

April 18, 1944.

A. O. GROOMS
REFRIGERATING APPARATUS

2,346,837

Filed Feb. 24, 1941

2 Sheets-Sheet 1

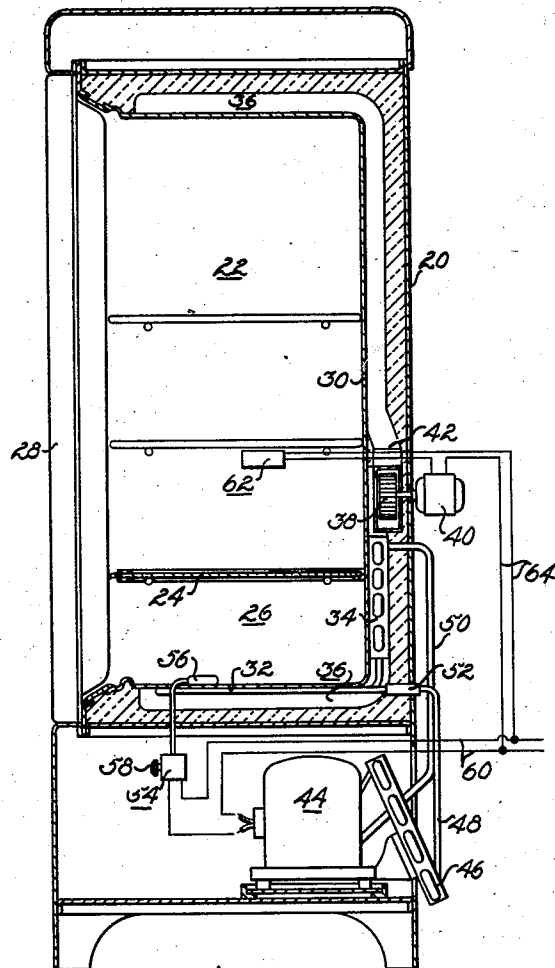


Fig. 1

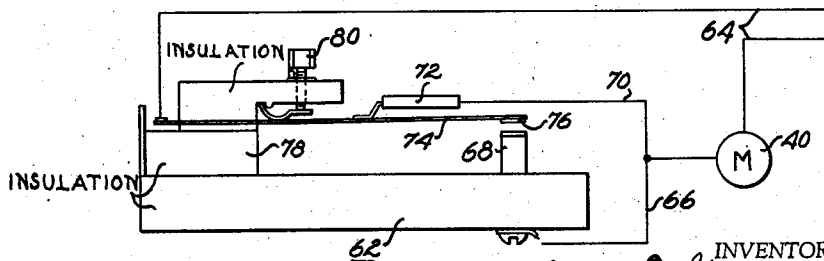


Fig. 2

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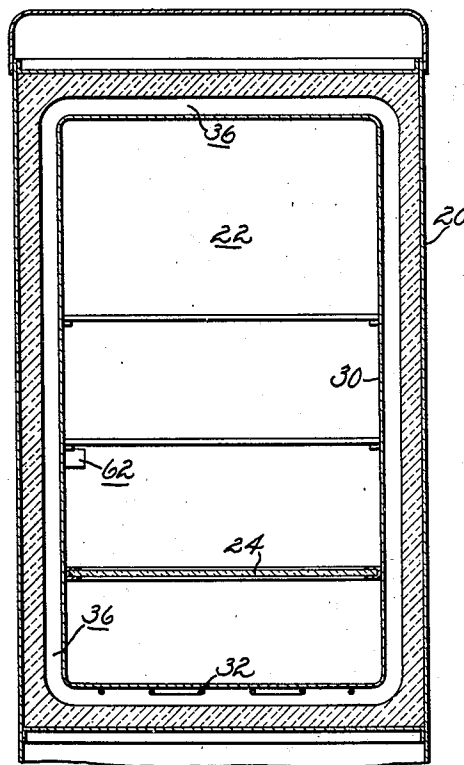


Fig. 3

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UNITED STATES PATENT OFFICE

2,346,837

REFRIGERATING APPARATUS

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Application February 24, 1941, Serial No. 380,252

7 Claims. (Cl. 62—4)

This invention relates to refrigerating apparatus and more particularly to control systems therefor.

At present, some refrigerators have food compartments which are cooled through the walls thereof. Inasmuch as the public demands ice freezing facilities in refrigerators, it is necessary to operate the refrigerant evaporator at temperatures below freezing. It is undesirable to cool the walls of food compartments at such low temperatures.

It is therefore an object of my invention to provide a refrigerating system wherein the temperature of the walls of a compartment to be cooled is controlled substantially independently of the temperature of the refrigerant evaporator.

