April 27, 1943. C. F. ALSING 2,317,709

REFRIGERATION APPARATUS

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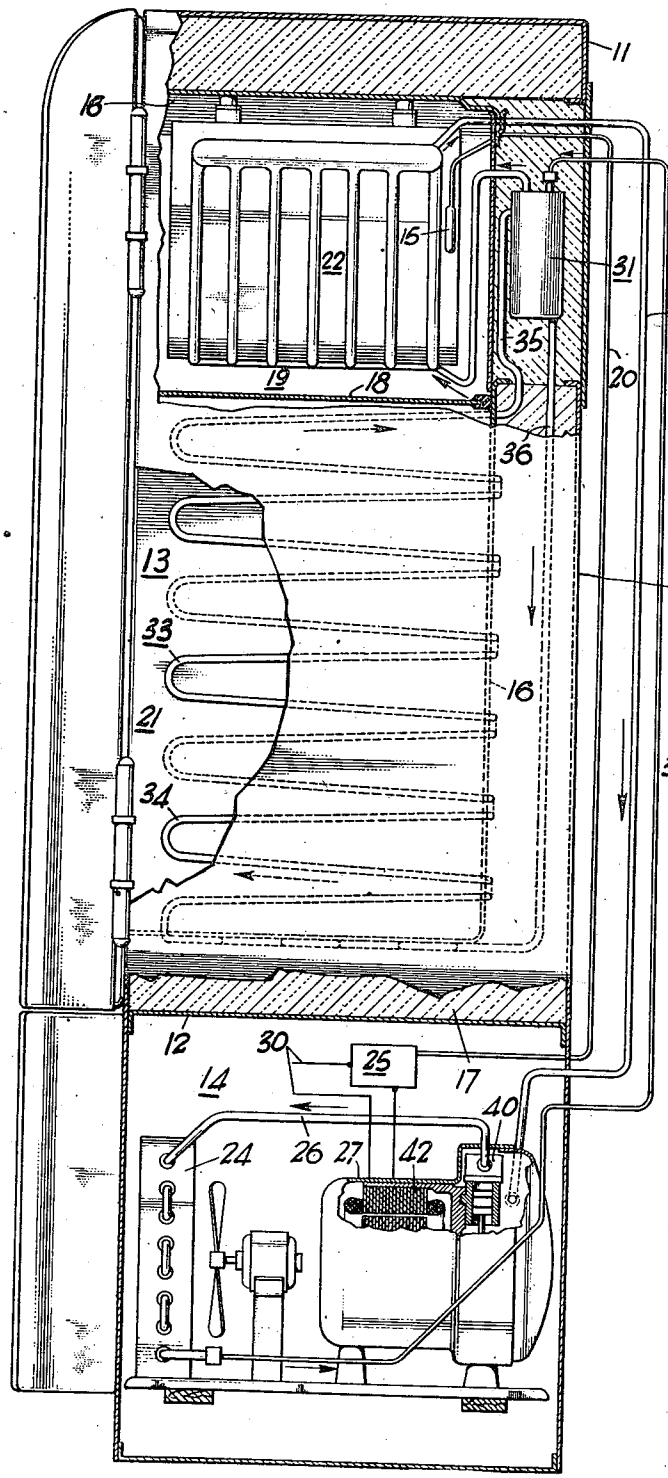

FIG. 1.

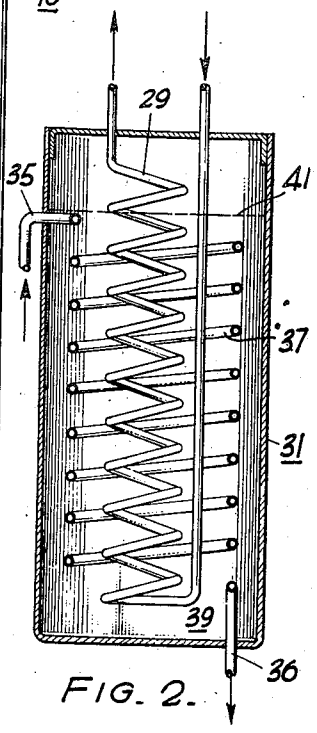

FIG. 2.

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REFRIGERATION APPARATUS

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5 Claims. (Cl. 62—99)

This invention relates to refrigerating apparatus and more especially to apparatus adapted to maintain a food-storage compartment at a high humidity.

One object of the invention is to provide a thermal storage capacity for an intermittently-operating refrigerating system.

Another object of the invention is to decrease the fluctuation in the temperature of the food-storage compartment caused by an intermittently-operating refrigerating apparatus.

