Oct. 13, 1942. W. J. MEYER 2,298,896

REFRIGERATOR CAR

Filed May 4, 1942 4 Sheets-Sheet 1

FIG. 2

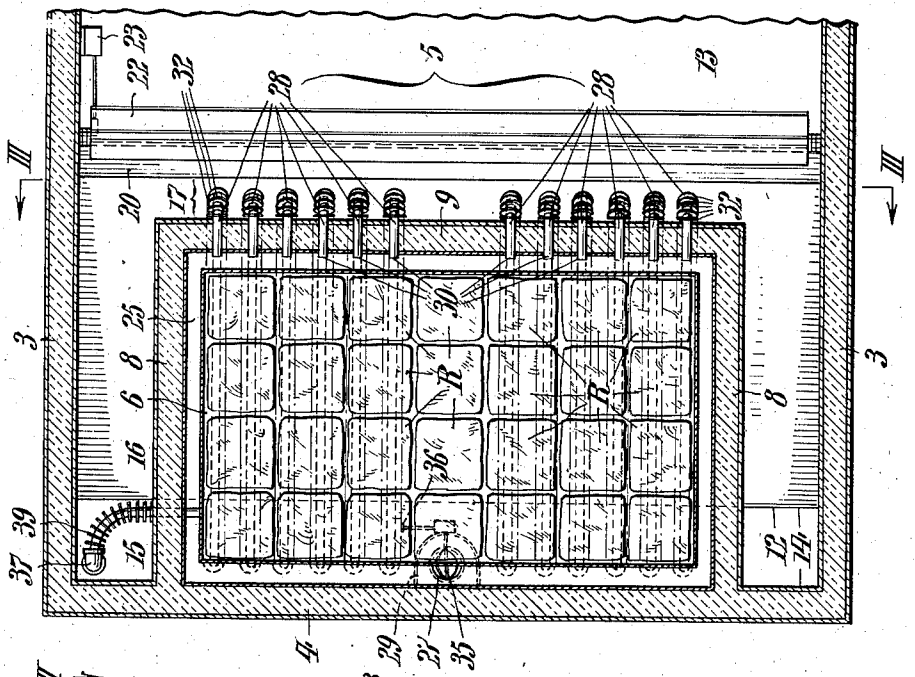
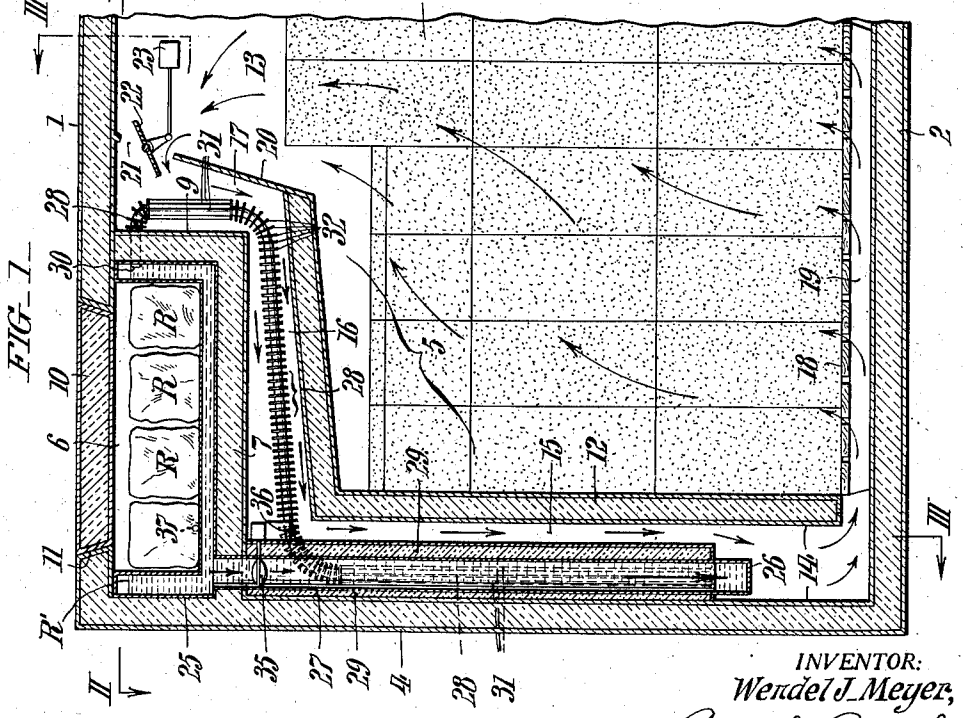


