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3,225,822

CONTAINERIZED CARGO REFRIGERATION SYSTEM AND METHOD

Filed Aug. 26, 1960

3 Sheets-Sheet 1

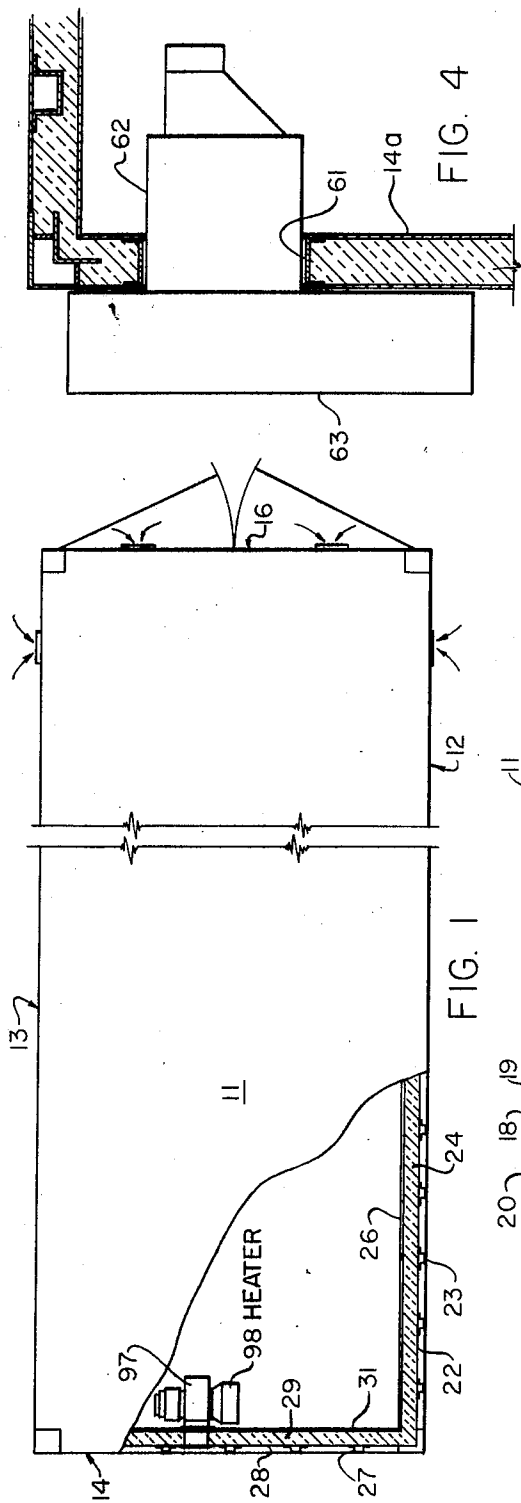


FIG. 1

