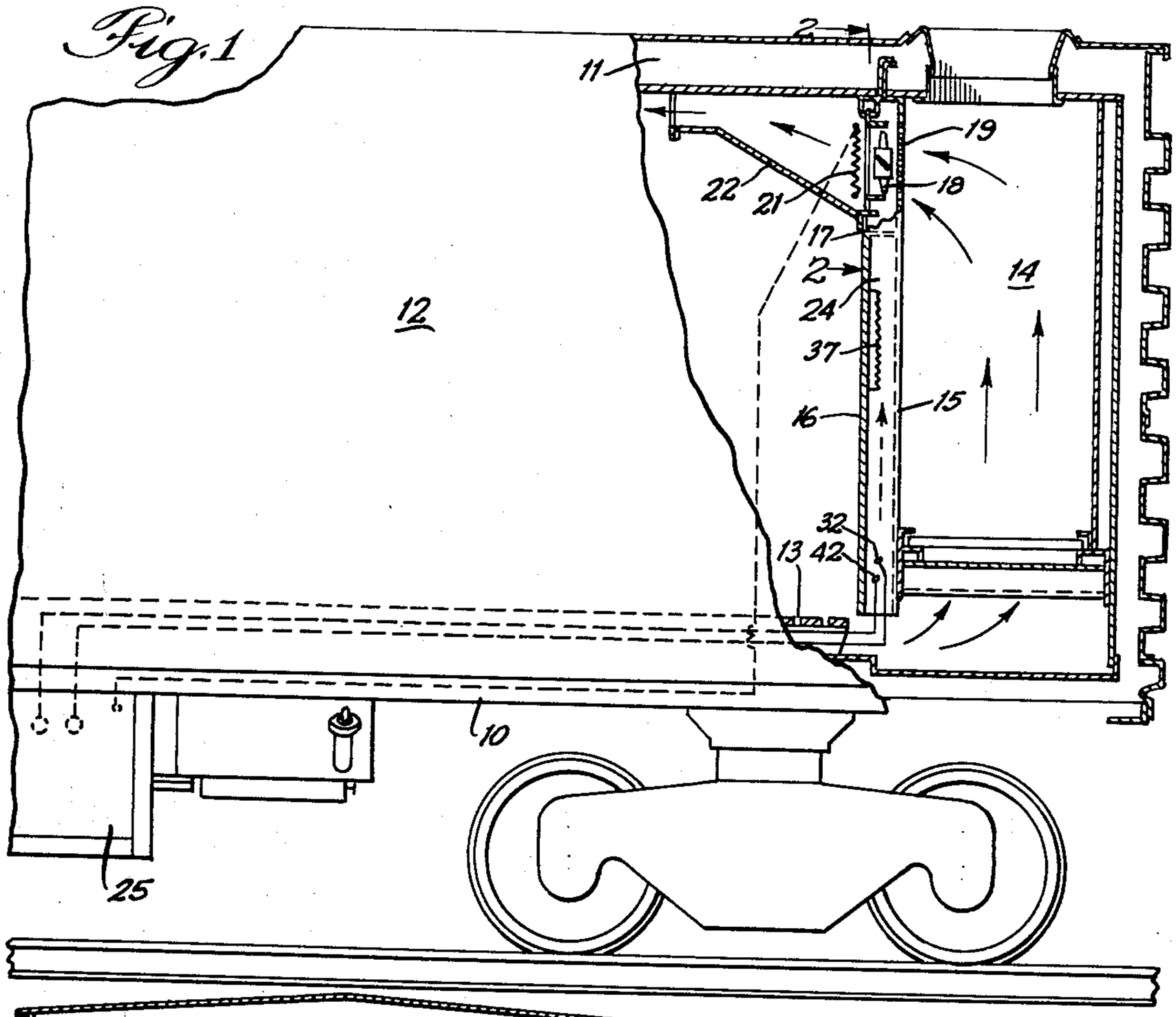
April 27, 1965 H. D. BREEN 3,180,403

RAILWAY REFRIGERATOR CAR

Filed Oct. 31, 1960

Fig. 1