FIG. 1



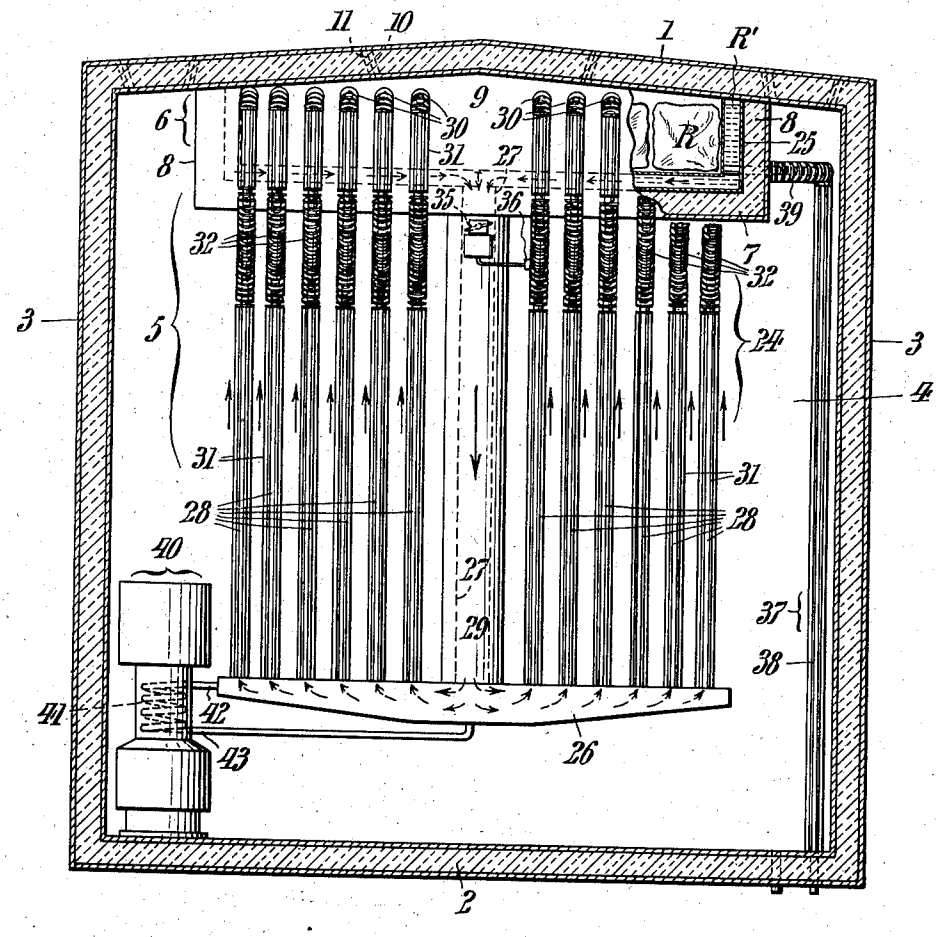
INVENTOR:
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REFRIGERATOR CAR

Filed May 4, 1942 4 Sheets-Sheet 2

FIG_3_



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REFRIGERATOR CAR

Filed May 4, 1942 4 Sheets-Sheet 3

FIG. 5.

