Feb. 2, 1954 L. W. ATCHISON 2,667,756

TWO-TEMPERATURE REFRIGERATING SYSTEMS

Filed Jan. 10, 1952

Fig. 1.

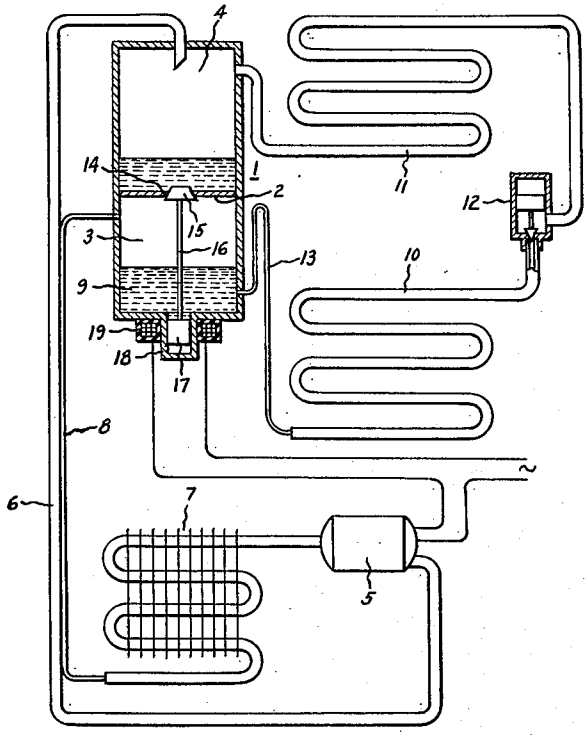


Fig. 2.

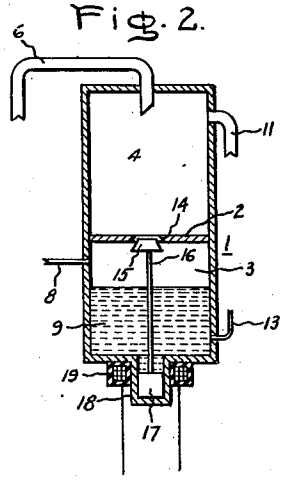


Fig. 3.

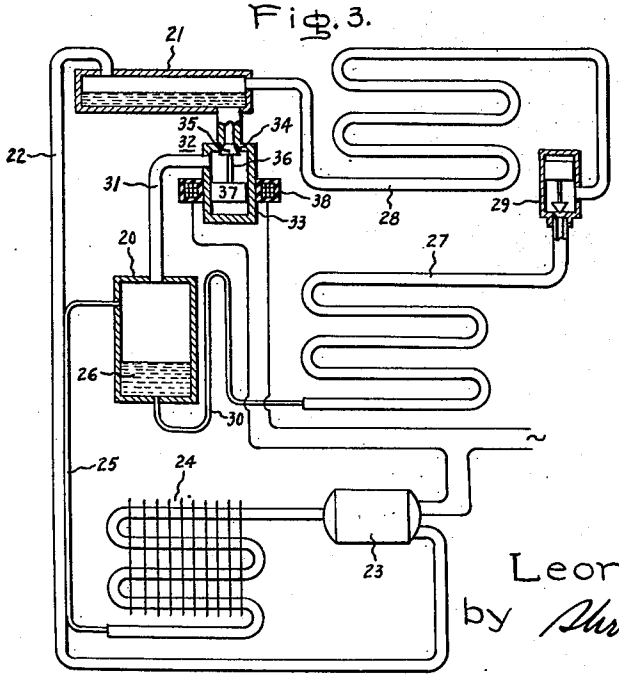
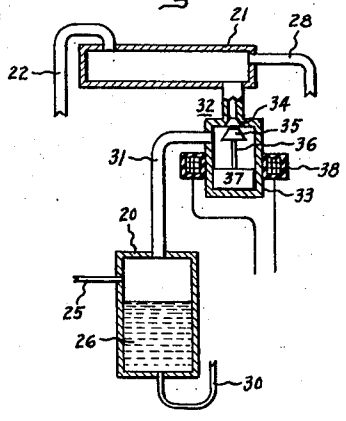


Fig. 4.



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TWO-TEMPERATURE REFRIGERATING SYSTEM

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7 Claims. (Cl. 62—3)

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My invention relates to refrigeration apparatus and pertains more particularly to two-temperature refrigerating systems wherein the fresh food evaporator and freezer evaporator are connected and operated in series.

