Sept. 17, 1940. H. Y. STEBBINS 2,214,975

MEANS AND METHOD OF REFRIGERATING

Filed Aug. 12, 1938 2 Sheets-Sheet 1

Fig. 1.

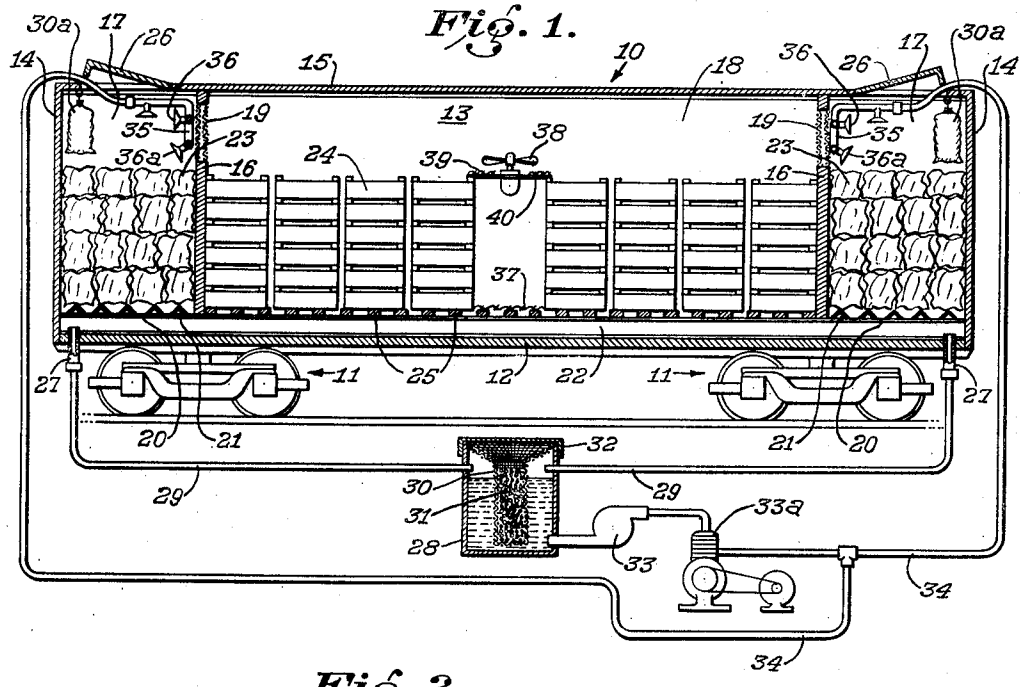

Fig. 2.

