Oct. 4, 1932. P. W. HILLER 1,881,079

SHIP REFRIGERATION

Filed Sept. 20, 1930 3 Sheets-Sheet 1

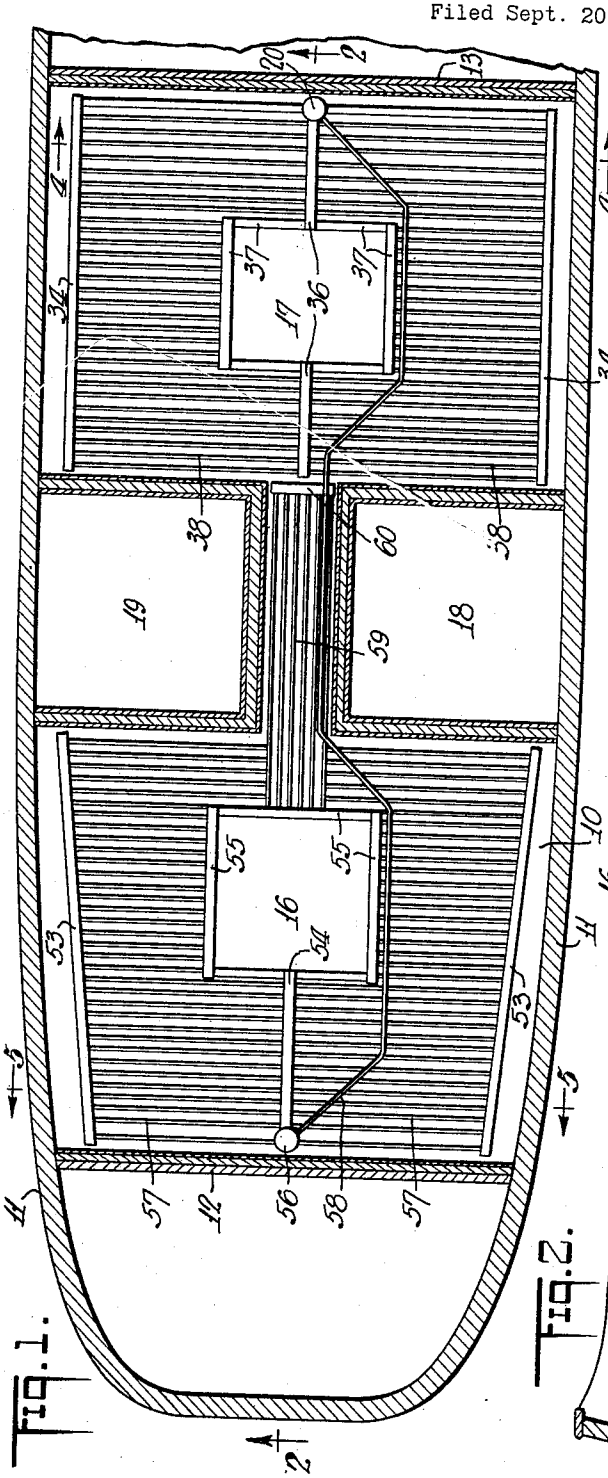


Fig. 1.

