

Feb. 9, 1932.

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1,844,822

REFRIGERATOR PLANT

Filed July 8, 1929 111 2 Sheets-Sheet 1

Fig. 1.

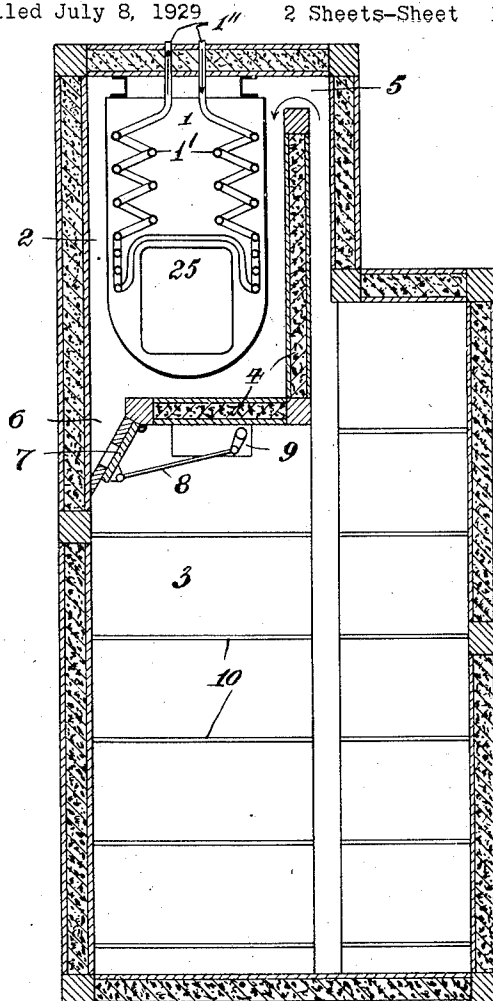


Fig. 3.

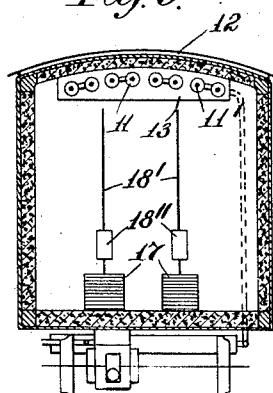
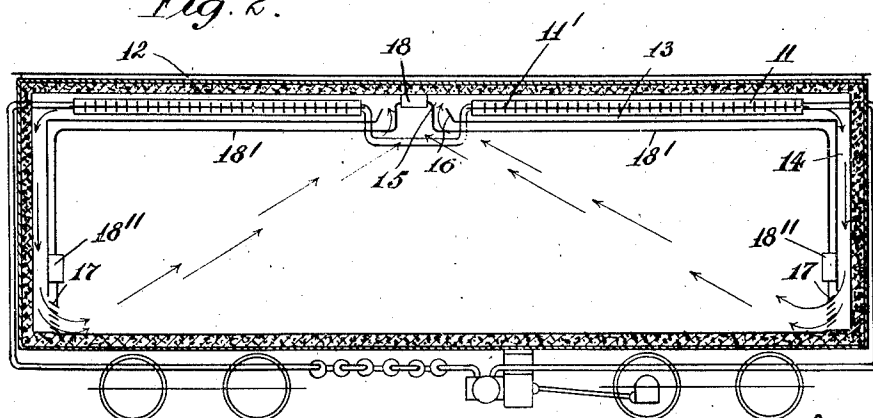


Fig. 2.



