Dec. 31, 1940. F. A. ECOFF 2,226,753

AIR CONDITIONING FOR RAILWAY CARS

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Fig. 1.

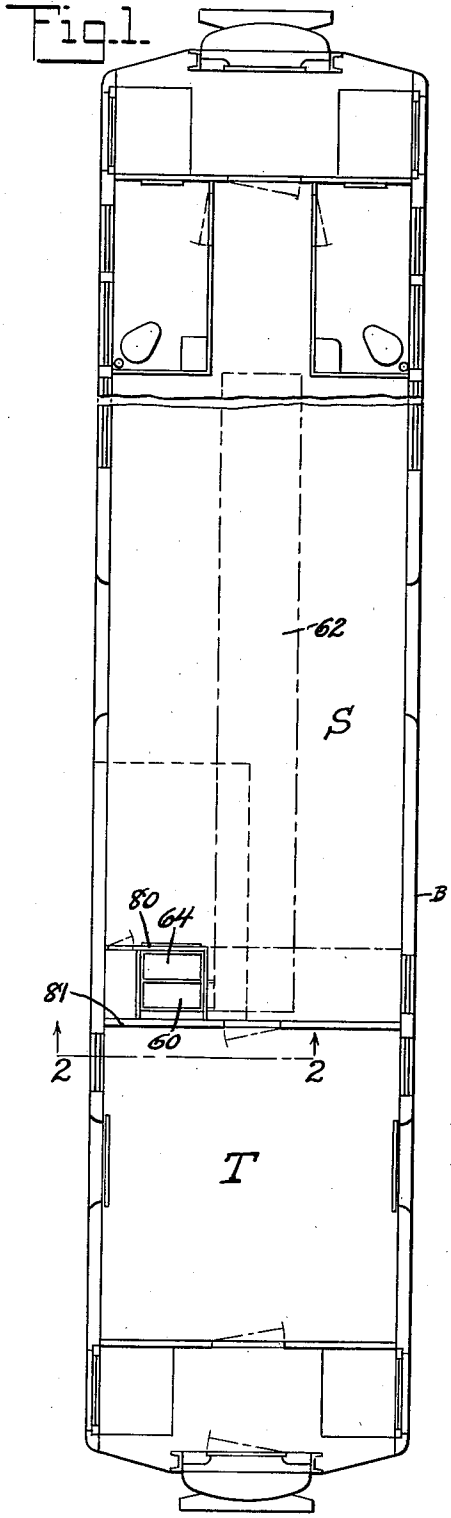
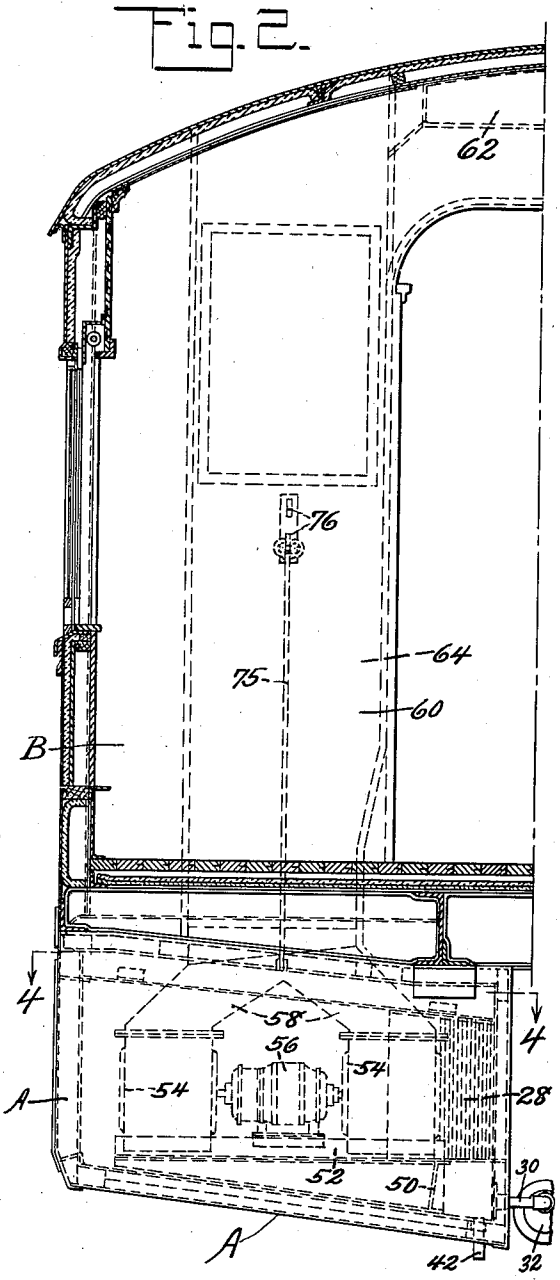