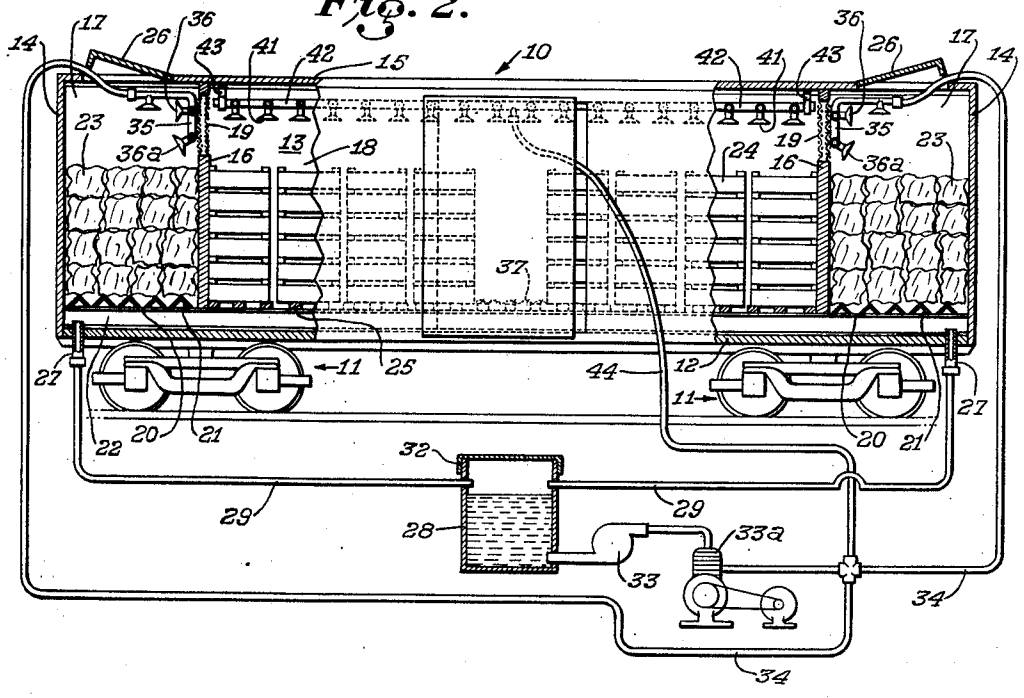

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Fig. 3.

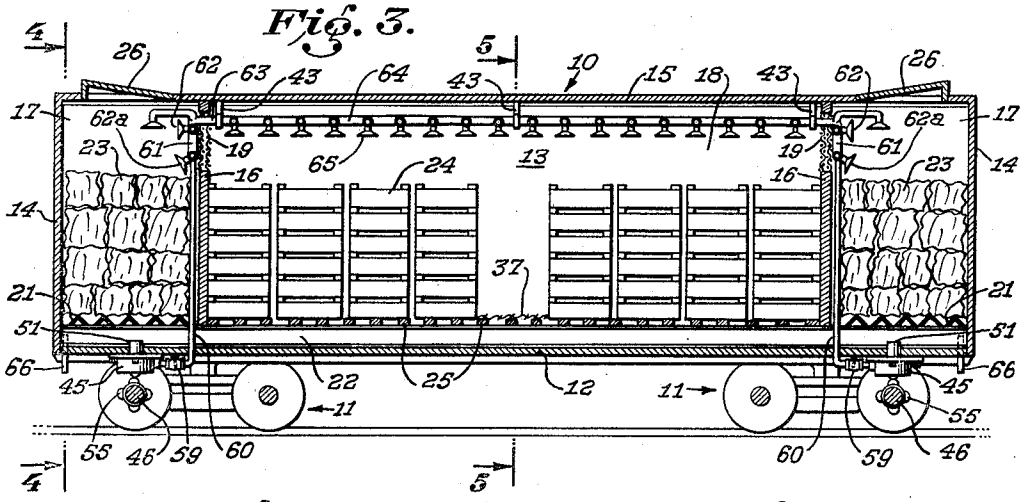


Fig. 4.

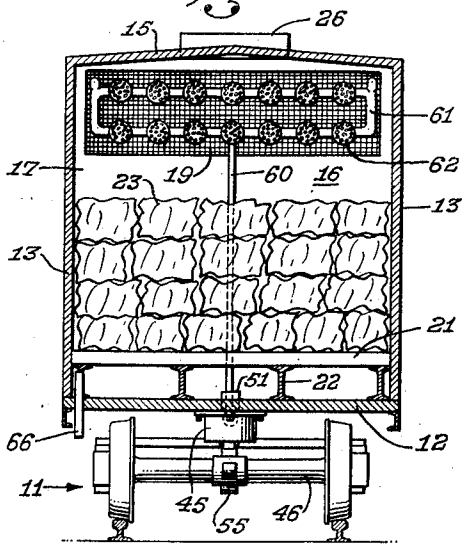
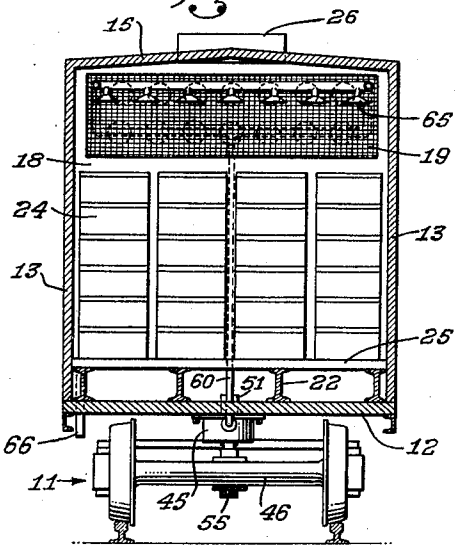


Fig. 5.



