Nov. 28, 1939. R. H. TULL 2,181,635

FORCED AIR COOLED DISPLAY CASE

Filed July 9, 1938 2 Sheets-Sheet 1

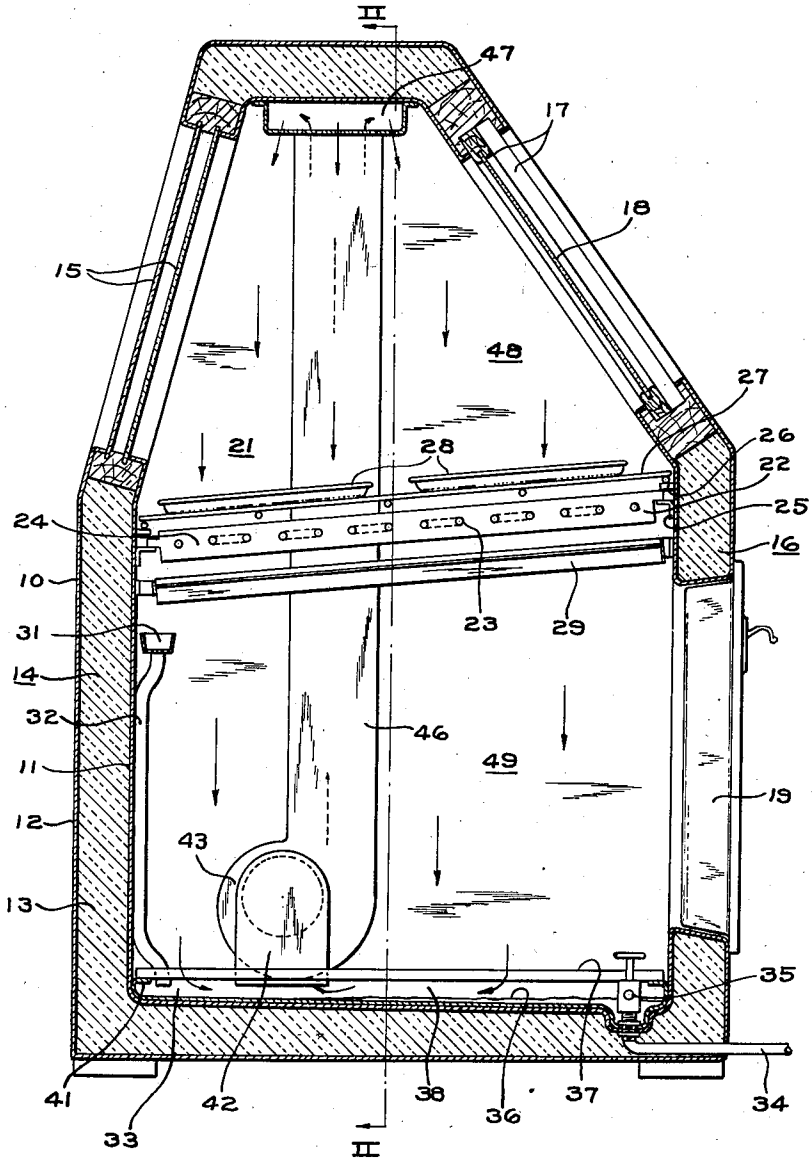


FIG. 1.

