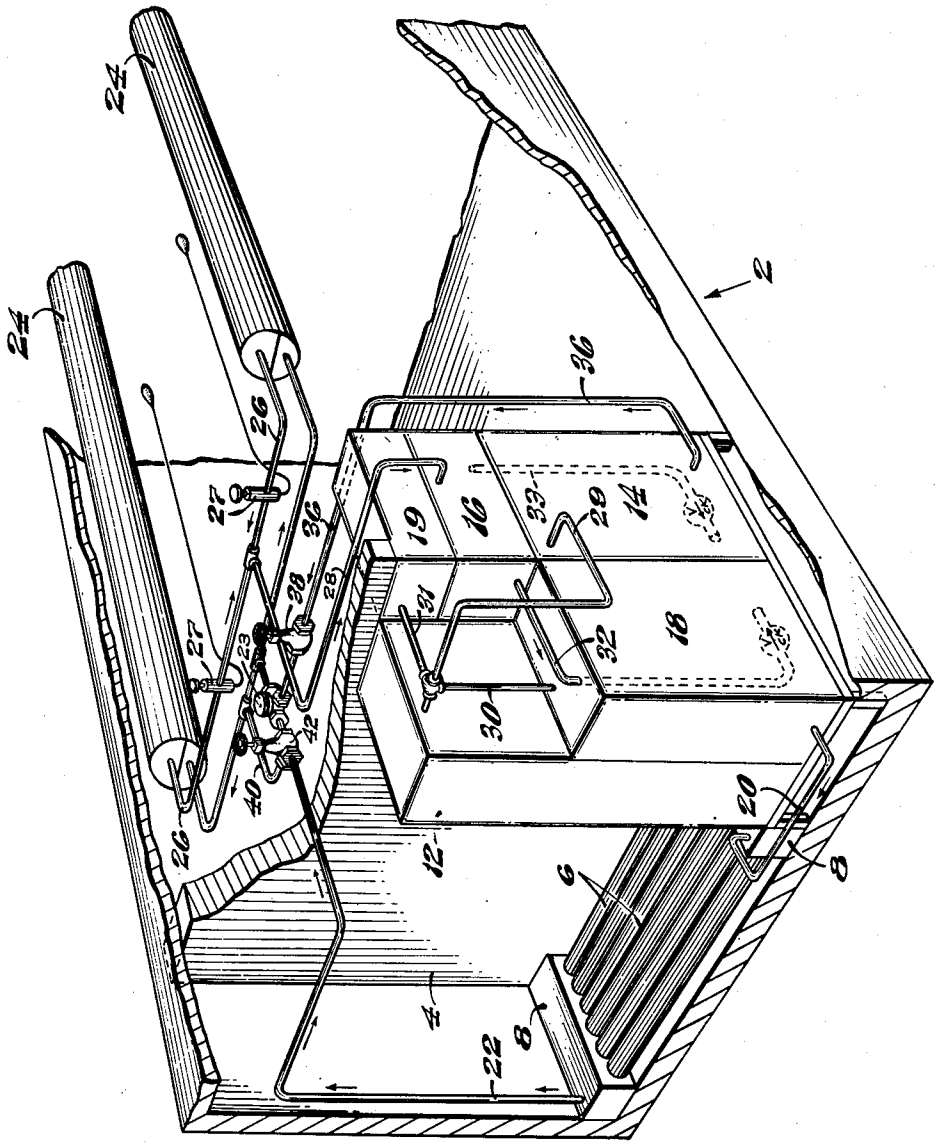
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REFRIGERATING APPARATUS

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## REFRIGERATING APPARATUS

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The present invention relates to refrigerating systems, and more particularly to temperature control systems useful in connection with refrigerating apparatus described in the Brunsing Patent 2,450,713, and my copending application filed of even date herewith.

The apparatus there described uses Dry Ice to cool a liquid refrigerant, which is in turn used to cool the refrigerated space. The refrigerant is circulated by the pressure from a separate tank of Dry Ice, and its flow is regulated by thermostatically controlled valves.

