April 8, 1969 R. B. GELBARD 3,436,931

COMBINATION EVAPORATOR AND RADIANT HEATER DEFROST MEANS

Filed Oct. 12, 1967 Sheet 1 of 2

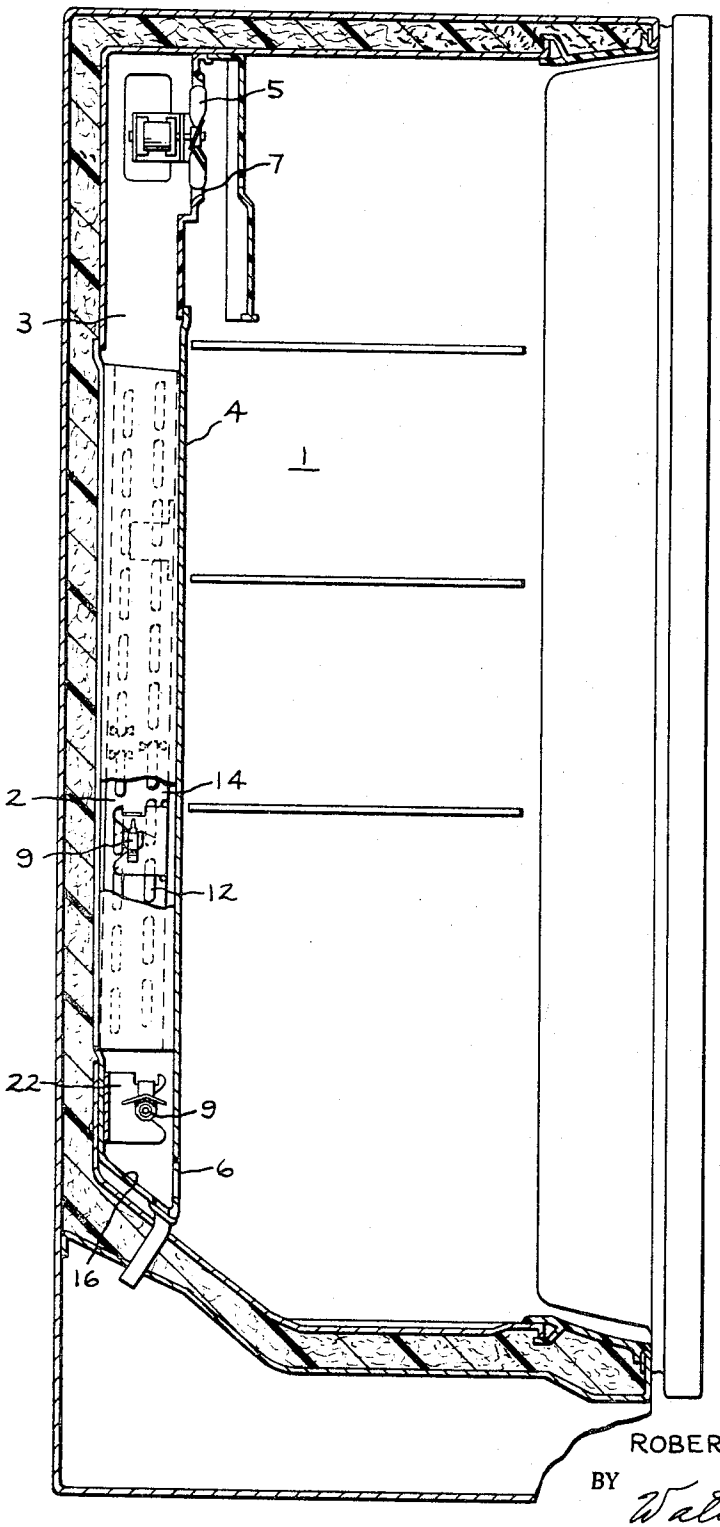


FIG. 1

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April 8, 1969 R. B. GELBARD 3,436,931

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Filed Oct. 12, 1967 Sheet 2 of 2

