March 8, 1960 V. G. SHARPE ET AL 2,927,441

REFRIGERATING APPARATUS WITH MEANS PREVENTING CONDENSATE ON TRANSPARENT PANELS

Filed Jan. 16, 1956 5 Sheets-Sheet 1

Fig. 1

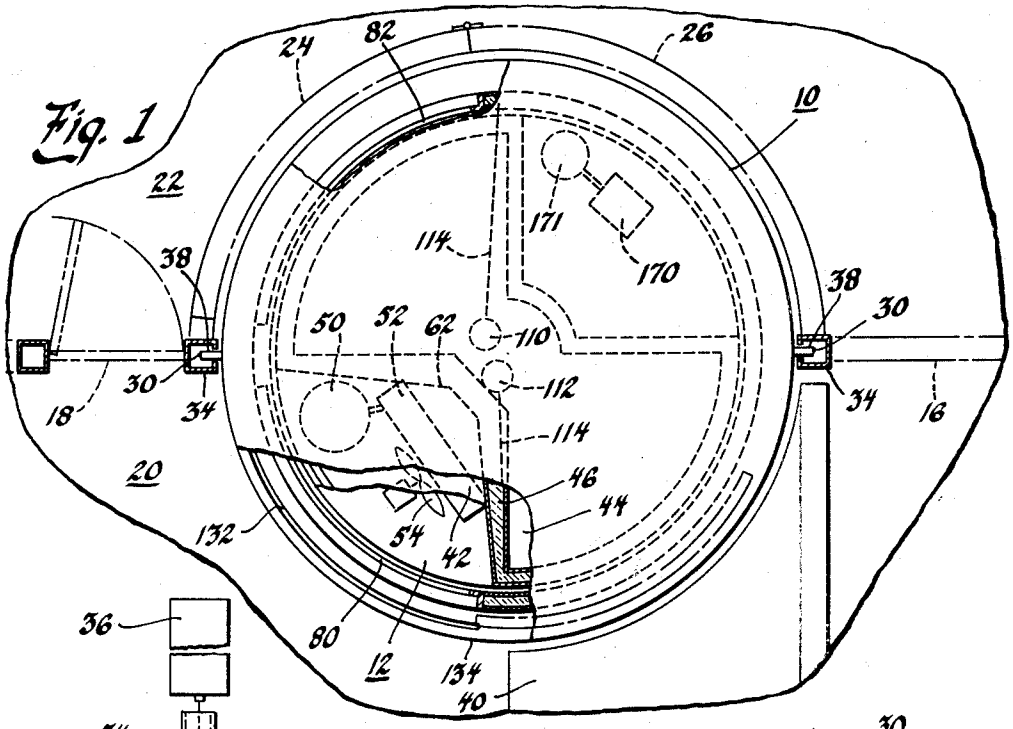


Fig. 2

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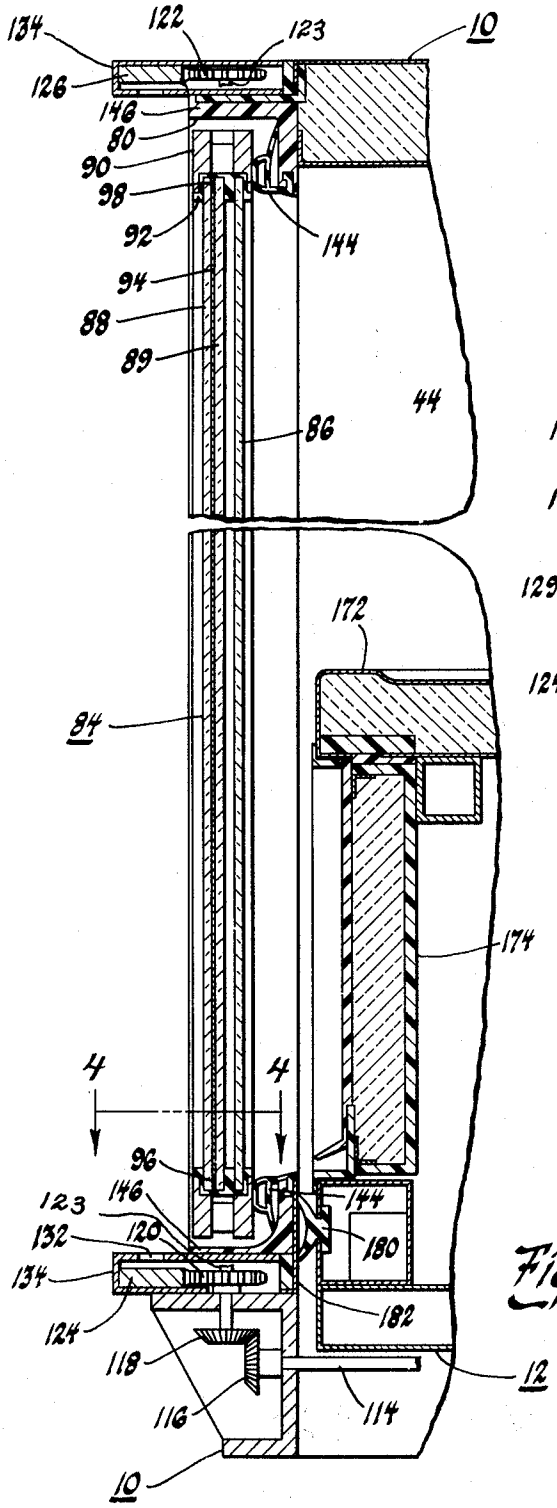


