Jan. 5, 1965 S. B. FIELD 3,164,120

FLUME STABILIZATION SYSTEM FOR TANKERS AND THE LIKE

Filed June 13, 1963 4 Sheets-Sheet 1

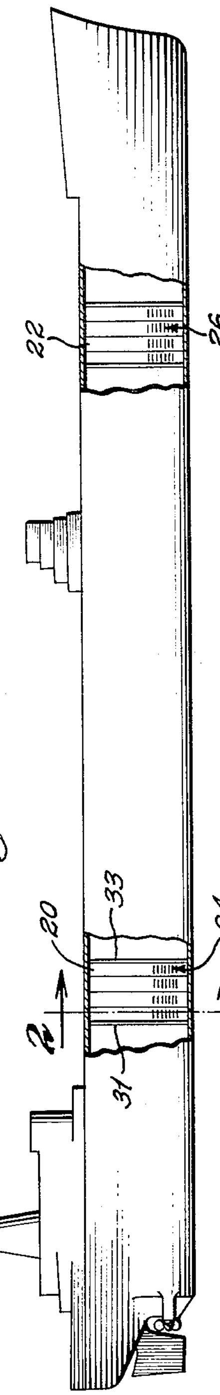

Fig. 1.

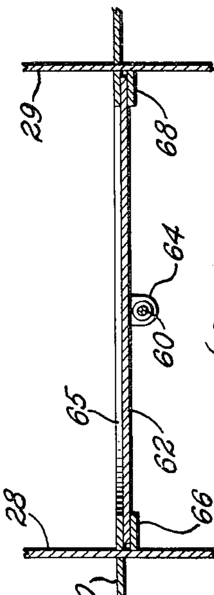

Fig. 6.

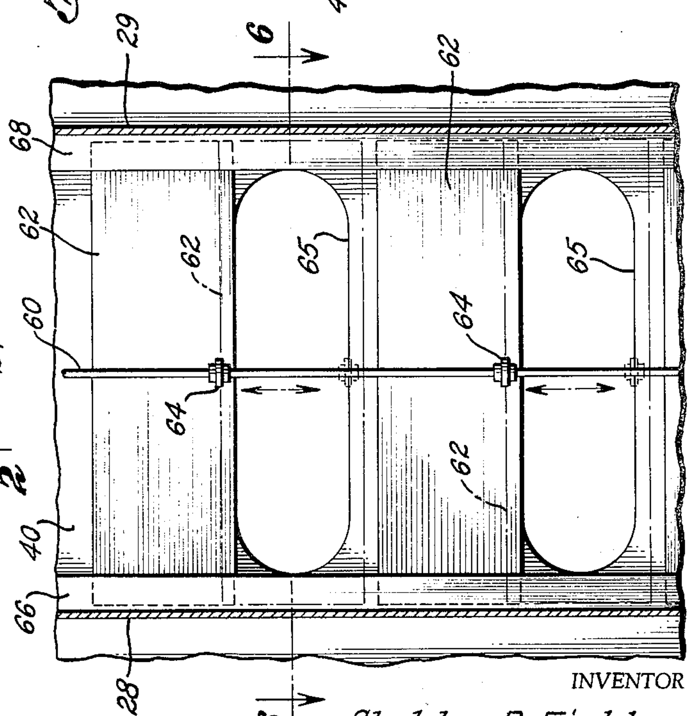

Fig. 5.

