Jan. 1, 1963 J. J. O'CONNELL 3,070,973

REFRIGERATING APPARATUS

Filed June 16, 1961

2 Sheets-Sheet 1

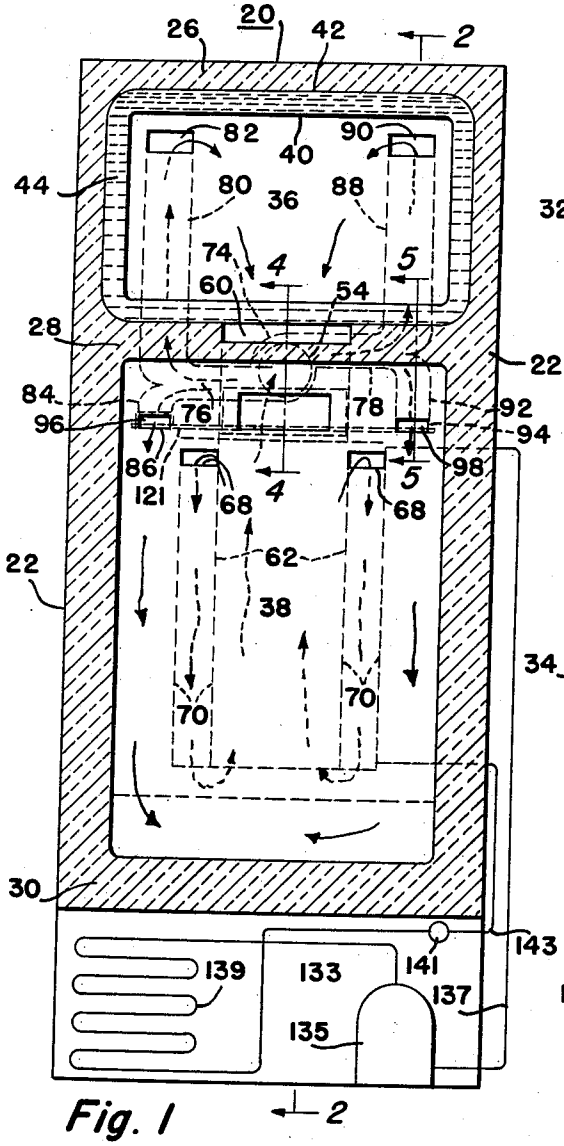

Fig. 1

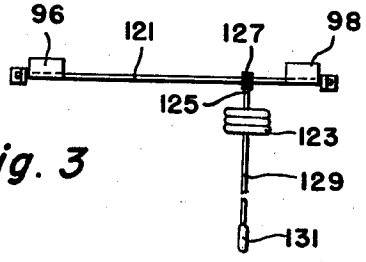

Fig. 3

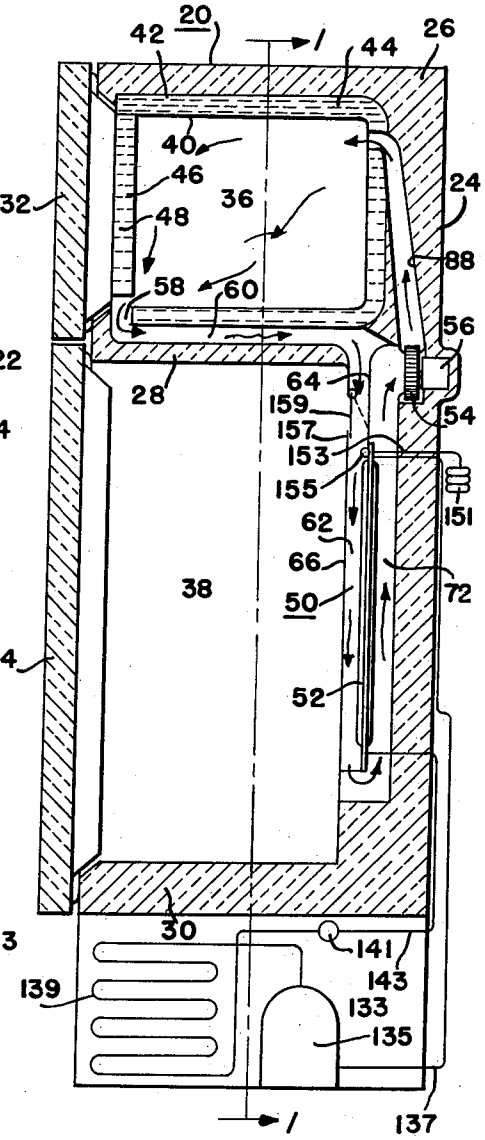

Fig. 2

INVENTOR.
John J. O'Connell
BY
Carl A. Sticker
His Attorney

Jan. 1, 1963 J. J. O'CONNELL 3,070,973

REFRIGERATING APPARATUS

Filed June 16, 1961 2 Sheets-Sheet 2

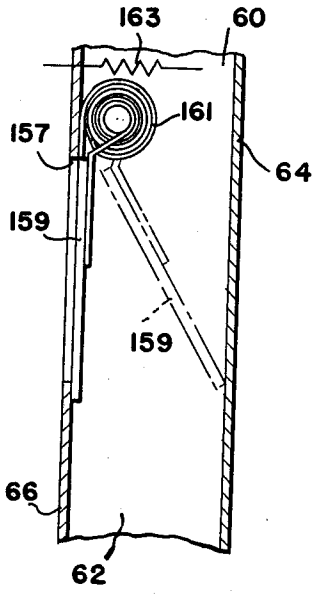

Fig. 4

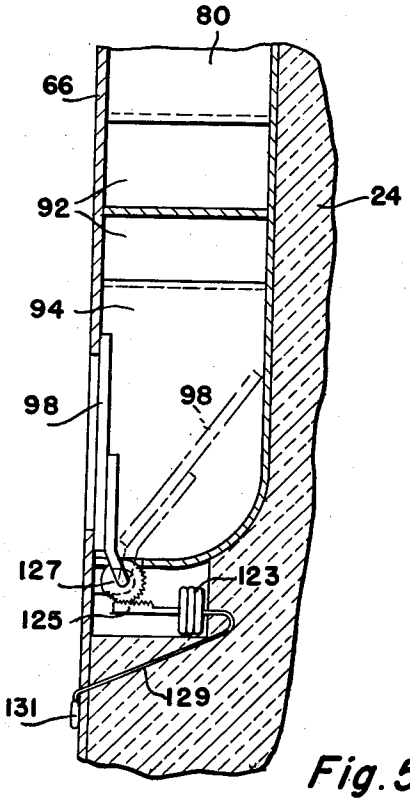

