

May 15, 1928.

M. W. BROWNE

1,670,187

FORCED AIR CIRCULATION AND REFRIGERATION IN REFRIGERATOR CARS

Filed Oct. 13, 1925

2 Sheets-Sheet 1

Fig. 1.

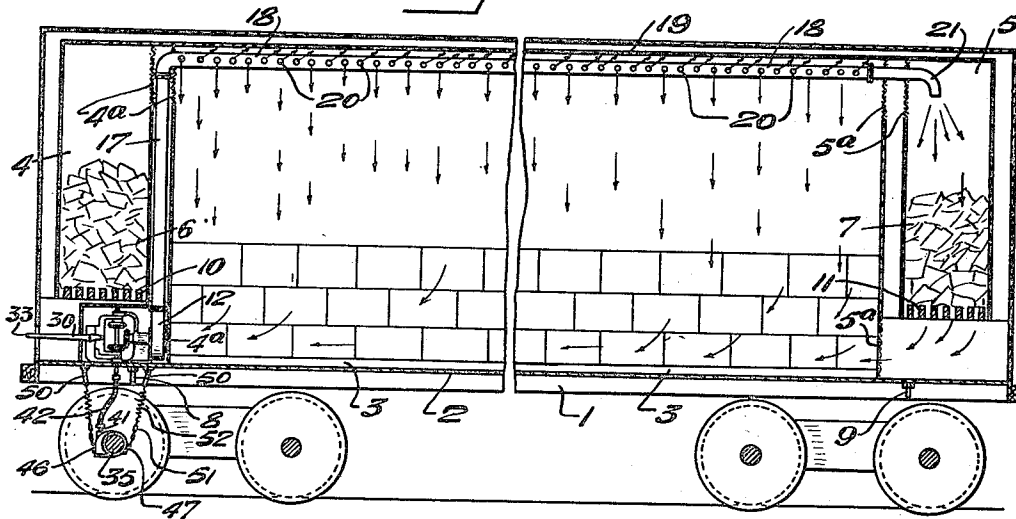
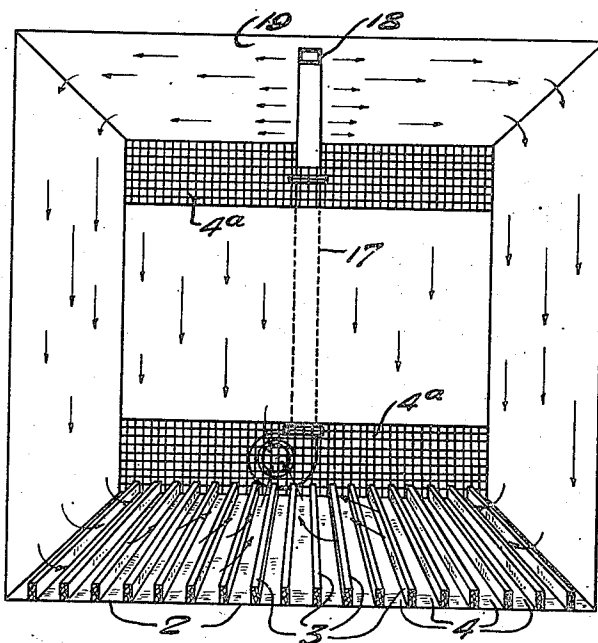


Fig. 2.



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Fig. 3.

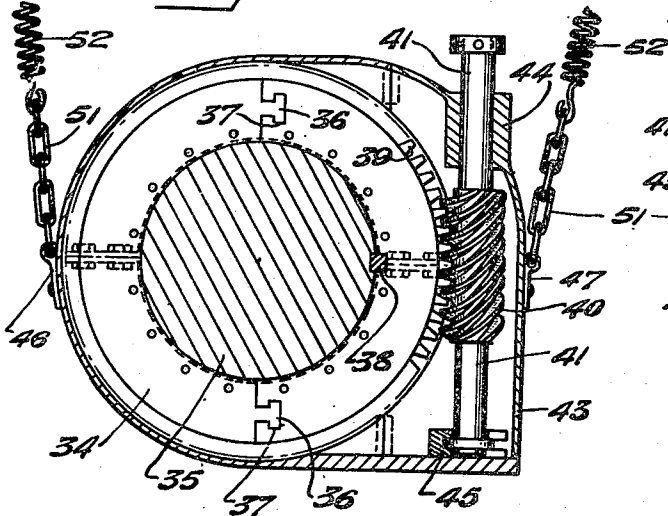


Fig. 4

Fig. 5.

