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DEFROSTING AND FROST PREVENTION

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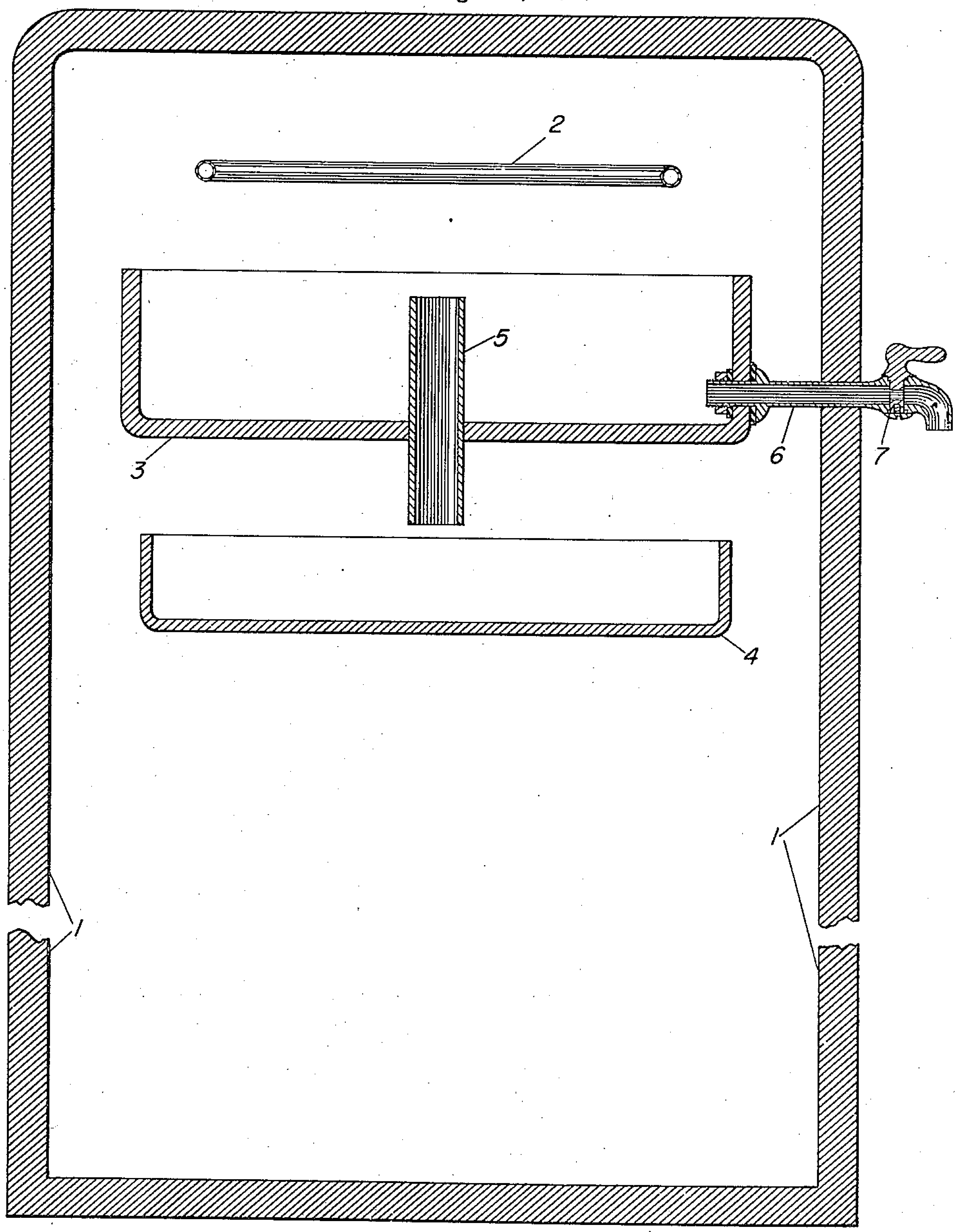

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DEFROSTING AND FROST PREVENTION

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15 Claims. (Cl. 62—103)

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This application is made under the act of March 3, 1883, as amended by the act of April 30, 1928, and the invention herein described and claimed, if patented, may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment to us of any royalty thereon.

This invention has for its chief object the provision of a method for eliminating frost and ice formations on the cooling or heat exchange units of refrigerating systems. Another object of this invention is the provision of a method for defrosting the cooling units of refrigerating systems and for maintaining them free of frost and ice during the operation of the refrigerator without shutting off the refrigerating machinery. Other objects will be apparent from the description hereafter given.

"Frost" as used in this description includes "ice."