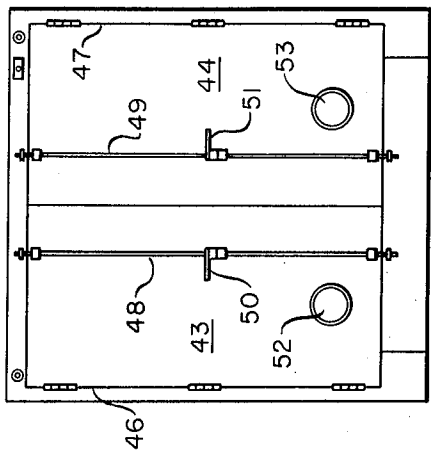


FIG. 2

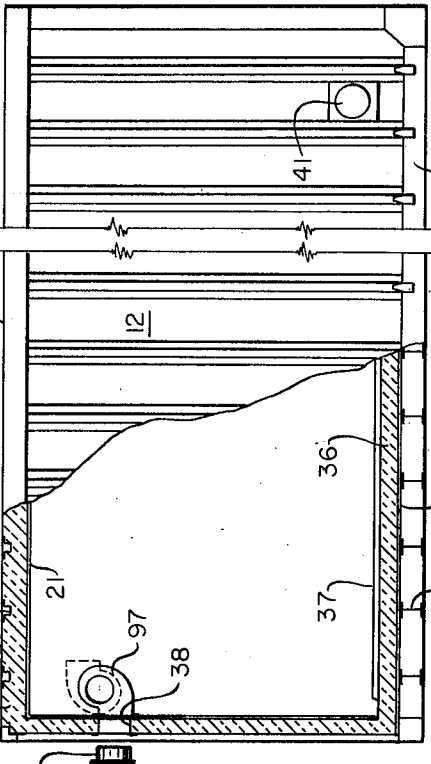


FIG. 3

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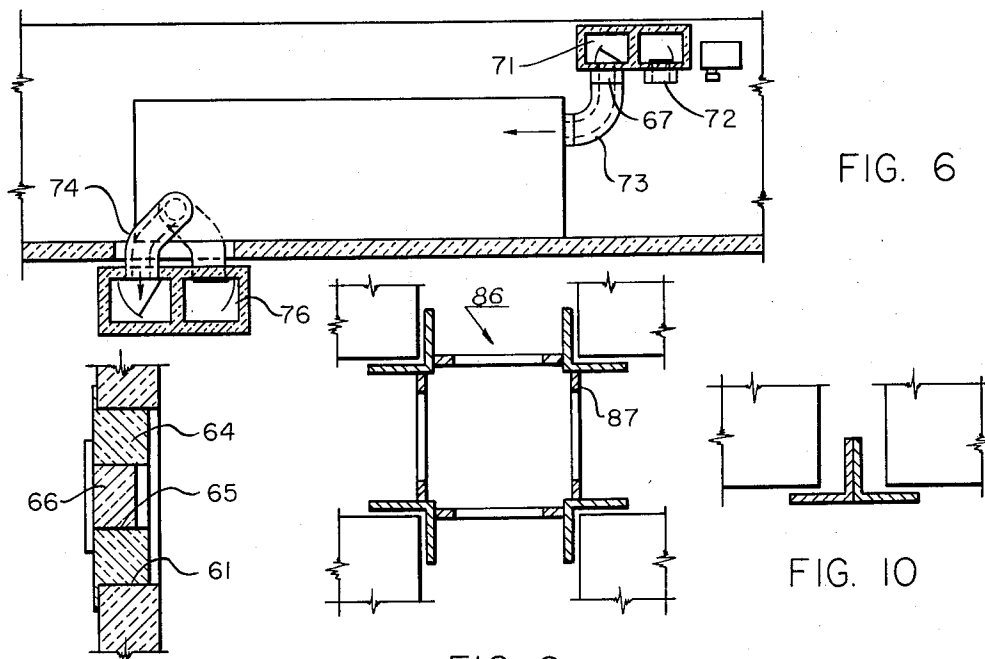
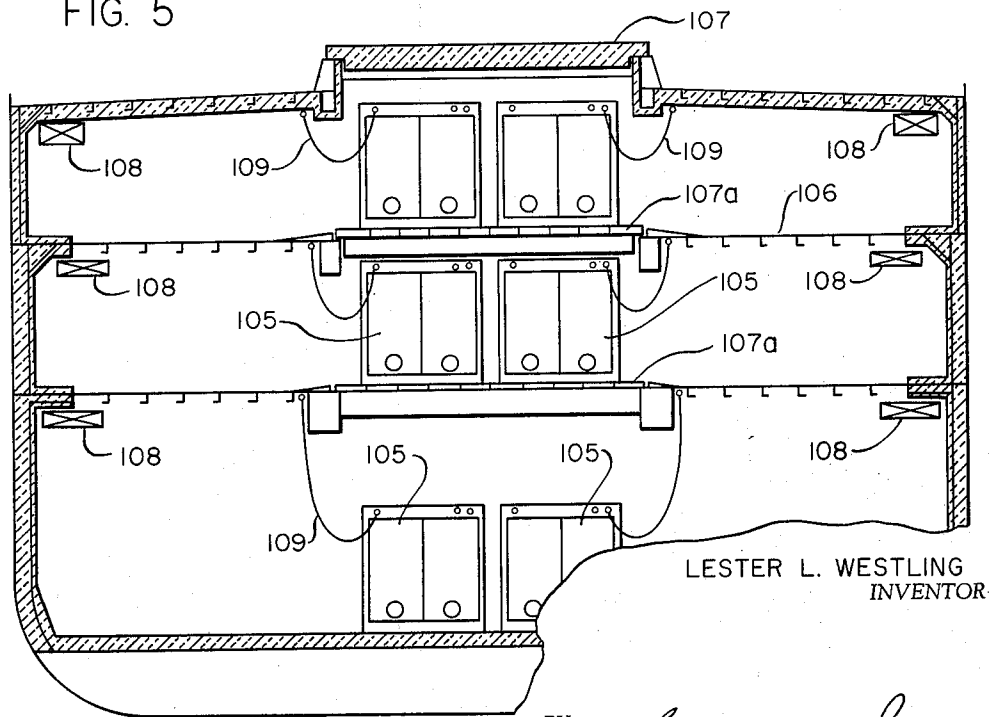