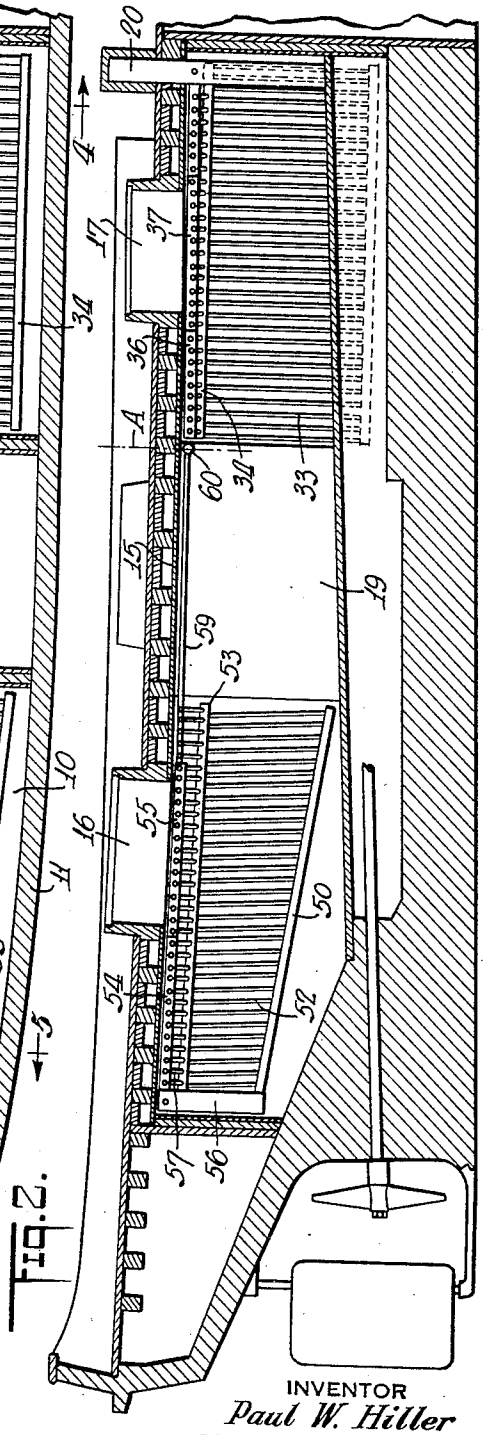


Fig. 2.

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Filed Sept. 20, 1930 3 Sheets-Sheet 2