Fig. 2.



INVENTOR
Francis A. Ecoff
BY
Donald H. Rich
ATTORNEY

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Fig. 3.

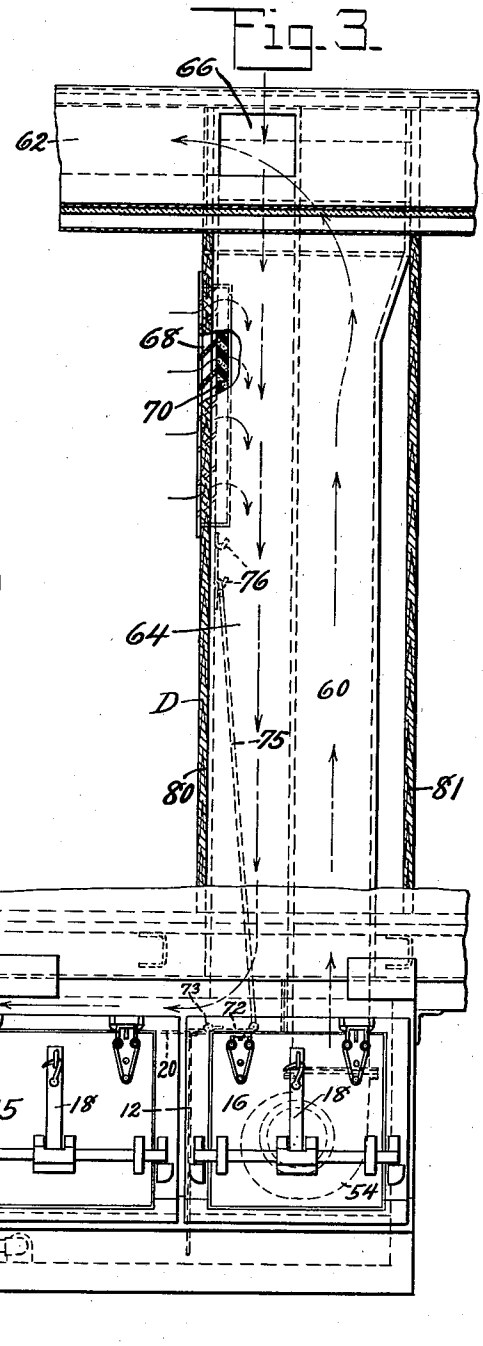
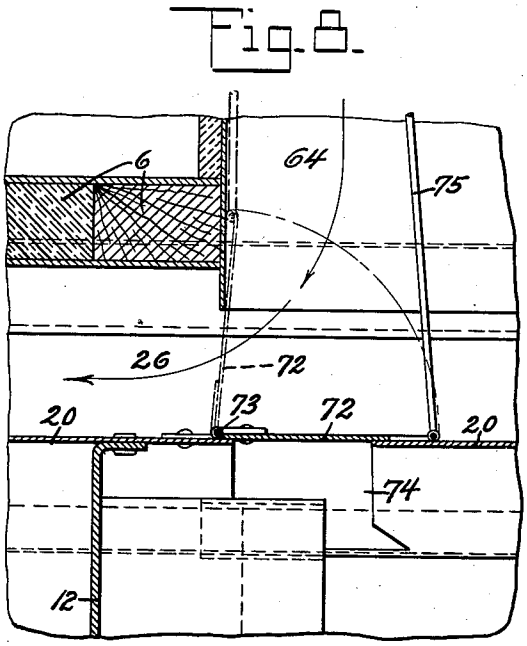