FIG. 5



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FIG. 11

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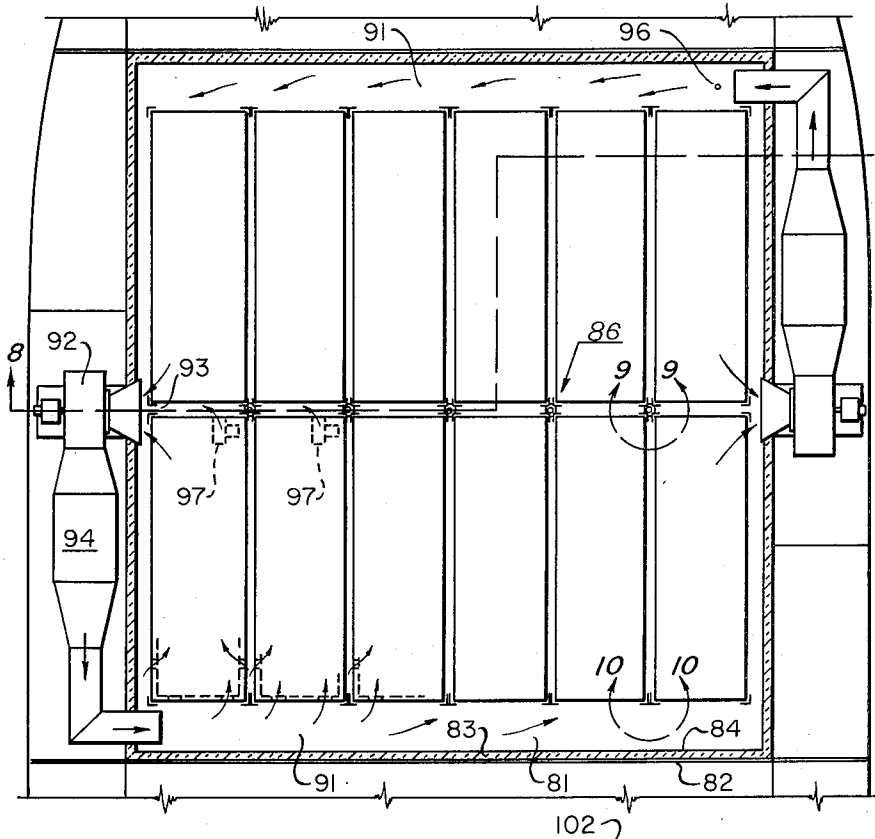


