

Nov. 15, 1938.

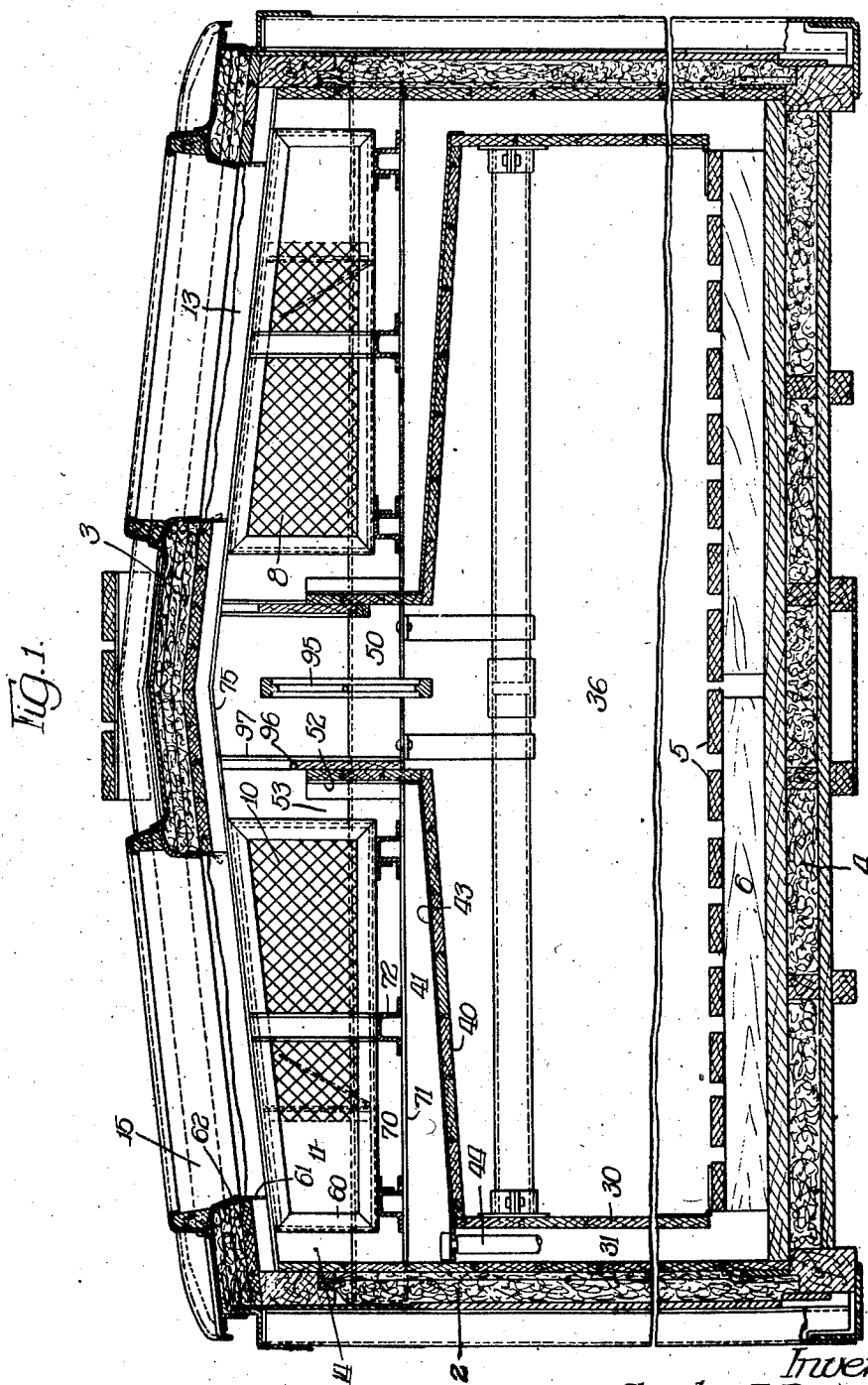
C. D. BONSALL

2,136,999

REFRIGERATOR CAR

Filed Nov. 16, 1936

7 Sheets-Sheet 1



Inventor:
Charles D. Bonsall,
By *Linton E. ...*

Nov. 15, 1938.

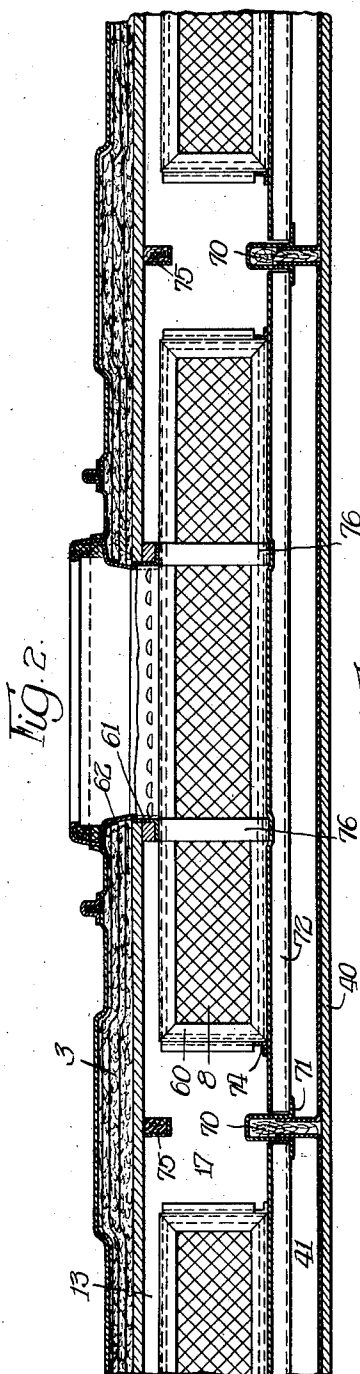
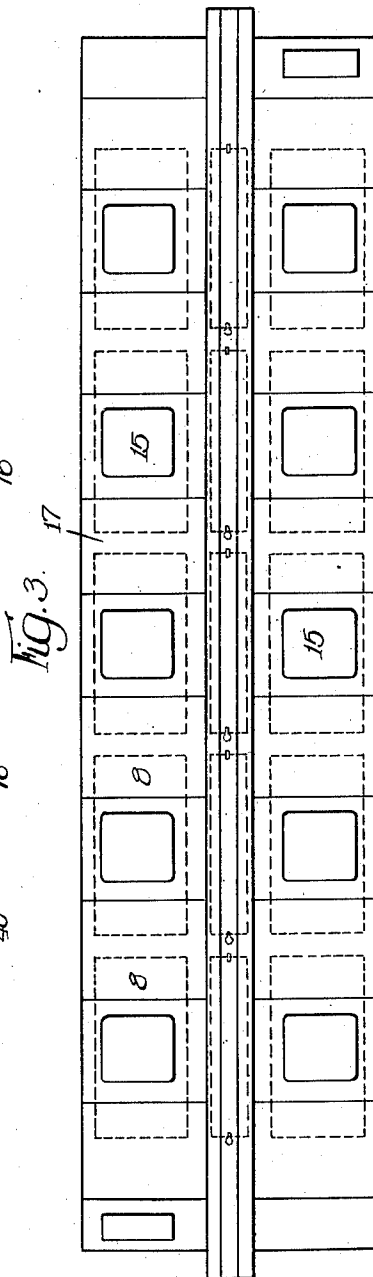
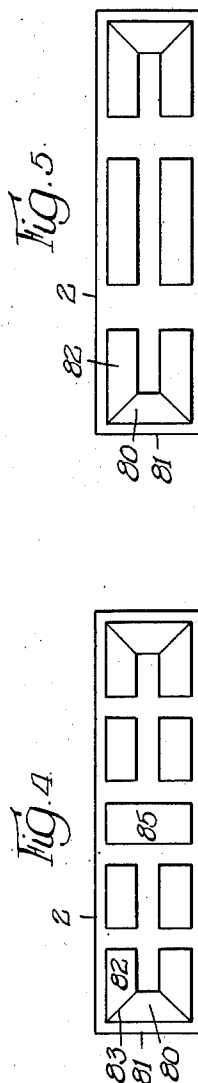
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2,136,999