Fig. 8.



INVENTOR
Francis A. Ecoff
BY
Donald U. Rich
ATTORNEY

Dec. 31, 1940. F. A. ECOFF 2,226,753

AIR CONDITIONING FOR RAILWAY CARS

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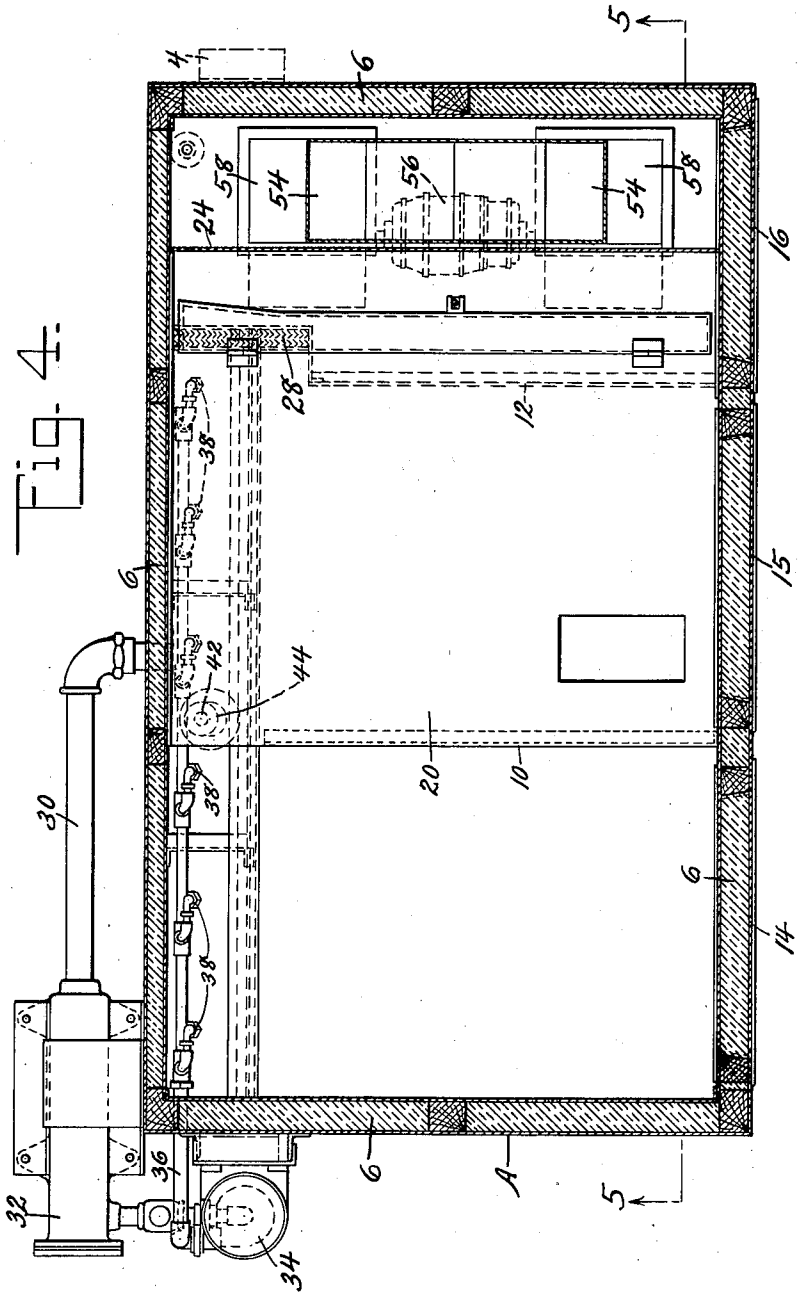
Fig. 4.