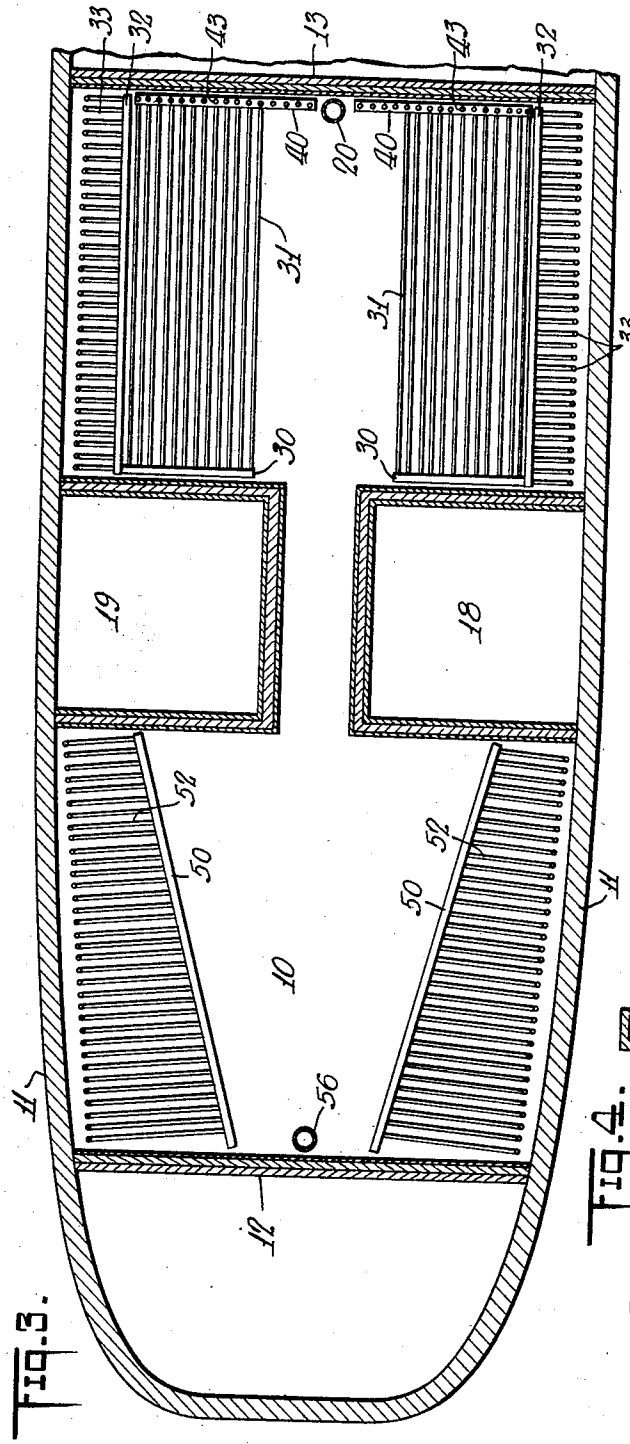


FIG. 3.

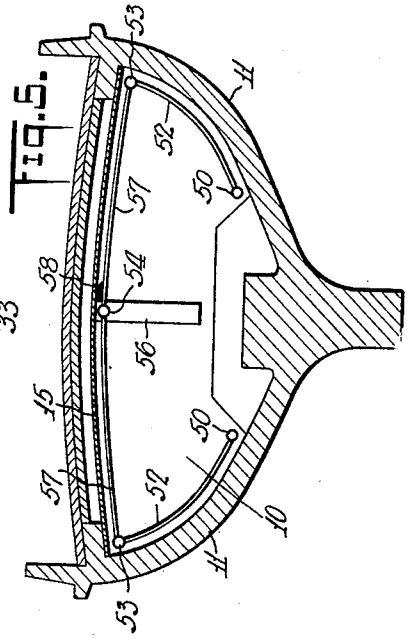


FIG. 5.

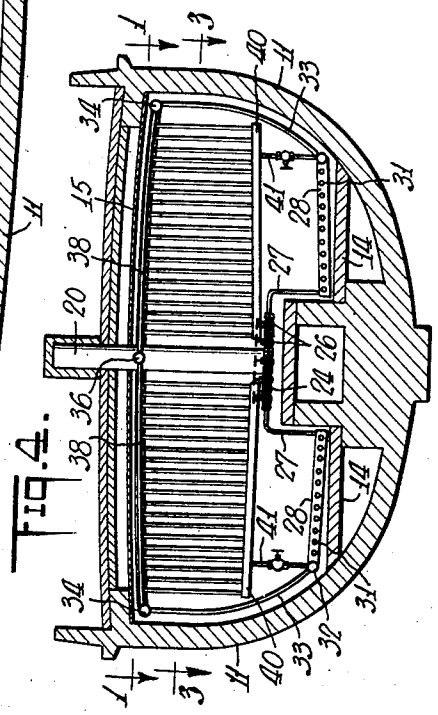


FIG. 4.