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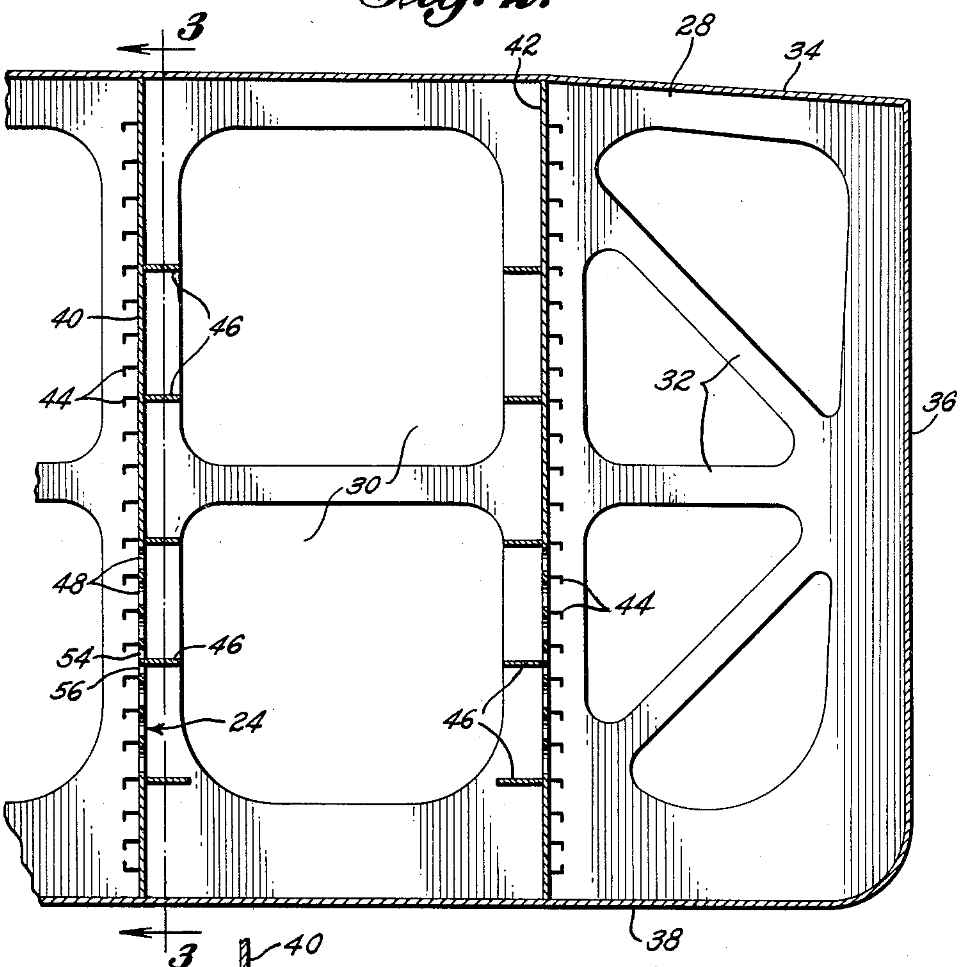
Fig. 2.



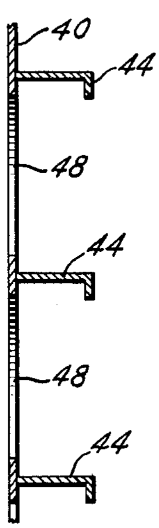


Fig. 4.

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FLUME STABILIZATION SYSTEM FOR TANKERS AND THE LIKE

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Fig. 3.