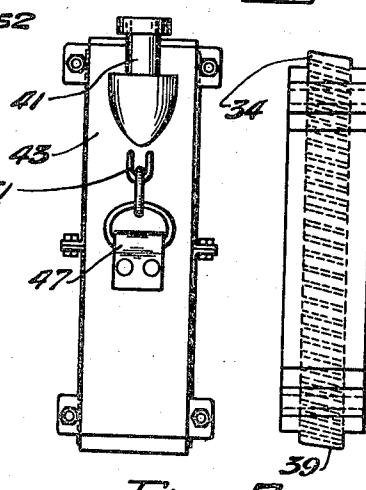


Fig. 6.

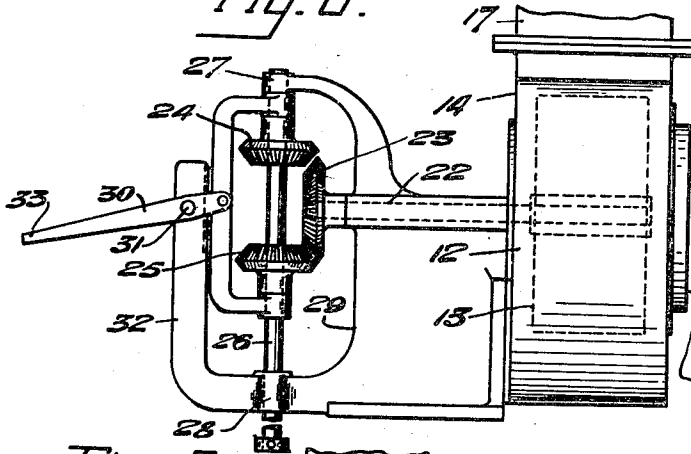


Fig. 7.

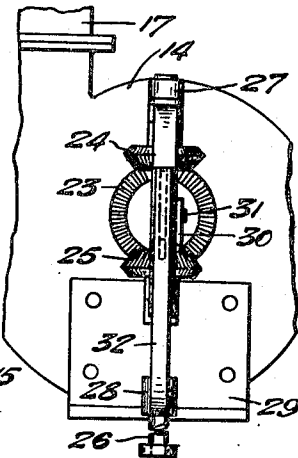


Fig. 8.

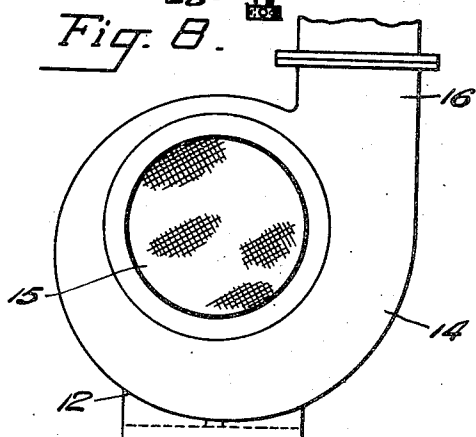
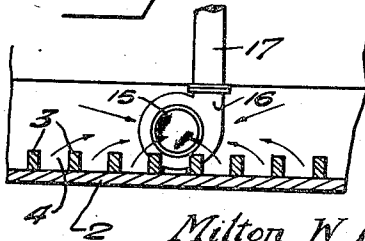


Fig. 9.



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UNITED STATES PATENT OFFICE.

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FORCED-AIR CIRCULATION AND REFRIGERATION IN REFRIGERATOR CARS.

Application filed October 13, 1925. Serial No. 62,300.

The present invention relates to improvements in forced air circulation and refrigeration in refrigerators, especially refrigerator cars, and more particularly to means for producing and maintaining air circulation and refrigeration in refrigerators or refrigerator cars whereby fresh meats, fruits, vegetables and other perishable foods will be successfully preserved while under refrigeration or while being transported from the producer to the ultimate consumer.

