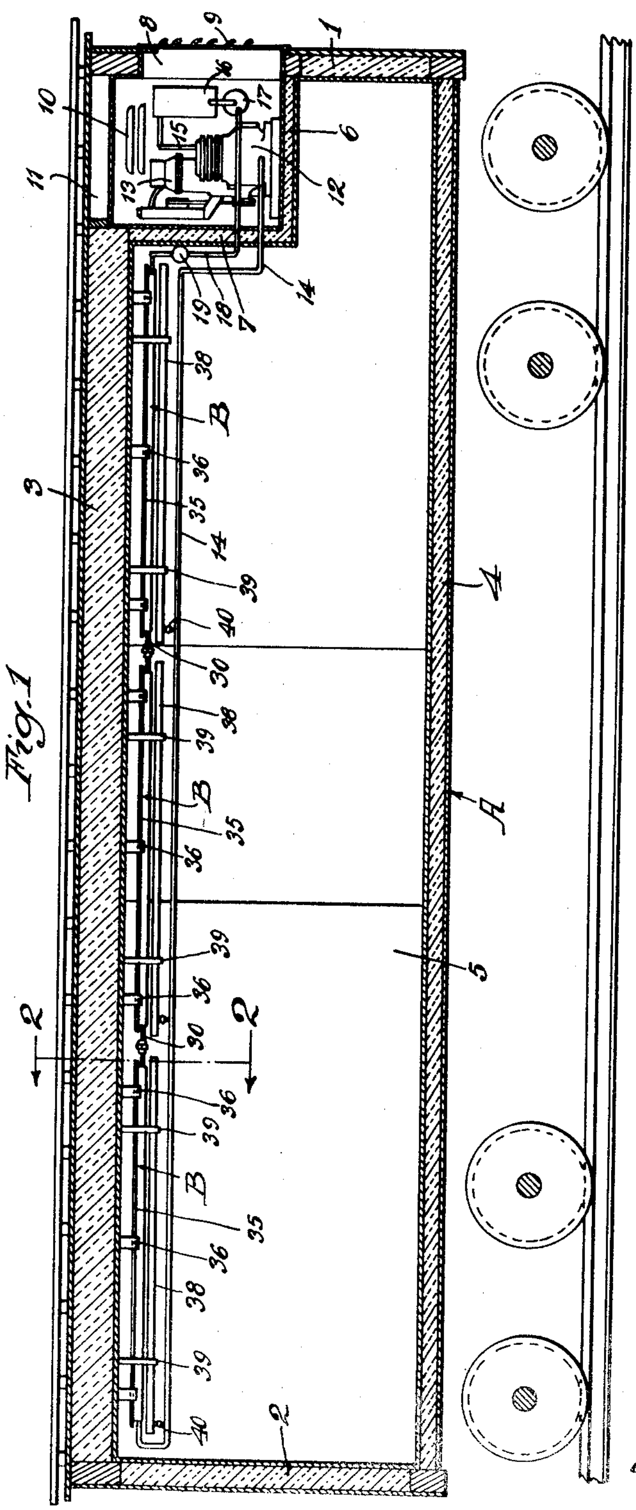
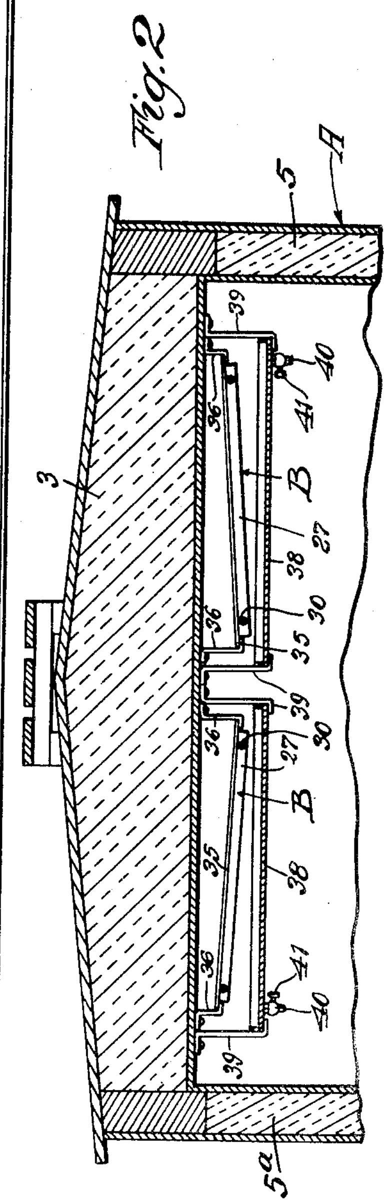
Dec. 19, 1950 | H. W. KLEIST | 2,534,273