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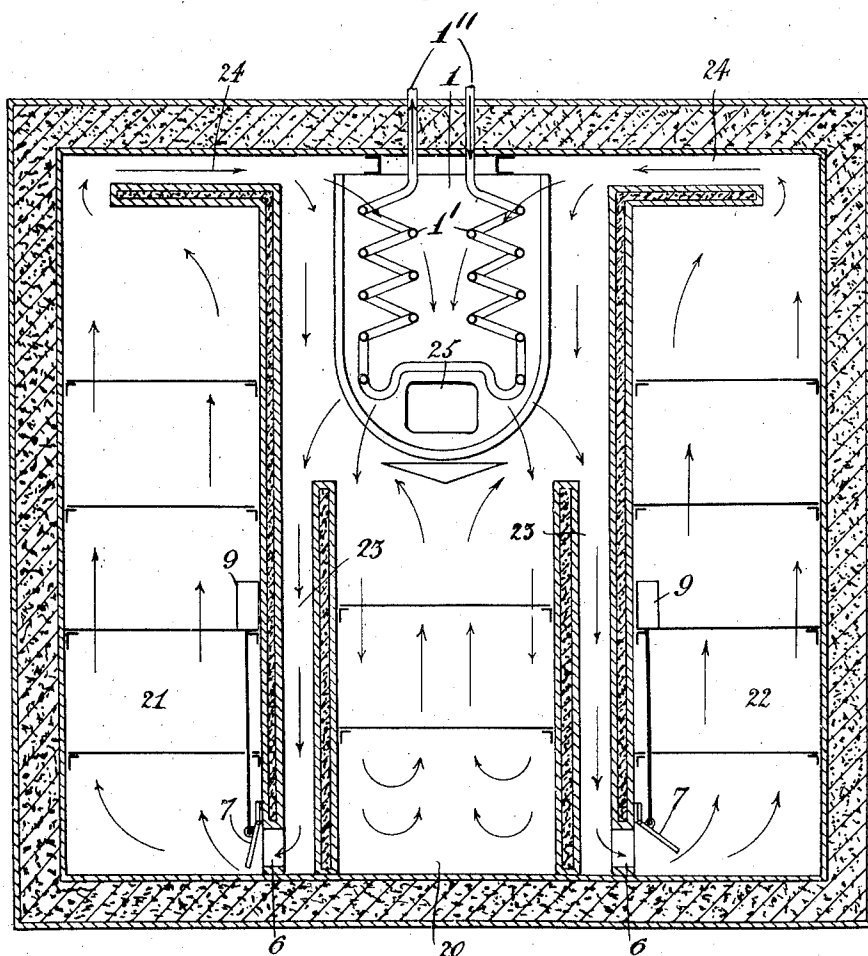
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Fig. 4.



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UNITED STATES PATENT OFFICE

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REFRIGERATOR PLANT

Application filed July 8, 1929, Serial No. 376,651, and in Great Britain July 13, 1928.

This invention comprises improvements in refrigerator plant, particularly for use on vehicles such as railway carriages and vans. In such installations, the cold has been produced dynamically by evaporating a volatile liquid at a low temperature and pressure and re-condensing it at a higher pressure and temperature, the pressure being increased by a compressor driven from a running axle.

One object of this invention is to increase the cold storing capacity of the customary brine or "hold over" tanks which are cooled by the evaporation of the volatile fluid and serve for absorbing heat leaking into the cold chamber during periods of idleness of the compressor. The capacity of brine for storing "cold" merely by changing its sensible heat is relatively small and it is not permissible to employ large brine tanks on vehicles, for example, as it is important to preserve as large a carrying capacity as possible. Thus, heretofore, the difficulty has been experienced that the plant, under certain climatic conditions, may produce too low a temperature when running continuously and must be shut off for part of the time, whereas during a prolonged period of standing there is insufficient "cold" stored or accumulated for preserving the appropriate reduced temperature in the cold chamber or van.

A further object of the present invention is to provide an installation of a compact character occupying a minimum of space and nevertheless possessing a relatively large capacity for storing or accumulating "cold", the cold accumulator being available for preserving the desired reduced temperature in the vehicle, compartment or chamber during idle periods of the compressor as when a vehicle stands in a siding or at a wharf or dock, to enable the plant to be run for the whole of the journey of the train and so obtain the maximum of refrigeration possible and at the same time to permit the temperature inside the vehicle, compartment or chamber to be controlled within the desired limits.