These and other objects are effected by my invention as will be apparent from the following description and claims taken in accordance with the accompanying drawing, forming a part of this application, in which:

Fig. 1 is an elevation of a domestic refrigerator with parts broken away to show the refrigerating system of this invention; and

Fig. 2 is an enlarged sectional view of the thermal storage tank of this invention.

Referring to the drawing for a detailed description of the invention, the reference numeral 10 designates a refrigerating cabinet comprising an outer metal shell 11. The shell is divided by a horizontal partition 12 into an upper food-storage compartment 13 and a machine compartment 14 below the food-storage compartment 13. The food-storage compartment 13 is provided with an inner metal liner 16. Heat-insulating material 17 is packed between the inner liner 16 and the upper portion of the metal shell 11 and the partition 12. The food-storage compartment 13 is further divided by a horizontal partition 18 into an upper low-temperature, low-humidity compartment 19 and a high-humidity compartment 21 below the low-humidity compartment 19.

A primary refrigerant evaporator 22 is located in the low-humidity compartment and is provided with primary refrigerant liquid through a capillary tube 23 and a coil 29 from a primary refrigerant condenser 24. The condenser 24 receives compressed refrigerant vapor through a tube 26 from a compressor 40 driven by an electric motor 42, both the compressor 40 and the electric motor 42 being housed in a sealed casing 27. The compressor 40 withdraws refrigerant vapor through a suction tube 28 from the primary evaporator 22. The coil 29 is located in a thermal storage tank 31 and forms a second evaporator in series with the primary evaporator 22.

The refrigerating apparatus 22, 24, and 40 is operated intermittently to maintain the temperature of the primary evaporator 22 between, for example, 0° and 30° Fahrenheit. To this end a bulb 15 containing a volatile liquid is affixed in heat transfer relationship with the primary evaporator 22. The bulb 15 communicates through a tube 20 with an electric switch mechanism 25 interposed in one of two leads 30 which supply the electric motor 42 in the casing 27 with electric power. The switch mechanism 25 is of the snap-acting type and preferably has a temperature differential of 10° Fahrenheit in order to prevent an excessive number of starts of the refrigerating apparatus and to permit equalization of the refrigerant pressures in the system between operating cycles. The above-described regulating thermostat is well known in the art.

The high-humidity compartment 21 is refrigerated by a system containing a secondary refrigerant and including a secondary evaporator 33 comprising a tube 34 secured in heat-transfer relationship with the outer surface of the inner liner 16. The tube 34 is convoluted back and forth along the side walls, the back, and the bottom of the inner liner 16 to cool substantially the entire surface thereof. The tube 34 connects through tubes 35 and 36 with a secondary refrigerant condenser comprising a horizontally-coiled tube 37 located in the thermal storage tank 31 and spaced from the coil 29. The top area of the high-humidity compartment 21 is also refrigerated by conduction through the partition 18.

The thermal storage tank 31 contains a liquid 39, the upper level of which is indicated by the dotted line 41. The liquid comprises a solution of, for example, alcohol or glycerin and water, the solution preferably having a freezing point of from 15° to 25° Fahrenheit depending on the quantity of the liquid which is frozen.

Operation

The coil 29 forms an evaporative cooling unit fluctuating in temperature between 0° and 30° Fahrenheit with the active and inactive periods of the primary refrigerating apparatus 22, 24, and 40. When the primary refrigerating apparatus 22, 24, and 40 is active, and the temperature of the coil 29 is below 15° Fahrenheit, portions of the liquid 39 will freeze. During the freezing of the liquid 39, the latent heat of the frozen portion thereof is transmitted to the coil 29, so that the refrigerating effect of the coil 29 is not directed entirely to lowering the temperature of the secondary condenser coil 37. This keeps the unit running at higher suction pressure with better efficiency.

In like manner, when the refrigerating apparatus 22, 24, and 40 is inactive between operating periods, the temperatures of the coils 29 and 37 tend to increase above 15° Fahrenheit, but are partially prevented from doing so by the melting of the frozen solution in the thermal storage tank 31, which, on melting, regains its latent heat by absorbing heat mainly from the coil 37. The absorption of heat from the coil 37 tends to

continue its action as a condenser for the secondary refrigerant to cool the coil 34.

The full cooling effect of the primary refrigerant coil 29 is thus not transmitted toward the cooling of the secondary refrigerant coil 37 and the secondary refrigerant evaporator 34 during the active cycle of the refrigerating apparatus 22, 24, and 40 because a portion of the cooling effect of the coil 29 is stored by the formation of a frozen solution in the thermal storage tank 31. During the inactive period of the refrigerating apparatus 22, 24, and 40, the frozen solution melts and absorbs heat from the secondary refrigerant condenser 37, thereby to maintain the temperature in the high-humidity compartment 21 more uniform to overcome the effect of cycling of the refrigerating apparatus 22, 24, and 40.

