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REFRIGERATING APPARATUS

Filed May 29, 1931

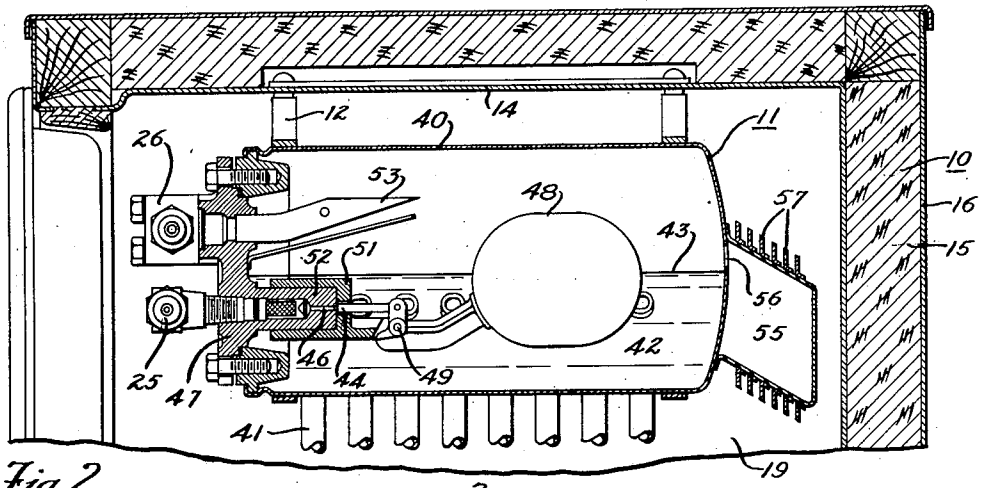


Fig. 2

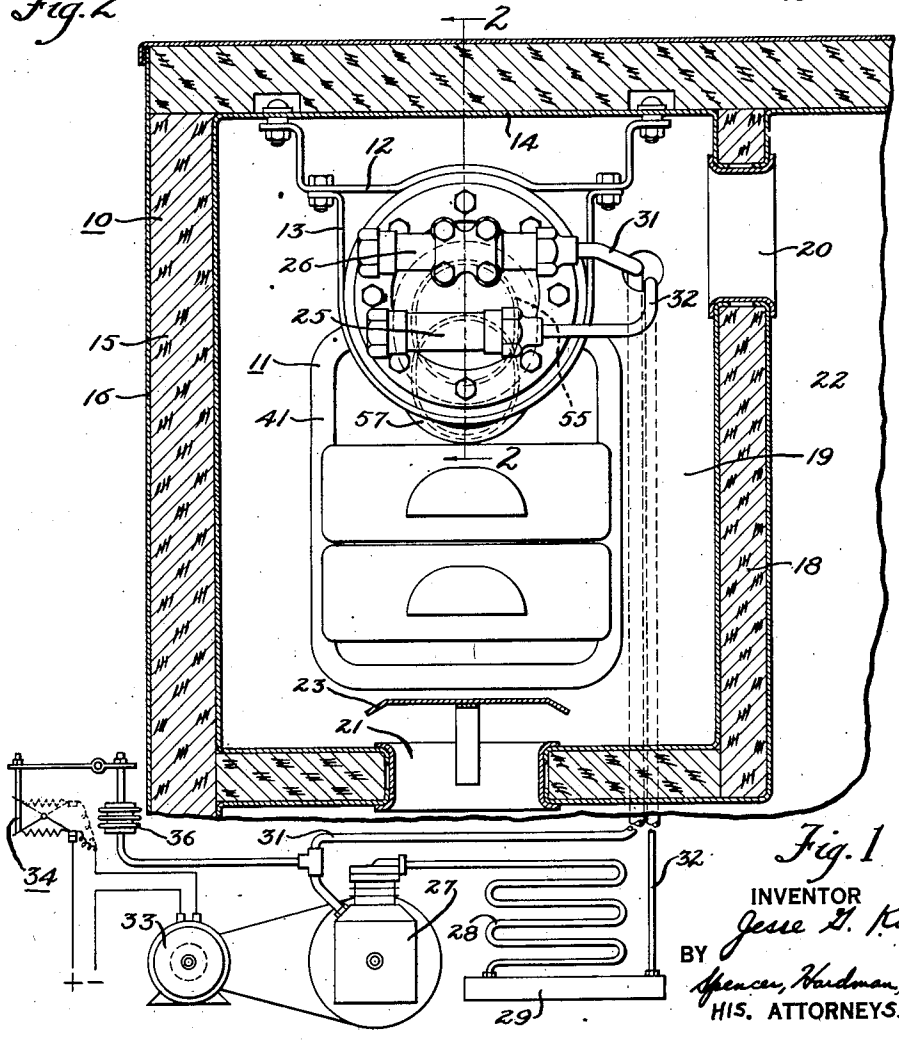


Fig. 1

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REFRIGERATING APPARATUS

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This invention relates to refrigerating systems and particularly to that type of a system in which a quantity of liquid refrigerant is maintained in the evaporator thereof.

Heretofore in refrigerating systems, employing a valve to normally maintain a predetermined quantity or level of liquid refrigerant in the evaporator of the system, no provision has been made to prevent excess liquid refrigerant entering the evaporator during temporary abnormal operation of the system, or during periods of time when the valve is temporarily held open, from flowing into the outlet thereof. Excess liquid refrigerant upon entering the outlet of the evaporator and the gaseous refrigerant conduit leading therefrom causes frost to collect on this conduit which frost will melt, when operation of the system again becomes normal, and will flow on to the floor or walls of the building in which the system is installed, thus causing deterioration of the floor and these walls.

The object of the present invention is to provide an evaporator of a refrigerating system with means whereby a temporary flow of an excessive quantity of liquid refrigerant to the evaporator is prevented from entering the outlet thereof.

Another object of the invention is to provide means whereby a temporary flow of an excessive quantity of liquid refrigerant to an evaporator of a refrigerating system will be readily vaporized to prevent the level of liquid refrigerant maintained therein from rising above a predetermined height. In carrying out my invention I provide a trap or reservoir