Feb. 4, 1969 T. F. BRIDGES 3,425,583

ARRANGEMENT FOR KEYING LIQUEFIED GAS STORAGE TANKS WITHIN A TRANSPORT VESSEL

Filed Sept. 7, 1966 Sheet 1 of 4

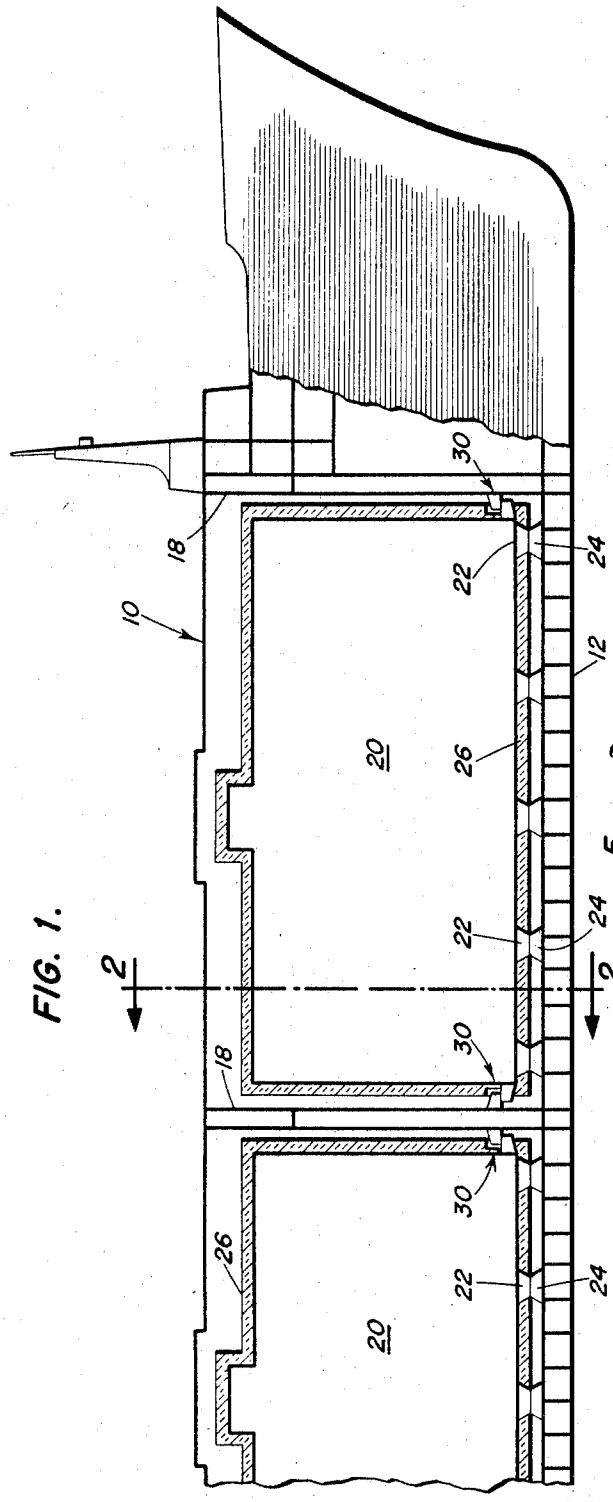


FIG. 1.

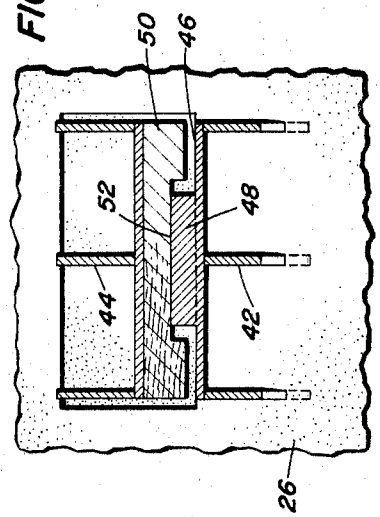


FIG. 5.