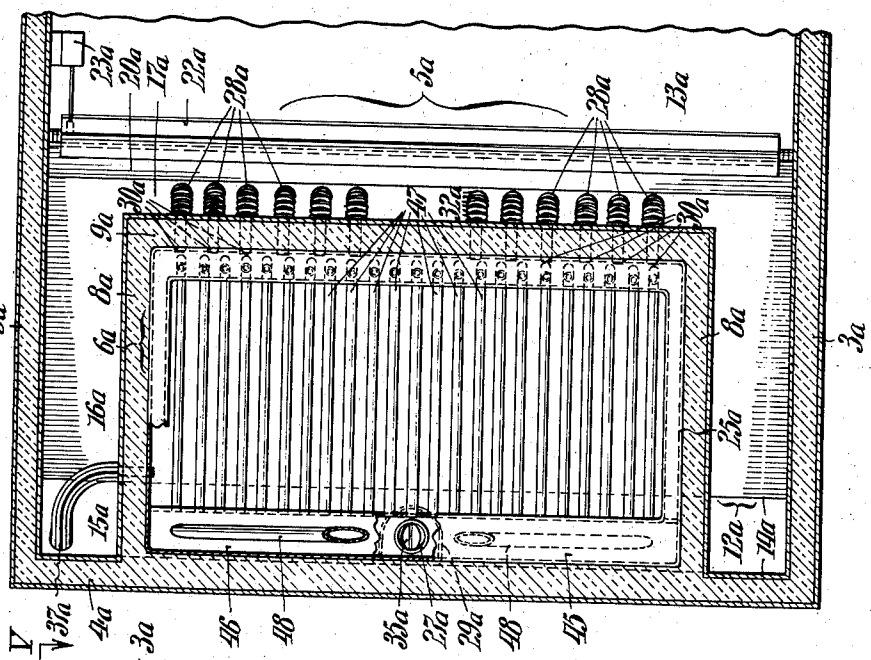
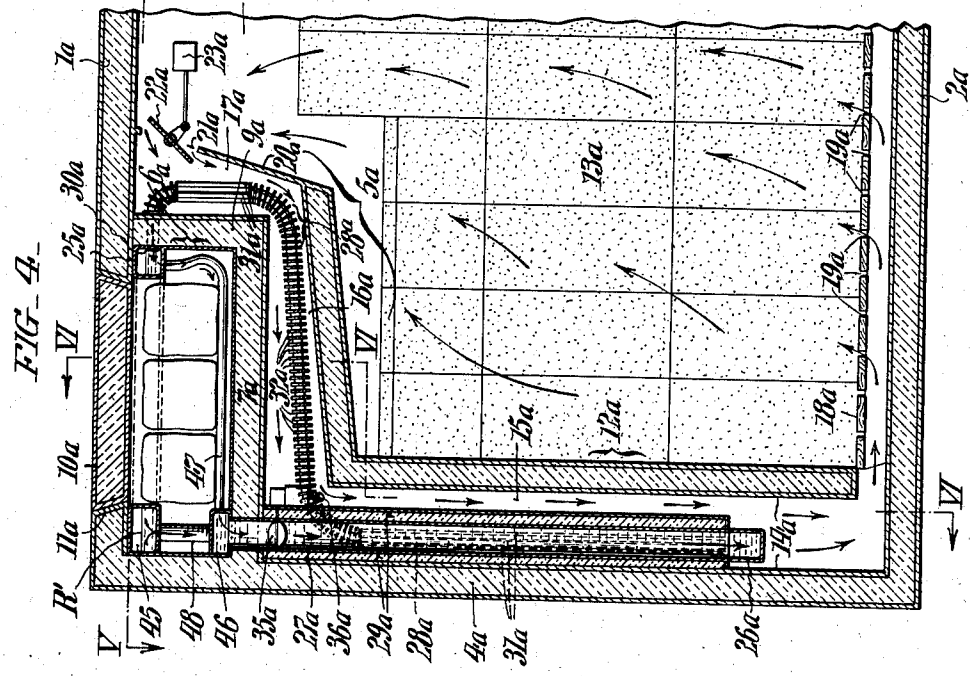


FIG. 4.