REFRIGERATOR CAR

Filed Nov. 16, 1936

7 Sheets-Sheet 2



Inventor:
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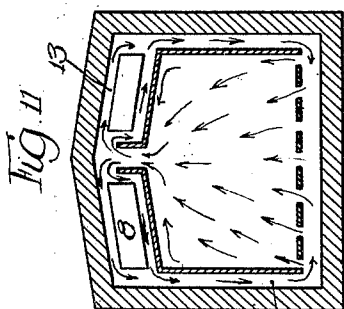
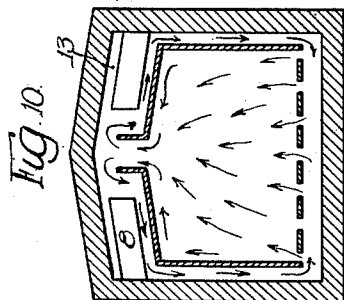
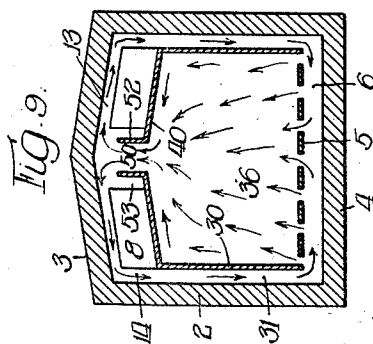
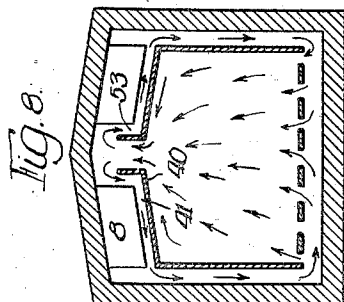
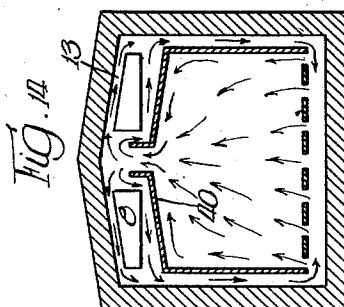
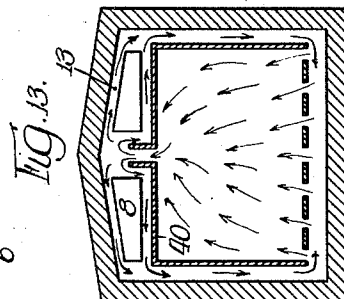
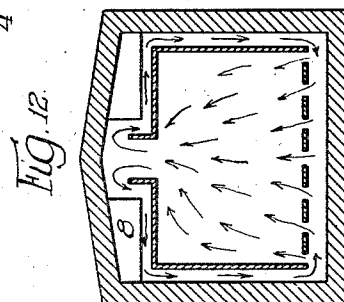
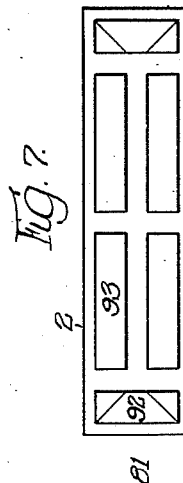
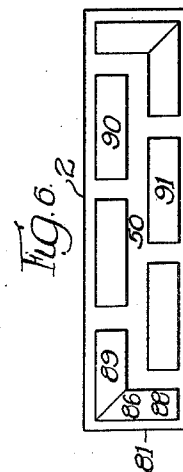
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REFRIGERATOR CAR

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7 Sheets-Sheet 3



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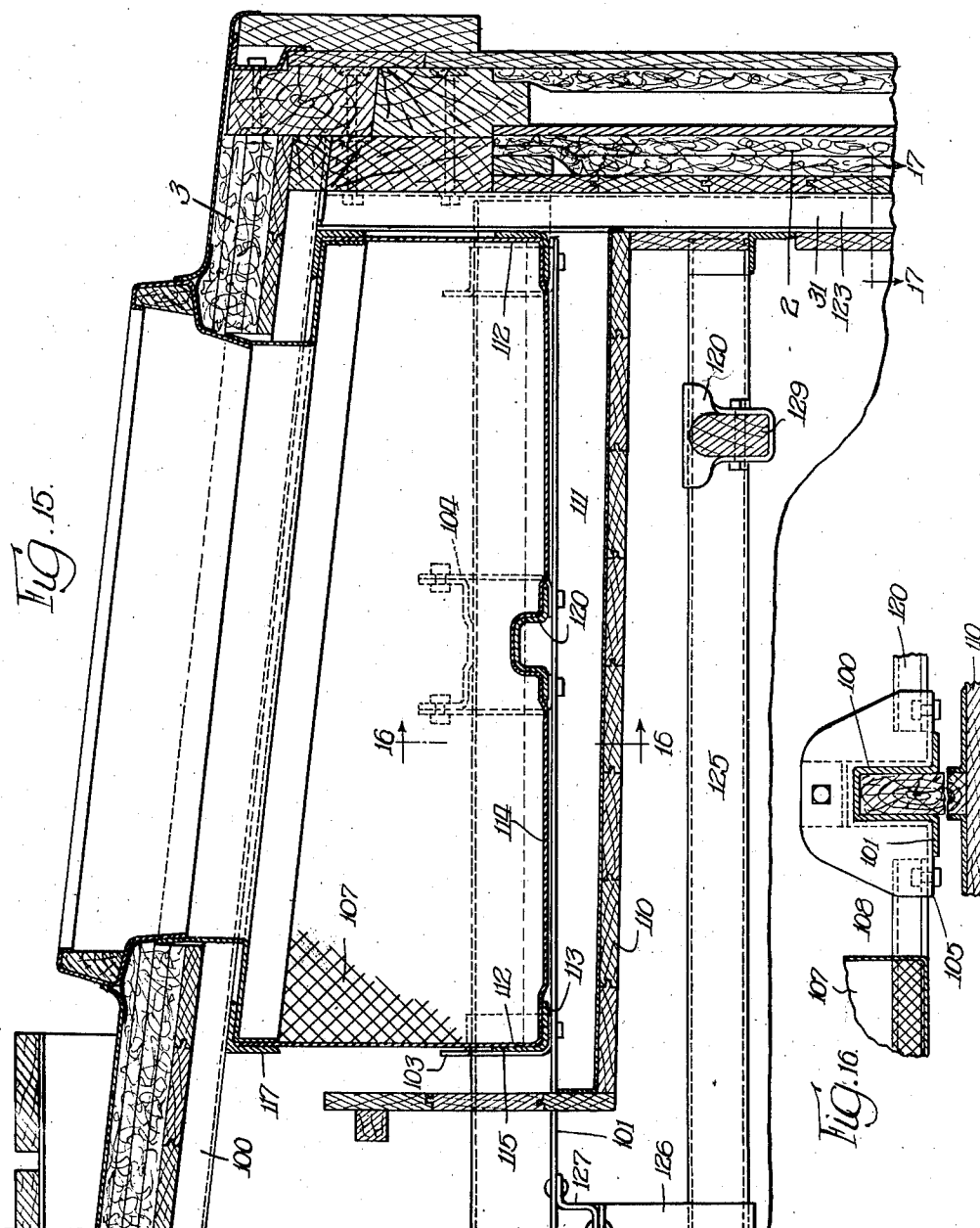
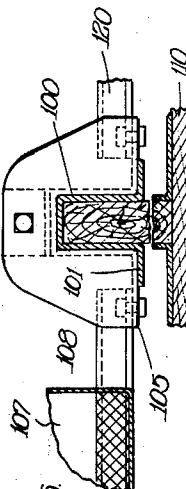
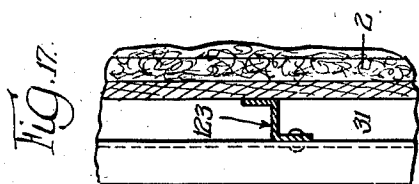
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REFRIGERATOR CAR

