Oct. 25, 1938. J. H. ASHBAUGH 2,133,951

REFRIGERATION APPARATUS

Filed Oct. 2, 1935 2 Sheets-Sheet 1

FIG. 1.

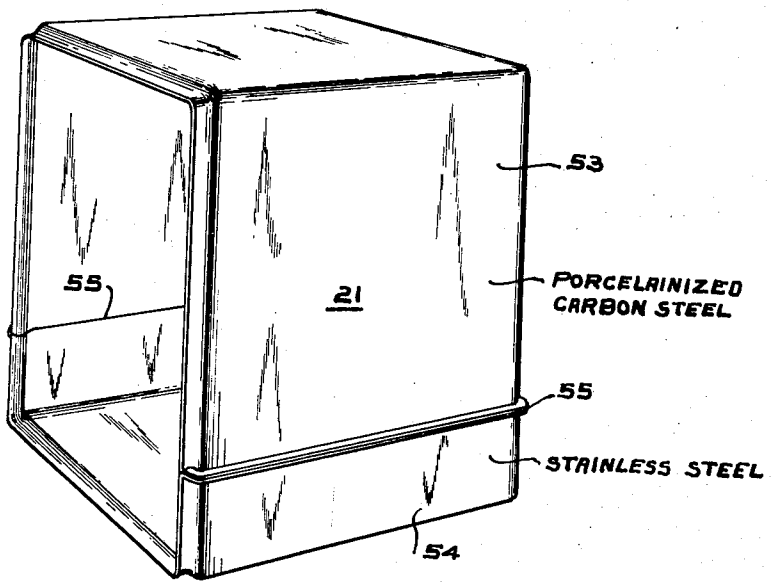
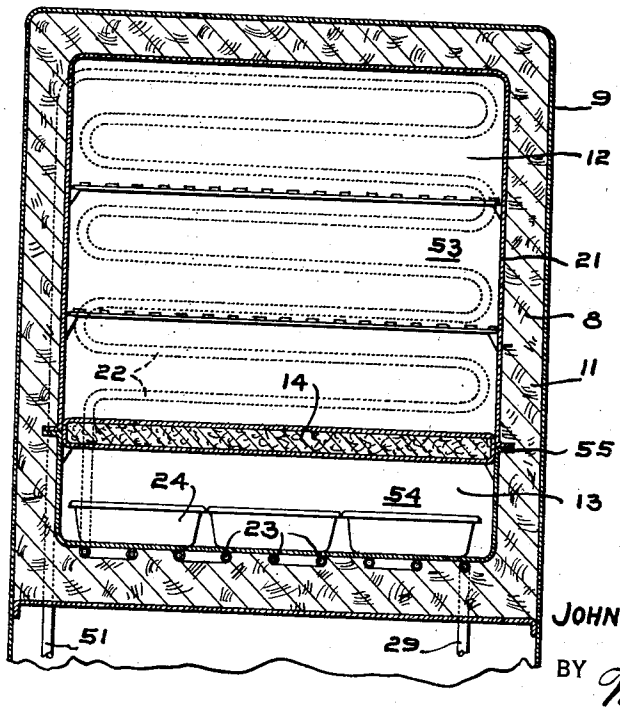


FIG. 2.