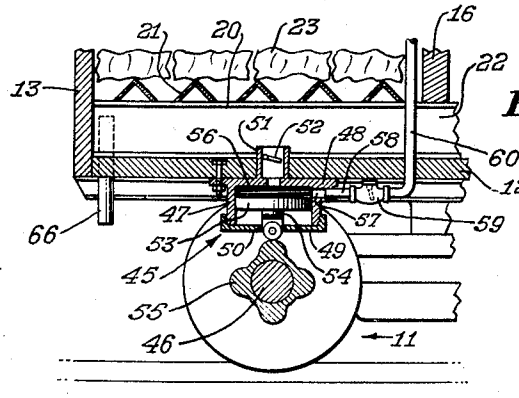


Fig. 6.

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UNITED STATES PATENT OFFICE

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MEANS AND METHOD OF REFRIGERATING

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Application August 12, 1938, Serial No. 224,534

15 Claims. (Cl. 62—24)

This invention relates to means and methods of refrigerating railway freight cars and the like, and more particularly contemplates apparatus for spraying fluid within the compartment to be cooled to refrigerate by means of absorption of heat units by the fluid itself and by air cooled by ice and the fluid, and circulated by the force of the spray.

Conventional types of refrigerator freight cars are provided with bunker compartments at each end into which ice is packed. Air above the ice in the bunkers, upon being cooled, will flow downwardly between the ice blocks, through supporting rails and under the bulk head into the freight compartment, from which area it will rise through the freight and be returned through a screen provided in the upper end of the bulk head into the ice bunker, thus providing a continuous circulation of refrigerated air through the freight compartment of the car. A difficulty of this system is due to the fact that the circulation is too slow to afford proper protection for highly perishable products.

It is therefore an important object of this invention to increase the rate of air flow through the ice and freight compartments of refrigerator cars by spraying a liquid under high pressure within the bunker compartment in the direction of the normal air flow.

Another object is to flow a liquid over the ice within the bunkers to refrigerate the liquid and subsequently spray the cooled liquid through the air to refrigerate the latter, which is then permitted to circulate through the compartment to be cooled and absorb heat therefrom.

Another object is to provide apparatus for circulating a refrigerated liquid from the top of the freight compartment downwardly directly on the freight or containers therefor, either at the point of loading, in transit, or both.

Another object is to provide a refrigerator car having a pair of pumps actuated by a rotating axle of the car during transit, to pump water from the ice compartment to the top of the bunker for ejection through nozzles into the path of air flowing from the freight compartment into the ice bunker to increase the rate of air circulation through the ice chamber and freight compartments, as well as to facilitate the refrigeration of circulated air by absorption of heat therefrom, not only by the ice, but also by the refrigerated water.

Another object is to provide a plurality of spray nozzles within the freight compartment of a refrigerator car in conjunction with an axle actuated pump to convey refrigerated water from the ice chambers through the nozzles by which the water may be sprayed on the freight or produce.

Another object is to augment the refrigeration in any of the above-noted methods of cooling by the addition of a salt solution to the liquid sprayed through either the jets for increasing the rate of air circulation through the car, on the ice in the bunkers and/or directly on the freight.

Another object is to provide a refrigerating unit to be operated externally of the refrigerator car in combination with means to spray water, brine, or the like from said refrigerating unit through the bunkers or within the freight compartment of the car on the produce to be cooled.

Other objects and corresponding advantages of the separate and various combinations of the apparatus of my invention which, as will appear, are adaptable to numerous uses other than those specifically described herein, will be apparent to those of skill in the art from an examination of the following description read in the light of the accompanying drawings, in which:

Fig. 1 is a sectional view of a conventional form of railway refrigerator car with one embodiment of my invention operatively associated therewith, said embodiment being particularly adapted for use at the point of loading the car before transit;

Fig. 2 is a sectional view showing the apparatus similar to that of Fig. 1 with the addition of a spray attachment for the freight compartment of refrigerator cars;

Fig. 3 is a sectional view of another modification of the apparatus showing a form adapted for use during transit;

Figs. 4 and 5 are sectional views taken on correspondingly-numbered lines of Fig. 3;

Fig. 6 is an enlarged sectional view of the lower end portion of a refrigerator car showing more in detail the pump of the embodiment of Fig. 3 and the actuating mechanism therefor.