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SHIP REFRIGERATION

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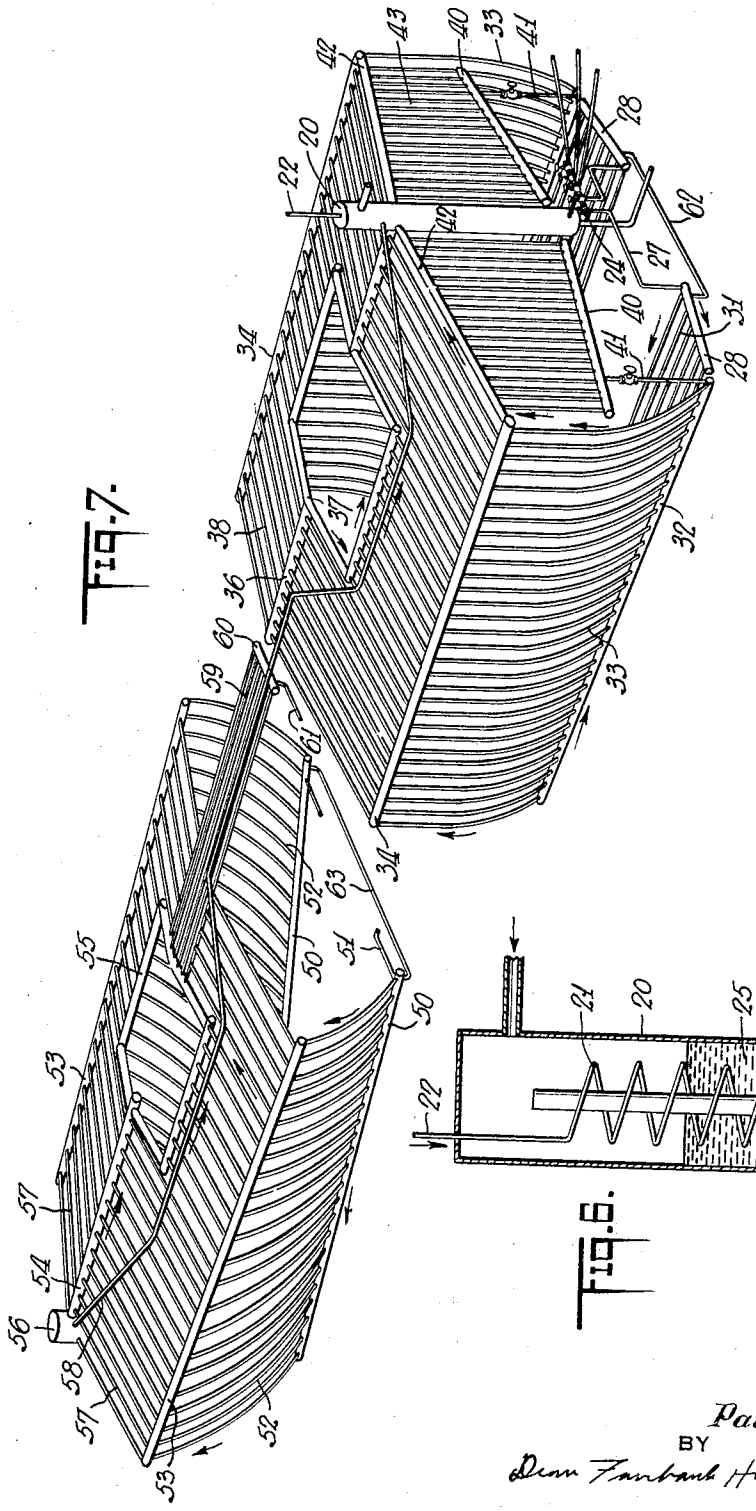


Fig. 7.

Fig. 6.

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Patented Oct. 4, 1932 1,881,079

UNITED STATES PATENT OFFICE

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SHIP REFRIGERATION

Application filed September 20, 1930. Serial No. 483,155.

The invention relates to the art of refrigeration of comestibles in transit on vehicles, and more particularly to the refrigeration of fish and the like on boats.

The limitation of available space in vehicles such as ships for the cold storage of perishable material is of paramount consideration. The present invention accordingly provides an improvement in the arrangement of the cooling coils of the cold storage chamber of a ship so as to afford a maximum amount of storage capacity.

The present invention also provides an improvement in the arrangement of cooling conduits which takes advantage of the shape of the ship to more effectively induce the circulation of the refrigerant through the coils.

The invention also provides an improvement in the construction and arrangement of the expansion coil which effects a reduction in the surging of the refrigerant resulting from the rolling of the ship, and an efficient operation when the ship is at any and all angles in its pitch or roll.

In a preferred embodiment of the present invention, the expansion coils surrounding a cold storage room are made in the form of grids with the pipes thereof so positioned as to follow the general shape or camber of the ship where this camber extends upwardly in the general direction of circulation of the refrigerant fluid. By this arrangement, traps are eliminated and the flow of liquid through the expansion coils of the system is effected in approximately the same direction as the gases liberated from the surface of said liquid, thereby minimizing surging action and inducing a smoother circulation through the coils. This reduction in the surging of the refrigerant decreases the differential pressure of the system and results in a corresponding increase in efficiency of circulation.

