Sept. 16, 1952 G. K. IWASHITA 2,610,479

TWO-TEMPERATURE REFRIGERATOR

Original Filed July 14, 1943

Fig. 2.

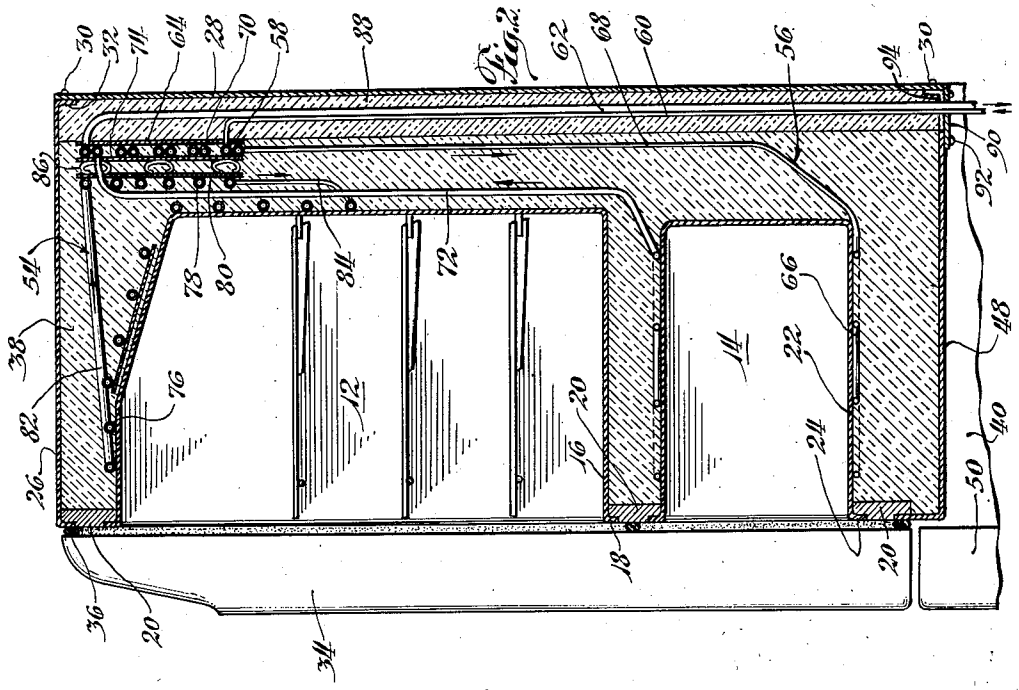
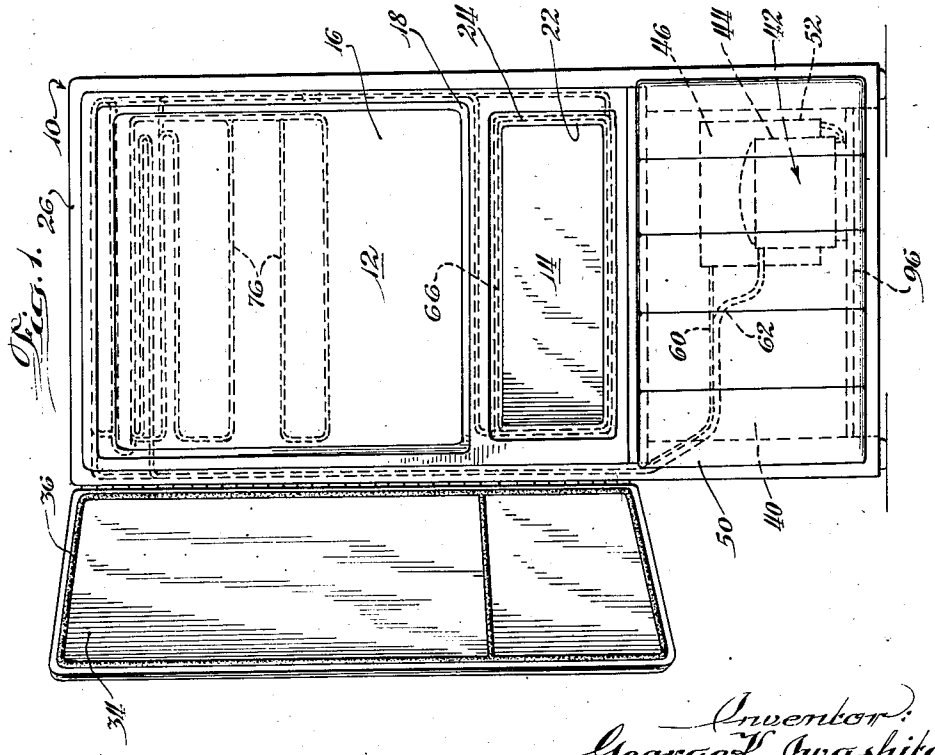


Fig. 1.