FIG. 7

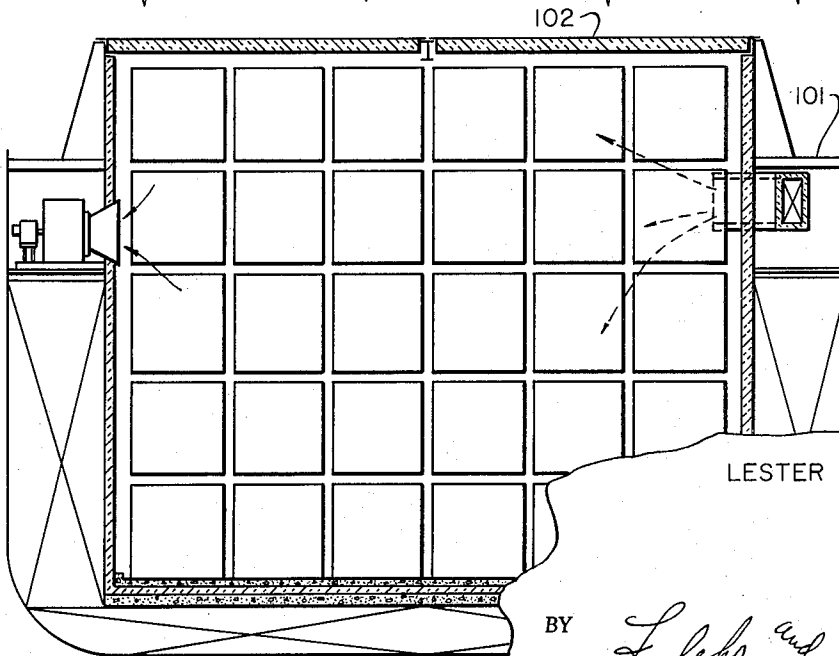


FIG. 8

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CONTAINERIZED CARGO REFRIGERATION SYSTEM AND METHOD

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5 Claims. (Cl. 165—48)

This invention relates to a containerized cargo system and method, and more particularly to containers, resident air conditioning systems, particularly refrigeration systems, for the containers, and methods of handling containerized cargo.

Due to the high labor costs which are involved in handling cargo, containerization of cargo has been considered in recent years and some preliminary installations have been constructed. Cargo for a particular destination is placed in a single container which is moved as a single unit rather than individually handling each of the various pieces of cargo involved. Generally, the containerized approach is finding great utility in marine transport industry.

In recent years there has been an effort to handle perishable goods in insulated containers. The refrigeration is applied individually to the containers by individual mechanical refrigeration systems. When the container with its refrigeration system is aboard ship, the ship's crew must service and maintain the refrigeration machinery. In order to provide access to the individual refrigeration systems, the containers must be spaced apart. Thus, a large amount of lading space is wasted. To provide easy access, it is the present practice to place such containers on the weather decks of the ship. Consequently, containers and refrigeration systems are exposed to the corrosive effect of marine transportation. This reduces considerably the useful life of the containers and refrigeration system.

The almost universal practice is to provide individual replaceable direct expansion refrigeration machines with each of the containers. The refrigeration machine associated with the containers chills the air of the container and a fan recirculates the air through the same. It is the practice to ship only precooled produce in the containers. The refrigeration machine is generally designed only for the removal of heat which is generated by the cargo and the heat that is transmitted through the insulated walls of the container.

While such a system is necessary for long distance and long periods shoreside hauling or standby, a large percentage of the perishables intended for marine transshipment originate at or are destined to point sufficiently near the ship's terminal that the pre-cooled or pre-frozen produce when carried in an efficiently insulated container may be transported to and from the ship's terminal without benefit of external refrigeration and without suffering deterioration and damage due to temperature rise. Thus, in certain instances, the refrigeration machinery may become superfluous and unnecessary and add to the weight transported.

The complete assembly, including refrigerating machinery, is taken on board. The supervision and responsibility is then in the hands of people remote from the owner and consequently, maintenance, repairs and the availability of spare parts not assured. Obviously, the hazards of the failure of the refrigerating machine is ever present. The machines may be idle during return shipment.

Often in marine transport of canned goods and other products sensitive to damage by sweating and moisture, the temperature of the goods is below the dewpoint temperatures encountered during transport or at the destination; this results in sweating and moisture forming on the goods and products with consequent damage. This problem is particularly serious in winter shipment of goods by water.

It is an object of the present invention to provide an air conditioning system and method for containerized cargo in which resident air conditioning facilities are provided for serving cargo containers.

It is another object of the present invention to provide a refrigeration system and method for containerization of cargo in which resident refrigeration facilities are provided while on board ship. It is understood that the same procedure may be applied in shoreside refrigeration.