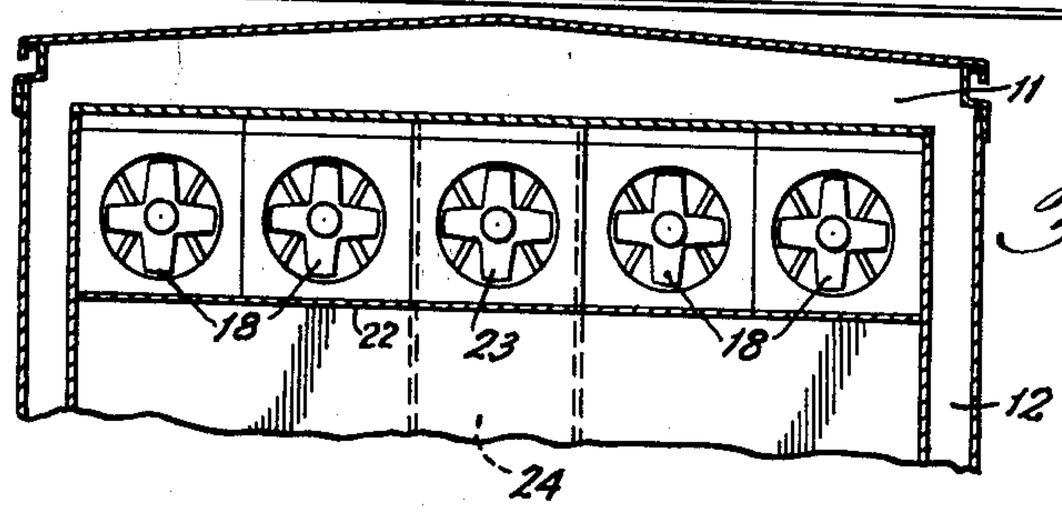


Fig. 2

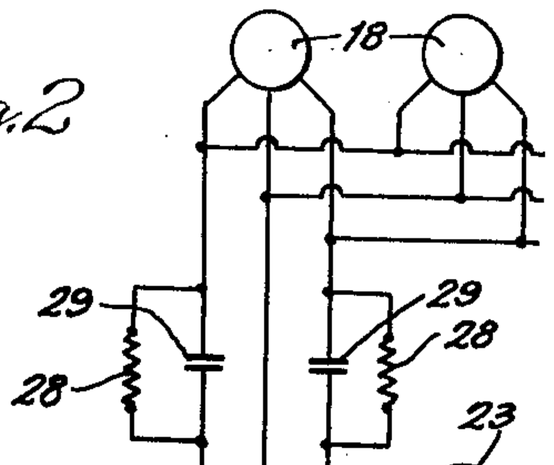
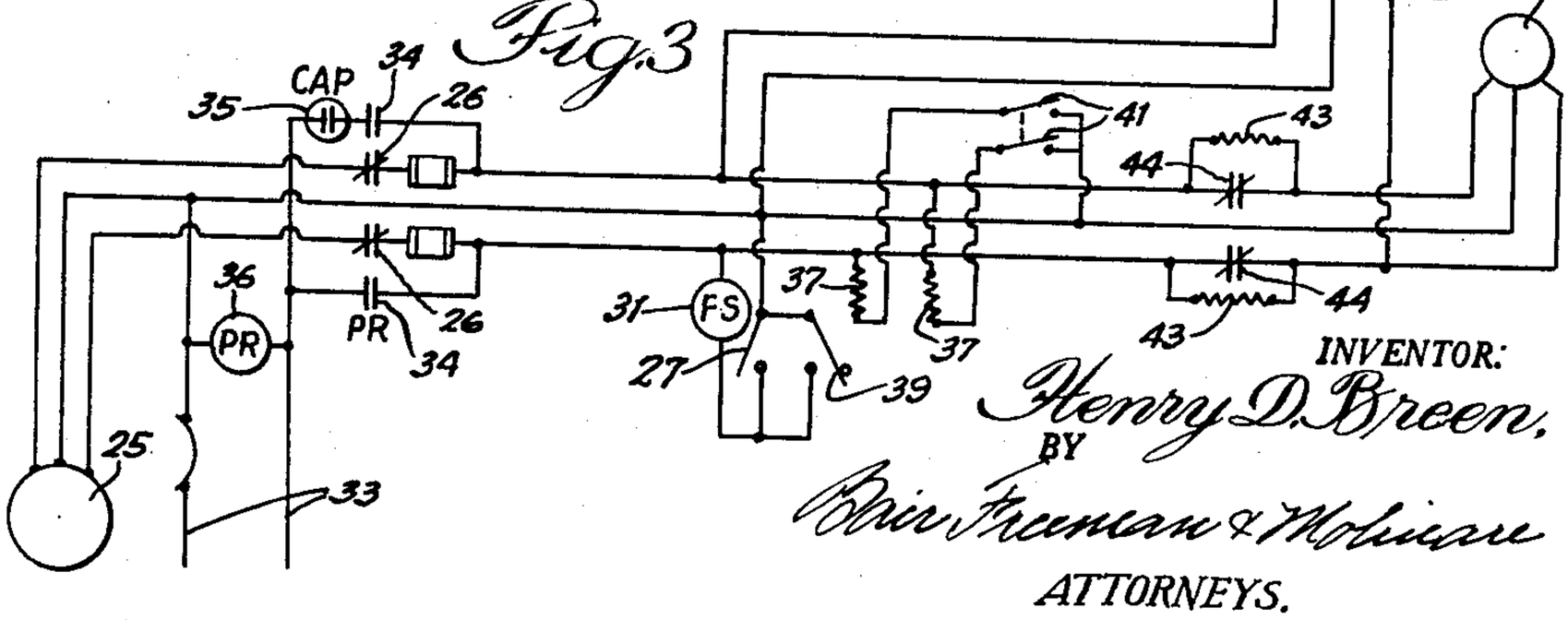


