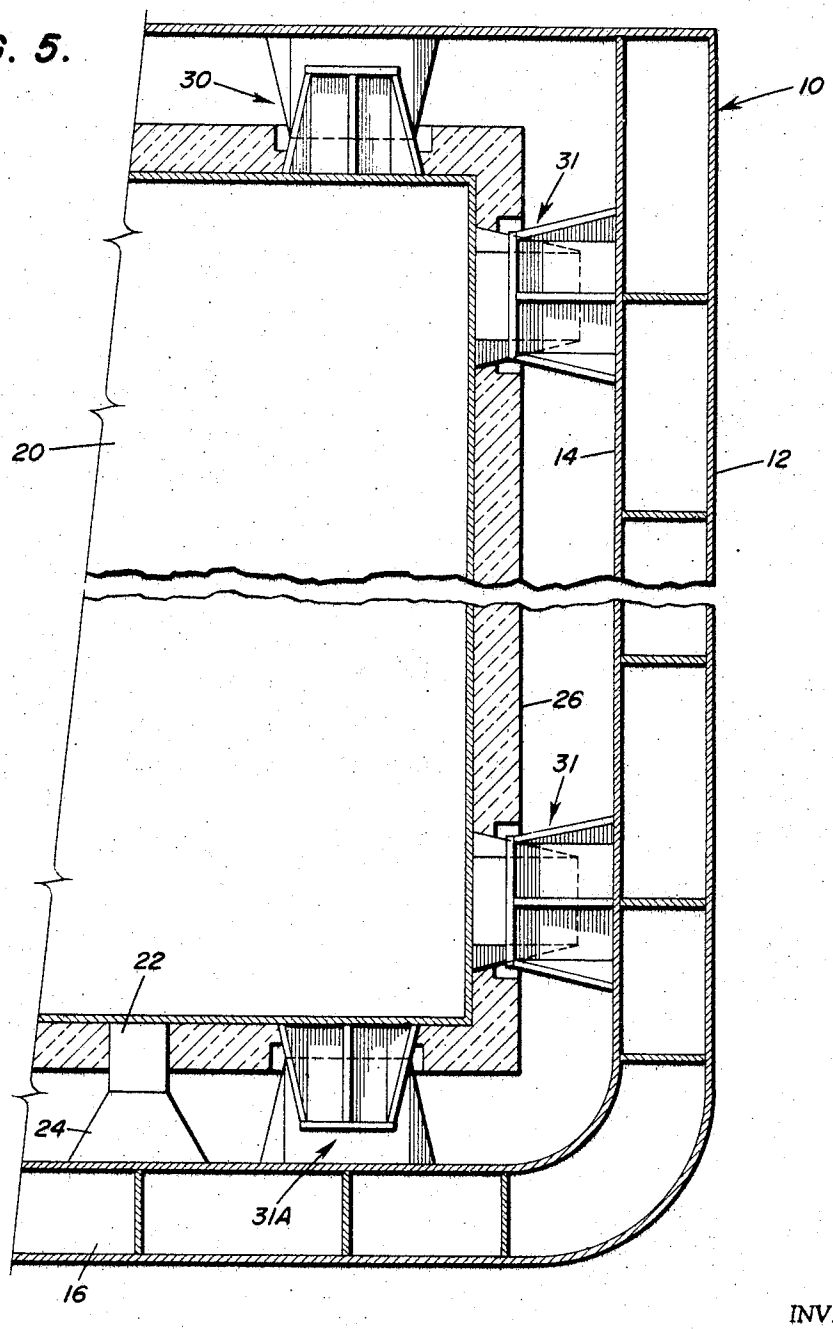
FIG. 4.



INVENTORS
Thomas F. Bridges
Norman K. Basile

BY Stevens, Davis, Miller & Mosher
ATTORNEYS

FIG. 5.