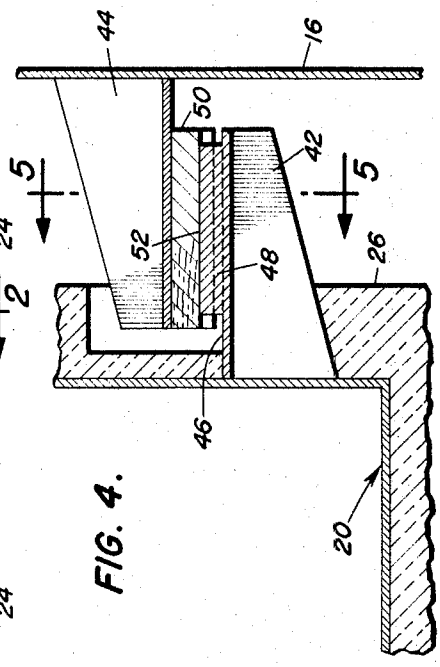


FIG. 4.

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FIG. 2.

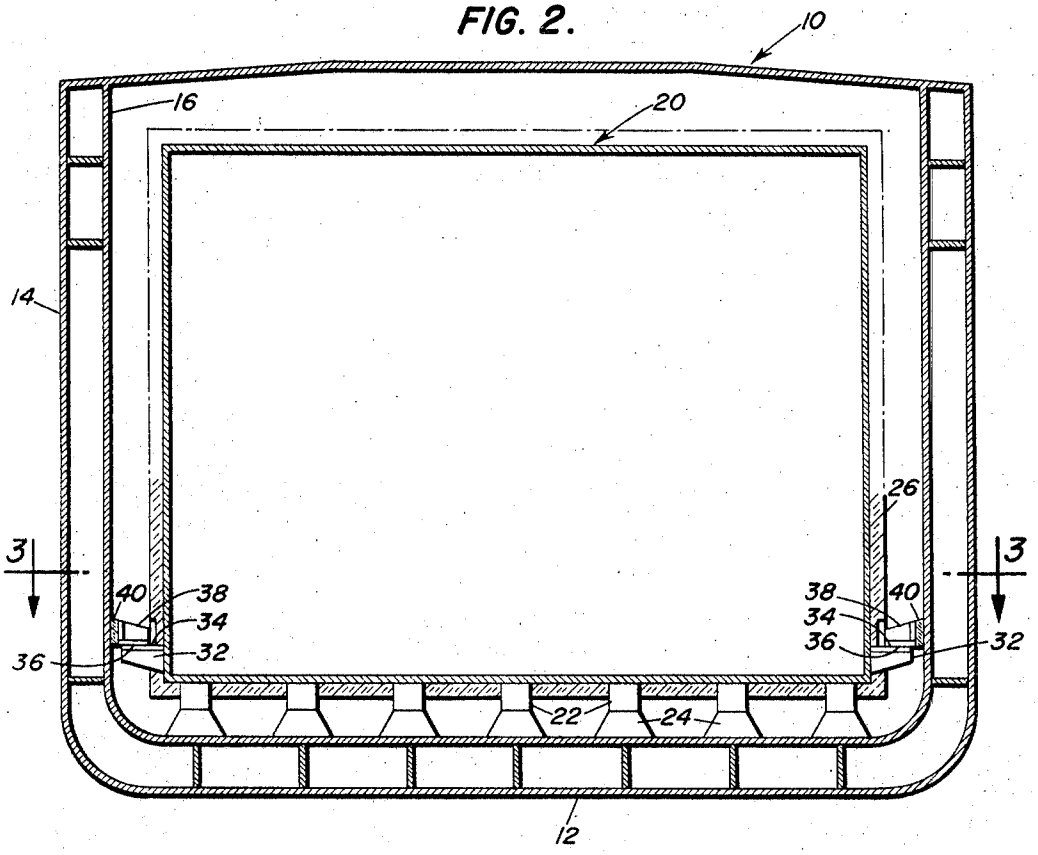
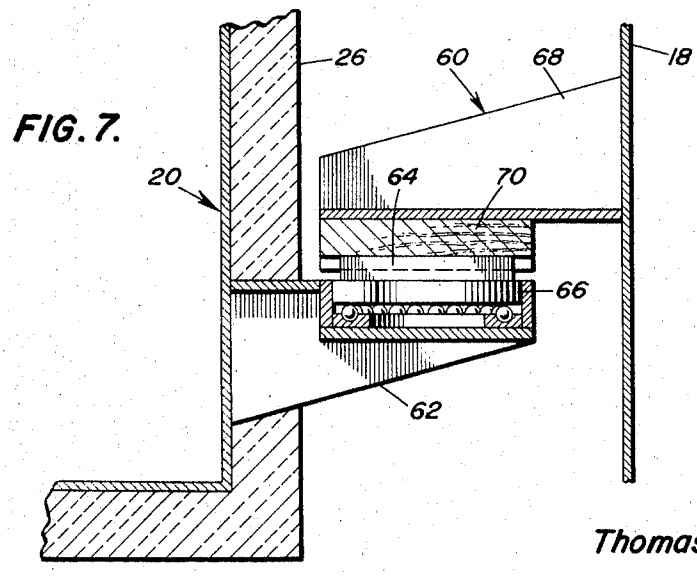