communicating with the interior of the evaporator, so as to receive the temporary flow of excess liquid refrigerant thereto, which trap I dispose in the path of flow of the medium to be or being cooled by the evaporator so that rapid vaporization of the excess liquid refrigerant occurs.

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

In the drawing:

Fig. 1 is a vertical section through a portion of a refrigerator cabinet having an evaporator constructed in accordance with my invention installed therein and operatively connected with a refrigerant liquefying unit shown diagrammatically; and

Fig. 2 is an enlarged sectional view of my improved evaporator taken on the lines 2—2 of Fig. 1.

Referring to the drawing, Fig. 1 discloses a vertical section of a portion of a cabinet 10 illustrating the installation of an evaporator or cooling unit 11 constructed according to my invention. The evaporator 11 is supported within the cabinet 10 by brackets 12 and 13 attached to the inner lining 14 of the cabinet. The lining 14 of the cabinet 10 is covered with insulation 15 and an outer framework or covering 16. An L-shaped partition 18 provides a compartment 19 for the evaporator and has openings 20 and 21 located therein for the circulation of air through compartment 19 for cooling the rest of the cabinet or food storage chamber 22 thereof. The bonnet 23 prevents any dripping of condensed moisture from the evaporator on to the food stored in the chamber 22 below the opening 21. The air within the compartment 19 upon being cooled by the cooling effect produced by the evaporator is caused to circulate. The cold air circulates downwardly through the opening 21 and into the food storage chamber 22 while the relative warmer air in chamber 22, upon being displaced by the air cooled by the evaporator, flows through the opening 20 and thence downwardly over the evaporator.