INVENTOR
Francis A. Ecoff
BY
Donald U. Rich
ATTORNEY

Dec. 31, 1940. F. A. ECOFF 2,226,753

AIR CONDITIONING FOR RAILWAY CARS

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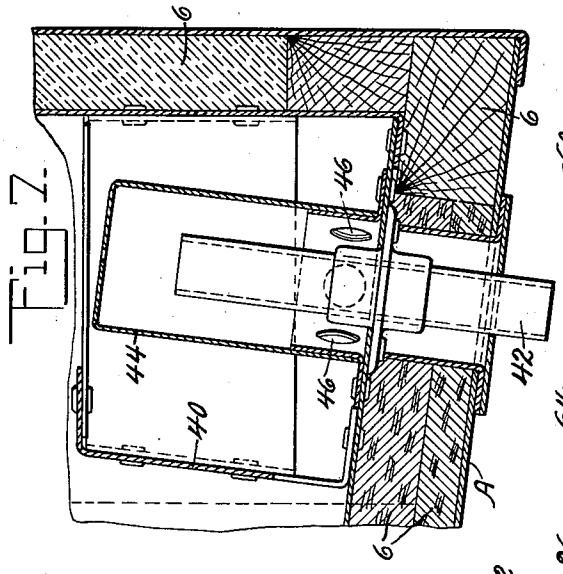

Fig. 7.

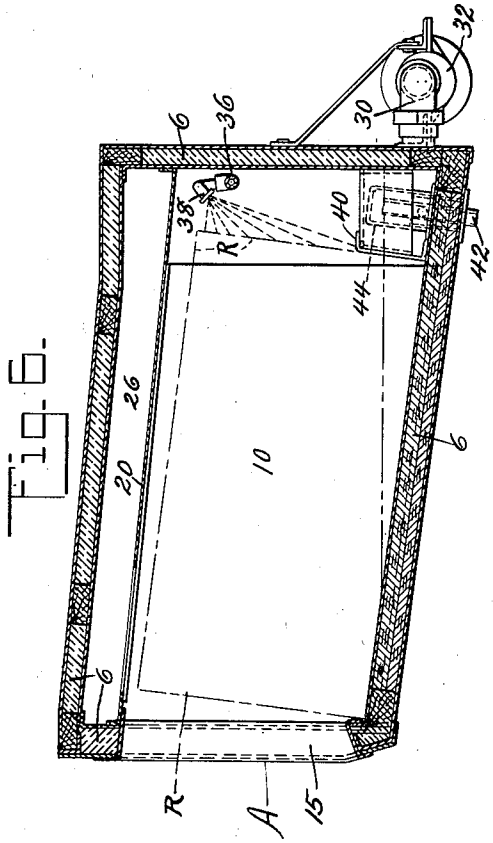

Fig. 6.