It is another object of the present invention to provide a refrigeration system in which containers may be served by a resident refrigeration system to refrigerate the same, thus eliminating the need for separate refrigeration machinery associated with each of the containers.

It is another object of the present invention to provide a reliable centralized resident source of refrigeration of permanent construction for groups of containers while aboard ship. The operation, maintenance and repair of the centralized resident refrigeration system is the responsibility of the crew. For example, such a centralized resident system may comprise a ship's insulated and refrigerated cargo compartment having a conventional high efficiency central plant operating under ideal conditions. The compartment may also be a special compartment for handling containers which is refrigerated by a high efficiency plant. Such compartments are herein designated as the ambient or resident refrigerator.

It is another object of the present invention to provide an efficiently insulated container which is fitted with means for circulating ambient air within or through the same; the ambient air circulated through the container, entering through inlet openings and leaving through outlet openings formed in the walls of the container.

It is another object of the present invention to provide a method of refrigerating a plurality of containers with a single refrigeration system whereby individual container controls are eliminated and the limitation in numbers with normally staffed ships is overcome. The system being suitable for refrigerating containers which are too small to justify individual refrigeration machinery.

It is a further object of the present invention to provide a refrigeration system in which the various containers may be closely stowed with respect to one another thereby minimizing the amount of loss of revenue space.

It is another object of the present invention to provide a shoreside resident refrigeration means for pre-cooling refrigerated cargo or maintaining previously attained conditions of the refrigerated cargo by attaching inlet and outlet openings of the individual containers to supply and return ducts which circulate chilled air supplied from a room type cold storage plant (resident refrigeration) through the container.

It is another object of the present invention to provide a containerized cargo refrigeration system suitable for pre-cooling perishable cargo or maintaining previously attained conditions of refrigerated cargo by attaching inlet and outlet openings of individual containers to supply and return ducts which circulate air conditioned by a remote conditioning plant through the containers.

It is another object of the present invention to provide a containerized cargo system and method in which the containers may be employed to ship goods subject to damage by sweating or moisture by conditioning the air and the product within the container so that a harmless relationship exists between the goods, their temperature and the ambient dewpoint, and where the relationship is maintained by the container during transport.

It is another object of the present invention to provide a container which is rugged in construction, unencumbered with attached refrigeration machinery and which is readily adaptable for the transportation of unrefrigerated cargo to increase the versatility of the container

and make it adaptable for gainful employment on home-bound voyages or when refrigeration space is not in demand.

It is a further object of the present invention to provide a containerized cargo refrigeration system and method which reduces the power requirements of a ship handling refrigerated cargo by reducing the relative areas exposed to the surroundings and by substituting for the individual less efficient refrigeration machinery presently employed with each container and operating under unfavorable conditions, the ship's highly efficient resident refrigeration plant operating under ideal conditions.

It is another object of the present invention to provide a containerized cargo refrigeration system and method in which the ship's refrigerated compartment may carry a combination of refrigerated containers and refrigerated bulk cargo.

It is still a further object of the present invention to provide a containerized cargo refrigeration system and method for long haul and/or long period shore transport in which the refrigerating machinery is not used during the marine transport of the containers thereby freeing the same for other and immediate shoreside service.

The foregoing and other objects of the invention will become more clearly apparent from the following description taken in conjunction with the accompanying drawing.

Referring to the drawing:

FIGURE 1 is a plan view of a short haul container;

FIGURE 2 is a side elevational view of the container of FIGURE 1;

FIGURE 3 is an end view showing the doors;

FIGURE 4 is a fragmentary view showing a long haul container;

FIGURE 5 shows a closure suitable for use in the container shown in FIGURE 4;

FIGURE 6 shows a container cooperating with a terminal resident refrigeration system;

FIGURE 7 is a plan view of a ship's hold including resident refrigeration;

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

FIGURE 9 is an enlarged view of the portion 9—9 of FIGURE 7;

FIGURE 10 is an enlarged view of the portion 10—10 of FIGURE 7; and

FIGURE 11 shows a containerized cargo transported in a conventional refrigerated hold.