SELF-CONTAINED REFRIGERATING FREIGHT CAR UNIT

Filed June 28, 1948 | 3 Sheets-Sheet 1





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SELF-CONTAINED REFRIGERATING FREIGHT CAR UNIT

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Fig. 3

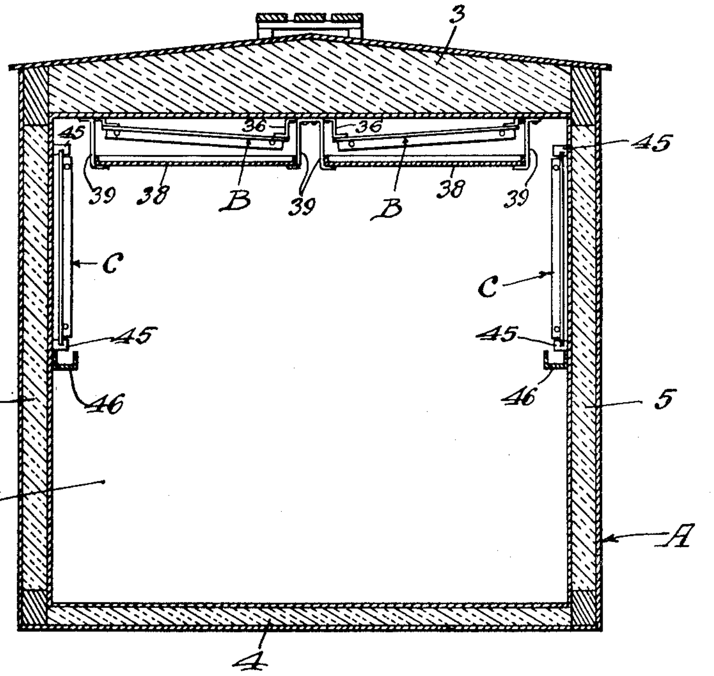


Fig. 4

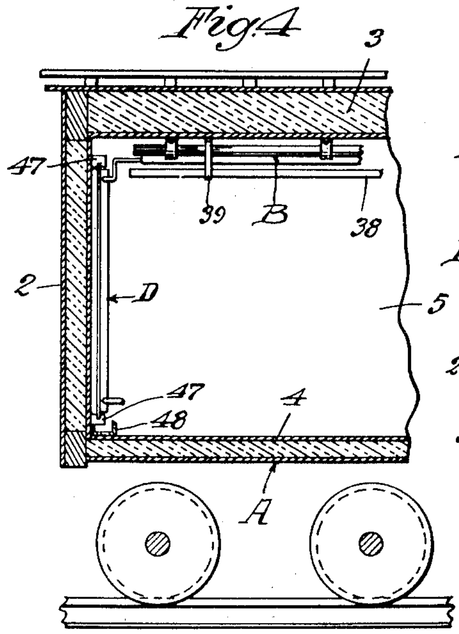


Fig. 5

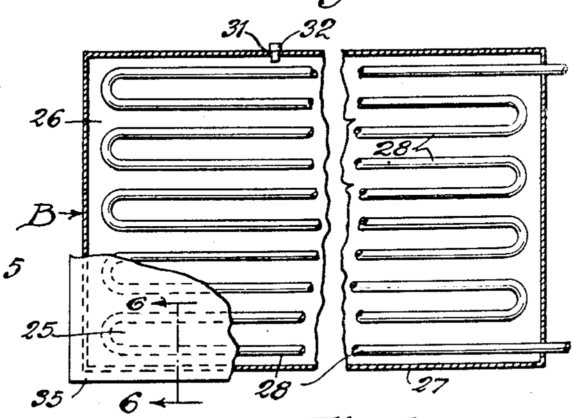
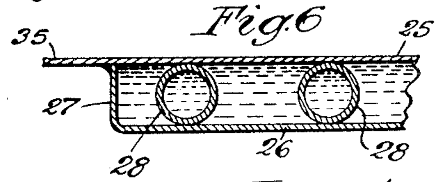


Fig. 6



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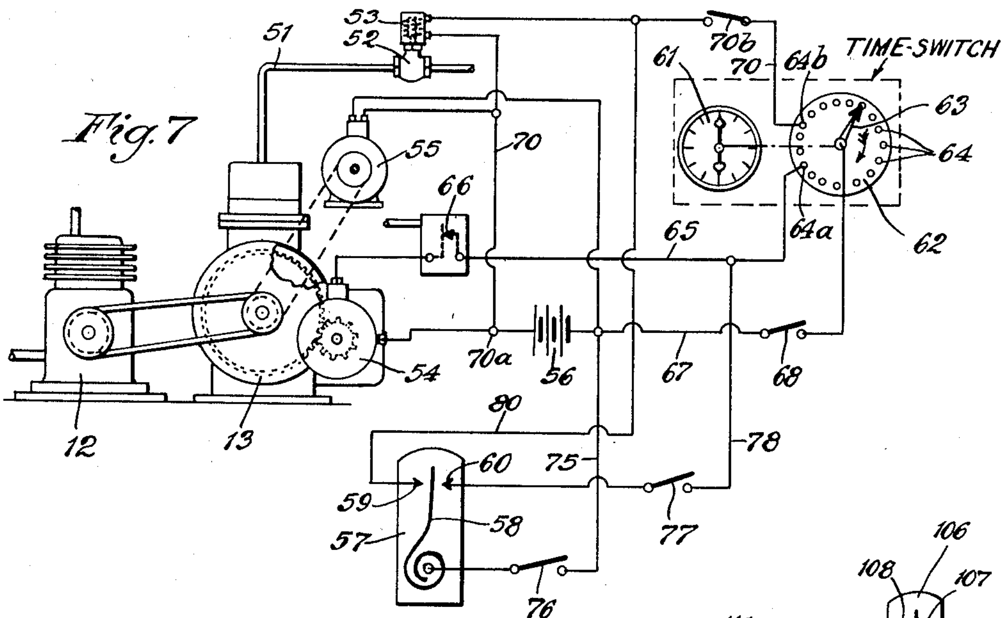