The primary object of my invention is to provide an improved two-temperature refrigerating system including a fresh food evaporator and a freezer evaporator connected in series, and means for promptly supplying liquid refrigerant to the evaporators substantially immediately after a refrigerating unit in the system commences operating.

Another object of my invention is to provide an improved two-temperature refrigerating system including a fresh food evaporator and a freezer evaporator connected in series, means for supplying liquid refrigerant to the evaporators during operation of a refrigerating unit in the system, and means whereby pressure equalization is effected between the high and low pressure sides of the system during idle periods of the refrigerating unit.

Further objects and advantages of my invention will become apparent as the following description proceeds and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

In carrying out the objects of my invention, I provide a two-temperature refrigerating system including a reservoir, a header, a refrigerating unit, a fresh food evaporator and a freezer evaporator connected in series, and means in the connection between the evaporators for maintaining a pressure differential therebetween. The refrigerating unit is arranged to supply refrigerant to the reservoir and to exhaust refrigerant from the header. By means of a trap, the inlet side of the fresh food evaporator is connected to the reservoir below a normal liquid level therein. The outlet side of the freezer evaporator is connected to the header. Communication is provided between the reservoir and the header. The communication is controlled by a solenoid-operated valve which is connected in series with the motor of the refrigerating unit. When the refrigerating unit is operating, the valve is maintained closed, and when the refrigerating unit is idle, the valve is open.

For a better understanding of my invention, reference may be had to the accompanying drawing, in which

Fig. 1 is a schematic showing of a two-temperature refrigerating system illustrating one embodiment of my invention;

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Fig. 2 is a sectional view of the vertical member illustrating the valve open;

Fig. 3 is a schematic showing of a two-temperature refrigerating system illustrating a second embodiment of my invention; and

Fig. 4 is a sectional view of the reservoir and header arrangement in the second embodiment of my invention and illustrating the valve open.

I have shown in Fig. 1, a two-temperature refrigerating system including a vertical member 1. The vertical member 1 is divided by a partition 2 into a lower chamber 3 and an upper chamber 4. The lower chamber 3 is a refrigerant reservoir and the upper chamber 4 is a header. Also included in the system is a refrigerating unit 5. A suction line 6 connects the refrigerating unit 5 with the upper chamber or header 4. The refrigerating unit 5 exhausts vaporous refrigerant from the header 4 through the suction line 6, compresses it, and delivers it to a condenser 7. From the condenser 7, liquid refrigerant is delivered by a capillary tube 8, placed in heat exchange relationship with the suction line 6, to the lower chamber or reservoir 3. The reservoir 3 is adapted to hold a reserve of liquid refrigerant indicated by 9.

Connected in series in the system is a fresh food evaporator 10 and a freezer evaporator 11. In the connection between the fresh food evaporator 10 and the freezer evaporator 11 is a weight-type pressure differential valve 12. By means of a trap 13, the inlet side of the fresh food evaporator 10 is connected to the reservoir 3 at a point below the normal level of the liquid reserve 9. The outlet side of the freezer evaporator 11 is connected to the header 4 at a point adjacent the top thereof.

Formed in the partition 2 for providing communication between the reservoir 3 and the header 4 is an aperture 14. Provided for cooperating with the aperture 14 to control the communication between the header and the reservoir is a valve head 15. This broad feature of controlling communication between a header and a reservoir by means of a valve is not my invention but is described and claimed in the copending application of Frank A. Schumacher, Serial No. 265,813, filed January 2, 1952, now Patent No. 2,641,113, and assigned to the same assignee as the present application. In the present invention, the valve head 15 is fixed on the upper end of a stem 16. The lower end of the stem 16 extends downwardly into the liquid reserve 9 and is suitably secured to a plunger 17 disposed for vertical sliding movement in a non-magnetic cup 18 fitted in the bottom of the reservoir 3. The

plunger 17 is the armature of a solenoid 19, the coil of which is fitted on the exterior of the cup 18, as shown in Figs. 1 and 2. The circuit of the solenoid 19 is connected in series with the motor (not shown) of the refrigerating unit 5.

