Sept. 12, 1961 W. E. SCHOMBURG 2,999,368

HOME APPLIANCE

Filed Nov. 23, 1959

Fig. 1.

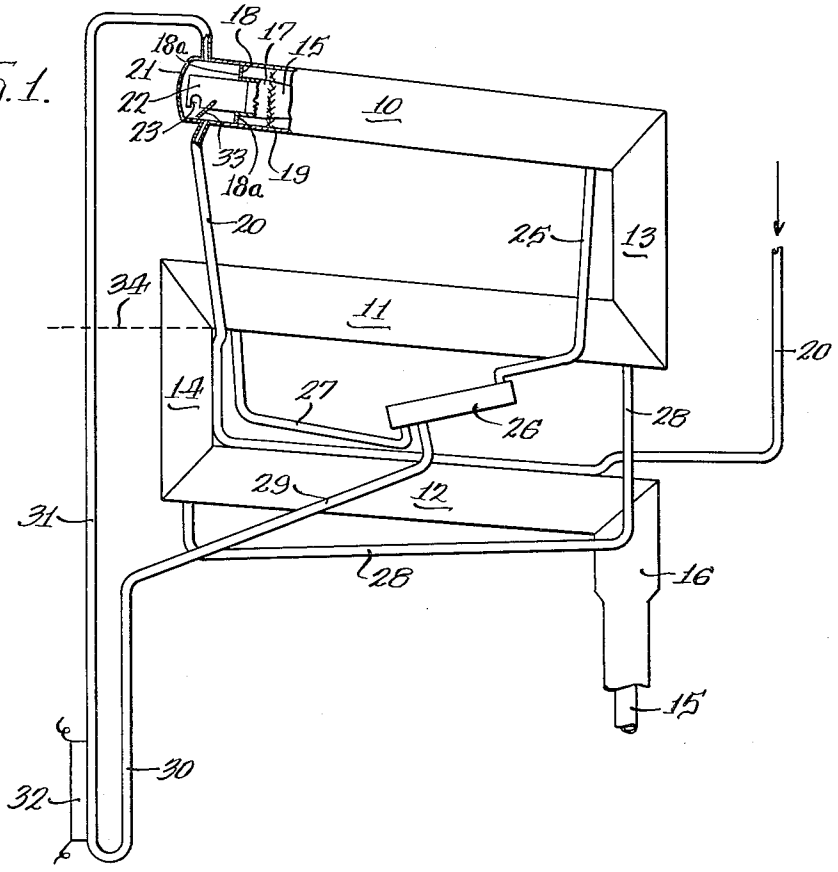


Fig. 2.

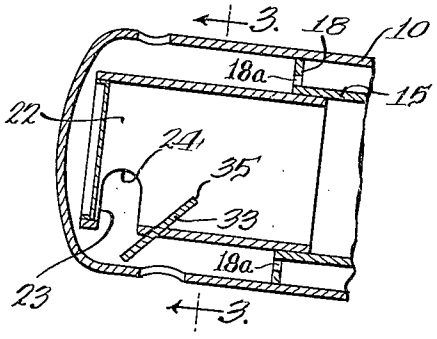
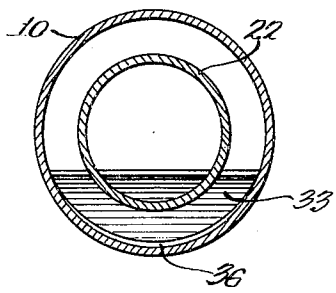


Fig. 3.



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2,999,368

HOME APPLIANCE

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7 Claims. (Cl. 62—272)

This invention relates to an absorption refrigeration system and particularly to a defrosting apparatus including means for automatically at least partially blocking the flow of inert gas into an evaporator during a defrost cycle.

In the copending application of B. A. Phillips, John Roeder, Jr. and R. W. Kruggel Serial No. 852,876, filed November 13, 1959, there is disclosed and claimed a defrost system for defrosting a refrigerator and particularly an absorption refrigerator in which liquid refrigerant is maintained in a reservoir and then during a defrost cycle is heated and conveyed through the evaporator of the refrigeration system while means are provided for materially restricting the flow of inert gas into the evaporator. The invention here is concerned with an improved defrosting apparatus including means for automatically restricting the flow of inert gas into the evaporator during the defrosting cycle.

