United States Patent

Gelbard et al.

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[54] SIDE-BY-SIDE REFRIGERATOR INCLUDING LOW COST EVAPORATOR MEANS

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[73] Assignee: **General Electric Co.**

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[52] **U.S. Cl.** **62/276,** 62/515

[51] **Int. Cl.** **F25d 21/06**

[58] **Field of Search** 62/275, 276, 515

[56] **References Cited**

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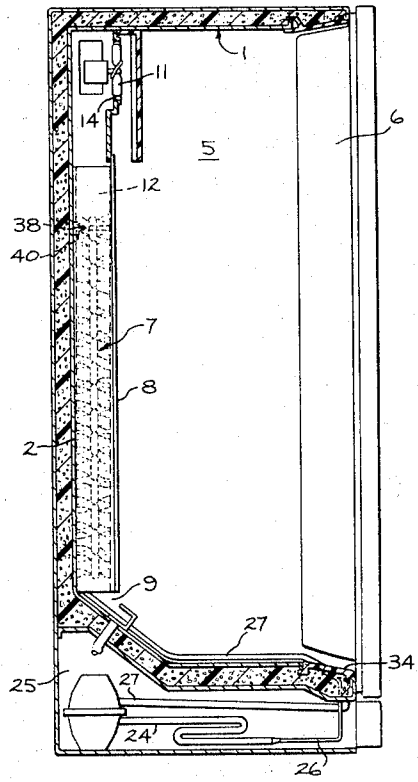
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[57] **ABSTRACT**

A side-by-side combination refrigerator containing a liner defining a freezer compartment and a low cost vertically extending evaporator mounted on the rear wall of the freezer compartment. The evaporator is a single bank serpentine tube having horizontally extending fins and is folded so that adjacent return bends contact one another, these return bends being held in contact by a tie wire. Low costs means are provided for supporting the evaporator, a cover plate separating the evaporator from the storage portion of the freezer compartment and a radiant heater defrost means on the liner walls.

