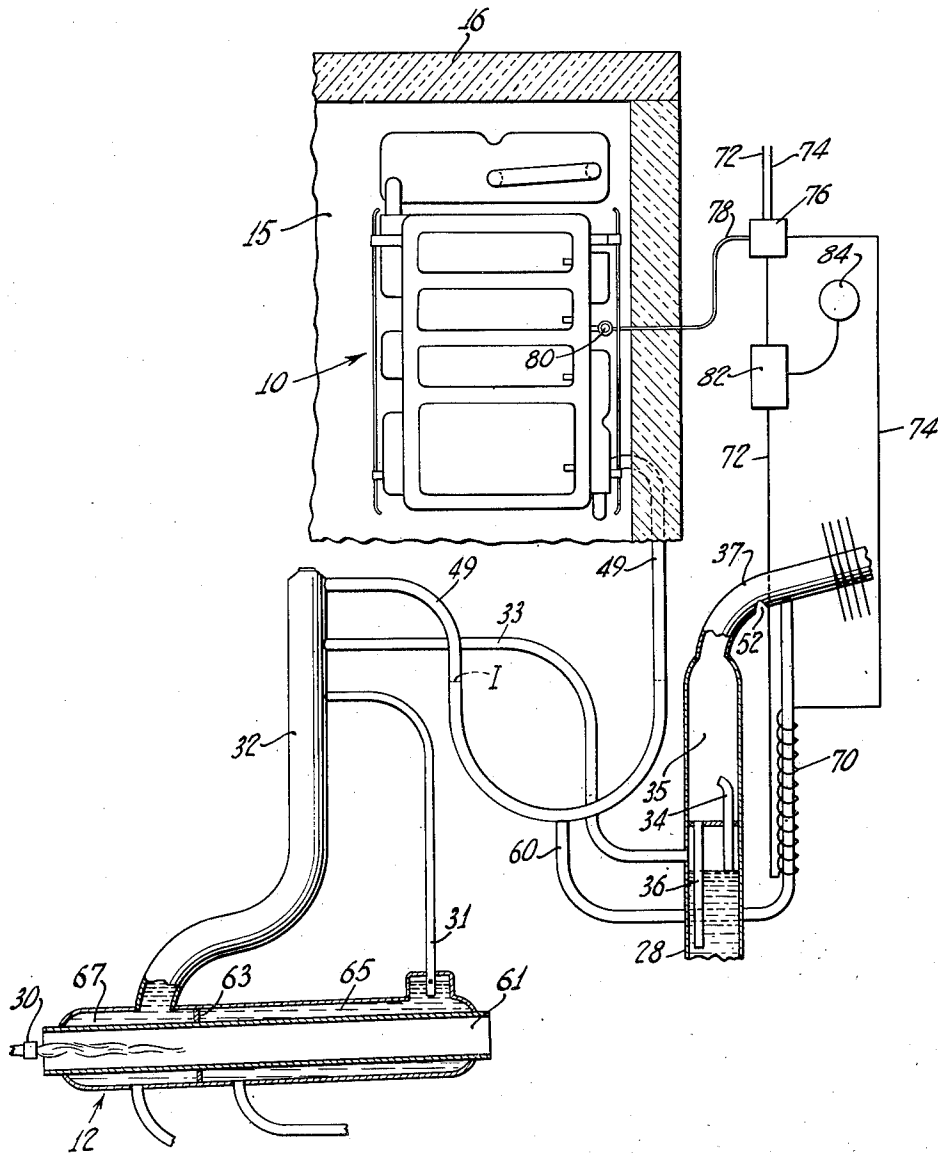


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REFRIGERATION
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REFRIGERATION

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This invention relates to refrigeration and more particularly to defrosting the cooling element of a refrigerator.