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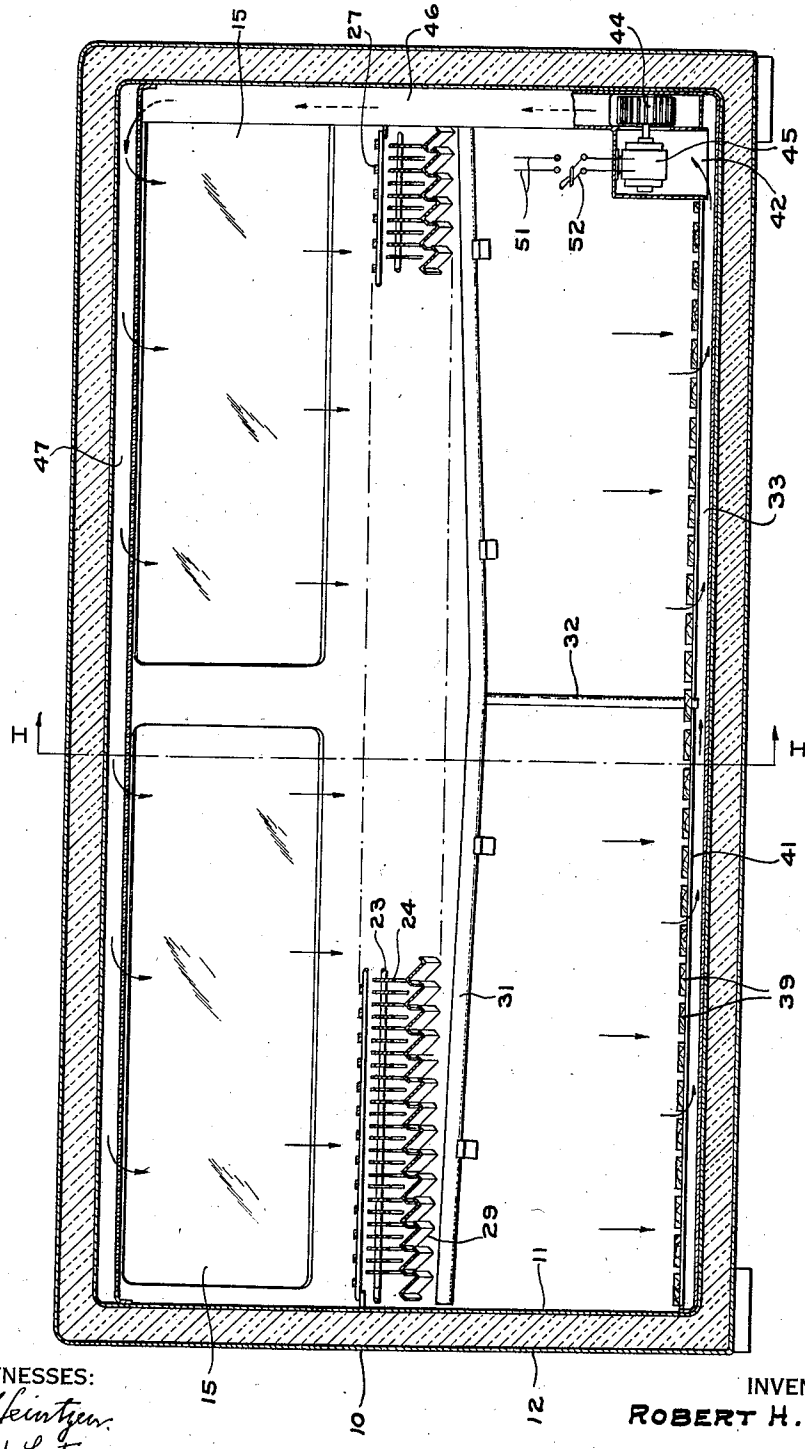


FIG. 2.

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Patented Nov. 28, 1939 2,181,635

UNITED STATES PATENT OFFICE

2,181,635

FORCED AIR COOLED DISPLAY CASE

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Application July 9, 1938, Serial No. 218,270

8 Claims. (Cl. 62—89.5)

This invention relates to refrigerators and to a method of operating the same, and particularly to refrigerators of the type wherein the air in the refrigerated storage space is forcibly circulated therein.

One object of the invention is to provide a refrigerator of the forced convection type in which the refrigerated storage space is maintained at a high humidity.

Another object is to provide a refrigerator having an improved structure for maintaining two compartments of a refrigerator at different temperatures.

Another object of the invention is to provide a refrigerator having two compartments, one of which may be rendered relatively inactive to reduce operating expense.