Inventor:
George K. Iwashita
By Hinkle, Horton, Allbery & Dupree
Attorneys.

Patented Sept. 16, 1952 2,610,479

UNITED STATES PATENT OFFICE

2,610,479

TWO-TEMPERATURE REFRIGERATOR

George K. Iwashita, Nutley, N. J., assignor to Admiral Corporation, Chicago, Ill., a corporation of Delaware

Original application July 14, 1943, Serial No. 494,629, now Patent No. 2,511,851, dated June 20, 1950. Divided and this application June 16, 1950, Serial No. 168,595

6 Claims. (Cl. 62—117.3)

1

This invention relates to refrigerators and particularly to refrigerators of the type having two food storage compartments to be maintained at different temperatures. This application is a division of the copending application of George K. Iwashita, Serial No. 494,629, filed July 14, 1943 and issued on June 20, 1950 into Patent No. 2,511,851.

The principal object of this invention is to provide an improved multi-compartment, multi-temperature refrigerator which has advantages in construction and operation not possessed by prior art refrigerators.

Another object of the invention is to provide an improved two temperature refrigerator having a single primary and dual secondary refrigerant circulating circuits.

Another object is to provide an improved two temperature refrigerator having a single primary refrigerant circulating circuit provided with a single evaporator and dual secondary refrigerant circulating circuits, each provided with a single evaporator and a single condenser portion and in which the heat absorbing characteristics of the two secondary condensers are maintained at predetermined relative values.

Still another object of this invention is to provide a two temperature refrigerator having a single primary refrigerant circulating circuit provided with an evaporator and dual secondary refrigerant circulating circuits, each having a secondary condenser maintained in heat exchange relation with the primary evaporator, the difference in the temperatures of the refrigerated compartments being maintained by a difference in effectiveness of the heat transfer between the primary evaporator and each of the two secondary condensers.

Still another object of this invention is to provide an improved multi-temperature, multi-compartment refrigerator of the type having the above recited advantages and wherein the primary refrigerant circulating circuit is removable.

Other objects and advantages will become apparent from the following description taken in conjunction with the drawing wherein:

Fig. 1 is an elevational view of a refrigerator constructed according to the present invention showing the door which closes the access openings to the two compartments standing open; and

Fig. 2 is a longitudinal medial section on an enlarged scale showing the arrangement of the refrigerant circulating circuits and the disposition of the two food storage compartments relative to each other.

In the drawing the reference character 10 designates a refrigerator which is provided with an upper main food storage compartment 12 and a lower compartment 14 which is to be maintained at a lower temperature than the upper compartment and is frequently called a "frost chest." The frost chest 14 is for the freezing of ice cubes and foods and for the storage of frozen foods. The food storage compartment 12 is formed by a metallic liner 16 having its forward flanged edge 18 secured to a front supporting frame 20 which is preferably made of a thermal insulating material. In a similar fashion the frost chest 14 is formed by a metallic liner 22 having its forward flanged edge 24 secured to the frame 20. The frame 20 has a part positioned between the frost chest liner 22 and the storage compartment liner 16 and thus thermally insulates these liners from each other at the front of the cabinet.

The cabinet 10 includes an outer metallic shell 26 which is secured to the frame 20 and a rear panel 28 which is removably secured by screws 30 to an inturned flange 32 of the outer shell 26.

The access openings to the compartments 12 and 14 are closed by a thermally insulated door 34 which when closed is sealed against the face of the cabinet by a deformable sealing gasket 36 carried adjacent the periphery of the door. The space between the shell 26 and the liners 16 and 22 is filled with a thermal insulating material 38 which may be of any of several well known types such as rockwool, balsa wool and the like. Below the frost chest 14 the refrigerator cabinet is provided with a machinery compartment 40 which houses a refrigerator liquefying mechanism 42 consisting of a compressor 44 and condenser 46. The machinery compartment is closed at its top by a wall 48 secured to the frame 20 and to the outer liner 26 and to which the rear panel 28 is removably secured by the previously mentioned screws 30. The machinery compartment 40 is closed at the front of the cabinet panel 50.

The cooling system comprises a primary refrigerant circulating system 52, which includes the previously mentioned compressor 42 and condenser 46, and a pair of secondary refrigerator circulating systems 54 and 56.

