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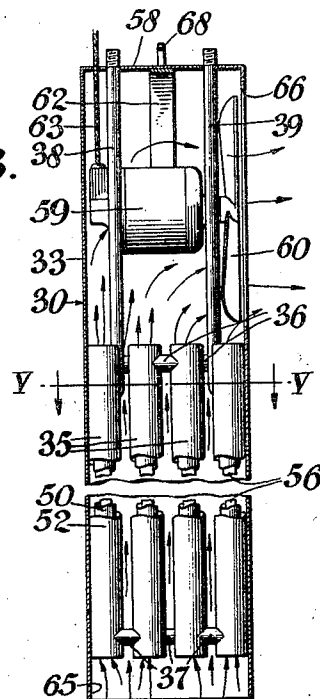
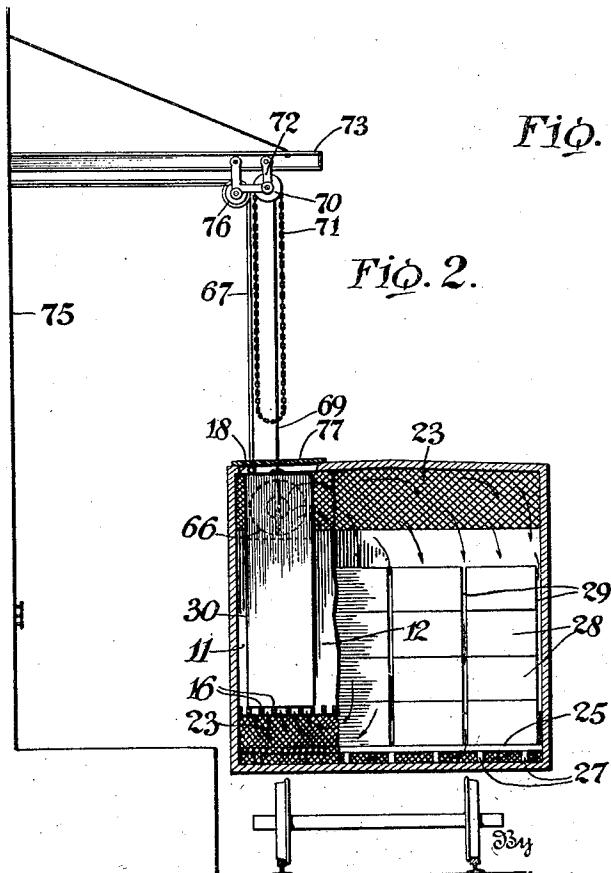
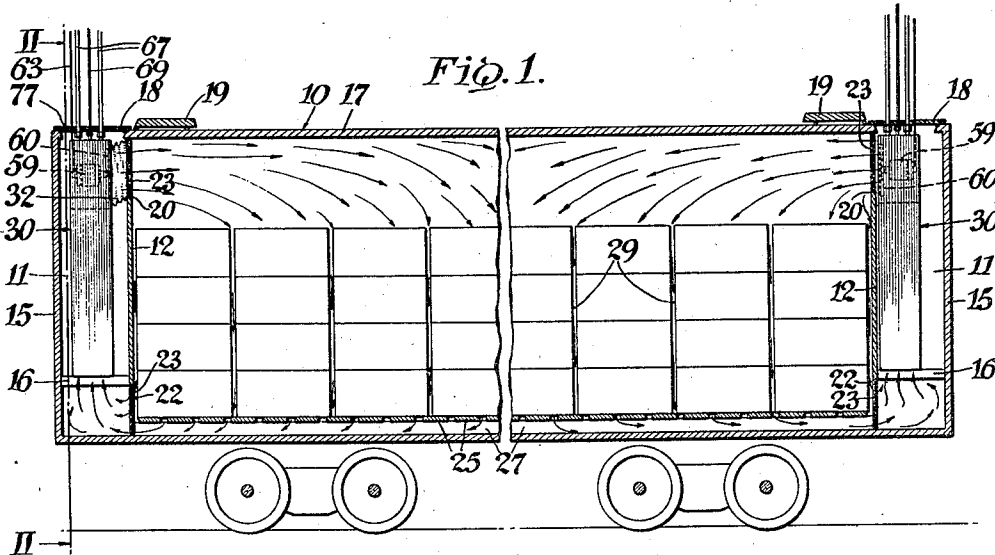
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2,223,581