The evaporator 11 includes connections 25 and 26 adapted to be connected to a refrigerant liquefying unit. I have shown the evaporator 11 connected to a refrigerant liquefying unit of the compressor-condenser-expander type which includes a compressor 27, a condenser 28 and a liquid refrigerant tank 29. Refrigerant vapor is withdrawn from the evaporator 11 through a vapor or low pressure conduit 31 and is liquefied in the condenser 28 and returned to the evaporator 11 through a liquid or high pressure

conduit 32. The compressor 27 is operated by a motor 33 controlled by an automatic switch 34 which may be actuated in response to the refrigerating demand, for example by a pressure-responsive device 36 connected to the low pressure conduit 31. It is obvious in systems of the type disclosed that the pressure-responsive device 36 which actuates the switch 34 for controlling the electric circuit to the motor is adjusted to operate between certain pressure limits. Since pressures and temperatures of the refrigerant increase or decrease uniformly, it is apparent that the device 36 is adapted to maintain certain predetermined temperature limits within the evaporator of the system.

At the beginning of operation of the system, the period of time between starting of the motor and compressor and stopping thereof is referred to as the "on phase" of a cycle of operation of the refrigerant liquefying unit, the period of time between two successive operating periods or "on phases" of the refrigerant liquefying unit is referred to as an "off phase" of a cycle of operation of the unit. Thus, it is apparent that while the system is in operation to produce refrigeration, the refrigerant liquefying unit is cyclically operated and that each cycle thereof includes an "one phase" and an "off phase".

Referring now to Fig. 2, evaporator 11 comprises a header or receptacle 40 forming a reservoir for liquid refrigerant, and a plurality of ducts 41 depending from the receptacle or header 40 for circulating refrigerant to a point remote from the header. The liquid refrigerant indicated at 42 is normally prevented from rising above the predetermined level 43 by a valve 44 which controls a liquid refrigerant inlet opening 46 extending from the connection 25 through an end plate 47. Valve 44 is actuated in response to the liquid refrigerant level by a float 48. Float 48 is pivotally mounted as at 49 to a member 51 which is secured, in any suitable manner, to an inwardly extending boss 52 formed on the end plate 47. The liquid refrigerant is supplied to the evaporator through inlet connection 25 and the vapor or gaseous refrigerant is withdrawn through an outlet opening or inwardly extending pipe 53, thence through the connection 26 connected to the vapor conduit 31.

In refrigerating systems of the type disclosed employing a valve for maintaining a predetermined quantity or level of liquid refrigerant in the evaporator thereof, it has been found that foreign particles in the system, which tend to circulate with the refrigerant, often gets caught or stuck between the control valve and its seat, thus causing an excess flow of liquid refrigerant to the evaporator. It is to be understood that this excess flow of liquid refrigerant may occur only temporarily or between one operating or "on phase" of the refrigerant liquefying unit and the succeeding "on phase" thereof. However, this temporary flow of excess liquid refrigerant into the evaporator has been found to be sufficient at times to raise the liquid level thereof in the evaporator to such a height that upon the succeeding "on phase" of a cycle of the refrigerant liquefying unit, liquid refrigerant will be splashed by the boiling action thereof into the gaseous refrigerant outlet of the evaporator. This splashing of liquid refrigerant into the outlet of the evaporator causes evaporation thereof in the gaseous refrigerant return conduit, leading from the outlet to the compressor of the unit, consequently a refrigerating effect is produced by the conduit and frost collects on the exterior thereof. In most installations of refrigerating systems of the type disclosed the gaseous refrigerant return conduit, leading from the evaporator to the refrigerant liquefying unit, has a greater portion of its length located exteriorly of the cabinet being refrigerated by the system. The collection of frost on the gaseous refrigerant conduit of the system, while the valve controlling the ingress of liquid refrigerant to the evaporator leaks temporarily, will melt when the valve again maintains a perfect seat against the inlet opening, to cause normal and proper flow of refrigerant to the evaporator, and moisture created by the melting of the front will flow from the conduit. This moisture upon flowing from the conduit drops or flows onto the floor or walls of the building, in which the refrigerator cabinet or the system is located, and causes deterioration thereof.

