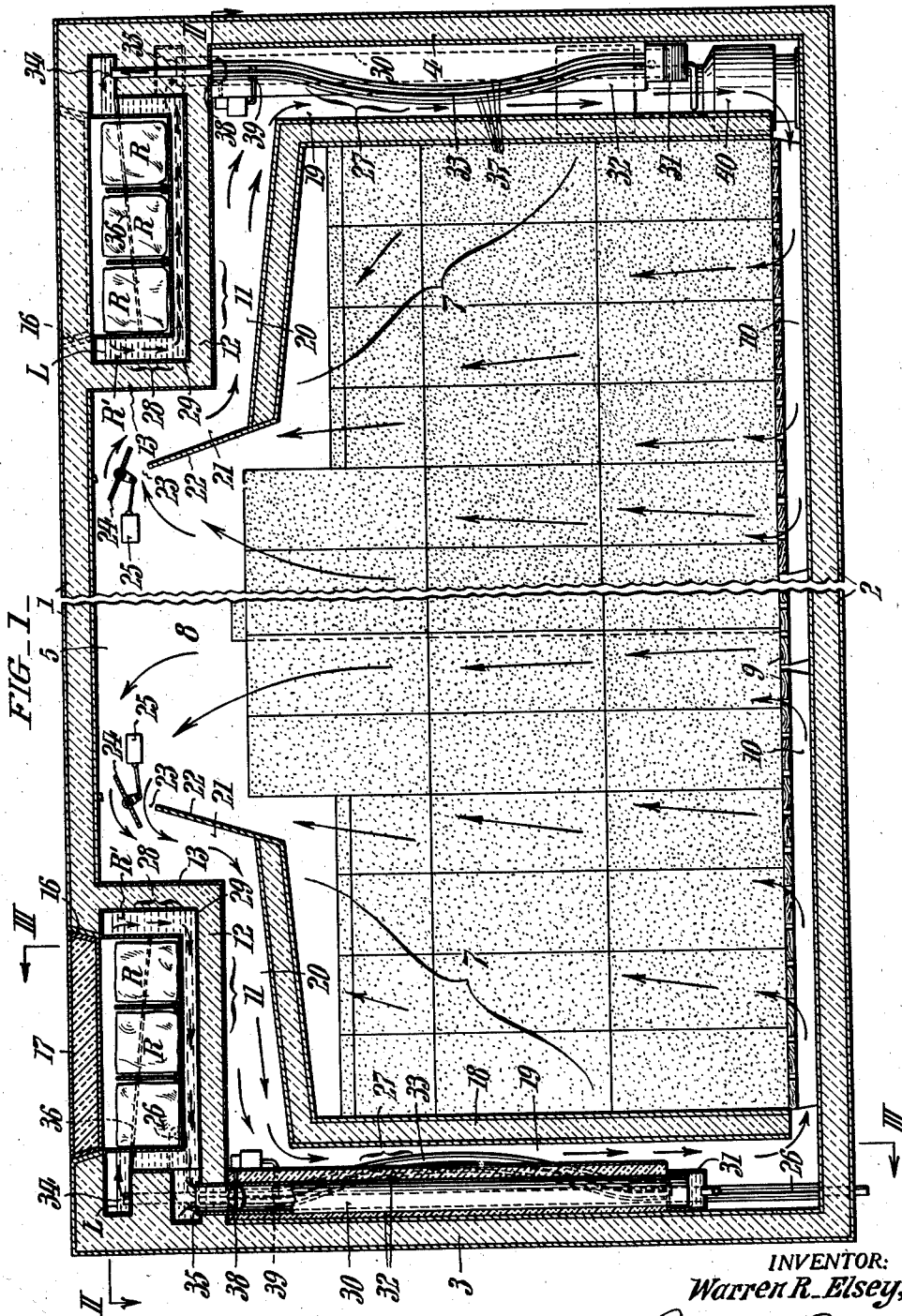


Oct. 13, 1942.