Referring to the drawings in detail, the numerals of which indicate similar parts throughout the several views, 10 designates generally a refrigerator car of conventional construction comprising a running gear 11, sub-floor 12, side walls 13, end walls 14, and roof 15. The interior of the car is divided by a pair of transverse bulk heads 16 adjacent respective end walls 14 to form at the ends of the car, ice bunkers 17, and between the bulk heads 16, the freight compartment 18 of the car. An opening is formed in the

upper portion of each bulk head extending the width of the car which is covered by a heavy screen 19 to permit comparatively warm air to flow from the freight compartment 18 into the ice bunkers 17 for refrigeration. A grate 20 of spaced inverted V-irons 21 is mounted above the sub-floor 12 in each bunker 17 for the support of ice blocks 23, on rails 22 extending the length of the car. A brace load of freight generally indicated by numeral 24 is supported within compartment 18 on a rack comprising a plurality of transverse bars 25 carried on rails 22. In the roof of the conventional refrigerator car over each ice bunker a hatch 26 is provided through which the ice is moved into the bunkers. Each bunker is provided with a drain fitting 27 through the sub-floor 12 for the drainage of the ice melt.

The form of my invention illustrated in Fig. 1 is adapted primarily for use in refrigerating the interior of the car and freight after loading just prior to transit in order to lower temperature rapidly before sealing the car. The use of this embodiment will ordinarily, though not necessarily, be utilized to cool freight of the type which the ice on the bunkers is sufficient to properly refrigerate during transit after the temperature is once lowered, or where the freight is to be moved a comparatively short distance.

A tank 28 is provided externally of the car and is connected with the drain fittings 27 by means of hoses or pipes 29 whereby water from the ice in the bunkers will flow into the tank. A screen insert 30 is hung within the tank 28 into which salt, indicated by the numeral 31, may be placed for a purpose later referred to. The tank 28 is covered by a closure 32 and may be insulated to maintain as nearly as possible the temperature of the water which flows from the bunkers through the hoses 29. A centrifugal pump 33 is connected to the tank to pump water, or brine if salt is introduced into the tank, through pipes or hoses 34 through a refrigeration unit 33*a* of conventional design back into the respective bunkers 17. The hoses 34 are each connected to a portable header 35 in which a plurality of spray nozzles 36 are threaded. The exact form of the headers employed may be varied in specific embodiments. The headers 35 with hoses 34 connected thereto are introduced through respective hatches 26 into the bunkers and the headers are hung within the bunkers on screens 19, in the opening in the bulkhead if the screen is omitted, or to the top of the car by hooks or hangers or any means well known in the art (not shown), with the nozzles positioned to direct fluid ejected thereby from the screen toward the middle of the respective bunkers. Some of the nozzles 36*a* are directed downwardly to spray fluid against the ice and toward the V-irons 21, the exact arrangement of the nozzles being within the skill of those engaged in the art. The apparatus may be quickly installed in this manner. Water or brine pumped through the refrigeration unit 33*a* will be discharged from the nozzles 36 and 36*a* to cool the air, and will then flow over the ice to further refrigerate the fluid. As the headers 35 are hung adjacent the respective screens, the spray will, by induction, increase the rate of the normal flow of air through the screens from the freight compartment and downwardly over the ice. The air thus cooled is forced by the downward movement of cooling air in the upper portion of the bunker and the force of the spray, through the V-irons, under the bulk heads, along the sub-floor, and thence upwardly between the bars 25 under and between the boxes of freight to the top of the car. In a brace load, an unoccupied space is left in the center of the car, and accordingly, it will be observed that the cooled air will tend to move to this portion of the car rather than between the freight where the space is more restricted. To prevent this result, the bars 25 in the middle of the car are covered with a canvas baffle 37. The air will be drawn to the top of the freight compartment by the suction produced by the movement of air through the screen in response to the force of the spray as above noted. The salt within the tank will assist in the refrigerating process in a well known manner.