Fig. 3

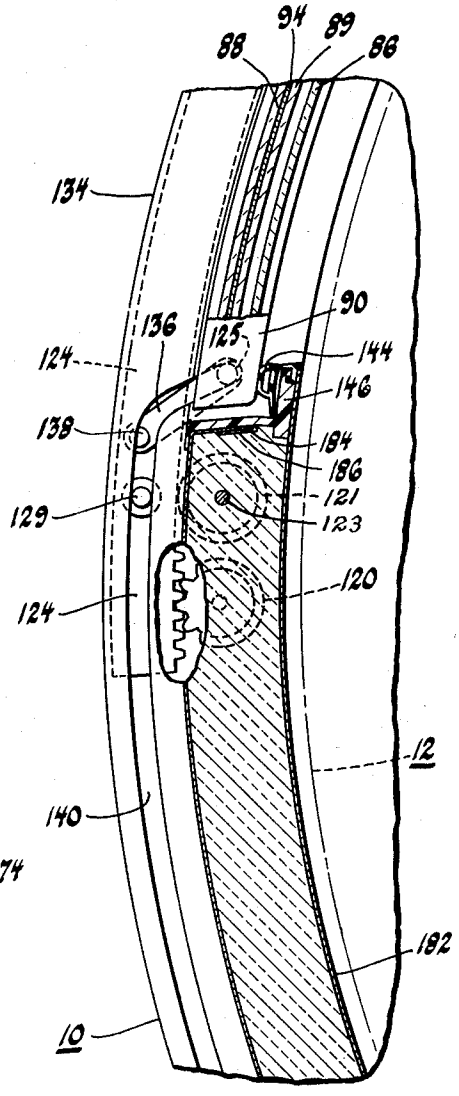


Fig. 4

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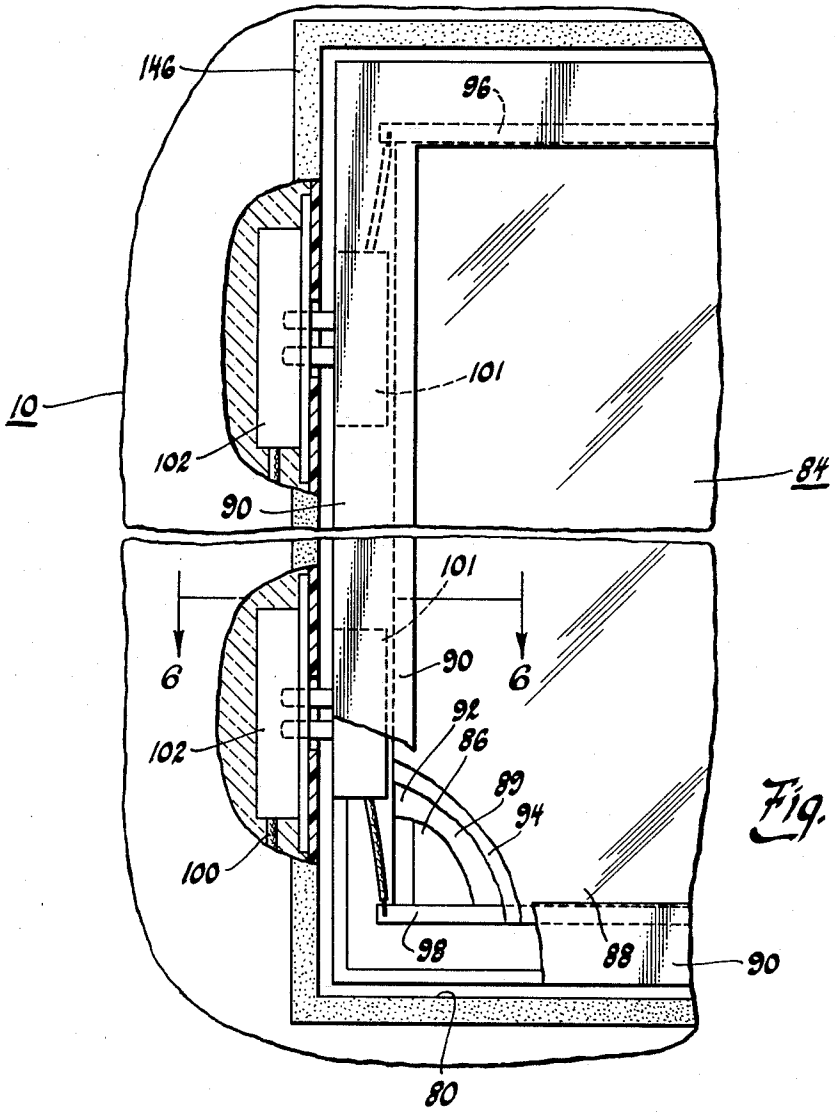