The primary circuit 52 has a single evaporator coil 58 which is connected to the outlet side of the liquefying unit 42 by a capillary tube 60; and the outlet side of the evaporator 58 is connected to the inlet of the primary condenser 44 by a suction tube 62. Throughout the greater portion of their lengths the tubes 60 and 62 are preferably brazed or soldered together so that

2

the suction tube will cool the relatively warm capillary tube. The evaporator coil 58 is secured to one face of a heat transfer plate 64, the function of which will become apparent hereinafter.

The secondary system 56 includes an evaporator coil 66 which is secured in heat transfer relation with the outer surface of the liner 22 of the frost chest 14. It is connected by means of a downwardly extending tube 68 to the outlet side of a condenser coil 70, the inlet side of which is connected by means of the tube 72 to the outlet side of the evaporator coil 66. The primary evaporator coil 58 and the secondary condenser coil 70 are confined between the previously mentioned metallic heat transfer plate 64 and a similar metallic heat transfer plate 74. These two plates effect heat exchange between the coils 58 and 70. Furthermore the coils 58 and 70 are arranged so as to be in contact with each other in so far as is possible, as shown in Fig. 2. Thus the thermal conductivity between the primary evaporator and the secondary condenser of the refrigerant circulating circuit 56 is extremely efficient.

The secondary refrigerant circulating system 54 includes an evaporator portion 76 in heat transfer relation with the outer surface of the liner 16, and a condenser portion 78 mounted on a metallic heat transfer plate 80. The inlet side of the condenser coil 78 is connected to the outlet of the evaporator coil 76 by means of a tube 82, and the inlet side of the evaporator coil 76 is connected to the outlet of the condenser coil 78 by means of downwardly extending inlet tube 84. The heat transfer plate 80 to which the condenser coil 78 is secured is not in direct contact with either of the plates 64 or 74 but is thermally connected thereto by means of metallic spacers 86 which are confined between the plates 80 and 74. Because the condenser 70 of the secondary system 56 for the frost chest 14 is in direct heat exchange relation with the primary evaporator 58 and the condenser 78 of the secondary system 54 for the compartment 12 is in heat exchange relation with the primary evaporator 58 only through the spacers 86, a desired temperature differential between the frost chest 14 and the compartment 16 is maintained. The degree of temperature differential between the compartments can be adjusted or regulated by choosing spacers 86 of the proper number, type and size to maintain the heat exchange rate for the compartment 14 above the heat exchange rate for the compartment 12 at a predetermined desired ratio.

It should be noted that the outlets from the secondary condensers are above the inlets to the primary evaporators and below the condenser inlets so that the flow of refrigerant in the secondary tubing will always be in the same direction and so flow obstructions will be created.

The above described system provides an extremely simple primary circuit, since the system requires but a single primary evaporator. It has the advantage that the primary be completely sealed and is easily removable from the cabinet for servicing, and that the secondary circuits are so arranged as to have a constant refrigerant circulation according to the principles of fluid flow. Furthermore, the temperature differential between the compartments is not maintained by the use of a differential pressure valve as is customary in many prior systems, but is merely maintained by means of a difference in the effectiveness of heat extraction by the primary system between the two secondary systems.

The complete primary system is removable from the refrigerator through the back thereof. To do this it is necessary to remove the rear panel 28 of the refrigerator cabinet so that that part of the insulation designated by the reference character 88 immediately adjacent the panel 28 may be removed to expose the heat transfer plate 64 and the evaporator coil 58. The tubes 60 and 62 pass through a closure plate 90 which is removably secured by means of sheet metal screws 92 to the plate 48 to close a slotted opening 94 therein. This closure plate is removed with the tubes 60 and 62, and the primary system may be removed from the back of the cabinet. The liquefying unit 42 is secured to a frame 96 in the machinery compartment by any suitable readily detachable means. Thus the primary system is very simply removed from the cabinet for servicing or replacement.

All of the objectives which were enumerated in the opening paragraphs are embodied in the refrigerator of this invention. It will, however, be apparent to those skilled in the art that numerous modifications may be made in this refrigerator without departing from the fundamental principles of the invention, which is to be limited only by the scope of the appended claims.

