

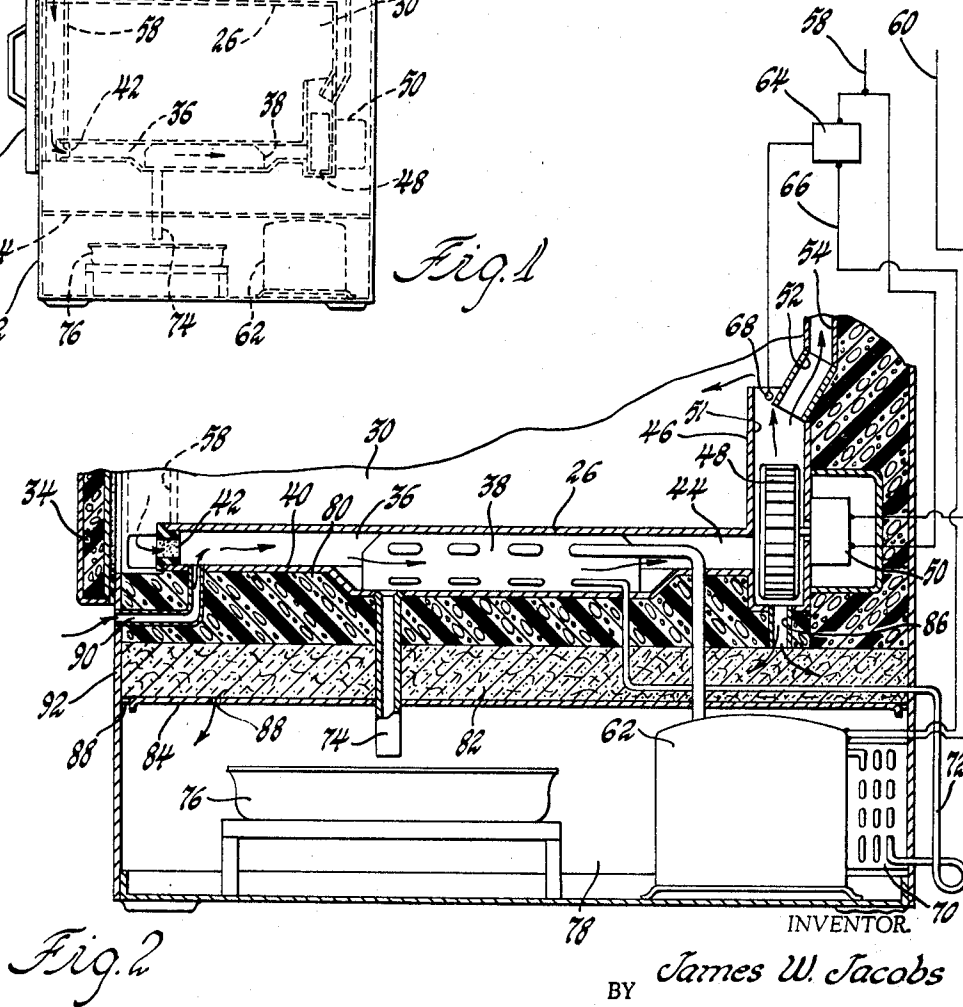
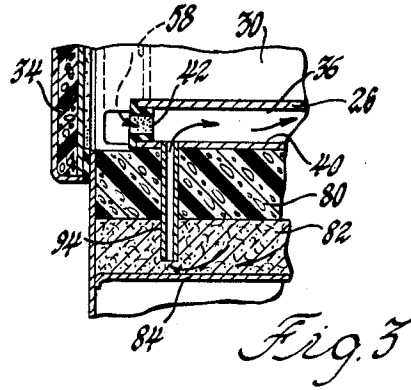
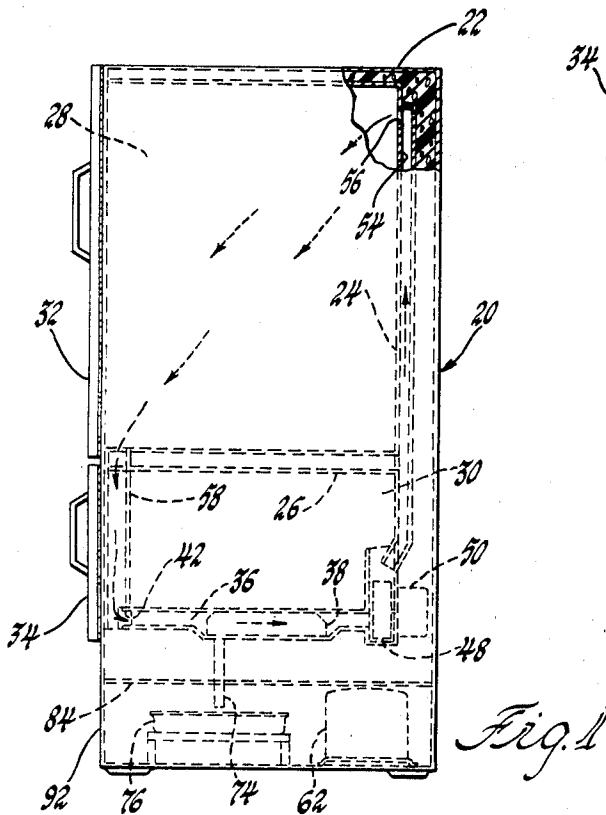
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KEEPING INSULATION DRY

