June 9, 1942. T. W. RUNDELL 2,285,945

REFRIGERATION APPARATUS

Filed Sept. 20, 1939 2 Sheets-Sheet 1

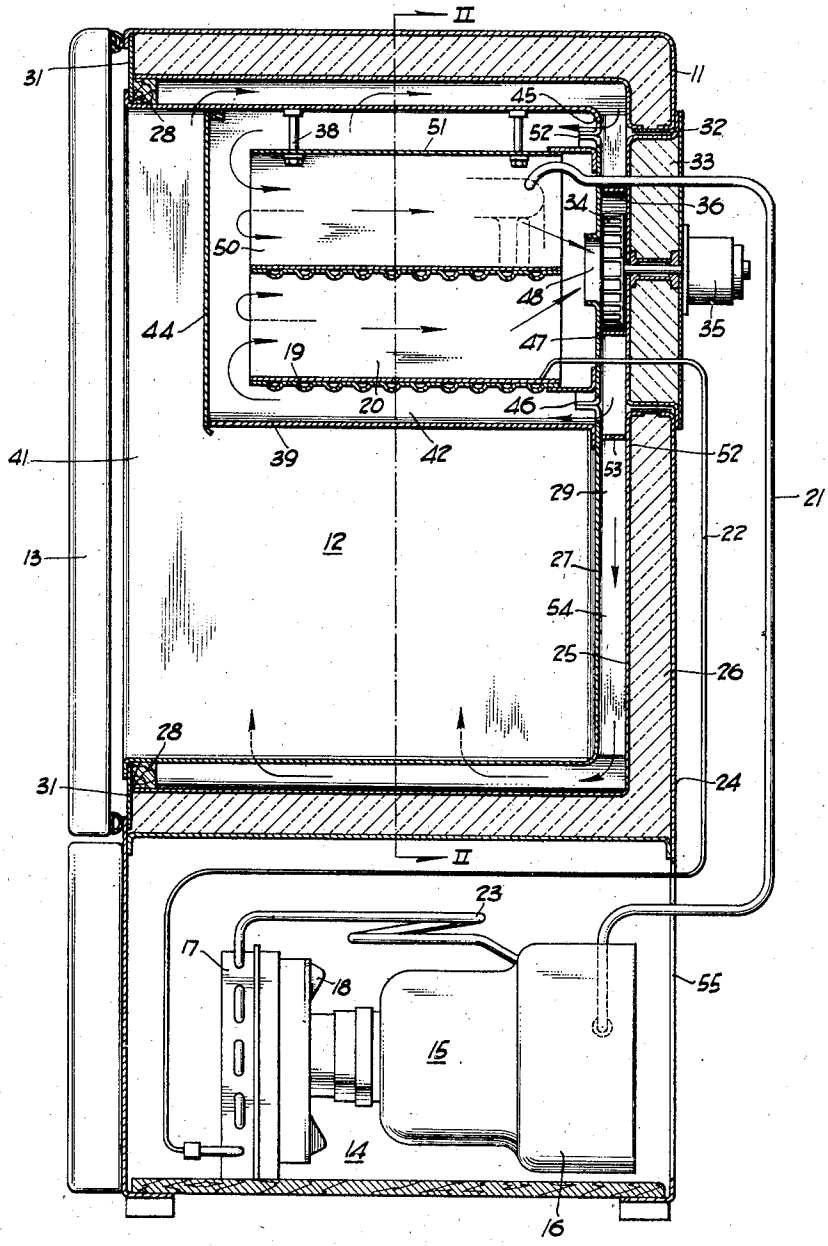

Fig 1.

WITNESSES:
E. M. Van Steiver
E. H. Lutz.

INVENTOR
THEODORE W. RUNDELL
BY W. A. Steiger
ATTORNEY

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Filed Sept. 20, 1939 2 Sheets-Sheet 2