It is another object of my invention to provide a simple means for controlling the temperature of the walls of a compartment to be cooled in accordance with the compartment temperature.

It is another object of my invention to provide a simple temperature regulating system for regulating the refrigeration of the walls of a "cold-wall" type of refrigerator.

It is still another object of my invention to provide a two-temperature refrigerator in which the high temperature refrigeration is regulated by the circulation of air which in turn is regulated by a vibrating contact device.

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:

Fig. 1 is a vertical sectional view of a refrigerator embodying somewhat diagrammatically one form of my invention;

Fig. 2 is a view of the vibrating contact control together with a wiring diagram.

Fig. 3 is a vertical central section through Fig. 1.

Briefly, I have shown a refrigerator in which the primary evaporator is provided at the bottom of the cabinet for freezing purposes. In order to cool the food compartment, air cooled by the primary evaporator is circulated in heat exchange relation with the outside of the inner liner member. This circulation is accomplished by a centrifugal fan operating under the control of an adjustable temperature responsive vibrating contact device.

Referring now to the drawings and more particularly to Fig. 1, there is shown a refrigerator cabinet 20 containing an upper food compartment

22, which is separated by a removable glass shelf or partition 24 from the freezing compartment 26 provided in the bottom of the cabinet. A common door 28 provides access to both compartments and the remainder of both compartments is enclosed within a metal inner liner member 30. The freezing compartment 26 is cooled principally through its bottom wall which is provided with tubing 32 extending in serpentine fashion over the greater portion of the bottom wall of the inner liner member and constituting the first portion of the primary evaporator. A second portion 34 of the primary evaporator is connected in series refrigerant circuit relation with the portion 32 and constitutes a finned heat transfer member.

This finned heat transfer member 34 as well as the portion 32 are located in an air circulating passageway 36 which extends upwardly to a centrifugal fan 38 directly driven by an electric motor 40. The inlet to the fan 38 is at the open end of the centrifugal fan casing for receiving air from the portion of the air circulating passage beneath the evaporator portion 32 and drawing the air through the finned portion 34 after which the air is discharged from the outlet 42 of the fan upwardly through the air circulating passage 36 to the portion above the top of the inner liner 30 after which the air divides and passes down along the outside of both side walls of the inner liner member 30 until it returns to the portion beneath the evaporator portion 32. By this air circulating arrangement, the inner liner member 30 is surrounded by circulating cold air.

The primary evaporator portions 32 and 34 are supplied with liquid refrigerant from the refrigerant condensing unit including a sealed motor-compressor unit 44 and the air-cooled condenser 46 from which liquid refrigerant is forwarded through the supply conduit 48 in heat exchange relation with the suction conduit 50 to a restrictor 52 which controls the flow of liquid refrigerant into the initial portion 32 of the evaporator. The operation of the refrigerant condensing unit is controlled by a thermostatic switch 54 operated in accordance with the temperature of a bulb 56 mounted in heat exchange relation with the bottom of the inner liner 30. This switch may be adjusted by the adjusting knob 58 to vary the temperature of the portions of the primary evaporator over a considerable range. The switch 54 and the sealed unit 44 are connected in series in an electric circuit 60. The motor 40 for the fan 38 is connected in series with a control device 62 in a circuit 64 which is connected in parallel with

the circuit 60 so that it is controlled independently of the operation of the sealed motor-compressor 44.

The object in cooling the upper compartment 22 through the walls thereof is to cause the refrigeration to take place at a relatively high temperature through a sufficiently large surface so that the temperature of the air in the compartment 22 is very nearly as low as the temperature of the walls through which the refrigeration is accomplished. This temperature should be always above freezing and generally between about 35° and 42° F. This provides refrigeration under excellent conditions since by this method of cooling there is very little air circulation and very little moisture loss from foodstuff stored in the compartment. In order to maintain the temperature of the air within the compartment 22 as well as the temperature of the walls of the inner liner 30 within desirable limits I provide the control 62 in the form of a vibrating contact device better shown in Fig. 2.

In Fig. 2 the electric motor 40 is shown connected in the circuit 64. The motor 40 is connected by a conductor 65 with a stationary contact 68 and is also connected by conductor 70 with an electric heater 72 which is mounted upon a cantilever supported bimetal strip 74 carrying at its free end a movable contact 76. This bimetal strip 74 is anchored at the opposite end in a support 78 of insulating material. The bimetal strip 74 is so positioned that when heated it will move to close the contacts 68 and 76. The bimetal strip 74 may be adjusted by an adjusting screw 80 which operates through a follower to apply a slight closing pressure upon the bimetal strip 74 adjacent its anchorage.