My invention is directed to a refrigerating system whereby temporary splashing of liquid refrigerant into the outlet of the evaporator thereof and the gaseous refrigerant return conduit connected to the outlet is prevented. This thereby prevents the collection or accumulation of frost on the conduit and consequently deterioration of the floor or walls, in which the refrigerator cabinet or the system is located, is prevented. I provide the evaporator of the system with conduit means or a trap, which is normally devoid or free of liquid refrigerant, to receive excess liquid refrigerant entering the evaporator. I place this trap or conduit means in the path of flow of the warmest air circulating within the cabinet and being cooled by the evaporator to cause rapid vaporization of the excess liquid refrigerant which enters the evaporator. By providing the evaporator with this conduit means or trap, liquid refrigerant is prevented from rising above a certain predetermined abnormal level in the evaporator and therefore evaporation of refrigerant in the evaporator does not splash liquid refrigerant into the outlet thereof.

Referring again to Fig. 2 of the drawing, I have provided an evaporator with means for receiving excess liquid refrigerant entering the evaporator and isolating same out of contact with the main body of liquid refrigerant in the evaporator which means also causes rapid vaporization of the excess liquid refrigerant. This means includes a trap or conduit means 55 carried by or secured to the header 40 of evaporator 11 and extending outwardly therefrom. The conduit means or trap 55 has an opening or a point of communication 56 with the interior of the evaporator. This opening 56 is disposed at a height or on a horizontal plane between the gaseous refrigerant outlet of the evaporator and the liquid refrigerant level 43 normally maintained therein. Fins or heat conducting members 57 may be secured in any suitable manner to the conduit means or trap 55 so as to be in good thermal contact therewith. Trap 55 is adapted to be located in the compartment 19 being, or to be, cooled by the evaporator so that it is disposed in the vicinity of or adjacent the opening 20. For the purpose of illustrating my invention I have shown the trap or conduit means 55 as being connected to the rear wall of the header 40 of the evaporator 11 and extending outwardly therefrom so as to be disposed in the path of relatively warm air entering the compartment 19 from the chamber 22 through the opening 20. It is thus apparent that the fins 57 will absorb heat from the relatively warmer air flowing thereover and conduct this heat to the liquid refrigerant in the trap, if any is present therein, thereby causing rapid vaporization of the liquid refrigerant.

During operation of the system, as previously described the compressor 27 upon being operated withdraws gaseous refrigerant from the evaporator 11 and reduces the pressure therein, thus causing more refrigerant to evaporate from the body of liquid thereof. As liquid evaporates it is obvious that the level 43 thereof within the header 40 will tend to lower but the float 48 responsive to this level also moves downwardly, thus moving the valve 44 away from its seat and permitting the entrance of liquid refrigerant from the conduit 32 and connection 25. If any particles of foreign material, tending to circulate with the refrigerant in the system, should get caught or become stuck between the valve 44 and its seat during the period of time the valve is open, the valve 44 will not entirely seal the liquid refrigerant inlet opening 46, after it has admitted the proper amount of liquid refrigerant to the evaporator. Therefore liquid refrigerant continues to leak past the valve 44 and raises the level 43 thereof in the header 40. The compressor 27 is usually of such capacity that a small leak of liquid refrigerant into the evaporator will not cause continuous operation of the refrigerant liquefying unit, therefore the compressor will reduce the pressure in the evaporator to the desired low limit and cause the pressure responsive device 36 to actuate the electric switch 34 to stop the motor 33 which drives the compressor 27. Upon the next succeeding operating period of the compressor the valve will again open and ordinarily such small particles caught between the valve and its seat will be removed or flushed therefrom by the force of the incoming liquid refrigerant to the evaporator. It is apparent therefore that such leakage of liquid refrigerant past the valve occurs only temporarily and between a few occasional complete cycles of the system only. Leaking of liquid refrigerant past the valve 44 causes the liquid refrigerant level 43 in the header 40 to rise to the opening or point of communication 56 between the trap 55 and the header 40. Thereafter the excessive quantity of liquid refrigerant entering the evaporator flows into the trap 55 where it is stored temporarily out of contact with the main body of liquid refrigerant in the evaporator. Since the trap 55 is disposed in the relatively warmer circulating air, rapid vaporizaton of the liquid refrigerant received therein will occur. In this manner the level of liquid refrigerant in the evaporator is prevented from rising and therefore this level does not attain a sufficient abnormal height to permit boiling or evaporating refrigerant in the evaporator to cause splashing of liquid refrigerant into the outlet thereof during the time the valve permits temporary leaks.