Fig. 3



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RAILWAY REFRIGERATOR CAR

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This invention relates to railway refrigerator cars and more particularly to means for regulating the temperature and circulation of air in a conventional ice bunker car.

In shipping many types of perishable commodities in ice bunker cars it becomes a serious problem to prevent overcooling while still maintaining adequate cooling when required. For example, in shipping various types of fresh fruits and vegetables east from the west coast, maximum cooling is required at the beginning of the trip and possibly toward the latter part thereof, but relatively low temperatures may be encountered through the mountain areas, requiring little if any cooling.

In conventional ice bunker cars without forced circulation the lading in the lower part of the car may be overcooled and damaged even while the lading in the upper part of the car is inadequately cooled. To overcome this problem, forced air circulating fans have commonly been provided in the cars operating counter to the normal gravity circulation to maintain even temperatures throughout the cars. Even with such fans overcooling may occur and it becomes highly desirable to shut off or minimize circulation of air through the bunker compartment of the car to minimize cooling while still maintaining circulation of air through the lading compartment to prevent stratification.

It is one of the objects of the present invention to provide a railway refrigerator car in which circulation of air through the bunker compartment is minimized or shut off when the temperature in the lading compartment reaches a predetermined minimum value while still maintaining sufficient circulation through the lading to prevent stratification.

Another object is to provide a railway refrigerator car in which control of the air circulation is effected by controlling the speed of certain of the fans with no moving valves or dampers, or similar parts.

According to a feature of the invention, one or more fans which circulate air through the bunker compartment are variably speed controlled to go from maximum speed for maximum cooling to a minimum speed at which they create a head just sufficient to balance the gravity head on the air in the bunker compartment thereby to stop or minimize circulation of air through the bunker. At the same time, one or more additional fans are provided to maintain air circulation through the lading compartment and through a bypass around the bunker compartment which is preferably formed by a duct in the bulkhead.

The above and other objects and features of the invention will be more readily apparent from the following description when read in connection with the accompanying drawing, in which:

FIGURE 1 is a side elevation of a railway refrigerator car embodying the invention with parts in section;

FIGURE 2 is a partial section on the line 2—2 of FIGURE 1; and

FIGURE 3 is a wiring diagram of the controls.

The invention is shown as applied to a conventional

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ice bunker refrigerated car defined by a floor **10**, a roof structure **11** and side walls **12**. The car carries the usual lading rack **13** in its lading compartment which is normally formed of spaced slats and which is supported above the floor of the car to carry the lading. By this means, air may circulate through the lading and through the rack and in the space beneath the rack to maintain adequate air circulation in the lading compartment of the car.