Fig. 5

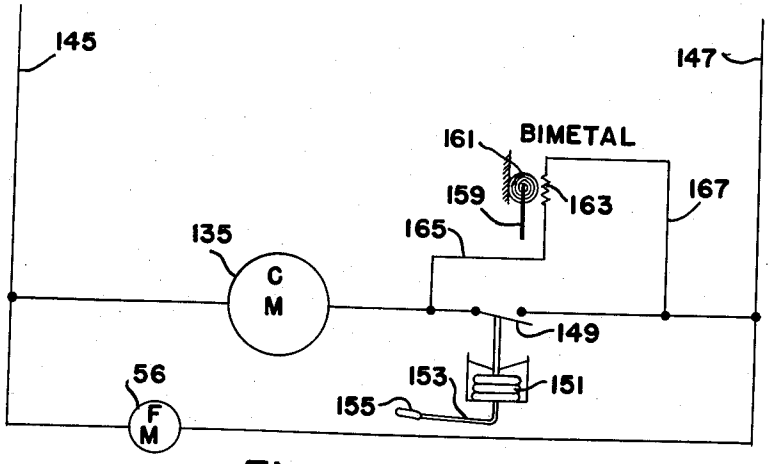

Fig. 6

INVENTOR.
John J. O'Connell
BY
His Attorney

United States Patent Office 3,070,973 Patented Jan. 1, 1963

3,070,973

REFRIGERATING APPARATUS

John J. O'Connell, Dayton, Ohio, assignor to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Filed June 16, 1961, Ser. No. 117,750
8 Claims. (Cl. 62—180)

This invention pertains to refrigerating apparatus and more particularly to household refrigerators having frost-free below and above freezing compartments.