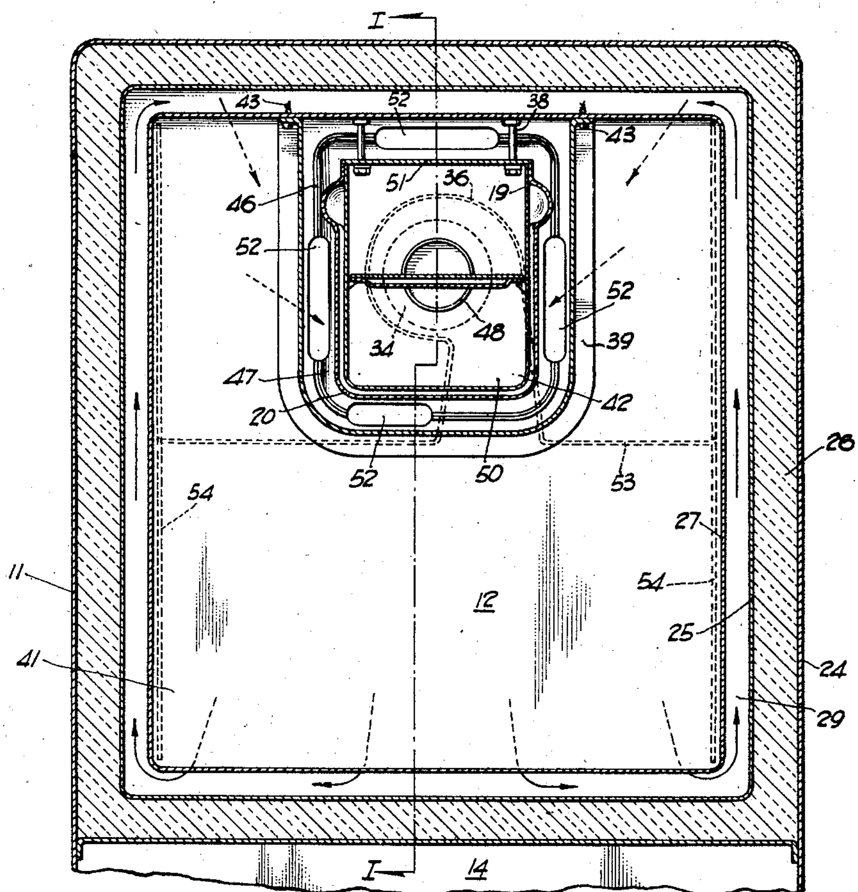

Fig. 2.

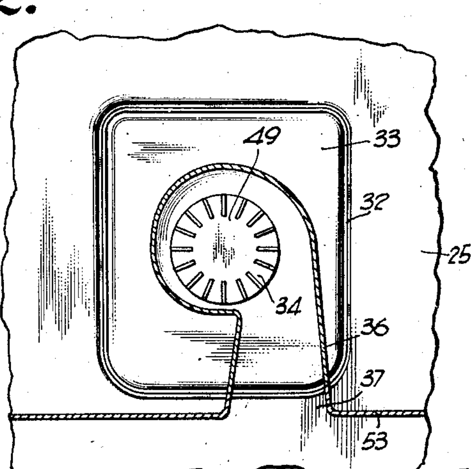

Fig. 3.

WITNESSES:

W. M. Van Sciver

E. H. Lutz

INVENTOR

THEODORE W. RUNDELL

BY H. A. Steiger

ATTORNEY

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UNITED STATES PATENT OFFICE

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REFRIGERATION APPARATUS

Theodore W. Rundell, Indianapolis, Ind., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application September 20, 1939, Serial No. 295,710

3 Claims. (Cl. 62—102)

My invention relates to refrigeration apparatus and particularly to an improved high humidity refrigerator for the storage of foods.

It is an object of my invention to construct a high humidity refrigerator so that substantially the same condensing unit may be used both for high humidity refrigerators and for conventional refrigerators wherein the cooling element or evaporator is directly exposed to the air in the food storage compartment.

It is another object of my invention to provide an improved and novel path for the flow of air in a high humidity refrigerator.

It is a further object of my invention to provide a novel and improved cabinet construction for a high humidity refrigerator and to provide for ease of mounting the condensing unit in the refrigerator cabinet without disturbing the refrigerant connections.

It is also an object of my invention to so construct a high humidity refrigerator that the temperature of the air in the food storage compartment is relatively low and the relative humidity therein is high.

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, in which:

Fig. 1 is a sectional view of a refrigerator embodying my invention taken on line I—I of Fig. 2;

Fig. 2 is a sectional view of the refrigerator taken on line II—II of Fig. 1; and

Fig. 3 is a view of a portion of the refrigerator with the evaporator, rear wall of the evaporator enclosing casing and the inner liner of the refrigerator cabinet removed.

Referring specifically to the drawings for a detailed description of the invention, numeral 11 designates, generally, a refrigerator cabinet comprising an insulated compartment 12 having an access door 13, and a machinery compartment 14. Numeral 15 designates generally a refrigerant condensing unit of the compression type including a hermetically-sealed motor-compressor unit 16, a condenser 17, a fan 18 for cooling the motor-compressor unit and condenser and a U-shaped sheet metal evaporator or cooling element 19, having imperforate walls 20. Suction gas and liquid-conveying conduits 21 and 22, respectively, connect the evaporator 19 with the motor-compressor unit 16 and the condenser 17, the liquid-conveying conduit 22 preferably being a tube of small internal diameter and serving as the restricting device to control the flow of refrigerant from the condenser 17 to the evaporator 19. A discharge conduit 23 connects the motor-compressor unit 16 to the condenser 17 and conveys high-pressure refrigerant gas to the condenser 17. The refrigerating system operates on the conventional compression-condensation-evaporation refrigeration cycle and further explanation is, therefore, unnecessary.