Filed Nov. 16, 1936

7 Sheets-Sheet 4



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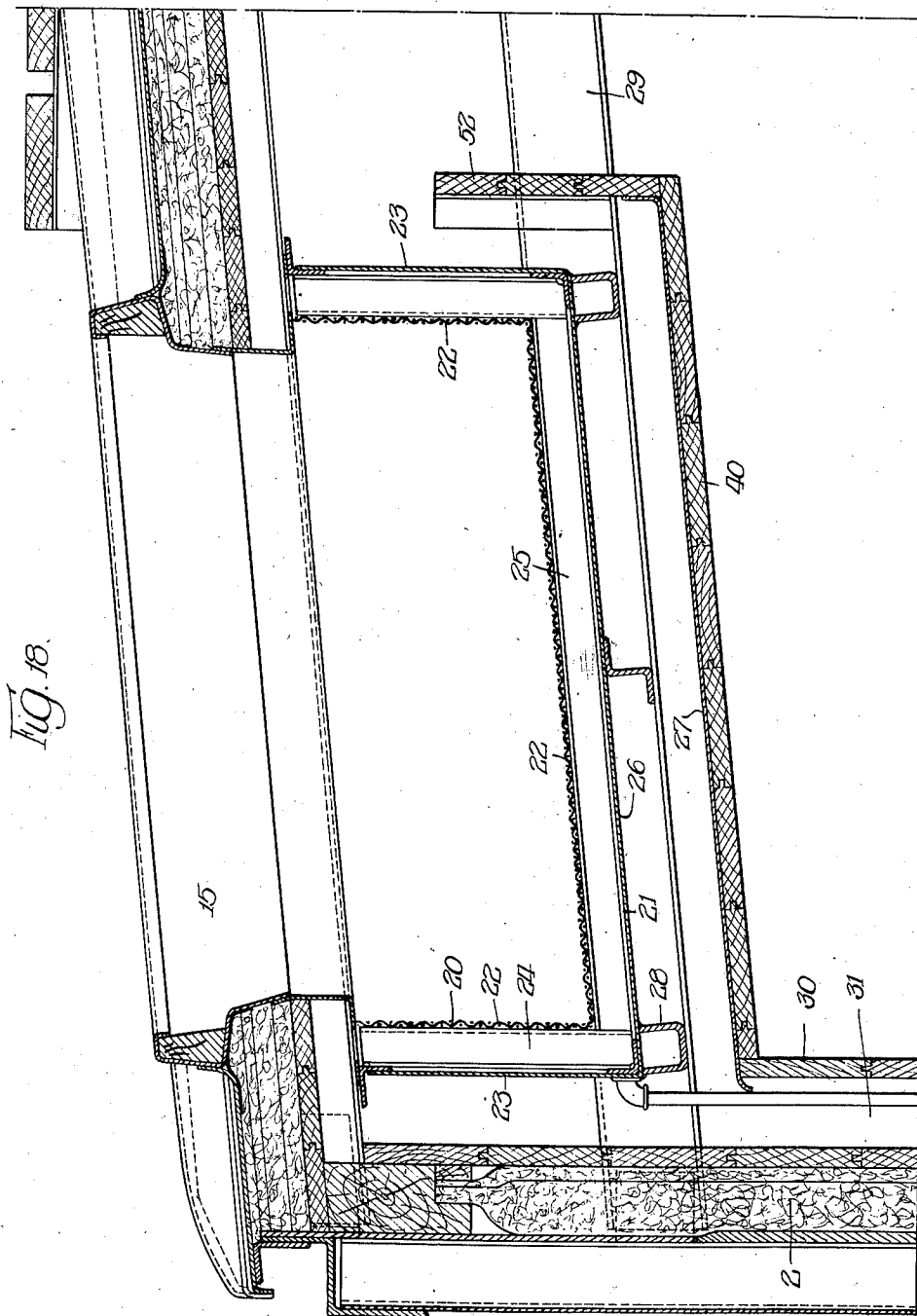
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REFRIGERATOR CAR

Filed Nov. 16, 1936

7 Sheets-Sheet 5



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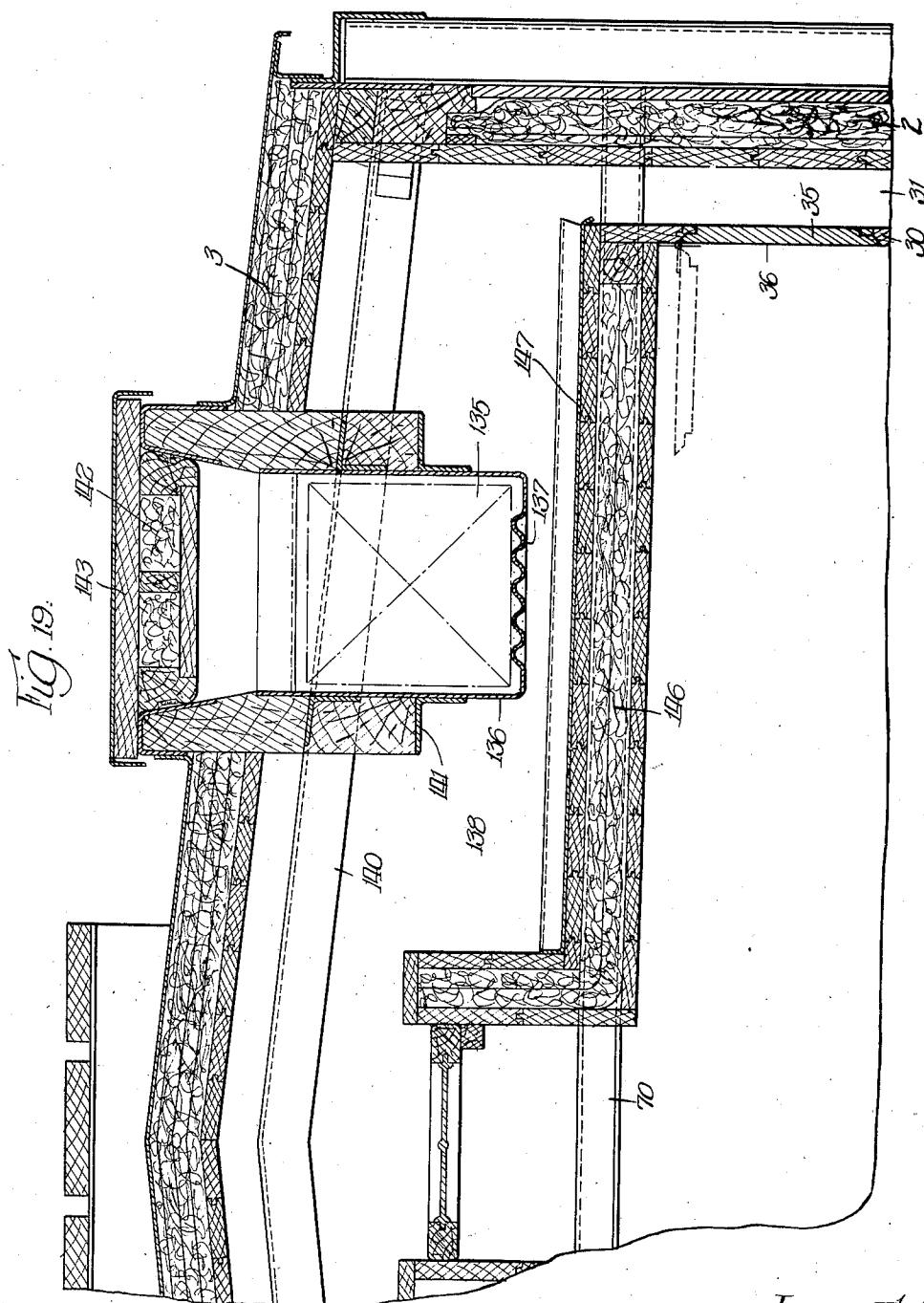
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REFRIGERATOR CAR