3 Claims, 4 Drawing Figures



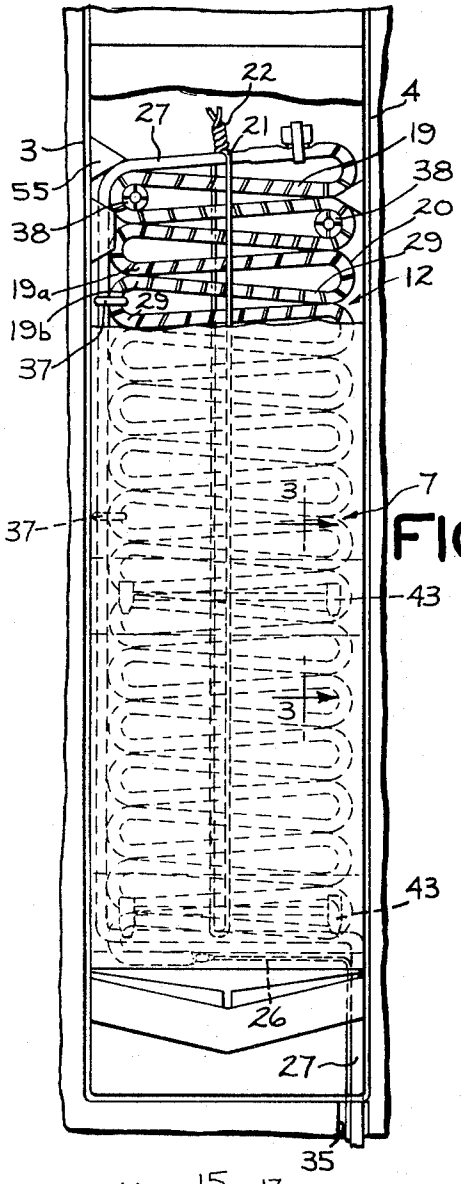


FIG.2

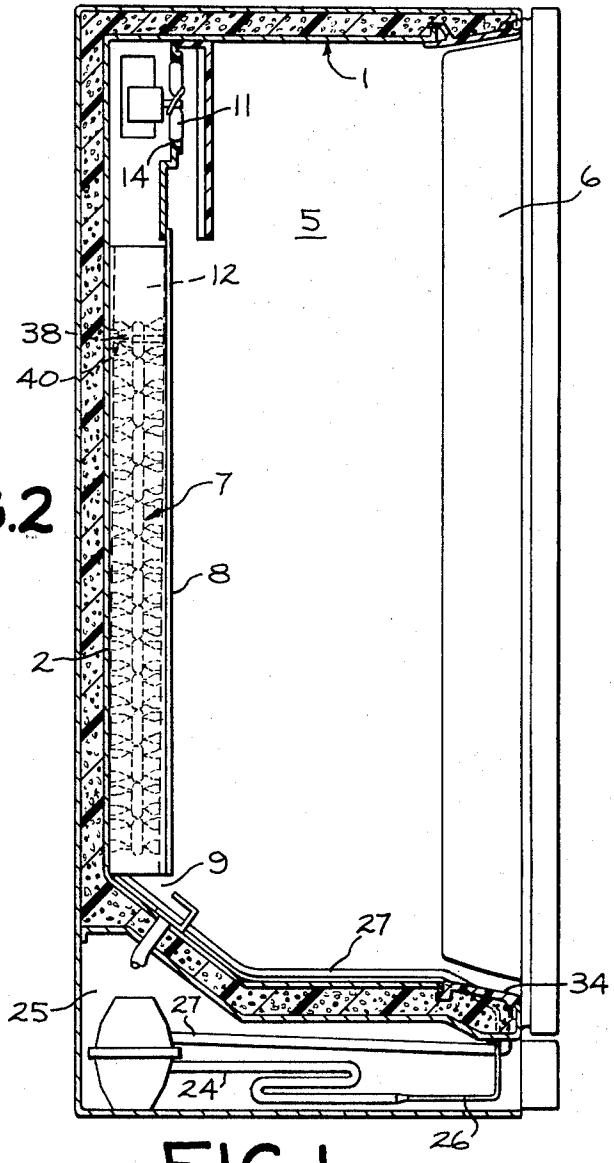


FIG.1

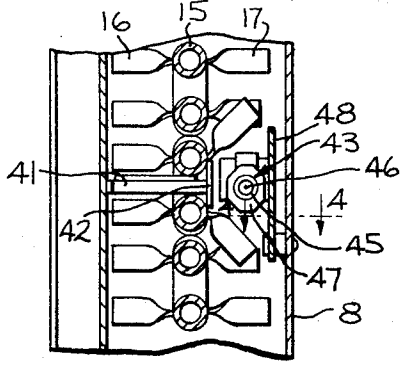


FIG.3

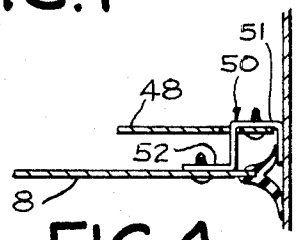


FIG.4

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SIDE-BY-SIDE REFRIGERATOR INCLUDING LOW COST EVAPORATOR MEANS

BACKGROUND OF THE INVENTION

Most household refrigerators having below and above freezing storage compartments located in side-by-side relationship and separated by an insulating wall commonly include a refrigerant evaporator which is vertically arranged along the rear wall of the below freezing compartment and an air circulating system for circulating refrigerated air from the evaporator to the two compartments. In the manufacture of a number of refrigerators of this type, the refrigeration unit, completely assembled, charged and tested, is mounted through the front of the cabinet after the linear forming at least the outer walls of the storage spaces and the shell have been preassembled and foam insulated. In this type of construction, the evaporator component of the refrigeration system is supported on that portion of the back liner wall forming the rear wall of the freezing compartment and a cover plate is thereafter applied over the evaporator. The cover plate forms the rear wall of the freezing compartment storage area and the front wall of the freezing compartment storage area and the front wall of an evaporator chamber. The cabinet, of course, also includes a suitable fan means and air passage or duct means for the circulation of air from the two compartments over the evaporator and the return of refrigerated air to the compartments.

The present invention is directed to a side-by-side refrigerator of this type and is particularly concerned with the provision of improved and low cost evaporator and evaporator chamber structure.

SUMMARY OF THE INVENTION

In accordance with the illustrated embodiment of the present invention, there is provided a side-by-side refrigerator comprising liner means including spaced side walls and a back wall defining a freezer compartment, an evaporator mounted on the back wall and an evaporator cover in front of the evaporator defining with the back wall and adjacent side walls of the evaporator, a chamber having an air inlet at the bottom and an air outlet at the top. The evaporator comprises a serpentine tubular member including a plurality of horizontally extending passes that are arranged in a single vertical plane and are connected by return bends adjacent the side walls of the liner. The serpentine tubular member is vertically compressed so that the adjacent return bend portions are in contact with one another and a longitudinally extending tie wire is provided for maintaining the return bends in their compressed position. The fin structure on the tubular member consists of two diametrically opposed sets of horizontally extending spaced fins aligned longitudinally of the tubular member. This evaporator structure is supported on the rear wall by means of a pair of plastic pins secured to the rear wall and adapted respectively to be received in return bends on opposite sides of the upper portion of the evaporator. These pins include means for spacing the upper end of the evaporator away from the back wall and relatively close to the evaporator cover plate. Retaining means are provided at the lower portion of the evaporator for maintaining that portion in engagement with the rear wall and radiant heater defrost means extending substantially the full width of the evaporator are positioned adjacent these retaining means. Brackets employed to support the radiant heater means are also used to secure the evaporator cover or plate in position.