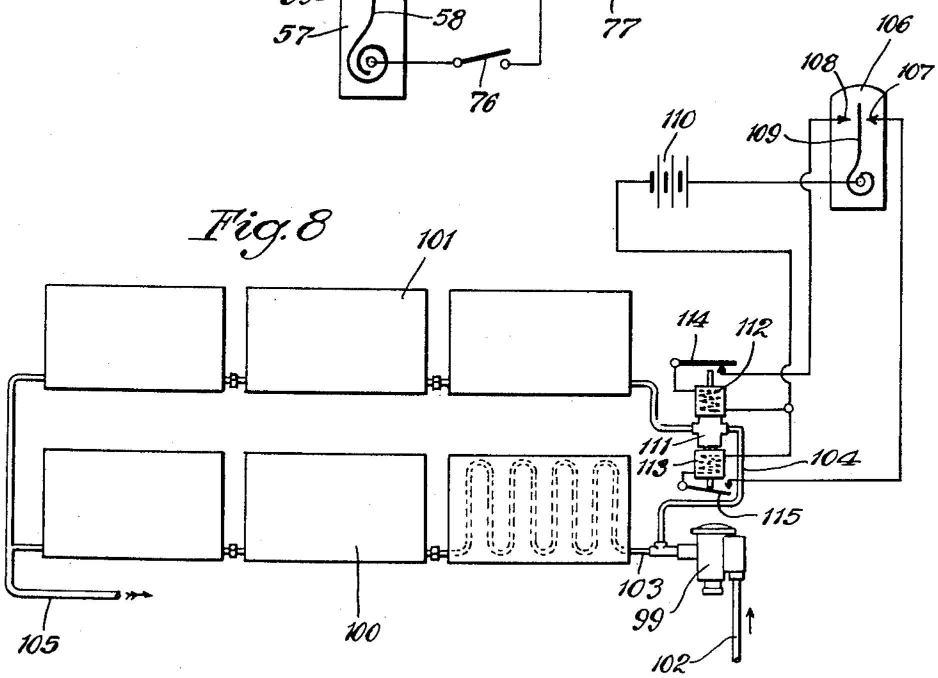

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Patented Dec. 19, 1950

2,534,273

UNITED STATES PATENT OFFICE

2,534,273

SELF-CONTAINED REFRIGERATING FREIGHT CAR UNIT

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Application June 28, 1948, Serial No. 35,545

4 Claims. (Cl. 62—115)

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My invention relates to an improvement in cars, trucks and the like, and has for one purpose the provision of a refrigerating system for insulated freight cars.

Another purpose is to provide a hold-over system for freight cars in which, while the freight car carries its own power source, and refrigeration cycling equipment, it is necessary to operate it only at relatively wide intervals.

Another purpose is to provide such a system in which no operation of the cycling mechanism is necessary during a normal run or trip of a particular car, whereby the car may be loaded, transported to its destination, and unloaded, during the interval between successive actuation of the refrigerant cycling mechanism.

Another purpose is to provide an improved car structure in which a cycling mechanism is insulated from the interior of the car.

Another purpose is to provide an improved disposition of refrigerating plates in the interior of a car.

Another purpose is to provide an arrangement of refrigerating plates which promotes an adequate circulation of refrigerated air.

Other purposes will appear from time to time in the course of the specification and claims.

I illustrate the invention more or less diagrammatically in the accompanying drawings, wherein:

Figure 1 is a vertical longitudinal section through a typical freight car;

Figure 2 is a section on an enlarged scale on the line 2—2 of Figure 1;

Figure 3 is a section illustrating the additional employment of refrigerating elements along the side of the car;

Figure 4 is a partial vertical longitudinal section illustrating the use of a car end cooling member;

Figure 5 is a section with parts broken away illustrating a typical cooling member;

Figure 6 is a section on an enlarged scale along the line 6—6 of Figure 5;

Figure 7 is a wiring diagram illustrating the controls of the system; and

Figure 8 is a diagrammatic illustration of a variant control arrangement.

Like parts are indicated by like symbols throughout the specification and drawings.

Referring to the drawings, A generally indicates a refrigerated freight car which includes insulated ends 1, 2 and insulating roof structure 3, an insulating floor structure 4, and insulated side wall structures 5 and 5a. It will be under-

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stood that any suitable insulated structure may be employed, the details of car insulation not, of themselves, forming a part of the present invention.

Referring to Figure 1, I find it advantageous to employ a separate cabinet or house, insulated from the interior of the car. Whereas such a house or compartment may be formed in a variety of ways, I illustrate as an example, a compartment which includes an insulated bottom wall 6 and an insulated side wall 7. The compartment may extend entirely across the freight car or it may be of less width than the interior of the freight car, depending upon the desire of the designer. With reference to Figure 1, the space within the compartment is insulated by the walls 6 and 7 from the interior of the freight car, but is preferably otherwise bounded by non-insulated wall areas. I illustrate for example, an opening 8 in the end wall of the freight car which is closed by a louver member 9 which permits the entry or circulation of air. A similar louver member 10 is shown in one of the car side walls. The roof structure is provided with a non-insulated portion indicated at 11.