METHOD OF AND APPARATUS FOR CONTROLLING TEMPERATURE

Filed June 20, 1933

2 Sheets-Sheet 1



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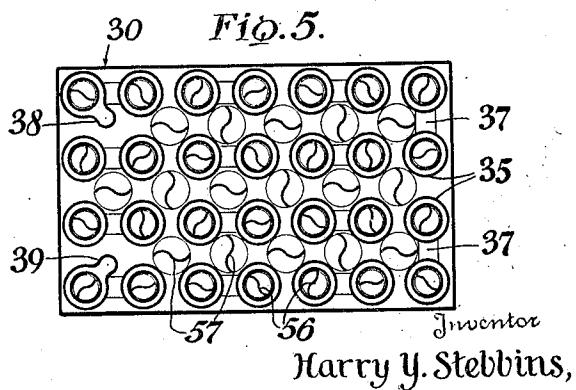
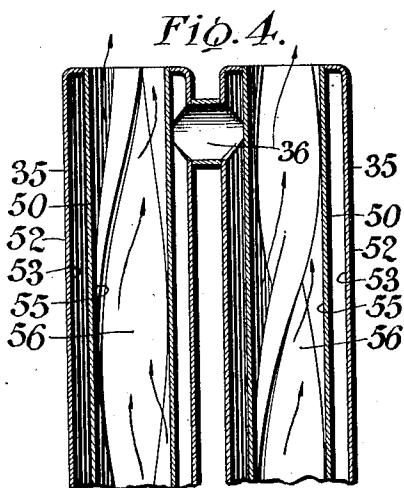
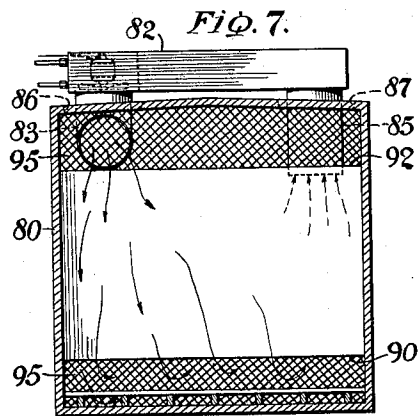
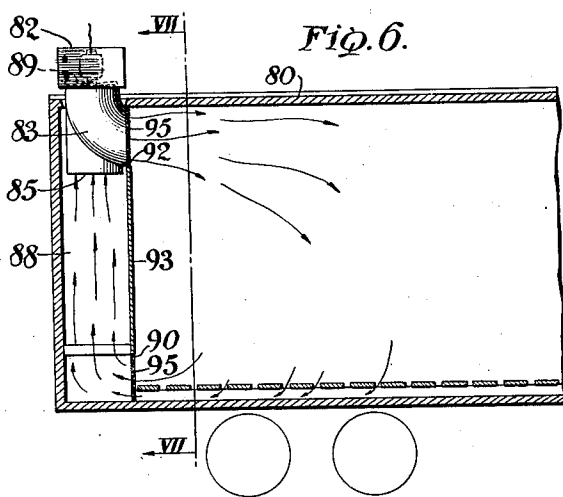
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METHOD OF AND APPARATUS FOR CONTROLLING TEMPERATURE

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,223,581

METHOD OF AND APPARATUS FOR CONTROLLING TEMPERATURES

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4 Claims. (Cl. 62—117)

This invention relates to temperature controlling apparatus, and it has particular relation to the refrigeration of loaded or unloaded commercial transportation vehicles, together with devices and methods employed in rendering the vehicle properly refrigerated.

One object of the invention is to provide a system of refrigerating transportation vehicles without the use of ice and in which a single unit can be employed to refrigerate numerous vehicles.

Another object of the invention is to provide a method of refrigerating vehicles, whereby extremely low temperatures are attainable without using ice and whereby various vehicles can be refrigerated successively by using the same apparatus.

Another object of the invention is to provide a heat exchange unit particularly adapted for refrigerating transportation vehicles and also adapted to be employed as a unit for heating vehicles or the like.

Another object of the invention is to provide an arrangement whereby a conventional insulated refrigeration car can be used in conjunction with a special type of portable heat transfer unit, together with devices for handling the unit, to provide proper refrigeration inside the car and then using the same unit for treating other refrigeration cars.

Heretofore, in refrigerating transportation vehicles, particularly railway cars, it has been customary to provide bunkers at each end of the vehicle and to fill these bunkers with ice. In certain instances devices have been employed for circulating air from the interior of the cars through iced bunkers and back through the cars. Conduits or separate ducts were employed to circulate the cooled atmosphere. It was, of course, necessary to provide each refrigerating bunker with a supply of ice, and consequently large amounts of ice were necessary to reduce one car, or a series of cars, to the proper temperature.