In accordance with my invention, the refrigerator cabinet comprises an outer shell 24, preferably formed of sheet metal and an intermediate shell 25, preferably formed of a heat insulating material, for example, stainless steel, chrome iron or one of those known by the trade-marked names of "Micarta" or "Fiberboard," with heat insulation 26 disposed between the shells 24 and 25. A third shell or inner liner 27, preferably formed of a metal or some other material which is a good heat conductor, is inserted within the intermediate shell 25 and is supported in spaced relation therefrom by insulating blocks 28, thus forming a duct space 29 around five sides of the liner 27. The three shells 24, 25 and 27 are open at the front to afford access to the compartment 12 and door 13 closes the access opening. Breaker strips 31 extend between the outer shell 24 and the liner 27 to seal the insulation 26 between shells 24 and 25 and to seal the duct space 29 between shell 25 and liner 27.

An opening 32, for the insertion and removal of the evaporator 19 and other apparatus to be presently described, is provided in the rear of the cabinet. The opening 32 is closed by a heat-insulated plug or closure 33 through which the suction and liquid conduits 21 and 22 extend in their passage to the evaporator 19. The closure 33 also supports a fan 34 preferably of the centrifugal type, a motor 35 for driving the fan, and a fan casing 36 having its outlet 37 extending in a downward direction in the space 29 between the shell 25 and liner 27.

The evaporator 19 when disposed in the compartment 12 is supported by removable bolts 38 from the top of the liner 27 and is provided with a removable enclosing casing, generally indicated by numeral 39, which completely encloses the evaporator 19 and divides the compartment 12 into a food storage compartment 41 and a freezing compartment 42. The enclosing casing 39 comprises a U-shaped sheet metal housing surrounding the bottom and sides of the evaporator 19 and attached to the top of the liner 27 by sheet metal screws 43. The front of the enclosing casing 39 is formed by a hinged door 44 afford-

ing access to the interior of the freezing compartment 42, so that ice trays (not shown), which are usually supported by refrigerated surfaces of the evaporator 19, may be readily inserted and removed. The rear portion 45 of the liner 27 is also provided with an opening 46 registering with opening 32 in shells 24 and 25. A panel 47 of such size that it will pass through opening 32 closes opening 46 in portion 45 of liner 27, thus forming with the liner 27, the rear of the enclosing casing 39. The top of the enclosing casing 39 is formed by the top of the liner 27.

The panel 47 is provided with an inlet aperture 48 in registry with inlet chamber 49 of the fan 34, which aperture communicates with the interior of the imperforate U-shaped evaporator 19. A partition wall 51 extends across the top of the U-shaped evaporator, thus forming a generally cylindrical chamber 50. The panel 47 and liner 27 are also provided with apertures 52 at the top, bottom and sides of the exterior of the imperforate walls of the evaporator 19.

A horizontal baffle 53 and vertical baffles 54 are disposed in the duct or space 29. Horizontal baffle 53 is in back of the liner 27 and, although formed separately, connects with the outlet 37 of the fan 34 and with the vertical baffles 54. The vertical baffles 54 are also disposed in back of liner 27 near the sides thereof and extend substantially from the bottom to the top of liner 27.

The circulation of air through the cabinet to cool the food storage compartment and to maintain a low temperature and high humidity therein is as follows, the arrows in Figs. 1 and 2 illustrating the path of the air. Cold air from the fan 34 is discharged through the fan outlet 37 and is directed by baffles 53 and 54 down the duct space 29 at the rear of the liner 27 below horizontal baffle 53 and forwardly toward door 13 in the duct space 29 at the bottom of the liner 27. The air then circulates up both sides of the liner 27 through duct space 29 and is directed to the top of the liner 27 by the vertical baffles 54. Air then passes through the duct space 29 over the top and down the back of liner 27 as far as horizontal baffle 53. The air enters the apertures 52 on the outside of the imperforate evaporator 19 and travels forwardly to the front of evaporator 19, the air being cooled as it passes over the exterior of the evaporator walls. The air then travels back inside the evaporator chamber 50 and is further cooled as it passes over the interior of the evaporator walls. The air then enters the fan inlet aperture 48 and the inlet chamber 49 of the fan 34 and is again discharged through fan outlet 37.