FIG. 7.



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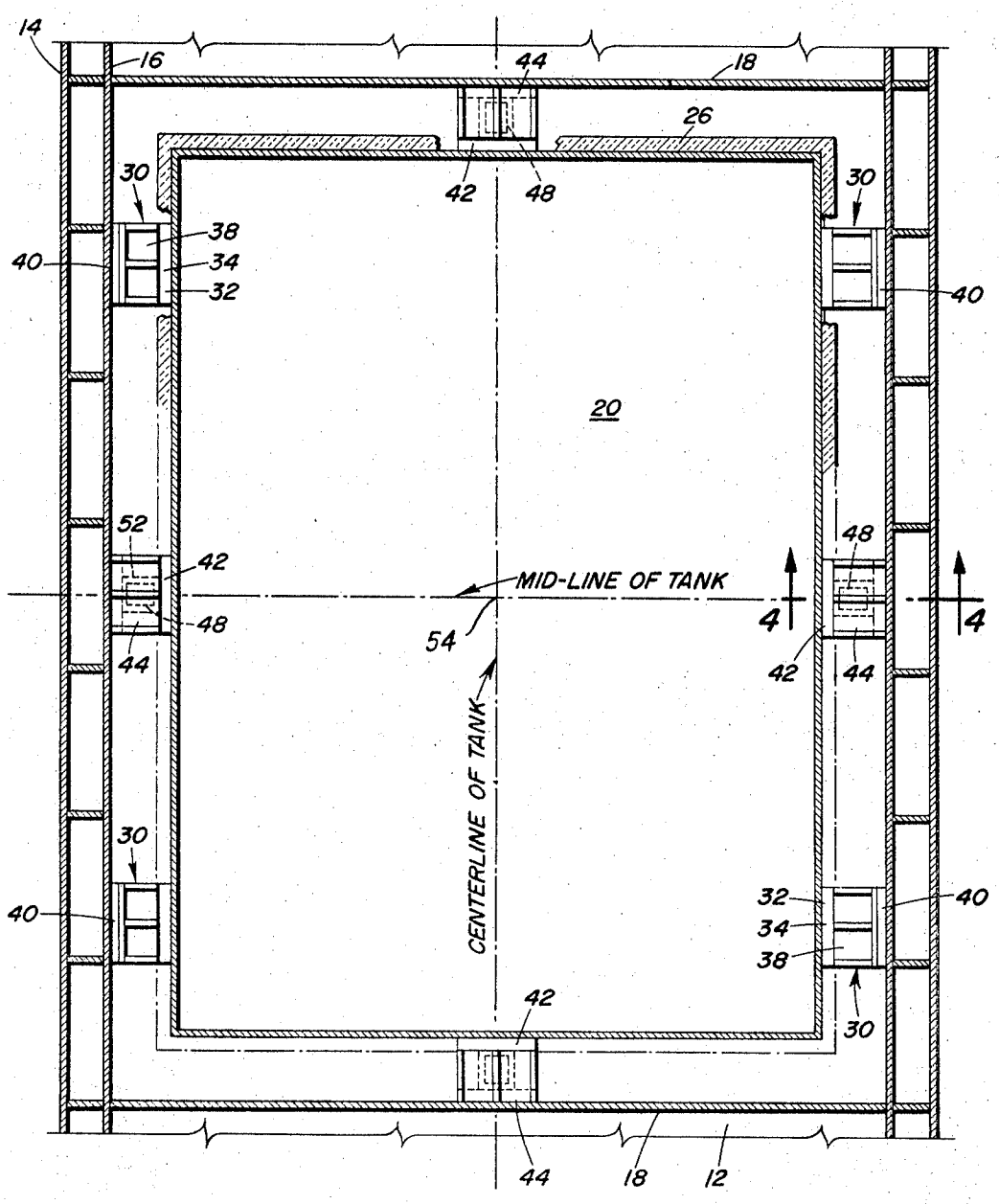


