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REFRIGERATOR CAR AND METHOD OF USING

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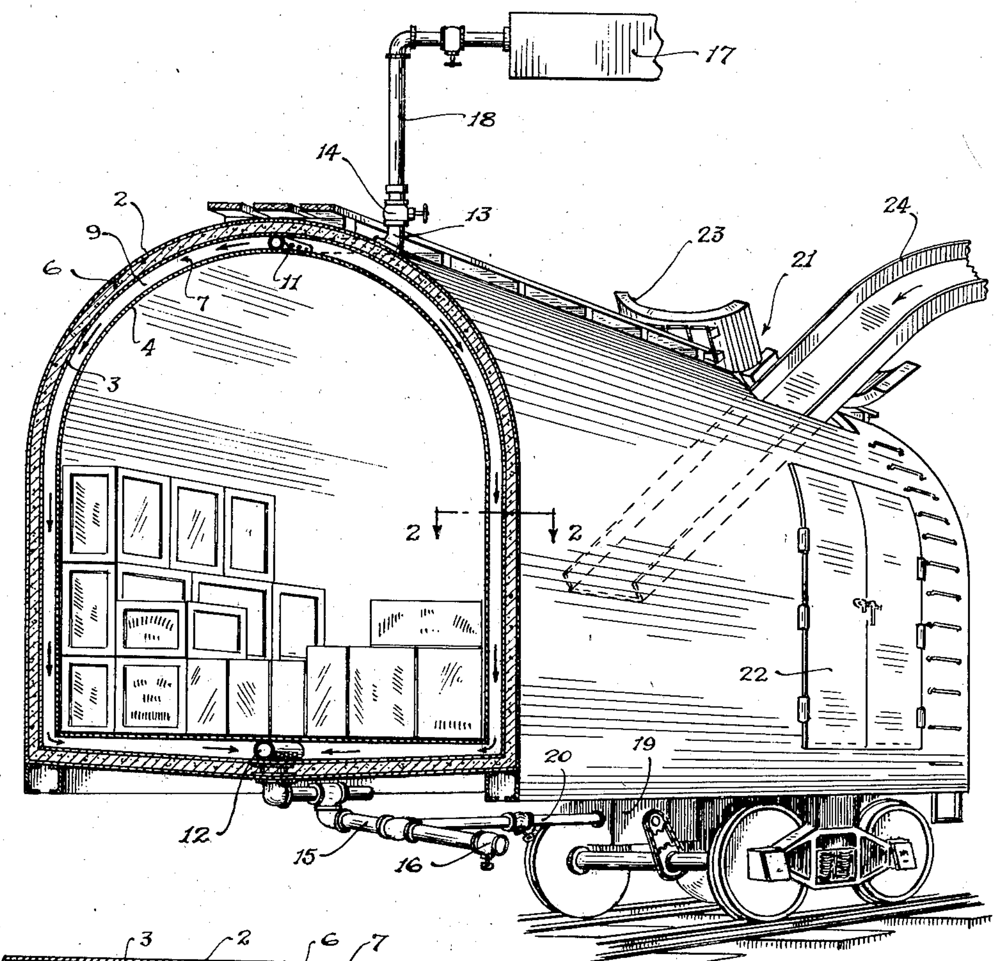

Fig. 1

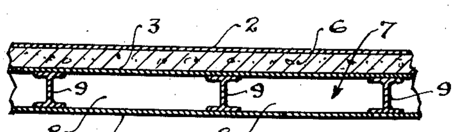

Fig. 2

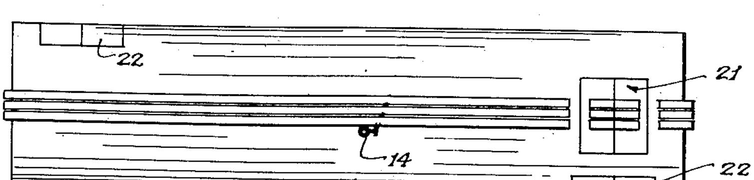

Fig. 3

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REFRIGERATOR CAR AND METHOD OF USING

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5 Claims. (Cl. 62—15)

This invention relates to an insulated vehicle and more particularly to a refrigerated vehicle.