The lading compartment is separated from an ice bunker compartment, indicated generally at **14**, at one or both ends of the car by one or more bulkheads **15**. Each bulkhead is a hollow structure having a facing **16** to engage the lading in the car and a bunker wall spaced from the facing. As shown, each bulkhead terminates at its lower end at approximately the level of the lading rack **13** to leave an air circulating space between its lower edge and the floor of the car and terminates at its upper edge, as indicated at **17**, at a level spaced well beneath the roof of the car.

In order to circulate air through the bunker and lading compartments a plurality of fans are provided, as shown in FIGURE 2. As illustrated, there are five fans although a greater or lesser number could be employed according to the requirements of the car. The four outer fans, designated **18**, are mounted between the top of the bulkhead and the roof of the car and open at their back ends through screens **19** into the upper part of the bunker compartment. The forward faces of the fans open through a screen **21** into a shroud **22** which opens near the roof of the car to discharge air into the car. When these fans are operating at their normal cooling speed, they will draw air downward through the lading beneath the floor rack up through the bunker compartment and through the shroud **22** back into the upper part of the lading compartment to circulate downward through the lading.

The center fan **23** is similar to the fans **18** but communicates at its inlet end with the upper end of a duct **24** formed in the bulkhead and extending vertically therethrough. The back wall of the duct extends completely to the ceiling of the car so that the fan **23** receives air only from the duct and not from the bunker compartment and discharges the air through the shroud **22** or a division thereof into the lading compartment of the car. Operation of the fan 23 causes a circulation of air downwardly through the lading beneath the lading rack **13**, upwardly through the duct **24** and back into the upper part of the lading compartment thereby completely bypassing the bunker compartment.

The fans, as shown, are electrically driven by power supplied from a power generator, indicated generally at **25**, which is preferably mounted beneath the car. The fans **18** are variably speed controlled in response to the temperature in the lading compartment of the car to change from maximum speed at which they will produce maximum air circulation through the lading and bunker compartments to a minimum speed which is just sufficient to balance the gravity head and the head produced by fan **23** on the air so that circulation through the bunker compartment will be stopped or minimized.

The control circuit for effecting this control is illustrated diagrammatically in FIGURE 3 with two-phase current being supplied by the generator unit **25** through normally closed relay switches **26** to the center fan **23** and to the fans **18**. The circuits to the fans **18** include

dropping resistors 28 shunted by thermostatic relay switches 29 which are closed when a thermostatic relay 31 in circuit with a thermostatic switch 27 is energized. A manual switch 39 may shunt the switch 27 to cause high speed operation of the fans 18 when desired as for ventilating. The circuit to the fan 23 includes dropping resistors 43 shunted by relay switches 44 which are opened when the relay 31 is energized. With the circuit in this condition, the center fan will be energized to run at full speed when switches 44 are closed and at part speed just sufficient to prevent back flow through the bypass duct when the switches 44 are open. Fans 18 will run at full speed when the switches 29 are closed and at part speed determined by the values of the resistors 28 when the switches are open. When the thermostat switch 27 is open, indicating a desired temperature condition in the car, the relay 31 will be de-energized to open the switches 29 and close switches 44. At this time, the fans 18 will run at minimum speed sufficient just to balance the gravity circulation through the bunker and reverse pressure due to fan 23 so that cooling will be minimized but the fan 23 will operate at maximum speed to circulate air through the lading compartment to prevent stratification. The temperature in the lading compartment is measured by any suitable type of thermostat which may conveniently be mounted in the bypass duct 24, as shown at 32. When the thermostat senses a temperature higher than the desired lading temperature, the switch 27 will close to energize the relay 31 and close the switches 29 and open switches 43. At this time, the fans 18 will operate at maximum speed to circulate the maximum quantity of air through the lading compartment and the bunker thereby to effect maximum cooling and fan 23 will operate at minimum speed just sufficient to prevent reverse flow through the duct.

In order that the fans may be operated from a conventional 110 volt, 60 cycle single phase supply through a plug-in connection when the car is running, power lines 33 are provided terminating in a conventional plug. One of the lines 33 is connected to the neutral line of the two-phase system and the other is connected through relay switches 34 to the outer lines of the two-phase system, a phase shift capacitor 35 being provided in one of the outer line connections. A relay 36 for operating the switches 26 and 34 is connected between the lines 33 to be energized when the plug-in connection is made. When the plug-in connection is made, the relay 36 will open the switches 26 and close the switches 34 so that the fans 18 and 23 can operate from the plug-in power source rather than from the generator 25.

