Aug. 8, 1939. W. E. BAILLIE 2,168,553

REFRIGERATOR CAR

Filed Oct. 8, 1938 2 Sheets-Sheet 1

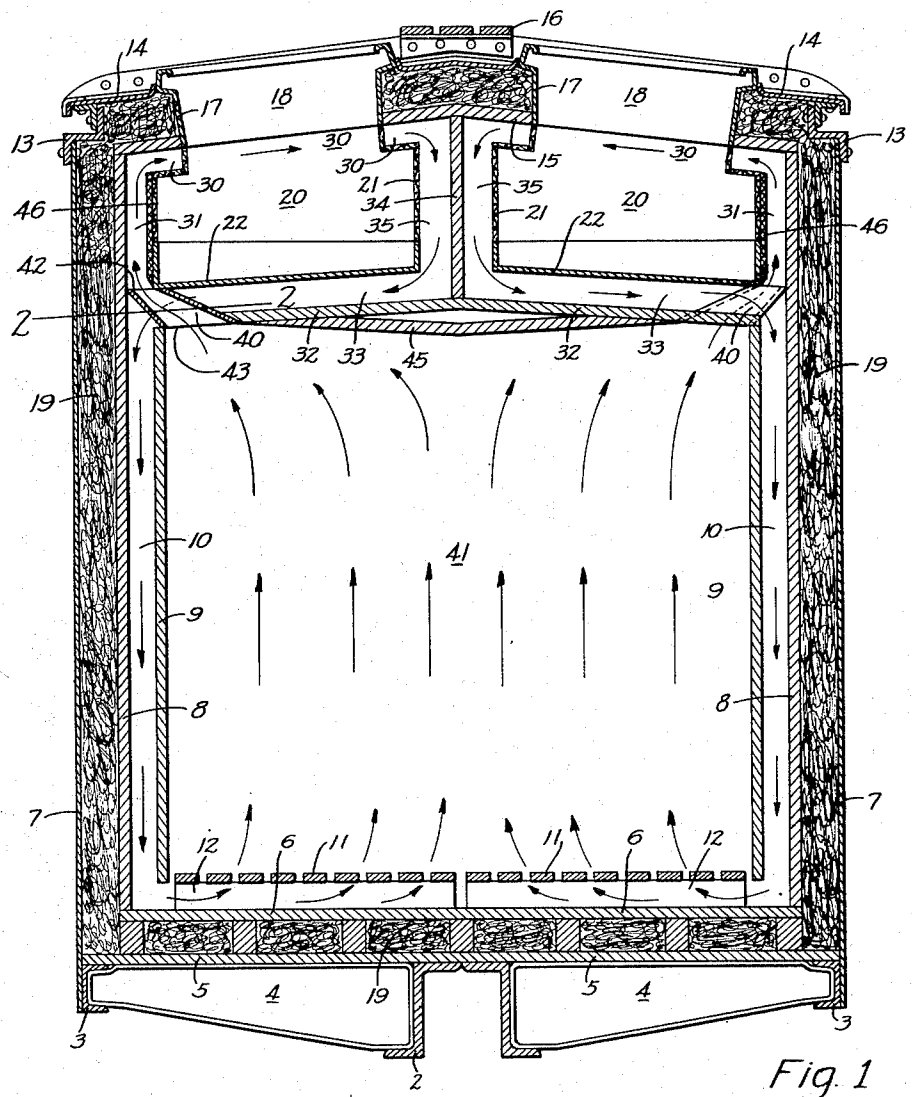


Fig. 1

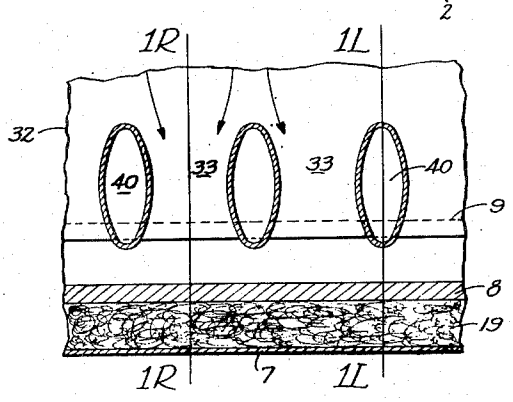


Fig. 2

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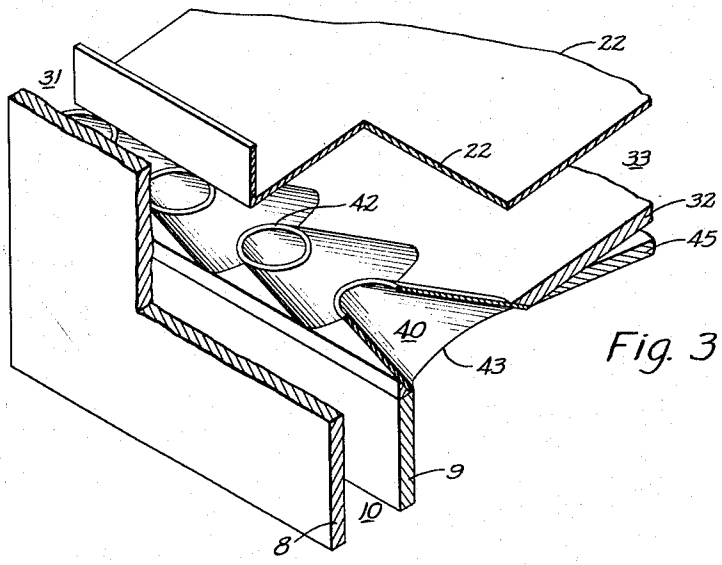


Fig. 3

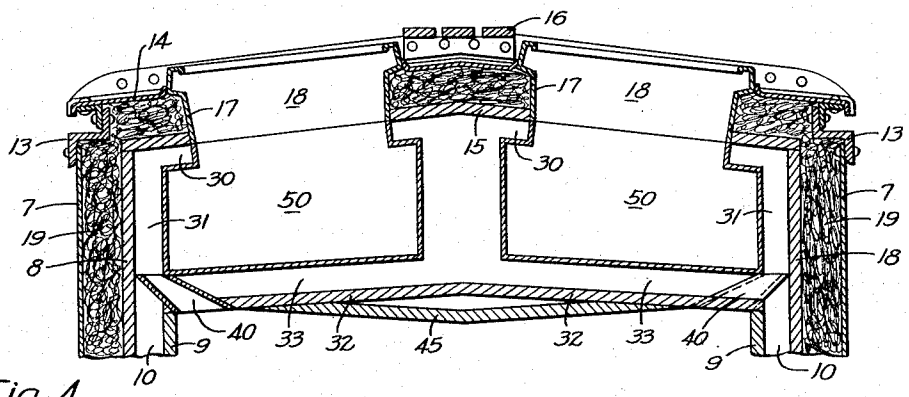


Fig. 4

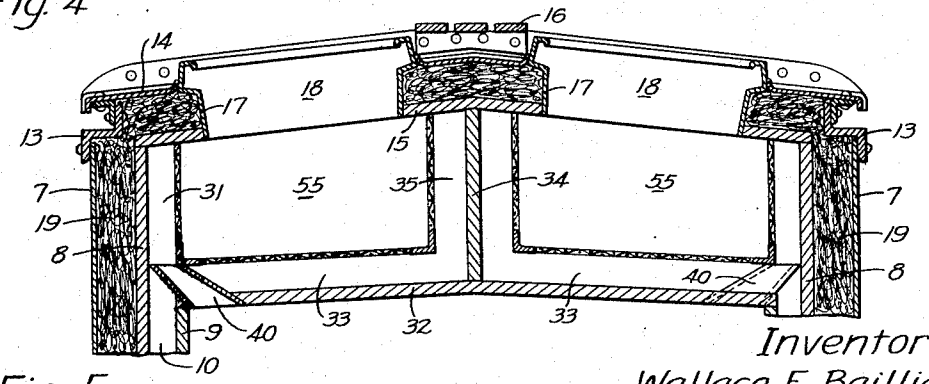


Fig. 5

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UNITED STATES PATENT OFFICE

2,168,553

REFRIGERATOR CAR

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Application October 8, 1938, Serial No. 233,908

8 Claims. (Cl. 62—17)

This invention relates to refrigerator cars used to transport perishable commodities at a predetermined temperature. A refrigerator car comprises insulated floor, walls, and roof and a cooling means when used in summer or a heating means when used in winter.

The invention herein disclosed relates particularly to cars in which the cooling means consists of containers suspended immediately below the ceiling, said containers being adapted to the use of refrigerants such as water, ice, brine, dry ice or eutectic ice. Cars of this type are often provided with flues adjacent the side walls so that air cooled by the refrigerating means may circulate downwardly through said flues and under the floor rack. It then circulates upwardly through the lading compartment, contacting and cooling the lading.

It is an object of this invention to utilize a major portion of the refrigerant surface. My invention consists of providing a plurality of ducts which communicate between the lading and refrigerant compartments. By placing these ducts near the aforementioned flue, I have provided a circulatory system in which the circulating air completely encircles the refrigerant container. The efficiency of the system is therefore high, due to the protracted contact of air and refrigerant.