An object of the invention is to provide a refrigerated car having insulation so perfect that the expensive and troublesome operation of initial icing and, also, the reicing of such cars in transit, may be avoided.

Another object of the invention is to provide a multiple wall refrigerated car employing heat insulation between the outer and inner walls of the body and having a space in the wall for the circulation of a chilling or heating medium, which space can be vacuumized after the temperature of the car has been adjusted.

Another object of the invention is to provide a multiple wall refrigerator car wherein substantially the entire inner wall of the car may form a primary chilling or heating surface completely surrounding the product stored in the car.

A further object of the invention is to provide an improved method of prechilling or preheating a multiple walled refrigerator car.

The present day refrigerator car provides a compartment within a solid insulated wall structure and a brine tank is generally provided at each end of the compartment to receive the refrigerant for cooling the car. The brine tank is provided with a heat transmitting wall against which the atmosphere of the car flows so that it is cooled, and the cold air falls from this wall of the brine tank onto the floor of the car. The brine solution is controlled to have a temperature from 0° F. to —4° F. and this temperature differential maintained at the cooling wall is effective to produce a temperature of about 35° F. at the center of the car with the temperature varying from 35° F. to about 10° F. in the zone adjacent to the cold brine wall.

After a car has completed a trip, it is generally delivered to a siding to be cleaned and await a new assignment. While standing on a siding, the internal temperature may build up to approximately 100° F. and when an empty car is delivered from the siding to an icing station, the standard 36′ car is initially loaded with approximately 3 to 4 tons of ice and salt. The car must then stand about 12 hours until it has been cooled down to a temperature of about 35° F. and it is then reiced to make up for the ice which has been melted. The cooled car is then delivered to the loading station and, while being filled, the inside temperature of the car may go up to between 50° F. and 60° F. and after loading is completed and the car is closed, additional ice and salt are added to the bunkers to top off the supply of refrigerant for the cooling chamber in order to make up for the heat which has been permitted to enter the car during loading. After the door is closed and the topping off is completed, the temperature of the compartment in the car is lowered and maintained at about 10° F. to 35° F. as above explained until a large part of the ice is melted.

In transporting the car from Chicago to New York, for example, due to the very heavy construction of the car occasioned by the insulation and the large weight of ice which must be carried in addition to the weight of the meat product, the car must be moved with slow freight trains. During such a slow trip, particularly in the summer time, much of the ice melts long before the journey is completed and, therefore, the ice in the brine tanks must be replenished several times throughout the trip. In the ordinary practice, a refrigerator car making this trip is generally three to four days in transit and must be reiced two or three times.

In order to reice a refrigerated car it must be uncoupled from the freight train and delivered to an icing station while the rest of the freight train continues its journey. The reicing of the standard refrigerator car is accomplished by adding from 1600 pounds to 1800 pounds of ice and salt to the ice bunkers and then the car is ready to continue its journey. Considerable delay always results, however, in the handling of the car for delivery to and from the reicing station and additional delay follows from the fact that the car, after having been reiced, must remain in the freight yards until picked up by the next freight train moving toward the destination of that particular car. Thus, due to the weight of the car which governs the speed with which it can be hauled, the reicing procedure is required and an unreasonable amount of time is consumed between the loading of a car in Chicago and delivery to the consumer market in New York.

A standard 36′ refrigerator car has a capacity of from 5600 pounds to 8000 pounds and usually carries an average of 6000 pounds of ice and salt. A 40′ refrigerator car requires from 9000 pounds to 13,000 pounds of ice. In either the standard car or the 40′ car, this considerable weight of material must be hauled in addition to the weight of the load of meat in order merely to maintain the product refrigerated during the trip.

It has been proposed heretofore to construct refrigerator cars with spaced inner and outer walls, the space therebetween being adapted to be vacuumized but, so far as is known, these prior art constructions have not been practical or especially adaptable for the transportation of perishable products. Moreover, due to the imperfections inherent in such a form of insulation when adapted to actual practice in these prior art constructions, it has been necessary to provide auxiliary chilling means, such as ice bunkers, chilled brine containers, or the like, in combination with the vacuum insulated wall in order to hold the goods under proper temperature conditions.