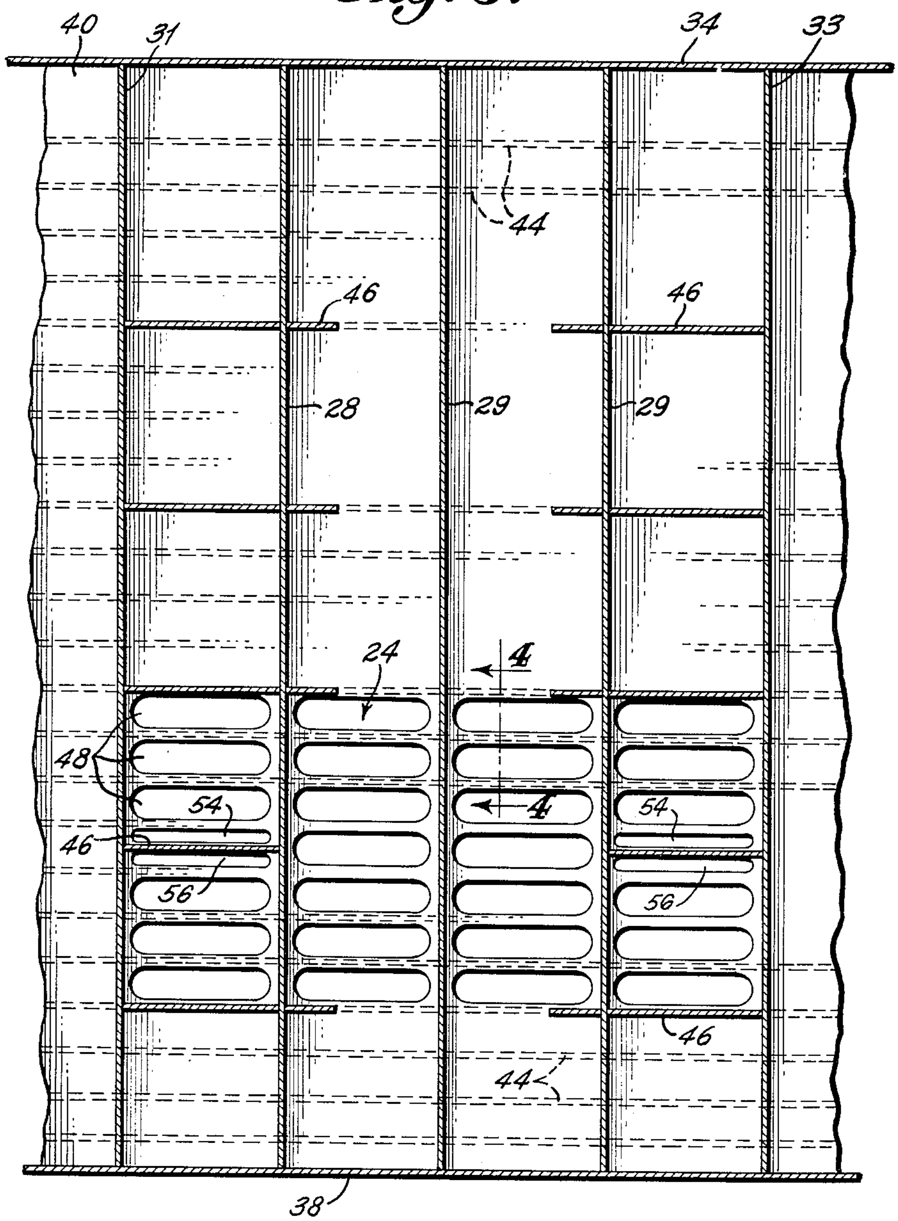

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Fig. 7.

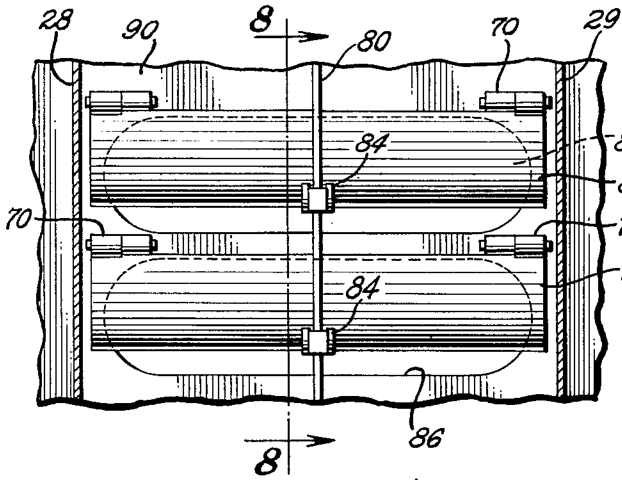


Fig. 8.

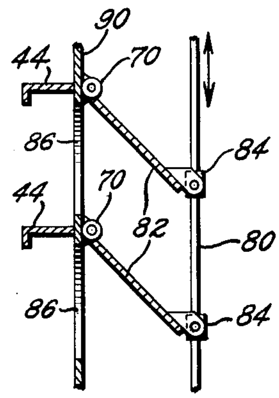


Fig. 9.