The deposition of frost on cooling or heat exchange units, such as refrigerant coils, pipes, and other heat exchange elements, is a well-known phenomenon. It is caused by the distillation of water from the materials undergoing refrigeration to the heat exchange unit, and moisture condensed from the air in the refrigeration compartment when the temperature of the evaporator is below the dew point of the ambient air. Frost being a relatively poor conductor of heat, the transfer of heat between the surrounding atmosphere and the heat exchange unit is greatly hindered by the frost and consequently the efficiency of refrigeration is significantly lowered. In order to compensate for a poor transfer of heat through the frost, the heat exchange unit must be kept at a temperature lower than what would otherwise be necessary if such frost were not present, thus putting a heavier load on the refrigerating machinery. Furthermore, the building up of layers of frost on heat exchange units necessitates some method of defrosting the units from time to time, which is both expensive and time-consuming. Some of the common methods of defrosting now in use are:

1. Shutting down the refrigerating machinery for such a length of time that the heat exchange unit can warm up sufficiently to permit the frost to melt.

2. Removing the frost from the cooling unit by mechanical means, such as chopping, scraping, and so forth.

3. Attempting to prevent frost formation on the cooling unit by the use of special paints.

Besides being both time-consuming and expensive, none of these methods has been found to be wholly satisfactory.

We have discovered that frost on a heat exchange unit can easily be removed and its formation on the unit easily prevented by a simple and inexpensive process which comprises, generally, the placing of a suitable vessel containing a volatile liquid miscible with water in whole or in part in proximity to the cooling or heat exchange unit. The liquid should be volatile enough to distill from the container to the cooling unit under the small temperature differential prevailing between the unit and the surrounding air. Some of the liquids which have been found to work well in the process are methyl alcohol, ethyl alcohol, n-propyl alcohol, isopropyl alcohol, acetone, methyl ethyl ketone, and diethyl ketone. Mixtures of liquids can also be used. The foregoing examples are merely illustrative of the liquids which may be used in the process, and this invention is not to be considered limited thereby. Also, this invention is not limited to the use of alcohols or ketones or mixtures thereof, for although these types of compounds have been found to work most satisfactorily, other classes of compounds may also be used.

Our novel process depends for its success on the fact that a compound will distill from a warmer region to a cooler region. It also depends on the fact that, in general, a relatively small amount of a compound will lower the freezing point of a liquid when dissolved in it. Thus, in the defrosting process, the volatile liquid distills from the container to the cooling unit because of the difference in temperature between the two, even though the difference is slight. Upon coming into contact with the frost on the cooling unit, the condensed liquid causes the frost to melt, due to the lowering of the melting point of the frost by the presence of the liquid which has distilled. The condensed liquid, together with the melted frost, then falls off the cooling unit. (The process of defrosting is believed to take place as outlined above. However, this invention is not to be considered limited in any manner by the explanation offered.)

If the vessel containing the volatile liquid used in the process is placed beneath the cooling unit so as to receive from it the melted frost plus condensed volatile liquid from the cooling unit, the volatile liquid in the container will progressively become more and more dilute until it finally loses its full effectiveness. We have innovated modifications of our process which greatly minimize this dilution effect.

One modification of our process comprises placing in the vessel, in addition to the volatile liquid, a water-soluble compound or material capable of salting out the volatile liquid from an aqueous solution thereof. Water-soluble compounds suitable for use in this modification of the process are sodium chloride, sodium carbonate, sodium sulfate, sodium dihydrogen phosphate, disodium phosphate, potassium chloride, potassium carbonate, potassium sulfate, potassium dihydrogen phosphate and dipotassium phosphate. These compounds are cited merely by way of illustration and not by way of limitation, since any water-soluble compound capable of establishing a salting out effect on the liquid used in the process may be employed. The function of the compound so used is to cause a separation of the mixture in the container into two phases, namely, a lower phase consisting essentially of an aqueous solution of the compound and an upper phase consisting essentially of the volatile liquid. The volatile liquid is thus kept floating as the upper phase and is maintained practically undiluted by the melted frost from the cooling unit. Consequently, it is available for continued use in the process. The lower phase can be drawn off whenever necessary and discarded or, if desired, the compound dissolved therein, may be recovered and returned to the system by evaporating the water.

Another modification of our process comprises placing in the vessel, in addition to the volatile liquid, a compound or material which will dehydrate, in whole or in part, the liquid used in the process. Compounds or materials suitable for use in this modification are anhydrous sodium carbonate, anhydrous sodium sulfate, anhydrous potassium carbonate, anhydrous magnesium sulfate, anhydrous calcium sulfate, calcium chloride, calcium oxide, barium oxide, anhydrous copper sulfate, and activated aluminum oxide. These compounds are cited merely by way of illustration and not by limitation and it is to be understood that this invention is not limited thereby. Any drying agent capable of dehydrating or removing water in whole or in part from the volatile liquid used may be employed. The function of the dehydrating agent is to maintain the volatile liquid in a dry or reasonably dry state, so that the liquid does not become diluted with too much water. Certain drying agents can be reactivated by removing absorbed water. Where this is possible the drying agent may be used over and over again.