The present invention is designed to overcome the difficulties found in these prior constructions and provides an improved type of vehicle for storing and transporting perishable goods.

The car described herein provides an improved combination of insulating means for a storage and delivery vehicle wherein a space for the circulation of a chilling or heating medium is provided, which space can be vacuumized after the circulating medium has performed its function. The vacuumized space thereafter serves the additional function of completing the insulation of the body.

The most common application of this invention may best be exemplified in the well known refrigerator type of car and it comprises three or more spaced walls in the form of a shell within a shell. The outer wall of the car may be covered with a white heat-reflective surface which serves to reflect the heat and the rays of the sun rather than to absorb the same. The inner wall surface of the car body is polished or japaned in order to cut down the radiation of any heat from that wall to the product in the car. Between the outer and intermediate walls there is provided an insulating means, such as cork, rock wool, spun glass or any other well known form of heat insulator, and between the inner wall and the intermediate wall, the wall construction provides a fluidtight but substantially free space.

Because of the efficient heat insulation provided by this body construction for a refrigerator car, as will appear more fully below, the need for the conventional ice bunkers, chilled brine, or ice containers, which are usually required in order to maintain the car under refrigerated conditions is obviated. Also, the necessity for stopping the car to ice and reice in transit, which occasions expense and delay, is eliminated.

This construction further makes possible the performance of a novel method for prechilling the interior of the car prior to loading, which method contemplates the circulation of a refrigerant in the free space between the inner wall and the intermediate wall. The space there provided is adapted to be subsequently evacuated to serve additionally as a part of the insulating means. The space in which the refrigerant is circulated extends substantially all around the inner wall of the car and makes available means such that the perishable product is almost entirely surrounded by a primary chilling surface. In so increasing the effective chilling surface, the average temperature differential between the refrigerant and the product can be reduced thus resulting in substantially reducing the dehydration or desiccation of food products caused by circulating an extremely cold atmosphere over the product as has been the practice in the past.

In the present day type refrigerator car, wherein ice bunkers are required, it is necessary to chill these bunkers by means of crushed ice and salt or other refrigerant down to around 0° F. in order to maintain an average of around 35° F. at the center of the car to preserve its contents. The very low temperature to which the circulating atmosphere is cooled removes substantially all the moisture entrained therewith and this water deposits on the cold surface of the wall as a frost. This decreases the efficiency of the cooling wall and, furthermore, the circulation of the dry atmosphere over the exposed surfaces of fresh beef, lamb, veal or other moisture containing products causes the dehydration thereof.

The present invention further renders the distribution of perishable meat products more rapid and efficient in the disclosure of a refrigerated car having such improved refrigerating and insulating means as to permit freshly slaughtered meat to be loaded directly into the car while warm and to become thoroughly chilled or frozen while stored therein. Thus, in making full use of this invention, it is not necessary to prechill freshly slaughtered meat or other products in regular plant coolers for a period of from 12 to 48 hours to remove the animal heat and freeze the product before loading it into the car. The unchilled or partly chilled product may be loaded directly into the car and it can be further cooled while en route to its destination.

The provision of such means makes possible the slaughtering of kosher beef, lamb and veal, for example, at points far distant from the consumer market and subsequent delivery to the market for distribution within the time limits prescribed by the Mosaic law. The most economical procedure in the slaughtering of meat animals is to butcher the carcass in the Middle West where the animal is raised, eliminate all by-products, and then ship the finished cuts east to the consumer market. As explained above, the present day refrigerator car requires about 3 to 4 days to deliver meat from Chicago, one of the larger slaughtering centers, to New York and, thus, it is uneconomical to deliver kosher meat by this means into the largest kosher meat market in the East.

In order to supply kosher meat to the metropolitan districts in the East, live cattle are shipped to New York and are butchered there for delivery to the kosher trade and a 1000 pound steer shipped into New York will yield approximately 200 pounds to 250 pounds of kosher meat. While a larger quantity of meat may possibly be derived from the carcass, the cost of preparing the hindquarter by removing the veins is too high and, therefore, only the forequarter of a beef carcass is generally offered in the trade. It is seen that a large number of cattle must be shipped to derive a small yield of kosher meat and, considering further, that approximately 400 pounds of the 1000 pound steer are by-products which have relatively small market value, the unsound economics of the situation are apparent. The necessity for the present invention, by which delivery of meat may be greatly speeded, is readily visualized.