Another object of the invention is to provide a means for so-called stage cooling of the air. It is often desirable to use a type of container known as a semi-brine tank having a foraminous upper portion and an imperforate lower portion. The upper portion is foraminous to facilitate air circulation therethrough. The lower portion is imperforate to retain a mixture of ice and brine which has a considerably lower temperature than the substantially salt-free ice in the upper portion of the container. The aforementioned ducts lead the upwardly circulating warm air to the upper or foraminous portion of the container. The first state, or preliminary, cooling of the air occurs during contact with the ice in said upper portion. Then, as circulation continues, the air comes in contact with the lower portion of the container and is cooled in the second stage. The low temperature of the bottom portion cools the air to a lower temperature than would be possible using only the refrigerant in the upper portion. The final temperature is also lower than would be obtained using only the lower portion because the preliminary cooling extracts a certain amount of heat from the air, thus allowing it to enter the second stage already partly refrigerated.

In the drawings:

Fig. 1 is a transverse section of a refrigerator car embodying my invention, the left half being on line 1L—1L and the right half on line 1R—1R of Fig. 2.

Fig. 2 is a section on line 2—2 of Fig. 1.

Fig. 3 is a fragmentary perspective view showing the arrangement of the warm air ducts and associated portions of a refrigerant container and drip pan.

Figs. 4 and 5 show modified constructions.

The usual parts of a refrigerator car are shown in Fig. 1, such as, center sill 2, side sills 3, cross members 4 of the underframe, sub-floor 5, floor 6, side sheathing 7, side lining 8, false wall 9 forming the side flue 10, floor rack 11 providing the space 12, side plates 13, roof 14, ceiling 15, running board 16, hatch frames 17 surrounding the hatches 18, and insulation 19. The refrigerant containers 20 are shown as semi-brine tanks having foraminous upper portions 21 and imperforate lower portions 22 for retention of brine.

The refrigerant container 20 is spaced below the ceiling 15 and at a distance from the side lining 8 to provide the channels 30 and 31. A partition 32 substantially parallel to and spaced from the bottom 22 of the container 20 provides the passage 33 for air circulation and for the draining of liquid from the container 20. A member 34 extending between the ceiling 15 and the partition 32 is spaced from the container 20 to provide the path 35.

A plurality of spaced apart ducts 40 communicate between the lading compartment 41 and the channel 31, crossing the passage 33 but not communicating therewith. The ducts 40 are spaced intermittently as shown in Figs. 2 and 3, allowing a distance between each duct 40 for the passage 33 to communicate with the flue 10. The upper end 42 of each duct is at the same level with or above the lowermost part of the container 20 so that there is no tendency for cold air flowing through the passage 33 to enter the top of a duct 40 and flow downwardly therethrough. The lower end 43 of the duct 40 is shown elliptical in shape with its major axis extending transversely of the car or parallel to the direction of air flow in the passage 33. This construction is preferable because it allows the maximum area for the duct 40 and restricts air flow through the passage 33 to a minimum. The upper end 42 of the duct 40 is shown circular in shape although any shape would be satisfactory if it meets the requirements of having an area as large as the lower end 43 of the duct 40 and of communicating directly with the channel 31.

It may be preferable to provide a portion 45 sloping upwardly toward the duct 40 to guide the air from the lading compartment 41 through the ducts 40. The circulation of air in a car of this type depends entirely on natural convection, i. e., the difference in density between warm and cool air. If the air, being warm as it leaves the lading compartment 41, is cooled upon entering the channel 31, there might be a tendency for it to fall downwardly through the duct 40, thus causing a stagnation of the air and consequent ceasing of the refrigeration. Therefore, it is probably desirable to provide the insulating member 46 between the channel 31 and the refrigerant container 20.

The refrigerating cycle in the type of car shown in Fig. 1 is as follows:—The air in the lading compartment 41 is warmed by contact with the lading and rises toward the top of the car by reason of its lower density. The air flows upwardly through the ducts 40 and the channels 31. It then flows horizontally through the channels 30 where it is cooled by the refrigerant, such as ice, in the upper portions of the containers 20 and downwardly through the path 35 where it is further cooled by contact with the sides of the refrigerant containers 20. The circulating air flows through the passage 33 where it is cooled to a low temperature by contact with the bottoms 22 of the containers 20, said bottoms being at a low temperature due to the brine therein. The air continues through the passage 33, flowing between the ducts 40, as shown by the arrows in Fig. 2, downwardly through the flue 10, through the space 12, and upwardly through the foraminous rack 11 to the leading compartment 41.

The first stage of the two-stage cooling occurs as the air flows through the channel 30 and the path 35, the temperature of the refrigerant being substantially that of fresh water ice. The second stage is during flow through the passage 33, the refrigerant being the brine in the lower part 22 of the container 20 and being at a considerably lower temperature than the ice in the upper portion 21 of the container 20.