It is an object of this invention to provide for defrosting a cooling element of a refrigerating system such, for example, as a domestic refrigerator, and to carry on the defrosting process at a time and in a manner which will be convenient to the user of the refrigerator. A further object is to provide a supervisory control for a refrigeration unit which will interrupt the normal control of the unit to prevent defrosting during periods when the defrosting operation would interfere with the use of the apparatus. A further object is to provide a control mechanism which is responsive to a condition associated with the use of the refrigerator.

The above and other objects and advantages of the invention will be apparent in the following description taken in connection with the accompanying drawing which forms a part of this specification and in which the figure is a more or less schematic view partly in vertical section of certain elements of an absorption type refrigeration system.

The illustrative embodiment of the present invention is applied to a refrigeration unit like that described in a copending application of Carl T. Ashby, Serial No. 306,258, filed November 27, 1939, entitled "Refrigeration." Accordingly, that application which has matured into Patent No. 2,285,884 granted June 9, 1942, is incorporated herein, and reference may be had thereto for a more detailed consideration of certain features of the apparatus.

Referring to the single figure of the drawing, a generator 12 is provided which is heated by a gas burner 30 and from which vapor refrigerant such as ammonia, is expelled from an absorbent, such as water, and delivered to a condenser (not shown). The vapor is condensed in the condenser and liquid refrigerant flows therefrom to an evaporator or cooling element 10 disposed in an enclosed space 15 which in this embodiment is a food storage compartment of a thermally insulated cabinet 16, only a portion of which is shown. The refrigerant liquid evaporates in cooling element 10 and diffuses into inert gas such as hydrogen to produce a refrigerating effect. The resulting gas mixture of refrigerant gas and hydrogen flows from cooling element 10 to an absorber (not shown), and in the absorber the refrigerant gas is absorbed into solution by the absorption liquid. The hydrogen gas weak in refrigerant vapor flows from the absorber back

to the cooling element, and the absorbent liquid which is strong in ammonia returns to the generator. Suitable heat exchange units and other auxiliary apparatus are provided, some of which are shown.

Generator 12 is in the form of a cylindrical chamber with a flue 61 extending through its center, and the cylindrical chamber is divided by an annular partition 63 into a right-hand section 65 and a left-hand section 67. Opening into the right-hand section 65 is a vapor-liquid lift tube 31, the upper end of which empties into a stand-pipe 32. Stand-pipe 32 is open at its lower end to the left-hand section 67 of generator 12, and the top of the stand-pipe is connected through a conduit 33 to an analyzer 28. In analyzer 28 the expelled vapor flows through a vapor-liquid lift tube 34 into an upper chamber 35 from which the raised liquid drains back through a tube 36. From the upper chamber 35 of analyzer 28 the refrigerant vapor flows through a conduit 37 to the condenser. A plurality of fins or heat dissipating elements are fixed to the lower part of conduit 37 to provide an air-cooled rectifier in which is condensed water vapor accompanying refrigerant vapor expelled from solution in generator 10. The rectifier is only partly illustrated in the drawing and shown completely in the Ashby application referred to above.

The extreme upper end of stand-pipe 32 is connected through a U-pipe 49 to the lower end of evaporator 10, and at the lowest point of this U-pipe a conduit 60 is connected which extends downward and to the right and then upward again where it is connected to conduit 37. At the left of the point where conduit 60 opens into conduit 37, a dam 52 is provided which prevents the flow of liquid to the left down conduit 37 with the result that liquid from the rectifier flows down conduit 60.

During the normal operation of the unit, sufficient liquid such as water condensed in the rectifier is accumulated in conduit 60 and U-pipe 49 to maintain the liquid level indicated at "L," and this forms a liquid seal to prevent the flow of vapor through U-pipe 49 and conduit 60. When it is desirable to defrost the cooling element 10, this liquid seal is broken by removing the liquid from conduit 49 so that the hot vapor from the top of the stand-pipe 32 flows directly into the evaporator. This liquid is removed by a vapor-liquid lift in the right-hand leg of conduit 60, and the liquid is percolated downward out of pipe 60 and emptied into conduit 37.

