Sept. 10, 1940. C. F. HENNEY 2,214,055

REFRIGERATING APPARATUS

Filed June 29, 1935 2 Sheets-Sheet 1

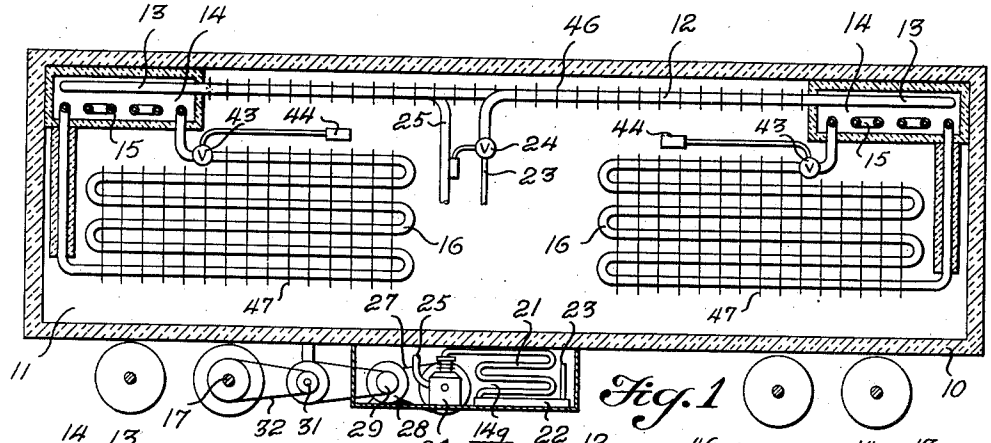


Fig. 1

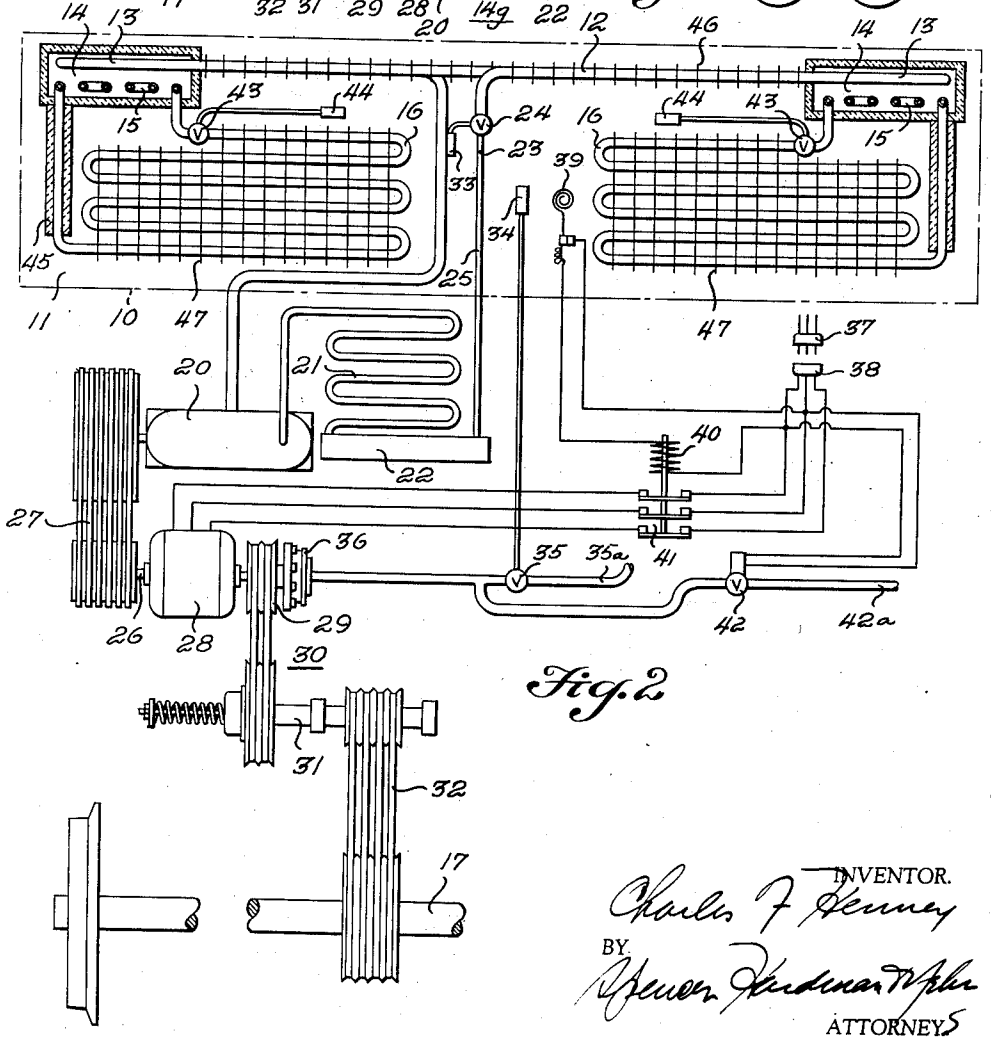


Fig. 2

INVENTOR.
Charles F. Henney
BY
Glenn Henderson & Hyler
ATTORNEYS

Sept. 10, 1940. C. F. HENNEY 2,214,055

REFRIGERATING APPARATUS

Filed June 29, 1935 2 Sheets-Sheet 2

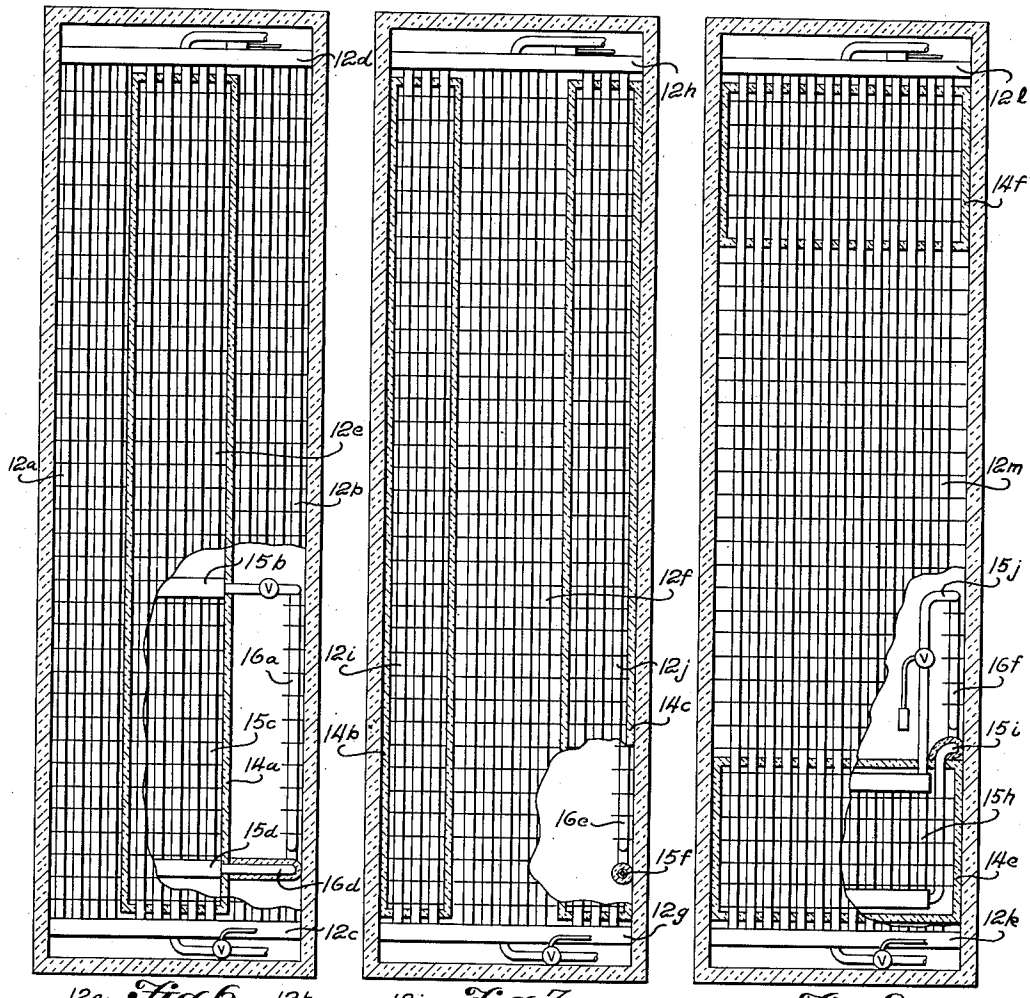


Fig. 6 Fig. 7 Fig. 8

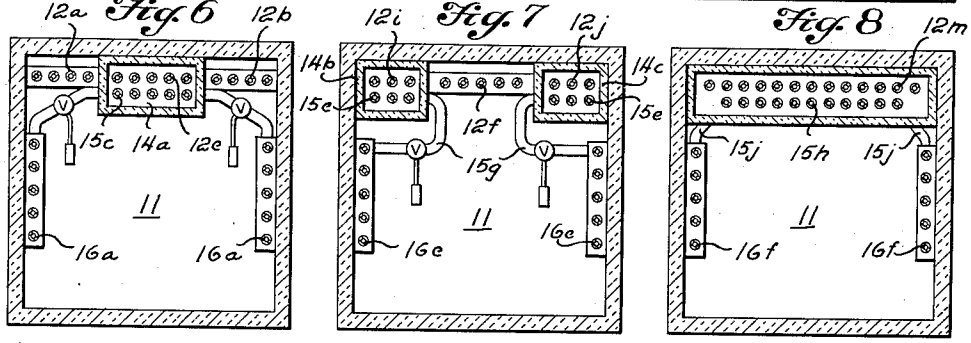


Fig. 3 Fig. 4 Fig. 5

INVENTOR.

Charles F. Henney

BY

Spencer Henderson & Spencer

ATTORNEYS

Patented Sept. 10, 1940 2,214,055

UNITED STATES PATENT OFFICE

2,214,055

REFRIGERATING APPARATUS

Charles F. Henney, Dayton, Ohio, assignor to General Motors Corporation, Dayton, Ohio, a corporation of Delaware

Application June 29, 1935, Serial No. 29,119

8 Claims. (Cl. 62—6)

This invention relates to refrigeration.

It is among the objects of this invention to provide an improved arrangement of refrigeration for railway cars or the like in which a mechanical refrigerating system may be operated from a live axle while the car is in motion and in which refrigeration may be provided from a holdover while the car is not in motion or is operating at too slow a motion.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a vertical cross-sectional view, somewhat diagrammatic, of a refrigerating system as applied to a railway car;