FIG. 2

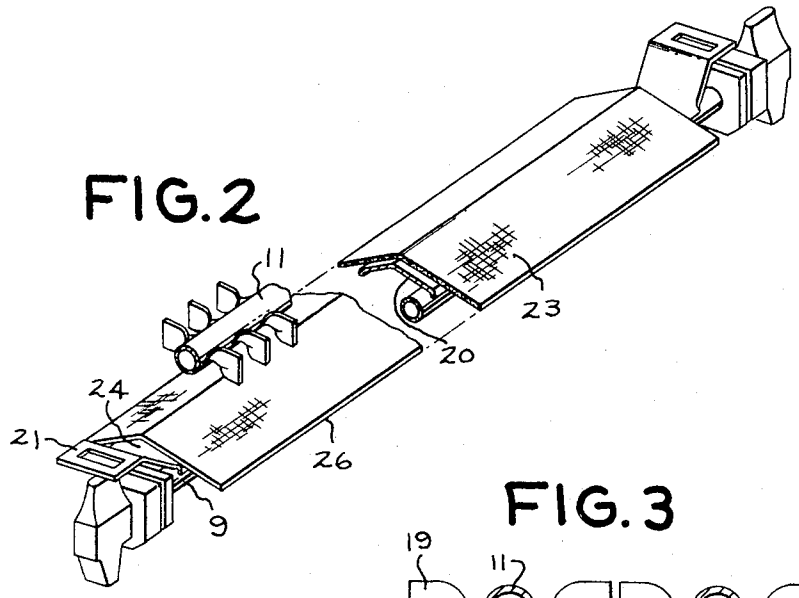
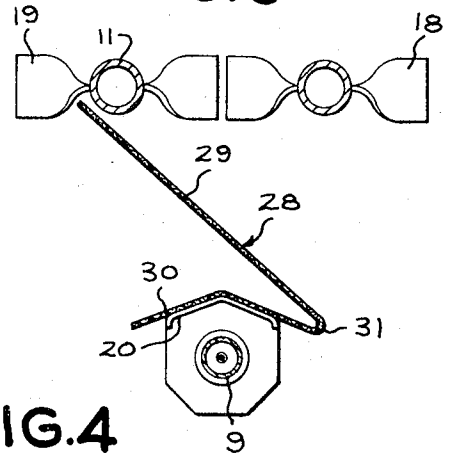


FIG. 3



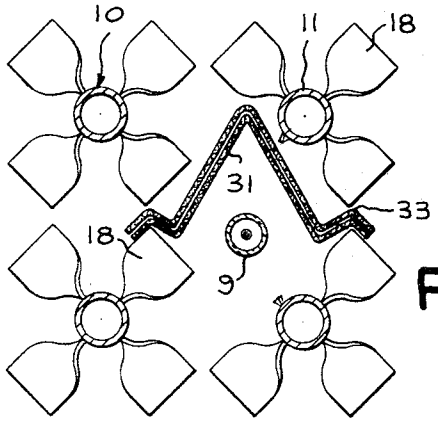
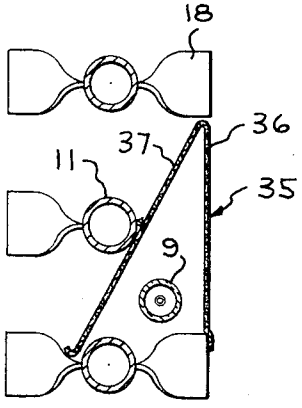


FIG. 4

FIG. 5



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COMBINATION EVAPORATOR AND RADIANT HEATER DEFROST MEANS

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U.S. Cl. 62—276 7 Claims

ABSTRACT OF THE DISCLOSURE

A combination evaporator and radiant heater defrost means including a metal screen so constructed and arranged above the radiant heater so as to prevent defrost water from impinging directly on the surface of the water.