The invention provides novel and improved means for producing and maintaining forced air circulation in the refrigerator whereby excessive moisture and impure air are removed from the food products under refrigeration and the proper temperature is maintained uniformly, or substantially so, throughout all parts of the refrigeration chamber, the humidity being so controlled that the accumulation of excess moisture about the products undergoing refrigeration is avoided to the end that highly perishable foods may be stored for long periods or shipped successfully for great distances in reasonably prime condition while their flavor, weight and other natural qualities will be preserved substantially without change or loss and they will be free from mold or decay. A method and apparatus of this general class are set forth in Letters Patent No. 1,515,546, granted to me on November 11, 1924, and the present invention provides means for advantageously applying such method and apparatus to refrigerator cars whereby no structural changes in the general construction of such cars is required, the apparatus being driven automatically by power derived from the movement of the car and adapted to the refrigerating of ice bunkers commonly used in the ends of refrigerating cars and which can be refilled or replenished daily or at regular intervals at icing stations in accordance with the practice heretofore followed with respect to ordinary refrigerator cars.

To these and other ends, the invention consists in certain improvements and combinations and arrangements of parts, all as will be hereinafter more fully described, the features of novelty being pointed out particularly in the claims at the end of the specification.

In the accompanying drawings:

Figure 1 represents a vertical section taken longitudinally through a refrigerator

car, the same being shown equipped with forced air circulation and refrigeration apparatus in accordance with the present invention;

Figure 2 is a diagrammatic view, looking toward one end of the car, showing the apparatus embodying the present invention applied thereto;

Figure 3 is a detail view on an enlarged scale and in section, illustrating driving means provided by the present invention for operating the apparatus by power derived from one of the car axles;

Figure 4 is an exterior elevation of the driving means shown in Figure 3, as viewed from the right thereof;

Figure 5 is a detail view of the main driving gear of the driving means, the same being adapted to be mounted on one of the car axles;

Figure 6 is a side elevation of the fan for forcing the air circulation in the car and reversible means for driving it in a forward direction irrespective of the direction of travel of the car;

Figure 7 is an end elevation of the fan and its driving means as viewed from the left in Figure 6;

Figure 8 is a detail view of the fan on an enlarged scale showing the air inlet thereof; and

Figure 9 is a fragmentary cross-section taken vertically through the floor of the car and the bottom of one of the bunkers, illustrating the mounting of the fan and the manner in which it takes in air from at or near the floor level.

Similar parts are designated by the same reference characters in the several views.

The present invention is applicable to refrigerators of various kinds, and particularly to refrigerator cars such as those now in use by refrigerator car lines and transportation systems for the transportation of perishable food products under refrigeration, but it is especially applicable to the storing or shipping of fresh meats, fruits and vegetables of various kinds which require the presence of the proper volume of cold air, the proper relative humidity and the correct, even, unvarying temperature in all parts of the refrigerating chamber for their preservation while under refrigeration and in transit.

Heretofore gravity alone has been fully depended upon for the movement of air with-

in a refrigerator car, and it has been found that in depending wholly upon such air circulation, excessive moisture and dampness accumulate within the car, and upon the products, especially upon fresh meats, fresh fruits and vegetables. Owing to the highly perishable nature of such products, this accumulation of excessive moisture and dampness thereon results in their early deterioration, and, moreover, it causes such products to become moldy while in transit under refrigeration owing to the fact that such products are not supplied with the necessary amount of air. Furthermore, the temperature in the upper levels of the ordinary refrigerator car varies greatly from the temperature at or near the floor level, especially near the bunker ends of the car, there being relatively warm air in the center and upper portions of the car, while the temperature at or near the floor levels and the bunkers will frequently be much below the correct temperature which insures the successful shipping and transportation of these products. In consequence, it has been possible to ship perishable food products such as fresh meats, fruits and vegetables for only a relatively short distance in refrigerator cars as heretofore used and which depended wholly upon gravity for air circulation therein, if the products are to arrive at their destination in the proper and marketable condition. Through the use of such equipment without air circulation and efficient refrigeration, considerable losses have occurred not only in the weights, flavor and other natural qualities of these products, but also through rot and decay which are the natural results of insufficient air circulation and refrigeration within refrigerator cars as heretofore used.

According to the present invention, the required volume of forced air circulation is produced and maintained within a refrigerator whereby the necessary aeration for the successful carrying of meats, fruits, vegetables and other perishable food products under refrigeration or in transit, is supplied, and, at the same time, the accumulation of excessive moisture or dampness on the products is prevented, the proper humidity for the preservation of the food products is maintained, and a substantially even or uniform temperature is insured within the refrigerator or within the car throughout its journey, irrespective of the distance or the length of time the shipment is in transit. The results are that the perishable food products are subjected uniformly to the most advantageous temperature and air conditions, and, in consequence, they will withstand storage or arrive at their destination in a reasonably fresh prime condition.