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KEEPING INSULATION DRY

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5 Claims

ABSTRACT OF THE DISCLOSURE

In the preferred form of this refrigerator, a centrifugal fan draws air from the compartments to be cooled and through the evaporator before returning the air to the compartments. To keep the insulation dry, a small duct extends from the housing of the centrifugal fan to part of the insulation space which is provided with an outer layer of glass fiber insulation. The cold dry air circulates through and removes moisture from this outer layer and an inner layer of polyurethane foam insulation and can either leak out through the outer wall or be returned to an area of lower pressure in the circulating air.

This invention pertains to a refrigerator in which the compartments are cooled by circulating air through an evaporator compartment by a fan from which a minor part is circulated through the insulation space for keeping dry the insulation.

Leakage of air from outside the refrigerator cabinet into the insulation space will cause condensation of moisture within the space from such air. Also, any leakage of liquid therein from the interior of a refrigerator will cause the insulation to become wet and ineffective. Such wet insulation deteriorates the insulating effect and increases the heat leak into the cabinet thereby making the refrigerator unsatisfactory. The prevention of such moisture accumulation has been a formidable problem.

It is an object of this invention to forcibly circulate a small amount of dry air through the insulation to prevent the accumulation of moisture therein.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein preferred embodiments of the present invention are clearly shown.

In the drawings:

FIGURE 1 is a side elevational view of a refrigerator cabinet embodying one form of my invention;

FIGURE 2 is a fragmentary side vertical section, partly diagrammatic, of the lower portion of the refrigerator shown in FIGURE 1; and

FIGURE 3 is a fragmentary front lower side section showing a modified form of the invention.

Referring now to the drawings and more particularly to FIGURES 1 and 2, there is shown a refrigerator 20 including an outer metal shell 22 and upper and lower inner liners 24 and 26 enclosing an upper above freezing compartment 28 and a lower below freezing compartment 30. These compartments 28 and 30 are closed by the upper and lower doors 32 and 34.

Beneath the bottom of the lower inner liner 26 there is provided an evaporator compartment 36 containing a vertical fin evaporator 38 which rests upon the bottom wall 40 of the compartment 36. Compartment 36 is provided with a front entrance 42 in front of the evaporator 38 and a rear exit 44 to the rear of the evaporator 38. The rear exit connects to the inlet of the housing 46 of a centrifugal fan 48 driven by the electric motor 50, preferably at all times. The fan housing 46 has two upper discharge ports 51 and 52. The discharge port 51 dis-

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charges the major portion of the air previously cooled by the evaporator 38 into the compartment 30. The port 52 receives a much smaller portion of the cooled air which is delivered through the duct 54 to a discharge opening 56 located adjacent the top rear of the compartment 28. The air from the compartment 28 is returned to a duct 58 to the entrance 42 while the air in the compartment 30 flows freely and directly to the entrance 42. A more complete disclosure of the above arrangement may be found in Patent 3,104,533, issued Sept. 24, 1963 or Patent 3,120,111, issued Feb. 4, 1964.