A bag 30*a* containing salt may be hung by any suitable means within each bunker against which the spray from the nozzles 36 may be discharged to melt the salt and form a brine solution of the refrigerated liquid which is then drained from the bunkers through hoses 29, as above noted.

If it is desired that the rate of air flow be increased as, for example, for the initial cooling of a car containing a brace load, a booster fan 38, hung within a frame 39, may be supported on the load in the center of the car to force air upwardly. The frame 39 around the fan is preferably covered with a closure 40 to secure maximum benefit from the fan. It will be observed that with the bars 25 below the fan 38 covered by canvas baffle 37, the air moved by the fan will be drawn through the boxes of freight and produce.

While the outside refrigerating unit 33*a* may ordinarily be dispensed with, it is useful where ice from the bunkers is not available and where it is necessary that the car be cooled quickly.

In Fig. 2, a similar apparatus is illustrated with the addition that nozzles 41 (about to be described) are provided in the upper portion of the freight compartment of the car to spray ice water drained from the bunkers and refrigerated by the auxiliary unit 33*a* directly on the freight, as where the latter consists of leafy vegetables and the like which tend to wilt if not kept moist.

To this end a portable header 42 or a plurality of connected headers are suspended by hangers 43 from the roof of the car within the freight compartment or may be hung on the screens of respective bulkheads if desired. The header carries a plurality of downwardly directed nozzles 41, and is connected to one of the hoses 34 leading from the pump 33 by a hose 44 which extends into the car through the side doorway thereof. In this embodiment it will be seen that the water sprayed through the bunkers from nozzles 36 will be refrigerated by contact with the ice and will then drain into the tank 28 through hoses 29. From the tank the water will be pumped through the refrigerating unit 33*a* and a portion of the water will flow through hose 44 and into header 42 for discharge from nozzles 41 against the freight. The water thus ejected will similarly drain to the sub-floor 12 and thence to the drain hoses 29 through fittings 27 and return to the tank.

In the embodiment of my invention shown in Figs. 3–6, inclusive, the apparatus is adapted for use in refrigerating the car and freight in transit. A pump 45 is mounted on the underside of a sub-floor 12 adjacent each end of the car directly over an axle 46 of the running gear which is under the respective ice bunkers. Each pump 45 comprises a cylinder 47 (Fig. 6) and an upper and lower head 48 and 49, respectively. The lower head 49 is formed with a central opening

50 which is in vertical alignment with the axle 46. A pipe 51 extends from the upper end of the cylinder through the sub-floor into the bunker under which the pump is located. A check valve 52 is disposed within the pipe 51 to open to the flow of fluid from the ice in the bunker into the cylinder 47 of the pump, but adapted to close to a balance of pressure within the pump. A piston 53 within each cylinder 47 is provided with a cam follower 54 on the underside which extends through opening 50 in head 49. A cam 55 is carried rigidly by each axle 46 on which the follower 54 rides to reciprocate the piston 53 as will be obvious to those of skill in the art. A helical spring 56 within the cyinder of each pump is located between piston 53 and the upper head 48 to retain the follower 54 on the cam 55. An opening 57 is formed through the upper end of cylinder 47 into which a pipe 58 is threaded. A check valve fitting 59 of conventional construction is connected to the pipe. A pipe 60 extends from valve fitting 59 through the floor of the car and through the bunker under which the pump is disposed, upwardly along the bulk head, for connecting with a header 61 overlying the screen 19 comprising the upper portion of the bulk head. The header 61 carries a plurality of spray nozzles 62 of a character above described in connection with the embodiments of Figs. 1 and 2 which direct fluid horizontally toward the respective end walls 14. Nozzles 62*a* are also threaded into each header 61 which spray fluid against the ice in the respect bunkers. The opposite ends of each header 61 is communicated by means of a pipe 63 which extends through the screens 19 of the bulk head, with a header 64 suspended from the roof in the freight compartment by hangers 43. A plurality of spray nozzles 65 are threaded into header 64 and are directed downwardly. As the car is moved, the cam 55 on the axle 46 will reciprocate the piston 53 to draw fluid through pipe 51 and discharge the same through pipes 58 and 60 on alternate strokes thereof. From pipe 60 the fluid will flow into the headers 61 and 64 for ejection through nozzles 62, 62*a* and nozzles 65. The water from nozzles 62 will be refrigerated by its flow over the ice and will absorb heat from the air circulated through the car upon being subsequently sprayed from headers 61 and 64. A drain pipe 66 through the sub-floor 12 of each bunker may be substituted for each of the usual drain fittings in the bunkers, the upper end of pipe 66 terminating between the upper end of pipe 51 and a horizontal line through the lower end of the bulk heads in order to prevent the ice melt from rising to a level sufficient to fill the area between the sub-floor and the V-irons which would shut off circulation of air below the bulk heads.