One of the features of this invention therefore is to provide a defrosting apparatus for an absorption refrigeration system comprising an improved apparatus for automatically restricting the flow of inert gas in the evaporator portion of the refrigeration system during a defrosting cycle in which heated gaseous and liquid refrigerant are used in the defrosting operation.

Other features and advantages of the invention will be apparent from the following description of one embodiment thereof taken in conjunction with the accompanying drawings. Of the drawings:

FIGURE 1 is a fragmentary elevational schematic view of a refrigeration system embodying the invention.

FIGURE 2 is an enlarged fragmentary sectional view of one portion of the apparatus of FIGURE 1.

FIGURE 3 is a sectional elevational view taken substantially along the line 3—3 of FIGURE 2.

The basic refrigeration system illustrated herein is described more fully and claimed in the copending application of B. A. Phillips, Serial No. 778,370, filed December 5, 1958, and assigned to the same assignee as the present invention. This refrigeration system as illustrated in the accompanying drawings comprises a first or freezer evaporator tube **10** normally operating at a relatively low temperature, a second or refrigerator evaporator tube **11** normally operating at a higher temperature and a heat exchanger tube **12**. These tubes are all inclined slightly from the horizontal and the lower ends of the two evaporator tubes **10** and **11** are connected by a substantially vertical tube **13**. The upper ends of the tubes **11** and **12** are similarly connected by means of a substantially vertical tube **14**. Inert gas such as hydrogen is supplied to the upper end of the first evaporator tube **10** by means of a pipe **15** leading from an absorber (not shown) up through the interior of a connector tube **16** which communicates with the lower end of the heat exchanger **12** so that the tubes **10** to **14** and the tube **16** are all arranged in series. The inert gas pipe **15** is spaced from the sides of the tubes **10** to **14** and **16** and is in heat exchange relationship with the interior of these tubes.

The upper end of the pipe **15** is somewhat enlarged in

diameter as indicated at **17** and provided with a spacer ring **18** having openings **18***a* that permit fluid flow therethrough. This spacer construction is fully disclosed in U.S. Patent 1,880,533. The inert gas pipe **15** is also provided with radially extending spaced sloped fins illustrated diagrammatically at **19** in FIGURE 1.

Liquid refrigerant is supplied from a condenser (not shown) through a pipe **20** which extends in heat exchange contact with the outer surfaces of the heat exchanger **12** and the vertical tube **14** up to the bottom of the upper end **21** of the first evaporator **10**. The pipe **20** communicates with the bottom surface of the evaporator **10** so as to supply liquid refrigerant thereto. During its passage the liquid refrigerant in the pipe **20** is pre-cooled by the tubes **12** and **14**.

Positioned at the end of the inert gas tube **15** adjacent the upper end **21** of the evaporator **10** is a pipe extension **22** having an arcuate opening or slot **23** in its lower surface with the ends **24** thereof extending well up on the sides of pipe extension **22**.

The lower end of the first evaporator tube **10** is provided with a downwardly extending pipe **25** leading to the upper end of a downwardly inclined accumulator chamber **26**. The lower end of the chamber **26** is connected to a pipe **27** whose other end is connected to the upper end of the second evaporator tube **11**. The lower end of this evaporator tube **11** is connected by means of a pipe **28** to the upper end of the heat exchanger **12**.

The accumulator **26** is also connected to a pipe **29** at a point on the bottom of the accumulator **26** above the point of connection of the pipe **27**. The pipe **29** includes a downwardly extending loop **30** and an upwardly extending leg **31** whose upper end empties into the top of the first evaporator tube **10** adjacent the upper end **21** thereof and above the upper end of the pipe extension **22**. The bottom of the leg **31** at the loop **30** is provided with an electrically powered heater **32**.

Within the upper end of the first evaporator tube **10** at the bottom surface thereof there is positioned a transverse inclined baffle **33** forming a dam. This dam **33** is located between the arcuate slot **23** and the liquid refrigerant inlet pipe **20**. It is also positioned downstream from the end of the leg **31** that is connected to the tube **10**.