The fan motor 50 is connected at all times across the supply conductors 58 and 60 while the sealed motor compressor unit 62 is connected by the thermostatic cycling control switch 64 and the conductor 66 across the supply conductors 58 and 60. The cycling control switch 64 is controlled in accordance with the temperature of its thermo-sensitive bulb 68 located in the outlet port 51. The sealed motor compressor unit 62 withdraws the evaporated refrigerant from the evaporator 38 and pumps the compressed refrigerant through the condenser 70 where the refrigerant is liquified and flows through a capillary restrictor 72 back to the evaporator 38 thereby maintaining the evaporator at a temperature of between about -5 and -15° F.

This evaporator operating at such low temperatures not only cools the circulating air but also removes moisture therefrom. From time to time the evaporator may need to be defrosted and during the defrost period the defrost water is drained from the bottom wall or collecting pan 40 by the tube 74 into the collecting pan 76 located in the machinery compartment 78 beneath the bottom wall. This defrosting may be accomplished through various types of defrosting systems such as, for example, as shown in Patents 3,107,501, issued Oct. 22, 1962; 3,138,006, issued June 23, 1964; and 3,359,750 issued Dec. 26, 1967.

Normally, because it is impossible to provide perfect hermetic sealing, moisture tends to collect in the insulation space surrounding the lower below freezing compartment 30. This moisture greatly reduces the efficiency of the insulation and causes difficulty in maintaining the desired temperature in the compartment, as well as increases current consumption by the refrigerating system. According to my invention, in addition to the customary layer of plastic foam insulation 80 beneath the wall 40, I provide a second layer 82 between this foam insulation 80 and the outer bottom wall 84. The insulation 80 may be formed of either polyurethane foam containing an insulating gas or polystyrene foam or beads. The insulation layer 82 is preferably permeable glass fibers or mineral wool through which air can circulate.

To keep all of the insulation dry, the housing 46 of the fan 48 is provided with a small lower outlet duct 86 extending through the inner layer 80 of the insulation into the outer layer 82. As shown in FIGURE 2 there may be provided small leakage holes 88 through the wall 84 so that this small amount of air discharged through the duct 86 can circulate freely through the glass fiber or mineral wool insulation 82 and pick up moisture from this insulation as well as contacting the adjacent surface of the foam insulation 80 and can flow out through the leakage holes 88 into the air outside the refrigerator.

This air is especially effective for drying since it has been dried and cooled by its flow through the evaporator 38. As it flows through the fibrous insulation 82 it will be warmed by the heat from the air surrounding the refrigerator as well as from the heat dissipated by the sealed motor compressor unit 62 and the condenser 70. This heating will reduce the relative humidity of the air so that its vapor pressure is greatly reduced and it has a high capac-

ity for absorbing moisture from both types of insulation. For example, if the air discharged by the fan 48 is at a temperature of 0° F. and 100% relative humidity it will have a very low specific humidity (5.4 grams of moisture per pound of dry air) and will warm up sufficiently during its flow through the insulation 82 to reduce the relative humidity to about 3 to 5%. This has a very strong drying effect upon the insulation which maintains the efficiency of the insulation.

To replace the air which is discharged through the leakage holes 88, there may be provided a very small air duct 90 extending from an aperture in the front wall 92 to an aperture in the wall 40 which allows a small amount of outside air to flow into the evaporator compartment 36 in front of the evaporator 38. Through this arrangement, moisture is kept out of the insulation and the insulating efficiency of the cabinet and the thermal efficiency of the refrigerator are maintained.