During operating periods of the refrigerating unit 5, the solenoid 19 is energized and the plunger or armature 17 is held in the raised position shown in Fig. 1. When the plunger 17 is raised, the valve head 15 is maintained seated in the aperture 14. Thus, communication between the reservoir 3 and the header 4 is discontinued and refrigerant pressure is permitted to accumulate in the reservoir 3. This accumulation of pressure in the reservoir 3, which commences substantially immediately upon starting of the refrigerating unit 5, exerts a force on the surface of the liquid reserve 9 therein, and since one end of the trap 13 is connected to the reservoir below the level of the reserve, the liquid refrigerant is thereby promptly supplied through the trap 13 to the inlet side of the fresh food evaporator 10. When the pressure of the refrigerant in the fresh food evaporator 10 is sufficient to overcome the weight on the valve in the pressure differential valve 12, it passes therethrough and to the inlet side of the freezer evaporator 11. From the outlet side of the freezer evaporator 11, the refrigerant is expelled into the header 4 in both vaporous and liquid forms. The vaporous refrigerant is drawn out of the header through the suction line 8 by the refrigerating unit 5. The liquid refrigerant collects in the bottom of the header 4, in the manner shown in Fig. 1.

When the refrigerating unit 5 stops operating due to opening of the circuit of the motor therein, the solenoid 19 which is connected in series with the motor is de-energized. With the solenoid de-energized, the plunger 17 falls to a lowered position, as shown in Fig. 2. Lowering of the plunger 17 lowers the valve head 15 out of the aperture 14, thereby permitting communication between the reservoir 3 and the header 4. In this manner, the liquid refrigerant collected in the header 4 is permitted to drain into the reservoir 3 for replenishing the liquid reserve 9 in preparation for the next operating period of the refrigerating unit 5. Also, lowering of the valve head 15 out of the aperture 14 provides for equalization of pressures between the high and low pressure sides of the system, or between the outlet side of the capillary tube 8 and the inlet side of the suction tube 6.

It will be seen that if the pressure differential valve 12 were removed from the connection between the fresh food evaporator 10 and the freezer evaporator 11, the temperature of both evaporators would be substantially the same and, in effect, would constitute a single or one-temperature evaporator. Therefore, it will be seen also that my invention applies equally as well to one-temperature refrigerating systems as to two-temperature refrigerating systems.

In Fig. 3, I have shown a second embodiment of my invention which includes a refrigerant reservoir 20 and a header 21 located above the refrigerant reservoir. A suction line 22 connects the header 21 with a refrigerating unit 23. The refrigerating unit 23 exhausts vaporous refrigerant from the header 21 through the suction line 22, compresses it, and delivers it to a condenser 24. From the condenser 24, liquid refrigerant is delivered by a capillary tube 25 placed in heat exchange relationship with the suction line 22 to the reservoir 20. The reservoir 20 holds a reserve of liquid refrigerant indicated by 26.

Connected in series in the system is a fresh food evaporator 27 and a freezer evaporator 28. Provided in the connection between the fresh food evaporator and the freezer evaporator is a weight-type pressure differential valve 29. Connected to the bottom of the reservoir 20 is one end of a trap 30. The other end of the trap 30 is connected to the inlet side of the fresh food evaporator 27. The outlet side of the freezer evaporator 28 is connected to the side of the header 21 adjacent the top thereof. Provided for connecting the bottom of the header 21 with the top of the reservoir 20 is a conduit 31. Included in the conduit construction for controlling communication between the reservoir 200 and the header 21 is a solenoid-operated valve 32. The valve 32 includes a non-magnetic housing 33 having a valve seat 34 formed therein, and a valve head 35 arranged to cooperate with the valve seat. The valve head 35 is connected by a stem 36 to a plunger 37 arranged for vertical sliding movement in the housing 33. The plunger 37 is the armature of a solenoid 38 the coil of which is fitted on the exterior of the housing 33, as shown in Figs. 3 and 4. The circuit of the solenoid 38 is connected in series with the motor (not shown) of the refrigerating unit 23.

During operation of the refrigerating unit 23, the solenoid 38 is energized and the plunger or armature 37 is thereby held in the raised position shown in Fig. 3. When the plunger 37 is raised, the valve head 35 is maintained seated in the valve seat 34. Thus, communication between the reservoir 20 and the header 21 is discontinued and refrigerant pressure is permitted to accumulate in the reservoir. This accumulation of pressure in the reservoir 20 commences substantially immediately after the starting of the refrigerating unit 23 and effects an exertion of force on the surface of the liquid reserve 26. As a result, liquid refrigerant is forced out of the reservoir 20 and up through the trap 30 to the inlet side of the fresh food evaporator 27. After passing through the pressure differential valve 29 and the freezer evaporator 28, the refrigerant is discharged from the outlet side of the freezer evaporator into the header 21 in both vaporous and liquid forms. The vaporous refrigerant is drawn out of the header 21 through the suction line 22 by the refrigerating unit 23, and the liquid refrigerant collects in the bottom of the header 21 as shown in Fig. 3.