Referring to FIGURES 1—3, the container is a box-like container having a top wall 11, side walls 12 and 13, end walls 14 and 16, and a bottom 17. The top wall includes an outer metal shell 18, provided with a plurality of reinforcing channels 19 extending transversely across the same. Insulating material 20 is disposed adjacent the wall. A protective interior lining or inner shell 21 is provided adjacent the inner side of the insulating material 20. The side walls are similarly constructed. They include a metal shell 22, and vertically extending reinforcing channels 23. Insulation 24 is placed adjacent the shell and a protective inner lining 26 is provided. Similarly, the end wall 14 includes vertically running channels 27, a shell 28 attached thereto, insulation 29, and an interior lining 31.

One end is provided with insulated doors which are similarly constructed. The bottom includes a plurality of transverse I-beams 33 which are attached to the metal shell 34. Insulating material 36 is disposed over the metal shell and a cargo receiving floor 37 is suitably supported adjacent the interior of the insulating material 36.

The end wall 14 may be provided with a port 38 which can receive an insulated plug 39, if desired. As will be presently described, the port 38 cooperates with ambient air circulating means to circulate air through the container. Ports 41 may be provided on each of the side walls. The ports 41 may likewise include plugs 42. The

container may be completely enclosed by inserting the plugs as will be presently described.

The end 16 is provided with a pair of insulated doors 43 and 44 which are hinged at 46 and 47, respectively. Locking bars 48 and 49 including handles 50 and 51, respectively, are employed to lock the doors. The doors may likewise include ports 52 and 53, respectively, into which insulated plugs 54 and 56 may be placed for closing the envelope.

To load the container, the doors are open and the cargo is placed on the floor 37 in the desired stacking relationship.

The container may be designed to receive and carry a mechanical refrigeration machine for certain long haul shoreside operations. Referring to FIGURE 4, the end wall 14a is shown having an opening 61 which accommodates the projecting portion 62 of the mechanical refrigeration machine 63. As is well known, such a system includes within the compartment an evaporator together with fan means for continuously circulating the air in the envelope past the evaporator.

Referring to FIGURE 5, there is illustrated an insulated closure or panel 64 which may be inserted into the opening 61 to form a short haul container having an air port 65 which receives a plug 66. The insulating closure or panel 64 may carry a fan for purposes to be presently described.

As described above, in certain applications as, for example, when the cargo originates from a nearby location and the cargo is already pre-cooled or pre-frozen, it is possible to close off all of the ports and to rely upon the insulating capabilities of the container for short periods of time during transport and standby at the terminal prior to loading into the hold of the ship.

In other instances, it may be desired to close off all the ports and transport the containers from a source of origin to the terminal or shoreside facility. The standby storage period at the point of loading, at a consolidation station or at the marine terminal may be relatively long. In such instances it is desirable to provide a resident refrigeration system to which the containers may be coupled.

For this purpose, a conventional type refrigeration system may be employed to supply conditioned air to one or more ducts 71 which are provided with a plurality of fittings 72. The fittings 72 are adapted to provide communication between the ducts 71 and the port on the end or side of the container. Portable flexible ducts 73 are employed for providing the communicating connection between the container and the supply ducts 71. The portable flexible ducts 73 may be insulated fabric. If the system is pressurized, then the pressure within the low temperature supply ducts will cause the refrigerated or conditioned air to flow through the container and be expelled from the ports at the other end. The refrigerated air travelling over the cargo maintains it refrigerated and removes any heat generated by the cargo and heat which passes through the insulating wall. Portable flexible ducts 74 may be provided to communicate with return ducts 76 of the resident refrigeration system. The supply ducts and the return ducts are connected to a conventional refrigeration or conditioning system for conditioning the circulating air. The load upon the resident system will be dependent upon the number of containers, the insulating properties of each of the containers and the properties of the load.