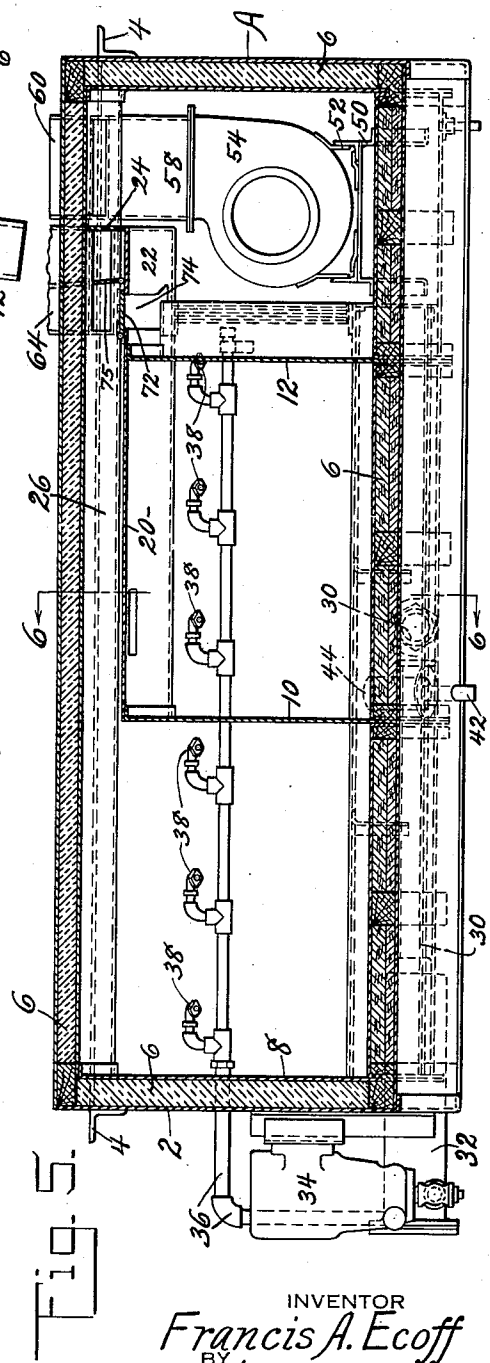

Fig. 5.

INVENTOR
Francis A. Ecoff
BY
Daniel M. Rich
ATTORNEY

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UNITED STATES PATENT OFFICE

2,226,753

AIR CONDITIONING FOR RAILWAY CARS

Francis A. Ecoff, Richmond Heights, Mo., assignor to American Car and Foundry Company, New York, N. Y., a corporation of New Jersey

Application January 5, 1938, Serial No. 183,435

9 Claims. (Cl. 62—133)

This invention relates to air conditioning in general and in particular to air conditioning systems for use on railway cars.

In the past the majority of air conditioning systems have been installed with at least some of the equipment located in the car body above the floor area which results in loss of passenger space and a raising of the center of gravity of the car. This loss of passenger space and raising of the center of gravity is extremely objectionable in high speed trains where passenger space is at a premium and speed requirements necessitate the location of the center of gravity as close to the rail as is possible. It is an object, therefore, of the present invention to provide a system in which the air is conditioned in a chamber located below the car floor and exterior of the car body, thus conserving passenger space and lowering the center of gravity of the car.

A further object of the invention is the provision of a system in which the air is temperature conditioned by passing over a cooling medium and through water sprays in a channel formed in part by the cooling medium itself.

A still further object of the invention is the provision of an air conditioning system in which any desired proportion of fresh or recirculated air may be forced into the car body by means located exterior of the car and in which means the air may be temperature conditioned or not as desired.

These and other objects of the invention will be apparent to persons skilled in the art from a study of the following description and accompanying drawings, in which

Figure 1 is a plan view of one type of railway car with the improved system applied thereto;

Figure 2 is a sectional view taken substantially on line 2—2 of Figure 1 and showing the relation of the air passages in the car body;

Fig. 3 is a side view of a portion of the car with parts broken away in order to more clearly show the air conditioning chamber and passages within the car body;

Fig. 4 is a sectional view of the air conditioning unit and taken substantially on line 4—4 of Fig. 2;

Fig. 5 is a sectional view of the unit and taken substantially on line 5—5 of Fig. 4;

Fig. 6 is a sectional view taken substantially on line 6—6 of Fig. 5 disclosing the relation of the cooling medium to the water sprays and air passages;

Fig. 7 is an enlarged detail section showing the improved over-flow means, and

Fig. 8 is an enlarged sectional view showing the means for controlling the flow of air through the air conditioning unit.