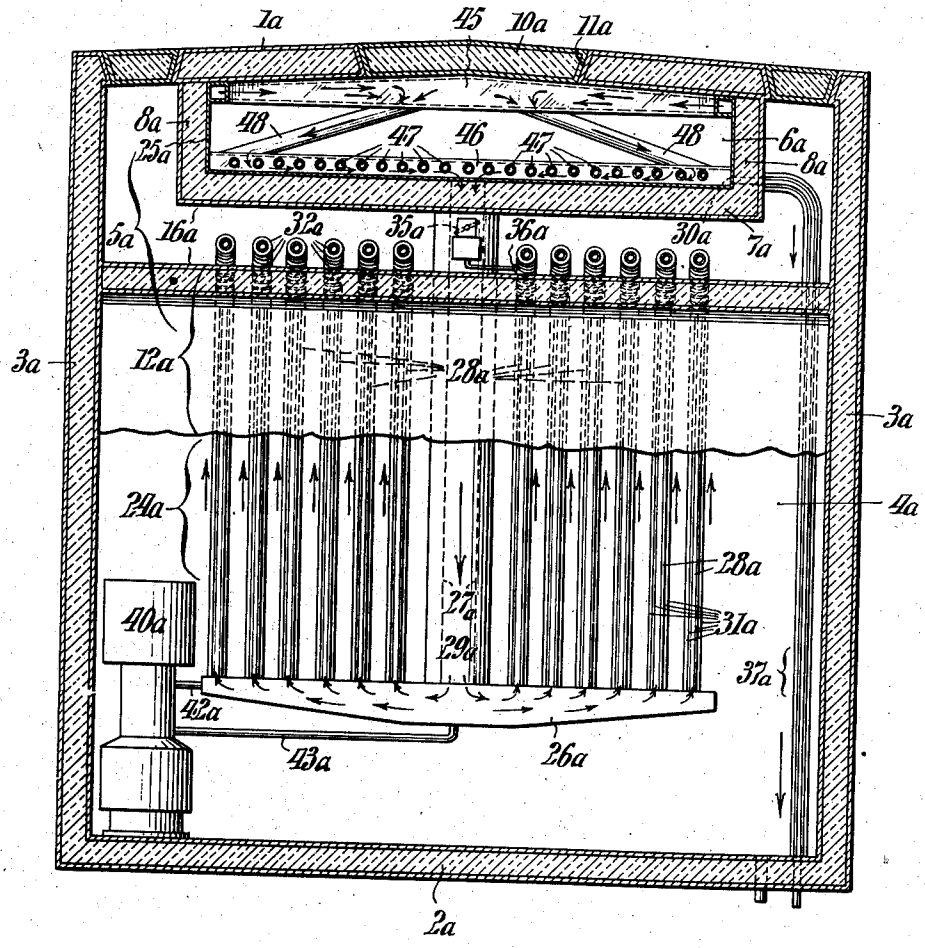
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REFRIGERATOR CAR

Filed May 4, 1942 4 Sheets-Sheet 4

FIG. 6



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Patented Oct. 13, 1942 2,298,896

UNITED STATES PATENT OFFICE

2,298,896

REFRIGERATOR CAR

Wendel J. Meyer, Philadelphia, Pa., assignor to The Pennsylvania Railroad Company, Philadelphia, Pa., a corporation of Pennsylvania

Application May 4, 1942, Serial No. 441,591

10 Claims. (Cl. 62—91.5)

This invention relates to refrigerating apparatus of a type in which brine or other equivalent solution circulated under the convection principle in a closed system, is utilized as a secondary refrigerant or heat exchange medium between a primary refrigerant such as water-ice or solid carbon-dioxide, and the atmosphere in a cold storage compartment or chamber.

My invention has for its main object to insure in a refrigerating apparatus of the kind referred to the maintenance of a constant flow of the secondary refrigerant under all conditions of operation without incurring wasteful consumption of the primary refrigerant.

This desideratum I realize in practice as hereinafter more fully disclosed, through provision of a radiator for the secondary refrigerant having a down-flow pipe and a plurality of up-flow pipes vertically arranged in an air-flow space between top and bottom headers, said down-flow pipe extending through a portion only of the air-flow space and being there insulated against the influence of thermal changes in the air, while the up-flow pipes extend the full length of said air-flow space and are finned throughout their length, as a result of which construction an effective temperature differential is established in the system to stimulate convective action in said secondary refrigerant for maintenance of the constant flow.