WITNESSES:
W. M. van Sciver
J. K. Mosser

INVENTOR
JOHN H. ASHBAUGH.
BY
ATTORNEY

Oct. 25, 1938. J. H. ASHBAUGH 2,133,951

REFRIGERATION APPARATUS

Filed Oct. 2, 1935 2 Sheets-Sheet 2

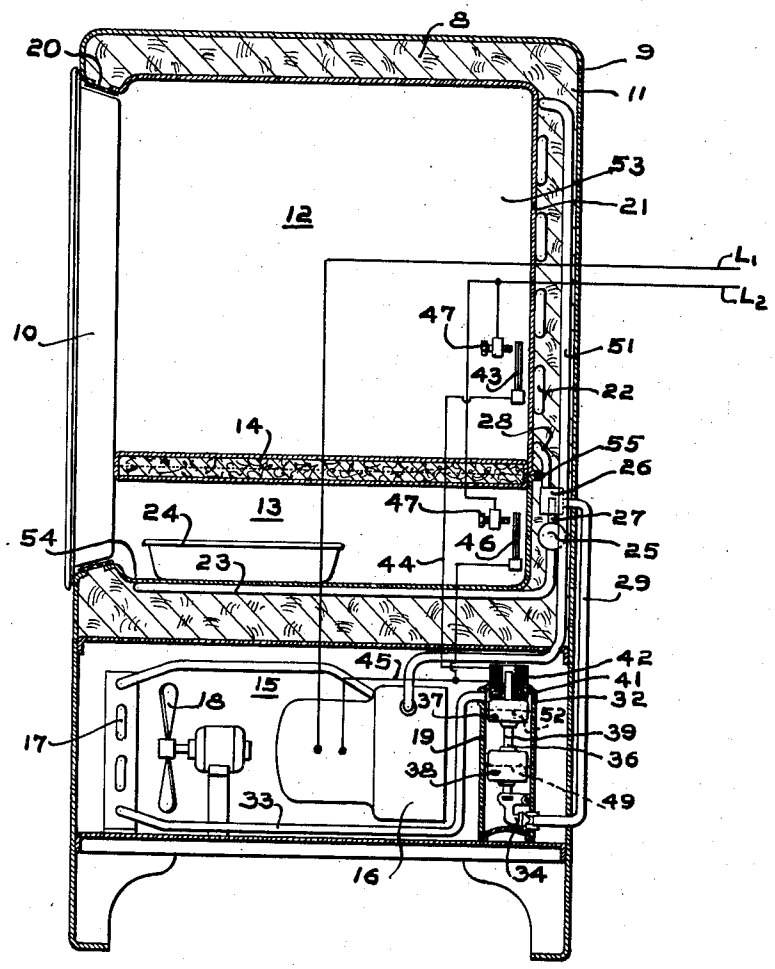


FIG. 3.

WITNESSES:

W. M. Van Sciver

J. L. Mosser

INVENTOR

JOHN H. ASHBAUGH.

BY W. M. Steiger

ATTORNEY

Patented Oct. 25, 1938

2,133,951

UNITED STATES PATENT OFFICE

2,133,951

REFRIGERATION APPARATUS

John H. Ashbaugh, Springfield, Mass., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application October 2, 1935, Serial No. 43,163

5 Claims. (Cl. 62—99)

My invention relates to refrigeration apparatus, and particularly to domestic refrigeration apparatus of the two-temperature type.

My invention is particularly, although not exclusively, applicable to the type of refrigeration apparatus wherein two compartments are maintained at different temperatures by independently operating evaporating or cooling elements. In such a refrigerator, it is desirable to effect refrigeration by the warmer evaporator for a large percentage of the running time of the mechanical refrigerating system, since the system operates at increased efficiency at higher suction pressures. In the copending application of Leslie B. Buchanan, Serial No. 15,003, filed April 6, 1935, for Refrigeration apparatus and assigned to the Westinghouse Electric & Manufacturing Company, a two-temperature refrigerating system is disclosed wherein warmer and colder evaporators are associated with respective compartments to be refrigerated and operate independently as one or the other compartments requires refrigeration. A similar system is contemplated in practicing the present invention. I have found, however, that heat from the warmer compartment is conveyed to the cooler compartment through the metallic food liner of the food storage compartments, with the result that refrigerating system refrigerates through the lower temperature cooling element for too large a percentage of the running time to absorb this heat.

Accordingly, my invention has for one of its objects to so construct a two-temperature refrigerator that it inherently operates at high efficiency.

It is another object of my invention to provide a unitary fabricated food liner for both compartments of a two-temperature refrigerator, in which the leakage of heat through the food liner from one compartment to the other and between the liner and the outer cabinet walls is retarded.

It is a further object of my invention to provide an improved two-temperature refrigerator cabinet which is readily manufactured and assembled.

It is still another object of my invention to provide an improved, inexpensive food compartment liner for a refrigerator cabinet.

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 perspective view of a metallic lining for a two-temperature refrigerator cabinet constructed in accordance with my invention;

Fig. 2 is a vertical section of a refrigerator cabinet constructed in accordance with my invention; and,

Fig. 3 is a sectional view of the refrigerator cabinet embodying a complete refrigerating machine and two-temperature control therefor.