W. R. ELSEY
REFRIGERATOR CAR
Filed May 4, 1942

2,298,879

3 Sheets-Sheet 1



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FIG. 2

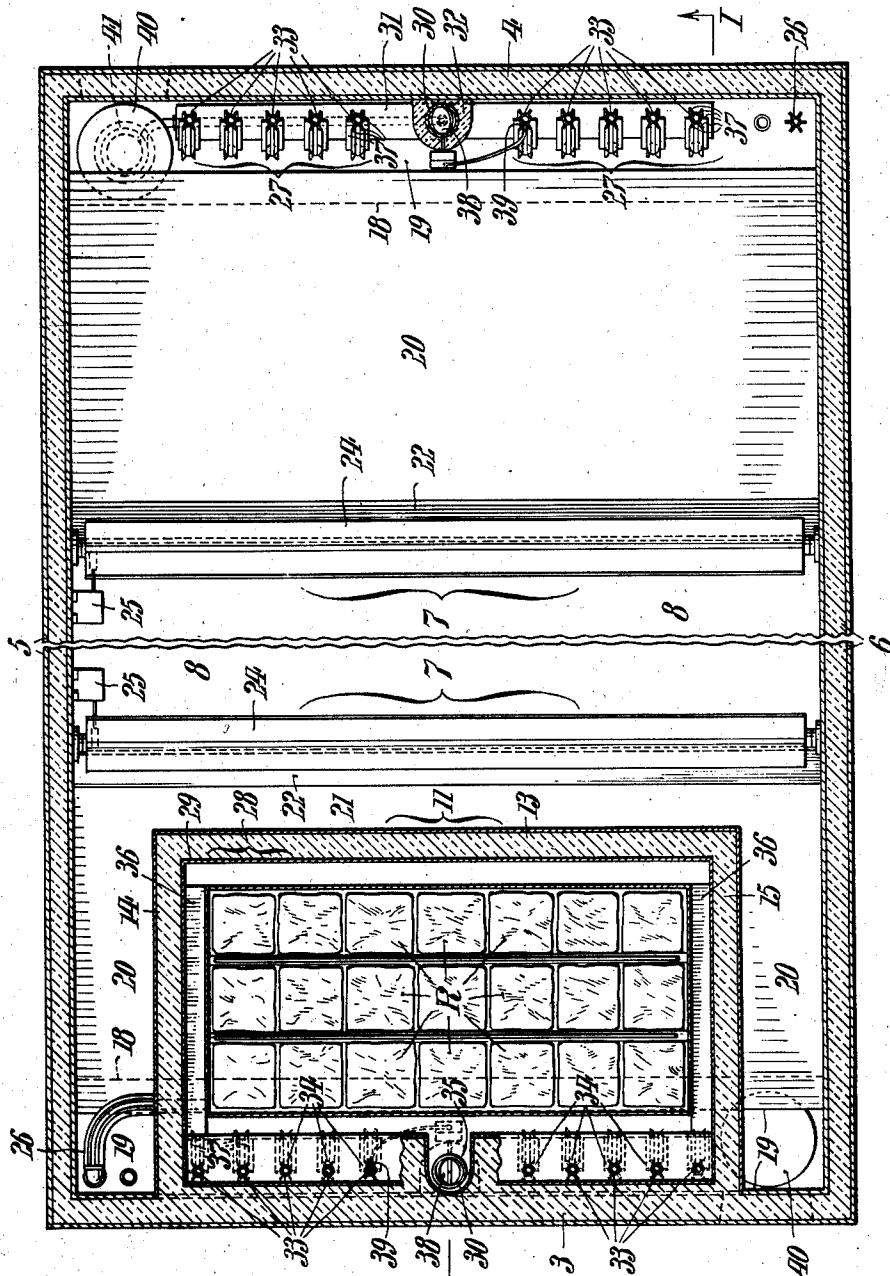
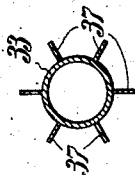