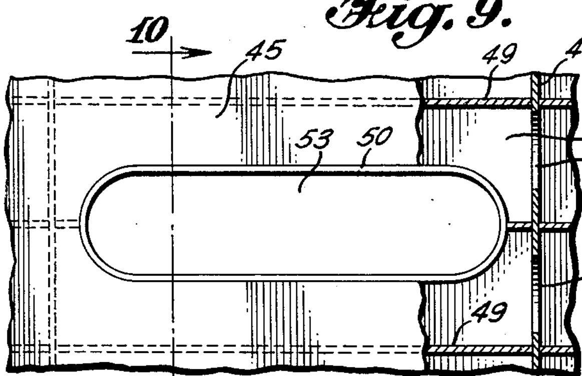
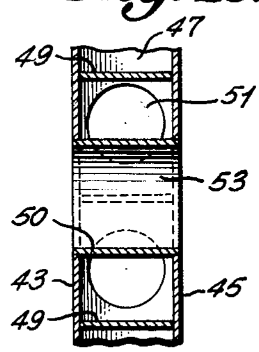


Fig. 10.



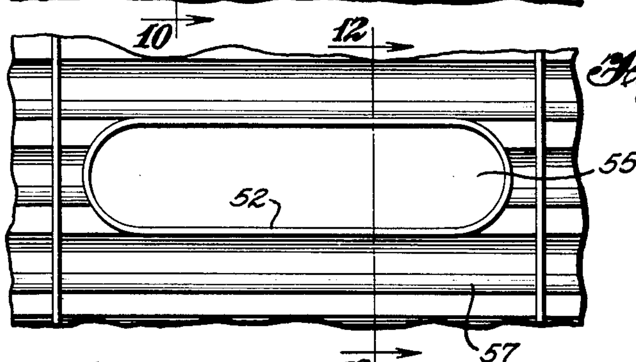
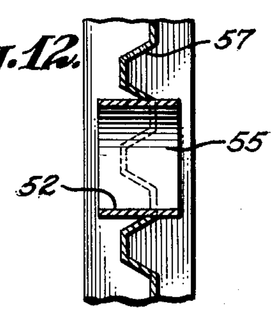


Fig. 11.

Fig. 12.



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3,164,120
FLUME STABILIZATION SYSTEM FOR TANKERS AND THE LIKE

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14 Claims. (Cl. 114—125)

The present invention relates to improved roll stabilizing apparatus for ships or other water going vessels and more particularly to tankers or bulk carriers to stabilize against roll regardless of water conditions encountered.

It is already well known that vessel stabilization against rolling can be achieved through the use of passive stabilization systems incorporating liquid storage points aboard ship usually spaced as far apart athwartship as it is practicable and interconnecting these storage points by means of a liquid duct with appropriate damping means located in this duct. A suitable liquid, usually seawater, is then added to the tank system to a predetermined level to accomplish the desired roll stabilizing effect. Such stabilization systems are described in U.S. Patents Nos. 3,054,373, 3,083,672 and 3,083,674.

Shipowners and users have long appreciated the desirability of this stabilizing effect and the various flume stabilization systems now in use have notably accomplished this result. The extent to which any ship is subjected to rolling is dependent largely upon the roll characteristics of the individual ship, including its own dampening properties and the frequency and amplitude of the waves exciting the ship. In the design of passenger carrying ships the inclusion of hull configurations which will give the most comfortable passenger ride can be an important consideration. However, in ships primarily designed for carrying cargo, hull configurations are very strongly determined by the economic necessity of gaining the maximum cargo space within the hull, and riding characteristics are of a secondary nature. This has been particularly true in some of the more recent large size tankers, such as, for example, a ship which has a length overall of about 940 feet, a beam of about 132 feet, and a depth (molded) of about 67 feet. Such a tanker is capable of carrying more than 100,000 tons of dead weight at very competitive speeds. If a passive tank stabilization system were to be designed for such a ship in accordance with past teachings, it would be necessary to install at least two large tanks athwartship at the ship's widest beam together with the necessary crossover ducting and accompanying dampening means for the water passing through this crossover duct. This type of installation would be accomplished by fabricating the tanks in the ship according to specification, installing them at a high level and between adjacent decks to gain the maximum stabilizing effect while using a minimum of interior space. In a large ship, an appreciable amount of cargo space would be eliminated in order to install such a stabilization system. In addition, the cost of installation of a stabilization system in a ship such as a large tanker also tends to be very expensive because the hull may be highly compartmentalized and it would be necessary to cut through many webs and bulkheads to add the necessary auxiliary tanks and to add additional strengthening to compensate for that which was cut away. Also, because of the inherent mobility of a liquid cargo in a tanker the roll characteristics of the ship will vary with the load being carried, possibly necessitating the installation of some for means adjusting the stabilizing system to tune it to the characteristics of the ship.