It should be noted that these coils in following the camber of the ship, particularly the curved sides and deck, provide a means for rendering the expansion coil system somewhat flexible and permit a certain degree of expansion in the coils.

It is also within the contemplation of the present invention to provide a series of expansion coils arranged in grid fashion between headers so as to eliminate the use of bends. This arrangement obviates the creation of "hammer slugs", and also minimizes to a certain extent the agitation of the refrigerant during the rolling of the ship. By "hammer slugs" I mean accumulations of liquid in pockets from which the evaporated gas would have to displace the liquid with violence and consequently retard the gas outflow.

The invention also consists in certain new and original features of construction and combinations of parts hereinafter set forth and claimed.

Although the novel features which are believed to be characteristic of this invention will be particularly pointed out in the appended claims, the invention itself, as to its objects and advantages, the mode of its operation and the manner of its organization may be better understood by referring to the following description taken in connection with the accompanying drawings forming a part thereof, in which

Fig. 1 is a top plan section of the stern end of a fishing boat taken on line 1—1 of Fig. 4.

Fig. 2 is a section taken on line 2—2 of Fig. 1.

Fig. 3 is a top plan section of the stern end of fishing boat taken on line 3—3 of Fig. 4.

Figs. 4 and 5 are sections taken on lines 4—4 and 5—5 respectively, of Fig. 1.

Fig. 6 is a view of the accumulator constituting part of the refrigerating system, and

Fig. 7 is a perspective of the expansion coil arrangement of the refrigerating system.

The accompanying drawings show the adaptation of the present invention to a fishing boat, having a suitably insulated cold storage room 10, bounded by the side hulls 11, bulkheads 12 and 13 mounted athwart-wise, floor plates 14, and a deck plate or wall 15 having the approximate curvature or camber of the deck. This deck plate 15 has two hatch openings 16 and 17 to provide means of access to the interior of the storage room 10.

Occupying part of this storage room 10 and receiving refrigeration therefrom are two bait wells 18 and 19, although these are not essential.

Centrally disposed with respect to the sides of the ship and extending into the cold storage room 10 is an ordinary accumulator 20 or any other suitable source of distribution for the refrigerating liquid. This accumulator has the usual coil 21, one end 22 of which is connected to a suitable condenser (not shown), and the other end 23 of which is connected to a manifold piping system 24. This coil 21 is immersed in a bath 25 of liquid refrigerant constituting the return fluid of the system and serving to cool the refrigerant in the coil 21. The other adjuncts of the refrigerating system such as the compressor and condenser may be disposed near the forward end of the ship and are not shown for the sake of simplicity.

The manifold piping system 24 is provided with a series of expansion valves 26, two of which have connections 27 to the headers 28. These headers 28 extend athwartwise of the ship, and slope upwardly towards the sides thereof. Disposed near the bait wells 18 and 19 are headers 30, which are disposed a little above the headers 28, and which are joined to said headers 28 through a series of expansion coils 31, so as to form a grid unit. Also joining the headers 30 are headers 32, which slope upwardly toward the stern, and which have extending therefrom in grid fashion a series of expansion coils 33. These coils 33 lead into the longitudinal headers 34 disposed underneath the deck plate 15, and are disposed close to the sides of the ship to approximately conform with the curvatures thereof.

The headers 34 run in approximate parallelism with the deck plate 15, which has the usual longitudinal camber running upwardly from either side of a point on the athwart plane A of least free board near midship.

Extending through the center of the ship is a return header 36, connected at one end thereof to the accumulator 20, and having branches 37 offset to accommodate for the hatch opening 17. Connecting the headers 34 and 36 are a grid series of coils 38 which are slightly curved to conform with the curvature of the deck plate 15. It should be noted that the deck of a ship usually curves downwardly from both sides of the longitudinal center thereof, so that by sloping the coils 38 as indicated, the refrigerant therein is given an upward tread in its passage from the headers 34 to the return header 36.