Household refrigerators having frost-free storage compartments are commercially successful and provide excellent carefree refrigeration, but they are sufficiently expensive that the sale is limited to those with larger incomes. Models with two evaporators, two temperature controls and a defrosting control have been built in considerable numbers. Certain single evaporator models have been proposed but, to obtain good temperature control, several controls in addition to complicated defrosting controls for the sealed evaporator are required.

It is an object of this invention to provide an inexpensive household refrigerator having frost-free below and about freezing compartments, a single evaporator, and a single air circulating fan with a single simple control system which will satisfactorily control both the temperatures and the defrosting.

It is another object of this invention to provide an inexpensive household refrigerator having frost-free below and above freezing compartments, a single evaporator and a single air circulating fan which will accurately maintain safe uniform refrigerated storage temperatures throughout both the below and above freezing compartments and which will also automatically defrost the evaporator during each off cycle without adversely affecting the temperatures in the storage compartments.

It is another object of this invention to provide an inexpensive household refrigerator having frost-free below and above freezing compartments in which the below freezing compartment is surrounded by an eutectic solution for maintaining the uniform safe below freezing temperatures therein during the off cycle in which the evaporator defrosts.

These and other objects are attained in the form shown in the drawings in which the insulated refrigerator cabinet is provided with a below freezing compartment in which the door as well as the walls thereof are provided with hollow containers containing an eutectic solution which freezes between 5° and 10° F. A single upright plate-type evaporator is provided in the evaporator compartment in the rear wall of the above freezing compartment and is provided with a central downwardly extending passage on its front face connecting with a passage from the below freezing compartment and separate passages along both edges receiving air through upper outlets in the rear wall of the above freezing compartment. The air from all of the separate passages is free to mix after it passes around the bottom edge of the evaporator and is drawn upwardly along the rear face of the evaporator to the inlet of a centrifugal fan. The centrifugal fan is provided with dual outlets extending to opposite sides which connect with separate passages extending upwardly and downwardly to the upper portions of both the below and the above freezing compartments so as to provide a uniform discharge of cold air into both of these compartments. Dual thermostatically controlled dampers control the discharge of the air into the above freezing compartment so as to prevent the above freezing compartment from being cooled below freezing temperatures.

A cycling thermostatic switch responsive to the temperature of the evaporator starts the motor compressor unit in response to a temperature above freezing and stops the motor compressor unit in response to a predetermined temperature well below freezing. During the off cycle of the refrigerating system, a bimetal operated damper is electrically heated to open an opening from the above freezing compartment into the passage for the below freezing compartment air and to close the passage from the below freezing compartment to stop circulation through the below freezing compartment while all the air circulating over the evaporator is taken from the above freezing compartment so as to rapidly heat and defrost the evaporator during the off cycle.

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 embodiment of the present invention is clearly shown.

In the drawings:

FIGURE 1 is a front vertical sectional view of a two-compartment frost-free refrigerator, partly diagrammatic, taken along the line 1—1 of FIGURE 2 embodying one form of my invention;

FIGURE 2 is an irregular side vertical section of the refrigerator shown in FIGURE 1 taken along the line 2—2;

FIGURE 3 is a separate view in elevation of the dual thermostatic damper control system;

FIGURE 4 is a fragmentary vertical sectional view taken substantially along the line 4—4 of FIGURE 1;

FIGURE 5 is a fragmentary vertical sectional view taken substantially along the line 5—5 of FIGURE 1; and

FIGURE 6 is a wiring diagram.

Referring now to the drawings and more particularly to FIGURES 1 and 2, there is shown an insulated refrigerator cabinet 20 having insulated side and rear walls 22 and 24 and horizontal top, intermediate and bottom insulated walls 26, 28 and 30 together with the front doors 32 and 34 enclosing upper below freezing and lower above freezing frost-free refrigerator storage compartments 36 and 38. For the purpose of preventing any objectionable rise in temperature in the below freezing compartment during the off period of the refrigerating system, the below freezing compartment 36 is provided with a liner formed of metal inner and outer walls 40 and 42 between which there is provided an eutectic or congealing solution 44 which freezes between 5° and 10° F. The inner face of the door 32 is also provided with a hollow container 46 containing a similar eutectic or congealing solution 48. The Fleischer patent 1,968,195, issued July 31, 1934, contains specific examples of a number of satisfactory solutions.