Accordingly, it is a principal object of the present invention to provide a means of stabilizing a large tanker without the necessity of extensive modification of bulkheads and other supports.

It is another object of the present invention to provide a system of installing a passive stabilization apparatus in a ship utilizing as much of the existing structure of the ship as possible.

It is another object of the present invention to provide a means stabilizing a tanker while utilizing the tanker's fluid cargo itself or ballast as the stabilizing medium rather than adding additional non-productive weight.

Other and further objects of the present invention will become more readily apparent from the following detailed description of a preferred embodiment of the present invention when taken in conjunction with the appended drawings, in which:

FIGURE 1 is a side elevation of a tanker with broken-away portions showing the location of the flume stabilization system tanks;

FIGURE 2 is a sectional view along line 2—2 of FIGURE 1;

FIGURE 3 is a sectional view along line 3—3 of FIGURE 2;

FIGURE 4 is a sectional view along line 4—4 of FIGURE 3;

FIGURE 5 is a sectional view through a transverse bulkhead showing an alternate method of spacing the openings for the stabilization system with means to adjust the opening;

FIGURE 6 is a sectional view along line 6—6 of FIGURE 5;

FIGURE 7 is a sectional view similar to FIGURE 5 showing another alternate method of adjusting the size of the openings of the stabilization system;

FIGURE 8 is a sectional view taken along line 8—8 of FIGURE 7;

FIGURE 9 is an alternate view showing the installation of an opening for the stabilization system when the longitudinal bulkhead is of a double wall construction;

FIGURE 10 is a sectional view taken along line 10—10 of FIGURE 9;

FIGURE 11 is an alternate view when the longitudinal bulkhead is corrugated; and

FIGURE 12 is a sectional view along line 12—12 of FIGURE 11.

Referring now to the drawings in greater detail, FIGURE 1 shows a profile view of a large tanker ship with a cut-away portion to show the location of two of the cargo tanks, 20 and 22, one located near the forward part of the ship, and the other located aft. For a very large cargo ship where the dead weight is in excess of 100,000 tons two complete cargo tanks could be modified to be used as a flume stabilization system. However, it is to be understood that on smaller vessels, it is contemplated that only one tank or part of one tank would be used in a midship location and on even larger vessels a greater number of tanks may be required to be modified. This is dependent upon the arrangement of the structure, the requirements for cargo separation and the stabilizing properties of the vessel. Numerals 24 and 26 refer to the location of the stabilization system openings to be explained in greater detail in connection with FIGURE 3.

FIGURE 2, a sectional view along line 2—2 of FIGURE 1 shows one of the transverse webs 28 with large cutout openings 30 made for lightening purposes and structural ribs 32 remaining for strength. These openings and ribs are part of the structure of the ship and are not disturbed in the installation of the Flume Stabilization System. Also shown in section is the top deck 34, the side of the vessel 36 and the bottom of the vessel 38. The center-line longitudinal bulkhead 40 and a parallel longitudinal bulkhead 42 also appear in section and evenly spaced along these bulkheads are stiffeners 44, which are so placed for reinforcement purposes. The centerline bulkhead may or may not be present, depending on the design of the basic ship. Normally these longitudinal bulkheads 40 and 42, are of a solid material and have no openings through them, but serve to divide each cargo tank into four separate tanks, two of them being illustrated here. The numeral 29 (FIGURE 3) refers to the transverse webs which have large openings and are similar in plan to web 28. It is understood that although only the port side of the transverse web 28 is illustrated here, the starboard side is identical and is similarly divided into two tank compartments in the case illustrated. Web plates 46 are located at vertically spaced intervals along the inside of the tank compartments, as more clearly shown in FIGURE 3.