Fig. 2 is a diagrammatic representation of the controls for the system shown in Fig. 1;

Figs. 3, 4 and 5 are cross-sectional views of various arrangements for the system shown in Fig. 1; and

Figs. 6, 7 and 8 are corresponding plan views respectively.

A railway car, or other vehicle, 10 is provided with a compartment 11 which is to be cooled. This compartment is refrigerated while the car is in operation by an air cooling section 12 of a primary refrigerant evaporator. This primary refrigerant evaporator is also provided with a congealing section 13, and the evaporator is in primary refrigerant flow relationship with a refrigerant liquefying unit 14*g*. The congealing section 13 is in thermal exchange relationship with a congealing solution contained in the compartment 14 in the upper portion of the car. This congealing solution may be any of the usual holdover solutions such as an alcoholic aqueous solution, water, brine or the like. A secondary condenser 15 is in secondary refrigerant flow relationship with a secondary evaporator 16. While the car is in motion the liquefying unit 14*g* is driven from a live axle 17 and provides refrigeration for the compartment 11 through the air cooling section 12. If the rate of travel is sufficiently fast enough, excess refrigerating power causes some or all of the solution to be congealed in the compartment 14. Thereafter if the car should stop or slow down the secondary evaporator 16 cools the air in the compartment 11, receiving its refrigerating power from the frozen solution in compartment 14.

The refrigerant liquefying unit 14*g* may include a compressor 20 which discharges into a condenser 21 having a refrigerant receiver 22. Liquid refrigerant flows through the line 23, to the expansion valve 24 into the primary evaporator which has sections 12 and 13 and the evaporated refrigerant returns through the line 25 to the compressor 20. The compressor 20 is driven from a shaft 26 through the medium of belts 27. The shaft 26 may have mounted thereon a standby motor 28 and the driven portion 29 of an automatic variable ratio drive 30. The driving portion of this drive may be mounted on a jack-shaft 31 swingingly mounted on the car. This jack-shaft may be driven through the medium of belts 32 from the live axle 17. A fan, not shown, may be provided for blowing air over the condenser 21 and this fan may be driven from the same axle which drives the compressor 20.