It may be desirable under many conditions to supply heat to the lading to prevent excess cooling thereof when the car is operating under extremely low outside temperature conditions. For this purpose, electric heating elements 37 may be provided in the duct 24 so that all of the air circulating through the car will circulate over one or more heating elements to be warmed thereby when the heating elements are energized. The heating elements 37, as shown, are connected in circuits from the outer lines of the two-phase system and through thermostatic switches 41 back to the common line of the system. The switches 41 may be controlled by a heating thermostat 42 mounted adjacent to the cooling thermostat 32.

The thermostat 42 is set to operate several degrees below the thermostat 32 so that there will be no overlapping of the heating and cooling cycles. If the temperature in the car falls below the desired value for which thermostat 42 is set, the thermostatic switch 41 will close to energize the heating elements 37 so that the air will be heated as it is circulated through the duct. The thermostat 42 and thermostatic switch 41 will energize and de-energize the heating element, as required, to prevent the temperature in the car from falling to an excessively low value.

It is contemplated that the fans may run in a direction to circulate air downwardly through the bunker compartment and upwardly through the lading compartment in the same direction as gravity circulation tends to produce. In this case, the fans 18 may be stopped when the temperature reaches the desired low value with the positive pressure produced by the bypass fan 23 at the bottom of the bunker compartment and the negative pressure at the top of the bunker compartment serving to balance the gravity head in the bunker compartment and stop the flow of air therethrough.

While one embodiment of the invention has been shown and described herein, it will be understood that it is illustrative only and not to be taken as a definition of the scope of the invention, reference being had for this purpose to the appended claims.

What is claimed is:

1. A railway refrigerator car comprising a car body, a vertical bulkhead in the car body spaced from but adjacent to one end of the car body separating it into a relatively large lading space and a bunker space at one end of the car adapted to contain a cooling medium, the bulkhead being permanently open at its top and bottom for flow of air therearound, a first air circulating device to circulate air in a closed circuit over the top of the bulkhead, down through the lading space, beneath the bottom of the bulkhead, and up through the bunker space in contact with the cooling medium therein, means defining a permanently open bypass from the top to the bottom of the bulkhead in open communication with the lading space but bypassing the bunker space, a second air circulating device to circulate air in a closed circuit from the upper end of the bypass down through the lading space to the lower end of the bypass and up through the bypass, means to drive the second air circulating device continuously, drive means to drive the first air circulating device at a high speed for maximum cooling or at a low speed just sufficient to prevent circulation through the bunker space due to the effects of gravity and the second air circulating device, and thermostatic means responsive to the temperature in the lading space to control the last named means.

2. The railway refrigerator car of claim 1 including heating means in the last named closed circuit, and thermostatic means responsive to the temperature in the lading space to control the heating means.

3. A railway refrigerator car comprising a car body, a vertical bulkhead in the car body spaced from but adjacent to one end of the car body separating it into a relatively large lading space and a bunker space at one end of the car adapted to contain a cooling medium, the bulkhead being permanently open at its top and bottom for flow of air therearound, a first air circulating device to circulate air in a closed circuit over the top of the bulkhead, down through the lading space, beneath the bottom of the bulkhead, and up through the bunker space in contact with the cooling medium therein, means defining a permanently open bypass from the top to the bottom of the bulkhead in open communication with the lading space but bypassing the bunker space, a second air circulating device to circulate air in a closed circuit from the upper end of the bypass down through the lading space to the lower end of the bypass and up through the bypass, means to drive the second air circulating device continuously, drive means to drive the first air circulating device at a high speed for maximum cooling or at a low speed just sufficient to prevent circulation through the bunker space due to the effects of gravity and the second air circulating device, second drive means to drive the second air circulating device at high speed or at a low speed just sufficient to prevent air circulation through the bypass due to the effect of the first named air circulating means, and thermostatic means responsive to the temperature in the lading space to cause the first drive means to operate at high speed and the second

drive means to operate at low speed when the temperature is above a predetermined value and to cause the first drive means to operate at low speed and the second drive means to operate at high speed when the temperature is below said value.

4. The railway refrigerator car of claim 3 including heating means in the bypass, and a thermostat responsive to the temperature in the lading space to energize the heating means when the temperature is below a lower predetermined value.

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