In the installation of a flume stabilization system in a tanker, openings 48 (see FIGURE 3) are cut through the normally liquid-tight bulkheads 40 and 42 to enable fluid stored in adjacent transverse tanks to flow back and forth across the ship as the ship rolls. These openings serve as restrictions between the most outboard compartments which act as wing-tanks of the stabilization system and the central cargo tanks which act as the crossover sections for the system. As the ship rolls and the fluid in the tank, which may be either oil or water, flows from the tank which is elevated, it passes through the openings 48 of the stabilization system. Energy dissipation or dampening occurs as the liquid is transferred into and out of the central tanks, which act as liquid crossover section, to the outer tanks which act as the wing tanks of the stabilization system. The size of the openings 48 will vary considerably as the design parameters are changed, such as the viscosity and density of the liquid that is being carried in the tanks, the normal roll period of the ship, and the amount of dampening that one seeks to achieve with a given size tank. In a tanker such as described previously the openings are about 9 feet wide and 2½ feet high. Note that as shown in FIGURE 4, these openings are carefully placed in a manner to avoid disturbing any of the structural rigidity of the ship with the opening 48 being centered between two of the stiffeners 44 so that it is generally unnecessary to add any additional structural material.

Similarly as shown in FIGURES 9 and 10, when the bulkhead is constructed with double walls of smooth plates 43 and 45 on the outside with vertical webbing 47 and horizontal webbing 49 between the plates in an egg crate design for stiffening, a finished opening through the bulkhead is provided by welding a sleeve 50 in the opening. This sleeve serves both to provide structural rigidity and prevent the formation of any deposit-retaining pockets. Lightening holes 51 are sometimes provided in the bulkhead webbing. This smooth-walled type of bulkhead may be used in tankers where ease of cleaning is important such as when wines or edible cooking oils are carried.

When corrugated bulkhead walls 57 are encountered, as shown in FIGURES 11 and 12, the inside edge of the opening 55 may, if required, be lined with a sleeve 52, which projects out on each side of the corrugations to compensate for any loss of structural rigidity due to the opening. All of the sleeves are held in place by a continuous weld around their outside diameters.

As previously stated, each installation must be designed for the particular ship on which it is to be used, and the openings spaced in such a manner as to avoid as much interference as possible with the structure of the ship. To this end, it may be necessary that the location of some of the openings be varied, such as openings 54 and 56 (FIGURE 3), which are designed to avoid interference with the web plate 46. Numerous other design considerations will influence the location of the openings in the bulkheads for the stabilization system and although in FIGURE 3, it is shown that the extent of the area

within which openings are made is spaced up from the bottom of the cargo tank, it is contemplated that in other instances it may be necessary to space a plurality of openings in such a manner that they would run much closer to the bottom of the hull. In other instances, the area of openings may be shifted to be spaced down a short way from the top of the hull, depending upon the type of cargo carried and the normal height of the liquid level. In other installations, it may be found necessary to space the openings at irregular intervals or to run them through the bulkhead at every feasible space from the bottom of the hull to its top.

As previously mentioned, it has also been found desirable to make provisions for modifying the size of the openings depending upon the type of fluid being carried in the ship. To this end, various types of valving mechanisms as shown in FIGURES 5 and 6, and in FIGURES 7 and 8 are contemplated.

Referring now to FIGURES 5 and 6, which illustrate a sliding valve type of mechanism which is particularly adaptable to openings which are spaced at rather wide intervals because of structural requirements of the ship, there is shown a control rod 60 which may be moved axially up and down from a control point on deck of the ship. This is secured to each valve gate 62 by a retainer 64, and is slidably mounted in front of the opening 65, and held in place by the edge of the bulkhead 40 and retainers 66 and 68. Thus, as the rod 60 is moved up and down, a plurality of valve gates 62 may be opened or partially closed in unison to control the size of the openings 65. It is contemplated that sections of openings, either near the top or near the bottom of the cargo tank may be ganged together so that they may be opened or closed individually without affecting the remainder of the openings. If for any reason, it is desired to discontinue the use of the flume stabilization system temporarily such as when dissimilar fluids are carried in adjacent cargo holds, all of the gates 62 may be tightly closed to prevent any crossover of fluid.