The refrigerator car of the present invention will be described as an improvement in railway rolling stock. It will be understood, however, that this is only by way of illustration since the novel features of the present invention are equally adaptable to other forms of transportation for shipping a perishable product in an enclosed chamber, such as trucks, trailers and other forms of refrigerated vehicles.

Reference is had to the drawing in which

Figure 1 is a perspective view, partly broken away of the refrigerator car of the present invention,

Figure 2 is a sectional view of the wall structure partly broken away and taken on line 2—2 of Figure 1 and,

Figure 3 is a plan view of the car shown in Figure 1.

The refrigerator car of the present invention may be and preferably is constructed of any suitable metal such as the lighter aluminum alloys, stainless steel, or the like. The walls of its body are formed of spaced walls 2, 3 and 4. The disposition of the walls 2, 3 and 4 is such as to provide a plurality of spaces 6 and 7, the outer space of which 6 is adapted to be filled with an insulating material, for example, cork, rock wool, spun glass etc., while the inner space is left substantially free for a purpose that will appear below. The outer surface of the car is preferably covered with a white heat-reflective surface which serves to reflect the sun's rays and other heat impinged upon the car.

The walls 2 and 3 may be braced from each other in any conventional manner as is usual in the insulation art. The wall 4, however, is interbraced with wall 3 in such a manner that a plurality of intercommunicating channels 8 fill space 7. The supporting elements 9, which constitute the bracing between walls 3 and 4, preferably take the form of continuous walls of a non-heat conducting material and define the walls of channels 8.

The channels 8 may be laid out in any desired pattern in space 7 and are designed to control the circulation of a heat transfer medium through the space 7. It is seen that, with this wall construction, an insulated layer 6 is provided around space 7 and, thus, if a refrigerant is circulated in space 7, a refrigerated zone may be efficiently established within the confines of the wall 4. The channels 8 may extend from end to end of the car to distribute the refrigerant over the wall 4 to cool it, or they may extend transversely around the car to circulate the refrigerant through a shorter path as shown in Figure 1. It is desirable, however, that each channel 8 be of substantially the same length and capacity as every other channel 8, insofar as possible, so that the refrigerant being circulated in each channel will have an equal opportunity to absorb heat whereby a uniform cooling action is accomplished. Also, the channels should pass around substantially all the walls of the zone to be cooled.

The channels 8 all communicate with a header 11 through which refrigerant or other medium may be supplied to them and the medium after flowing through the channels 8 passes into a common collecting header 12. Any convenient connection as lead 13 may connect to header 11 so that the medium may be delivered thereto and valve 14 is provided to seal this entrance passage. An outlet 15 leads from header 12 to the side of the car for practical operation and valve 16 controls the flow through outlet pipe 15.

After the channels 8 have served their function of circulating the temperature adjusting medium, the space 7 is adapted to be evacuated and outlet means 15 and 16 are, therefore, adapted for connection to any well known form of vacuum pump. The medium is first run off, of course, and after valve 14 is closed, as perfect a vacuum is drawn as is possible in space 7, whereupon the fluidtight space may be sealed by closing valve 16. Automatic pressure control means, such as are well known, may be provided to automatically effect connection and disconnection of the vacuum producing means with space 7.

The vacuum produced in space 7 serves, in cooperation with insulation in space 6, as an insulation against the transfer of heat with respect to the confined body of the car and it is contemplated that the vacuum shall be reestablished from time to time, if necessary, to insure the best insulation possible. The insulating layer 6 serves initially to protect the car against the loss of refrigeration while the car is being cooled and, when space 7 is later evacuated, layer 6 and vacuum chamber 7 provide a most efficient insulating structure for the controlled space.