What is claimed as new and desired to be secured by United States Letters Patent is:

1. A refrigerator comprising a liner forming a low temperature compartment, a refrigerant coil having an evaporator portion in heat exchange transfer with said low temperature compartment liner, a liner forming a higher temperature compartment, a refrigerant coil having an evaporator portion in heat transfer relation with said higher temperature compartment liner, and a sealed primary refrigerating system including an evaporator removably maintained in heat transfer relation with the condenser portions of both the low temperature compartment refrigerant coil and the high temperature compartment refrigerant coil, the heat transfer from either condenser being accomplished through metallic heat conductors, and the distance through the metallic heat conductors between the secondary condenser and the primary evaporator being substantially greater in the case of the higher temperature compartment refrigerant coil than in the case of the lower temperature compartment refrigerant coil.

2. A refrigerator comprising a liner forming a low temperature compartment, a refrigerant coil having an evaporator portion in heat exchange transfer with said low temperature compartment liner, a liner forming a higher temperature compartment, a refrigerant coil having an evaporator portion in heat transfer relation with said higher temperature compartment liner, a sealed primary refrigerating system including an evaporator coil removably maintained in heat transfer relation with the condenser portions of both the low temperature compartment refrigerant coil and the high temperature compartment refrigerant coil, and spaced metallic heat conductors through which heat transfer is effected between said primary evaporator and said secondary condenser portions, the distance through the metallic heat conductors between the secondary condenser and the primary evaporator being substantially greater in the case of the higher temperature compartment refrigerant coil than in the case of the lower temperature compartment refrigerant coil.

3. A refrigerator comprising a liner forming a low temperature compartment, a refrigerant

coil having an evaporator portion in heat exchange transfer with said low temperature compartment liner, a liner forming a higher temperature compartment, a refrigerant coil having an evaporator portion in heat transfer relation with said higher temperature compartment liner, a sealed primary refrigerating system including an evaporator coil in heat transfer relation with condenser portions of both the low temperature compartment refrigerant coil and the high temperature compartment refrigerant coil, and metallic heat conductors interposed between said primary evaporator and said secondary condensers, the distance through the metallic heat conductors between the secondary condenser and the primary evaporator being substantially greater in the case of the higher temperature compartment refrigerant coil than in the case of the lower temperature compartment refrigerant coil.

4. In a refrigerator having means forming a first compartment and means forming a second compartment, a primary refrigerant circulating system including an evaporator, a pair of secondary refrigerant circulating systems, one of said systems being adapted to cool the first compartment to within a first temperature range and the second of said systems being adapted to cool the second compartment to within a second temperature range which is higher than said first temperature range, each of said secondary systems having a condenser portion, means for effecting direct heat transfer between said primary evaporator and the condenser for the secondary system adapted to cool said first compartment, and means for effecting indirect heat transfer between said primary evaporator and the condenser for the secondary system adapted to cool said second compartment so that said first compartment is cooled to a lower temperature than said second compartment.

5. In a refrigerator having means forming a first compartment and means forming a second compartment, a primary refrigerant circulating system including an evaporator, a pair of secondary refrigerant circulating systems, one of said systems being adapted to cool the first compartment to within a first temperature range and the second of said systems being adapted to cool the second compartment to within a second temperature range which is higher than the first temperature range, each of said secondary

systems having a condenser portion, and thermally conductive means between said primary evaporator and said secondary condensers, said thermally conductive means being so constructed and arranged that the heat transfer path between said evaporator and the condenser of said secondary system for the higher temperature compartment is longer than that between said evaporator and the condenser of said secondary system for the lower temperature compartment, whereby said first compartment is cooled to a lower temperature than said second compartment.

6. In a refrigerator having means forming a first compartment and means forming a second compartment, a primary refrigerant circulating system including an evaporator, a pair of secondary refrigerant circulating systems, one of said systems being adapted to cool said first compartment and the second of said systems being adapted to cool said second compartment, each of said systems having a condenser portion, thermally conductive means for effecting heat transfer between said primary evaporator and one of said secondary condensers, and the other thermally conductive means for effecting heat transfer between said primary evaporator and the other of said secondary condensers, said last named means having a smaller heat transfer capacity so that one of the compartments is cooled to a lower temperature than the other compartment.

GEORGE K. IWASHITA.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,798,951	Munters	Mar. 31, 1931
1,865,513	Gaugler	July 5, 1932
1,926,384	Hull	Sept. 12, 1933
2,035,573	Smith	Mar. 31, 1936
2,101,656	Steenstrup	Dec. 7, 1937
2,309,797	Stickel	Feb. 2, 1943
2,405,392	Atchison	Aug. 6, 1946
2,416,354	Shoemaker	Feb. 25, 1947
2,416,777	Schweller	Mar. 4, 1947

FOREIGN PATENTS

Number	Country	Date
575,535	Germany	Apr. 28, 1933