The operation of the vibrating contact device is as follows: When the contacts 68 and 76 are in the open position as shown, the current passing through the motor 40 will also pass through the high resistance heater 72 so that the amount of current flowing will be very small and will not be sufficient to keep the motor 40 operating at its normal speed. However, the current which does pass through heater 72 will heat the bimetal strip 74 causing the bimetal strip 74 to bend to move the contact 76 into engagement with the contact 68 to allow current to flow through the conductor 66, contacts 68 and 76 and the bimetal strip 74 to the other side of the circuit 64. The bimetal strip 74 is made with sufficient current-carrying capacity that it will not be heated appreciably by the current flowing through it. However, it will be affected considerably by the temperature in the food compartment 22 and the higher the temperature in the food compartment the greater portion of the time, the bimetal will hold the contacts 68 and 76 in the closed position. The closing of the contacts 68 and 76 will de-energize the heater 72 and allow the cooling of the bimetal strip 74 which in turn will allow the upward bending of the bimetal strip 74 to open the contacts 68 and 76.

This cycle of opening and closing will be repeated rapidly and will regulate the average amount of current flowing through the fan motor 40 so that the speed of the fan motor 40 will be controlled in accordance with the percentage of time the contacts 68 and 76 are in the closed position. This percentage of time in which the contacts 68 and 76 are in the closed position will be governed by the temperature of the compartment 22 which will exert a temperature influence upon the operation of the bimetal strip 74. This tem-

perature influence is sufficient to regulate the operation of the motor 40 in accordance with the temperature of the compartment 22 and the speed of the motor 40 will be so controlled by the vibrating contact thermostat 62 that sufficient current will flow through the motor to maintain the air circulation necessary to keep the food compartment 22 at the temperature for which the control device 62 is adjusted.

10 The motor 40 which drives the fan 38 will operate continuously since the vibration of the bimetal strip 74 will be sufficiently rapid that the motor will not start and stop but will operate continuously and will vary its speed only in accordance with the temperature of the compartment 22. By this simple means I am able to cool the food compartment 22 through the walls thereof at a desirable temperature and to regulate the temperature of the atmosphere within the food compartment in a very simple, convenient and inexpensive way.

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, all coming within the scope of the claims which follow:

What is claimed is as follows:

1. Refrigerating apparatus including an insulated cabinet containing a compartment to be cooled, a lining member surrounding the compartment, means forming a circulating passageway surrounding the compartment, a cooling unit in heat exchange relation with said circulating passageway, electrically operated means for circulating a fluid through said passageway into heat exchange relation with said cooling unit and the outside of said lining member, and temperature responsive means for varying the speed of operation of said electrically operated means gradually.

2. Refrigerating apparatus including an insulated cabinet containing a compartment to be cooled, a lining member surrounding the compartment, means forming a circulating passageway surrounding the compartment, a cooling unit in heat exchange relation with said circulating passageway, electrically operated means for circulating a fluid through said passageway into heat exchange relation with said cooling unit and the outside of said lining member, and temperature responsive vibrating contact means for gradually varying the operation of said electrically operated means.

3. Refrigerating apparatus including an insulated cabinet containing a compartment to be cooled, a lining member surrounding the compartment, means forming a circulating passageway surrounding the compartment, a cooling unit in heat exchange relation with said circulating passageway, electrically operated fan means for circulating air through said passageway into heat exchange relationship with said cooling unit, and electrical control means for gradually varying the supply of electrical energy to said fan means to gradually vary the output of the fan means.

4. Refrigerating apparatus including an insulated cabinet containing a compartment to be cooled, a cooling unit, electrically operated circulating means for circulating air into heat exchange relation with said cooling unit and said compartment, and temperature responsive means for varying the speed of operation of said electrically operated means gradually.

5. Refrigerating apparatus including an insulated cabinet containing a compartment to be cooled, a lining member surrounding the com-

partment, means forming a circulating passageway surrounding the compartment, a cooling system including a cooling unit in heat exchange relation with said circulating passageway, electrically operated means for circulating a fluid into heat exchange relation with said cooling unit and the outside of said lining member, means responsive to temperature conditions of said cooling unit for controlling the cooling system, and separate means responsive to temperature conditions of said compartment for varying the operation of said electrically operated means.

6. Refrigerating apparatus including a cabinet to be cooled, a cooling means for cooling the in-

terior of said cabinet, and vibrating contact means responsive to temperature conditions within said cabinet for gradually varying the rate of heat removal by said cooling means.

5 7. Refrigerating apparatus including a cabinet to be cooled, a cooling means for cooling the interior of said cabinet, electrically operated fan means for circulating a fluid into heat exchange relationship with said cooling means and said cabinet, and vibrating contact means responsive to temperature conditions within said cabinet for gradually varying the operation of said fan means.

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