Other objects and attendant advantages will appear from the following detailed description of the attached drawings, wherein

Fig. 1 is a fragmentary view in longitudinal section of one end of a railway car with an in-built refrigerating unit conveniently embodying my invention.

Fig. 2 is a fragmentary horizontal sectional view of the car taken as indicated by the angled arrows II—II in Fig. 1.

Fig. 3 is a staggered cross sectional view taken as indicated by the angled arrows III—III in Fig. 1.

Figs. 4, 5 and 6 are views corresponding to Figs. 1–3 showing an alternative embodiment of my invention.

With more detailed reference first to Figs. 1–3 of these drawings, it will be noted that the housing of my improved refrigerator is illustrated as having the form of a railway car body with a roof 1, a floor 2, side walls 3, and end walls whereof one is indicated at 4, all of which are relatively thick and in practice constructed with interposition of heavy thermo-insulating material. Located at one end of the car is a refrigerating unit which is comprehensively designated by the numeral 5 and which may be duplicated at the opposite end of the car, if desired, or if the length of the latter should warrant it. As shown, the refrigerating unit 5 includes a bunker 6 for the primary refrigerant R which may be water-ice or solid carbon-dioxide in block form, said bunker being built onto the end wall 4 of the car body at the center beneath the roof 1 and having a bottom 7, side walls 8 and an inner end wall 9, its outer end wall being coincident with said car wall. Access to the bunker 6 for loading is had from above upon removal of a wedge cover 10 from an opening 11 in the car roof. By means of an irregular partition 12 the interior of the car body is sub-divided into a main or cold storage chamber 13 and a relatively narrow flue 14 which extends vertically along the car wall 4 as at 15, then horizontally beneath the bunker 6 as at 16, and then upwardly to the inner end wall of said bunker as at 17. At its lower end the partition 12 terminates slightly short of the car floor at the level of a reticulate false floor 18 in the chamber 13 with resultant formation of a shallow horizontal air-flow passage 19 in communication with the bottom of the flue. Immediately below the car roof 1, the short vertical portion 20 of the partition 12 is provided with a transverse aperture 21 with a flow-control damper vane 22 therein which is actuated automatically by a Sylphon bellows thermostat 23 sensitive to temperature changes within the chamber 13.

The refrigerating unit 5 further includes a radiator-like structure 24 for the circulation of the secondary refrigerant, said radiator having a top header which in this instance is in the form of a jacket 25 lining the bunker 6 with the ice blocks R resting on its bottom; a transversely arranged bottom header 26 which is located in the lower part of the flue 14; a single centrally located down-flow pipe 27; and a plurality of up-flow pipes 28 which are symmetrically grouped at opposite sides of said down-flow pipe. As shown in Fig. 1, the down-flow pipe 27 is relatively short and extends downward within the vertical portion 15 of the flue 14 adjacent the end wall 4 of the car body from the top header 25 to the bottom header 26. Within the flue 14, the down-flow pipe 27 is completely encased by heavy thermal insulation 29, and in practice preferably has a cross sectional area which aggregates the combined cross-sectional areas of the up-flow pipes 28. The up-flow pipes 28, on the other hand, are considerably longer than the down-

flow pipe 27 and extend from the upper part of the top header 25 at 30 through the inner end wall 9 of the bunker 6, then downward in the short upper vertical portion 17 of the flue 14, then laterally in the horizontal portion 16, and finally downward through the main vertical portion 15 of said flue and connect into the top of the bottom header 26. As shown, the vertical portions of the up-flow pipes 28 are longitudinally finned as at 31 and the horizontal portions transversely finned as at 32 for a reason which will presently appear.