FIG. 4



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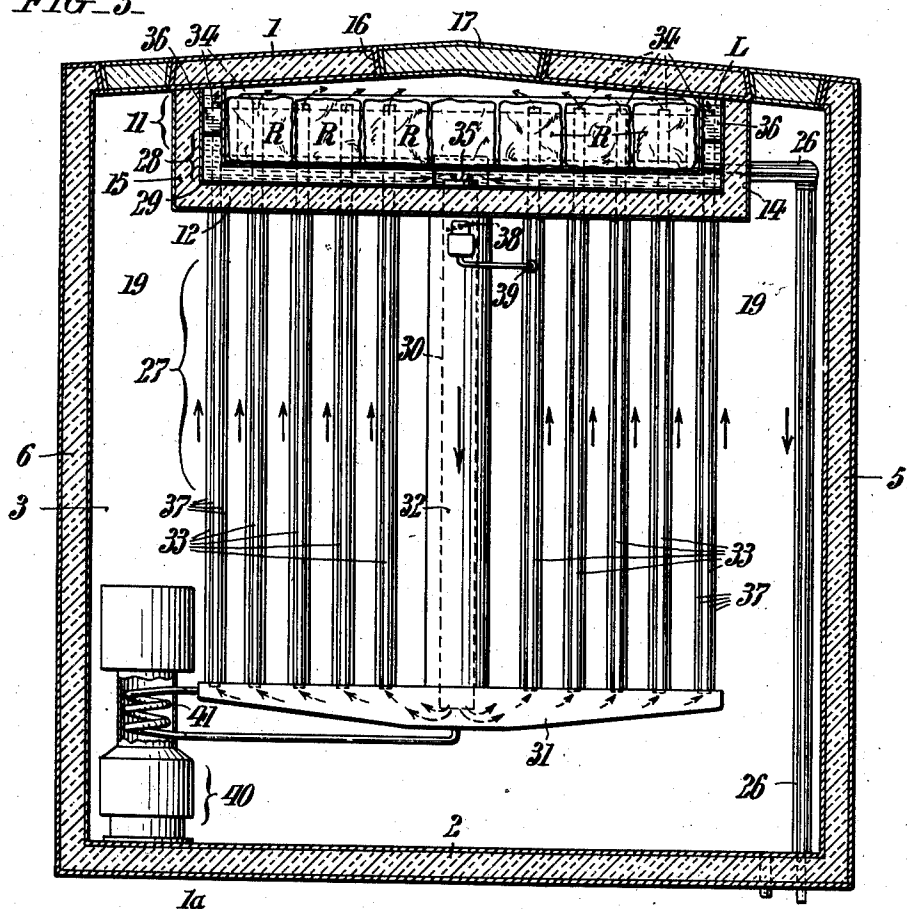
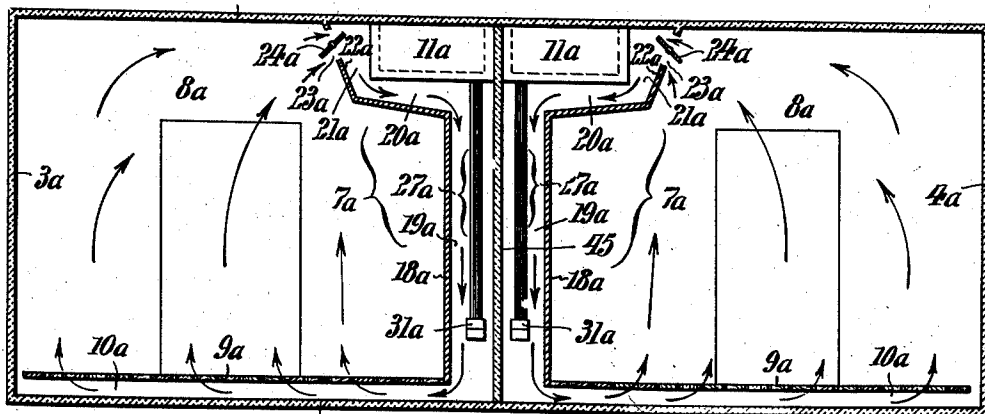
2,298,879