The more uniform temperature of the high-humidity storage compartment 21 permits of a higher humidity therein, because less of the moisture in the air of the compartment 21 is condensed on the portion of the inner liner 16 of the compartment 21 during the active cycle of the refrigerating apparatus 22, 24, and 40, because of the higher temperature of the inner liner during the active cycle.

It will be apparent from the above that this invention provides thermal storage for an intermittently operating refrigerating system which storage decreases the fluctuations in the temperature of the high-humidity food-storage compartment and makes possible the maintenance of a higher humidity therein.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What I claim is:

1. In refrigerating apparatus, the combination of an insulated cabinet defining a low-humidity and a high-humidity compartment, a thermal storage liquid, a primary cooling unit for cooling the low-humidity compartment and the thermal storage liquid, means for intermittently supplying the primary cooling unit with refrigerant to maintain the temperature of said primary cooling unit between predetermined limits, a secondary evaporative cooling unit for cooling the high-humidity compartment, said secondary evaporative cooling unit having extended heat-absorbing surfaces, and a condenser for said secondary evaporative cooling unit, said condenser being in heat-transfer relationship with said thermal storage liquid, said thermal storage liquid having a congealing point of such temperature that a substantial portion of the liquid congeals when said means supplies the primary cooling unit with refrigerant and melts when said means does not supply the primary cooling unit with refrigerant.

2. In refrigerating apparatus, the combination of an insulated cabinet defining a low-humidity and a high-humidity compartment, a primary cooling unit for cooling the low-humidity compartment, a second primary cooling unit for cooling a thermal storage liquid, means for intermittently supplying said cooling units with refrigerant, a secondary cooling unit for cooling the high-humidity compartment, said secondary cooling unit having extended heat-absorbing surfaces, and means for conveying heat from said secondary cooling unit to said thermal storage liquid, said thermal storage liquid having a congealing point of such temperature that a substantial portion of the liquid congeals when said means supplies said second primary cooling unit with refrigerant and melts when said means does not supply the second primary cooling unit with refrigerant.

3. In refrigerating apparatus, the combination of an insulated cabinet defining a low-humidity and a high-humidity compartment, a primary cooling unit for cooling the low-humidity compartment, a second primary cooling unit for cooling a thermal storage liquid, means for intermittently supplying said cooling units with refrigerant to maintain the temperature of the low-humidity compartment between predetermined limits, a secondary evaporative cooling unit for cooling the high-humidity compartment, said secondary evaporative cooling unit having extended heat-absorbing surfaces, and a condenser for said secondary evaporative cooling unit, said condenser being in heat-transfer relationship with said thermal storage liquid, said thermal storage liquid having a congealing point of such temperature that a substantial portion of the liquid congeals when said means supplies the second primary cooling unit with refrigerant and melts when said means does not supply the second primary cooling unit with refrigerant.

4. In refrigerating apparatus, the combination of a cabinet, a metal liner therein, said cabinet defining a low-humidity and a high-humidity compartment, a primary cooling unit for cooling the low-humidity compartment, a second primary cooling unit for cooling a thermal-storage liquid, means for intermittently supplying said cooling units with refrigerant, a secondary cooling unit in heat-transfer relationship with a large portion of the metal linear of the high-humidity compartment, and means for conveying heat from said secondary cooling unit to said thermal-storage liquid, said thermal-storage liquid having a congealing point of such temperature that a substantial portion of the liquid congeals when said means supplies said second primary cooling unit with refrigerant and melts when said means does not supply the second primary cooling unit with refrigerant.

5. In refrigerating apparatus, the combination of a cabinet, heat-insulating material surrounding said cabinet, a chamber located in said heat-insulating material, a thermal-storage liquid in said chamber, a partition in said cabinet to divide the same into two food-storage compartments, a primary cooling unit for cooling one of said compartments, a second primary cooling unit for cooling said thermal-storage liquid, means for intermittently supplying said primary cooling units with refrigerant, a secondary cooling unit for cooling the other of said compartments, said secondary cooling unit having extended heat-absorbing surfaces, and means for conveying heat from said secondary cooling unit to said thermal-storage liquid, said thermal-storage liquid having a congealing point of such temperature that a substantial portion of the liquid congeals when said means supplies said second primary cooling unit with refrigerant and melts when said means does not supply said second primary cooling unit with refrigerant.

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