Fig. 5

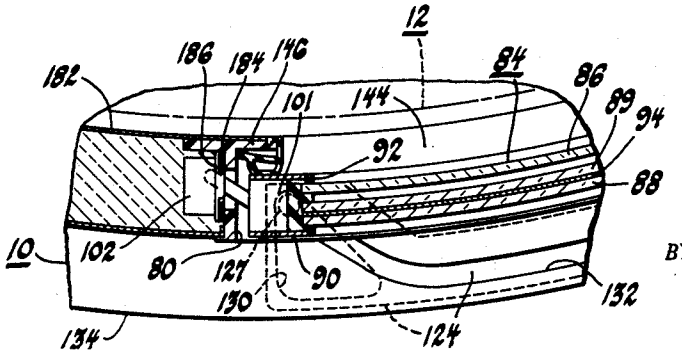


Fig. 6

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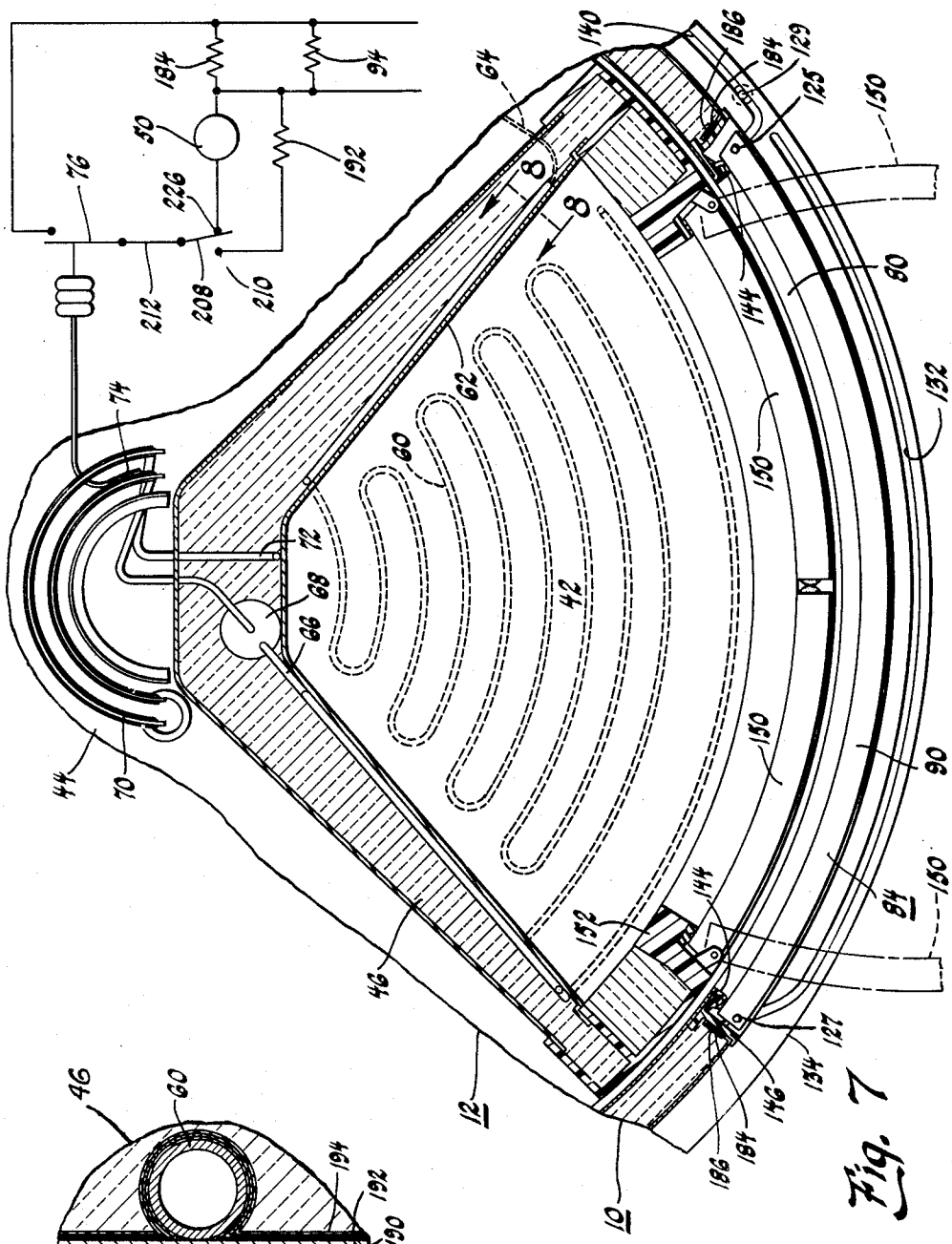