Referring now to the drawings in detail, it will be seen that the system comprises a complete conditioning unit A mounted beneath the floor and underframe of the car body B and receiving and discharging air from and to the car body through duct system D. The air conditioning unit in the present instance consists of a substantially box-shaped container 2 suitably secured to the car underframe by means of angle brackets 4. The box-shaped container is suitably insulated on all sides by insulation 6 located between the outer shell and an inner waterproof shell 8 forming an inner watertight container which container is divided into three compartments by a pair of partitions 10 and 12. As illustrated particularly on Fig. 3 the compartment is closed on the side adjacent the car side by means of doors 14, 15 and 16 hinged to the outer shell and retained in position by suitable latch means 18. The doors 14 and 15 permit loading of ice or other cooling medium into two of the compartments, while door 16 permits access to the third compartment containing the motor and blower units. As clearly shown in Figs. 4 to 6 inclusive, the partitions 10 and 12 are stopped short of the ceiling of the inner container and joined together at their top portion by means of a plate 20 extending continuously from the front wall of the inner container to the rear wall thereof and also extending beyond the partition 12 as at 22 into the blower compartment where it is connected with a vertical wall 24 extending upwardly to the ceiling of the inner container, thus forming a passageway 26 within the inner container and above the central compartment. The rear edge of partition 10 is spaced from the rear wall (Fig. 6) of the container in order to provide a passageway, while partition 12 is likewise stopped short of the rear wall to provide a passageway in which an eliminator 28 may be placed which, together with the partition 12, will substantially isolate the refrigerant compartments from the blower compartment. Chilled water from the refrigerant compartments is drained through outlet pipe 30 into a filter 32 from which it is drawn by motor driven pump 34 and forced through pipes 36 to a plurality of spray nozzles 38 located along the rear wall of the refrigerant compartments. These spray nozzles direct an extremely fine spray downwardly and outwardly upon a refrigerant, which in the present case is water ice indicated as at R (Fig. 6). The floor of the waterproof refrigerant compartment slopes downwardly and

inwardly toward the center of the car and in order to prevent injury to the spray nozzles as well as to insure maintenance of an air channel between the ice cakes and back wall of the container a channel or other spacing means **40** extends continuously along but spaced from the rear wall of the container (Figs. 6 and 7). In order to maintain a substantially constant liquid level within the ice compartments an overflow is provided as shown in Fig. 7 between the ice spacing channel **40** and the rear wall of the container. This overflow consists of an overflow pipe **42** welded or otherwise secured to the inner container extending upwardly into the container with its upper end covered by a housing **44** having relatively small openings **46** in the lower portion thereof. This arrangement forms a trap preventing entrance of air into the ice compartments while at the same time preventing excessive loss of liquid due to surges caused by travel of the car.

A framework **50** is secured to the floor of the blower compartment and is adapted to slidably receive the base **52** upon which blowers **54** and blower motor **56** are mounted, thus permitting the ready withdrawal or insertion of the motor and blower unit through the opening made accessible by the raising of the door **16**. The blower outlets are detachably connected to Y-shaped casing **58** which merges into a vertical duct **60** extending upwardly into the car for connection at its upper end to the cold air discharge duct **62** preferably located in the ceiling zone of the car (Figs. 1 to 3 inclusive). A recirculated air duct **64** is located substantially parallel to the discharge duct and is connected at its upper end to a fresh air inlet **66**, at its intermediate portion to a recirculated inner grille **68** protected by a filter **70** and at its lower end extends through the air conditioning unit for connection with the passageway **26** previously referred to. In order to control the distribution of the air flowing to the recirculated air duct a damper **72** is provided hinged to the plate **20** as at **73** and adapted when closed to cover an opening **74** formed in the plate and when open to close the passage **26** as shown in line and dash outline (Fig. 8). This damper is controlled by means of link **75** connected at its upper end to any suitable adjusting means such as slide hook **76** (Figs. 2 and 3). As shown the vertical ducts **60** and **64** are located in one corner of the passenger space S between the partitions **80** and **81** and adjacent the baggage compartment T, but it is obvious that they may be located in any other position desired since the ducts do not necessarily have to connect directly and vertically into the conditioning unit but if desired the unit may be located wherever possible beneath the car and auxiliary connecting ducts applied between the vertical ducts and the air conditioning unit.