Accordingly, the right-hand leg of pipe 60 is

surrounded by an electric heating element 70, and when desirable this heating element is supplied with electricity from a suitable source through a pair of wires 72 and 74. These wires are connected through a thermostatically controlled switch 76, which is connected through a capillary tube 78 to a bulb 80 positioned in an ice gap on the refrigerator cooling element 10. Bulb 80 is so mounted that it is normally maintained at substantially the air temperature within the refrigerated space 15, but when the frost or ice builds up upon the cooling element, bulb 80 is cooled to substantially the temperature of the evaporator. The thermostatically controlled switch is so adjusted that when bulb 80 is cooled in this manner, the switch is closed to energize heating element 70 and thereby initiate the defrosting operation outlined above.

However, wire 72 is connected through a relay switch 82, which is controlled by a photoelectric cell unit 84 positioned where the photoelectric cell will have light striking it if there is light in the room where the refrigerator is positioned. Illustratively, photoelectric cell unit 84 is positioned upon the outer wall of the refrigerator. Photoelectric cell unit 84 and its relay switch are so adjusted that the relay switch remains closed only when there is substantially no light radiation striking the photoelectric cell. Thus, when there is light at the exterior of the refrigerator, the relay switch 82 is open and heating element 70 cannot be energized to initiate the defrosting operation. In this way the defrosting operation does not occur during the time that the refrigerator is being used, as the refrigerator is used only when there is light in the room where it is positioned. Illustratively, a domestic refrigerator may be used entirely during the daylight hours, and in that event the defrosting operation would occur at any time during the night. However, if the refrigerator is also used during the evening, there will be a light in the room where the refrigerator is positioned, and this light will prevent the starting of the defrosting cycle until the period of use of the refrigerator is ended and the light is extinguished. In this manner the defrosting operation does not interfere with normal use of the refrigerator, and the operation is fully automatic and dependable. Furthermore, with this particular embodiment the defrosting operation is carried on in a rapid and efficient manner by heating the cooling element only until the ice on the cooling element is melted. At that time the refrigerating operation is restarted and the refrigerated space 15 is not warmed enough to cause spoilage of food.

While I have shown and described one embodiment of my invention, it will be apparent to those skilled in the art that modifications and changes may be made without departing from the spirit and scope of the invention. Thus, the electrical control circuit may operate an electrical relay or an electrical switch for defrosting an absorption refrigeration system or a compression refrigeration system. I therefore do not wish to be limited to the embodiment shown in the drawing and described in the specification and aim in the following claims to cover all of the modifications and changes which fall within the true spirit and scope of the invention.

I claim:

1. In refrigeration apparatus, the combination of, a refrigerating unit having a cooling element within a refrigerated space upon which frost

tends to accumulate, a thermostat unit having a bulb positioned in spaced relationship with respect to said cooling element in such a manner that when ice forms on said cooling element the temperature of said bulb is changed, an electrical circuit which is energized to initiate a defrosting operation to defrost said cooling element, control means operated by said thermostat unit to control the energization of said electrical circuit, and a photoelectric cell assembly responsive to the presence of light at the exterior of said refrigerated space to open said electrical circuit and prevent the initiation of the defrosting operation.

2. In a method of refrigerating a space with a system in which liquid refrigerant evaporates in a cooling element with the result that frost is formed on said cooling element and in which heat is utilized to expel refrigerant vapor from an absorbent, the steps of, carrying on the refrigerating cycle by expelling refrigerant from the absorbent in the form of vapor and condensing the vapor to provide liquid refrigerant which flows to the evaporator, by-passing the vapor refrigerant around the condenser so that vapor refrigerant is delivered to the evaporator to thereby defrost the evaporator, and preventing the carrying on of the last-named step if there is light at the exterior of said space.

3. In a refrigerator including a cooling element subject to the formation of frost or ice thereon during normal operation of the refrigerator, and structure to modify the operation of said refrigerator to effect defrosting of said cooling element to cause melting of the frost or ice accumulated thereon, a control device responsive to the light intensity in the vicinity in which the refrigerator is located for controlling said modifying structure, said device being operable to restrict the defrosting of said cooling element by said structure when the light intensity in the vicinity in which the refrigerator is located is at or above a predetermined value.