For the purpose of automatically controlling the circulation of the secondary refrigerant which is indicated conventionally at R' and maintained at the level shown in Fig. 1 in the top header 25 with provision of an air space above it to allow for expansion, I have provided a valve means 35 which is located in the down-flow pipe 27 immediately below the bottom 7 of the bunker 6, said valve means being arranged for automatic actuation by a temperature sensitive thermostatic bulb 36 located in one of the adjacent up-flow pipes 28, see Fig. 3. The water or gas accumulation (as the case may be) resulting from the melting or sublimation of the primary refrigerant is carried off through a pipe 37 which extends from a point within the ice space of the upper header 25 downward in one corner of the car end and at its bottom passes through the car floor 2 as shown in Fig. 3, the vertical portion of this pipe being longitudinally finned as at 38 and the horizontal portion thereof transversely finned as at 39 like the up-flow pipes 28 of the radiator. The pipe 37 thus assists in cooling the air within the flue 14.

By reason of the disposal of the upper connections of the pipes 28 with the top header 25 at a higher level than the connection of the pipe 27, the circulation of the secondary refrigerant will be as indicated by the arrows in Fig. 3, that is to say down through the pipe 27 and upward through the pipes 28 under convectional influence. Due to the protection afforded by the heavy insulation at 29, the liquid in the down-flow pipe 27 will be unaffected by temperature changes within the flue 14, while, as a consequence of the finning of the up-flow pipes 28, rapid thermal interchange will take place between the refrigerant in the latter pipes and the air within the flue 14, with consequent establishment of a temperature differential whereby the circulation in the radiator 24 is effectively stimulated. Circulation of the atmosphere between the cold storage chamber 13 and the flue 14 is likewise brought about by convection, i. e., through rise of the warm wair within said chamber and fall of the chilled air within said flue, the air circulation being contrary to the flow of the secondary refrigerant in the radiator as also indicated by the arrows in Fig. 1.

As an adjunct I have shown at 40 within one corner of the flue 14 a heater with a coil 41 therein whereof the terminals 42 and 43 connect with the bottom header 26 of the radiator at different levels. The heater may be automatically controlled by suitable thermostatically governed means (not illustrated) sensitive to thermal changes in the chamber 13.

The modified embodiment of my invention featured in Figs. 4–6 is generally like the first described embodiment. Accordingly, in order to obviate the necessity for repetitive description, all the elements illustrated in Figs. 4–6 and having their counterparts in the first described embodiment are identified with the same reference numerals previously employed, except for the addition in each instance, of the letter *a* for convenience of more ready distinction. In the alternative embodiment, the upper header 25*a* instead of being in the form of a jacket, here comprises a main upper section 45 of rectangular configuration which extends around the upper part of the bunker 6*a* and a lower section 46 which lies only along the outer end wall at the bottom of the bunker. Extending from the crosswise portion of the upper section 45 of the top header 25*a* adjacent the end wall 9*a* of the bunker 6*a*, first downwardly along said wall and then horizontally across the bottom of said bunker to the lower section 46 is a series of tubes 47 which jointly constitute a grid whereon the ice blocks R directly rest. As shown in Figs. 4 and 6, the end portion of the upper section 45 of the top header 25*a* lying directly above the lower section 46 is connected by diagonally disposed conduits 48 which extend in opposite directions from the central portion of said upper section to the ends of said lower section. By reason of the described construction of the top header 25*a* of the modified radiator with its multiple tubes 47 in contact with the primary refrigerant in the bunker 6*a*, the influence of the temperature differential is made even more potent than in the first described embodiment in its stimulating action to promote the convectional circulation of the secondary refrigerant.

Having thus described my invention, I claim:

1. A refrigerator car or the like including a cold storage compartment; a bunker below the car roof adjacent one of the car walls; a reticulate false floor setting apart a horizontal air-flow passage in the bottom of the compartment; a partition extending upward substantially parallel to the wall, then laterally beneath the bunker and finally upward and parallel to the inner end of said bunker to the car roof to form a flue which is in communication with the compartment at the top by way of an inlet port at the upper end of the partition; and a closed convection circuit means for a fluent secondary refrigerant in the form of a radiator comprising a top header arranged for contact with ice in the bunker, a bottom header within the vertical portion of the flue, a down-flow pipe leading at one end directly from the bottom of the top header to the bottom header, and an up-flow pipe leading up from the lower header through the vertical portion of the flue, then through the horizontal portion of said flue beneath the bunker and connecting into the top header at the opposite end and at a higher level.