Referring to the accompanying drawings which illustrate the invention as applied to

refrigerator cars, 1 designates generally a standard refrigerator car which may be built substantially like those heretofore used generally by transportation systems. In applying the present invention to such a car, it is preferable to secure to the floor 2 thereof a series of strips 3 which project upwardly from the floor and extend lengthwise or longitudinally of the car, the spaces 4 between these strips constituting channels or passageways through which air may flow and thus pass beneath and reach the under side of the food products which rest on the upper edges of the upstanding strips 3, thus enabling the air to circulate freely under and around the products. 4 and 5 represent the bunkers or refrigerant compartments in the ends of the car having openings covered by wire meshes 4^a and 5^a, which provide means for air communication between the upper and lower portions of the bunkers and the interior of the car, and these bunkers contain means for producing the required refrigeration. In the present instance the bunkers are adapted to be supplied with charges of ice 6 and 7 to which salt may be added, and suitable drain pipes 8 and 9 may be provided for discharging the waste water resulting from the melting of the ice. The bottoms 10 and 11 of the bunkers are spaced above the floor of the car, and the bottoms of the bunkers may be in the form of a rack or grid to permit passage of air there-through. The bunkers may be charged with ice daily or regularly at icing stations as in the manner usual with ordinary refrigerator cars.

A fan or air-inducing means 12, which may comprise a multi-vane fan 13 within a surrounding housing 14, is provided, it being mounted, for example, below the bottom 10 of the bunker 4 and it has an air inlet 15, which is located at or slightly above the floor level of the car, so that it will, during its operation, draw into the casing 14 air from at and near the floor level of the car. The outlet 16 of the fan housing is connected to an air conduit 17 which extends upwardly between the bunker heads of the bunker 4 so that it will be surrounded by the refrigerating influence of the ice in this bunker, and this upright conduit joins an air distributing pipe 18 which extends longitudinally of the car immediately below the ceiling 19 thereof, this air distributing pipe having series of holes or orifices 20 in its opposite sides through which refrigerated air is discharged and distributed substantially uniformly from the opposite sides of the distributing pipe and at or near the ceiling of the car. Preferably, the distributing pipe 18 is tapered to a degree that will compensate for the presence of the discharge openings or orifices 20 therein so that the air will be discharged at substantially uniform

form pressure throughout the length of the distributing pipe. The terminus of the distributing pipe is provided with an elbow or nozzle 21 which is located in the top or upper portion of the bunker 5, this elbow acting to discharge air from the distributing pipe downwardly through the ice contained in this bunker.

The fan 12 is driven while the car is in transit, by power taken from one of the axles of the car. Preferably, and as shown, the shaft 22 of the fan 13 is driven by reversible gearing which is capable of being set according to the direction of travel of the car, so that the fan will be driven in the proper direction to conform with the direction of travel of the car. The reversible driving gearing shown in the present instance comprises a bevel gear 23 which is fixed on the fan shaft and is arranged to be engaged by one or the other of a pair of bevel gears 24 and 25, these bevel gears being splined on a shaft 26 which is journaled in bearings 27 and 28 provided by a suitable bracket 29, and the bevel gears 24 and 25 being shiftable axially on the shaft 26 although connected to be driven thereby. The gears 24 and 25 are controlled in their operation with respect to the gear 23 by a yoke 29 which is shiftable by a lever 30 which is pivoted at 31 to an extension 32 forming part of the bracket 29, this lever having a handle 33 which projects to the exterior of the car. The construction is such that when the lever 30 is swung into one position, as, for example, that shown in Figure 5, the gear 25 will mesh with the gear 23 while the gear 24 will be out of engagement therewith, and, in consequence, the fan shaft 22 will be driven in a forward direction from the shaft 46 for a given direction of travel of the car. When the direction of travel of the car is to be reversed, the lever 30 is shifted into a reverse position, this operation carrying the gear 25 out of mesh with the gear 23 and bringing the gear 24 into mesh with the gear 23. With the driving gear adjusted in this way, travel of the car in a reverse direction will drive the fan shaft 22 in a forward direction, as before, as the driving of the gear 23 by the gear 24 instead of by the gear 25 compensates for the reverse direction of rotation of the shaft 26.