When the circuit of the motor in the refrigerating unit 23 is opened for stopping the unit, the solenoid 38 which is connected in series with the motor is de-energized. With the solenoid 38 de-energized, the plunger 37 falls to the lowered position shown in Fig. 4. This results in the lowering of the valve head 35 out of the valve seat 34. Opening of the valve 32 in this manner permits communication between the header 21 and the reservoir 20. Thus, the liquid collected in the header 21 is permitted to drain into the reservoir 20 for replenishing the liquid reserve 26 therein in preparation for the next operating period of the refrigerating unit 23. Also, opening of the valve 32 provides for equalization of pressures between the high and low pressure sides of the system or between the outlet side of the capillary tube 25 and the inlet side of the suction tube 22.

In this embodiment, as in the first-described embodiment, removal of the pressure differential

valve between the fresh food evaporator and the freezer evaporator would result in obtaining a system with a one-temperature evaporator. Therefore, it will be seen that this embodiment of my invention is also as equally adaptable to one-temperature refrigerating systems as to two-temperature refrigerating systems.

While I have shown and described specific embodiments of my invention, I do not desire my invention to be limited to the particular constructions shown and described, and I intend by the appended claims to cover all modifications which fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A refrigerating system comprising a refrigerant reservoir, a header located above said reservoir, a refrigerating unit supplying refrigerant to said reservoir and exhausting refrigerant from said header, refrigerant evaporating means, one side of said refrigerant evaporating means being connected to said reservoir below the normal level of a liquid reserve therein, the other side of said refrigerant evaporating means being connected to said header, means providing communication between said reservoir and said header, a solenoid-operated valve controlling said communication between said reservoir and said header, and control means for said solenoid-operated valve operated in response to the operation of said refrigerating unit to effect the operation of said valve to close said communication during operation of said refrigerating unit thereby to permit an accumulation of pressure in said reservoir and the prompt supply of refrigerant therefrom, and said control means effecting the operation of said solenoid-operated valve to open said communication during idle periods of said refrigerating unit thereby to permit drainage of liquid refrigerant from said header into said reservoir and effect the equalization of pressure between the high and low pressure sides of the system.

2. A refrigerating system comprising a refrigerant reservoir, a header located above said reservoir, a refrigerating unit including a motor, said refrigerating unit supplying refrigerant to said reservoir and exhausting refrigerant from said header, refrigerant evaporating means, one side of said refrigerant evaporating means being connected to said reservoir below the normal level of a liquid reserve therein, the other side of said refrigerant evaporating means being connected to said header, means providing communication between said reservoir and said header, a valve controlling said communication between said reservoir and said header, and a solenoid connected in series with said motor of said refrigerating unit being operably associated with said valve, said solenoid being energized and closing said valve during operation of said refrigerating unit thereby to permit an accumulation of pressure in said reservoir and the prompt supply of refrigerant from said liquid reserve therein to said refrigerant evaporating means, and said solenoid being de-energized and said valve being open during idle periods of said refrigerating unit to permit drainage of liquid refrigerant from said header into said reservoir for replenishing said reserve and to equalize pressure between the high and low pressure sides of the system.

3. A two-temperature refrigerating system comprising a vertical member divided into lower and upper chambers, said lower chamber being a refrigerant reservoir, said upper chamber being a header, a refrigerating unit supplying refrigerant to said reservoir and exhausting refrigerant from said header, a fresh food evaporator and a freezer evaporator connected in series, means maintaining a pressure differential between said fresh food evaporator and said freezer evaporator, the inlet side of said fresh food evaporator being connected to said reservoir beneath the normal level of a liquid reserve in said reservoir, the outlet side of said freezer evaporator being connected to said header, means providing communication between said reservoir and said header, a solenoid-operated valve controlling said communication between said reservoir and said header, and control means for said solenoid-operated valve operated in response to the operation of said refrigerating unit to effect the operation of said valve to close said communication during operation of said refrigerating unit thereby to permit an accumulation of pressure in said reservoir and the prompt supply of refrigerant therefrom, and said control means effecting the operation of said solenoid-operated valve to open said communication during idle periods of said refrigerating unit thereby to permit drainage of liquid refrigerant from said header into said reservoir and effect the equalization of pressures between the high and low pressure sides of the system.