Fig. 7

Fig. 8

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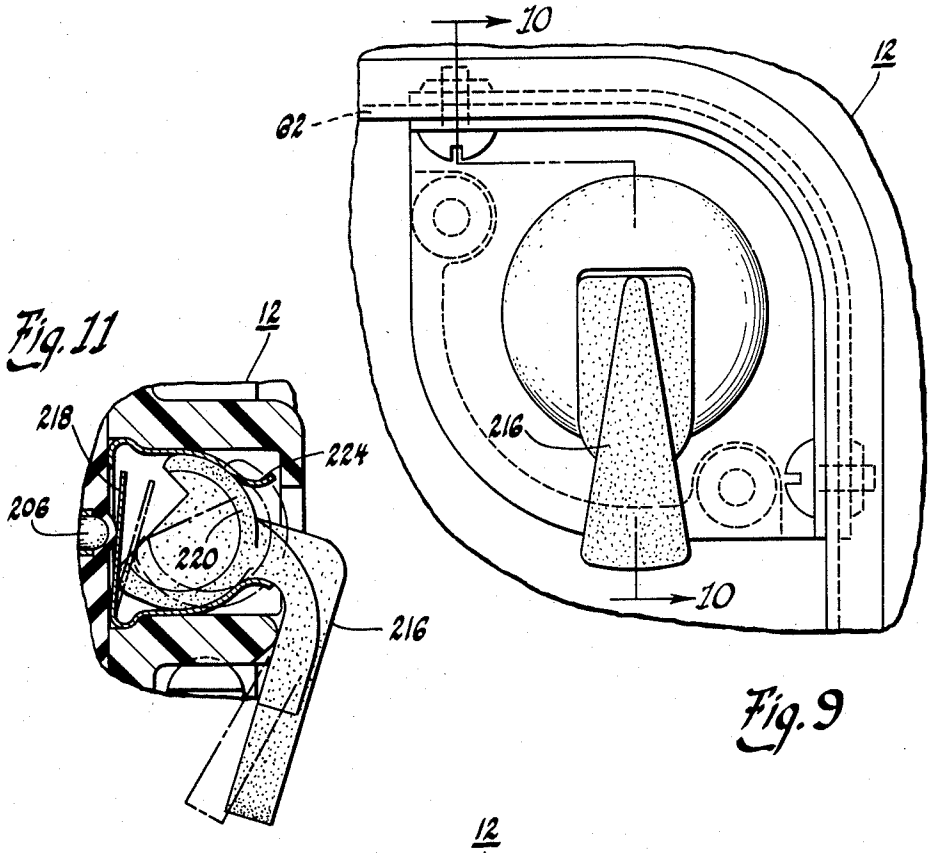


