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REFRIGERATING APPARATUS

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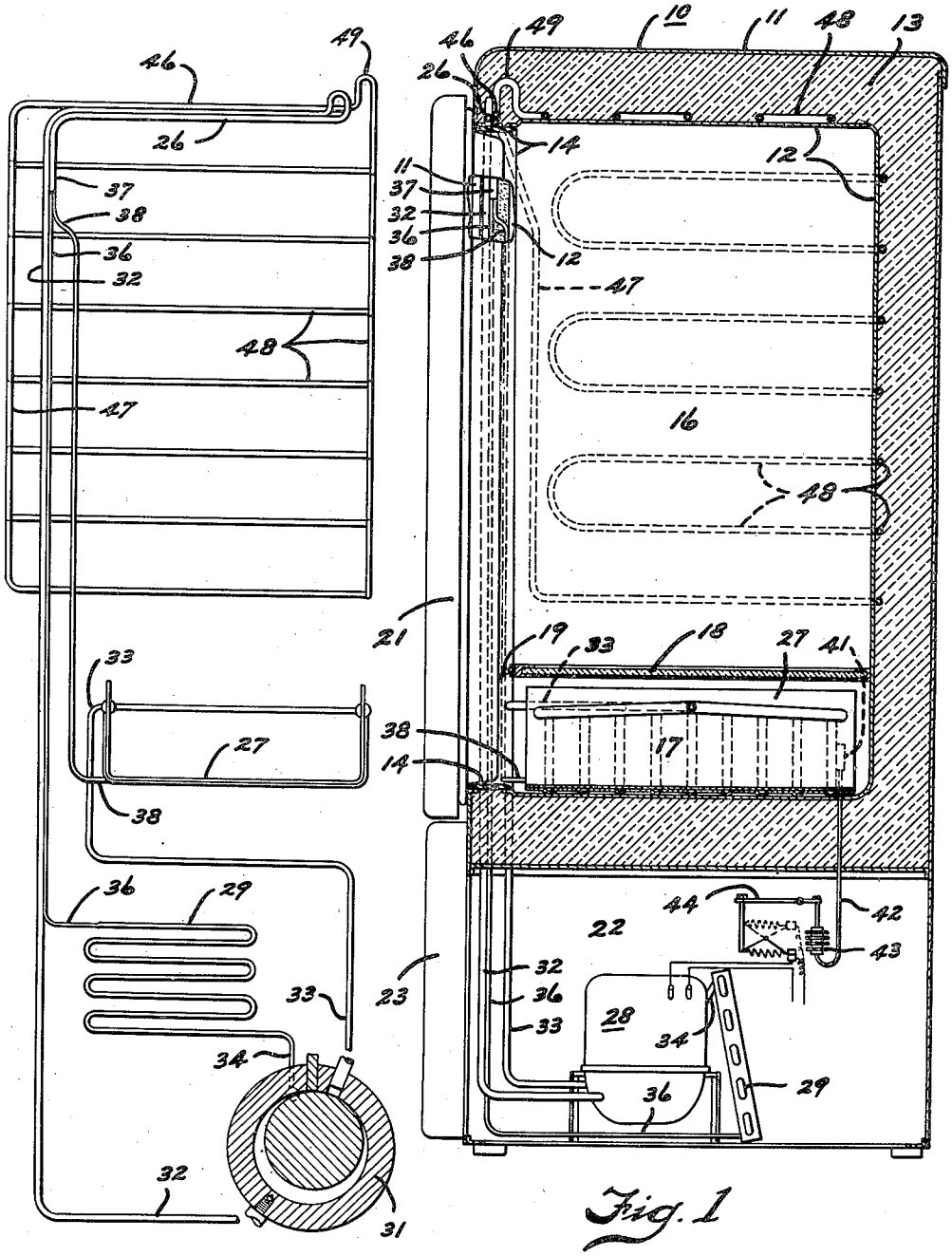



Fig. 1

Fig. 2

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## REFRIGERATING APPARATUS

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5 Claims. (Cl. 62—99)

This invention relates to refrigerating apparatus and particularly to a two-temperature refrigerator cabinet.

An object of my invention is to provide an improved two-temperature refrigerator cabinet.

Another object of my invention is to provide an improved and more efficient manner of refrigerating a two-temperature refrigerator cabinet of the type wherein a portion of a secondary refrigerant circuit is associated with a part of a primary refrigerating system and is employed to cool the interior of the uppermost compartment of superimposed compartments in the refrigerator cabinet.

A further object of my invention is to associate a primary refrigerating system, having two evaporators disposed one above the other, with a two-compartment refrigerator cabinet wherein the lowermost of the evaporators is employed to cool the lower compartment of the cabinet, and the other or uppermost evaporator is utilized to render a closed secondary refrigerant circuit effective to cool the upper compartment of the cabinet and to provide the primary refrigerating system with a multiple effect compressor for withdrawing refrigerant directly and simultaneously from both primary evaporators to thereby maintain the temperature differential between the two compartments substantially uniform.

A still further and more specific object of my invention is to provide for the detachment of the primary evaporator in a system of the type described in the preceding object from the condensing portion of the secondary refrigerant circuit and for the removal of the primary refrigerating system as a unit from the cabinet.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing, wherein a preferred form of the present invention is clearly shown.

In the drawing:

Fig. 1 is a vertical sectional view of a refrigerator cabinet having my invention embodied therein; and

Fig. 2 is a diagrammatic showing of the refrigerating systems associated with the refrigerator cabinet disclosed in Fig. 1.