This invention can be varied in many ways. For example, two vessels may be used instead of one. One vessel may be used to catch the drippings, while the other vessel with the volatile liquid, is placed at some other point in the refrigerator. The first vessel, if desired, may contain a compound capable of effecting a salting out reaction or it may contain a compound or material having dehydrating or drying properties in order to remove water from the drippings, but the use of such compounds is not indispensable, since the full strength of the volatile liquid will be retained in the second vessel. Where such modifications are employed, a drain pipe from the lower phase in the first vessel to the exterior of the refrigerator housing may be employed, so that this phase may be drawn off from time to time. Also, a pipe connection may be used between the upper phase of the first vessel and the second vessel, so that salted out or dehydrated volatile liquid in the first container may be returned to the second vessel, thereby making the system regenerative with respect to the volatile liquid.

In the accompanying drawing there is illustrated the modification of our invention in which two vessels are employed. The drawing is a vertical section of a refrigerator box 1 containing the usual cooling coils or heat exchange unit 2. Below the unit 2 there is disposed a vessel 3 for catching the drippings from the unit 2. At another point in the box there is disposed another vessel 4 containing the volatile liquid. In the drawing, this vessel 4 is placed directly beneath the vessel 3. However, any point in the refrigerator is suitable so long as the vessel 4 is kept free from dilution. The vessel 3 is provided with either a salting out or a dehydrating compound for the purposes mentioned above, and an overflow 5 from the vessel 3 to the vessel 4 is provided. Also, a drain pipe 6 having a valve 7 is connected to the vessel 3 to draw off, occasionally, excess quantities of the lower phase.

Having thus described our invention, we claim:

1. In combination with a refrigeration system having an evaporator unit, said evaporator being disposed in a compartment, a vessel beneath said unit to catch drippings therefrom, another vessel in the compartment at a region normally warmer than the evaporator containing a volatile water-miscible liquid.

2. In combination with a refrigeration system having an evaporator unit, a vessel beneath said unit to catch drippings therefrom, said vessel having an overflow at the top and a drain pipe at the bottom, a second vessel beneath said first-mentioned vessel in a region normally warmer than the evaporator, whereby when a volatile water-miscible liquid is placed in said second vessel it will evaporate and condense on the evaporator, and whereby said first-mentioned vessel will catch drippings from said evaporator.

3. The method of defrosting and of preventing the formation of frost on the evaporator of a refrigeration system surrounded by humid air, comprising mixing the air with the vapor of a water-miscible liquid.

4. The method of defrosting and of preventing the formation of frost on the evaporator of a refrigeration system surrounded by humid air, comprising mixing the air with the vapor of a volatile liquid chosen from the group consisting of water-miscible alcohols and water-miscible ketones.

5. The method of defrosting and of preventing the formation of frost on the evaporator of a refrigeration system surrounded by humid air, comprising mixing the air with the vapor of an alcohol chosen from the group consisting of methyl alcohol, ethyl alcohol, n-propyl alcohol, and isopropyl alcohol.

6. The method of defrosting and of preventing the formation of frost on the evaporator of a refrigeration system surrounded by humid air, comprising mixing the air with the vapor of a ketone chosen from the group consisting of acetone, methyl ethyl ketone, and diethyl ketone.

7. The method of defrosting and of preventing the formation of frost on the evaporator of a refrigeration system surrounded by humid air, comprising mixing the air with the vapor of methyl alcohol.

8. The method of defrosting and of preventing the formation of frost on the evaporator of a refrigeration system surrounded by humid air,

comprising mixing the air with the vapor of ethyl alcohol.

9. The method of defrosting and of preventing the formation of frost on the evaporator of a refrigeration system surrounded by humid air, comprising mixing the air with the vapor of n-propyl alcohol.

10. The method of defrosting and of preventing the formation of frost on the evaporator of a refrigeration system surrounded by humid air, comprising mixing the air with the vapor of isopropyl alcohol.

11. The method of defrosting and of preventing the formation of frost on the evaporator of a refrigeration system surrounded by humid air, comprising mixing the air with the vapor of acetone.

12. The method of defrosting and of preventing the formation of frost on the evaporator of a refrigeration system surrounded by humid air, comprising mixing the air with the vapor of methyl ethyl ketone.

13. The method of defrosting and of preventing the formation of frost on the evaporator of a refrigeration system surrounded by humid air, comprising mixing the air with the vapor of diethyl ketone.

14. The method of defrosting and of preventing the further formation of frost on the evaporator of a refrigeration system surrounded by humid air, comprising mixing the air with the vapor of a water-miscible liquid.

15. The method of preventing the formation of frost on the evaporator of a refrigeration system surrounded by humid air, comprising mixing the air with the vapor of a water-miscible liquid.

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