Fig. 4 shows my invention adapted to the use of solid brine tanks 50. The circulation cycle is substantially similar to that heretofore described, the advantage being that the circulating air is more positively cooled if it completely encircles the refrigerant container than if it contacts only one or two sides. It probably leaves the refrigerant chamber at a lower temperature due to more contact with the refrigerant and therefore refrigerates the car more efficiently.

Fig. 5 shows the adaption of an open basket type refrigerant container 55 to a car embodying my invention. The circulation cycle in this case is from the lading compartment upwardly through the ducts 40 and the channel 31, horizontally through the upper part of the container 55 which has foraminous walls, downwardly through the path 35, through the passage 33, between the ducts 40 and downwardly through the flue 10. The air thus leaves the refrigerant compartment at a low temperature by reason of its protracted contact with the refrigerant.

The accompanying drawings illustrate the preferred form of the invention, though it is to be understood that the invention is not limited to the exact details of construction shown and described, as it is obvious that various modifications thereof, within the scope of the claims will occur to persons skilled in the art.

I claim:

1. In a refrigerator car having a lading compartment, insulated walls, roof and floor, a foraminous floor supported above said insulated floor to provide a space therebetween, and a refrigerant container below said roof in spaced relation thereto and to one of said walls to provide air channels therebetween, the combination of a vertical flue associated with one of said walls, a partition below said container and spaced therefrom to provide a passage communicating with said flue, a duct crossing said passage and being non-communicative therewith, said duct communicating between said lading compartment and said channels so that air may circulate from said lading compartment respectively through said duct, said channels, said passage, said flue and said space to said lading compartment.

2. In a refrigerator car having a lading compartment, insulated walls, roof and floor, a foraminous floor supported above said insulated floor to provide a space therebetween, and a refrigerant container below said roof in spaced relation thereto and to one of said walls to provide air channels therebetween, the combination of a vertical flue associated with one of said walls, a partition below said container and spaced therefrom to provide a passage communicating with said flue, a plurality of spaced apart ducts crossing said passage and being non-communicative therewith communicating between said lading compartment and said channels so that air may circulate from said lading compartment respectively through said ducts, said channels, said passage, said flue and said space to said lading compartment.

3. In a refrigerator car having a lading compartment, insulated walls, roof and floor, a foraminous floor supported above said insulated floor to provide a space therebetween, and a refrigerant container below said roof in spaced relation thereto and to one of said walls to provide air channels therebetween, said container having a foraminous upper part and an imperforate lower part for retention of liquid refrigerant, the combination of a vertical flue associated with one of said walls, a partition below said container and spaced therefrom to provide a passage communicating with said flue, a duct crossing said passage and being non-communicative therewith, said duct communicating between said lading compartment and said channels so that air may circulate from said lading compartment respectively through said duct, said channels, said passage, said flue and said space to said lading compartment.

4. In a refrigerator car having a lading compartment, insulated walls, roof and floor, a foraminous floor supported above said insulated floor to provide a space therebetween, and a refrigerant container below said roof in spaced relation thereto and to one of said walls to provide air channels therebetween, the combination of a vertical flue associated with one of said walls, a partition below said container and spaced therefrom to provide a passage communicating with said flue, a substantially vertical member spaced from the side of said container most remote from said walls to provide a path communicating between the upper channel and said passage, a duct crossing said passage and being non-communicative therewith, said duct communicating between said lading compartment and said channels so that air may circulate from said lading compartment respectively through said duct, said channels, said

path, said passage, said flue and said space to said lading compartment.

5. In a refrigerator car having a lading compartment, insulated walls, roof and floor, a foraminous floor supported above said insulated floor to provide a space therebetween, and a refrigerant container below said roof in spaced relation to one of said walls to provide an air channel between said container and said wall, said container having a foraminous upper part, the combination of a vertical flue associated with one of said walls, a partition below said container and spaced therefrom to provide a passage communicating with said flue, a duct crossing said passage and being non-communicative therewith, said duct communicating between said lading compartment and said channel so that air may circulate from said lading compartment respectively through said duct, said channel, the foraminous upper part of said container, said passage, said flue and said space to said lading compartment.

6. A structure as defined in claim 1 wherein said partition has an upper part sloping downwardly toward said flue and a lower part sloping upwardly toward said duct.

7. A structure as defined in claim 1 wherein the vertical wall of said container adjacent said channel is insulated to retard heat transfer between the refrigerant and circulating air.

8. A structure as defined in claim 1 wherein the cross section of said duct is substantially an ellipse having its major axis extending transversely of the car to decrease the resistance to air flow through said passage.

WALLACE E. BAILLIE.