The rear wall 24 behind the above freezing compartment 38 is provided with a false rear wall 66 forming an evaporator compartment 50 containing upright plate-type evaporator 52. The evaporator 52 is impervious and divides the evaporator compartment 50 into a front downwardly extending passage space or subcompartment and a rear upwardly extending passage space or subcompartment connecting with the inlet of the centrifugal fan 54 driven by the fan motor 56 both of which are located in the rear wall 24 adjacent the top of the evaporator compartment 50. The below freezing compartment 36 has an outlet 58 beneath the hollow container 46 connecting with central rearwardly extending passage 60 extending within the horizontal wall 28 and connecting at the rear with a central downwardly extending duct 62 in front of the dividing wall 64 and the central portion of the evaporator 52 extending down to the bottom of the evaporator compartment 50. The false rear wall 66 forming the front of the evaporator compartment 50 is provided with two symmetrical upper outlet openings

68 connecting with two downwardly extending ducts 70 located on opposite sides of the duct 62 and located between the false rear wall 66 and the front face of the edges of the evaporator 52. These ducts 70 extend down to the bottom of the evaporator 52 where the air from both the central duct 62 and the side ducts 70 is free to mix.

The passage 72 between the rear face of the evaporator 52 and the rear insulated wall 24 is undivided and connects with the inlet of the fan 54 as previously mentioned. The fan 54 is provided with a dual discharge scroll extending horizontally and connecting with the laterally extending passages 76 and 78. The passage 76 has a divided outer end with one portion 80 extending upwardly in the rear wall to an outlet 82 discharging into the upper left portion of the below freezing compartment 36. The second division 84 extends downwardly to an outlet 86 in the upper left rear wall of the above freezing compartment 38. Similarly, the right end of the passage 78 is divided and has an upwardly extending division 88 in the rear wall 24 connecting with the discharge outlet 90 in the upper right portion of the below freezing compartment 36. The second division extends downwardly and forms the passage 92 connecting with the discharge outlet 94 in the upper right corner of the above freezing compartment 38.

The discharge of cold air from the outlets 86 and 94 should be sufficiently restricted to prevent the above freezing compartment from being cooled below freezing temperatures. To achieve this accurately, I provide dual dampers 96 and 98 respectively for the openings 86 and 94. These dampers 96 and 98 (see FIGURE 3) are connected together by a rod 121. A fluid motor in the form of a bellows 123 is located in and thermally isolated in the insulated rear wall 24 and is connected by a rack 125 and a pinion 127 for operating the dampers 96 and 98 through the shaft 121. The bellows 123 is connected through a capillary tube 129 with a thermostat bulb 131 located in front of the false rear wall 66 of the above freezing compartment 38. This temperature control system is so calibrated that the damper 98 is moved to the fully open dotted line position shown in FIGURE 4 when the temperature of the bulb 131 reaches 39° F. and it moves to the full line fully closed position when the bulb 131 reaches 33° F. By this arrangement, the above freezing compartment 38 is maintained substantially uniformly at a temperature of about 36° F.

Beneath the horizontal wall 30 is a machinery compartment 133 containing a refrigerant liquefying apparatus including a sealed motor compressor unit 135 which, through a suction conduit 137, withdraws evaporated refrigerant from the evaporator 52 and forwards compressed refrigerant to the condenser 139 from which the condensed refrigerant flows under the control of a suitable flow regulator 141 to the evaporator 52 through the supply conduit 143.

As shown in the wiring diagram, FIGURE 6, the fan motor 56 is connected across the supply conductors 145 and 147 at all times so that the fan 54 is driven continuously. The compressor or sealed unit 135 is connected in series with the thermostatic switch 149 across the supply conductors 145 and 147. This snap acting switch 149 is provided with a fluid operating motor 151 connected by the capillary tube 153 with a bulb 155 which is mounted upon the upper portion of the evaporator 52. This cycling thermostatic switch 149 is of the snap acting toggle type calibrated to close in response to a temperature of the evaporator 52 of 37° F. and to open when the evaporator 52 reaches a temperature of −2° F. These settings will assure the freezing of the congealing solution 44 during the running period of the motor compressor unit 135 and also assure the defrosting of the evaporator during the off cycle of the motor compressor unit 135.