Within the housing thus formed I illustrate a compressor 12 which may be driven by any suitable motor 13. 14 is a return or suction duct extending to the compressor. The compressor delivers compressed refrigerant through the duct 15 to any suitable condenser 16 from which condensed refrigerant may flow to a receiver 17 for delivery through the pressure duct 18. It will be understood that any suitable means may be employed for circulating air or a suitable cooling medium about the condenser 16. Any suitable means may be employed for causing a pressure drop whereby the volatile refrigerant which flows through the duct 18 through the below described cold plates or evaporators may have its pressure reduced to the desired degree.

I illustrate diagrammatically any suitable pressure reduction valve or assembly 19. It will be understood that when the motor 13 is driving the compressor 12, the gaseous refrigerant from the return duct or pipe 14 is compressed and condensed and delivered back toward the evaporators or cooling elements through the duct 18.

Whereas I may use a variety of evaporating elements, I prefer to employ hold-over vacuum plates in which an evaporator coil is surrounded by a eutectic and is held in adequate heat conducted relation with the preferably plane walls of a plate structure. Referring for example to Figures 5 and 6, I illustrate a plate for plane parallel walls 25 and 26 which with circumferential side walls 27 form a closed container. Within this container is formed or bent any suitable evaporator coil 28. The evaporator coil receives a volatile refrigerant, at reduced pressure from the supply pipe 18 through the pressure reduction structure 19. The individual members may be arranged in any suitable arrangement or circuit but for convenience I illustrate them herein as arranged in series and connected by connecting ducts 30, the whole series eventually returning the evaporated refrigerant to and through the return pipe or duct 14. I find it advisable partially to exhaust the air within the individual unit. I may for example, employ an aperture 31 which is closed by any suitable fitting 32 which is sealed after the eutectic has been added and the air has been partially exhausted. Preferably I leave an empty space of 10 percent or less of the capacity of the interior of the plate, rather than filling the plates completely with the eutectic.

With reference, for example, to Figure 2, I illustrate the individual vacuum plates, which I indicate as B in a pair of rows which may extend substantially from end to end of the car. The individual plates may be supported by their edge flanges or extensions 35 upon any suitable brackets 36. Preferably the parts are so arranged that the plates may readily be removed from the brackets. For example, in Figure 2, the plates are not actually secured to the brackets but merely rest upon them. As an inner edge of a plate is raised to the inner surface of the roof, the outer edge is then freed from its supporting brackets 36 and the plate may be removed. However, if desired to prevent an unintended movement of the plates, they may be bolted or otherwise removably secured to the brackets.

Beneath each row of brackets, I illustrate drip receiving pans 38 mounted in any suitable brackets 39 and provided with liquid drip outlets 40 normally closed and controlled by any suitable valve knobs or handles 41.

In the form of Figure 1, I illustrate the plates as arranged only along the roof of the car. It will be understood that the brackets are formed and disposed to permit free circulation of air between the pans 38 and the roof and about the cold plates B.

With reference to Figure 3 I may find it advantageous to add a series of cold plates C along the sides of the car. These may be supported at their upper and lower ends as by brackets 45. Any suitable drip trough 46 may be employed. It will be understood that the plates C may be tied into the fan system or cycle or, if desired additional cycling means may be provided for the additional plates or evaporators.

With reference to Figure 4, I illustrate an end plate or evaporator D with its supporting brackets 47 and its drip trough 48. It will thus be understood that I may arrange my cooling elements, such as vacuum plates at any desired point or area of the inner surfaces which bound the storage space within the car. However, in general it is sufficient, and advantageous, to mount the plates or evaporators on or along the roof, where they are out of the way, are not damaged by the loading and unloading of the car, and don't use up valuable space.