If desired the side of the storage room 10 adjacent the bulkhead 13 may be provided with a coil system which includes headers 40. These headers 40 slope upwardly from the center of the ship and have connections 41 with the headers 32. Connecting the headers 34 and the accumulator 20 are the headers 42 which follow the curvature of the deck plate 15. Extending between said headers 42 and the headers 40 are a series of coils 43.

The part of the cold storage room nearest the stern is similarly provided with an expansion coil system, which includes headers 50 having connections 51 with the accumulator 20, and sloping upwardly towards the stern. Extending in close conforming relationship with the sides of the ship are a series of coils 52, arranged in grid fashion, and connecting said headers 50 and a pair of headers 53 disposed adjacent the underside of the deck plate 15. Another header 54 is provided which is centrally positioned with respect to the sides of the ship and which has branches 55, offset to accommodate for the hatch opening 16. One end of this header 54 is connected to a trap or collection main 56 and has a series of coils 57 extending therefrom and connected to the headers 53. These coils 57 are bent to follow the curvature of the deck so that they slope upwardly towards the center of the ship. The trap 56 is directly connected to the accumulator through a return pipe 58.

In order to provide refrigerating means adjacent every available portion of the walls of the storage room 10, that part of the underside of the deck plate 15, between the bait wells 18 and 20, may have extending therebetween a series of grid coils 59. These coils 59 follow the longitudinal camber of the ship and are joined together at one set of corresponding ends by a header 60, and at the other set of ends by one of the branch headers 55. This header 60 has a connection 61 to one of the expansion valves of the manifold pipe system 24, and is disposed near the plane A of least freeboard so that the refrigerant liquid in the coils 59 is given an upward trend in its passage from the header 60 to the header 55.

It should be observed that the entire coil system is symmetrically mounted about the longitudinal center line of the ship, so that this system can be expeditiously equalized through the mere agency of two connections 62 and 63 joining the headers 28 and 50 respectively.

The circulation of the refrigerant in the expansion coils is effected in the direction indicated, so that by inclining these coils as described, a continuous upward trend is imparted thereto throughout the entire expansion cycles.

It should be noted that the coils are arranged to follow the camber of the ship where this arrangement imparts to the refrigerating fluid an upward trend, in the course of its circulation. This organization permits the coils to be mounted in closer relationship with the boundaries of the room 10, thereby providing a correspondingly

greater storage space therefor. The cost of mounting the coils in conforming relationship with the curvature of the ship is also lessened. Furthermore, by sloping the coils to follow the general camber of the ship, where this camber extends upwardly in the general direction of circulation of the refrigerant fluid, the gases liberated from the liquid refrigerant is made to follow the same direction as said liquid refrigerant. In this manner the surging of the refrigerant fluid is minimized and a smoother circulation induced.

It should also be noted that the coils adjacent the sides of the ship and the deck are curved to follow the camber thereof, thereby providing an effective means for rendering the expansion coil system somewhat flexible and permitting a certain degree of expansion in the coils.

It should also be noted that by arranging the coils in grid fashion between headers, and by eliminating bends, the creation of hammer slugs is obviated and the agitation of the refrigerant during the rolling of the ship minimized. This reduction in the agitation of refrigerant decreases the differential pressure of the system and results in a corresponding increase in efficiency of circulation.

It should be further noted that the individual coils generally extend in the same direction as the direction of the air during its convective circulation between the walls of the room 10 and the coils. In this way, the baffling of the air is minimized and a smoother circulation thereof induced during its convection cycle.

While certain novel features of the invention have been shown and described and are pointed out in the annexed claims, it will be understood that various omissions, substitutions and changes in the forms and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention. For instance, in broad ships there may be two rooms arranged athwartwise, and the system may be disposed in accordance with the present invention by leading the refrigerant from the accumulator to a feed header disposed near the hull at the bottom of the room. This feed header may have a plurality of upwardly extending expansion coils leading therefrom into an upper header disposed underneath the deck plate near the hull. From this upper header a plurality of expansion coils would lead therefrom into a header disposed at the inboard side of the room in such a position that the expansion coils therefrom follow the general camber of the deck. If it is desired to refrigerate all the sides of such a room, two feed headers may be disposed at the bottom of the room near the hull, and each may have a plurality of expansion coils extending upwardly along the deck and along the bottom of the room, respectively, so as to have an upward trend throughout. In each case it is favorable to have the upper inboard headers of each room connected to a centrally disposed accumulator.