BRIEF DESCRIPTION OF THE DRAWING

In the accompanying drawing:

FIG. 1 is a side elevational view, partly in section, illustrating a side-by-side household refrigerator including the improved evaporator construction of the present invention;

FIG. 2 is a front view, partly in section, of the evaporator structure of the present invention;

FIG. 3 is an enlarged sectional view taken along line 3—3 of FIG. 2; and

FIG. 4 is a detailed constructional view taken generally along line 4—4 of FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIGS. 1 and 2 of the accompanying drawing, there is shown a portion of a side-by-side refrigerator comprising a liner means 1 including a rear wall 2 and opposed side walls 3 and 4; this liner defining a freezer compartment 5 having an access at the front thereof closed by a door 6. An evaporator 7 is mounted on the rear wall 2, this evaporator 7 extending for a substantial vertical distance along the rear wall 2. An evaporator cover or face plate 8 separates the evaporator 7 from the main storage volume of the freezer compartment 5. The evaporator cover 8 and related structure are designed to provide an air inlet 9 below the evaporator 7 through which air from the freezer compartment 5 is drawn by a fan 11 positioned in the upper portion of the evaporator chamber 12 defined by the liner walls and the cover plate 8. The air is discharged through the air outlet 14 back into the freezer compartment 5. It will be understood of course that additional air passages are provided for circulating some of the cooled air through a fresh food compartment (not shown) adjacent the freezing compartment 5.

The evaporator 7, as shown in FIGS. 2 and 3 of the drawing, includes a tubular portion 15 having two sets of diametrically opposed fins 16 and 17 extending radially outwardly from the tubing 15 and twisted through an angle of about 90°. This type of tubular heat exchange stock is fully described in U.S. Pat. No. 3,457,756 Rohde issued July 29, 1969, and assigned to the same assignee as the present invention.

In accordance with the present invention, the evaporator 7 is in the form of a single bank of serpentine bent or folded finned tubing, the tubing being bent to form a plurality of horizontally extending passes 19 connected by return bends 20. The horizontal dimensions of the evaporator are such that the evaporator extends substantially the full width of the evaporator compartment 12 and the fins 16 and 17 extend horizontally on the opposite faces of the structure.

More specifically, in accordance with the present invention, the serpentine convolutions of the evaporator are compressed, in a vertical direction as illustrated in FIG. 2 of the drawing, to the point that the convolutions formed by the passes 19 and return bends 20 make contact at both ends of the passes, and the evaporator 7 is held in this shape by means of a tie wire 21 longitudinally encirculating the passes with the ends of the wire twisted together as illustrated by the numeral 22.

By this evaporator construction, each of the horizontally extending passes 19 are slightly inclined so that adjacent passes such as passes 19*a* and 19*b*, which are series connected at one end by a return bend 20 but are maintained in physical contact at their other ends by the tie wire 21 slant in opposite directions.

By employing this evaporator configuration and introducing liquid refrigerant from a condensing unit 24 positioned in the machinery compartment 25 into the evaporator through a capillary inlet 26 at the bottom pass of the refrigerator and returning vaporized refrigerant through a suction conduit 27 connected to the upper pass of the evaporator, liquid refrigerant flowing upwardly through the tubing 15 is progressively vaporized as it approaches the upper end of the evaporator. One advantage of the inclined pass configuration of the evaporator is that as refrigerant flows upwardly through the evaporator, the liquid and vapor phases are separated in each of the pockets or traps such as indicated by the numeral 29 at the junction of each inclined pass 19 and an adjacent bend, the liquid tending to remain in these pockets so that only vaporized refrigerant reaches the suction line.

The evaporator 7 forms part of an integrated refrigeration unit adapted to be front mounted into the cabinet, after which the cover plate 8 is put into position within the freezer compartment. The evaporator 7 and the condensing unit 24 are connected by the suction line 27 and capillary 26 and these

components may simply be positioned along a lower corner portion of the freezer compartment 5 and passed beneath the breaker strip 34 and downwardly through a slot 35 in the lower face portion of the cabinet.

Also in this preassembled unit, the vertical portion of the suction line 27 extending downwardly along one side of the serpentine may be connected by means of hog rings 37 to spaced end turns or return bends.