Referring to the drawings for a detailed description of my invention, numeral 11 designates generally a two-temperature refrigerator having a metallic outer wall 9 and a heat insulated food storage space divided into two main sub-compartments 12 and 13 by a partition 14. Both sub-compartments have access openings normally closed by a single door 10. The cabinet 11 is also provided with a machinery compartment 15 in which is disposed a motor-compressor unit 16, a condenser 17, a fan 18 for cooling the condenser 17 and a valve 19 more particularly described hereinafter.

The food storage space is provided with a metallic lining in the form of a five-sided shell, generally designated at 21. A heat breaker strip 20 connects the outer walls 9 with the lining 21 peripherally of the cabinet access opening. Heat insulating material 8 is disposed between the outer walls 9 and lining 21. A cooling element 22 is attached to the upper portion of the lining 21 to maintain the upper sub-compartment 12 at a relatively high refrigerating temperature. A second cooling element 23 is attached to the bottom of the lining 21 to maintain the bottom sub-compartment, 13, at a relatively low refrigerating temperature to congeal liquids in containers 24 disposed on the bottom of the sub-compartment 13.

The refrigerating system shown in Fig. 3 maintains the sub-compartments 12 and 13, at high and low refrigerating temperatures, in the following manner, more fully described in the aforementioned copending application of Leslie B. M. Buchanan.

Referring to Fig. 3, the cooling element 23 for the colder compartment 13 comprises a plurality of tubes bent into U-shape with the ends thereof connected to a header 25. The tubes are secured to the under surface of the bottom wall portion of the food liner 21. The warmer compartment 12 is refrigerated by the cooling element 22 comprising a serpentine coil secured to the back surface of the rear wall portion of the food liner, 21.

The evaporators 22 and 23 are connected to each other and to a source of liquid refrigerant through a connecting chamber 26, which may be

of a cylindrical form disposed with its axis extending vertically. This chamber is disposed at a higher level than the header 25 and a short conduit 27 is connected to the top of the header 25 and projects centrally into the chamber 26.

The inlet end 28 of the warmer evaporator 22 connects with the chamber 26 above the upper end of the conduit 27. A conduit 29, which is connected to the chamber 26 below the upper end of the conduit 27, provides communication with the float valve structure 19.

Refrigerant is retained or released by the float valve structure 19, which includes a chamber 32 connected to the condenser 17 through a conduit 33, a valve 34 therein for controlling the flow of refrigerant to the evaporators through the conduit 29, and a float member 36 for operating the valve 34. The float member 36 comprises upper and lower float elements 37 and 38, which are fixed in vertically spaced relation by a stem 39. A weight member 41 is also provided within the chamber 32 and adapted either to rest on the float member 37 or to be lifted by a solenoid coil 42.

I also show, in Fig. 3, a control system comprising line conductors L_1 and L_2, the former being connected to one terminal of the compressor motor. A thermostat 43, disposed within the warmer compartment 12, has one contact connected to the line conductor L_2 and the other contact connected to one terminal of the solenoid 42 through a conductor 44, while the other terminal of the solenoid is connected through a conductor 45 to the other terminal of the compressor motor. A thermostat 46 is disposed in the cold compartment 13 and connected between the line conductor L_2 and the conductor 45. Each of the thermostats 43 and 46 may obviously be of any desired type known in the art and for purposes of illustration are shown as comprising bi-metallic strips. Each thermostat is adjustable to provide any desired temperature within the respective compartment. In the illustrated embodiment, each thermostat includes a thumb screw 47, which forms the stationary contact and which may be adjusted to vary the temperature setting of the thermostat. It is to be understood that any suitable form of starting relay for the compressor-motor may be used, as is fully understood in the art, and that any other usual electrical provisions may be made.

The operation is as follows: Assume that the warmer compartment 12 requires refrigeration while the colder compartment 13 is sufficiently cold, so that the contacts of the thermostat 43 are closed while the contacts of the thermostat 46 are open. The solenoid 43 and the compressor motor are both energized, the circuit extending from line conductor L_1 through the motor, the conductor 45, the solenoid 42, the conductor 44, and the thermostat 43 to the line conductor L_2. The solenoid 42 lifts the weight 41, and the motor drives the refrigerant compressor. The float member 36 being relieved of the weight 41 maintains a lower liquid level indicated at 49. The refrigerating system is charged with a sufficient quantity of refrigerant, so that, under this condition, there is sufficient liquid refrigerant conveyed through the conduit 29 to the chamber 26 to first completely fill the colder evaporator 23 through the conduit 27, and then to supply sufficient refrigerant to the warmer evaporator 22 for operation thereof.