If it is desired to provide a system for a ship having three rooms disposed athwartwise, the coil system for the outside rooms may be arranged as above described with reference to the two room system, while the middle room may be arranged in accordance with the arrangement in the accompanying drawings. However, the coils adjoining the sides of this middle room may be made to follow the side walls of this room instead of the hull as hereinbefore described. In such an arrangement, it is desirable to have all of the upper inboard headers of the side room and the upper central header of the middle room connected to a centrally disposed accumulator.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a ship having a deck which slopes downwardly to the sides, a cold storage room bounded on the top by a deck wall having the approximate camber of the deck, a plurality of athwart-wise extending coils constituting part of an expansion cycle of a refrigerating system and disposed in close proximity to said wall, said coils being in the form of grids with headers extending lengthwise of the ship and at different elevations, and parallel connecting pipes between said headers extending transversely of the ship and substantially following the transverse camber of the deck.

2. In a ship, a cold storage room bounded on the sides by the hull of the ship and on the top by a deck wall having the approximate camber of the deck, and a plurality of refrigerating expansion coils disposed adjacent the boundary walls of the storage room and arranged in grid fashion between headers, said coils including pipes connected in parallel and sloped to conform with the camber of the ship where said sloping imparts to the refrigerating agent an upward trend in its direction of circulation.

3. In a ship, a cold storage room, an expansion coil system in said room, a source of distribution for the refrigerating agent in said coil system, said source of distribution being disposed proximate the transverse center of the ship, and a return header connected to said source of distribution and extending longitudinally of the ship, said coil system including a plurality of athwart-wise extending coils arranged in grid fashion on both sides of said return header and connecting with said header.

4. In a ship having a deck which slopes

downwardly to the sides, a cold storage room bounded on the sides by the hull of the ship and on the top by a deck wall having the approximate camber of the deck, an expansion coil system in said room, a source of distribution for the refrigerating agent in said coil system, said source of distribution being disposed proximate the transverse center of the ship, and a return header connected to said source of distribution and extending longitudinally of the ship, said coil system including a plurality of athwart-wise extending coils disposed in close conforming proximity to said hull and deck wall, and arranged in grid fashion between headers, the coils adjacent the deck wall leading into both sides of the return header.

5. In a ship, an expansion coil system including a first series of coils extending upwardly proximate the hull of the ship, a second series of coils connected to the top of the last mentioned series and sloping upwardly towards the longitudinal center of the ship, means for delivering a refrigerant to the low point of the first series for circulation through said first series of coils in an upward direction, and then through the second series of coils towards the center of the ship, and a gas outlet at the upper end of the second series.

6. A ship refrigerating system for the cold storage room of a ship, including a plurality of expansion coils in grid form including headers extending lengthwise of the ship and at different elevations, and parallel connecting pipes between said headers extending athwart-wise of the ship and inclined in respect to the horizontal.

7. A refrigerating system for the cold storage room of a ship, including a pair of headers at different elevations and closely adjacent to the wall of the cold storage room, and a plurality of pipes connecting said headers to form a grid, said pipes being bent to follow the contour of the camber of the ship.

8. In a ship, a cold storage room bounded on one or more sides by the hull of the ship, and a plurality of expansion grids within said room and each substantially parallel to an adjacent wall of said room, each of said grids including headers at different elevations, and substantially parallel pipes connecting said headers and upwardly inclined, a liquid inlet for the lower header of each grid and a gas outlet for the upper header of each grid.

Signed at Wilmington in the county of Los Angeles and State of California this eleventh day of September A. D. 1930.

PAUL WINANS HILLER.