The evaporator is suspended on the rear liner wall 2 employing a pair of spaced mounting pins 38 secured to the upper portion of the back wall and adapted to be received in the openings defined by return bends 20 on opposite sides of the evaporator structure. These pins, preferably composed of a plastic material, each include a base portion 40 adapted to space the upper end of the evaporator forwardly from the rear wall 2.

Lower portions of the serpentine evaporator 7 are secured to the rear wall 2 by means of brackets such as the bracket 41 illustrated in FIG. 3 of the drawing. These brackets 41 include heat portions 42 engaging the front surface of the serpentine and are preferably provided at those points at which radiant heater defrost means generally indicated by the numeral 43 are also mounted. In the illustrated embodiment of the invention, two such defrost heaters 43 are also mounted. In the illustrated embodiment of the invention, two such defrost heaters 43 are also mounted. In the illustrated embodiment of the invention, two such defrost heaters 43 are employed, one at about the vertical mid point of the evaporator and the other adjacent the lower end of the evaporator.

These radiant heaters are of the type described more fully in U.S. Pat. No. 3,280,581 Turner. They comprise a quartz tube 45 containing a heater coil 46, the ends of the tube being closed by mounting caps 47 supporting the radiant heater on a combination support and baffle member 48, this baffle member 48 being positioned on the opposite side of the radiant heater from the evaporator, that is between the radiant heater and the evaporator cover 8.

Also in accordance with the present invention, the means employed for supporting the radiant heater portion is employed to secure the evaporator cover 8 in place. As shown in FIG. 4 of the drawing this means comprises brackets 50 suitably secured to the side walls of the freezer compartment and formed to provide horizontally spaced mounting sections 51 and 52. The rear mounting section 51 supports the baffle and support member 48 of the radiant heater while the front portion 52 is used to secure the evaporator cover 8 in position. Thus the evaporator cover 8 is maintained in spaced relationship with the baffle support member 48 which protects the evaporator cover 8 from direct radiation from the radiant heater 43.

Preferably foamed insulation, triangular shaped pads 53 are positioned on opposite sides of the evaporator adjacent the upper end thereof to insure that all of the air passing through at least the upper passes of the evaporator rather than through any relatively narrow spaces which may exist on each side thereof.

From the above description, it will be seen that the subject evaporator design provides improved economy and heat transfer by virtue of its novel construction. The heat exchange surface is generated by a single bank of shredded fin tubing, the convolutions of which are compressed to the point of making contact at both ends of the convolutions thereby increasing the amount of tubing which can be provided within a given vertical dimension. By employing binding wire as a low cost means to maintain the evaporator structure in this compressed state, there is provided a rigid structure which does not require the usual more expensive end brackets for supporting the tube passes. Thus the entire evaporator tubing including the end turn or return bend regions are available for heat transfer.

In addition the liquid storage capacity of the trap portions of the evaporator store liquid refrigerant so that there is no need for a refrigerant accumulator. The mounting brackets 50 maintain the evaporator cover 8 and the heater shield 48 thermally insulated from one another.

While there has been shown and described a specific embodiment of the invention, it will be understood that it is not limited thereto and it is intended by the appended claims to cover all modifications that fall within the true spirit and scope of the invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A refrigerator comprising:
a liner including spaced side walls and a back wall;
a vertically extending evaporator adjacent said back wall;
an evaporator cover in front of said evaporator and defining with back wall and side walls an evaporator chamber;
said evaporator comprising a serpentine tubular member including a plurality of horizontally extending passes arranged in a vertical plane and connected by return bends adjacent said side walls;
said evaporator having a refrigerator inlet connected to a lower portion thereof and an outlet at the upper end thereof;
said tubular member having two diametrically opposed sets of horizontally extending spaced fins aligned longitudinally of said tubular member;
means for maintaining adjacent return bend portions of said tubular member in contact with one another whereby adjacent passes slant in opposite directions;
means for supporting said evaporator comprising a pair of pins mounted on said back wall and adapted respectively to be received in return bends on opposite sides of the upper portion of said evaporator; said pins including means for positioning the upper end of said evaporator relatively close to said evaporator cover;
retaining means for securing the lower portion of said evaporator in engagement with said rear liner wall;
radiant heater defrost means extending substantially the full width of said evaporator to defrost said evaporator, said defrost means being positioned adjacent said retaining means and between adjacent passes of said evaporator; said defrost means including heater shield means between said heater and said evaporator cover; and
bracket means mounted on said liner for supporting said heater means and said evaporator cover.

2. A refrigerator according to claim 1 in which said pins are composed of a plastic material.

3. A refrigerator according to claim 1 in which said heater is positioned at an elevation between adjacent passes.

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