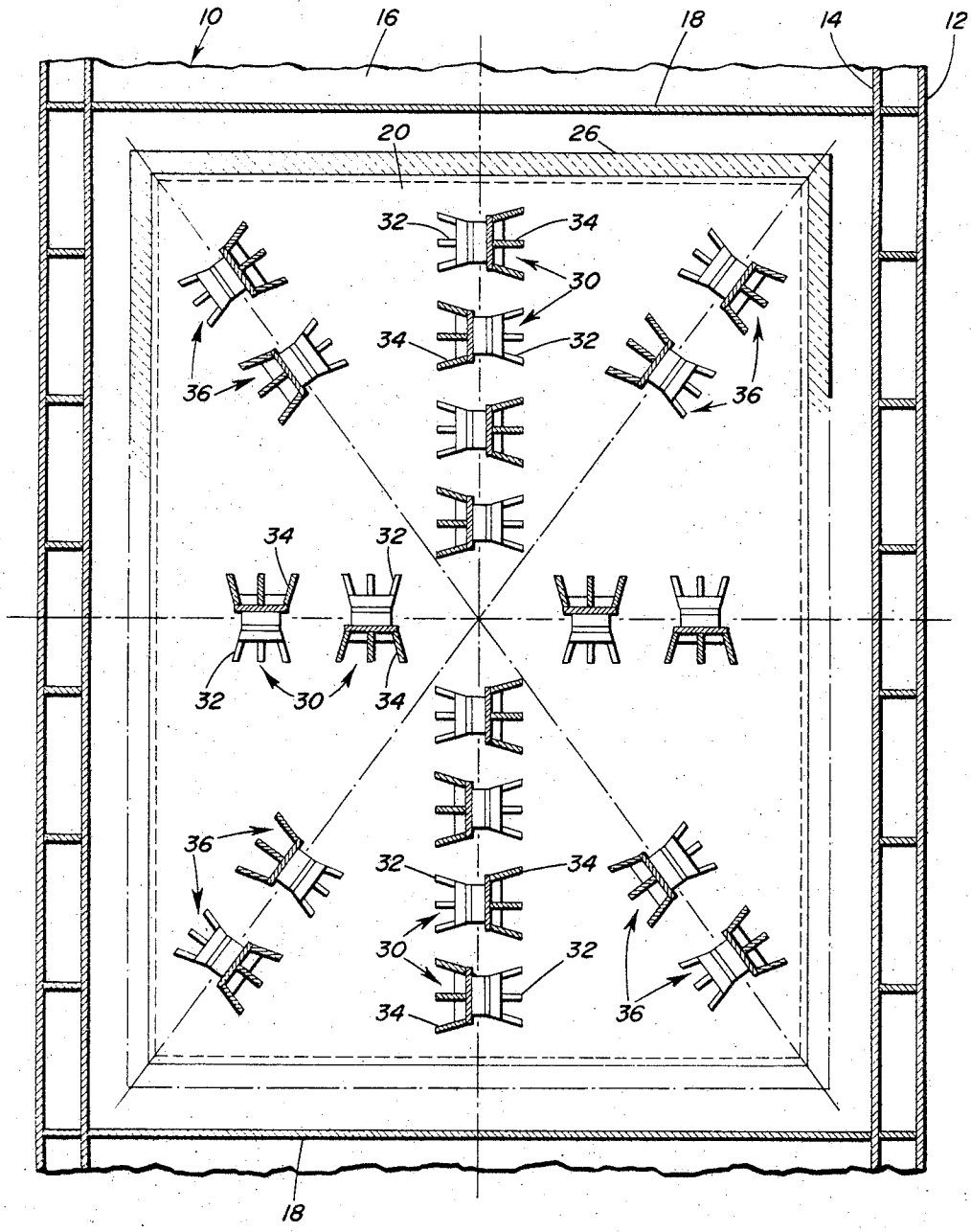


INVENTORS
Thomas F. Bridges
Norman K. Basile

BY Stevens, Davis, Miller & Mosher
ATTORNEYS

Feb. 18, 1969 N. K. BASILE ET AL 3,428,205
ARRANGEMENT FOR MAINTAINING ALIGNMENT OF COLD TANKS WITHIN A SHIP OR THE LIKE
Filed Sept. 16, 1966 Sheet 4 of 4

FIG. 6.