Filed Nov. 16, 1936

7 Sheets-Sheet 6



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C. D. BONSALE
REFRIGERATOR CAR

2,136,999

Filed Nov. 16, 1936

7 Sheets-Sheet 7

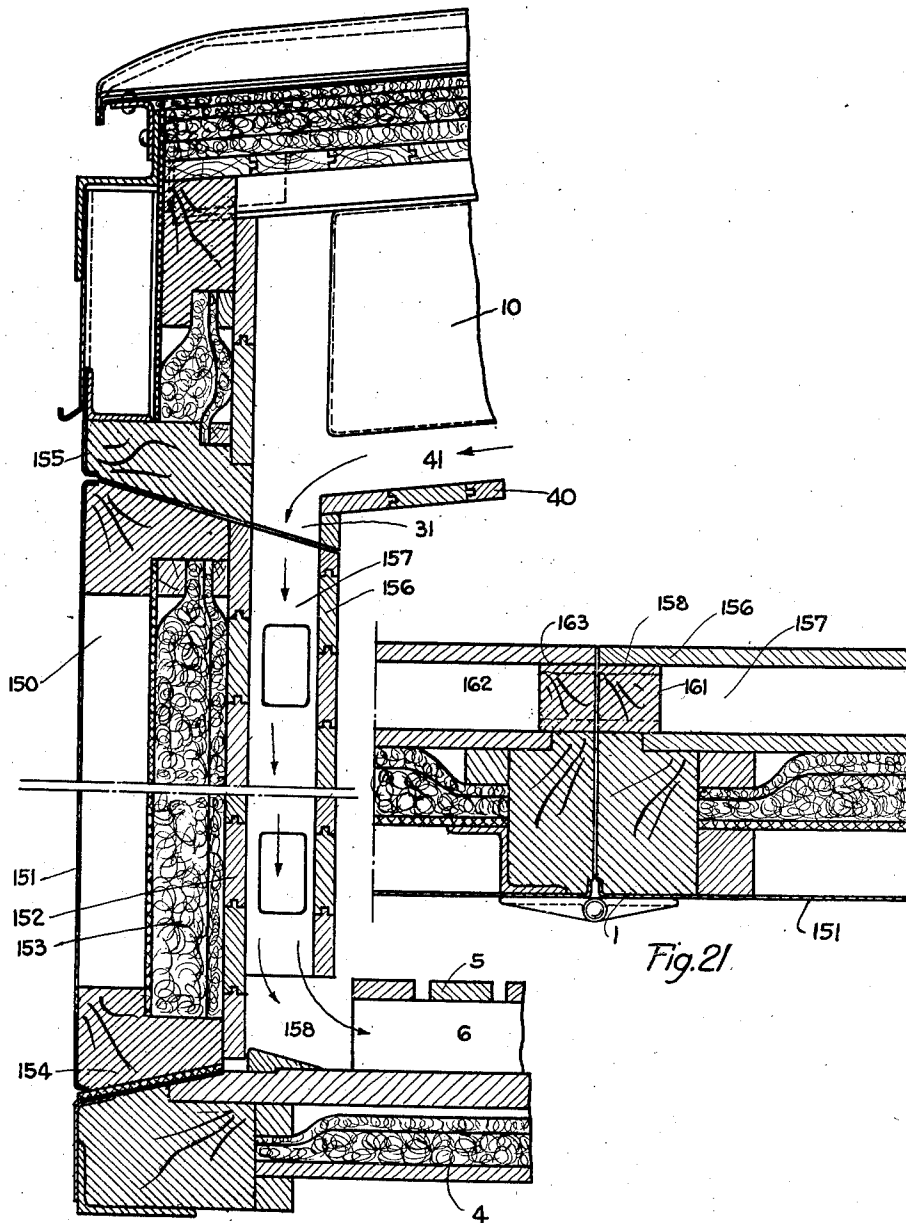


Fig. 20

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UNITED STATES PATENT OFFICE

2,136,999

REFRIGERATOR CAR

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Application November 16, 1936, Serial No. 111,058

21 Claims. (Cl. 62—17)

The device or system relates to insulated refrigerator cars used to transport perishable commodities, such as vegetables, fruits, berries, meats, eggs, frozen fish, etc., and to maintain such commodities while in transit within a predetermined range of temperatures, thus necessitating the use of a cooling means in the summer and a heating means in the winter. It has been found that perishable commodities which have not been allowed to get too cold (freeze) or too hot (bake) have a high market value because they have a longer storage life.

The object of the invention is to provide a cooling means in a refrigerator car which will obtain a lower temperature or a more even temperature of the lading in the car than in the present conventional refrigerator car; retard car wall leakage by retarding infiltration of air through the vertical walls of the car; to vary the amount of refrigeration produced without increasing or decreasing the amount of refrigerant; to provide means to refrigerate one side of the car more or less than the other side of the car without increasing or decreasing the amount of refrigerant; to increase the lading capacity of the car; to rapidly reduce the temperature of a warm lading in the car; to provide a car adaptable to use either wet ice, dryice, eutectic ice or brine as a refrigerant, and to provide a single refrigerant container in which either a solid or a liquid refrigerant may be used.

Another object of the invention is to obtain a positive circulation of air between a refrigerant chamber and the lading compartment of a refrigerator car; to obtain a relatively short path of movement of the circulating air and a relatively fast movement of the circulating air; thereby obtaining a lower temperature and a more even temperature to the circulating air, and also obtaining a lower temperature and a more even temperature of the car lading than in the conventional end bunker refrigerator car. By obtaining a lower temperature to the circulating air between the refrigerant and the lading a warm load (such as fruit with the field heat therein) can be cooled quicker than in the conventional car, thus reducing the amount of spoilage which frequently occurs when the cooling system is too slow, therefore, another object of the invention is to provide a cooling means which can be used to precool a car before it is loaded or precool a warm lading after it is loaded in the car and before the car is moved.

Another object of the invention is to provide a positive circulation of air between the refrig-

erant chamber and lading compartment of a refrigerator car by placing the refrigerant chamber in the upper part of the lading compartment and providing an uninterrupted insulated flue from the refrigerant chamber to an air space below a foraminous secondary floor, and a further object is to form the floor of the refrigerant chamber to cause the cooled air to move by gravity into the above mentioned insulated flue and to form the ceiling of the lading compartment to direct the air warmed by the lading into the refrigerant chamber.

Another object of the invention is to provide a heating means below the lading compartment, or adjacent the lower part thereof, (or perhaps in the air space below the foraminous floor) so that said ceiling will direct the air warmed by the heating means into the refrigerant chamber and said chamber floor will cause the relatively cool air to move by gravity into the above mentioned insulated flue. In other words, one of the objects is to so associate and arrange the elements comprising the device so that either air cooled by a refrigerant or air warmed by a heating means will cause positive circulation of air about or through the lading in the car.