To prevent the below freezing compartment 36 from being warmed during the defrosting period of the evaporator 52, there is provided an opening in the false rear wall 66 between the above freezing compartment 38 and the duct 62 providing a passage therebetween. This opening is normally closed by a bimetal operated damper 159 as shown in FIGURE 4. This damper 159, shown in the normal position in full line, is provided with a spiral bimetal operating motor 161 which is heated during the defrosting period of the evaporator 52 by a shunt heater 163 connected by the conductors 165 and 167 to the opposite sides of the cycling switch 149. When heated, the spiral bimetal operating motor 161 uncurls to move the damper 159 to open position. Therefore, during every open period of the switch 149, the heater 163 is energized to heat the spiral bimetal 161 to operate the damper 159 during every defrosting period of the evaporator 52 to open the opening 157 and to close the passage 60 to prevent the circulation of warm air through the below freezing compartment 36. During such defrost periods, the refrigeration for the below freezing compartment 36 is provided by the eutectic solution 44 and 48 which surrounds it. This serves to maintain the temperature of the compartment 36 normally below 8° F. The defrosting period of the evaporator 52 is, of course, provided by the stopping of the motor compressor unit 135 by the opening of the switch 149 until the temperature of the evaporator 52 rises to 37° F.

While the embodiment of the present invention, as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. A refrigerator including insulating means enclosing a below freezing compartment and an above freezing compartment, an evaporator compartment associated with said insulating means containing an evaporator, an alternate control and circulating means for circulating in one arrangement air from said below and above freezing compartments through said evaporator compartment in heat transfer with said evaporator and in contact with each other and returning the cooled air to said compartment in proportion to maintain said compartments respectively normally at below and above freezing temperatures and for circulating in the alternative arrangement air from the above freezing compartment only through said evaporator compartment in heat transfer with said evaporator to defrost said evaporator and returning the air to said above freezing compartment, refrigerant liquefying means operatively connected to said evaporator, and means coincidental to the circulation in said alternative arrangement for preventing operation of said liquefying means and for preventing circulation of air between said below freezing compartment and said evaporator compartment, and a congealing solution in heat transfer with said below freezing compartment for minimizing any rise in temperature therein while the operation of said liquefying means is prevented.

2. A refrigerator including insulating means enclosing a below freezing compartment and an above freezing compartment, an evaporator compartment associated with said insulating means containing an evaporator, refrigerant liquefying means operably connected to said evaporator, means comprising a single fan means for circulating air from both said below and above freezing compartments through said evaporator compartment in heat transfer with said evaporator and returning the air to said compartments in proportion to normally maintain said compartments at below and above freezing refrigerating temperatures respectively, cycling control means responsive to a predetermined low temperature of said evaporator for stopping said liquefying means and circulation of air from said below freezing compartment to said evaporator compartment and responsive to a predetermined higher temperature of said evaporator for starting said liquefying means and restoring the circulation of air from said below freezing compartment to

said evaporator compartment, and a congealing solution in heat transfer with said below freezing compartment for minimizing any rise in temperature therein while said liquefying means is stopped.

3. A refrigerator including insulated upright and horizontal walls enclosing separated below and above freezing compartments, an upright evaporator compartment associated with one of the upright walls containing an upright evaporator, means cooperating with said compartment and one side of said evaporator providing separate passages for below and above freezing compartment air in contact with said one side, both of said separate passages connecting with a common passage extending in contact with the other side of said evaporator within said evaporator compartment, a single fan having its inlet connected to said common passage and having an outlet connected to both said below and above freezing compartments, said insulated walls including a first passage extending from said below freezing compartment to said separate passage for below freezing compartment air and a second passage extending from said above freezing compartment to said separate passage for above freezing compartment air and a third passage extending from said above freezing compartment to said first passage, and damper means for alternately closing said first and third passages.