In the normal refrigerating operation of the refrigeration system inert gas enters the upper end of the first evaporator tube **10** through the pipe **15** from the absorber (not shown). At this upper end liquid refrigerant enters from the pipe **20** which is connected to the usual condenser (not shown). The inert gas enters the interior of the tube **10** through the arcuate opening **23**. In this system the inert gas and refrigerant flow down the tube **10** and the refrigerant evaporates into the inert gas atmosphere. The remaining liquid refrigerant flows down through the pipe **25**, the accumulator **26** and the pipe **27** into the upper end of the second evaporator **11**. The vaporized refrigerant and the inert gas flow down the tube **13** into the second evaporator **11**. In this evaporator **11** more of the liquid refrigerant evaporates to produce a further cooling effect. The remaining liquid refrigerant flows from the bottom end of the second evaporator tube **11** through the pipe **28** into the upper end of the heat exchanger **12**. The mixed inert gas and vaporized refrigerant flow from the second evaporator tube **11** through the vertical tube **14** into the upper end of the heat ex-

changer 12. In this heat exchanger any remaining liquid refrigerant evaporates and a rich mixture of inert gas and refrigerant then flow down the connector tube 16 back to the absorber (not shown).

Because of the provision of the pipe 29 including the loop 20 and leg 31 this tube is filled with liquid refrigerant from the accumulator 26 up to a liquid level as indicated by the line 34. This liquid level is determined by the level of the exit end of the pipe 27 which supplies liquid refrigerant to the upper end of the second evaporator 11. With this arrangement the pipe 29 including the depending loop 30 and the bottom of the leg 31 up to the level 34 forms a reservior of liquid refrigerant that is used only during a defrost cycle.

During the defrost cycle which may be automatically timed to operate say 15 minutes out of each 24 hours, the electric heater 32 is energized. This vaporizes some of the liquid refrigerant in the bottom of the leg 31 of the loop 30. It also heats the liquid refrigerant in this portion of the loop. With this action the leg 31 then operates as a pump or lift tube to lift heated mixed refrigerant vapor and liquid and pump it through the top of the leg 31 into the upper end of the evaporator tube 10. Because of the forward or downstream location of the dam 33 the heated refrigerant liquid is trapped by the dam 33 to form a sump behind this dam. This sump is defined by the dam 33, the upper end 21 and the bottom of the evaporator tube 10. The heated liquid refrigerant reaches a maximum level substantially even with the top 35 of the dam 33 so that all but the two upper ends 24 of the arcuate slot 23 is closed. This greatly restricts the flow of inert gas out the slot 23 so that evaporation of liquid refrigerant is substantially stopped. The bottom of the dam 33 is spaced slightly from the bottom of the evaporator tube 10 so as to provide an arcuate opening 36. However, as heated refrigerant is continually supplied during the defrosting cycle through the tube leg 31 the sump formed by the dam 33 is kept substantially filled at all times during the defrosting cycle. The heated liquid refrigerant overflows the dam 33 and together with the heated vaporized refrigerant flows down the evaporators 10 and 11 to defrost the system. Then at the conclusion of the defrosting cycle when the heater 32 is turned off and the flow of heated refrigerant is stopped the liquid behind dam 33 leaks out through the opening 36 to again expose the arcuate slot 23 so as to permit unrestricted normal flow of inert gas. The refrigeration system then functions in its normal manner.

One of the chief advantages of the means for interrupting the flow of inert gas during the defrosting cycle of this invention is that it is simple, inexpensive and easily assembled. Furthermore, it operates automatically in a trouble-free manner to restrict but not stop the flow of inert gas during the defrost cycle and automatically returns this gas flow to its normal condition at the end of the defrost cycle.

The foregoing detailed description is given for clearness of understanding only and no unnecessary limitations are to be understood therefrom, as some modifications will be obvious to those skilled in the art.

The embodiment of the invention in which an exclusive property or privilege is claimed is defined as follows:

1. In an absorption refrigeration system including a tubular evaporator having a wall, a conduit for liquid refrigerant and a tubular conduit for inert gas each having an outlet emptying into the evaporator, defrosting apparatus, comprising: means for defrosting the evaporator during a defrost cycle including a conduit for hot liquid refrigerant emptying into the evaporator; and means in the tubular evaporator cooperating with said wall to form a sump receiving said hot liquid, the gas outlet having at least a major portion thereof beneath the top of the sump to be at least partially blocked by liquid in said sump.