Another object is to position a refrigerant container near the roof of the car and adjacent each of the side walls of the car and provide means so that the movements of the air currents between the respective refrigerants and the lading compartment will be in coextensive vertical planes extending crosswise or laterally of the car. In the present so-called end bunker car a refrigerant chamber is located at each end of the car and as such a car is about thirty-four feet between end bunker bulkheads, the length of the path of circulating air in one horizontal direction is one-half of this distance or seventeen feet; whereas in my arrangement, the length of each path of circulating air in one horizontal direction is about four feet. This means that even though the speed of the movement of air is the same in my car as in the conventional end bunker car (which it is not) the circulating air would more frequently be cooled by the refrigerant which would result in a colder air and a more even temperature of the circulating air and also a colder lading and a more even temperature of the lading. To obtain the best results with my arrangement the lading should be positioned in the car with vertical spaces or flues between the packages or other containers of lading to allow the air to rise and cool the lading. However, this is now customary.

Another object is to so place refrigerant containers near the roof and adjacent the side walls of the car so as to provide flues between the refrigerant and the walls, roof, drip pan and adjacent containers, whereby air may circulate on all six sides of the container, (that is, completely surround it) so as to obtain the maximum area of refrigerant exposure to the circulating air.

Another object of the invention is to provide somewhat independent movements of circulating air adjacent each side wall of the car which co-operate to balance each other under normal conditions and maintain substantially the same temperatures on both sides of the car, and another object is to provide means to cause the refrigerating means or heating means on one side of the car to function more than the corresponding means on the other side of the car. When trains are making long runs from west to east (as from Wenatchee, Washington, to New York, N. Y.,) in the winter it may be desirable to heat the north side of the train more than the south side, thereof.

Another object of the invention is to provide insulation to prevent the air which has been cooled by the refrigerant from entering the lading compartment until it reaches the air space below the secondary foraminous floor, thereby preventing leakage or "shorts" in the circulating air system which would decrease the volume of moving air and also reduce its speed. A more rapid circulation of air causes the air to come in contact more frequently with the refrigerant thereby lowering the temperature of the air so as to increase its heat absorbing capacity. In other words, one of the objects is to provide a positive or forced circulation of air between the refrigerant and the lading in the car.

Another object is to provide a refrigerant container positioned relative to the air flues to cause circulation of air between the refrigerant chamber and the lading compartment of the car in which either a wet ice, dryice, eutectic ice or brine may be used as a refrigerant, and a further object is to provide a wet ice container (with foraminous walls) in which a dryice container (with solid walls) may be placed in such a position so that the dryice will function as a refrigerant to cause the aforesaid circulation of air between the refrigerant chamber and lading compartment.

Another object of the invention is to arrange the elements comprising the cooling device so that the cold air moving from the refrigerant chamber will pass through air circulating flues within, or adjacent to, the vertical walls of the car. Another object of the invention is to provide vertical air flues in an insulated side door corresponding with and functioning the same as the circulating air flues in the other part of the side walls. In such an arrangement the cold air forms a blanket around the lading and an additional wall insulation to prevent leakage of air from the interior to the exterior of the car or vice versa. The lading next to the wall is relatively colder and, therefore, protects the rest of the lading. When the car is in heater service the air in the side wall and side door flues is warmer than the air outside the car which also retards infiltration of air through the wall. Trains of refrigerator cars hauling perishable commodities are moved as fast as sixty miles per hour which increases the infiltration of air through the walls and roof of the car. Also the fast movement of long and heavy trains, together with the severe shocks of switching, cause considerable racking and weaving of

the cars, causing leaky walls, and thus necessitating protection against air entering through the walls of the car.

The refrigerant being positioned between the lading compartment and the roof of the car constitutes an additional insulation for the upper part of the car so that the amount of insulation in the actual roof of the car may be reduced.

Another object of the invention is to drain the melted ice of a wet ice refrigerant into ducts within or adjacent to the vertical walls of the car so as to further cool these vertical walls. The above mentioned air circulating flues may be used for these drains. These ducts preferably extend to the outside of the car and are preferably provided with water seals.

Another object of the invention is to position the refrigerant containers (or refrigerant chambers) adjacent the roof of the car so as to increase the area of the floor space over the conventional car which has a refrigerant bunker in each end of the car extending from the floor to the ceiling of the car, without increasing the length or width of the car, and thereby increase the carrying capacity of the car. The conventional car can not be loaded to within less than two feet from the ceiling on account of the high temperature of the atmosphere near the ceiling spoiling the commodity, whereas owing to the colder temperature of the air adjacent the ceiling of the lading compartment of a car of the type herein described and claimed, the lading may be piled very close to the ceiling without damage to the lading.

Another object of the invention is to attach the refrigerant containers to the car structure so that they can be removed and replaced independently of each other and without disturbing the roof of the car.

Another object is to provide a plurality of refrigerant containers, preferably arranged in rows near the roof of the car and adjacent each of the side walls, with each of said containers provided with means for loading it with a refrigerant independently of the other containers so that some of the containers may be filled with refrigerants, while the others remain empty or one end only of the car may be refrigerated. The refrigerant containers adjacent the doorways, where the most heat leakage occurs, may be made deeper, wider or otherwise made to hold more refrigerant. In the above mentioned arrangements a more even distribution of the cold air may be provided.

Another object of the invention is to provide a frame work within the car and to support the refrigerant containers to both such frame work and the roof of the car to take advantage of the great strength of the modern all-steel car roof so as to decrease the weight and cost of the frame work and the space which it occupies within the car. Meat racks may be supported by such frame work.

In the drawings:

Fig. 1 shows a typical cross section of a railway refrigerator car incorporating my improved method of refrigerating and heating the lading in the car and also showing methods of supporting and associating the refrigerant container with the car structure.

Fig. 2 is a cross section of upper part of the construction shown in Fig. 1 extending longitudinally of the car.

Fig. 3 is a plan of a railway refrigerator car showing the preferred arrangement of the refrigerant containers in the car.

Figs. 4-7 inclusive are diagrams showing modifications in the arrangement of refrigerant containers.

Figs. 8-14 inclusive are diagrams showing modifications in the relative position of the refrigerant containers to the other parts of the car.

Figs. 15, 16 and 17 show a modified construction wherein the refrigerant container is supported by members which do not interfere with the movement of air below the container.

Fig. 18 shows a modification wherein a foraminous container is positioned within a container having solid walls.

Fig. 19 shows a modification showing a container to be used with dryice.

Figs. 20 and 21 show an improved side door for a refrigerator car to be used with my improved car.

My invention is adaptable to a refrigerator car having spaced apart insulated car walls 2; an insulated roof 3; an insulated floor 4; a foraminous floor or floor rack 5 above the insulated floor and an air space 6 between said floors.

A refrigerant container 8 is positioned near the roof 3 of the car and adjacent each of the side walls 2-2 of the car. These containers 8 are made with foraminous walls when wet ice or eutectic ice is used as a refrigerant; with solid walls when brine, or dryice is used as a refrigerant, or partially solid and partially foraminous if desired; for instance, the foraminous part 10 may be used to hold wet ice for precooling the car and lading and the solid part 11 may be used to hold dryice to provide refrigeration in transit. A foraminous basket 20, as shown in Fig. 18, may be set in a container 21 having solid walls with the foraminous walls 22 spaced apart from the solid walls 23 to provide air flues 24-25 therebetween so that wet ice may be used as a refrigerant by putting such ice in the foraminous basket 20 so that air will circulate between the foraminous walls 22 and the solid walls 23 and also between the solid bottom walls 26 of the container and a drip pan 27 below the container. When brine (or other liquid) is used as a refrigerant it is confined by the solid walls 23-26 and the air circulates between the solid bottom wall 26 of the container and the drip pan 27. Under certain conditions frost will form on the bottom 26 of the solid container but the melted frost is caught by the drip pan 27 and furthermore the moving air retards such formation of frost. The containers are supported by the beams 28 to the rafters 29. A drain may be provided for the container which is provided with a closing valve. When brine is being used as a refrigerant the foraminous basket 20 retards the movement of the liquid brine due to the movements of the car.