Consideration has been given to the use of a system of this general type for cooling freight cars carrying perishable foods, such as lettuce, celery and spinach. These vegetables must be kept at a temperature of about 40° F. In the Brunsing system the cooling coils are usually at a temperature of approximately 0° F. to 10° F. This causes the moisture of the air to condense and freeze on the cooling coils, thereby lowering the humidity of the car and causing the vegetables to become dehydrated.

The object of the present invention is to provide a temperature control system which will keep the temperature in the refrigerated space at a pre-determined level without allowing the temperature of the cooling coils to fall below the freezing point.

With this object in view, the principal feature of the present invention contemplates the division of the refrigerant returning from the cooling coils into two streams, only one of which is circulated through the cooling coils. These two streams are then mixed by a thermostatically controlled valve which maintains the refrigerant at some pre-determined intermediate temperature. If the body of the freight car is to be kept at 40° F., the mixing valve may be set to maintain the refrigerant at a temperature of 33° F. Refrigerant of this temperature is sufficiently cold to refrigerate the car, but not cold enough to cause the condensate on the cooling coils to freeze. Thus dehumidification of the cargo is avoided.

The accompanying drawing is a diagram of the preferred apparatus according to the present invention.

In the drawing the freight car 2 is indicated in outline. The car has at one end a cooling space ordinarily of the type used as an ice bunker, bounded by the wall 4, which completely separates the bunker from the body of the car. On the floor of this space is a series of cooling pipes or coils 6 connected with headers 8 and

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adapted to support a considerable quantity of Dry Ice. Contained within the tubes and headers is a circulating cooling medium which may be an alcohol, an ethylene glycol mixture or any suitable material having a sufficiently low freezing point so that it remains fluid at the temperature encountered in the Dry Ice system. This material is sometimes referred to as "brine" even though it contains no salt.

The storage space in which the Dry Ice is contained may be referred to as the Dry Ice bunker. This bunker may contain several thousand pounds of Dry Ice which is in intimate heat exchange relation with the cooling coils.

Immediately beside the Dry Ice bunker is a container 12 which is referred to as the Dry Ice pressure tank. This container holds a relatively small quantity of Dry Ice which is used as a means of generating pressure for the circulating medium.

Two chambers, 14 and 18, are provided for the circulating medium. Above the chamber 14 is a float chamber 16, which receives the warm refrigerant. The compartment 19 above the float chamber contains valves and piping which are described in my above-mentioned copending application.

A pipe 20 connects the bottom of the chamber 18 with one of the headers 8 of the cooling coils. The other header is connected by a pipe 22 through a mixing valve 23 (to be later described) with ceiling coils 24 preferably located near the top of the car. Return pipes 26 lead from the coils 24 through thermostatic control valves 27 to a line 28 leading to the float chamber 16.

Pipes 29 and 30 lead from the Dry Ice pressure tank 12 into the chambers 14 and 18 to apply pressure continuously thereto. A pipe 31 leads from the pressure tank 12 to the valve chamber 19 which contains a valve controlled by a float in the chamber 16. A pipe 32 leads from the float chamber into the tank 18 and a pipe 33 leads from the float chamber into the tank 14, both of these pipes being provided with check valves to prevent back flow of fluid when the float chamber is vented to atmosphere.

Except for the chamber 14, the connections thereto, and the mixing valve, the parts thus far described are similar to those of my copending application, and are not here described in detail. It is sufficient to note that the valve mechanism in the chamber 19 applies pressure intermittently to the float chamber 16. This mechanism is operated by a float in the chamber 16. When the refrigerant coming from the cool-

ing coils 24 rises to a certain level in the float chamber, the float trips a valve which then applies the pressure from the Dry Ice pressure chamber to the float chamber through the line 31. Hence when the pressure of the carbon dioxide is equalized in all three chambers the refrigerant flows by gravity from chamber 16 into the chambers 14 and 18. When the brine in the float chamber has fallen to a certain level, the float again operates the valve mechanism, and vents the float chamber to atmosphere. This restores the pressure differential in the system which causes the refrigerant to circulate from 18 through the cooling coils and back to 16 as above described. It will be understood that the circulation of refrigerant is under the control of the thermostatic valves 27, whereby circulation is shut off except when the temperature in the car has risen to such a point that refrigeration is called for.