INVENTORS
Thomas F. Bridges
Norman K. Basile

BY Stevens, Davis, Miller & Mosher
ATTORNEYS

United States Patent Office 3,428,205
Patented Feb. 18, 1969

3,428,205

ARRANGEMENT FOR MAINTAINING ALIGNMENT OF COLD TANKS WITHIN A SHIP OR THE LIKE

Norman K. Basile, Bronx, and Thomas F. Bridges, Port Washington, N.Y., assignors to John J. McMullen, Montclair, N.J.

Filed Sept. 16, 1966, Ser. No. 579,868
U.S. Cl. 220—15 8 Claims
Int. Cl. B65d 25/24; B63b 25/08

ABSTRACT OF THE DISCLOSURE

An arrangement for maintaining a liquefied gas storage tank orientation within a ship's hull comprising buffer means connected to the tank and supporting ship structure for maintaining the alignment and orientation of the tank within the ship but permitting thermal expansion and contraction of the tank, each of said buffer means including a first member formed on the tank and a second member formed on ship structure, said members having overlapping surfaces and being aligned such that the members are free to move relative to each other in any direction except toward each other when the surfaces are in effective mutual contact, and wherein the buffer means comprises a plurality of such cooperating first and second members spaced from the others and arranged relative to one another such that each adjacent pairs thereof develop appropriately directed reaction forces so that said pairs act as a guide to confine the direction of thermal growth for the particular part of the tank with which the first member is formed.

The present invention relates to the transport of cryogenic liquids and more particularly to an arrangement for maintaining the alignment in orientation of liquefied gas cargo tanks within a transporting vehicle such as a ship or the like.

In the sea transport of liquefied gases such as methane and the like at approximately ambient pressure, large storage tanks are mounted within and spaced from the ship's hull. Because the tank experiences temperaturs in a wide range, provision must be made to permit thermal tank growth independent of the ship's structure. However, when the ship is at sea, the various ship motions must be imparted to the tank so as to avoid relative movement between the tank and the ship. Thus, on the one hand, the tank must be independent and free to grow relative to the ship and on the other hand the tank must move with the ship when at sea.

Conventional arrangements to maintain tank orientation within the ship include vertical keys and keyways mounted along the upstanding walls of the tank and supporting ship structure. For tanks resting on a flat and continuous bed of thermal insulation, horizontal channels have been cut on the top surface of the insulation and cooperating tank keys are provided to cooperatively slide within these channels in an attempt to maintain direction for the thermally growing tank.

It is the primary object of the present invention to provide a new and improved arrangement for maintaining the tank orientation relative to the ship and permitting thermal tank growth and for imparting the ship's motion to the tank so that there is no relative tank-ship movement when at sea.

In brief, a preferred embodiment of the present invention includes a plurality of buffers placed in any ones of a number of positions, that is, on the center line of the tank, midline of the tank, or diagonal of the tank and including the side and bottom of the tank. Each buffer is

formed of a bracket or foundation member mounted to the tank and a cooperating bracket or foundation member mounted to the ship, the said members having mutually facing overlapping surfaces so that one member is free to move in any direction relative to the other member except in the direction toward the other member. In a preferred embodiment, the overlapping surfaces are separated by a block of load bearing insulation connected to one of the members, said insulation preventing heat transfer from the tank to the ship through the bracket members. In addition, one surface of the insulation may act as a bearing surface for the other member. With the buffers alternately arranged in direction of reaction, the buffer system acts as a guide for contraction and expansion, and by virtue of the reaction force of the buffer members, the tank is secured in position while the ship is rolling or otherwise in motion.