It is observed, however, that a refrigeration or conditioning machine is not associated with each of the containers. For applications where the refrigerated containers come from a distant location, then individual refrigeration machines are used. The machines may be removed at the terminal or standby location, a closure 64 applied, and suitable connection made by the flexible ducts to circulate air through the container and to maintain the desired conditions. The mechanical refrigeration unit is then freed for use in other insulated containers or

may be returned to the point of origin and again used. On shipboard a relatively small number of people is required to operate the ambient refrigeration system necessary to maintain the plurality of containers under refrigeration, as will be presently described.

In accordance with another feature of the present invention, the holds aboard ship are provided with central high efficiency refrigeration or air conditioning means whereby the ambient air within the hold is maintained at a predetermined temperature. Referring to FIGURES 7 and 8, there is shown an insulated hold 81 which includes an exterior wall shell 82, a layer of insulating material 83, and an interior shell 84, which may be a fabric or plastic coating.

Within the hold there is provided a framing which is adapted to engage the corners of cargo containers, as will be presently described, to guide and hold the containers. Referring to FIGURE 9, columns 86 are provided which include vertically extending angle irons connected to one another by a plurality of plates 87 which may, for example, be welded to the angle irons. It is apparent that other frameworks may be designed which guide and hold the containers. The above sets forth one example.

The hold is constructed so that at the exposed ends of the containers there is formed a space 91, in effect a plenum, into which refrigerated air is supplied. The refrigerated air is supplied by refrigeration machinery which includes a blower 92 which withdraws air from the hold at 93 and blows the same over the refrigeration coils 94 and thence into the space 91. Suitable temperature sensing means 96 may be provided for sensing the temperature of the air to maintain the ambient air within the compartment at a suitable temperature. Other sensing devices may be employed to sense and control humidity, etc. whereby the ambient air is conditioned as desired.

As previously described, the containers may include a fan means 97, FIGURES 1, 2, or 7 which may circulate air in the container or, if desired, exhaust the air from the interior. A fan 97 is shown in dotted line in FIGURE 7. The fan circulates air from the ambient envelope over and through the cargo and back into the hold from where the air is carried by the resident fans to and through the air cooling coils. The fan 97 may also include a thermostatically controlled heater 98. The heater provides means whereby a sealed cargo container can be maintained at a temperature above that of the ambient air. The heater adds heat to the air which is recirculated by the fan to maintain prescribed container temperature.

The containers are enveloped in ambient air which is at substantially the correct temperature for the cargo. Thus, heat transfer through the insulated walls of the container into and out of the cargo containers is minimized or negligible. If a fan means should fail in any of the containers, in all likelihood the container will remain at the correct temperature for the period of transport and the perishable food will not be spoiled.

Referring to FIGURE 8, the hold extends above the deck 101 and is provided with an insulated cover 102. The space between the hold and the sides of the vessel and the bottom of the vessel may provide wing tanks and deep tanks for transporting of fluid or the like. It is understood that any space may be refrigerated to provide suitable ambient conditions and that the above is merely illustrative of a particular hold.

As previously described, certain ships already include cold storage holds. It is possible to transport containers in these holds in accordance with the present invention. For example, such a hold is shown in FIGURE 11; it includes deck or bottoms 106 with hatches 107 for providing various compartments for the storage of cargo.

The proper ambient conditions are provided for the cargo by the ducts 108 disposed along the sides of the ship. It is possible to dispose containers 105, in accordance

with the present invention, below the hatch 107 on the intermediate hatches 107a. Electrical connection may be made to the fans or blowers as indicated at 109. Thus, the ship's conventional refrigerated hold is suitable for storage of containerized cargo as well as bulk cargo. It is understood that should the operator elect and handling facilities are available, containers of permissible dimensions can be stowed under the decks. Also packaged bulk cargo can be stowed in other compartment volumes not occupied by containers.

A typical operation of the system and method is as follows: The container for long haul service would be fitted with plugs to close the ventilating ports and with a detachable mechanical refrigeration machine placed in the opening 61. The refrigeration machine refrigerates the container until its arrival at the marine terminal where it is removed. The container closure or panel 64 is placed in the opening 61 and suitably secured. The closure 64 may be fitted with a fan 97 and ventilating fan outlet for shipboard stowage in accordance with the invention.