In the use of my cooling system, I find it desirable to employ a suitable time control. I illustrate herein what I may call a traveling container, which is shown as a freight car but which might be a truck or a room on a steamer. This traveling container has an insulated interior storage space, in the present example bounded by the insulated walls, roof and floor of a refrigerated flat car. This space I cool by plates or evaporators through which a volatile refrigerant may be cycled. The particular plates I illustrate herein are what I call vacuum plates, in which the evaporator coil 28 is largely surrounded by a eutectic. However, these plates or coils are not normally cycled during transportation. For example, in preparation for a railroad run, the eutectic of the plate may be frozen solids between compressor-condenser-receiver assembly which I find advantageous to power by a Diesel engine such as the engine 13 of Figure 1. The refrigerating effect of the eutectic is sufficient to maintain the desired temperature for a substantial period. On short runs it may not be necessary to operate the cycling assembly at all, but I prefer to provide one and I show it in Figure 7. The time control, after a predetermined time lapse, may be actuated to start the Diesel engine 13, which will then operate the compressor 12 to cycle the refrigerant through the evaporators to restore them to full cooling efficiency by re-freezing the eutectic. In Figure 7 I illustrate more or less diagrammatically the necessary controls. For lack of space, because of the scale of the drawing, they are not shown in Figure 1. It will be understood, however, that the system shown in Figure 1 will be used in connection with the control assembly shown in Figure 7.

Referring to Figure 7, which illustrates the control circuit, 13 is a Diesel engine to which liquid fuel may be supplied through the duct 51 controlled by the valve 52. The valve 52 may, for example, be controlled by the solenoid diagrammatically illustrated at 53. When the Diesel engine 13 is operating, it serves to drive the compressor 12. The Diesel 13 may be started by any suitable starter, diagrammatically illustrated at 54. Any suitable generator 55, driven by the Diesel engine, may be employed to maintain a charge in the battery 56. 57 generally indicates a thermostat responsive to temperature within the car. It includes the heat responsive warping bar 58 and the normally fixed contacts 59 and 60.

Assume that a loaded car, with properly frozen eutectic charged vacuum plates, begins a trip. For a predetermined period of time no additional refrigeration is necessary, since the frozen eutectic maintains the interior of the car at the desired temperature. With reference to Figure 7, I may rely on a time device for initiating the cycling of the volatile refrigerant after a predetermined period, by starting the Diesel engine 13 to recharge the plates by freezing the eutectic. For example, I illustrate any suitable clock 61, with its associated time switch 62, having the moving contact 63 and a plurality of fixed contacts 64. Assume that it is desired to start the engine when the moving contact 63 reaches the fixed contact 64*a*. A suitable conductor is connected to the contact 64*a* and extends thence, as at 65, to the starter 54. 66 is any suitable vacuum control switch responsive to the pressure of the Diesel.

It will be understood that as soon as the engine starts, the switch 66 is operative to prevent further current flow through the conductor 65. The starting circuit is completed by the conductor

67, in which the battery 56 is included. 68 is any suitable switch for actually breaking the starting circuit. Thus it will be understood that when the movable contact 63 reaches the fixed contact to which the conductor 65 extends, for example, the contact 64a, the starter 54 is battery-driven to start the Diesel 13. As soon as the Diesel 13 starts, the pressure condition in the engine opens the switch 66 and prevents further flow of current through the starting circuit. Thus cycling of the volatile refrigerant through the plates is initiated after a predetermined time lag, which can be varied or controlled at the desire of the operator, through the clock 61 and the adjustable time switch 62.