With these objects in view refrigerator plant according to the invention comprises a thermodynamic source of cold associated with a cold accumulator utilizing the latent

heat of a cold storing medium and consisting of one or more relatively small brine tanks or drums disposed in a well or chamber under the roof or on the walls of a vehicle, van or the like. Said chamber or the like has an automatically regulated communication with the insulated space or cold chamber in which reduced temperature is to be preserved. The cold storing agent with which such tank or tanks are charged is a chemical solution or "brine", the nature, density, and freezing point of which is adjusted so as to enable congelation to take place at a predetermined temperature. The compressor and its associated refrigerating plant will be of such capacity that the compressor is capable, in addition to cooling the cold chamber, of eventually producing solidification or congelation of the brine whereby a large capacity for storing "cold" is obtained owing to the latent heat of solidification of the ice crystals in the congealed brine. Thus, on a railway vehicle for example, the compressor may run the whole of the time that the train is running and at a speed proportional to the speed of the axle from which it is driven, and after reducing the temperature of the cold chamber to the desired degree, the excess of refrigeration produced over and above that required for the maintenance of the desired temperature, is employed for congelation of the brine, or changing its state from a liquid to a solid. In this way, an accumulation of cold is obtained, which is large relatively to the dimensions of the apparatus employed and is available for maintenance of the desired reduced temperature in the cabinet or chamber during periods when the vehicle and refrigerator plant are not running.

Various embodiments of the invention are illustrated by way of example in the accompanying drawings in which:—

Figure 1 is a cross section of a refrigerator cabinet suitable for use on a railway vehicle.

Figures 2 and 3 are a longitudinal section and a cross section respectively of a railway refrigerator van and

Figure 4 shows an arrangement similar to Figure 1 but provided with a number of cold

chambers to be kept at different temperatures.

In the arrangement illustrated in Figure 1, a brine tank 1, which may be a rectangular vessel having a semi-circular or spherical bottom, is arranged in a well or top space 2 of a cold cabinet or chamber 3. The brine tank 1 is provided with the usual evaporator coil 1' for its positive cooling connected by the pipes 1'' with the refrigerator compressor, not shown. The tank 1 itself is uninsulated, but is enclosed by insulating walls 4 which are spaced from it and one of which does not extend to the top of the cabinet, thus forming a duct 5 whereby the relatively warm air from the cabinet 3 may rise and pass over the top of such wall and have access to the brine tank. A lower portion of one of these walls has an opening 6 which may be closed by a flap, louvre, or valve 7 which is operatively connected by a linkage 8 with a thermostatic device 9 calibrated to operate the flap or valve 7 at the reduced temperature predetermined for the cabinet or chamber. The walls enclosing the brine tank may be lined with zinc and a receptacle may be provided therein for collecting and running off liquid condensed upon the tank and falling therefrom. The cabinet or chamber may be divided into compartments by suitable partitions 10, and on the flooring of each compartment there may be trays, flanges, or appropriate devices for causing foodstuffs and other articles to be placed clear of the walls in order to leave a circulation space for the air.

In operation, the flap or valve 7 may be fully open when the train starts on a run and the compressor commences work. At first, the refrigerating effect produced by the compressor will be utilized in cooling the interior of the cabinet or chamber 3 together with the produce contained therein and overcoming the heat leakage into the same, due to the thermal head across the insulation, which thermal head varies, of course, throughout the day and from day to day throughout the year. When the temperature within the cabinet is reduced to the predetermined degree, the thermostat 9 operates to close, wholly or partly, the flap or valve 7, such closure restricts or prevents circulation through the tank chamber 2 of air rising from the compartments of the cabinet 3, and avoids an unnecessarily low temperature in said cabinet, and so, as the heat loss through the insulation is directly proportional to the thermal head across the insulation, conserves the refrigeration being produced. Thus the refrigerating effect thereafter is utilized wholly or partly for taking out the latent heat of the brine solution and eventually, if the run is sufficiently prolonged, to congeal the brine to a solid mass. When the valve or flap is fully closed by the thermostat, there is no outlet from the bottom part of the tank chamber 2. Consequently, the only cooling effect upon the air in the com-

partments of the cabinet 3 will be that which is due to cold air which may be spilled from the tank chamber due to vibration or movement of the vehicle. Naturally, when the temperature within the cabinet 3 rises above the predetermined degree, the thermostat 9 opens the flap or valve 7, or permits it to open, so that air highly cooled by contact with the brine tank 1 is permitted to descend into the compartments thus giving an automatic control of the cabinet temperature, as will be readily understood.