Each refrigerant container 8 is preferably spaced apart from the roof 3 of the car to provide an air flue 13 therebetween and also preferably spaced apart from the adjacent side wall 2 of the car to provide an air flue 14 therebetween. A hatch opening 15 is provided preferably in the roof of the car above the refrigerant container 8 for filling it with a refrigerant, removing the refrigerant or cleaning the container. The hatch opening may be provided with the usual plug, lid, locking and supporting mechanisms. I preferably provide a row of refrigerant containers adjacent each eave of the car, (see Fig. 3), which are spaced apart (17) to provide air flues between the ends of the respective containers. In this arrangement the air can completely surround the

refrigerant container so that all six sides form cooling areas for the circulating air. The refrigerant containers 8 preferably have horizontal bottoms, as shown in Figs. 1, 12, 13 and 14, to retain the refrigerant evenly distributed over the bottom to maintain a large area of contact between the circulating air and the refrigerant.

An insulated partition 30 is preferably provided on the inside of each car side (and end) wall 2 and spaced apart therefrom to provide a vertical wall flue 31 which communicates with the air space 6 below the foraminous floor 5 and also communicates with the air flues 13-14 having contact with the refrigerant in the refrigerant containers. These air flues 31 are preferably separated into a plurality of vertical flues so as to create a pull or draft from the refrigerant to the space below the foraminous floor. The vertical flue 31 is preferably lined on both sides with thin sheets of metal which are preferably painted with brine resisting bituminous material. These metallic sheets of metal protect the side wall 2 and partition 30 from moisture and rotting and also prevent infiltration.

Some kind of closure aperture or duct, such as the doorway 35 and hinged door 36 (see Fig. 19) is preferably provided between the vertical flues 31 and the lading compartment for access for cleaning which are preferably positioned adjacent the upper part of the side wall. For instance, a stream of water may be run through such an aperture to flush the accumulated mud and debris on to the floor from where it can be easily removed.

An insulated partition 40 is provided below each of the refrigerant containers 8 which preferably also form the floor of the refrigerant chamber. This insulated partition 40 is spaced apart from the refrigerant container so as to provide an air flue 41 therebetween which communicates with the vertical air flue 31 near or in each side wall of the car and the vertical air flues in the side door. This partition 40 is preferably inclined downwardly and outwardly (see Figs. 1, 9, 10, 11 and 12) so that the air cooled and densified by the refrigerant will move by gravity toward and into the vertical flues 31. Each partition 40 preferably comprises a metallic (or otherwise waterproofed) upper member 43 forming a drip pan for the melted ice, brine or debris, which pan is positioned to direct such melted ice, brine or debris into the adjacent vertical flue 31 which forms a drain. The drain is preferably provided with means to discharge such materials outside of the car, which means is preferably provided with a water seal. A drain 44 independently of the flue may be provided.

The insulated partition 40 may comprise one or more layers of tongue and groove boards with insulation therebetween if desired.

The insulated partitions 40 on the opposite sides of the car are spaced apart to provide an air passageway 50 adjacent the longitudinal center of the car through which the warm air rises and moves into the refrigerant chambers on opposite sides of the car. The inclined partitions 40 direct the air warmed by the lading into and through this passageway 50. The margins of the inclined partitions 40 adjacent the passageway 50 may be provided with insulated members 52 extending upwardly therefrom so as to further raise the bottom of the air entrance ports into the refrigerant chamber above the lower portion of the inclined partition 40 so as to cooperate with the inclined partition to direct the movement of

circulation of air. These upstanding members 52 will also serve as splash boards to prevent melted ice or brine from splashing into the lading compartment and will also serve to prevent ice from accidentally getting into the lading compartment when the refrigerant container is being filled. These members 52 are spaced away from the refrigerant container to provide flues 53.

The insulated partition 40 below the refrigerant container 8 and the insulated partition 30 between the side wall 2 and the lading compartment are associated to form a continuous uninterrupted insulation from the passageway 50 to the foraminous floor 5 and the air flue 41 below the refrigerant container 8 and the air flue 31 between the insulated partition 30 and the side wall 2 are associated and arranged to provide a continuous uninterrupted air flue for circulating air from the passageway 50 to the space 6 below the foraminous floor 5 so that heat from the lading compartment cannot be absorbed by the cold air circulating until the air has reached the space below the foraminous floor; in other words, the cold in the circulating air cannot short circuit (to use an electrical term) into the lading compartment.

As shown by the arrows in Figs. 8 to 14 inclusive I provide two circulations of air, each moving in a plane crosswise to the car which move theoretically independently of each other, but which in fact cooperate with each other to balance the temperature of the air on opposite sides of the lading compartment of the car. The arrows in Figs. 8 to 11 inclusive show that the air warmed by the lading rises upwardly and is guided by the inclined partition 40 into the passageway 50 and coming in contact with the refrigerant in the refrigerant containers 8 is cooled and densified and therefore moves down the inclined partitions 40 until the vertical car wall flues 31 through which it descends by gravity into the space 6 below the foraminous floor 5 from whence it rises to replace the aforesaid warmed air. The rising warmed air causes a pull on the cooled air in the side wall flues and also the gravity push of the cooled air in the side wall flues causes the warmed air in the lading compartment to rise.

In the application of my invention to a refrigerator car, as shown in Figs. 1, 2 and 3, the refrigerant container 8 for use with wet ice or eutectic ice as a refrigerant, comprises a metallic frame 60 having foraminous walls provided by the use of a netting, expanded metal or perforated plate. This refrigerant container 8 is positioned below the hatch opening 15 for filling and is preferably provided with an upstanding flange 61 which underlies a flange of the hatch frame 62 to direct the ice into the container. The upstanding flange 61 is preferably provided with inwardly deflected louvers 63 to allow air to circulate over the refrigerant but these louvers are bent inwardly to direct ice or brine into the refrigerant container 8. When dryice or brine is used as a refrigerant the refrigerant container will be provided with solid or non-perforated walls. In Fig. 1, the refrigerant container 8 is shown having the part 11 adjacent the side wall 2 with solid walls for use with dryice and the remaining portion 10 of the container with foraminous walls for use with wet ice. Wet ice is frequently used to precool the car (and sometimes also the lading) while dryice is frequently used to maintain the desired temperature while the car is in transit.

The lower rafters 70 extend between and are supported by the opposite car side walls 2—2 and preferably comprise an inverted channel section, outwardly projecting lateral flanges 71. Longitudinal extending supports 72 extend between and are supported by lateral flange 71 of adjacent lower rafters. The containers 8 rest upon and are supported by these rafters 70 in such a manner as to allow the containers to expand and contract as their temperature varies. In other words, the containers 8 are slidably supported by the supports 72 and a stop 74 (Fig. 2) or other means is positioned adjacent the ends of the containers to limit such expansive movement.

The upper arched rafters 75 are positioned adjacent the roof structure 3 and extend between and are supported by the car side walls 2—2 and the containers 8 are suspended from these upper rafters by the straps 76. In this arrangement the containers are supported by both the upper and lower rafters.

The length of each container 8 is less than the distance between the flanges of adjacent lower rafters (see Fig. 2) so that after part of the partition 40 has been removed a container 8 could be removed (or replaced) by swinging the rafters 70 in a horizontal plane and then dropping them out of the way.

Fig. 3 is a plan view of the car of Figs. 1 and 2 and shows the relation of the refrigerant containers 8, hatch openings 15, spaces 17 between adjacent containers and passageway 50.

The damper 95 is pivotally mounted upon the lower rafters 70 and is movable to vary the area of the passageway 50. The damper 95 is preferably controlled by thermostats positioned in the lading compartment.