The refrigerating system now operates in the usual manner of such apparatus to effect refrigeration of the warmer compartment 12, the liquid refrigerant in the evaporator 22 being vaporized and withdrawn through conduit 51 to the motor compressor unit 16, wherein its pressure is increased. It is then condensed in the condenser 17 and returned to the float chamber 32. Due to the higher temperature maintained in the chamber 12, evaporation of liquid refrigerant in the evaporator 22 effects a higher pressure in the low side of the system, which higher pressure is imposed on the liquid refrigerant in the evaporator 23. However, the increased pressure has no effect on the liquid therein, thereby avoiding condensation and heating of the colder chamber 13 which would take place if vapor under the higher pressure were admitted to the evaporator 23.

Assume now that the temperature in the colder compartment 13 rises to the maximum limit for which the thermostat 46 is set so as to close the contacts thereof for effecting refrigeration of said compartment. The thermostat 46 completes a circuit from line conductor L_1 through the motor, the conductor 45 and the thermostat 46 to the line conductor L_2 to effect operation of the motor. The solenoid 42 is now deenergized and releases the weight 41, regardless of whether the thermostat 43 is open or closed, since, if it is closed, the solenoid is shunted by the thermostat 46. Accordingly, the weight member 41 rests on the float member 37, so that the liquid level within the float chamber 32 must rise to a higher level, shown at 52, before the float member will rise to open the valve 34. There is thus retained in the float chamber 32 an additional quantity of liquid refrigerant filling the space between the float elements 37 and 38, which is sufficient to reduce the effective refrigerant charge to the extent that only the colder evaporator 23 will receive liquid refrigerant. The liquid refrigerant remaining in the evaporator 22 from previous operation and that filling the vapor space in the top of the header 25 are first evaporated while condensed refrigerant is retained in the float chamber 32 until the upper level 52 is reached. Further operation of the compressor reduces the suction pressure until evaporation in the evaporator 23 takes place.

The refrigerant system now operates in the usual manner, the refrigerant admitted to the chamber 26 flowing through the conduit 27 into the header 25 to supply the colder evaporator 23, inasmuch as the upper end of the conduit 27 is at a lower level than the inlet end of the conduit 28, and there is only sufficient liquid to cause evaporation in the evaporator 23. The refrigerant vaporized in the evaporator 23 passes through the evaporator 22, and being at a lower temperature, extracts some heat therefrom, thereby superheating the vapor. Such superheating, however, does not affect the lower suction pressure now effected. When the temperature in the colder compartment 13 is reduced to the lower limit for which the thermostat 46 is set, the latter opens its contacts. If the contacts of the thermostat 43 are open at this time, operation of the refrigerating system ceases but, if they are closed, the solenoid 42 is energized and the motor continues to operate to effect refrigeration of the warmer compartment in the manner first described.

In the control system of Fig. 3, the thermostat 46 may be referred to as the preferred thermostat, since the compartment associated therewith receives refrigeration in preference to the other when both require refrigeration.

When the refrigerating system is operating to withdraw refrigerant from the higher temperature cooling element 22, the motor-compressor unit 16 is pumping dense refrigerant at a relatively high suction pressure. Therefore, more pounds of refrigerant are pumped per unit time than if the motor-compressor unit were operating to compress less dense refrigerant at lower suction pressure. It is desirable, therefore, to operate the motor-compressor unit to withdraw refrigerant from the warmer cooling element 22 for as large percentage of the running time as possible because the refrigerating system operates at increased efficiency under these conditions.

In order to retard the leakage of heat from the warmer sub-compartment 12 to the colder sub-compartment 12, and to decrease the heat leakage from the colder compartment to the outer walls 9 of the refrigerator cabinet, I form the lining 21 of different materials. The upper portion 53 of the liner 21 which defines the warmer compartment 12 is preferably porcelainized carbon steel, since carbon steel is a relatively good conductor of heat and heat is therefore efficiently transferred from the warmer sub-compartment 12 to its associated cooling element 22. Furthermore, carbon steel is relatively inexpensive and may be porcelainized to provide a pleasing appearance. The lower portion 54 of the lining 21 defining the colder sub-compartment 13 is formed of a metal of relatively low heat conductivity, with respect to carbon steel, the preferable metal used being stainless steel. The portions 53 and 54 of the lining 21 are attached by welding at 55 along flanges of each portion, although any suitable means of fastening the two portions together may be employed.