While I have described the system as circulating refrigerant only it is to be understood that it is usually necessary to lubricate operating parts thereof with a lubricant or oil and it is well-known to those skilled in the art that an oil lighter in specific gracity than the liquid refrigerant can be used successfully. Some of this lubricant may circulate with liquid refrigerant to the evaporator and will separate by gravity from the liquid refrigerant in the evaporator and will rise to the top surface thereof. Obviously this lubricant may flow into the trap or conduit means 55 of my improved evaporator without impairing the results desired to be obtained by its use. Such lubricant present in the trap 55 will be displaced by the entrance of liquid refrigerant thereto which refrigerant is heavier than the lubricant and gravitates to the bottom of the trap.

From the foregoing it is apparent that I have provided a novel evaporator and consequently an improved refrigerating system when operatively connected with such an evaporator. My improved evaporator insures that gaseous refrigerant only will enter the outlet thereof at all times, thereby the collection or accumulation of frost on the gaseous refrigerant return conduit leading

from the outlet of the evaporator is eliminated. By eliminating the collection of frost from the conduit during temporary abnormal conditions within the evaporator, I provide an improved system which is capable of operation over long periods of time without the danger of deteriorating floors or walls in which the system is located.

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 refrigerating system comprising in combination, an evaporator including a liquid refrigerant inlet opening and a gaseous refrigerant outlet opening, means controlling the ingress of liquid refrigerant through said inlet opening to said evaporator and for normally preventing liquid refrigerant from rising above a predetermined level therein, conduit means communicating with the interior of said evaporator and extending outwardly therefrom, the point of communication of said conduit means with said evaporator being disposed in a plane between the plane of said outlet opening of said evaporator and the liquid refrigerant level being maintained therein, said conduit means being normally entirely free of liquid refrigerant and arranged to receive liquid refrigerant rising above the normal level maintained in said evaporator by said first named means and said conduit means being also arranged to insolate liquid refrigerant received therein out of contact with the main body thereof in said evaporator.

2. In a refrigerating system comprising in combination, an evaporator including a liquid refrigerant inlet opening and a gaseous refrigerant outlet opening, means controlling the ingress of liquid refrigerant through said inlet opening to said evaporator and for normally preventing liquid refrigerant from rising above a predetermined level therein, a trap communicating with the interior of said evaporator and extending outwardly therefrom, the point of communication of said trap with said evaporator being disposed in a plane between the plane of said outlet opening of said evaporator and the liquid refrigerant level being maintained therein, said trap being normally entirely free of liquid refrigerant and arranged to receive liquid refrigerant rising above the normal level maintained in said evaporator by said first named means.

3. In a refrigerating system comprising in combination, an evaporator including a liquid refrigerant inlet opening and a gaseous refrigerant outlet opening, means controlling the ingress of liquid refrigerant through said inlet opening to said evaporator and for normally preventing liquid refrigerant from rising above a predetermined level therein, a trap carried by said evaporator and communicating with the interior thereof, the point of communication of said trap with said evaporator being disposed in a plane between the plane of said outlet opening of said evaporator and the liquid refrigerant level being maintained therein, said trap being normally entirely free of liquid refrigerant and arranged to receive liquid refrigerant rising above the normal level maintained in said evaporator by said first named means.

4. In a refrigerating system comprising in combinaton, an evaporator including a liquid refrigerant inlet opening and a gaseous refrigerant outlet opening, means controlling the ingress of liquid refrigerant through said inlet opening to said evaporator and for normally preventing liquid refrigerant from rising above a predetermined level therein, conduit means communicating with the interior of said evaporator and extending outwardly therefrom, the point of communication of said conduit means with said evaporator being disposed in a plane between the plane of said outlet opening of said evaporator and the liquid refrigerant level being maintained therein, said conduit means being normally entirely free of liquid refrigerant and arranged to receive liquid refrigerant rising above the normal level maintained in said evaporator by said first named means, said conduit means being also arranged to insolate liquid refrigerant received therein out of contact with the main body thereof in said evaporator, and means on said conduit means to cause liquid refrigerant received therein to vaporize more rapidly than liquid refrigerant in the main portion of the evaporator.