If I wish, I can arrange to stop the operation of the Diesel, and thus the cycling of the volatile refrigerant, after a further predetermined and controllable time lag. I may employ a stopping circuit including the conductor 70 which may, for example, be connected to the fixed contact 64b. The conductor 70 extends to the conductor 67, as at 70a, and forms a stopping circuit in which the solenoid 53 and the battery 56 are included. Thus, when the movable contact 63 reaches the fixed contact 64b, and assuming that the switch 70b is closed, the solenoid valve 53 is energized to close the valve 52, and to prevent, for the time being, any further flow of fuel along the pipe 51 to the Diesel 13. It will be understood, of course, that as soon as the contact 63 passes the contact 64b, the solenoid is deenergized and the valve 52 is open, so that it will not prevent later starting of the Diesel engine. It will also be understood that as soon as the Diesel stops, the switch 66 is closed, ready for the next starting impulse. It will be understood, of course, that any suitable means may be employed for varying the setting of the time switch so that, at the will of the operator, the Diesel can be started after a predetermined time lag, and may again be stopped after a predetermined time of operation. Both the starting and the stopping circuits may also be put out of action by opening the manual switches 68 or 70b, respectively.

In place of, or as a supplement to, the time control I may employ a thermostatic control responsive to the temperature within the storage space. Assume that within a predetermined temperature range, the warping member 58 remains in the intermediate position in which it is shown in Figure 7. As long as it is in that position the thermostat has no control over the operation of the cycling system. After a predetermined temperature increase the warping bar 58 moves to the right to contact the fixed contact 60. When it does so, current flows from the battery 56 through the conductor 75, and the at that time closed switch 76, through the warping bar 58, the fixed contact 60, the switch 77, the conductor 78, and back through the conductor 65 and the vacuum controlled switch 66 to the starter 54. The result is the starting of the Diesel 13, in response to the movement of the warping bar 58 against the hot contact 60. If the various switches are set to close the thermostatic circuits and to open the time control circuits, then the Diesel will continue to operate until the warping bar 58 moves to the left, away from the hot contact 60 and against the cold contact 59. The contact of the warping bar 58 with the cold contact 59 closes a stopping circuit through the conductor 80 to the solenoid 53 and back along the conductor 70 to the battery 56 and back across the switch 76 to the warping bar 58.

Thus I show a time controlled starting circuit, a thermostat controlled starting circuit, a time controlled stopping circuit, and a thermostat controlled stopping circuit. By merely closing the proper switches I can obtain the following operative features:

(A) I may start the engine and stop the engine, both by time control only.

(B) I may stop the engine and start the engine, solely by thermostatic control.

(C) I may start the engine by time control and stop the engine by thermostatic control.

I thus provide a very flexible operating system in which, by the mere manipulation of switches, the operator may determine whether he will rely solely on time control, solely on thermostatic control, or on a combination of time and thermostatic control. This is very helpful in connection with the different lengths of trip or run which may be made by a given refrigerating car, and, also, it permits the operator to relate his control system to the ambient temperatures or changes in temperature to which the exterior of the car or truck is subjected.

As a further simplification, it will be understood that if all the switches are open except the starting switch, the engine can be started and permitted to run continuously until the end of the trip. This may be important, as where a low temperature is desired and goods are being handled which would not be handled by a higher temperature.

With reference to Figure 8, I illustrate an arrangement whereby a multiple of eutectic filled plates, indicated as the series 100 and the series 101, may be so connected to the cycling system as to be alternatively put in use or kept out of use. For example, the operator may wish to have all of the plates simultaneously functioning, or he may wish to cut out some of the plates. In Figure 8 I illustrate a single expansion valve 99 which receives a volatile refrigerant under pressure along the duct 102, and delivers it by the duct 103 to the bank 100, and by the duct 104 to the bank 101. The two banks then return the evaporated refrigerant along the return duct 105 to the compressor. In order to cut the bank 101 in or out, as desired, I may, for example, employ any suitable thermostat 106 with its fixed contacts 107, 108, and its temperature responsive contact 109 in circuit with any suitable power source, such as the battery 110. 111 generally indicates a solenoid controlled valve, there being two solenoid windings 112 and 113 respectively. When the warping contact 109 contacts the fixed contact 108, a circuit is closed through the solenoid winding 112 and the closed switch 114. The energization of the winding 112 actuates the valve, which may be set either to open or to close, depending upon the desire of the operator. At the same time, the switch 114 is opened to prevent drain on the battery 110. Assume that the winding 112 is effective to open the valve, and that the bank 101 is active. After a predetermined period, the warping bar 109 swings into contact with 107 and energizes the winding 113. The result is to close the valve, cutting out the bank 101. At the same time, the switch 115 is opened, preventing drain on the battery 110.