When the body is to be cooled, the refrigerant that is to be circulated in channels 8 may take the form of a brine solution, an expansible gas which may be released into the space 7, or a liquid which evaporates within the space 7. The vacuum producing means is selected to handle either a gas or liquid depending upon the choice of refrigerant used. The refrigerant can be supplied from any conventional means 17 and a flexible pipe 18 may be located at the loading platform so that the car can be chilled while the loading thereof proceeds, or the refrigerant supply can be taken from any other convenient source. The vacuum producing means may have and preferably does include a pumping unit 19 mounted upon the car and driven from an axle of the car.

The vacuum means 19 is connected into header 12 through pipe 20 and outlet 15. The initial vacuum may be produced in chamber 7 by a centrally disposed means if desired, however, the unit 19 carried on the car itself should be of such a capacity that it can maintain the low pressure produced therein.

Suitable entrances into the body must be provided and a hatch 21 in the top and side doors 22 are preferably provided for this purpose. Cork, rock wool, or similar insulation may be used to insulate the cover 23 for the top opening and also for the side doors 22. The edges of the openings cooperating with the hatch cover and doors should be provided with a suitable sealing engagement.

In the past, when shipping refrigerated products, and before loading the car with prechilled products, the atmosphere within the interior of the car has been chilled to approximately 30° F. to 35° F. so that when the cold product was moved from the storage freezer to the refrigerator car, moisture which might be entrained with the warmer atmosphere would not condense on the colder product. The usual practice is to load such precooled cars through side opening doors, such as 22, and it has been found that a considerable loss of cold air and heating up of the car results. Although curtains are used, a portion of the heavier cold air in the car spills out of the open side door and loss of refrigeration results.

In using the refrigerator car of the present invention, and when a prechilled product is to be loaded into the car, the interior of the car is chilled by pumping cold air into the car or by circulation of refrigerant in space 7. After the car has been precooled and in following the preferred form of this invention the side doors are left closed and the top hatch is opened. The product is delivered into the car from chute 24 through hatch 21 and this procedure minimizes the loss of cold air. Prechilled products may be delivered into the car in this manner without the accompanying loss of refrigeration, and furthermore, as there is no substantial inflow of new air into the car during the loading thereof, the possibility of a warm moist atmosphere entering the car to cause precipitation of moisture on the cold surface of the chilled product is precluded.

After loading has been completed the top opening door of the car is tightly closed and, if need be, a refrigerant is again introduced into the space 7 between the inner and intermediate walls of the car. When proper cooling has been accomplished, the chilling medium is withdrawn from the space 7 through outlet 15. In actual practice, it is preferred to prechill the interior of the car to around 0° F. prior to loading but the temperature should be leveled off at about 30° F. to 35° F. during actual shipment. The exact temperature to be maintained during shipment is obviously determined principally from the properties of the product to be shipped.

It will be noted that this construction can be used for cooling a product stored in the car and, in this instance, the entire inner surface of the car forms a primary refrigerating surface for the atmosphere circulating over the product. The provision of such a large cold surface for chilling the atmosphere circulating over the stored product makes possible proper cooling with a smaller temperature differential between the product being stored and the circulating atmosphere. Because of the very large primary refrigerating surface provided, the circulating atmosphere may be passed over it more frequently or, in other words, a larger volume of gases may be cooled thereby, and the average temperature differential between the atmosphere in the car and the product being cooled may thus be reduced.

This reduction in the temperature differential results in the elimination of one of the more serious defects in the present day apparatus in which a small volume of the atmosphere must be chilled to a very low temperature to maintain an average temperature within the desired range. As above explained, the building up of a coating of frost on the bunker wall is encountered and whenever this very cold atmosphere of the prior art devices touches a product containing moisture, the product is unduly desiccated because of the dry condition of the atmosphere, and further, the excess chilling of itself may be injurious to the product. This effect is avoided by providing the large primary refrigerating surface as here taught whereby the atmosphere may be recirculated more rapidly.

It will be obvious that space 7 may be used for heating the car during extremely cold weather. This may be readily accomplished by pumping warm water, steam, or other heating medium into the space substantially in the manner as described in connection with circulating a refrigerating fluid through this space.

Following the chilling or heating of the walls as described above, space 7 may be evacuated by means of the pump 19 and line 20 and the increased heat insulation of the combined vacuum and layer 6 is had.