The resulting unitary lining construction 21 is easily manufactured, readily assembled in the cabinet 11, and effectively retards the leakage of heat from the warmer compartment 12 to the colder compartment 13 through the lining 21. As hereinbefore stated, the lower portion 54 of the lining 21 is preferably formed of stainless steel. Stainless steel is particularly adapted for use as the food liner of a refrigerator cabinet because it is pleasing in appearance, acid resisting, and need not be painted or porcelainized. Furthermore, the stainless steel food liner, being formed of a metal which is a relatively poor conductor of heat, reduces the heat leakage from the food storage compartment through the insulation 8 to the outer walls 9 of the refrigerator cabinet. Furthermore, heat leakage is also reduced between the portion 54 of the lining 21 and the outer cabinet walls 9 through the heat breaker 20, thereby preventing or reducing the possibility of moisture condensing from the atmosphere on the outer walls 9 of the cabinet adjacent the door opening. This is particularly important in a refrigerator cabinet of the two-temperature type wherein the lower temperature compartment is normally operated at below freezing temperatures and the dew point of the cabinet walls adjacent the access opening of the low temperature compartment is at a low value.

When such a lining construction is utilized with the refrigerating apparatus illustrated in Fig. 3, the warmer cooling element 22 is operated a large percentage of the running time of the motor-compressor unit 16 because, instead of heat leaking from the warmer sub-compartment 12 into the colder sub-compartment 13 to be absorbed by the colder cooling element 23, most of this heat is absorbed by the warmer cooling element 22. As a result, the motor-compressor unit is pumping relatively dense refrigerant at a higher suction pressure for a greater percentage of its running time and the overall efficiency of the system is therefore materially increased.

From the foregoing, it will be apparent that I have provided a two-temperature refrigerator which is cheap to manufacture, easy to assemble, and which inherently operates at high efficiency. Furthermore, I have provided a unitary food storage compartment lining for two-temperature refrigerators which effectively retards the leakage of heat from a warmer to a colder sub-compartment through the lining. In addition, I have provided an improved food compartment lining construction formed of stainless steel or similar alloy which is a relatively poor heat conductor, is acid resisting, and is pleasing in appearance without painting or porcelainizing.

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. In refrigeration apparatus, the combination of spaced inner and outer casings, means for dividing said inner casing into a plurality of compartments, and means for refrigerating said compartments at relatively different temperatures, the portion of said inner casing defining the lower temperature compartment being formed of a metal having a relatively lower heat conductivity than the portion of the inner casing defining the higher temperature compartment.

2. In refrigeration apparatus, the combination of an outer casing, an inner casing disposed within the outer casing, said inner casing embodying two portions composed, respectively, of metals of relatively high and low heat conductivities, means for attaching the inner casing portions to each other, and means for refrigerating the portion of the casing of higher heat conductivity at a relatively higher temperature than the portion of the casing of lower heat conductivity.

3. In refrigeration apparatus, the combination of spaced inner and outer casings, means for dividing said inner casing into a plurality of compartments, and means for refrigerating said compartments at relatively different temperatures, the portion of said inner casing defining the lower temperature compartment being formed of stainless steel and the portion of the inner casing forming the higher temperature compartment being formed of carbon steel, said stainless steel portion of the inner casing retarding the leakage of heat from the higher temperature compartment to the lower temperature compartment.

4. In refrigeration apparatus, the combination of spaced inner and outer casings, means for dividing said inner casing into two compartments, and means for refrigerating said compartments at relatively different temperatures, the portion of said inner casing defining the lower temperature compartment being formed of a metal having a relatively lower heat conductivity than the portion of the inner casing defining the higher temperature compartment, said portions

being fastened together adjacent said dividing means to form a unitary inner casing.

5. In refrigeration apparatus, the combination of spaced inner and outer casings, means for dividing said inner casing into a plurality of compartments, and means for effecting refrigeration of said compartments at relatively different temperatures, a portion of said inner casing defining one of said compartments being formed of a metal having a relatively lower heat conductivity than the portion of the inner casing defining another compartment.

JOHN H. ASHBAUGH.