Fig. 9

Fig. 11

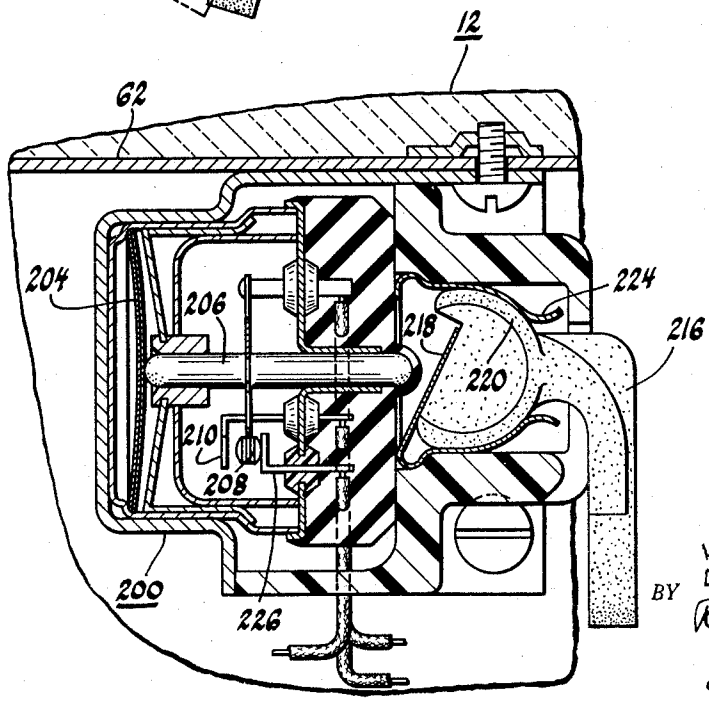


Fig. 10

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2,927,441

REFRIGERATING APPARATUS WITH MEANS PREVENTING CONDENSATE ON TRANSPARENT PANELS

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Application January 16, 1956, Serial No. 559,474

2 Claims. (Cl. 62—248)

This invention relates to refrigerating apparatus and more particularly to an improved adjustable height, multiple compartment refrigerator for use in preserving foods and the like.

It is an object of this invention to provide an improved refrigerator cabinet and door arrangement for facilitating insertion and removal of food.

Another object of this invention is to provide an improved door construction which makes it practical to use glass panels in the door.

Still another object of this invention is to provide an improved means for applying heat to refrigerant evaporators, transparent door panels and the like.

A further object of this invention is to provide improved control mechanism for use in refrigerators.

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

In the drawings:

Figure 1 is a plan view, somewhat schematic, with parts broken away, showing a preferred embodiment of the invention;

Figure 2 is a vertical sectional view showing the kitchen cabinet in section and showing the relationship of the refrigerator to the kitchen cabinet;

Figure 3 is a fragmentary vertical sectional view showing the construction of the door and door actuating mechanism;

Figure 4 is a fragmentary sectional view taken substantially on line 4—4 of Figure 3 and showing the door jamb and door actuating mechanism;

Figure 5 is a fragmentary front elevational view, with parts broken away, showing the arrangement for making electrical contact with the heated glass door panel;

Figure 6 is a fragmentary sectional view taken substantially on line 6—6 of Figure 5;

Figure 7 is a fragmentary horizontal sectional view showing the construction of the frozen food storage portion of the refrigerator;

Figure 8 is a fragmentary sectional view taken substantially on line 8—8 of Figure 7 and showing the relationship between the evaporator and the heater used in defrosting the evaporator;

Figure 9 is a fragmentary elevational view showing the switch for use in energizing the defrost heater element;

Figure 10 is a sectional view taken substantially on line 10—10 of Figure 9; and

Figure 11 is a fragmentary sectional view showing two possible positions of the switch actuator shown in Figures 9 and 10.

Referring now to the drawings wherein a preferred embodiment of the invention has been shown, reference numeral 10 generally designates a non-rotatable but vertically adjustable refrigerator housing which is circular in cross-section. The refrigeration equipment is all supported on a rotatable base or core 12 that rotates within the outer housing or shell 10. The refrigerator is adapted to be mounted in an opening in a wall such as the wall 16 which separates the kitchen 20 from the service entrance 22. For purposes of illustration, the wall 16 has been shown provided with a door 18 which connects the kitchen space 20 with the service entrance 22. The arrangement is such that fresh groceries which are to be placed in the refrigerator may be loaded into the refrigerator from the service entrance 22 whereas foods to be used in the preparation of meals may be removed from the refrigerator from the kitchen side 20. In the illustration shown, a door 24 which is preferably provided with a lock (not shown) has been provided in the wall portion 26 which surrounds the refrigerator 10 on the service entrance side of the refrigerator.

In the embodiment shown, the entire refrigerator housing 10 and its contents may be raised and lowered by means of cables 30 which pass through the hollow studs 34 arranged adjacent to the opposite sides of the refrigerator, as shown. The cables 30 are adapted to be operated by suitable reversible motor means such as the means 36 shown in Fig. 2. The cabinet 10 is provided with projecting arms 38 which engage the cables 30, as best shown in Fig. 2. When it is desired to use the upper surface of the refrigerator cabinet 10 as a work surface substantially at the same height as the kitchen counter 40, the cabinet 10 will be lowered so as to occupy the position in which it is shown in full lines in Fig. 2 of the drawing, whereas when it is desired to place articles of food in the refrigerator or to remove articles of food from the refrigerator, the motor 36 will be energized so as to raise the cabinet 10 to the dot-dash line position shown in Fig. 2 so as to place the access doors 84 of the refrigerator at a more convenient level.