BACKGROUND OF THE INVENTION

Many modern domestic refrigerators include an evaporator which normally operates at below freezing temperatures at which a layer of frost builds up on the surfaces thereof. A known means for quickly warming such evaporators to defrosting temperatures comprises a high temperature concentrated heat source, such as a radiant heater, positioned in spaced but radiant heating relationship with the evaporator surfaces. One suitable type of radiant heater comprises a coil of heater wire enclosed within a heat resistant and electrically insulated tube of quartz or similar material. Preferably such heaters, which operate at temperatures above the boiling point of water, are located either below at least a portion of the evaporator, in order to obtain both radiant and convection heating of the evaporator surfaces. However, when so positioned, any defrost water droplets from the defrosting evaporator surfaces falling onto the exterior surfaces of the heater will boil violently and produce undesirable and disturbing noises within the refrigerator during defrost cycle operation of the refrigerator. To prevent defrost water droplets from dripping directly onto the radiant heater surface, it has been proposed to position a metal shield above the heater. However, unless some means is provided for conducting heat away from such shielding means during operation of the heater, the shield itself may reach an elevated temperature at which water droplets contacting the shield also boil and produce the same undesirable and disturbing noises. Also such shields, if wide enough to provide positive protection of the heater, effectively shield substantial portions of the evaporator above the shield from the direct radiant heating thereof and therefore delay the warming of these evaporator portions to defrost temperatures.

SUMMARY OF THE INVENTION

The present invention has as its principal object the provision of an improved evaporator-radiant heater defroster combination including shield means for preventing defrost water from dripping from the evaporator surfaces onto the heater, the shield means being so constructed and arranged as to operate generally below the boiling point of water during the defrosting of the evaporator, to provide minimum interference with the radiant heating of the evaporator during the defrost operation and to provide minimum interference with the flow of air through the evaporator.

In accordance with the general aspect of the present invention, the above and additional objects are attained by shielding means positioned above the radiant heater and below a frost collecting portion of the evaporator and essentially comprising at least one metal wire screen of a relatively fine mesh so arranged that water droplets

will impinge on the upper surface of the screen and be dispersed by deflection and capillary dispersion of the droplets along the screen. The protecting portions of the screen are preferably inclined to provide optimum deflection and dispersion of the droplets and preferably the angle of inclination of the screen or the combination of the screen with additional shielding means is such that capillary dispersion of the water droplets during the defrost operation will serve to cool the shielding means and maintain it at temperatures substantially below the boiling point of water during operation of the heater.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawing:

FIGURE 1 is a side elevational view, partly in section, illustrating a household refrigerator including the improved evaporator-radiant heat defrost combination and shield means of the present invention;

FIGURE 2 is a perspectvie view of one embodiment of the shielding means of the present invention;

FIGURE 3 is a sectional view of a second embodiment of the shielding means of the present invention;

FIGURE 4 is a sectional view illustrating still another embodiment of the invention; and

FIGURE 5 is a sectional view illustrating an additional embodiment or modification of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The refrigerator illustrated in FIGURE 1 of the accompanying drawing comprises a freezer compartment **1** maintained at subfreezing temperatures by circulating compartment air over an evaporator **2** positioned in a vertical chamber **3** separated from the compartment **1** by a removable wall **4**. More specifically, a fan **5** positioned in the upper portion of the chamber **3** draws compartment air through an air passage **6** at the bottom of the chamber **3** and discharges air cooled by the evaporator **2** through a passage **7** back into the compartment **1**. The evaporator **2** is of the type designed to normally operate at below freezing temperatures with the result that moisture and air blowing through the chamber **3** collects on the evaporator surfaces in the form of frost. Periodically this accumulated frost is removed from the evaporator surfaces by energizing one or more radiant heaters **9** positioned in radiant heating relationship with the evaporator surfaces.

While the evaporator may be any of the well known types, the illustrated evaporator comprises a finned tubing **10** bent in the form of a serpentine to provide, as shown in FIGURE 2, a plurality of horizontal passes **11** in vertical spaced arrangement and connected by return bends **12**. The evaporator is of a generally rectangular construction and the various passes are supported in spaced relationship on opposed frame members **14** at opposite sides of the evaporator.