The operation of the system is as follows: Ice cakes R are charged into the two refrigerant compartments by raising of doors **14** and **15** and when so charged the cakes will rest at their inner ends against the channel **40**, thus providing an air space between them and the back wall of the compartments. When cooling is desired within the car the blower and pump units will be started either separately or simultaneously with the pump unit drawing water from the ice compartments through the strainer and forcing it to the spray nozzles **38**, thus causing a cold, fine spray to completely fill the passage to the rear of the ice cakes. In the meantime the blower will have started circulating air drawing it downwardly through duct **64** past damper **72** into passageway **26** from which it will flow over the ice cakes in the end compartment, then downwardly into the passage at the rear of the ice cakes and through the sprays along the rear edge of the ice cakes to the eliminator, then through the eliminator into the blowers and from the blowers it will be forced upwardly through duct **60** into duct **62** for distribution to the passenger space. The air flowing through duct **64** may be obtained either from the grilled recirculated opening or from the fresh air inlet which is preferably controlled by suitable slide means in order that the proportion of fresh and recirculated air may be controlled. If it is desired to condition all of the air flowing through duct **64** the damper **72** will remain closed, but if it is desired to merely circulate the air through the car without temperature conditioning it, then the damper will be opened closing the passage **26** and permitting the air to flow directly from the duct **64** through opening **74** to the blowers without passing through the ice compartments. It is, of course, obvious that any intermediate location of the damper may be used, in which case any desired proportion of the air may be conditioned or circulated without conditioning. It is obvious that as rapidly as the ice cakes are melted by the passage of air and under the action of the water sprays they will move downwardly against the channel **40** thus insuring a passageway formed on at least one part by the ice cakes during the melting thereof. Even after the cakes are substantially melted the opening in partitions **10** and **12** will insure passage of the air along the back wall of the compartment and through the cold water sprays.

While the improved system has been described more or less in detail, it is obvious that various modifications and rearrangements of parts and relocation of the equipment may be accomplished without departing from the scope of the following claims:

What is claimed is:

1. An air conditioning system for a railway car comprising an insulated container carried by the car beneath the floor thereof, a plurality of ducts connecting the container and car interior, a refrigerant compartment in the container, water ice in the refrigerant compartment held spaced from the back wall thereof to form a passageway, spray nozzles carried on the back wall in the passageway, means in the container for drawing a stream of air from the car body through one of the ducts and the passageway for discharge through other ducts into the car body, and means forcing chilled water to the nozzles for spraying into the air stream in the passageway.

2. An air conditioning system for a railway car comprising an insulated container carried by the car beneath the floor thereof, said container comprising a plurality of refrigerant compartments for the reception of water ice, an air duct overlying at least one of the refrigerant compartments, means in said compartments to hold water ice therein in position to cooperate with the rear walls of the compartments to form a clearly defined passageway, spray nozzles carried by the rear walls of the compartments and directed transversely of the passageway toward the water ice, means drawing chilled water from the compartments and forcing the same to the spray nozzles, a plurality of air ducts connecting the container with the car interior, and

means circulating air through the ducts and passageway for cooling and dehumidification by the ice and water sprays

3. An air conditioning system for a raliway car comprising an insulated container carried by the car beneath the floor thereof, said container comprising a plurality of refrigerant compartments for the reception of water ice, an air duct overlying at least one of the refrigerant compartments, means in said compartments to hold water ice therein in position to cooperate with the rear walls of the compartments to form a clearly defined passageway, spray nozzles carried by the rear walls of the compartments and directed transversely of the passageway toward the water ice, means drawing chilled water from the compartments and forcing the same to the spray nozzles, a plurality of air ducts connecting the container with the car interior, and means circulating air through the ducts and passageway for cooling and dehumidification by the ice and water sprays, said last named means being removably located in a compartment of the container adjacent the refrigerant compartments.