Similarly in FIGURES 7 and 8, another form of valving mechanism is illustrated which is especially adaptable for use when the stabilization system openings must be placed relatively close together. As previously described a control rod 80 may be moved axially up and down, being secured to the valve gate 82 by a retainer 84 so that as the rod is lifted, the gate pivots about hinge point 70 to open or close the opening 86 in the bulkhead 90. This design presents the additional advantage that a direction change is given to the fluid as it passes through the opening and strikes against the partially closed gate 82. This direction change can add additional dampening effect for added energy dissipation when needed.

It is also contemplated that these stabilization system openings may be equipped with various types of nozzle devices as described in the U.S. patents previously mentioned such as a cylindrical piece of tubing spaced vertically across the opening to enable added energy dissipation to be obtained.

In some designs of bulk cargo vessel it may be found desirable to install a horizontal plate member part way down in a cargo hold or tank to isolate the section that is used for stabilization. This may occur when it is deemed desirable to use a heavier liquid such as sea water as the stabilizing medium or when a dry cargo such as grain is carried in the lower part of the hold. At other times this method may be found more expeditious because greater stabilization may be achieved by placing the flume stabilization above the center of rotation of the ship. In any of these instances the existing bulkheads would be utilized in designing the system.

Thus, it can be seen that through the addition of properly designed and spaced openings between otherwise liquid-tight bulkheads placed between adjacent cargo tanks inside a tanker vessel, it is possible to obtain a stabilized roll by allowing the liquid on the high side of the vessel to flow downwardly through a properly designed passageway to dissipate its energy and arrive at the low side of the vessel at a proper time, as it begins to rise, to impede that rise. This principle is more fully discussed in U.S. Patent No. 3,054,373 and others previously mentioned.

Although the invention has been shown and described in terms of a specific preferred embodiment, it will be appreciated that various changes and modifications will occur to those skilled in the art from a knowledge of the teachings of the present invention.

What is claimed is:

1. A liquid cargo tanker comprising a hull, at least one liquid-tight transverse bulkhead extending across the hull, at least one longitudinal bulkhead disposed normal to said at least one transverse bulkhead, said transverse and longitudinal bulkheads extending vertically throughout the depth of the hull, said transverse and longitudinal bulkheads defining with the hull at least two tanks arranged across the hull, a stabilization system defined by said tanks comprising a plurality of openings in said at least one longitudinal bulkhead vertically spaced in aligned defined areas, a body of fluid in said tanks at a level in repose which is at least above the lowest of said openings so that a portion of said fluid flows through said openings in response to the rolling motion of the vessel, said openings causing a substantial energy dissipation from said fluid flowing therethrough.

2. A liquid cargo tanker comprising a hull, at least one liquid-tight transverse bulkhead extending across said vessel, at least one longitudinal bulkhead disposed normal to said at least one transverse bulkhead, said transverse and longitudinal bulkheads extending vertically throughout the depth of said hull, said transverse and longitudinal bulkheads defining with said hull at least two tanks arranged across said hull, a stabilization system defined by said tanks comprising horizontal stiffeners mounted on said at least one longitudinal bulkhead in vertically spaced relation, a plurality of openings in said at least one longitudinal bulkhead vertically spaced in aligned defined areas with each opening defined between an adjacent pair of stiffeners, a body of fluid in said tanks at a level in repose which is at least above the lowest of said openings so that a portion of said fluid flows through said openings in response to the rolling motion of the vessel, said openings causing a substantial energy dissipation from said fluid flowing therethrough.

3. A liquid cargo tanker comprising a hull, at least one liquid-tight transverse bulkhead extending across said vessel, at least one longitudinal bulkhead disposed normal to said at least one transverse bulkhead, said transverse and longitudinal bulkheads extending vertically throughout the depth of said hull, said transverse and longitudinal bulkheads defining with said hull at least two tanks arranged across said hull, a stabilization system defined by said tanks comprising a plurality of openings in said at least one longitudinal bulkhead vertically spaced in aligned defined areas with each opening defined by at least one corrugation, a body of fluid in said tanks at a level in repose which is at least above the lowest of said openings so that a portion of said fluid flows through said openings in response to the rolling motion of the vessel, said openings causing a substantial energy dissipation from said fluid flowing therethrough.