Other and further objects of the invention will become apparent with the following detailed description when taken in view of the appended drawings in which:

FIGURE 1 is a longitudinal sectional view illustrating one of the tanks arranged according to the present invention within a ship.

FIGURE 2 is a side elevation of one embodiment of the buffers according to the present invention.

FIGURE 3 is a sectional view taken along line 3—3 of FIGURE 2.

FIGURE 4 is a top plan with parts broken away of a tank arranged in a ship and including the buffer system of the present invention.

FIGURE 5 is a partial vertical transverse section taken along line 5—5 of FIGURE 4.

FIGURE 6 is a top plan view similar to that of FIGURE 4 but depicting an alternate buffer arrangement for the tank.

With reference to the drawings in detail, a transport ship **10** having an outer skin **12** and an inner hull **14** and double bottom **16** is divided into holds by transverse bulkheads **18**. A liquefied gas storage tank **20** made of material that can withstand extremely low temperatures, such as —160° centigrade in the case of liquefied methane, is supported within each hold. Tank **20** can be of any suitable construction such as a double or single barrier tank with flat or corrugated wall plating. The bottom of tank **20** is provided with a plurality of depending stools **22** each of which rests on an insulated pillar **24** which is secured to bottom **16**. The contacting surfaces of stools **22** and pillar **24** are such to permit lateral relative movement in response to thermal growth and the like. However, tank **20** can be supported by any other suitable arrangment such as beds of load bearing insulation. In order to reduce the heat transfer, layers of thermal insulation **26** blanket the outside of tank **20** in such a way that there is a space between the outer surface of the insulation **26** and the surrounding ship's structure. Alternately, the insulation can be hung within the outer ship structure so that the dead space exists between the insulation and the outer tank wall.

According to the invention, the tank guide system formed by a plurality of buffers **30** maintain a predetermined tank-ship orientation but permit thermal tank expansion and contraction and impart all the ship motion to the tank. As can be seen from the figures, buffers **30** are arranged on the top, sides and bottom of the tank, but it should be understood that the number and locations of the buffers **30** depends upon the ship and tank sizes and the particular stresses and forces anticipated for the job.

With reference to FIGURES 2 and 3, a preferred embodiment of buffer **30** is illustrated. Each buffer **30** comprises a foundation or bracket member **32** connected to tank **20** and another cooperating foundation or bracket

member **34** formed on the ship's supporting structure, such as inner hull **14**. Brackets **32** and **34** extend in opposite directions and have overlapping mutually facing surfaces **36** and **38**. In order to reduce heat transfer, a block **40** of load bearing insulation such as balsa wood or the like, is connected to bracket **32** by conventional means (not shown) such as bolts or the like. In this way, the surface of block **40** contacting surface **38** of bracket **34** provides a bearing surface so that bracket **32** can slide in a plane parallel to the contacting part of surface **38**.

The operation of buffer **30** is such that the adjacent part of the tank near bracket **32** is permitted to move in any direction except in the direction toward the overlapping part of bracket **34** when block **40** and surface **38** are in mutual contact.

An alternate configuration for buffer **30** would be to provide metal-to-metal contact by surfaces **36** and **38** and to mount one of the brackets **32** or **34** upon a block of load bearing insulation so as to reduce heat transfer in the conventional way. It should also be understood that block **40** of the embodiment of FIGURE 2 can be alternately connected with bracket **34** in lieu of being connected to bracket **32**.

Referring now to FIGURES 4 and 5, four of the buffers are arranged on the top of tank **20** near the outer edges thereof. Two buffers **30** are aligned with the center line axis of the tank and the other two are aligned with the midline axis of the tank. Additional buffers **31** similar in construction to buffers **30** are formed between the tank upstanding walls and the upstanding ship supporting structure generally as shown in the figures. It is preferable to locate buffers **31** near the top and bottom of tank **20** so that the reactive force developed thereby has benefit of a long moment arm to the roll axis of ship **10**. If desired, additional buffer members **31A** similar in construction to buffers **30** are provided on the bottom of tank **20**.