In the arrangement shown in Figures 2 and 3, a number of drums 11 of circular section are suspended from the roof 12 of a cold storage or refrigerator wagon. These drums 11 contain a chemical solution as described in the foregoing paragraph through which pass ribbed evaporator pipes 11', connected in series. The cooling drums 11 are enclosed in a duct 13 insulated to prevent condensation of atmospheric moisture on the under side of such duct. The duct is carried down to floor level at one end 14 and is left open at the top at the other end 15. A lip 16 is provided to prevent excessive spilling of the cold air when the circulation has been stopped. The lower end of the duct 14 which is carried down to floor level is arranged to be fitted with one or more frames containing louvres or shutters 17, which are controlled by a thermostat 18 through the medium of a mechanical, electrical or hydraulic relay gear. As illustrated the thermostat 18 and louvres 17 are connected hydraulically by pipes 18'. The thermostat is of the expanding bellows type and controls a ram adapted to displace oil in the pipes 18'. At the end remote from the thermostat each pipe 18' communicates with a cylinder 18'', containing a plunger suitably connected with the louvres 17. Impelled by displacement of the oil brought about by the movements of the thermostat, the plunger in the cylinder 18'' will follow said movements of the thermostat and thus adjust the air flow to suit the temperature conditions as explained in connection with Figure 1.

The air circulation is indicated by arrows. When the lower limit of the desired temperature in the van has been reached, the thermostat 18 operates to close the shutters 17, which prevents any more cold air being circulated through the van and its stowage until such time as the temperature rises to the top limit when the thermostat operates to again open the shutters and permit circulation of the air. In the van actually illustrated it will be seen that the brine drum arrangement is duplicated and the two sets of drums 11 extend from either side of a centrally disposed thermostat 18 towards the ends of the van.

A further application of the invention is shown in Figure 4. In this case it is desired to maintain three distinct temperatures in the

three compartments 20, 21, 22 of a cabinet, having but one cooler unit 1 which, as will be seen from the sketch, is suspended in a well extended downwardly to form a central freezing compartment 20, cooling this compartment to a low temperature, say 25° F. A second "chill" compartment 21 on the left is partitioned off by two insulated walls which form a cold air duct 23 as shown; the right hand side or "cool" cupboard 22 is arranged in a similar manner. Thermostatically controlled valves 7 are placed at openings 6 arranged at the bottom of each duct 23 and in the manner already described control the temperature in each compartment by regulating the circulation of the air from the cooler unit. Thus the "chill" compartment might be kept at 35-40° F. and the "cool" compartment at 45-50° F. The air circulation through the compartments and back by way of warm air ducts 24 is indicated by arrows. As in the case of Figure 1, ice drawers 25 may, if desired be provided in the brine tanks 1.

I claim:—

1. Refrigerator installation for wheeled vehicles, comprising an axle-driven compressor operative for circulating a suitable medium in a closed circuit, said compressor being intermittently operated for undetermined periods incident to stopping and starting of the wheeled vehicle, an evaporator coil in said circuit adapted for producing cold, an elevated cold accumulator in heat exchange relation with said coil, said accumulator being adapted for utilizing the effects of the latent heat of a cold-storing medium, compartment walls enclosing a chamber containing said accumulator, said chamber having free communication at its upper part with a refrigerated space in said vehicle, and a thermostatic control operative for regulating communication between the lower part of said chamber and said space substantially as set forth.

2. In a refrigerating installation for railroad cars subject to various stopping and starting operations for undetermined periods of time a thermo-dynamic refrigerating apparatus operative during the periods of operation of the car, said apparatus having a low temperature element an elevated chamber, a brine accumulator located in said chamber and in heat exchange relationship with said low temperature element, a refrigerating chamber having an air circulation connection with the elevated chamber, and valve means to control said circulation connection to induce freezing of the brine in the accumulator for use during said undetermined periods of cessation of operation of the thermo-dynamic action.

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