From the foregoing description, it is clear that the air which comes into contact with the evaporator 19, and is dehumidified thereby, never enters the food storage compartment 41, but cools all the walls of the food compartment liner 27 so that food compartment 41 is cooled by conduction of heat through extended refrigerated surfaces. The air in the food compartment 41 is, therefore, maintained at a high relative humidity of approximately 90%, while the air temperature therein is just slightly higher than the air passing through the duct 29.

A temperature control device such as shown in the application of R. E. Tobey, Serial No. 228,072, filed September 2, 1938, now Patent No. 2,192,850, dated March 5, 1940, and assigned to the assignee of the present application, may be provided for controlling operation of the motor-compressor unit 16, the thermal responsive element of the control which initiates operation of the unit 16 being disposed in the high humidity compartment 41.

In assembly of the condensing unit into the cabinet 11, the motor-compressor unit 16, condenser 17 and fan 18 are inserted into the machinery compartment 14 through an aperture 55 at the rear thereof. The evaporator 19 and panel 47 are inserted through apertures 32 and 46 in the rear of the cabinet and the evaporator is attached to liner 27 by the bolts 38. The fan 34, fan casing 36 and fan discharge passage 37, are attached to the insulated plug 33 and are inserted through the aperture 32. The U-shaped shroud 39 and door 44 are then attached to the liner 27 by screws 43, thus completing the assembly.

From the foregoing it will be apparent that a condensing unit 15 such as used in conventional low humidity refrigerators may be utilized to construct a high humidity refrigerator and that the condensing unit may be assembled to or removed from the refrigerator cabinet 11 without disturbing any refrigerant connections. If necessary, the condensing units 15 may be manufactured in one location and then be shipped and assembled in the cabinets. Furthermore, I have provided improved air circulation and cooling for maintaining a high relative humidity and a low temperature in a refrigerator cabinet.

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 specifically set forth in the appended claims.

What I claim is:

1. In refrigeration apparatus, the combination of a refrigerating unit including a cooling element having inner and outer exposed surfaces and means for circulating refrigerant through the cooling element, a refrigerator cabinet including a liner formed to impose but slight impedance to heat flow and having top, bottom, side and rear walls forming a food storage compartment, means for substantially isolating the cooling element from the food storage compartment, a shell surrounding the liner and forming a duct system therewith, air circulating means for forcing air through said duct system in contact with said cooling element to cool the food storage compartment by conduction of heat through said liner, said duct system being so arranged that as air leaves the cooling element it is conveyed in contact with the liner while passing down the back, forwardly under the bottom, up both sides, and over the top of the food liner, whereupon it again contacts the cooling element, said cooling element and duct system being so formed that air passing over the cooling element is conveyed first over the outside surfaces of the cooling element and then over the inside surfaces of the cooling element to the air circulating means.

2. In refrigeration apparatus, the combination of a refrigerating unit including a cooling element and means for circulating refrigerant through the cooling element, refrigerant conduit connections between the cooling element and the circulating means, a refrigerator cabinet including a liner formed to impose but slight impedance to heat flow and having top, bottom, side

and rear walls forming a food storage compartment, means for substantially isolating the cooling element from the food storage compartment, a shell surrounding the liner and forming a duct system, air circulating means for forcing air through said duct system and in contact with said cooling element to cool the food storage compartment by conduction of heat through said liner, said duct system being so arranged that as air leaves the cooling element it is conveyed in contact with the liner while passing down the back, forwardly under the bottom, up both sides, and over the top of the food liner, whereupon it again contacts the cooling element, said cooling element, air circulating means and a portion of said duct system constituting an assembly which is removable as a unit from the rear of the refrigerator cabinet without disturbing the refrigerant connections between the cooling element and the refrigerant circulating means.

3. In refrigeration apparatus, the combination of a refrigerating unit including a cooling element having inner and outer exposed surfaces and means for circulating refrigerant through the cooling element, a refrigerator cabinet including a liner formed to impose but slight impedance to heat flow and having top, bottom, side and rear walls forming a food storage compartment, means for substantially isolating the cooling element from the food storage compartment, a shell surrounding the liner and forming a duct system therewith, air circulating means for forcing air through said duct system and in contact with said cooling element to cool the food storage compartment by conduction of heat through said liner, said duct system being so arranged that as air leaves the cooling element it is conveyed in contact with the liner while passing down the back, forwardly under the bottom, up both sides, and over the top of the food liner to the rear thereof, whereupon it again contacts the cooling element, said cooling element and duct being so formed that air passing over the cooling element from the rear of the food liner is conveyed first over the outside surfaces of the cooling element and then over the inside surfaces of the cooling element to the air circulating means.

THEODORE W. RUNDELL.