It will be observed that I have provided apparatus adapted for facile installation in conventional refrigerator cars or the like, which may be employed to quickly lower the temperature of a car immediately after loading and before the car is sealed, or to maintain a lower temperature than heretofore economically possible during transit, by increasing the rate of flow of air through the ice bunkers and freight compartment and thereby facilitate refrigeration of the air by reason of its more quickly recurring contact with the ice, and further, by refrigerating liquid and flowing the same over the produce comprising the freight, as well as by increasing the rate of refrigeration of the air by spraying the same with said refrigerated liquid.

While I have described but three embodiments of my invention, all as adapted for use with railway refrigerator cars, it should be understood that numerous changes in size, design, number, and proportion of the various parts may be made which will enable utility of the invention for other analogous purposes as, for example, in refrigerating inclosures other than refrigerator cars; and further, that while only the tank in Fig. 1 is depicted as containing salt to form a brine solution, any of the embodiments shown may be provided with a salt container through which the fluid may be directed or any and all embodiments including that shown in Fig. 1 may be utilized without the addition of salt if desired, all without departing from the spirit of my invention as defined by the appended claims.

What I claim and desire to secure by Letters Patent is:

1. The method of cooling a refrigerator car having a bunker at one end which comprises spraying a liquid from the upper end of the bunker downwardly against ice blocks within the bunker, pumping the liquid from the bottom of the bunker to the top thereof and spraying the liquid into the air thereat to cool the air and induce cold-air circulation between and around the ice blocks and into the portion of the car outside of the bunker.

2. The method of refrigerating refrigerator cars having a bunker therein for storing ice comprising the steps of: refrigerating fluid in a refrigerating unit externally of the car, pumping said fluid into the car and spraying the same from adjacent the roof of the car and against the ice in the bunker, to circulate the air into which the fluid is sprayed through the bunker and freight compartment by the force of the spray, and draining the fluid thus sprayed into the refrigerating unit for its further refrigeration and return into said car.

3. In a device for cooling refrigerator cars having a bulk head dividing the car into a bunker for storing and the melting of ice and a freight compartment, the bulk head having an opening adjacent its upper end, a tank, means to drain ice melt from said bunker into said tank, a pump connected to said tank, a header connected by the opening of the bulk head having nozzles connected thereto directed toward the middle of the bunker away from said opening, and means to connect said pump to said header to pump ice melt from said tank through said nozzles to refrigerate air within said bunker and induce ice circulation downwardly through said bunker.

4. In a device for cooling refrigerator cars having a bulk head dividing the car into a bunker for storing and the melting of ice and a freight compartment, the bulk head having an opening adjacent its upper end, a tank, means to drain ice melt from said bunker into said tank, a pump connected to said tank, a header suspended within the freight compartment carrying nozzles directed downwardly, and means to connect said pump to said header to pump ice melt from said tank through said nozzles.

5. In a device of the character described, a refrigerator car having a body divided by a bulk head to form a freight compartment and an ice bunker, an axle below the body of the car and below said ice bunker, a cam carried by the axle, a pump secured to the underside of the body actuated by said cam, a header adjacent the

top of said ice bunker carrying spray nozzles directed into said bunker, means to carry fluid from said bunker into said pump, a conduit leading from said pump to said header, said pump upon being actuated by rotation of said axle to move fluid from said ice bunker through said nozzles to cool the air and induce air circulation through said bunker.