4. In the method of operating a refrigerator having a cooling element therein to produce a cooling effect with the aid of the system in which refrigerant vapor is liquefied and such liquid refrigerant normally flows to the cooling element for evaporation therein to produce the cooling effect, and in which the cooling element is defrosted by intermittently reducing the normal flow of liquid refrigerant to the cooling element and introducing refrigerant vapor into the cooling element to cause melting of frost or ice accumulated thereon, the improvement which consists in restricting the introduction of refrigerant vapor into the cooling element and allowing the normal flow of liquid refrigerant to said cooling element to continue, even when it is desired to effect defrosting, as long as the light intensity in the vicinity in which the refrigerator is located is at or above a predetermined value.

5. In a refrigerator including a cabinet having a thermally insulated space, refrigeration apparatus including a cooling element disposed in such space, the cooling element being subject to formation of frost or ice thereon, structure to effect defrosting of said cooling element to cause melting of the frost or ice accumulated thereon, and a control device associated with said structure, said control device being so constructed and arranged that, even when said structure is rendered operable to effect defrosting of said cooling element, the ability of said

structure to effect defrosting of said cooling element is restricted as long as the light intensity in the vicinity in which the refrigerator is located is at or above a predetermined value.

6. In a refrigerator including a cabinet having a cooling element therein subject to formation of frost or ice thereon, and self-actuating structure for intermittently causing defrosting of said cooling element to cause melting of the frost or ice accumulated thereon, a control device associated with said structure, said control device being so constructed and arranged that, even when said structure is rendered operable to cause intermittent defrosting of said cooling element, said structure is incapable of causing defrosting of said cooling element as long as the light intensity in the vicinity in which the refrigerator is located is at or above a predetermined value.

7. In a refrigerator including a cabinet having a cooling element therein subject to formation of frost or ice, and structure responsive to the accumulation of frost or ice on said cooling element to effect defrosting of said cooling element, a control associated with said structure so constructed and arranged that, even when frost or ice has accumulated on said cooling element to such an extent that said structure is rendered operable to effect defrosting of said cooling element, the ability of said structure to effect defrosting of said cooling element is restricted as long as the light intensity in the vicinity in which the refrigerator is located is at or above a predetermined value.

8. In a refrigerating unit having a cooling element, said cooling element being subject to formation of frost or ice thereon during normal operation of the refrigerating unit, structure to modify the normal operation of said refrigerating unit to cause melting of the frost or ice accumulated on said cooling element, a control device responsive to a factor of the environment in which the refrigerating unit is located

for controlling said structure, said control device being so constructed and arranged that, even when said structure is rendered operable to cause defrosting of said cooling element, the ability of said structure to cause defrosting of said cooling element is restricted as long as said factor of the environment is capable of influencing said control device.

9. In a refrigerator including a cabinet having a cooling element therein, such cooling element being subject to the formation of frost or ice thereon, and structure for automatically effecting defrosting of said cooling element to cause melting of frost or ice accumulated thereon, a control device responsive to a normal recurring factor of the environment in which the refrigerator is located for controlling said structure, said device being operable to restrict the defrosting of said cooling element effected by said structure when said normal recurring factor of the environment is capable of influencing said control device.

10. In a refrigerator including a cooling element subject to formation of frost or ice, structure operative to intermittently cause defrosting of said cooling element, and a control device operative responsive to change in the intensity of light in the vicinity of the refrigerator to restrict the defrosting of said cooling element by said structure when the intensity of light in the vicinity of the refrigerator is at or above a predetermined value.

11. In a refrigerator including a cooling element subject to formation of frost or ice, structure operative to intermittently cause defrosting of said cooling element, and a control device operative responsive to change in a factor of the environment of said refrigerator to restrict the defrosting of said cooling element by said structure to a period when said factor differs from a predetermined value.

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