2. A refrigerator car or the like according to claim 1, in which the down-flow pipe of the radiator is covered with heavy insulation so that the fluid therein is not influenced by temperature changes in the air passing through the flue; and in which the vertical portion of the up-flow pipe is longitudinally finned and the horizontal portion is transversely finned to accelerate rapid thermal exchange between the secondary refrigerant and the air passing through said flue.

3. A refrigerator car or the like according to claim 1, in which the top header of the radiator comprises two main sections which are disposed at different levels within the bunker, and multiple connecting flow tubes extending down from said upper section adjacent the inner wall of the bunker and then along the bottom of said bunker

to said lower section thereby to form a grate on which the ice is directly supported.

4. A refrigerator car or the like according to claim 1, in which the top header of the radiator comprises two main sections at different levels, the upper section being of rectangular configuration and extending perimetrically about the bunker near the top and the lower section extending along one side wall only of the bunker at the bottom of the latter, and multiple flow tubes extending downward from said upper section adjacent the opposite end wall of the bunker, and then along the bottom of said bunker to said lower section, thereby to form a grate on which the ice is directly supported.

5. A refrigerator car or the like according to claim 1, in which the down-flow pipe of the radiator is centrally located; and in which there are plural up-flow pipes symmetrically arranged in groups at opposite sides of said down-flow pipe.

6. A refrigerator car or the like according to claim 1, in which the down-flow pipe of the radiator is centrally located; in which there are plural up-flow pipes symmetrically arranged in groups at opposite sides of said down-flow pipe; and in which said down-flow pipe is covered with heavy insulation so that the fluid therein is not influenced by the temperature of the air passing through the flue.

7. A refrigerator car or the like according to claim 1, in which the down-flow pipe of the radiator is centrally located; in which there are plural up-flow pipes symmetrically grouped at opposite sides of the down-flow pipe; in which said down-flow pipe is covered with heavy insulation so that the fluid therein is not influenced by temperature changes in the air passing through the flue; and in which the up-flow pipes are finned to accelerate rapid thermal exchange between the secondary refrigerant and the air flowing through said flue.

8. A refrigerator car or the like according to claim 1, in which the down-flow pipe of the radiator is centrally located; in which there are plural up-flow pipes symmetrically grouped at opposite sides of the down-flow pipe; in which said down-flow pipe is covered with heavy insulation so that the fluid therein is not influenced by temperature changes in the air passing through the flue; and in which the vertical portions of the up-flow pipes are longitudinally finned and the horizontal portions transversely finned to accelerate thermal exchange between the secondary refrigerant and the air flowing through said flue.

9. A refrigerator car or the like according to claim 1, in which the down-flow pipe of the radiator is centrally located; in which there are plural up-flow pipes symmetrically grouped at opposite sides of said down-flow pipe; in which the top header comprises two main sections at different levels, the upper section being of rectangular configuration and extending around the bunker at the top and the lower section extending along one side wall only of the bunker; in which multiple flow tubes extend down from the upper section adjacent to the inner wall of the bunker remote from the lower section and then along the bottom of said bunker to said lower section to form a grate on which the ice is directly supported; and in which inclined conduits extend downwardly in opposite directions from the center of the top section to opposite ends of said lower section.

10. A refrigerator car or the like including a cold storage compartment; a bunker below the car roof adjacent one of the car walls; a partition extending upward substantially parallel to the wall aforesaid, then laterally beneath the bunker and finally upward and parallel to the inner end of said bunker to the car roof to form a flue, ports at the upper and lower ends of the partition through which the compartment communicates with the flue; and a closed convection circuit means for a fluent secondary refrigerant in the form of a radiator comprising a top header arranged for contact with ice in the bunker, a bottom header within the vertical portion of the flue, a down-flow pipe leading directly downward from the top header to the bottom header, and an up-flow pipe extending up from the lower header through the vertical portion of the flue, then through the horizontal portion of said flue beneath the bunker and connecting into the top header at a higher level.

WENDEL J. MEYER.