4. An air conditioning system for a railway car comprising an insulated container carried by the car beneath the floor thereof, said container comprising a plurality of refrigerant compartments for the reception of water ice, means in said compartments to hold water ice therein in position to cooperate with the rear walls of the compartments to form a clearly defined passageway, spray nozzles directed transversely of the passageway and toward the water ice, means drawing chilled water from the compartments and forcing the same to the spray nozzles, a plurality of air ducts connecting the container and the passageway with the car interior, and means for circulating air through the ducts and passageway for cooling by the ice and water sprays.

5. An air conditioning system for a railway car comprising an insulated container carried by the car beneath the floor thereof, said container comprising a plurality of refrigerant compartments for the reception of water ice, means in said compartments to hold water ice therein in position to cooperate with the rear walls of the compartments to form a clearly defined passageway, a plurality of spray nozzles for spraying water in the passageway, means supplying chilled water to the nozzles, a plurality of air ducts connecting the container and the passageway with the car interior, and means for circulating air through the ducts and passageway for cooling by the ice and water sprays.

6. An air conditioning system for a railway car comprising an insulated container carried by the car beneath the floor thereof, said container comprising a plurality of refrigerant compartments for the reception of water ice, means in said compartments to hold water ice therein in position to cooperate with the rear walls of the compartments to form a clearly defined passageway, a plurality of spray nozzles for directing water spray into the passageway, means supplying chilled water under pressure to the nozzles, a plurality of air ducts connecting the container and the passageway with the car interior, means normally circulating air through the ducts and passageway for cooling by the ice and water sprays, and means for controlling the quantity of air flowing through the passageway for cooling.

7. An air conditioning system for a railway car comprising an insulated container carried by the car beneath the floor thereof, said container comprising a plurality of refrigerant compartments for the reception of water ice, an air duct overlying at least one of the refrigerant compartments, means in said compartments to hold water ice therein in position to cooperate with the rear walls of the compartments to form a clearly defined passageway, spray nozzles carried by the rear walls of the compartments and directed transversely of the passageway toward the water ice, means drawing chilled water from the compartments and forcing the same to the spray nozzles, a plurality of air ducts connecting the container with the car interior, means circulating air through the ducts and passageway for cooling and dehumidification by the ice and water sprays, and damper means controlling the volume of air flowing through the passageway for cooling and dehumidification.

8. An air conditioning system for a railway car comprising an insulated container carried by the car beneath the floor thereof, a plurality of ducts connecting the container and car interior, a refrigerant compartment in the container, an air passageway located within the container and overlying at least a portion of the refrigerant compartment, blower means in the container for drawing air from the car body through one of the ducts, the passageway and refrigerant compartment for discharge through other ducts into the car interior and control means for directing any desired proportion of the air out of the passageway and direct to the blower means without passage through the refrigerant compartment.

9. An air conditioning system for a railway car comprising an insulated container carried by the car beneath the floor thereof, a plurality of ducts connecting the container and car interior, a refrigerant compartment in the container, water ice in the refrigerant compartment held spaced from a wall thereof to form a passageway, blower means for drawing a stream of air from the car interior through one of the ducts and the passageway for discharge through other ducts into the car interior, means for spraying chilled water into the air stream in said passageway, and control means for diverting any desired proportion of the air stream direct to the blower means for circulation without passage through the water sprays.

FRANCIS A. ECOFF.