5. In a refrigerating apparatus comprising in combination, a cabinet, an evaporator disposed in said cabinet for cooling and causing the circulation of air within said cabinet, said evaporator including a liquid refrigerant inlet opening and a gaseous refrigerant outlet opening, means controlling the ingress of liquid refrigerant through said inlet opening to said evaporator and for normally preventing liquid refrigerant from rising above a predetermined level therein, conduit means communicating with the interior of said evaporator and extending outwardly therefrom, the point of communication of said conduit means with said evaporator being disposed in a plane between the plane of said outlet opening of said evaporator and the liquid refrigerant level being maintained therein, said conduit means being normally entirely free of liquid refrigerant and arranged to receive liquid refrigerant rising above the normal level maintained in said evaporator by said first named means, said conduit means being disposed in the path of air circulating within said cabinet

and arranged to isolate liquid refrigerant received therein out of contact with the main body thereof in said evaporator.

6. In a refrigerating apparatus comprising in combination, a cabinet, an evaporator disposed in said cabinet for cooling and causing the circulation of air within said cabinet, said evaporator including a liquid refrigerant inlet opening and a gaseous refrigerant outlet opening, means controlling the ingress of liquid refrigerant through said inlet opening to said evaporator and for normally preventing liquid refrigerant from rising above a predetermined level therein, a trap communicating with the interior of said evaporator and extending outwardly therefrom, the point of communication of said trap with said evaporator being disposed in a plane between the plane of said outlet opening of said evaporator and the liquid refrigerant level being maintained therein, said trap being normally entirely free of liquid refrigerant and arranged to receive liquid refrigerant rising above the normal level maintained in said evaporator by said first named means, said trap being disposed in the path of air circulating within said cabinet.

7. In a refrigerating system comprising in combination, an evaporator including a receptacle having a liquid refrigerant inlet opening and a gaseous refrigerant outlet opening, means controlling the ingress of liquid refrigerant through said inlet opening to said receptacle and for normally preventing liquid refrigerant from rising above a predetermined level therein, conduit means communicating with the interior of said receptacle and extending outwardly therefrom, the point of communication of at least one of said conduit means with said receptacle being disposed in a plane between the plane of said outlet opening of said receptacle and the liquid refrigerant level being maintained therein, the said one of said conduit means being normally free of liquid refrigerant and arranged to receive liquid refrigerant rising above the normal level maintained in said receptacle by said first named means and said one of said conduit means being also arranged to isolate liquid refrigerant received therein out of contact with the main body thereof in said evaporator.

8. An evaporator of a refrigerating system comprising in combination, a reservoir adapted to contain a predetermined amount of liquid refrigerant, means for preventing the accumulation of more than said predetermined amount of liquid refrigerant in said reservoir, said means comprising a receptacle having an opening communicating with said reservoir adjacent the level of liquid refrigerant therein, said receptacle receiving liquid refrigerant from said reservoir in excess of said predetermined amount and collecting same out of contact with liquid refrigerant in the reservoir, a wall of said receptacle being arranged in the medium to be cooled by said evaporator to cause more rapid evaporation of refrigerant received therein, relative to evaporation of refrigerant in said reservoir, for normally maintaining said receptacle free of liquid refrigerant.

9. An evaporator of a refrigerating system comprising in combination, a reservoir adapted to contain a predetermined amount of liquid refrigerant, means for preventing the accumulation of more than said predetermined amount of liquid refrigerant in said reservoir, said means comprising a receptacle having an opening communicating with said reservoir adjacent the level of liquid refrigerant therein, said receptacle receiving liquid refrigerant from said reservoir in excess of said predetermined amount and collecting same out of contact with liquid refrigerant in the reservoir, and thermal conducting means associated with said receptacle and arranged in the medium to be cooled by said evaporator to cause more rapid evaporation of refrigerant received in said receptacle, relative to evaporation of refrigerant in said reservoir, for normally maintaining said receptacle free of liquid refrigerant.

In testimony whereof I hereto affix my signature.

JESSE G. KING.