Thus I illustrate a system whereby, of the total number of plates within the car or storage space, I may selectively cut some out, while leaving others connected in the cycling system. Figure 8 illustrates a circuit whereby this can be done thermostatically, but I do not wish to be so limited, as I may manually cut out some of the plates, if desired.

The use and operation of the invention are as follows:

The structure herein described and shown provides, in various forms, a refrigerating or refrigerated container such as a car or truck body. The container, with its insulated walls, such as 1, 2, 3, 4 and 5, houses or surrounds a space in which material may be stored and transported in frozen condition. Preferably, the plates B are, as shown in Figure 6, partially or substantially filled by an eutectic solution which is frozen solid before the car or container starts its run. If the material to be stored and transported in the container needs any precooling, then the frozen eutectic will absorb the extra heat from the goods transported, without raising the temperature of the storage space or of the container walls. For example, if the material is to be stored and transported at, say 0° F., and if it is put into the container or car at a temperature above 0, the eutectic is available to absorb the excess heat of the material transported and to bring it down to the desired temperature of, for example, 0° F. Thus material may be placed in the storage zone within the car, and be precooled there before or at the beginning of the transportation trip. It will make the trip, and end the trip, within a substantial time range, at its 0 temperature, there being no increase in the sensitive heat in the interior of the car or in the goods transported.

It will be understood that when the eutectic is completely frozen, the system again ceases to cycle. For this reason, I may employ a suitable thermostatic control responsive to the drop in temperature of the eutectic.

I may also employ, as a supplementary control, a temperature responsive assembly for initiating operation of the motor in response to a predetermined temperature rise.

It will be understood that I do not limit my invention to the use of a Diesel engine, although a Diesel engine is an efficient motor means for use in freight cars, refrigerated trucks and the like.

It will be realized that, whereas, I have described and illustrated a practical and operative device, nevertheless many changes may be made in the size, shape, number and disposition of parts without departing from the spirit of my invention. I therefore wish my description and drawings to be taken as in a broad sense illustrative or diagrammatic, rather than as limiting me to my precise showing.

I claim:

1. In transportable refrigerating means such as storage cars and the like, an insulating structure including walls surrounding and defining a storage zone to be refrigerated, an evaporator structure positioned in said storage zone and including one or more plates each having walls of heat-conductive material surrounding and sealing an enclosed space, each said plate space being partially filled with eutectic, an evaporator coil in each such plate space and in heat exchange relationship with said eutectic, said plates having faces exposed to the interior of said storage zone throughout an area sufficiently great to permit a prolonged refrigerating effect during and due to the thawing of the eutectic therein, a compressor-condenser unit located exteriorly of said storage zone, a Diesel engine therefor, pipes extending between the compressor-condenser unit and the evaporator coil, the eutectic in such plate or plates being in heat exchange relation with the interior of the storage zone through the plate walls, and means for initiating actuation of the Diesel engine after a predetermined time lapse during which the motor has not been in actuation, said time lapse being in predetermined relation to the melting period of the eutectic within the plate or plates, said plate or plates extending generally from end to end and generally throughout the top of the storage zone.

2. The structure of claim 1 characterized by and including a control adapted to terminate the actuation of the Diesel engine after the eutectic is refrozen.

3. The structure of claim 1 characterized by and including a control adapted to terminate the actuation of the Diesel engine after the eutectic is refrozen, such control being responsive to temperature conditions within the storage zone.

4. The structure of claim 1 characterized by and including a temperature responsive control assembly adapted to start the Diesel engine in response to a predetermined temperature rise, and means for terminating fuel supply to the Diesel engine and for thereby terminating its operation after the eutectic is refrozen.

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