By employing this type of refrigeration, it was possible to reduce the temperature of the cars a very limited degree because the ice temperature could not be reached throughout the car. Approximately 34 degrees Fahrenheit could be attained with ordinary ice and by using salt to increase the rate of melting of the ice, a lower temperature could be obtained, that is, approximately 32 degrees Fahrenheit. Inasmuch as the ice melts rapidly, whether or not salt is used, enormous amounts must be em-

ployed to refrigerate a train of cars and it is apparent that the cost of this type of refrigeration is relatively great.

According to this invention, the existing type of refrigerating railway cars, as well as other types of cars, can be refrigerated without using ice. In order to accomplish this purpose a device is used which includes a small compact heat exchange unit made up of coils which provide the maximum of heat exchange surface in a minimum of space. The heat exchange unit is temporarily inserted into the bunkers of the car. By employing this unit and including a blower or fan for circulating the gaseous fluid or air in the car through the unit and back into the car, the desired temperature is attained. Suitable refrigerant is supplied from a conventional source and circulated through the heat exchange unit. Thus the temperature of the unit can be reduced to values much lower than that of ice and such temperatures can be transmitted to the interior of the car and to its contents. This refrigerating treatment of the cars requires a very short period of time. If desired, a unit may be employed simultaneously at both ends of the car and thus expedite the rate of car refrigeration. Since a very low temperature can be attained in the cars, the refrigerating effect will remain for relatively long periods and by sealing or insulating the cars the desired temperature is further retained during long runs. However, if it is desired to refrigerate the cars en route, this can be done by providing units at intermediate stations. These units are relatively inexpensive and hence, in addition to great advantages of time saving, labor saving, and simplicity of practice, the invention costs less for a number of cars than the less efficient practice of using ice for one car, and furthermore, the same units can be used almost indefinitely. Moreover, the type of conduits or ducts previously used for communication from one of the conventional ice filled bunkers to the other is obviated by the arrangement provided in this invention.

The invention is also applicable to highway vehicles, which are often employed in carrying goods which must be refrigerated.

In addition to advantages of the invention as applied to refrigeration, the heat exchange unit is adapted to be employed as a radiator for heating vehicles.

In the drawings:

Fig. 1 is a diagrammatic fragmentary vertical section of a vehicle having the invention incorporated therein;

Fig. 2 is a cross section taken substantially along the line II—II of Fig. 1, and in addition illustrating diagrammatically a hoisting apparatus for lifting or handling a heat transfer unit;

Fig. 3 is a vertical section, on a larger scale, of a heat transfer unit employed in the invention;

Fig. 4 is a vertical section, on a larger scale, showing in detail elements of the heat transfer unit;

Fig. 5 is a diagrammatic cross-section of a heat transfer unit, taken substantially along the line V—V of Fig. 3;

Fig. 6 is a fragmentary vertical section similar to Fig. 1 illustrating another form of the invention;

Fig. 7 is a fragmentary cross-section taken substantially along the line VII—VII of Fig. 6.

Referring to Figs. 1 and 2, a vehicle 10 is shown which can be in the form of a railway refrigerator car, or other means of transportation, and is provided with so-called bunkers 11 at opposite ends defined by partition walls 12, vehicle end walls 15, and a bottom support 16. At its upper portion or top 17, the vehicle is formed with openings 18 which are normally closed by means of suitable doors 19. The bottom wall 16 is in the form of spaced members (Fig. 2) to provide for free passage of air therethrough.

Upper and lower openings 20 and 22 in the wall 12 are provided with grating 23 for insuring free passage of air, and the lower portion of the vehicle is provided with duck boards 25 spaced slightly from the bottom of the floor 26 of the vehicle by means of blocks 27. Merchandise, goods or other material 28, packed in the vehicle for transportation therein is provided with ventilating spaces 29 through which air may be circulated.

A heat transfer unit 30 can be lowered through one of the openings 18 into the bunker at one end or both ends of the vehicle and air can be circulated from the interior of the vehicle through the opening 22 of one or both of the bunkers and out through the opening 20 back into the vehicle. If desirable, a conduit 32 can be provided at the upper end of the conduit 30 for directing the air through the opening 20.