4. A liquid cargo tanker comprising a hull, at least one liquid-tight transverse bulkhead extending across said vessel, at least one longitudinal bulkhead disposed normal to said at least one transverse bulkhead, said transverse and longitudinal bulkheads extending vertically throughout the depth of said hull, said transverse and longitudinal bulkheads defining with said hull at least two tanks arranged across said hull, each longitudinal bulkhead composed of a pair of spaced plates between which are defined a plurality of cells by means of a plurality of plates normal to each other and to said pair of plates, a stabilization system defined by said tanks comprising a plurality

of openings in said at least one longitudinal bulkhead vertically spaced in aligned defined areas with each opening defined through a cell, a body of fluid in said tanks at a level in repose which is at least above the lowest of said openings so that a portion of said fluid flows through said openings in response to the rolling motion of the vessel, said openings causing a subtantial energy dissipation from said fluid flowing therethrough.

5. A liquid cargo tanker comprising a hull, at least one liquid-tight transverse bulkhead extending across said vessel, at least one longitudinal bulkhead disposed normal to said at least one transverse bulkhead, said transverse and longitudinal bulkheads extending vertically throughout the depth of said hull, said transverse and longitudinal bulkheads defining with said hull at least two tanks arranged across said hull, a stabilization system defined by said tanks comprising a plurality of horizontally elongated openings in said at least one longitudinal bulkhead vertically spaced in aligned defined areas, a body of fluid in said tanks at a level in repose which is at least above the lowest of said openings so that a portion of said fluid flows through said openings in response to the rolling motion of the vessel, said openings causing a substantial energy dissipation from said fluid flowing therethrough.

6. A liquid cargo tanker comprising a hull, at least one liquid-tight transverse bulkhead extending across said vessel, at least one longitudinal bulkhead disposed normal to said at least one transverse bulkhead, said transverse and longitudinal bulkheads extending vertically throughout the depth of said hull, said transverse and longitudinal bulkheads defining with said hull at least two tanks arranged across said hull, a stabilization system defined by said tanks comprising a plurality of openings in said at least one longitudinal bulkhead vertically spaced in aligned defined areas, a body of fluid in said tanks at a level in repose which is at least above the lowest of said openings so that a portion of said fluid flows through said openings in response to the rolling motion of the vessel, said openings causing a substantial energy dissipation from said fluid flowing therethrough.

7. A liquid cargo tanker comprising a hull, at least one liquid-tight transverse bulkhead extending across said vessel, at least one longitudinal bulkhead disposed normal to said at least one transverse bulkhead, said transverse and longitudinal bulkheads extending vertically throughout the depth of said hull, said transverse and longitudinal bulkheads defining with said hull at least two tanks arranged across said hull, a stabilization system defined by said tanks comprising a plurality of openings in said at least one longitudinal bulkhead vertically spaced in aligned defined areas, a body of fluid in said tanks at a level in repose which is at least above the lowest of said openings so that a portion of said fluid flows through said openings in response to the rolling motion of the vessel, said openings causing a substantial energy dissipation from said fluid flowing therethrough, and closures for said openings comprising hinged-plate valve means mounted on said at least one longitudinal bulkhead, and control means for actuating said closures.

8. A liquid cargo tanker as set forth in claim 1, wherein said openings are elongated in the horizontal direction.

9. A liquid cargo tanker as set forth in claim 1, wherein said openings comprise a sleeve, said sleeve projecting out each side of said opening.

10. The combination of claim 1 wherein said areas are spaced from the top and bottom of said longitudinal bulkheads.

11. The combination of claim 1 wherein said areas commence adjacent the bottom and terminate spaced from the top of said longitudinal bulkheads.

12. The combination of claim 1 wherein said areas commence adjacent the top and terminate spaced from the bottom of said longitudinal bulkheads.

13. The combination of claim 1 wherein closures for

said openings are mounted on said longitudinal bulkheads.

14. The combination of claim 13 wherein control means are provided to actuate said closures to provide partial and total closure of said openings.

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