Another object is to provide a method of operating a refrigerator so that dehydration of the comestibles stored therein is inhibited.

These and other objects are effected by my invention, as will be apparent from the following description and claims taken in connection with the accompanying drawings forming a part of this application, which show a refrigerator display cabinet. The invention, however, is not limited to this specific embodiment as it is applicable to numerous other types of refrigerated chambers.

In the drawings, Fig. 1 is a vertical section through the display case on the line I—I of Fig. 2.

Fig. 2 is a vertical section through the display case on the line II—II of Fig. 1.

Referring now to the drawings: numeral 10 designates a cabinet of conventional construction which comprises an inner shell 11 enclosing a refrigerated storage chamber 21 and an outer shell 12, between which is located heat insulating material 13. The cabinet 10 includes front and rear walls 14 and 16 and the upper portion of the front wall 14 is inclined and contains several spaced panes of glass 15 to permit a view of the contents of the cabinet 10. The upper portion of the rear wall 16 is also inclined and is provided with sliding doors 17, the panels of which are transparent panes of glass 18. The lower portion of the rear wall 16 is provided with hinged doors 19.

Located in approximately the center of the cabinet 10 is a relatively flat cooling unit or evaporator 22 comprising a tube 23 passing back and forth through a series of parallel and spaced-apart metal strips 24 which form fins for the tube 23. The cooling unit 22 is supported on the brackets 25. The refrigerant may be passed through the tube 23 by connecting a suitable refrigerating apparatus (not shown) to the ends of the tube 23.

The cooling unit 22 covers substantially the entire horizontal sectional area of the storage chamber 21 and divides it into an upper compartment 48 and a lower compartment 49. Above the cooling unit 10 and supported on the brackets 26 is a grid forming a shelf 27 on which may be placed display pans 28 as shown in Fig. 1. Below the cooling unit 22 is a series of Z-shaped channels 29 which overlap one another to catch all of the moisture dripping from the cooling unit 22, while permitting air to pass therethrough.

The cooling unit 22, the shelf 27, and the series of Z-shaped channels 29 are slightly inclined from the horizontal to permit a convenient view through the window 15 of the articles of food stored on the shelf and also to drain the moisture collected by the Z-shaped channels 29 into a trough 31 located on the front wall 14 of the cabinet 10. This trough 31 drains through a tube 32 into a storage pan 33 which covers substantially the entire floor area of the cabinet 10. An overflow drain 34 connects with this pan 33 to carry away the excess water. The purpose of this pan 33 is to humidify the air in the cabinet 10. The floor area of this pan 33 is slightly inclined and is provided with an overflow drain 34 at its lowest point. The entrance opening 35 of this drain is adjustable as to height so that the depth of the water and, therefore, the exposed surface 36 thereof is controllable by varying the height of the orifice 35. By thus changing the exposed surface of the water, the degree of humidity in the cabinet 10 may be controlled. This means of controlling the humidity forms the subject matter of a separate application, Serial No. 235,733, filed October 19, 1937. The inventor and assignee are the same as in the present application.

A second shelf 37 is located in the bottom of the cabinet a short distance above the surface of the water in the pan and forms an air duct 38 between the shelf 37 and the water 36. The shelf 37 is formed of spaced slats of wood 39 which are supported at their edges on the inturned flanges 41 of the pan 33.

Connected with the duct 38 is an inlet conduit 42 of a blower element comprising a casing 43, a fan 44, and a motor 45 for driving the fan 44. The motor is driven by an electric current flowing through the wires 51 and the controlling switch 52. The fan 44 passes the air taken from the duct 38 upwardly through a duct 46 to a

horizontal duct 47 located in the top wall of the cabinet 10. The lower surface of this horizontal duct 47 is foraminated and evenly distributes the air downwardly through the cabinet 10 where it passes through the upper food compartment 48, the cooling unit 22, the spaces between the channels 29, the lower food compartment 49, and through the spaces between the slats 39, over the surface of the water 36 in the pan 33, and is then recirculated by the fan 44.