The refrigerator is of the type which has a frozen food storage compartment 42 insulated from the higher temperature main food storage compartment 44 by means of an insulated wall 46. The bottom wall of the frozen food storage compartment 42 is arranged at a higher elevation than the bottom of the food storage compartment 44 so as to provide space below the frozen food storage compartment for the motor-compressor unit 50, the condenser 52 and the condenser fan 54.

The refrigerating system is of the same general type as that shown in Wurtz et al. Patent 2,672,020, the primary difference being only in the physical shape of the evaporators rather than in the refrigerant circuit. Thus, in the system shown herein the motor-compressor unit 50 discharges the compressor refrigerant vapor into the condenser 52 wherein the compressed vapor is liquefied before being supplied to the freezer compartment evaporator coil 60. The coil 60 is of the type which is wrapped around the metallic liner 62 which forms the inner walls of the frozen food storage compartment 42. A fixed restrictor 64 is provided in the line which leads from the condenser 52 to the freezer compartment evaporator 62 so as to reduce the pressure of the refrigerant entering the evaporator 60 in accordance with well-known practice. The excess liquid refrigerant leaves the evaporator coil 60 through the line 72 which connects to the inlet of a plate-type evaporator 70 located in the food storage compartment 44. For purposes of illustration, the evaporator 70 has been shown constructed in two arcuate shaped sections with the two sections arranged in side-by-side relationship within the compartment 44, as best shown in Fig. 7. The vaporized refrigerant leaving the evaporator 70 flows through the accumulator 68 and then leaves by line 66 which returns the vaporized refrigerant to the motor-compressor unit 50.

The main control for the refrigerating system includes a thermostat **74** located on the plate evaporator **70** and is arranged to operate a switch **76** which controls the starting and stopping of the motor-compressor unit **50** so as to cause defrosting of the evaporator **70** during each "off" cycle, in the manner more fully explained in the above-mentioned Wurtz application. In view of the fact that the construction of the refrigerating system may be varied considerably without departing from the spirit of the invention, it is not believed necessary to describe the particular refrigerating system shown herein in greater detail.

The refrigerator cabinet **10** is provided with a pair of door openings **80** and **82** which are arranged on opposite sides of the partition **16**, as best shown in Fig. 1 of the drawing. Each of the openings is provided with an arcuate glass paneled door **84**. This door consists of an inner glass panel **86** and a double outer glass panel **88**, **89** which is spaced from the panel **86**, as best shown in Fig. 3 of the drawing. The outer edges of the panels **86**, **88** and **89** are held in place by means of a suitable frame **90** which carries a sealing gasket **92** which prevents the passage of air into the space between the glass panels as well as preventing the leakage of air between the edges of the glass and the frame **90** into the refrigerator compartment.

The outer panel is a three-ply panel in which the middle ply **94** is a metallic oxide film which serves as a heating element for maintaining the adjacent glass panels **88**, **89** heated at all times so as to prevent moisture from the relatively warm and humid room air from condensing on the glass. Buss bars **96** and **98** are arranged at the bottom and top of the glass panel **88**, **89** so as to supply current to the upper and lower edges of the heating element **94**. Metallic oxide films of this type are now well known commercially and need no further description.

The buss bar **96** is connected to a power line **100** by means of the plug **101** and socket **102**. It will be noted that the plug **101** is incorporated in the framework **90** of the door, as best shown in Figs. 5 and 6 of the drawing, whereas the socket **102** is provided in the stationary part of the refrigerator housing.