4. A refrigerator including insulated upright and horizontal walls enclosing separated below and above freezing compartments, an upright evaporator compartment associated with one of the upright walls containing an upright evaporator, means cooperating with said compartment and one side of said evaporator providing separate passages for below and above freezing compartment air in contact with said one side, both of said separate passages connecting with a common passage extending in contact with the other side of said evaporator within said evaporator compartment, a single fan having its inlet connected to said common passage and having an outlet connected to both said below and above freezing compartments, said insulated walls including a first passage extending from said below freezing compartment to said separate passage for below freezing compartment air and a second passage extending from said above freezing compartment to said separate passage for above freezing compartment air and a third passage extending from said above freezing compartment to said first passage, refrigerant liquefying means operatively connected to said evaporator, and cycling thermostatic control means responsive to a predetermined high temperature of said evaporator for starting said liquefying means and closing said third passage and responsive to a predetermined low temperature of said evaporator for stopping said liquefying means and closing said first passage.

5. A refrigerator including insulated upright and horizontal walls enclosing separated below and above freezing compartments, an upright evaporator compartment associated with one of the upright walls containing an upright evaporator, means cooperating with said compartment and one side of said evaporator providing separate passages for below and above freezing compartment air in contact with said one side, both of said separate passages connecting with a common passage extending in contact with the other side of said evaporator within said evaporator compartment, a single fan having its inlet connected to said common passage and having an outlet connected to both said below and above freezing compartments, said insulated walls including a first passage extending from said below freezing compartment to said separate passage for below freezing compartment air and a second passage extending from said above freezing compartment to said separate passage for above freezing compartment air and a third passage extending from said above freezing compartment to said first passage, refrigerant liquefying means operatively connected to said evaporator, and cycling thermostatic control means responsive to the temperature of said evaporator for starting and stopping said liquefying means, and alternately operable damper means operable coincidentally to said cycling control means for alternately closing said third and first passages.

6. A refrigerator including insulated upright and horizontal walls enclosing separated below and above freezing compartments, an upright evaporator compartment associated with one of the upright walls containing an upright evaporator dividing said evaporator compartment into first and second subcompartments, means cooperating with said first subcompartment and one side of said evaporator providing separate passages for below and above freezing compartment air in contact with said one side, both of said separate passages connecting with the second subcompartment providing a common passage extending in contact with the other side of said evaporator within said evaporator compartment, a single fan having its inlet connected to said common passage and having two outlets extending to opposite sides each connected to opposite sides of the upper portions of both said below and above freezing compartments, said walls including passage means extending from said below and above freezing compartment respectively to said separate passages in said first subcompartment on said one side of said evaporator.

7. A refrigerator including insulated upright and horizontal walls enclosing separated below and above freezing compartments, an upright evaporator compartment associated with one of the upright walls containing an upright evaporator, means cooperating with said compartment and one side of said evaporator providing separate passages for below and above freezing compartment air in contact with said one side, both of said separate passages connecting with a common passage extending in contact with the other side of said evaporator within said evaporator compartment, a single fan having its inlet connected to said common passage and having two outlets extending to opposite sides each connected to opposite sides of the upper portions of both said below and above freezing compartments, said walls including passage means extending from said below and above freezing compartments respectively to said separate passages on said one side of said evaporator, and dual thermostatically controlled damper means for controlling the flow of air from said two outlets to said above freezing compartment.

8. A refrigerator including insulated upright and horizontal walls enclosing separated below and above freezing compartments, an upright evaporator compartment associated with one of the upright walls containing an upright evaporator dividing said evaporator compartment into first and second subcompartments, means cooperating with said first subcompartment and one side of said evaporator providing separate passages for below and above freezing compartment air in contact with said one side, both of said separate passages connecting with the second subcompartment providing a common passage extending in contact with the other side of said evaporator within said evaporator compartment, a single fan having its inlet connected to said common passage and having two outlets extending to opposite sides each connected to opposite sides of the upper portions of both said below and above freezing compartments, said walls including passage means extending from said below and above freezing compartment respectively to said separate passages in said first subcompartment on said one side of said evaporator, and means for alternately closing one of said passage means and opening another passage means.

References Cited in the file of this patent

UNITED STATES PATENTS

2,997,857	Clark	Aug. 29, 1961
3,018,637	Mann	Jan. 30, 1962