It will be seen that the refrigerator car of the present invention provides an improved construction having in combination an insulating means and a fluid tight space capable of accommodating a chilling or heating medium, which medium may be withdrawn so that the space may be vacuumized. This new structure serves not only as a structure to prevent the transmission of heat through the walls of the car, whereby the goods may be shipped while being maintained at substantially a constant temperature, but also includes within the same elements means for adjusting the temperature of the confined body of the car. Further, the insulating means and the herein disclosed method of loading a precooled car cooperate, as described, to substantially prevent condensation upon the product of the water vapor which otherwise might be entrained in the air. The disclosed invention is also operative to eliminate, to a great extent, the conditions which cause the dehydration of moisture containing meat and food products.

Obviously, many modifications and variations of the invention hereinbefore set forth will occur to those skilled in the art, all of which are contemplated to be within the scope of the following claims.

I claim:

1. A body for a vehicle adapted to transport perishable products which must be preserved under substantially constant temperature conditions, comprising a storage chamber, an enclosing wall surrounding the chamber, said wall being formed of a layer of insulation overlaying a substantially free space, means for enclosing said free space on all sides to form a fluidtight chamber substantially surrounding said storage chamber, said free space being divided into a plurality of flow channels, means to deliver a temperature control medium into each of said channels whereby when said medium is delivered into each of said channels it may be circulated around the storage chamber, and means for thereafter vacuumizing the free space to provide insulation against heat exchange through the wall.

2. A body for a vehicle adapted to transport perishable products which must be preserved under substantially constant temperature conditions, comprising a storage chamber, an enclosing wall surrounding the chamber, said wall being formed of a layer of insulation overlaying a substantially free space, means for enclosing said free space on all sides to form a fluidtight chamber substantially surrounding said storage chamber, said free space being divided into a plurality of flow channels, a pair of headers disposed to be connected to each of said channels, one of said headers being connected to said channels at one end and the other of said headers being connected to said channels at the other end, means for connecting one of said headers to a refrigerant supply whereby refrigerant may be delivered into said channels, and means for connecting the other of said headers to a vacuumizing means whereby said free space may be vacuumized, the construction being provided so that the chamber may be first cooled and thereafter insulated against heat exchange.

3. A body for a vehicle adapted to transport perishable products which must be preserved under substantially constant temperature conditions, comprising a longitudinally extending storage chamber, an enclosing wall surrounding the chamber, said wall being formed of a layer of insulation overlaying a substantially free space, means for enclosing said free space on all sides to form a fluidtight chamber substantially surrounding said storage chamber, said free space being divided into a plurality of channels directed transversely around the storage chamber, a header running longitudinally across the top of said storage chamber and communicating with each of said channels, a header running longitudinally below the floor of said chamber and communicating with each of said channels, means to connect said upper header with a refrigerant supply, and means for connecting said lower header with a vacuumizing means whereby the chamber

may be first cooled and thereafter insulated against heat exchange.

4. A method of loading a refrigerated vehicle with a plurality of packages of a prechilled product comprising prechilling the packaged product, chilling the storage chamber of said vehicle before loading, closing all openings to said storage chamber except an unobstructed opening through the ceiling, loading the packages containing the product to be stored into the chilled storage chamber through said opening in the ceiling of the chamber, and thereafter closing the opening in the ceiling.

5. A refrigerated means for transporting perishable products having an insulated refrigerated space and including a chamber substantially surrounding the refrigerated space, which chamber is adapted to serve the function of receiving a refrigerant to cool the space and after cooling the space, of adding to its insulation comprising; a storage space to receive the product to be stored; a chamber substantially surrounding the storage space; a layer of insulation surrounding said chamber; means for dividing said chamber into a plurality of flow passages; means connected to the chamber to supply a refrigerant to said flow passages at one time and thereafter to connect said flow passages to vacuumizing means; and a door through said chamber and layer whereby a product may be delivered into and withdrawn from the space; said construction being provided so that the storage space may be cooled upon introduction of refrigerant to said chamber and, after being cooled, said storage space may be further insulated from the surrounding atmosphere by having a vacuum produced in said flow passages which adds to the insulating effect of said layer in shielding the product in the storage space against a transfer of heat through the wall.

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