I also preferably provide a door 96 slidably mounted (97) upon each of the upwardly projecting insulated members 52 to form a restrictable extension thereof so as to provide means to vary the amount of air flow from the passageway 50 to the refrigerant container adjacent one car wall, relative to the air flow from the passageway 50 to the refrigerant container adjacent the other car wall.

So far I have described the containers as being positioned near the roof of the car and adjacent one of the car side walls. However, Figures 4 to 7 inclusive show modifications of arrangements of the containers in the car where in one container 80 is arranged partially parallel with an end wall 81 of the car which also has portions 82 thereof parallel with each of the side walls 2 of the car so that a blanket of insulated air is provided adjacent the end wall 81 as well as the side walls 2 of the car. In such a container the sloping partition adjacent the end wall would slope downwardly toward the end wall 81 and the portions of the ceiling adjacent the side walls would slope downwardly toward such side walls. The division between these sloping ceilings is shown by the light diagonal line 83. On account of the great leakage of heat into the car around the side doors it may be desirable to provide additional refrigeration at such places. In such case I would provide a laterally extending refrigerant container 85. Fig. 6 shows an arrangement wherein the end containers 86 are L-shaped having one portion 88 parallel with the end wall 81 and another portion 89 parallel with the side wall 2. In this arrangement the containers 90—91 adjacent the respective side walls are staggered. In Fig. 7

the rectangular container 92 is shown adjacent each end wall 81 and other rectangular containers 93 adjacent the side walls 2 and in such end wall container I prefer to position sloping partitions so as to direct part of the cooled air to the side wall flues and part to the end wall flues.

The end walls should be provided with insulated flues as heretofore described for the side walls.

In the modifications shown in Figs. 15, 16 and 17 the car is provided with a plurality of spaced apart rafters 100 preferably of inverted U-shape formation with laterally extending flanges adjacent the lower margin thereof. These rafters 100 are spaced below the roof 3 and extend between and are supported by the opposite side walls 2 of the car. Brackets 103—104 are mounted upon these rafters 100 which are arranged to move lengthwise of the rafters, and are provided with portions 105 which extend beyond the flanges 101 of the rafters.

Refrigerant containers 107 are positioned near the roof and adjacent to the side walls but are preferably provided with spaces or flues on all six sides of each container as heretofore described. I preferably provide a plurality of containers 107 on each side of the car for simplicity of manufacture; installation and removal from the car and I also preferably provide spaces or air conduits 108 between the ends of adjacent containers so that the length of each container 107 is less than the distance between the adjacent rafters 100 or less than the distances between the flanges 101 of adjacent rafters.

An insulated partition 110 is spaced below the containers 107 to form an air flue 111 therebetween as heretofore described.

Angular frame members 112 are provided having one arm 113 supporting the floor or lower wall 114 of the container and the other arm 115 extending upwardly adjacent one of the side walls of the container. These frame members 112 extend longitudinally of the car beyond the refrigerant container 107 and are attached to the rafters 100 so as to support the refrigerant and the refrigerant container upon the rafters. The upstanding arm 115 resists the inertia of the refrigerant whether such refrigerant is dry-ice, wet ice or brine. The upper frame members 117 are just the length of the container.

Carrying members 120 for supporting the floor of the container between the opposite angular frame members 112 extend upwardly within the container and also resist the inertia of the refrigerant. By projecting the angular frame members 112 and carrying member 120 upwardly instead of downwardly they do not project into the flue 111 and restrict the area thereof. By this arrangement the inside vertical height of the car may be increased, or putting it another way, the height of the car overall may be decreased.

The length of the frame members 112, preferably also the length of the carrying member 120, is less than the distances between the flanges 101 of adjacent rafters 100 and the ends of the angular frame members 112 and carrying members 120 are preferably supported by the brackets 103 and 104 respectively so that when it is desired to remove the container 107 by lowering it the brackets 103 and 104 are moved lengthwise of the rafter whereupon the refrigerant container with the angular frame members 112 and carrying member 120 attached thereto may be lowered without disturbing the rafters.

A plurality of vertical columns 123 are positioned within each of the side vertical flues. These columns 123 are supported at their lower ends to the sub-structure of the car in any convenient manner. The refrigerant containers are partially supported by these columns preferably by attaching the parts of the angular frame member 112 outside of the refrigerant container 107 to some of the columns. The ends of the rafters 100 are also preferably attached to the columns 123.

The meat rack comprises a tubular member 125 extending between and secured to the side walls 2 of the car. I preferably support these meat racks upon some of the columns 123. The central part of the meat rack is supported by the link 126 which is attached to the longitudinally extending beam 127 which in turn is supported by the rafters 100. The longitudinally extending timber 129, which is engaged by the meat hooks, is supported by the brackets 130 upon the meat rack 125.

Fig. 19 shows a modification wherein the container 135 is designed for use with dry-ice. The container has solid side walls 136 and a corrugated bottom wall 137 to maintain the dry-ice somewhat spaced apart from the refrigerant chamber 138 to retard the sublimation of the dry ice and consequent absorption of heat. The container 135 is suspended from the arched rafters 140 by the supports 141. An insulated plug 142 and lid 143 is provided to close the hatchway. The partition 146 is heavily insulated to prevent leakage of cold air through it. A drip pan 147 is shown to catch moisture of condensation.

Figs. 20 and 21 show a side door 150 having hinges at one vertical margin thereof to swing outwardly when opening. The usual door sheathing 151, door lining 152, door insulation 153, door threshold 154 and lintel 155 are shown. The door lining 152 is preferably flush with the side car wall lining. The partition 156 is spaced apart from the door lining 152 by the uprights 153 to provide the air circulating flue 157 which communicates with the wall flues 31 and forms a continuation thereof. The partition 156 is preferably flush with the side wall partition 30. This arrangement provides a smooth interior side wall surface and eliminates projections which might damage the lading. An aperture 161 is also provided in the upright 158 which registers with an aperture 162 in the upright 163 forming a part of the car body to provide lateral communication between the door flue 157 and the side wall flues 31. The bottom of the partition 156 is substantially flush with the foraminous floor 5 so that the door flue 157 communicates with the space 6 between the insulated floor 4 and the foraminous floor 5.

In this arrangement the entire side wall of the car is insulated by the cold air and protected from infiltration by the blanket of cold air and furthermore any air which leaks between the edge of the door and the adjacent car part is cooled by the cold air passing through the apertures 161 and 162. Leakage of air around the door usually makes the middle of the car the warmest part of the car and the lading, but with my arrangement a refrigerant container is preferably positioned adjacent the doorway and with my improved door, cold air is delivered under the load at the doorway.

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 spaced apart insulated car walls, an insulated roof, an insulated floor, a foraminous floor above the insulated floor and an air space between said floors, in combination with a refrigerant container near said roof and adjacent each car wall respectively, a vertical air flue in each of said car walls insulated from the lading compartment of the car and communicating with said air space below the foraminous floor, a downwardly and outwardly inclined insulated partition below each of said containers forming the floors thereof to provide downwardly and outwardly inclined flues therebetween, said containers being spaced apart from the roof to provide substantially horizontal air flues therebetween communicating with said vertical flues, the insulated partitions adjacent the opposite car walls being spaced apart to provide an air passageway adjacent the longitudinal center of the car, the inclined partition forming an upwardly and inwardly inclined ceiling for the lading compartment of the car, said insulated vertical flues and said insulated partitions associated to provide uninterrupted insulated flues from the passageway to the space below the foraminous floor whereby the air warmed by the lading rising upwardly is guided by the inclined ceilings into the passageway and coming in contact with the refrigerant in the refrigerant container is cooled and densified and therefore moves by gravity into the vertical car wall flues through which it descends by gravity into the space below the foraminous floor from whence it rises to replace the warmed air.