The container is then loaded into the ship's refrigerated hold. The ventilating port plugs are removed and electrical connection is made to the fan motor.

After all the containers are loaded into the ship, the insulated hatch cover is secured and the ambient refrigeration air cooling system is put into operation. When the temperature of the ambient air approaches within approximately 5° of the carrying temperature, the container fans are turned on to circulate refrigerated or conditioned air.

Upon arrival at the delivery port, the container fans are stopped and hatches are opened. As the containers become accessible, the plugs are put in place. The container is then lifted out of the ship and is ready for dispatching. Containers which have to be transhipped to distant points would be fitted with a detachable refrigerating machine by removing the closure 64 and placing the machine in the opening 61.

After the containers are empty, they become available for other refrigerated cargo or the carrying of dry cargo.

For short haul operations containers of the type shown in FIGURES 1 and 2 or a long haul container fitted with a closure 64 are employed. The precooled cargo is placed in the insulated containers whose ports have been closed. The insulation maintains the cargo until the containers are loaded aboard ship. The plugs are removed from the ports and the procedure described above is followed.

The resident refrigeration system at the terminal may be employed for precooling the cargo or for maintaining previously attained conditions merely by connecting the containers to the resident refrigeration system which includes the ducts 71 and 76 and a remote air conditioning plant (not shown) which conditions the air in the ducts.

In transporting canned goods and other products which are sensitive to moisture the containers are coupled to a resident terminal air conditioning system which serves to provide conditioned air to the containers. The temperature of the cargo is raised to a predetermined safe reading. The container is sealed when the conditions within the same are such that the goods and products will remain at or above the dew point enroute and on their arrival at their destination.

In summary then, there is provided an improved system in which a large number of refrigerated containers can be carried with a crew complement no larger than those presently on vessels. The connected electric loading for the system is relatively small in comparison to conventional methods. The refrigeration would be a high efficiency resident plant, operating under the close supervision of the engineer officers on duty. Modulating control refrigeration for the cargo can be affected remotely of the plant and in lieu of intermittent refrigeration provided by low efficiency attached mechanical units. The plan provides an environment for the perishables that is

superior either to conventional containers or the conventional built-in ship's refrigeration. The complete plan reduces capital investment since a large number of individual mechanical refrigeration units will not be required. The amount of space occupied on the ship by the extending machine or for access to the same is negligible thereby increasing the net revenue space in the ship.

I claim:

1. A containerized cargo refrigeration system comprising means defining a chamber, a resident source of refrigeration including means for supplying refrigerated air to said chamber, a plurality of transportable insulated cargo containers adapted to carry cargo as a single unit, means providing communication between the interior of select containers and the refrigerated air in said chamber, and independently powered air circulating means carried in each of said containers for circulating refrigerated air from the chamber through the selected containers.

2. A system as in claim 1 including air heating means in each of said containers for heating the interior of the containers.

3. A containerized cargo refrigeration system of the type in which cargo is placed in insulated containers comprising an insulated ship's compartment, a resident source of controlled refrigeration including means for supplying refrigerated air to said ship's compartment, a plurality of transportable insulated cargo containers disposed in said compartment to be surrounded by the refrigerated air in said compartment, each of said containers including means for selectively providing communication between the interior of the container and the refrigerated air, and independently powered means carried within each of said containers for circulating refrigerated air from the compartment through the container.

4. A system as in claim 3 including air heating means in each of said containers for heating the interior of the containers.

5. A containerized cargo refrigeration system comprising means providing a source of controlled refrigeration for supplying refrigerated air, a plurality of transportable insulated cargo containers adapted to carry cargo as a single unit, each of said containers including insulated walls forming an insulated enclosure for receiving cargo, at least one inlet opening and at least one outlet opening providing communication to the interior of the container, means for selectively closing and opening said openings, independently powered air circulating means disposed within each container for independently circulating air in each of said containers whereby in the transport of the containerized cargo the openings may be closed and the cargo maintained at substantially uniform temperature solely by the insulated cargo container, and means for releasably connecting said supply of refrigerated air to an inlet opening of said container.

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