6. In a device of the character described, a refrigerator car having a body divided by a bulk head to form a freight compartment and an ice bunker, an axle below the body of the car and below said ice bunker, a cam carried by the axle, a pump secured to the underside of the body actuated by said cam, a header suspended from the top of the freight compartment of the car, nozzles connected to said header directed downwardly toward the floor of the car, means to carry fluid from said bunker into said pump, a conduit leading from said pump to said header, said pump upon being actuated by rotation of said axle to move fluid from said ice bunker through said nozzles to cool the air and freight within the freight compartment.

7. In a device of the character described, a compartment for the storing and melting of ice, a salt container in said compartment, and means to spray the ice melt from said compartment into the air above the ice and against said salt container in said compartment.

8. In a device of the character described, a compartment, a refrigerating unit for fluid, a series of spray nozzles disposed adjacent the top of said compartment for ejecting fluid downwardly in said compartment, a fan and means to mount said fan in said compartment to draw air upwardly from the floor of said compartment through the downward spray of fluid from said nozzles, and means to pump fluid drained from said compartment through said refrigerating unit and to said nozzles.

9. A railroad car having a bulkhead at one end forming a bunker for ice, said bulkhead having openings adjacent its upper and lower ends, respectively, a nozzle adjacent the top of said bunker directed downwardly, means including a pump to convey the melt from ice in said bunker to said nozzles and eject said ice melt from said nozzles directly against ice in the bunker and to induce air circulation by said ejection through said opening at the top of the bulkhead downwardly over the ice and through the opening at the bottom of the bulkhead.

10. A railroad car having a bulkhead at one end forming a bunker for ice and a freight compartment, said bulkhead having openings adjacent its top and bottom, respectively, nozzles adjacent the top of the freight compartment, means to eject the ice melt from ice in said bunker from said nozzles, and means to circulate air into contact with the ice in said bunker and through said openings in said bulkhead.

11. A railroad car having a bulkhead at one end forming a bunker for ice and a freight compartment, said bulkhead having openings adjacent its top and bottom, respectively, nozzles adjacent the top of the freight compartment, means to eject the ice melt from the ice in said bunker through said nozzles, and means to circulate air into said bunker through the opening adjacent the top of the bulkhead downwardly against the ice and through the opening adjacent the bottom of the bulkhead and thence upwardly through said freight compartment against the downward movement of fluid ejected from said nozzles.

12. A refrigerator car having a body divided by a bulkhead to form a freight compartment and a bunker for ice, an axle below said body, a pump actuated by said axle, a conduit for ice melt from the ice in said bunker to said pump, and a conduit from said pump to the top of said bunker terminating in a downwardly directed nozzle, said pump being effective to move ice melt through said last-named conduit and eject the same into said bunker to induce air circulation through said bunker and freight compartment.

13. A refrigerator car having a body divided by a bulkhead to form a freight compartment and a bunker for ice, an axle below said body, a pump actuated by said axle, a conduit for melt of the ice in the bunker from said bunker to said pump, a conduit from said pump to the top of said freight compartment, and a downwardly directed nozzle carried by the end of said conduit in said freight compartment, said pump being effective to eject the ice melt from said nozzle downwardly into said freight compartment.

14. The method of refrigeration in a refrigerating car having a bulkhead dividing the car into a bunker and a freight compartment, which comprises the steps of: storing ice in the bunker and allowing the ice to melt therein, pumping the ice melt from the bunker to the top of the car and spraying a portion of the same from an opening at the top of the bulkhead into the bunker, and spraying another portion of the ice melt from the top of the freight compartment downwardly, and conducting air through an opening adjacent the bottom of said bulkhead from said bunker to said freight compartment.

15. The method of refrigerating railroad cars and the like, each incorporating a freight compartment and a bunker, which comprises the steps of: refrigerating fluid externally of the car, placing ice in the bunker, pumping said fluid into the bunker, and spraying the fluid through the bunker over the ice to induce by the force of the spray the circulation of air in a substantially direct path into contact with the ice and from the bunker into the freight compartment.

HARRY Y. STEBBINS.