The shaft 26 which drives the fan or air-inducing means receives its motion from one of the axles of the car, and the present invention provides novel and improved means for accomplishing this result. According to the present invention, a main driving gear 34 is fixed on one of the car axles 35. As the car axles are usually fixed at its ends in the car wheels, the gear 34 is preferably made in halves or segments which are split diametrically so that they can be applied individually at opposite sides of the axle and

they are united on the axle by suitable means, such as by forming T-shaped ribs 36 on one gear section to engage in correspondingly-shaped slots 37 formed in the meeting faces of the other gear section. A key 38 may also be applied between the axle and gear to fix the gear securely and non-rotatably on the axle. The periphery of the gear 34 is preferably formed with worm wheel teeth 39 which mesh constantly with a worm 40 formed on or fixed to a shaft 41, this shaft being operatively connected to the shaft 26. Preferably, a flexible shaft 42 is employed to connect the shafts 41 and 26 as such a shaft will maintain driving relationship between the shafts 41 and 26, notwithstanding the vertical and other relative movements which take place between the axle and the car body. The gears 34 and 40 are preferably mounted in a housing 43 which may be split or formed in sections, as shown, to enable it to be applied to the axle and the gears, this housing serving to enclose and protect the gears from dust and moisture and providing a receptacle for a bath of a lubricant in which the worm and worm wheel may operate. The shaft 41 is journaled at its ends in suitable bearings 44 and 45 formed as a part of the housing 43.

The driving torque of the gear 34 tends to rotate the housing 43 around the car axle as a center and, hence, means must be provided for holding the housing 43 from rotation, so that the gear 40 will be driven from the gear 34. The present invention provides means which sustains the torque applied to the housing 43 and which compensates for vertical or other relative movements which take place between the axle and the car body. The means provided for this purpose also affords sufficient yield in the drive of the fan to relieve the driving means of the effects of shocks produced by sudden displacements or changes in speed of the axle. Such means, in the present instance, comprises a pair of flexible members which are attached to the opposite sides of the housing 43, as at 46 and 47, and are attached at their upper ends to the car body, as at 48 and 49. Each of these members is flexible and longitudinally elastic, each member preferably comprising a link 50 which is attached at its upper end to the car body, a chain 51 which is attached at its lower end to the housing 43 and an interposed coil spring 52 which connects and exerts tension on the link 50 and chain 51. These members are suitably tensioned by the springs 52 to normally hold the housing 43 in such a position that the worm shaft 41 will be upright or vertical, or substantially so, and each spring 52 will sustain the torque or turning effort applied to the housing 43. Vertical lateral or other relative displacements of the axle with respect to the car body will be compensated for by yield of

these springs, and the fan will be protected from shock due to sudden starting or stopping of the car axle or sudden changes in its speed by the consequent yield which will take place in one or the other of these springs.

The mode of operation is substantially as follows: The bunkers are supplied with ice in the usual way, or at an icing station, and salt is generally added to rapidly melt the ice, and thus produce the required amount of refrigeration, the cars being re-iced and re-salted each day while en route. It will be understood that the handle 33 is set to drive the fan in a forward direction according to the direction in which the car is to travel. The melting of the ice in the bunkers brings about a temperature of 32° F., which approximates the melting point of ice, and the resulting refrigerated air in the bunker 5 flows downwardly through the bottom thereof to or near the floor level of the car. As the fan 12 is in operation while the car is in motion, it draws into its inlet 15 air from at or near the floor level of the car, and this air, which is relatively cooler than that contained in the upper or central portion of the car, is forced upwardly through the conduit 17, and during its passage therethrough it is further cooled or refrigerated by the ice contained in the bunker 4. The refrigerated air from the conduit 17 is then forced into the distributing pipe 18 and is discharged in a plurality of lateral jets at opposite sides thereof and near the ceiling of the car while the remainder of the air from the distributing pipe is discharged downwardly through the ice contained in the bunker 5. The air flowing along the floor of the car toward the fan produces a circulation of air under and around the food products resting on the strips 3, thus avoiding accumulation of excess moisture on or around the products but supplying them with fresh air. The refrigerated air discharged near the ceiling of the car by the discharge pipe 18, being heavy, descends by gravity to the food products in transit, taking up heat therefrom, and this air is again circulated by the fan through the conduit 17 and re-discharged from the pipe 18. As the refrigerated air is discharged from the pipe 18 throughout the length of the car between the ice bunkers, the maintenance of an even temperature of the air throughout the length of the car is insured. The air which is discharged from the elbow 21 onto the ice 7 in the bunker 5 effects removal of excess moisture, odors and gases from the car, as they will be condensed on or absorbed by the melting ice, and will be discharged from the car through the drain pipe 9 through which the waste water discharges. According to the present invention, air is caused to circulate under and around the products in storage or in transit, thus pre-