Automatic controls are provided. These include the automatic expansion valve 24 which is of the type that automatically introduces refrigerant into the evaporator when the pressure therein has been reduced below a predetermined limit. This valve is throttled under the control of a thermostatic bulb 33 in thermal heat exchange with the outlet pipe 25 when the refrigerating effect has reached the outlet of the evaporator. The operation of the refrigerant liquefying unit is placed under the control of a thermostatic bulb 34 placed in the compartment 11. This bulb controls a valve 35 which in turn controls the flow of air from the air brake system at 35*a* to a clutch 36. The action is such that when the temperature in compartment 11 reaches a predetermined temperature the clutch 36 is engaged causing the live axle 17 to drive the compressor 20. When the temperature in compartment 11 is reduced to a predetermined temperature the clutch 36 is disengaged thus stopping the compressor 20. When the car is standing still, and there is electric energy available, a plug 37 is inserted in the receptacle 38 which is connected with the motor 28. A thermostat 39, also in the compartment 11, is placed across two of the lines leading from the receptacle 38 and controls the relay winding 40 which in turn controls the switch member 41 in the lines leading to the motor 28. Two or more of these lines may also be connected to the solenoid air valve 42 which controls the flow of air to the pneumatically operated clutch 36 from the air brake system at 42*a*. When the motor 28 is connected to the source of electricity the flow of air to the pneumatic clutch 36 is controlled by valve 42 and this causes the clutch to disengage the axle 26 from the axle 17. This leaves the motor 28 free to

drive the compressor 20 under the control of thermostat 39. When the plug 37 is disconnected from the receptacle 38 the solenoid valve 42 is left in the open position thus leaving the air line under the control of valve 35.

The secondary refrigerant system is also automatically controlled. A valve 43 is placed in the line leading to the condenser 15. This valve is throttled by a bulb 44 whenever the temperature in the compartment 11 tends to fall below a predetermined temperature. When the valve 43 is closed or throttled, gaseous refrigerant is trapped in the evaporator 16 and this forces liquid refrigerant within the evaporator into the insulated section 45 thus reducing the refrigerating power of the evaporator 16.

The evaporators heretofore described may be disposed within the compartment 11 as indicated in Figs. 3 to 8 inclusive. Preferably there are secondary condensers and secondary evaporators placed at each end of the car. These evaporators are substantially the same and symmetrically arranged with respect to each other. The air cooling section 12 is preferably composed of a plurality of pipe sections having transverse vertical fins 46 in contact with the air in compartment 11. The tanks 14 are placed at each end of the car or along the center and the evaporators 16 are placed below the level of the tanks 14. Each evaporator 16 consists of a plurality of refrigerant pipes bridged by air cooling fins 47 transverse thereto. Preferably four secondary evaporators 16 are used, two at each side of the car at one end and two at each side of the car at the other end. As indicated in Figs. 3 and 6 the air cooling section is placed in the upper part of the compartment 11 and comprises twin sections 12*a* and 12*b* running the length of the car toward the sides of the roof. A central tank 14*a* is placed along the center of the car. The primary evaporator is provided with inlet and outlet headers 12*c* and 12*d* at each end of the car which are joined by the air and holdover cooling pipes 12*a*, 12*b* and 12*e*.

The secondary condensers are placed in the tank 14*a* and comprise headers 15*d* and 15*b* joined by pipes 15*c*. The gaseous refrigerant rises into the header 15*b* from the secondary evaporator 16*a*. The liquid refrigerant flows from the secondary condenser to the secondary evaporator through the covered pipe 16*d*.

In the modification shown in Figs. 4 and 7. The primary evaporator includes an air cooling bank of pipes 12*f* joining inlet header 12*g* and outlet header 12*h*. These headers are also joined by pipe banks 12*i* and 12*j* placed in congealing tanks 14*b* and 14*c*. The secondary evaporators 16*e* are placed at each corner of the car and are connected to secondary condensers 15*e* by liquid refrigerant pipe 15*f* and gaseous pipe 15*g*.

In the modification shown in Figs. 5 and 8 the primary evaporator includes inlet header 12*k* and outlet header 12*l* joined by bank of pipes 12*m*. Parts of this bank pass through congealing tanks 14*e* and 14*f* and the remainder forms the air cooling section. The secondary condensers 15*h* are connected to the secondary evaporators 16*f* placed at each corner of the car by liquid line 15*i* and gaseous line 15*j*.