2. The apparatus of claim 1 wherein said sump forming means comprises a dam in said evaporator.

3. In an absorption refrigeration system including a tubular evaporator having walls with sides and a bottom, a conduit for liquid refrigerant and a tubular conduit for inert gas each having an outlet emptying into the evaporator, defrosting apparatus, comprising: means for defrosting the evaporator during a defrost cycle including a conduit for hot liquid refrigerant emptying into the evaporator and a dam in the tubular evaporator cooperating with said sides and bottom of form a sump to receive said hot liquid, the gas outlet having at least a major portion thereof beneath the top of the sump to be at least partially blocked by liquid in said sump and the dam having means associated therewith for emptying the sump at the conclusion of said defrost cycle.

4. An absorption refrigeration apparatus, comprising: a tubular evaporator having walls; a conduit for liquid refrigerant emptying into said evaporator; a tubular conduit for inert gas in said evaporator having a bottom spaced from the bottom of the evaporator; means for defrosting the evaporator during a defrost cycle including a conduit for hot liquid refrigerant emptying into the evaporator; and a dam in the tubular evaporator cooperating with said walls to form a sump to receive said hot liquid, the dam extending from the bottom of the evaporator up to enclose the said bottom of the gas conduit and the gas conduit having an opening in its bottom extending to beneath the top of the dam and into said sump, the dam having an opening therein for emptying the sump at the conclusion of said defrost cycle.

5. An absorption refrigeration apparatus, comprising: a tubular evaporator having sides, a bottom and a closed end; a conduit for liquid refrigerant emptying into said evaporator; a tubular conduit for inert gas within the evaporator having sides and a bottom spaced from corresponding sides and bottom of the evaporator and having an end adjacent said closed end; means for defrosting the evaporator during a defrost cycle including a conduit for hot liquid refrigerant emptying into the evaporator; a dam in the evaporator downstream of the entering hot liquid refrigerant and extending from the bottom of said evaporator partially up around the sides and bottom of and partially into said tubular conduit to form a sump to receive said hot liquid, and the gas conduit having an opening in its bottom extending to beneath the top of the dam and into said sump, the dam having an opening therein for emptying the sump at the conclusion of said defrost cycle.

6. An absorption refrigeration apparatus, comprising: a tubular evaporator having sides, a bottom and a closed end, a conduit for liquid refrigerant emptying into said evaporator; a tubular conduit for inert gas within the evaporator substantially concentric therewith having sides and a bottom spaced from corresponding sides and bottom of the evaporator and a closed end adjacent said evaporator closed end; means for defrosting the evaporator during a defrost cycle including a conduit for hot liquid refrigerant emptying into the evaporator; a dam in the evaporator downstream of the entering hot liquid refrigerant extending from the bottom of said evaporator partially up around the sides and bottom of and partially into said tubular conduit to form a sump to receive said hot liquid, and the gas conduit having an opening on its bottom and lower portion of its sides extending to beneath the top of the dam and into the sump, the opening extending to above the top of the dam, the dam having an opening therein for emptying the sump at the conclusion of said defrost cycle.

7. An absorption refrigeration apparatus, comprising: a tubular evaporator having sides, a bottom and a closed end; a conduit for liquid refrigerant emptying into said evaporator; a tubular conduit for inert gas within the evaporator substantially concentric therewith having sides and a bottom spaced from corresponding sides and bot-

tom of the evaporator and a closed end adjacent said evaporator closed end; means for defrosting the evaporator having a defrost cycle including a conduit for hot liquid refrigerant emptying into the evaporator; a dam in the evaporator downstream of the entering hot liquid refrigerant extending from the bottom of said evaporator partially up around the sides and bottom of and partially into said tubular conduit to form a sump to receive said hot liquid, and the gas conduit having an opening on its bottom and lower portion of its sides extending to beneath the top of the dam and into the sump, the opening being arcuate around the bottom of said gas conduit with ends extending upwardly to above the top of the

dam, the dam having a portion thereof spaced above the bottom of the evaporator for emptying the sump at the conclusion of said defrost cycle.

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