FIG. 3.

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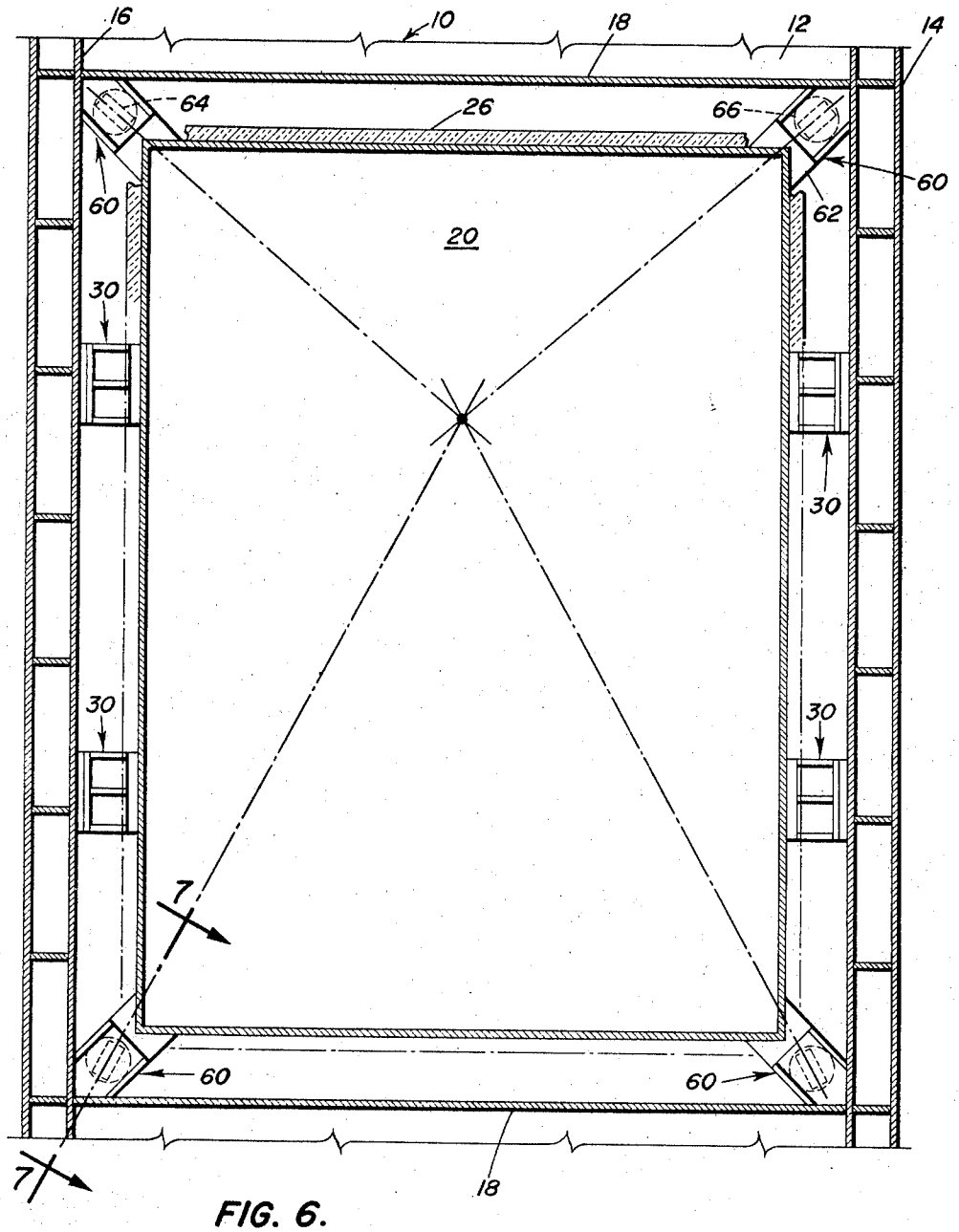