A line 36 connects the tank 14 directly with the mixing valve 23. Since the refrigerant circulated from tank 14 is not cooled, tank 14 may be termed the warm brine tank. Here the cold stream through 22 and the warm stream through 36 are mixed. The mixing valve is of conventional construction, having thermostatic means to control the mixing in such proportions as to maintain the refrigerant at any desired temperature, which may be in the neighborhood of 33° F. so that condensed moisture will not freeze on the coils 24.

The system may be operated in the manner of my copending application when transporting goods which require low-temperature refrigeration. To this end, there is provided a manual valve 38 in the warm-brine line 36. A by-pass line 40 connected to the cold-brine line 22 is connected around the mixing valve 23. A by-pass valve 42 is provided. When valve 38 is closed, the warm-brine stream is cut off and only the cold refrigerant is circulated. At the same time, valve 42 is turned to by-pass the cold refrigerant around the mixing valve. The system then operates in the manner described in my copending application.

Having thus described my invention, I claim:

1. A refrigerating system comprising a heat exchanger for cooling a fluid refrigerant, means for maintaining a supply of Dry Ice to cool the refrigerant, a container for Dry Ice to provide pressure for circulating the refrigerant, a chamber for receiving the circulated warm refrigerant, a pair of tanks, pipe connections between the tanks and chamber so disposed that part of the warm refrigerant flows into each tank, means for passing the refrigerant from one of the tanks through said heat exchanger, and a mixing valve for mixing the refrigerant thus cooled with warm refrigerant from the other tank to provide a cooling medium having a sufficiently high temperature to prevent excessive dehumidification of the space to be cooled.

2. A refrigerating system comprising a heat exchanger for cooling a fluid refrigerant, means for maintaining a supply of Dry Ice to cool the refrigerant, a container for Dry Ice to provide pressure for circulating the refrigerant, a float chamber to receive circulated warm refrigerant, a pair of tanks located below the level of the float chamber, pipe connections between the float chamber and tanks, pipe connections from the pressure container for applying pressure to the tanks, and a thermostatically controlled mixing valve for mixing the refrigerant cooled by the heat exchanger with warm refrigerant to provide a cooling medium having a sufficiently high temperature to prevent excessive dehumidification of the space to be cooled.

3. A refrigerating system comprising a heat exchanger for cooling a fluid refrigerant, means for maintaining a supply of Dry Ice to cool the refrigerant, a container for Dry Ice to provide pressure for circulating the refrigerant, a float chamber to receive circulated warm refrigerant, collecting means for warm refrigerant located below the level of the float chamber, pipe connections between the float chamber and collecting means, connections from the pressure container for applying pressure to the collecting means, a connection from the collecting means to the heat exchanger and a thermostatically controlled mixing valve for mixing the refrigerant cooled by the heat exchanger with warm refrigerant from the collecting means to provide a cooling medium having a sufficiently high temperature to prevent excessive dehumidification of the space to be cooled.

4. A refrigerating system comprising a heat exchanger for cooling a fluid refrigerant, means for maintaining a supply of Dry Ice to cool the refrigerant, a container for Dry Ice to provide pressure for circulating the refrigerant, a float chamber to receive circulated warm refrigerant, collecting means for warm refrigerant located below the level of the float chamber, means for dividing the circulated warm refrigerant into two streams, means for passing one of the streams through the heat exchanger, and a mixing valve to mix the two streams to provide a cooling medium having a sufficiently high temperature to prevent excessive dehumidification of the space to be cooled.

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