The cooling unit 22 is relatively flat so that the air passes quickly through the same and is cooled only a few degrees in temperature on passing through. This chilling is sufficient to abstract the heat absorbed by the air on passing over the articles in the refrigerator and along the walls of the refrigerator. The small degree of cooling and heating in each cycle results in but little moisture being abstracted by the cooling unit 22 from the air, and because of its intimate contact with the water in the pan 33 the humidity of the air will be high. Because of this high humidity, fruits, vegetables, meats and similar moisture-containing foods will retain their condition and palatable appearance while stored in the refrigerator.

The large area of the cooling unit insures an even distribution of temperature in each of the two food compartments 48 and 49. The large contact area of the cooling unit also permits of operation at a relatively high temperature and at a corresponding high suction pressure, thereby lowering the power consumption of the refrigerator.

The speed of the air through the display case is preferably about 6 feet per minute but may vary between 3 and 20 feet per minute. This low air speed reduces the dehydration of the comestibles in the display case. Furthermore, since but little energy is expended in the display case to drive the fan, the amount of heat which is added to the refrigerated storage space by the fan motor 45 is small.

The lower food compartment 49 is maintained at a lower temperature than the upper compartment 48 and may be utilized to carry the reserve stocks of merchandise, while the upper compartment 48 may be used for displaying the merchandise to be sold immediately. The air in both compartments is, however, always maintained at temperatures above 32 degrees F. The relative humidity is lower in the upper compartment 48 than in the lower compartment 49, but the humidities in both compartments are fairly high.

For overnight storage the articles of food may be removed from the upper compartment 48 and the fan motor 45 stopped by opening the switch 52. Most of refrigeration is then effected in the lower food compartment 49, the refrigeration occurring through convectional air currents from the cooling unit 22. This effects an appreciable saving in the operating cost of the refrigerator.

From the above it will be apparent that this invention provides a refrigerator in which dehydration of the comestibles placed therein is largely prevented. The refrigerator of this invention also provides a display case having two food storage chambers maintained at different temperatures for different kinds of storage. One of these chambers may also be rendered comparatively inactive to reduce the operating cost of the refrigerator.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. A refrigerator comprising an insulated cabinet, the length of which exceeds its breadth, a relatively flat and substantially horizontal cooling unit therein dividing said refrigerator into an upper and a lower refrigerated storage compartment, and motor-driven means for circulating air through said compartments and through said cooling unit, said motor-driven means including an air duct, an air inlet to said motor-driven means extending along substantially the entire length of the lower compartment and an air outlet extending substantially along the entire length of the upper food compartment.

2. In a refrigerator, the combination of a cabinet, a relatively flat cooling unit therein dividing said cabinet into two storage compartments, said cooling unit having transverse air passages substantially throughout its surface, said cooling unit being arranged to cooperate with the walls of the cabinet to prevent the passage of substantial quantities of air around the cooling unit, propelling means for circulating air in said cabinet, means for directing air from an extended area in one compartment to said propelling means, and means for discharging air from the propelling means into the other compartment over an extended area and towards said cooling unit, said air thereafter passing through the cooling unit, whereby the amount of heat removed by the cooling unit from the air passing therethrough is substantially uniform over the area of the cooling unit.

3. In a refrigerator, the combination of a cabinet, a relatively flat and substantially horizontal cooling unit therein dividing said cabinet into an upper and a lower storage compartment, said cooling unit having transverse air passages substantially throughout its surface, said cooling unit being arranged to cooperate with the walls of the cabinet to prevent the passage of substantial quantities of air around the cooling unit, propelling means for circulating air in said cabinet, means for directing air from an extended area in the lower compartment to said propelling means, and means for discharging air from the propelling means into the upper compartment over an extended area and towards said cooling unit, said air thereafter passing downwardly through said compartments and through said cooling unit, whereby the amount of heat removed by the cooling unit from the air passing therethrough is substantially uniform over the area of the cooling unit.