REFRIGERATOR CAR

Filed May 4, 1942

3 Sheets-Sheet 3

FIG-3



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FIG-5

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UNITED STATES PATENT OFFICE

2,298,879

REFRIGERATOR CAR

Warren R. Elsey, Wynnewood, Pa., assignor to
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Application May 4, 1942, Serial No. 441,607

9 Claims. (Cl. 62—91.5)

This invention relates to refrigerator cars and the like, and has reference more particularly to refrigerator cars or apparatus of the type in which ice (either water-ice or solidified carbon-dioxide gas) is used as a primary refrigerant, and in which a non-freezing fluid medium such as brine, chilled by indirect contact with the ice, is employed as a circulating secondary refrigerant to cool the atmosphere within the storage chamber or compartment of the refrigerator.

My invention is concerned with improvements in refrigerating structures of the kind referred to whereby freer and more positive circulation of the secondary or fluent refrigerant is secured, and in turn, a more rapid thermal exchange is had between said secondary refrigerant and air circulated within the storage chamber of the refrigerator, with resultant maintenance of a uniform temperature in the atmosphere in all parts of said chamber and enhancement of the efficiency of the refrigerator as a whole.

How the foregoing and other objects and attendant advantages may be readily realized in practice will appear from the following detailed description of the attached drawings, wherein Fig. 1 is a staggered longitudinal sectional view of a railway refrigerator car conveniently embodying my invention.

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

Fig. 3 is a cross sectional view of the car taken along a staggered vertical plane indicated by the angled arrows III—III in Fig. 1.

Fig. 4 is a cross sectional view of one of the pipes used in the means through which the secondary refrigerant is circulated; and

Fig. 5 is a diagrammatic view in longitudinal section of a railway car showing an alternative embodiment of my invention.

Referring first more particularly to Figs. 1-3, the roof, floor and end walls 1, 2, 3, 4, 5 and 6, respectively, of the car body there shown are all relatively thick suitably packed with thermal insulation. Disposed at each end of the car body is a refrigerating unit which is comprehensively designated by the numeral 7 in Fig. 1, and since these units are exactly alike, the description which immediately follows of the one will serve for the other also. The main portion 8 of the interior of the car body serves as a cold storage chamber and is shown as having a reticulate false floor 9 spaced somewhat from the main floor 2 with resultant formation of a shallow horizontal air-flow passage 10. Located immediately

below the roof 1 of the body and built onto the end wall 3 of the latter, is a bunker 11 having a bottom 12, an inner end wall 13, and side walls 14 and 15, said bunker being accessible through a top opening 16 in the car roof 1 which is normally closed air-tight by means of a removable wedge cover 17. The partition shown at 18 serves to set apart within the interior of the car body adjacent the end wall 3, a flue which, at the bottom, communicates with the horizontal air-flow passage 10 in the car floor, and which extends upwardly along said wall as at 19, then crosswise beneath the bunker 11 as at 20, and then upward beyond the inner end wall 13 of said bunker to the car roof 1 as at 21. As shown, the top portion 22 of the partition 18 has an opening 23 immediately below the car roof 1, with a damper 24 therein arranged to be automatically actuated by a thermostat 25 subject to the influence of temperature changes in the chamber 8.

As a primary refrigerant, I may use either ordinary water-ice or solid carbon-dioxide gas whereof blocks R are packed into the bunker 11 from which latter water accumulation or sublimated gas is released through a pipe 26 leading downward therefrom and discharging beneath the floor of the car, see Figs. 2 and 3.