For the purpose of periodically warming the evaporator surfaces to defrosting temperatures one or more radiant heaters **9** of the type generally described and claimed in Turner Patent 3,280,581 issued Oct. 25, 1966 and assigned to the same assignee as the present invention are positioned in radiant heating relationship with thet evaporator. These heaters, as described in the Turner patent, comprise a tube or envelope of insulating, heating transmitting material such as a quartz-like material and a radiant heater coil positioned within the tube. Energization of the heater coil provides a substantial amount of heat with the result that the tube or envelope attains a surface temperature above the boiling point of water during the defrosting of the evaporator. In order to conserve space and also provide some degree of convection heating of the evaporator during energization of the radiant heaters,

all or some of the heaters are preferably positioned below the evaporator or nested between the adjacent passes **11**. In the illustrated embodiment of the invention one of the heaters **9** is positioned below the evaporator in the lower portion of the chamber **3** whereby the V-shaped bottom portion **16** of the chamber which forms a drain trough is also warmed to defrosting temperatures during the defrost cycle. Adidtional heaters may be mounted as illustrated at spaced intervals along the vertical length of the evaporator **2**.

Also in the illustrated embodiment of the invention, the evaporator tubing **10** or more specifically the passes **11** are provided with fins **18** integral with the tubing and extending radially outwardly therefrom with the end portions **19** twisted through an angle of about 90°. Either two sets of fins **18** may be provided on opposite sides of the passes **11** or four such sets may be used as shown in FIGURE 4.

In accordance with the present invention, each of the radiant heaters are provided with improved shield means, the primary function of which is to prevent the water droplets from overlying portions of the evaporator from dripping onto the hot heater surfaces during defrost of the evaporator. While these shielding means may be of various shapes or constructions, all of them essentially comprise a relatively fine mesh wire screen forming the upper shield surface contacted by the defrost water droplets.

The specific shield illustrated in FIGURE 2 of the drawing is designed to be employed where vertical space is limited. This shield comprises an inverted V-shaped member **20** formed of sheet metal material extending longitudinally of the heater **9**. The member **20** may be supported by end portions **21** on brackets **22** which also function to support the radiant heaters **9** and an overlying screen member **23**. The solid sheet metal member **20** is relatively narrow so that it will produce only a minimum interference with the radiant heat rays emanating upwardly from the heater **9**. During energization of heater **9**, the member **20** is warmed to a temperature approaching that of the heater, which temperature is above the boiling point of water so that in the absence of the protection provided by screen **23** water droplets could drip onto the member **20** and sputter and violently boil to produce the same undesirable disturbing noises as those which would be produced by contact of the water droplets directly with the heater **9**. As shown in the drawings the screen member **23** is of an inverted V-shape and is maintained in spaced relationship with member **20** by being generally supported on the wider flattened end portions **24** of the member **20**. The screen member **23** preferably has a mesh of 30 or more so that it will disperse the water droplets dropping from the evaporator passes **11** before they contact member **20**. The water then becomes distributed by capillary dispersion throughout the screen to maintain this screen member **23** at acceptable operating temperatures. Preferably the edge portions **26** of the screen member **23** extend beyond the adjacent edges of the sheet metal member **20** thereby insuring against any water droplets following the solid edge of the member **20** and dropping off the bottom edge of the solid member **20** onto the heater **9**.

Where vertical space is available, there is preferably employed a shielding means consisting solely of wire screening of 30 or more mesh per inch as illustrated in FIGURES 3, 4 and 5 of the drawing. In these shielding structures, the portions of the wire screening above the heater **9** is disposed at an acute angle of at least 45° with a horizontal. By employing a relatively fine mesh screen and the proper angle, water droplets dropping onto the screen disperse by deflection and capillary dispersion instead of passing through the shield onto the heater **9**.

The embodiment of the shield means **28** illustrated in FIGURE 3 comprises a wire mesh screen bent to form an inclined section **29** positioned above the heater **9** and an inverted V-shaped section **30** adapted to be supported on the metal member **20**. Water droplets dropping from the passes **11** or from the fins **18** forming part of these passes drop onto the inclined portion **29** of the screen where they are either dispersed in the form of fine mist or gradually flow downwardly along the portion **29** to either drop from the lower edge **31** thereof or to be evaporated and thereby cool the screen during operation of the heater.