As best shown in Figs. 3 to 5, the heat transfer unit, which is rectangular in cross-section, includes an outer casing 33 in which a plurality of normally vertical pipes 35 are arranged in rows to provide a compact freely ventilated structure. Upper and lower connections 36 and 37 provide for inter-communication between the various pipes and further provides for circulation of a refrigerant throughout the interior of the pipes. In the circulation of the refrigerant it is admitted into the unit through a conduit 38 and travels alternately into the upper and lower portions of each pipe until it has passed through all of the pipes, at which time it is exhausted through an outlet conduit 39.

Each pipe 35 includes an inner wall 50 (Fig. 4) arranged substantially co-axially with respect to an outer wall 52 and forming therewith a refrigerant circulating chamber 53. Thus a central open space 55 inside the interior wall 50 is formed for passage of air longitudinally of the pipe. A strip of material 56 twisted or otherwise shaped into substantially spiral form, is disposed longitudinally inside the inner tubular wall 50, and similar spiral strips 57 (Fig. 5) are disposed between the several spaced pipes 35 at the outside of the outer pipe walls 52. It is not

necessary that the strips touch the surfaces of the walls but at least should be in close proximity thereto. A stream of air passing through the unit about the outside of the chamber 53 is so directed about the spiral strips as to impart a spiral motion to the air, and to provide a wiping action of the air against both the inner walls 50 and the outer walls 52 of the pipes. In this manner the temperature of the air passing through the casing is uniformly affected without possibility of having portions of the air spaced from the pipe insulated from the chamber walls by a surface air layer.

A plate 58 covers the upper end of the casing and an electric motor 59 having a fan 60 attached thereto is mounted in the casing immediately above the upper ends of the pipe 35. Suitable bracing structure 62 connected to the casing stabilizes the motor. An electric conductor 63 connected to a suitable source of electrical energy provides for operating the motor and rotating the fan, thereby drawing air through the opening 22 into the lower portion 65 of the casing and expelling the air out through an upper opening 66 of the casing adjacent the fan.

Since the fan and motor are relatively expensive elements they can be removed from the unit 30 by disassembling the motor supports 62 from the plate 58. In this manner a single motor and fan unit is capable of accommodating a series of heat transfer units.

Suitable lengths of flexible hose 67 are connected to the outlet pipe 38 or 39 for supplying a refrigerant to the chambers 53. Since the supply of refrigerant to a heat transfer unit is well known a showing of an entire refrigerating plant is not believed to be necessary for a proper understanding of this invention. Suffice it to say that air circulated to the casing 33 about the pipes 35 can be reduced to at least 0° F., and even to lower temperatures.

Referring to Figs. 2 and 3, it will be observed that the upper plate 58 of the heat transfer unit is provided with a loop connection 68 into which a cable 69 is fastened for raising and lowering the unit into the bunker 11. A suitable block and tackle 70 mounted upon a carriage 72 is movable upon a boom 73 by grasping the chain 71 and adjusting the carriage to the desired position over the vehicle bunker. The boom 73 is mounted upon the building 75, or other suitable support, and is swingable out over the vehicle. In order to maintain the hose 67, together with the electrical conductor 63, in such position as to permit persons or small vehicles to pass freely underneath the boom, they are trained over a pulley or drum 76 rotatably supported upon the carriage 72.

In the operation of the arrangement shown the vehicle 10, described with reference to Fig. 2 in the form of a railway car, is moved to a position adjacent the boom 73. Then the block and tackle 70 is operated to lower the heat transfer unit 30 into the bunker 11 through the opening 18. After the unit has been lowered to the position shown in Fig. 2 the opening 18 is closed by means of a flexible insulating blanket 77 which can be placed in the opening 18 closely around the hose, cable, and conductor to provide a substantially sealed closure.

By circulating refrigerant through the chambers 53 of the pipes 35 and operating the fan 60, refrigerated air from the spaces surrounding the pipes and from the spaces 55, is forced through the opening 20 into the interior of the vehicle 75

and drawn back through the opening 22 into the lower end 65 of the casing. This circulation of the air is continued until the desired temperature is reached in the interior of the vehicle and in the material or load carried in the vehicle. The transfer unit 30 is then hoisted from the vehicle and another vehicle can be brought to the same position to replace the first for similar treatment. In this manner the same unit can be used repeatedly for refrigerating as many vehicles as desired.

As shown in Fig. 1, two of the units 30 can be employed simultaneously in the same vehicle by employing one in each of the end bunkers 11.