4. A two-temperature refrigerating system comprising a vertical member divided into lower and upper chambers by a horizontal partition, said lower chamber being a refrigerant reservoir, said upper chamber being a header, a refrigerating unit including a motor, said refrigerating unit supplying refrigerant to said reservoir and exhausting refrigerant from said header, a fresh food evaporator and a freezer evaporator connected in series, means maintaining a pressure differential between said fresh food evaporator and said freezer evaporator, the inlet side of said fresh food evaporator being connected to said reservoir below the normal level of a liquid reserve in said reservoir, the outlet side of said freezer evaporator being connected to said header, a valve in said horizontal partition providing controlled communication between said reservoir and said header, and a solenoid connected in series with said motor of said refrigerating unit being operably associated with said valve, said solenoid being energized and closing said valve during operation of said refrigerating unit thereby to permit an accumulation of pressure in said reservoir and the prompt supply of refrigerant therefrom, said solenoid being de-energized and said valve being open during idle periods of said refrigerating unit thereby to permit drainage of liquid refrigerant from said header into said reservoir for replenishing said reserve and to equalize pressure between the high and low pressure sides of the system.

5. A two-temperature refrigerating system comprising a reservoir, a header, a refrigerating unit including a motor, said refrigerating unit supplying refrigerant to said reservoir and exhausting refrigerant from said header, a fresh food evaporator and a freezer evaporator connected in series, means maintaining a pressure differential between said fresh food evaporator and said freezer evaporator, the inlet side of said fresh food evaporator being connected to said reservoir below the normal level of a liquid reserve in said reservoir, the outlet side of said freezer evaporator being connected to said header, a conduit

providing communication between said reservoir and said header, a solenoid-operated valve in said conduit controlling said communication, and control means for said solenoid-operated valve operated in response to the operation of said refrigerating unit to effect the operation of said valve to close said communication during operation of said refrigerating unit thereby to permit an accumulation of pressure in said reservoir and the prompt supply of refrigerant therefrom, and said control means effecting the operation of said solenoid-operated valve to open said communication during idle periods of said refrigerating unit thereby to permit drainage of liquid refrigerant from said header into said reservoir and effect the equalization of pressure between the high and low pressure sides of the system.

6. A two-temperature refrigerating system comprising a reservoir, a header located above said reservoir, a refrigerating unit including a motor, said refrigerating unit supplying refrigerant to said reservoir and exhausting refrigerant from said header, a fresh food evaporator and a freezer evaporator connected in series, means maintaining a pressure differential between said fresh food evaporator and said freezer evaporator, the inlet side of said fresh food evaporator being connected to said reservoir below the normal level of a liquid reserve in said reservoir, the outlet side of said freezer evaporator being connected to said header, a conduit providing communication between said reservoir and said header, a valve in said conduit controlling said communication between said reservoir and said header, and a solenoid connected in series with said motor being operably associated with said valve, said solenoid being energized and closing said valve during operation of said refrigerating unit thereby to permit an accumulation of pressure in said reservoir and the prompt supply of refrigerant therefrom, and said solenoid being de-energized and said valve being open during

idle periods of said refrigerating unit to permit drainage of liquid refrigerant from said header into said reservoir for replenishing said reserve and to equalize pressure between the high and low pressure sides of the system.

7. A refrigerating system comprising a refrigerant reservoir, a header located above said reservoir, a refrigerating unit supplying refrigerant to said reservoir and exhausting refrigerant from said header, refrigerant evaporating means, one side of said refrigerant evaporating means being connected to said reservoir below the normal level of a liquid reserve therein, the other side of said refrigerant evaporating means being connected to said header, means providing communication between said reservoir and said header, a valve controlling said communication between said reservoir and said header, and means to control said valve to close said communication during operation of said refrigeration unit thereby to permit an accumulation of pressure in said reservoir and the prompt supply refrigerant therefrom and to open said communication during idle periods of said refrigerating unit thereby to permit drainage of liquid refrigerant from said header into said reservoir and effect the equalization of pressure between the high and low pressure sides of the system.

LEONARD W. ATCHISON.

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