In FIGURE 3, a modified form of the invention is shown in which the outside duct 90 is changed and replaced by an inner recirculating duct 94 which extends from the lower layer 82 of fiber insulation to an aperture in the bottom wall 40 of the evaporator compartment 36 between the entrance 42 and the evaporator 38. This arrangement avoids the necessity of providing for any leakage in the bottom wall 84 and also avoids the necessity for admitting any external or make-up air to make up for the leakage. The air will flow from the duct 86 through the glass fiber insulation 82 in the same manner as shown in FIGURE 2 and thence will return through the duct 94 to the evaporator compartment 36 in the front of the evaporator 38. This arrangement will likewise have an adequate capacity for removing moisture from the insulation layers 82 and 80 to keep the insulation dry. It will also provide an area of slightly higher pressure in the insulation 82 which will prevent a leakage of outside air into the insulation space. This, therefore, tends to cut off one possible source of moisture from the insulation so that only a very small amount of dry air circulation is necessary.

While the embodiments of the invention as herein disclosed constitute preferred forms, it is to be understood that other forms might be adopted.

I claim:

1. A refrigerator including a cabinet having spaced inner and outer walls enclosing a compartment to be cooled, insulating means between said walls, refrigerant evaporating means for cooling said compartment, circulating means for circulating air from said compartment into heat transfer with said evaporating means and back to said compartment, the improvement wherein said insulating means comprises a layer of plastic resin foam and a layer of fiber insulation, and means for circulating a minor portion of said circulating air through said layer of fiber insulation.

2. A refrigerator including a cabinet having spaced inner and outer walls enclosing a compartment to be cooled, insulating means between said walls, refrigerant evaporating means for cooling said compartment, circulating means for circulating air from said compartment into heat transfer with said evaporating means and back to said compartment, the improvement wherein said insulating means comprises a layer of plastic resin foam and a layer of fiber insulation, said circulating means comprising a fan for establishing a zone of higher pressure therein, and duct means extending from said zone of higher

pressure to said layer of fiber insulation for keeping dry said insulating means.

3. A refrigerator including a cabinet having spaced inner and outer walls enclosing a compartment to be cooled, refrigerant evaporating means for cooling said compartment, circulating means for circulating air from said compartment into heat transfer with said evaporating means and back to said compartment, wherein the improvement comprises a layer of plastic resin foam insulation between said walls and adjacent one of said inner walls having an exposed surface spaced from one of said outer walls and a layer of fiber insulation between said exposed surface and said one outer wall, means for directing a portion of said circulating air between said exposed surface and said one outer wall through said layer of fiber insulation into direct contact with said exposed surface.

4. A refrigerator including a cabinet having spaced inner and outer walls enclosing a compartment to be cooled, refrigerant evaporating means for cooling said compartment, circulating means for circulating air from said compartment into heat transfer with said evaporating means and back to said compartment, said circulating means comprising a fan for establishing a zone of higher pressure therein, wherein the improvement comprises a layer of plastic resin foam insulation between said walls and adjacent one of said inner walls having an exposed surface spaced from one of said outer walls and a layer of fiber insulation between said exposed surface and said one outer wall, duct means extending from said zone of higher pressure through said inner wall to said layer of fiber insulation and having a discharge outlet between said exposed surface and said one outer wall for keeping dry said insulation.

5. A refrigerator including a cabinet having spaced inner and outer walls enclosing a compartment to be cooled, refrigerant evaporating means, circulating means including a fan and fan housing for circulating air from said compartment into heat transfer with said evaporating means and back to said compartment, wherein the improvement comprises a layer of plastic resin foam insulation between said walls and adjacent one of said inner walls having an exposed surface spaced from one of said outer walls and a layer of fiber insulation between said exposed surface and said one outer wall, duct means extending from said fan housing through said one inner wall to said layer of fiber insulation and having a discharge outlet between said exposed surface and said one outer wall for conveying a limited amount of air for keeping dry the said insulation.

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