Adjacent pairs of buffers **30** and **31** are arranged so that the bracket member of buffer **31** attached to the ship and the bracket member of buffer **30** attached to the tank are on the same side of the imaginary line along which that part of the tank is to expand and contract. In this way, adjacent pairs of buffers **30** and **31** act as a guide to define the directions of thermal growth for each part of the tank. In addition, regardless of the ship's motion in roll, heave, and pitch, the forces of ship motion are imparted through the buffer members to the tank so that the relative tank-ship positions are maintained.

An alternate arrangement of the buffer system is depicted in FIGURE 6 wherein some of the buffers **36** are aligned along the diagonals of the tank to confine the thermal growth thereof along lines extending through the imaginary center of the tank.

It will be appreciated that tank **20** is supported on the bottom of the ship and is free to expand and contract vertically in response to temperature changes. If desired, a plurality of lift-preventing members may be formed on the tank and supporting ship's structure to prevent relative vertical movement between tank and ship. For further disclosure of such lift preventers, see the copending patent application entitled, Arrangement for Keying Liquefied Gas Storage Tanks Within a Transport Vessel, filed Sept. 7, 1966, applicant being Thomas F. Bridges and assigned to the present assignee.

What is claimed is:

1. An arrangement for maintaining a liquefied gas storage tank orientation within a ship's hull comprising buffer means connected to the tank and supporting ship structure for maintaining the alignment and orientation of the tank within the ship but permitting thermal expansion and contraction of the tank, each said buffer means including a first member having a flat surface fixedly secured on the tank and a second member having a flat surface fixedly secured on ship's structure, the flat surfaces of said members being in effective mutual engagement so that the members are free to move relative to each other in any direction except toward each other and wherein the buffer means comprises a number of sets of such cooperating pairs of first and second members, each said set comprised of a plurality of said cooperating pairs of first and second members spaced apart and with all their flat engaging surfaces aligned in a common plane extending through the stationary point of the tank, adjacent cooperating pairs developing oppositely directed reaction forces so that adjacent cooperating pairs act to guide and confine the direction of thermal growth of said tank along the several common planes extending through the stationary point of the tank.

2. An arrangement as set forth in claim **1** wherein said surfaces of each said cooperating first and second members are arranged in parallel planes extending across the general direction from one member to the other.

3. An arrangement as set forth in claim **1** wherein the said surface of each said member formed on the ship's structure acts as a guide along which the other cooperating surfaces can slide in a direction parallel to the plane of the first mentioned surface during periods of thermal tank growth.

4. An arrangement as set forth in claim **3** wherein each said first and second members comprise a pair of brackets, a block of thermal insulation formed integrally with one of said brackets to prevent heat transfer from the ship to the tank through said first and second members.

5. An arrangement as set forth in claim **4** wherein said block of insulation contacts said surface of the other member and acts as a bearing surface therefor.

6. An arrangement as set forth in claim **2** wherein a plurality of such first and second members are arranged on the top of said tank and main deck of the ship and along the upstanding tank walls and ship's supporting structure.

7. An arrangement as set forth in claim **2** wherein a plurality of such first and second members are provided with their surfaces aligned with the centerline and midline of the tank.

8. An arrangement as set forth in claim **2** wherein the surface of said first and second member are aligned in a plane which intersects an imaginary point in the tank which is maintained stationary at all times relative to the ship, said plane being other than the plane through the midline or center line axis of the tank.

References Cited

UNITED STATES PATENTS

2,798,364	7/1957	Morrison	114—74
3,011,321	12/1961	Clauson.	
3,064,612	11/1962	Gardner et al.	220—15 X
3,305,122	2/1967	Pringle	220—15
3,319,431	5/1967	Clarke et al.	114—74

JOSEPH R. LECLAIR, *Primary Examiner.*

JAMES R. GARRETT, *Assistant Examiner.*

U.S. Cl. X.R.

114—74