2. In a refrigerator car having spaced apart insulated car walls, an insulated roof, an insulated floor, a foraminous floor above the insulated floor and an air space between said floor, in combination with a refrigerant container near said roof and adjacent to but spaced apart from each car wall respectively to provide air flues therebetween, a vertical flue in each of said car walls insulated from the lading compartment of the car and communicating with said air space below the foraminous floor, a downwardly and outwardly inclined insulated partition below each of said containers and spaced therefrom to provide downwardly and outwardly inclined flues therebetween, said containers being spaced apart from the roof to provide substantially horizontal air flues therebetween, said flues communicating with said vertical flues, the insulated partitions adjacent the opposite car walls being spaced apart to provide an air passageway adjacent the longitudinal center of the car, the inclined partition forming an upwardly and inwardly inclined ceiling for the lading compartment of the car, said insulated vertical flues and said insulated partitions associated to provide uninterrupted insulated flues from the passageway to the space below the foraminous floor whereby the air warmed by the lading rising upwardly is guided by the inclined ceilings into the passageway and surrounding the refrigerant in the refrigerant container is cooled and densified and therefore moves down the inclined partition into the vertical car wall flues through which it descends by gravity into the space below the foraminous

floor from whence it rises to replace the warmed air.

3. In combination with the side walls, roof and floor of a refrigerator car: refrigerant containers adjacent the roof at opposite sides of the car; a rack spaced from the floor to support the lading and to form an air duct below the lading, said rack being foraminous to provide for the distribution of refrigerated air to the lading space; means providing ducts in the side walls of the car, the lower ends of which communicate with the space between the floor and the floor rack; and enclosing structures for said refrigerant containers substantially closed except for cold air discharge openings leading to said wall ducts, and air inlets at a higher elevation than said discharge openings, whereby air cooled by the refrigerant is compelled to pass downwardly through the side wall ducts and into the space under the lading whence it is distributed by the foraminous floor rack throughout the lading space and then passes into the spaces enclosing the refrigerant containers.

4. The refrigerator car construction of claim 3 in which the enclosing structures for refrigerant containers on opposite sides of the car are spaced apart so that air may pass from the lading space into either one or both of the spaces enclosing the refrigerant containers according to thermal conditions.

5. The refrigerator car construction of claim 3 in which the enclosing structures for the refrigerant containers have outwardly and downwardly sloping bottoms forming drip pans whereby the water from the refrigerant containers is conducted into the side wall ducts.

6. The refrigerator car construction of claim 3 in which the side wall ducts extend substantially from end to end of the car whereby circulation of air through said ducts aids in insulating the side walls through substantially their full length.

7. The refrigerator car construction of claim 3 in which one of the side walls has a door formed so that the duct on this side of the car extends through said door.

8. The refrigerator car construction of claim 3 in which the end walls of the car are provided with air ducts extending from the spaces enclosing the refrigerant containers to the space between the floor and floor rack.

9. The refrigerator car construction of claim 3 in which there are a plurality of refrigerant containers on each side of the car spaced apart longitudinally to provide for the circulation of air between the ends of the refrigerant containers.

10. The refrigerator car construction of claim 3 in which the refrigerant containers have horizontal bottoms and the enclosing structures therefor are provided with bottoms sloping downwardly toward the ducts in the side walls of the car.

11. The refrigerator car construction of claim 3 wherein heat insulation is provided between the lading space and the side wall ducts and between the lading space and the refrigerant containers.

12. The refrigerator car construction of claim 3 in combination with means for varying the proportion of air entering the enclosing structures for the refrigerant containers on opposite sides of the car, whereby either side of the car may be cooled more or less than the other side according to outside thermal conditions.

13. In combination with the roof, floor and side walls of a refrigerator car; refrigerant containers in the upper part of the car; foraminous racks to

support the lading, form an air duct below the lading and provide for the distribution of cold air into the lading space of the car; means providing enclosing spaces for the refrigerant containers; and means providing ducts in said side walls leading from said enclosing spaces to said air ducts, one of the side walls of the car being provided with a door and the duct in said wall extending through said door.

14. In combination with the roof, walls and floor of a refrigerator car; a refrigerant container in the upper part of the car having a horizontal bottom; an enclosing structure for refrigerant container, the bottom of which slopes downwardly toward one of the walls of the car; and means providing a duct in said last named wall communicating with the space within said enclosing structure and with the interior of the car near the floor.

15. In combination with the roof, walls and floor of a refrigerator car; a refrigerant container in the upper part of the car; means providing an air duct in one of the car walls for conducting refrigerated air from the region of said container to the interior of the car near the floor; and means for supporting said refrigerant container comprising posts located in said duct.

16. In combination with the roof, walls and floor of a refrigerator car; refrigerant containers in the upper part of the car under the roof; a foraminous floor rack to support the lading, form an air duct under the lading and provide for distribution of refrigerated air throughout the lading space; ducts formed in the side and end walls of the car, and in each case, extending substantially for the full length and width of said walls respectively for conducting refrigerated air from the region of said refrigerant containers to the space under said floor rack.

17. In combination with the walls, roof and floor of a refrigerator car; a refrigerant container adjacent the roof of the car; a rack spaced from the floor to support the lading, said rack being foraminous to provide for the distribution of refrigerated air to the lading space; means providing a duct in one of the car walls, the lower end of which communicates with the space between the floor and floor rack, and an enclosing structure for said refrigerant container substantially closed except for a cold air discharge opening leading to said wall duct and an air inlet at a higher elevation than the discharge opening whereby air cooled by the refrigerant is compelled to pass downwardly through the wall duct into the space under the lading whence it is distributed by the foraminous floor rack throughout the lading space.

18. The combination described in claim 3 including rafters extending between and supported by the car walls, longitudinally extending con-

tainer supports extending between and supported by the rafters, a plurality of vertical columns positioned within said ducts forming supports for the opposite ends of the rafters.

19. The combination described in claim 3 including rafters extending between and supported by the car walls, longitudinally extending container supports extending between and supported by the rafters, a plurality of vertical columns positioned within said ducts forming supports for the outer sides of the refrigerant containers and the opposite ends of the rafters.

20. A refrigerator structure comprising in combination with the side walls, roof and floor of a refrigerator car; refrigerant containers adjacent the roof and opposite sides of the car, a rack spaced from the floor to support the lading and to form an air duct below the lading, said rack being foraminous to provide for distribution of refrigerated air to the lading space, and insulated flues associated with the side walls of the car, the lower ends of which communicate with the space between the floor and the floor rack, said structure also including insulated compartments in which the refrigerant containers are arranged, which compartments are substantially closed except for cold air discharge outlets leading to said wall flues and air inlets at a higher elevation than said discharge outlets leading from the lading space of the car, whereby air cooled by the refrigerant in the containers is compelled to pass downwardly through the side wall flues and into the duct under the lading whence it is distributed by the foraminous floor throughout the lading space and then passes into said air inlets.

21. In combination with the side walls, roof and floor of a refrigerator car; refrigerant containers adjacent the roof and opposite sides of the car, a rack spaced from the floor to support the lading and to form an air duct below the lading, said rack being foraminous to provide for distribution of refrigerated air to the lading space, insulated flues associated with the side walls of the car, the lower ends of which communicate with the space between the floor and the floor rack, and means arranged to cooperate with said roof and side walls to define insulated compartments in which the refrigerant containers are arranged, said compartments having air outlets communicating with said flues and air inlets at a higher elevation than said outlets and communicating with the lading space of the car, whereby air cooled by the refrigerant in the containers is compelled to pass downwardly through the side wall flues and into the duct under the lading whence it is distributed by the foraminous floor throughout the lading space, and then passes into said air inlets.

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