As a secondary refrigerant (indicated conventionally at R' in Figs. 1 and 3) I employ a non-freezing fluid such for example as brine, and provide a closed-flow circuit means therefor in the form of a radiator 27 in which said secondary refrigerant is circulated by convection through contact of a portion of such means with the primary refrigerant. As shown, the radiator 27 has a top header 28 constituted by a jacket 29 which lines the walls of the bunker 11. Extending directly downward from the header 28 adjacent the end wall 3 of the car at the center within the main vertical portion 19 of the flue 18 is a single down-flow pipe 30 of a relatively large diameter which, at its lower end, connects centrally into a bottom header 31 within said flue. As shown in Fig. 3, the pipe 30 terminates somewhat below the top wall of the bottom header 31, and is covered with or embedded in heavy insulation 32. The radiator 27 further comprises a plurality of laterally spaced up-flow pipes 33 of smaller diameter arranged in groups symmetrically at opposite sides of the down-flow pipe 30 and extending upward in the vertical portion 19 of the flue 18 from the bottom header 31 to the top header 28, passing through the bottom 12 of the bunker 11 and connecting into said upper header at 34 at a level well above the outlet 35 for said

down-flow pipe 30. Intermediate these two levels in the upper header 28 are baffles 36 which slope downwardly slightly toward the inner wall 13 of the bunker 11, said baffles extending through the side portions and the left-hand end portion only of said header, and serving to define reverse flow strata for the secondary refrigerant in said jacket. In practice, the cross sectional areas of the up-flow pipes 33 are preferably made to aggregate the cross sectional area of the single down-flow pipe 30 so as not to have any retarding effect upon free flow of the secondary refrigerant R' in the radiator 27. It will be further noted from Figs. 1, 2 and 4 that, in accordance with my invention, the up-flow pipes 33 are longitudinally finned as at 37 for a purpose presently explained.

To automatically control the flow of the secondary refrigerant R' in the radiator I may employ means including a Sylphon bellows actuated valve 38 within the down-flow pipe 30 at a point immediately below the bunker 11 and a governing temperature sensitive bulb 39 located in one of the adjacent up-flow pipes 33, see Figs. 1 and 3. The direction of circulation of the secondary refrigerant R' (which is kept at the level L with provision of sufficient space above it in the upper header 28 to permit expansion) in the radiator is primarily due to the difference of level between the inlets 34 of the up-flow pipes 33 and the outlet 35 for the down-flow pipe 30, and the presence of the baffles 36 in the upper header 28. Convection circulation is on the other hand, greatly stimulated by reason of the heavy insulation around said down-flow pipe which prevents the refrigerant R' from being influenced by the temperature of the air passing through the flue 19, while more effective thermal interchange between the air in said flue and the refrigerant R' in the up-flow pipes 33 results from the vertical finning on the latter pipes. The circulation of the air between the cold storage chamber 8 and the flue 19 is likewise effected solely through convection, the warmer air rising to the top of said chamber and entering the flue through the opening 23, the flow of the air in said flue being thus contrary to the direction of flow of the secondary refrigerant R in the pipes 32 as shown by the arrows in Fig. 1.

As an adjunct to the system, I have shown in Figs. 2 and 3 a heater 40 having a tube coil 41 vertically disposed therein, one end of the tube being connected into one end of the bottom header 31 at the top and the other end to the center of the header at a lower level. This heater may be automatically controlled through suitable thermostatic means (not shown) sensitive to temperature variations in the chamber 8.

In the alternative embodiment of my invention, illustrated in Fig. 5, the car body is divided by a central transverse partition 45 into two compartments 8a, which are respectively provided with refrigerating units 7a. These refrigerating units 7a are of exactly the same construction as the units 7 of the first described embodiment with corresponding parts identified by the same reference numerals previously employed, except for the addition in each instance of the letter "a" for convenience of distinction to preclude the necessity for repetitive description, and are in the present instance arranged back to back against the central partition 45, although, they may, if desired or found more convenient, be located as in Figs. 1 and 2 at opposite ends of the car body.