FIG. 6.

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3,425,583

ARRANGEMENT FOR KEYING LIQUEFIED GAS STORAGE TANKS WITHIN A TRANSPORT VESSEL

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U.S. Cl. 220—15 9 Claims
Int. Cl. B65d 25/24; B63b 25/14, 25/16

ABSTRACT OF THE DISCLOSURE

A keying arrangement for liquefied gas storage tanks within a transport ship wherein the keying arrangement maintains one point of the planar bottom of the tank fixed relative to the hull structure of the ship when the tank is expanding or contracting. The keying arrangement is composed of two members cooperating to define the key and keyway, with one of the members fixed to the upstanding tank wall, and the other fixed to the hull structure. The movement of the keying arrangement is confined to a plane substantially parallel to the plane of the bottom of the tank.

The present invention relates to liquefied gas transport vessels and more particularly to a novel arrangement for maintaining the cargo tank orientation within the vessel.

In the transport of liquefied gas cargoes, such as methane or the like, at about ambient pressures, the tank must at times experience cryogenic temperatures and at other times be at ambient temperatures. Consequently, the tanks must be free to contract and expand in response to the wide temperature variations. It therefore becomes necessary to include means to maintain the tank orientation at some fixed or known position relative to the vessel and to prevent certain parts of the tank from binding during thermal tank growth such that high stress concentrations are not experienced by the tank.

It is the primary object of the present invention to provide a new and improved keying arrangement which includes at least one member integral with the tank and another member integral with the ship's supporting structure, said members being located outside the plane of one of the tank upstanding walls and forming a key and keyway arranged such that the key moves in a plane which is generally horizontal.

In brief, one embodiment of the present invention comprises a first member arranged on an upstanding wall of the tank and a second member arranged on the ship's supporting structure, the members having parts forming a generally horizontal key and keyway configuration and being located near the bottom of the tank. The first member is located below the second member so that the arrangement functions as a lift preventer as well as a part of the keying means. The keying arrangement comprises a plurality of such pairs of members positioned along the center line and midline of the tank so as to fix the theoretical center point of the tank bottom.

Another embodiment of the present invention comprises the first and second members as described wherein one of the members includes a rotatable mount for the key or keyway so that the line of travel of the tank member can change within the plane of rotation. A plurality of such first and second members is provided each being located at a different corner of the tank.

Other and further objects of the present invention will become apparent with the following detailed description when taken in view of the appended drawings in which FIGURE 1 is a longitudinal vertical section illustrating a plurality of tanks within the hold vessel.