In the form of the invention shown in Figs. 6 and 7, a vehicle 80, constructed in substantially the same manner as that previously described, is provided with a heat transfer unit 82 also constructed substantially like the unit 30. However, the unit 82 is provided with an air outlet conduit 83 and an air inlet conduit 85 that are disposed in openings 86 and 87 respectively, leading into the bunker 88 from the top of the vehicle. The transfer unit is supported upon the top of the vehicle.

Air is drawn by a fan 89 into the inlet conduit 85 through an opening 90 from the lower portion of the vehicle and the same air is forced by the fan through an opening 92 in the upper portion of the bunker wall 93. These openings 90 and 92 are provided with grating 95. Air is circulated about the interior of the vehicle and through the heat transfer unit in the same manner as that described with reference to the showing of Fig. 1 to reduce the vehicle interior and its contents to the desired temperature.

It is to be understood that the ends of the cable 69 and hose 67 can be detached from the top of the unit 30, and that the latter can remain inside the vehicle 10 as a permanent installation, or used until it is worn out, or until the vehicle is worn out, at which time proper replacements can be made.

From the foregoing description it will be apparent that the invention is adapted to be applied to various types of vehicles in which refrigeration is desired, and that the proper temperature inside the vehicle is insured for considerable period of time. Such temperatures are sufficient for adequate refrigeration of various products while the vehicles containing them are proceeding relatively great distances without need of further refrigeration. In the event longer periods of time are necessary in transporting the vehicles, intermediate stations can be provided for this purpose. However, since original loading of cars occurs in various sections of the country, it will not be difficult to establish the required number of refrigerating units at various points.

It has been found satisfactory to circulate the ordinary air inside the car and through the heat transfer unit until the desired temperature is attained for the contents of the car. On the other hand it is possible to circulate fluid other than air, that is, gases which would respond satisfactorily to the refrigerating apparatus.

The conventional refrigeration car is so constructed as to retain a given inside air temperature for prolonged periods, and it is one of the purposes of this invention to incorporate the features thereof in this type of car.

Although only the preferred forms of the invention have been shown and described in detail it is apparent to those skilled in the art that

the invention is not so limited but that various changes may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

I claim:

1. A method of lowering the temperature of a series of commercial transportation vehicles at a station stop which comprises lowering a refrigerant heat exchange unit into a bunker opening located on top of one of the vehicles, sealing the opening, causing low temperature refrigerant from a source of supply at said station stop to circulate through said unit, circulating and recirculating the air of the said one of said vehicles over said unit until the air is reduced to a predetermined low temperature, removing the unit from the bunker opening upon the attainment of the predetermined low temperature and immediately resealing said opening, and transferring the heat exchange unit to another of said vehicles and repeating the operation until all of the vehicles are refrigerated.

2. A method of lowering the temperature of a commercial transportation vehicle at a station stop which comprises lowering into a bunker opening on top of the vehicle, a refrigerant heat exchange unit including portable inlet and outlet conduits for refrigerant connected independently of said vehicle to a refrigerant source at said station stop, sealing the opening, causing low temperature refrigerant from said source to circulate through said unit, circulating and recirculating the air of the vehicle over said unit until the air is reduced to a predetermined low temperature, removing the unit from the bunker opening upon the attainment of the predetermined low temperature and immediately resealing said opening.

3. The combination with a station stop, of a substantially closed vehicle having a storage space, a bunker space and a hatch for said bunker space, a refrigerating system located at said station including a refrigerant heat exchange unit and means to supply said unit with refrigerant, means for raising and lowering said unit from and into said bunker space, and a seal for said hatch, said storage space having a perforated floor spaced from the vehicle floor, said bunker space communicating with the upper and lower portions of said storage space, said heat exchange unit including portable inlet and outlet conduits connected independently of said vehicle to said supply means, and means for circulating air between said bunker space and said storage space through said perforated floor.

4. The combination with a station stop, of a substantially closed vehicle having a storage space, a bunker space and a hatch for said bunker space, a refrigerating system located at said station including a refrigerant heat exchange unit and means to supply said unit with refrigerant, means for raising and lowering said unit from and into said bunker space, and a seal for said hatch, said storage space having a perforated floor spaced from the vehicle floor, said bunker space communicating with the upper and lower portions of said storage space, said heat exchange unit including portable inlet and outlet conduits connected independently of said vehicle to said supply means, an electric fan carried with said unit for circulating air between said bunker space and said storage space through said perforated floor, and electrical conductors for said electric fan connected independently of said vehicle with a supply circuit at said station.

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