4. In a refrigerator, the combination of a cabinet, a relatively flat and substantially horizontal cooling unit therein dividing said cabinet into two storage compartments, said cooling unit having a multiplicity of closely spaced transverse air passages substantially throughout its surfaces, said cooling unit being arranged to cooperate with the sides of the cabinet to prevent the passage of substantial quantities of air around the cooling unit, a drip collector below said cooling unit having air passages therein, propelling means for circulating air in said cabinet, means for directing air from an extended area in one compartment to said propelling means, and

means for discharging air from the propelling means into the other compartment over an extended area and towards said cooling unit, the air thereafter passing through the cooling unit and the drip collector, whereby the air passing through the cooling unit is cooled substantially uniformly throughout the area thereof.

5. In a refrigerator, the combination of a cabinet, a relatively flat and substantially horizontal cooling unit therein, dividing said cabinet into two storage compartments, said cooling unit having transverse air passages substantially throughout its surface, said cooling unit being arranged to cooperate with the sides of the cabinet to prevent the passage of substantial quantities of air around the cooling unit, a pan for storing water in the lower compartment adjacent the bottom thereof, propelling means for circulating air in said cabinet, means for directing air adjacent said pan to said propelling means, and means for discharging air from the propelling means into the other compartment over an extended area and towards said cooling unit, the air thereafter passing through the cooling unit, whereby the air passing therethrough is cooled substantially uniformly throughout the area of the cooling unit.

6. In a refrigerator, the combination of a cabinet, a relatively flat and substantially horizontal cooling unit therein dividing said cabinet into two storage compartments, said cooling unit having transverse air passages substantially throughout its surface, said cooling unit being arranged to cooperate with the walls of the cabinet to prevent the passage of substantial quantities of air around the cooling unit, a drip collector below said cooling unit comprising overlapping troughs, said troughs being spaced apart to provide air passages, a pan for storing water in the lower compartment adjacent the bottom thereof, means for conducting moisture collected by said drip collector to the pan, propelling means for circulating air in said cabinet, means for directing air from an extended area adjacent said water pan into said propelling means, means for discharging air from the propelling means into the other compartment over an extended area and towards said cooling unit, the air thereafter passing through the cooling unit and drip collector, whereby the air passing through the cooling unit is cooled substantially uniformly throughout the area thereof.

7. In a refrigerator, the combination of a cabinet, a relatively flat and substantially horizontal cooling unit therein dividing said cabinet into upper and lower food storage compartments, said cooling unit having transverse air passages substantially throughout its surface, said cooling unit being arranged to cooperate with the walls of the cabinet to prevent the passage of substantial quantities of air around the cooling unit, propelling means for circulating air in said cabinet, means for directing air from an extended area in one compartment into said propelling means and means for discharging air from the propelling means into the other compartment over an extended area and towards said cooling unit, the air thereafter passing through the cooling unit, and means for rendering said air propelling means inactive to reduce the refrigeration of said upper compartment.

8. A refrigerator comprising a cabinet, a relatively flat cooling unit having a multiplicity of closely spaced transverse air passages therethrough and throughout substantially its entire area, said cooling unit being disposed in said cabinet to divide the same into two food storage chambers and to occupy more than half of the cross-sectional area of said cabinet in the plane of the cooling unit, air propelling means and ducts associated with the cabinet to pass air through one compartment, then transversely through the cooling unit and substantially uniformly throughout its area, and then through the other compartment, said transverse movement of the air through the cooling unit being at a velocity below twenty feet per minute and providing substantially the sole contact of the air therewith, whereby said passage of the air at said velocity through the compartments effects substantially a uniform temperature in each of said compartments and a low and uniform moisture abstraction from the air throughout said cooling unit.

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