For purposes of illustration, the doors **84** have been shown as power operated doors which may be opened and closed by means of electric motors **110** and **112** (see Fig. 1). The door operating mechanism is similar for each of the doors **84** and consequently, only the one needs to be described. Each of the motors operates a drive shaft such as the shaft **114** shown in Figs. 1 and 3. This drive shaft is provided with a pinion **116** at its outer end which meshes with a complementary pinion **118** which in turn drives a set of door operating gears **120**, **121** and **122** located as shown in Figs. 3 and 4 of the drawing. The gears **120** and **122** operate arcuate rack elements **124** and **126**, respectively. The gear **120** is mounted on the same shaft which carries the pinion **118** and serves to operate the lower rack **124**. The rack **124** drives the gear **121** which is mounted on the lower end of shaft **123**. The gear **122** is secured to the upper end of the shaft **123** so as to cause the racks **124** and **126** to operate in unison. The shaft **123** has been broken away in Fig. 3 of the drawing so as not to obscure the showing of the door **84**. The rack elements are so constructed and arranged that upon energization of the door operating motor **112**, they move in an arcuate path for actuating the doors through pins **125** and **127** which project from the edges of the doors. Each door **84** is provided with a set of downwardly projecting pins **125** and **127** (see Figs. 4 and 6) and a similar set of upwardly projecting pins **125** and **127** which are actuated by the rack **124**. Thus, each of the pins **127** projects into a triangularly shaped cam slot **130** in the one end of the racks **124** and **126** (see Fig. 6), and also through a separate guide slot **132** provided in the rack guides **134** located directly above and below the door opening. The pin **125** is pivotally connected to a link **136** (see Fig. 4) which has its one end pivotally secured to a pin **138** carried by the rack **124**. The rack **124** has secured thereto a guide pin **129** which projects through the slot **140**. By virtue of the above-described arrangement, operation of the motor **112** will cause rotation of the shaft **114** which in turn drives the gears **120** and **122** so as to cause movement of the racks **124** and **126**. It will be noted that the pin **129** is guided in its movement by the cam slot **140** which is also provided in the rack guides **134**. The guide slots **132** and **140** are so designed that upon energization of one of the door operating motors, the associated refrigerator door **84** will first move radially outwardly out of contact with the door seal **144** carried by the breaker strip **146** and then move clear of the door frame or breaker strip **146** before it moves any appreciable distance in the circumferential direction.

It will be noted from Fig. 6 that as the door **84** moves out of sealing engagement with the sealing strip **144**, the electrical connections will be broken at the plug **101** and socket **102**. However, upon reclosing of the door the electrical connection will be reestablished so as to maintain the outer glass panel at a temperature high enough to prevent condensation of moisture thereon.

Insofar as certain aspects of this invention are concerned, any other type of door actuating mechanism could be used, likewise, the arrangement for preventing condensation on the doors could be used equally well in conventional doors having transparent windows therein.

As best shown in Fig. 7 of the drawing, the frozen food storage compartment **42** is provided with a pair of inner doors **150** which are carried by a door frame **152** which is fixed relative to the frozen food storage compartment **42**. By virtue of this construction, it is obvious that the inner doors **150** are movable with the central core **12** of the refrigerator so as to enable one to gain access to either the frozen food storage compartment or the main food storage compartment through either one of the doors **84** carried by the fixed outer shelf of the refrigerator. A motor **170** which operates mechanism **171** has been provided for automatically causing rotation of the central core of the refrigerator upon energization of the motor. Electrical circuit and switches used for energizing the motor **170** have not been shown as circuits of this type are well known. The motor **170** would preferably be of the reversing type whereby the direction of rotation of the rotatable core can be changed, depending upon the direction of rotation of the motor **170**. The motor **170** as well as the condensing equipment are mounted beneath the insulated floor **172** of the refrigerated space. As best shown in Fig. 3 of the drawing, access may be had to the apparatus mounted beneath the floor **172** through an insulated removable panel **174**. In order to obtain access to the machinery compartment, it is, of course, first necessary to so rotate the core of the refrigerator to a position in which the removable panel **174** will be in alignment with one of the doors **84**. Suitable seal means **180** (see Fig. 3) is provided between the lower edge of the rotatable core **12** and the inner wall **182** of the stationary outer cabinet **10**.

One of the problems in designing a refrigerator is that of preventing condensation of moisture from the relatively warm room air onto the door frame or breaker strip **146** which surrounds the refrigerator doors **84**. In the refrigerator shown, the breaker strip **146** is constructed of a molded plastic material having electrical insulating properties as well as heat insulating properties, and a coating of conducting material **184** is sprayed onto the outer surface of the breaker strip **146** and this is in turn protected by means of an insulating coating **186** which shields the conductor material **184**. Current is then passed through the coating material **184** so

as to cause heating of the breaker strip at the point where condensation would otherwise form. By virtue of the fact that the heater material **184** is of the type which is sprayed on, it is possible to apply the heater to an irregularly shaped breaker strip. Furthermore, the heater need not be handled as a separate element on the assembly line as it is carried directly by the breaker strip much like a coating of paint.