Having thus described my invention, I claim:

1. A refrigerator car or the like including a cold storage compartment; a bunker for ice below the car roof adjacent one of the car walls; a reticulate false floor setting apart a horizontal airflow passage in the bottom of the compartment; a partition defining a flue which extends upward of said wall from the horizontal airflow passage and which communicates at the top with said compartment; and a closed convection circuit means for a secondary refrigerant in the form of a radiator comprising a top header in contact with the ice in the bunker, a bottom header within the lower part of the flue, a vertical down-flow pipe extending down from the bottom of the top header through the flue to the bottom header, and a vertical up-flow pipe extending up from the lower header in the flue and connecting into the top header at a higher level, and heavy insulation surrounding the down-flow pipe throughout its length to prevent the fluid therein from being influenced by temperature changes in the air passing through said flue for maintenance of a temperature differential to promote circulation of the secondary refrigerant in said convection circuit.

2. A refrigerator car or the like according to claim 1, in which the up-flow pipe is finned throughout its length to promote more rapid thermal exchange between the secondary refrigerant and the air passing through the flue and in turn accelerate the circulation in the convection circuit.

3. A refrigerator car or the like according to claim 1, further including valve means subject to thermostatic control of the compartment temperature for regulating flow of the air through the flue.

4. A refrigerator car or the like including a cold storage compartment; a bunker for ice 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 defining a flue which extends upward of said wall from the horizontal air-flow passage and which communicates at the top with said compartment; and a closed convection circuit means for a secondary refrigerant in the form of a radiator comprising a top header in contact with the ice in the bunker, a bottom header within the lower part of the flue, a vertical down-flow pipe extending down from the bottom of the top header through the flue to the bottom header, and a vertical up-flow pipe extending up from the lower header in the flue and connecting into the top header at a higher level, a valve in the down-flow pipe, actuating means for the valve, and a temperature sensitive means in the up-flow pipe for automatically controlling the operation of the valve actuating means.

5. A refrigerator car or the like according to claim 4, in which a valve is located in the down-flow pipe at a point adjacent the connection of the latter with the upper header; and in which the temperature sensitive means is located in the up-flow pipe adjacent the connection of the latter with the upper header.

6. A refrigerator car or the like including a cold storage compartment; a bunker for ice below the car roof adjacent one wall of the car; a reticulate false floor setting apart a horizontal air-flow passage in the bottom of the compartment; a partition defining a flue which extends upward of said wall from the horizontal air-flow

passage and which communicates at the top with said compartment; and a closed convection circuit means for a secondary refrigerant in the form of a radiator comprising a top header in contact with the ice in the bunker, a bottom header within the lower part of the flue, a single centrally located vertical down-flow pipe extending down from the bottom of the top header to the bottom header in the flue, groups of vertical up-flow pipes symmetrically arranged at opposite sides of said down-flow pipe and extending up from the lower header in the flue and connecting into the top header at a higher level, and heavy insulation surrounding the down-flow pipe throughout its length to prevent the fluid therein from being influenced by temperature changes in the air passing through the flue, for maintenance of a temperature differential to promote circulation of the secondary refrigerant in said convection circuit.

7. A refrigerator car or the like according to claim 6, in which the down-flow pipe is covered with heavy insulation to prevent the fluid therein from being influenced by temperature changes in the air passing through the flue; and in which the up-flow pipes are finned to promote more rapid thermal exchange between the secondary

refrigerant and the air passing through said flue and in turn accelerate the circulation in the convection circuit.

8. A refrigerator car or the like according to claim 6, in which the cross sectional area of the down-flow pipe is substantially equal to the sum of the cross sectional areas of the up-flow pipes.

9. A refrigerator car or the like including a cold storage compartment; a bunker for ice below the car roof; and a closed convection circuit means for a secondary refrigerant in the form of a radiator comprising a top header in contact with the ice in the bunker, a bottom header exposed to the air within the car, a vertical down-flow pipe extending down from the bottom of the top header to the bottom header, a vertical up-flow pipe extending up from the lower header and connecting into the top header at a higher level, and heavy insulation surrounding the down-flow pipe throughout its length to prevent the fluid therein from being influenced by temperature changes in the air within the car for maintenance of a temperature differential to promote circulation of the secondary refrigerant in said convection circuit.

WARREN R. ELSEY.