venting the accumulation of excess moisture which would cause mold and decay and producing a constant supply of fresh air for the products to effect aeration thereof. By passing the air rapidly over the surface of the ice, sufficient moisture is picked up to produce a sufficiently high humidity to reduce the shrinkage of the products, so that they may be stored for long periods or they will reach their destination in fresh and reasonably prime condition, with only a normal amount of shrinkage.

The odors and gases removed from the products by the air circulation are, in turn, removed from the circulating air by the blowing of this air over the melting ice whereon it is absorbed by the melted ice water, and are discharged from the refrigerator or car with the melted ice water waste. The circulating air within the refrigerator or car is thereby clarified and maintained in such condition without requiring the admission of any outside air thereto. The temperature within the refrigerator or car, therefore, will not be affected materially by changes in temperature exteriorly thereof.

I claim as my invention:

1. Means for producing forced air circulation and refrigeration in refrigerator cars having therein a food storage compartment and a refrigerant compartment, the lower portions of which communicate, one with the other, comprising a fan operative to remove air from at or near the floor level and force such air to the upper portion of the car, and means connected to receive such air and operative to discharge such air into the upper portions of the food storage and refrigerant compartments.

2. Means for producing forced air circulation and refrigeration in refrigerator cars having ice bunkers therein comprising a fan operative to take in air from at or near the floor level of the car, a distributing pipe connected to receive such air and having orifices for the discharge thereof into the space in the car near the ceiling thereof and also operative to discharge air therefrom into one of the ice bunkers and into contact with ice therein.

3. The combination with a refrigerator car having ice bunkers in the ends thereof and a storage space between the bunkers, of a suction fan located at or near the floor level of the car to take in air therefrom, a distributing pipe located in the upper portion of the storage space and having a series of longitudinally spaced discharge orifices in its opposite sides, said pipe also discharging into the top of one of the ice bunkers and a conduit extending through one of the ice bunkers and connecting the distributing pipe to the outlet of the fan.

4. The combination with a refrigerator car having ice bunkers in the ends thereof

and a storage space between them, of a fan having an inlet located near the floor level for drawing air therefrom, a conduit leading upwardly through one of the ice bunkers from the outlet of the fan, and a distributing pipe located in the upper portion of the storage space near the ceiling thereof and having orifices spaced longitudinally thereof for discharging air laterally near the ceiling, said discharge pipe also having means for discharging air therefrom into contact with ice in the other of said ice bunkers.

5. Means for producing forced air circulation and refrigeration in a refrigerator having a food storage compartment and a refrigerant compartment, the refrigerant compartment being in communication with the food storage compartment, comprising a fan operative to remove air from at or near the bottom of the food storage compartment, and a pipe connected to receive such air from the fan and operative to conduct such air to and discharge it into the upper portion of the refrigerant compartment.

6. Means for producing forced air circulation and refrigeration in a refrigerator

having a food storage compartment and a refrigerant compartment, one compartment being in communication with the other, comprising a fan operative to remove air from at or near the bottom of the food storage compartment, and a pipe connected to receive the air thus removed by the fan and extending to and having outlets in the upper portions of the food storage and refrigerant compartments for the discharge of said air.

7. Means for producing forced air circulation and refrigeration in a refrigerator having a food storage compartment and an ice compartment, one compartment being in communication with the other, comprising a fan operative to remove air from at or near the bottom of the food storage compartment, and a pipe connected to receive the air thus removed by the fan and extending into the ice compartment and having an air discharge outlet therein located in the upper portion of the ice compartment to direct air into contact with the ice therein.

In testimony whereof I have hereunto set my hand.

MILTON W. BROWNE.