FIGURE 2 is a vertical transverse section taken along line 2—2 of FIGURE 1.

FIGURE 3 is a horizontal section along line 3—3 of FIGURE 2 and illustrating one of the tanks within one of the holds of the vessel.

FIGURE 4 is a side elevation of one of the key and keyway members of the present invention.

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

FIGURE 6 is a horizontal section illustrating a tank within the hold and including another embodiment of the present invention.

FIGURE 7 is a side elevation of a key and keyway member of the embodiment of FIGURE 6.

With reference to the drawings in detail, a vessel **10** of the type described includes a double bottom **12** and an outer skin **14** and spaced inner hull **16**. Transverse bulkheads **18** divide the cargo section of vessel **10** into holds. A single cargo tank **20** is arranged in each hold and is supported above the hull bottom by a plurality of pillars **22** integral with tank **20** and a plurality of insulated stools **24** each vertically aligned with one of the pillars **22**. The contacting surfaces of pillars **22** and stools **24** are generally flat permitting free lateral movement of the tank in response to expansion and contraction thereof. Tank **20** is a free-standing, self-upporting tank of any plate construction, such as flat plate, corrugated plate, or the like, and provides one or more barriers to the liquid therein. Layers of thermal insulation **26** completely blankets all outer surfaces of tank **20** although if desired the insulation can be spaced from tank **20** and held on the surrounding ship's supporting structure. For further disclosure of a suitable tank and tank insulation, see the patent application Ser. No. 440,081, filed Mar. 16, 1965, owned by the present assignee.

According to the present invention, a plurality of lift preventers **30** are provided near the bottom of tank **20** and serve to prevent any relative vertical movement of tank **20**, such movement as rocking or the like in response to the roll of the vessel **10** or the sway of the liquid within tank **20**. Each lift preventer comprises a first member **32** arranged on an upstanding wall and projecting outward therefrom, said member **32** having a generally flat upper surface **34** which contacts and cooperates with a flat lower surface **36** of the second member **38** which is mounted to the ship's supporting structure and extends toward and overlaps member **32**. One of the members, such as member **38**, is provided with a block of thermal insulation **40** in order to prevent heat transfer between the ship's supporting structure and tank **20**. Suitable mounting means such as bolts and the like (not shown) can be used to secure the parts of member **38** as an integral piece.

The keying arrangement according to the present invention includes a pair of members **42** and **44** arranged within the space outside of one of the tank's upstanding walls. The members are shaped generally as shown and member **42** has an upper flat surface **46** with an elongated key **48** defined on the top thereof. The bottom surface of member **44** includes a block **50** of loadbearing insulation such as balsa wood or the like in which there is defined a cooperating keyway **52** which receives the key **48** for reciprocation. Block **50** is held to member **44** by any suitable means such as bolts or the like (not shown) and serves to reduce the thermal transfer through members **42** and **44**. It can be seen that members **42** and **44** not only function as part of the key system but also serve as lift preventers in the same sense as preventers **30** as described. With members **42** and **44** arranged near the bottom of tank **20**, there is substantially no relative vertical movement between the key **48** and keyway **52** notwithstanding the wide temperature ranges experienced by tank **20**. It should be understood that the key could well

be formed by member **44** and the keyway by member **42** and the insulation my be provided by an arrangement such as member **40** in lieu of the insulation block **50** without departing from the spirit and scope of the present invention.

As better seen in FIGURE 3, a pair of members **42** and **44** are provided at each of the four upstanding walls of tank **20**. The keys and keyways are aligned along the center and midlines of the tank so as to fix the imaginary center point **54** of the bottom of tank **20**. In this way, the tank is free to expand and contract in all directions about point **54** and the alignment of tank is maintained by the keying arrangement. By confining the direction of thermal growth of certain parts of the tank, the key and keyway system prevent the development of high stress concentrations within the tank during the times the tank is changing its dimensions.