In all of the modifications shown in Figs. 3 to 8 the primary and secondary refrigerating systems are connected as indicated in Figs. 1 and 2. The flow of secondary refrigerant is in each case controlled by a thermostatic valve placed in the gaseous line. A part of this primary evaporator is placed near the roof and a secondary evaporator is placed at each corner of the car. The thermostat controlling the flow of primary refrigerant may be calibrated so as to stop the flow of primary refrigerant at a lower temperature than the temperature at which the flow of refrigerant is stopped in the secondary system.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. In a car having a compartment to be refrigerated, a live axle, a motor, a condensing unit connected to said axle and motor, a clutch between said axle and condensing unit, a thermostat controlling said clutch, a connector for connecting said motor to an outside source of current, a thermostat controlling said motor, means controlling said clutch when said connector is connected to said source, an evaporator for said compartment in primary refrigerant flow relationship with said condensing unit, a congealing solution in thermal contact with said evaporator, a secondary condenser in thermal contact with said solution, a secondary evaporator for said compartment and in refrigerant flow relationship with said secondary condenser, and a thermostatic control for said second evaporator.

2. In a car having a compartment to be refrigerated, a live axle, a refrigerant liquefying unit operated from said axle, a refrigerant evaporator in the upper part of said car connected to said liquefying unit in primary refrigerant flow relationship, said evaporator having an air cooling section in the upper part of said compartment and a congealing section, a congealing solution in the upper part of said car cooled by said congealing section, a secondary condenser in thermal contact with said solution, a secondary evaporator below said condenser and in refrigerant flow relationship therewith, said secondary evaporator being in said compartment, and means regulating the flow of secondary refrigerant.

3. In a car having a compartment to be refrigerated, a primary refrigerating system having a refrigerant liquefying unit on said car and a primary refrigerant evaporator in refrigerant flow relationship with said unit and including coils adjacent the ceiling of said compartment with portions in a holdover tank, a secondary refrigerating system including a secondary condenser in said holdover tank, and a secondary evaporator along the side of said compartment.

4. In a car having a compartment to be refrigerated, a primary refrigerating system having a refrigerant liquefying unit on said car and a primary refrigerant evaporator in refrigerant flow relationship with said unit and including coils adjacent the ceiling of said compartment with portions in a holdover tank, a secondary refrigerating system including a secondary condenser in said holdover tank, a secondary evaporator along the side of said compartment, and means controlling the flow of secondary refrigerant in accordance with air conditions in said compartment.

5. In a car having a compartment to be refrigerated, a primary refrigerating system having a refrigerant liquefying unit on said car and a primary refrigerant evaporator in refrigerant flow relationship with said unit and including

coils adjacent the ceiling of said compartment with portions in a holdover tank, a secondary refrigerating system including a secondary condenser in said holdover tank, a secondary evaporator along the side of said compartment, means responsive to temperature conditions within the compartment controlling the operation of said primary refrigerating system and separate means responsive to temperature conditions within the compartment for controlling the operation of said secondary refrigerating system.

6. In a car having a compartment to be refrigerated, a holdover means, a primary refrigerating system having a refrigerant liquefying unit on said car and a primary refrigerant evaporator in refrigerant flow relationship with said unit and including coils in thermal exchange with said holdover means and with the contents of said compartment, a secondary refrigerating system including a secondary condenser in thermal exchange relationship with said holdover means, and a secondary evaporator in thermal exchange relationship with the contents of said compartment.

7. In a car having a compartment to be refrigerated, a holdover means, a primary refrigerating system having a refrigerant liquefying unit on said car and a primary refrigerant evaporator in refrigerant flow relationship with said unit and including coils in thermal exchange with said holdover means and with the contents of said compartment, a secondary refrigerating system including a secondary condenser in thermal exchange relationship with said holdover means, a secondary evaporator in thermal exchange relationship with the contents of said compartment, means responsive to temperature conditions within the compartment controlling the operation of said primary refrigerating system and separate means responsive to temperature conditions within the compartment for controlling the operation of said secondary refrigerating system.

8. In a car having a compartment to be refrigerated, a live axle, a motor, a condensing unit connected to said axle and motor, a clutch between said axle and condensing unit, a thermostat controlling said clutch, a connector for connecting said motor to an outside source of current, a thermostat controlling said motor, means controlling said clutch when said connector is connected to said source, an evaporator for said compartment in primary refrigerant flow relationship with said condensing unit, a congealing solution in thermal contact with said evaporator, a secondary condenser in thermal contact with said solution, a secondary evaporator for said compartment and in refrigerant flow relationship with said secondary condenser, a thermostatic control for said first named evaporator, and a thermostatic control for said second evaporator.

CHARLES F. HENNEY.