In view of the fact that frost tends to accumulate on the inner wall **62** of the frozen food storage compartment **42**, it is desirable to provide means for applying heat to this wall for defrosting purposes. In the past, it has been conventional practice to use strip heaters lying adjacent the outer surface of the inner wall **62**, but strip heaters of this type tend to localize the heating to the point of contact between the strip heater and the wall 62. It has been found that a lower temperature can be used for defrosting the frozen food compartment liner if it is possible to uniformly heat all portions thereof. In order to accomplish such uniform heating a sprayed-on type of heating element has been employed. As shown in Fig. 8 of the drawing, the heating element consists of an insulating layer **190** which is first sprayed onto the entire outer surface of the inner wall **62**, as well as the outer surface of the refrigerant line **60**. A conducting layer **192** is then sprayed onto the insulating layer **190** and this, in turn, is protected by a second insulating layer **194** which protects the conducting material **192**. Electrical connections are then made to the layer **192** at spaced points, in accordance with well known practice, so as to cause the layer **192** to be heated.

The application of current to the heating material **192** is controlled by a manually reset thermostat element generally designated by the reference numeral **200**. This thermostat element includes a conventional Spencer thermostat disc **204** of bimetallic material which serves to actuate a switch operating plunger **206** which, in turn, actuates a switch contact **208**. As best shown in Figs. 7, 9, 10 and 11 of the drawing, the contact **208** is adapted to engage a stationary contact **210** connected to the defrosting heater element **192** so that whenever the contact **208** is manually moved into engagement with the contact **210** defrosting will take place and the circuit to the motor-compressor unit will be broken at contact **226**. The switch actuator **206** is moved to the defrost position by means of the manual operator **216** which is normally held in the full-line position shown in Fig. 10 by means of a spring **218**. It will be noted that the manual operator **216** includes a spherical portion **220** which normally rotates in the spring socket **224** from the full-line position shown in Fig. 10 to the full-line position shown in Fig. 11. Due to variations in manufacturing tolerances, it sometimes happens that it is necessary to move the actuator **216** further in some cases than in others, and in order to prevent excessive strain on those switch mechanisms which do not require as much movement as others, the spring socket **224** is arranged so as to allow an operator to move the member **216** from the full-line position shown in Fig. 11 to the dot-dash line position shown in Fig. 11 without exerting excessive force on the plunger **206**. The Spencer thermostat disc **204** is arranged so as to respond to changes in temperature of the frozen food storage compartment liner **62**. The thermostat is so calibrated that whenever the temperature of the liner **62** reaches the temperature of 50° F. or higher, the circuit to the defrosting heater will automatically be opened. Upon opening of the circuit to the defrost heater, the contact **208** moves into engagement with a contact **226** which is arranged in the circuit for the motor-compressor unit **50**. By virtue of the above-described arrangement, it is obvious that the defrost control switch automatically opens the circuit to the motor-compressor unit whenever the circuit is closed to the defrost heaters so as to stop operation of the refrigerator during the defrost period.

The use of a sprayed on type of heater element enables one to place the heater element in intimate contact with an irregularly shaped surface and to spread the heat uniformly over the entire surface to be heated whereby the heater not only operates more efficiently but also may be operated at lower temperatures than would otherwise be possible. This is especially important in refrigeration equipment.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, as may come within the scope of the claims which follow.

What is claimed is as follows:

1. In a refrigerator, the combination, a cabinet having an insulated food storage compartment therein, an evaporator for cooling said compartment, means supplying liquid refrigerant to said evaporator, said cabinet including an inner liner and an outer shell spaced from said inner liner, a breaker strip connecting said inner liner to said outer shell, said breaker strip comprising a molded plastic member formed of electrical insulation material, a layer of an electrical conducting material sprayed onto said member, said cabinet including a transparent window portion, said window portion comprising a coating of metallic oxide, and means for passing current through said layer of conducting material and said coating of metallic oxide so as to heat said breaker strip and said window to a temperature slightly above the dew point temperature of the air surrounding said breaker strip and thereby prevent condensation of moisture on said breaker strip.

2. In a refrigerator, the combination, a cabinet having an insulated food storage compartment therein, an evaporator for cooling said compartment, means supplying liquid refrigerant to said evaporator, said cabinet having a door opening in one wall thereof, a door for said opening including a transparent window assembly having an inner panel and an outer panel, said outer panel having a layer of transparent metallic oxide thereon, means for passing current through said layer of metallic oxide so as to heat said outer panel to a temperature slightly above the dew point temperature of the air surrounding said outer panel to thereby prevent condensation of moisture on said outer panel, and means for supporting said door for movement from a position in which said door closes said door opening to an open position in which said inner panel is arranged in juxtaposition to a portion of the outer wall of said cabinet whereby said inner door panel is shielded from convection air currents when said door is in its open position.

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