In reference to FIGURES 6 and 7 where like preference numerals refer to like structure, another embodiment of the present invention is disclosed. The keying members **60** are located again near the bottom of tank **20** but unlike the embodiment of FIGURE 3, the keying members **60** are arranged near the corners of the tank. As better seen in FIGURE 7, the member **62** forming the elongated key **64** is provided with a rotating mount **66** which supports the key **64**. Mount **66** cooperates with bearings or the like so as to be freely rotatable in the horizontal plane. Member **68** mounted on the ship's supporting structure, such as transverse bulkhead **18**, is provided with a block **70** of balsa wood or the like in which the keyway is defined in the manner described.

With the arrangement of FIGURE 6, the direction of movement of the key or member **62** can change within the plane of the rotating mount **66**. This feature becomes useful when a point other than the imaginary intersection between the center line and midline of the tank is held by some means fixed relative to the vessel for purposes of intentionally causing an uneven but predetermined tank growth.

It should be understood that other and various modifications can be made to the herein disclosed embodiments of the present invention without departing from the spirit and scope thereof.

What is claimed is:

1. A vessel for transporting liquefied gas or the like at about ambient pressure comprising a ship's hull, a tank to contain the liquid cargo having a substantially planar bottom arranged within said hull, support means supporting the bottom of said tank above the hull bottom, the upstanding walls, of the tank being horizontally spaced from the ship supporting structure, keying means within said hull for maintaining at least one point of the tank bottom fixed relative to the hull when the tank is expanding or contracting, said keying means comprising a plurality of first members fixedly secured to the upstanding walls of the tank adjacent their lower edges, each of said members defining one of a key and keyway and a plurality of second members fixedly secured to the ship supporting structure and each defining the other of a key and keyway cooperating with a corresponding one of said first members, the key and keyway formed by said first and second members being at least in part outside the plane of one of the upstanding tank walls and being arranged so that the movement of each of the keys relative to its corresponding keyway is confined to a plane which is generally parallel to the plane of the bottom of the tank.

2. A vessel as set forth in claim **1** wherein insulation means is mounted on one of said first and second members to reduce the heat transfer between tank wall and ship supporting structure.

3. A vessel as set forth in claim **2** wherein said insulation means comprises a block of insulation within which the keyway is defined.

4. A vessel as set forth in claim **1** further comprising a plurality of lift preventing means located on the two outboard sides of the tank and near the bottom thereof.

5. A vessel as set forth in claim **1** wherein said keying means is located near the bottom of the tank, said first member being formed on an upstanding tank wall and projecting outward therefrom.

6. A vessel as set forth in claim **1** wherein said keying means comprises four pairs of said first and second members, each pair being arranged at a different one of an upstanding tank wall, two of said pairs having their keyways aligned along the tank centerline, and the other two of said pairs having their keyways aligned along the tank midline.

7. A vessel as set forth in claim **1** wherein one of said first and second members includes a rotatable mount supporting its respective key or keyway to permit a change in key alignment during tank expansion or contraction.

8. A vessel as set forth in claim **7** wherein said keying means include at least two pairs of such first and second members, each pair being located near a different corner of the tank.

9. A vessel as set forth in claim **7** wherein said keying means includes at least four pairs of each first and second members, each pair being located near a different corner of the tank, and wherein additional means are provided to fix one point of the tank bottom relative the vessel, said point being other than the tank midline, centerline intersection.

References Cited

UNITED STATES PATENTS

1,094,712	4/1914	Gale	220—15
2,241,822	5/1941	Marsh	114—74
2,905,352	9/1959	Henry	220—15
2,954,003	9/1960	Farrell et al.	220—15X
3,025,993	3/1962	Horton et al.	220—15
3,064,612	11/1962	Gardner et al.	220—15X
3,071,094	1/1963	Leroux	220—15X
3,305,122	2/1967	Pringle	220—15
3,319,431	5/1967	Clarke et al.	114—74
3,339,515	9/1967	Reed	220—9

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U.C. Cl. X.R.

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