In the modification of the invention illustrated in FIGURE 4 of the drawing, no shield member corresponding to the member **20** is employed. Instead the shield **31** consists of a multilayer wire mesh screen bent to form a shield having an inverted V-shaped portion positioned directly above the heater **9** and end sections **33** at each of the longitudinal edges thereof adapted to be supported by adjacent fins **18**. By employing a multilayer screen, coarser mesh screen or less acute water runoff angles may be used. In order to provide space for the heater **9** as well as the screen **31** some of the fins **18** may be removed from passes, as for example from the two left hand passes **11**.

In the embodiment of the invention shown in FIGURE 5 some of the fins along the intermediate passes **11** have been removed to provide room for the heater **9** and the shield indicated by the numeral **35**. The heater **9** is arranged in a position forwardly from the vertical line of the passes **11** and includes a vertical support section **36** and a sloping section **37** connected at the top edges to form a generally inverted V-shaped shield member adapted to be supported on the fins on one of the passes **11**. Defrost water dropping from the fins **18** above this shield either flows down the vertical section **36** or down the inclined section **37** and in either case are prevented from dropping directly onto the heater **9**.

In all of the embodiments of the invention, the wire screen or mesh member which is initially contacted by water droplets functions not only to disperse these droplets but also to provide a surface which operates, during the defrosting of the evaporator, at temperatures just up to the boiling point of water and hence at temperatures which will not cause a violent flashing of the water into steam by droplets boiling and the concurrent undesirable noises. Also by maintaining the width of any solid member such as the sheet metal member **20** at a minimum and employing a wire screen as the primary or principal protective means, air flow upwardly through the evaporator during normal operation of the refrigerator, that is when the fan **5** is running, is not materially interfered with. In other words, the air passes freely through the openings in the screen so that maximum contact and cooling of the air by all of the passes of the evaporator is obtained.

An additional advantage of employing a screen shield for deflecting defrost water away from the radiant heater **9** is that the screen permits substantially radiant heating of the evaporator surfaces on the opposite side of the screen from the radiant heater. Also, as the shield or at least the major portion thereof is not in direct heat conducting relationship with the evaporator surfaces, the screen also operates at temperatures substantially above the normal operating temperatures of the evaporator whereby any water remaining on the screen surfaces following a defrost operation will be evaporated and transferred to the colder evaporator surfaces so that air can pass freely through the screen.

Also, where space limitations are at a premium, two thicknesses of screen may be emploeyd and these two thicknesses may be in contact with one another or spaced slightly whereby any substantial quantities of water passing through the upper layer of screening will be dispersed for collection on the lower layer.

While there has been shown and specifically described what are presently considered to be preferred embodiments of the present invention, it is to be understood that it is not limited thereto and is intended by the appended

claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

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

1. In combination, a refrigerant evaporator normally operable at frost collecting temperatures:

means for warming said evaporator to defrost temperatures comprising a radiant heater adapted to operate at a surface temperature above the boiling point of water, said heater being positioned in substantially spaced, radiant heating relationship with said evaporator and below at least one frost collecting portion thereof,

and shield means comprising a screen positioned above said heater and spaced from said evaporator to collect and disperse defrost water droplets dripping from said portion and prevent said droplets from contacting the surface of said heater.

2. The combination of claim 1 in which at least the portion of said screen directly above said heater is inclined.

3. The combination of claim 2 in which said screen has a mesh of at least 30.

4. The combination of claim 2 in which said shield means includes an inverted V-shaped sheet metal member between said screen and said heater.

5. The combination of claim 2 in which said screen and heater are supported between vertically spaced portions of said evaporator.

6. The combination of claim 5 in which said screen is at least partially supported on at least one portion of said evaporator.

7. The combination of claim 2 in which said screen is inclined at an angle such that most of the water droplets impinging thereon are capillary dispersed and retained on the screen to maintain the screen at a temperature substantially below the temperature of said heater.

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U.S. Cl. X.R.

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