Referring to the drawing, for illustrating my invention, I have shown in Fig. 1 thereof a refrigerating apparatus of the two-temperature household type. A cabinet 10 has a plurality of outer metal panels or walls 11 and an inner metal liner member 12 spaced therefrom and forming walls of a chamber within the cabinet. Any suitable or desirable insulating material 13 is disposed between the liner 12 and walls 11 of cabinet 10 to insulate the chamber therein. Liner member 12 has an aperture therein registering with an aperture formed in the front wall 11 of cabinet 10 to provide an access opening for the chamber. Breaker strips 14 of any suitable or desirable insulating material overlap the edge portion of the aperture in the cabinet front wall and the spaced edge portion of the aperture in liner 12 to provide walls of the access opening. These breaker strips 14 are removably secured in place in any convenient or conventional manner for a purpose to become apparent hereinafter. The chamber within cabinet 10 is divided into an upper food storage compartment 16 and a lower food storage or freezing compartment 17 by a removable glass plate or the like partition 18. Partition 18 has a rubber or the like gasket member 19 secured to all four edges thereof, and the gasket 19 engages the three vertical walls of liner 12 and the inner face of an insulated door structure 21 which normally closes the access opening to the cabinet chamber. The engagement of gasket 19 with walls of liner 12 and the door 21 causes partition 18 to isolate the compartments 16 and 17 from one another. The outer cabinet walls 11 depend below the insulated chamber and form a machine compartment 22 in the bottom of the refrigerator cabinet for housing a refrigerant liquefying and circulating unit of a primary refrigerating system. An opening provided in the front of the machine compartment 22, for a purpose to be hereinafter described, is closed by a cover or door 23.

The primary refrigerating system associated with the refrigerator cabinet 10 includes a first evaporator in the form of a conduit loop 26 which is disposed in the insulation 13 at the top of cabinet 10, under the breaker strip 14, and another or second evaporator 27 located below the first evaporator 26 and disposed within the lower compartment 17. Evaporator 27 is preferably of the sheet metal U-shaped variety wherein refrigerant expansion passageways are formed intermediate two secured together metal plate members. The refrigerant liquefying and circulating unit of the primary refrigerating system is mounted in the machine compartment 22 and comprises a sealed motor-compressor unit 28 and a condenser 29. In the present disclosure, the compressor 31 of unit 28 (see Fig 2) is of the multiple effect rotary type, preferably of the design fully shown and described in the Robert N. Feicht application Serial No.

192,846, filed February 26, 1938. This compressor 31 has separate refrigerant gas return conduit connections 32 and 33, with each of the evaporators 26 and 27 respectively for simultaneously withdrawing refrigerant therefrom. Refrigerant compressed by the compressor 31 of unit 28 is forwarded under pressure, through a pipe 34, to condenser 29 where it is cooled and liquefied in any suitable or desirable manner. The liquid refrigerant is circulated to the upper or first evaporator 26 by way of a long small-diametered pipe 36 which restricts or controls the flow of refrigerant into evaporator 26. Restrictor pipe 36 is connected to a depending end portion 37 of the larger conduit 26 of the upper evaporator, and some of the refrigerant upon entering this evaporator begins to evaporate while the remainder thereof stays in liquid form and is conveyed to the lower or second evaporator 27 by way of another long, small diametered pipe 38. Pipe 38 extends into the end portion 37 of evaporator 26 and communicates with the open end of pipe 36. This pipe 38 restricts or controls the feeding of liquid refrigerant from evaporator 26 into evaporator 27. The expanding or evaporating refrigerant entering the conduit evaporator 26 causes same to produce a refrigerating effect for a purpose to be hereinafter described. Refrigerant expanding into or evaporating within the lower or second evaporator 27 causes this evaporator to produce a refrigerating effect to cool the lower compartment 17. The temperature of evaporator 27 is at all times maintained below freezing in order to freeze water or other substances placed in trays and adapted to be located thereon. The cooling of compartment 17 at such low temperature causes frost to form on walls of the primary evaporator 27, which also causes dehydration of the air within the compartment and the maintenance of a low relative humidity therein. Starting and stopping of the electric motor of the motor-compressor unit 28 may be carried out in response to the temperature produced by evaporator 27. Thus, I locate a thermostatic bulb 41 within compartment 17 adjacent a wall of evaporator 27 and connect this bulb, by a pipe 42, with an expansible and contractable bellows 43 forming part of a snap-acting control switch 44 (see Fig. 1). Switch 44 is conventional and controls an electric circuit to the unit 28 to start and/or stop operation of the electric motor and consequently the multiple effect compressor 31 of the primary refrigerating system.

A closed secondary circuit containing a volatile liquid refrigerant is associated with the refrigerator cabinet 10 and comprises a refrigerant condensing portion 46 in the form of a conduit thermally contacting the upper evaporator 26 of the primary refrigerating system. Removable clamping means (not shown) may, if desired, be utilized for holding the condenser portion 46 of the secondary circuit in intimate thermal contact with the primary evaporator 26. A liquid feeding conduit 47 is connected with the condensing portion 46 of the secondary circuit and extends downwardly therefrom for feeding condensed liquid refrigerant to an evaporating portion 48 of the secondary circuit. The evaporator or evaporating portion 48 of the secondary circuit comprises a plurality of conduit loops secured to and extending over the outer surfaces of liner 12 so as to substantially traverse the top, back and side walls of the upper food compartment 16 of cabinet 10. A conduit having a goose-neck trap 49 formed therein connects the evaporating portion or loops 48 of the secondary circuit with the condenser 46 thereof as is customary in such systems to cause all liquid condensing in condenser 46 to drain directly into the feeding conduit 47. It will be noted that the greater portion of the secondary circuit is disposed below the level of the first or upper evaporator 26 of the primary refrigerating system and that the refrigerant evaporating portion 48 of the secondary circuit is located above the second or lower primary evaporator 27. Volatile refrigerant evaporating within the portions 48 of the secondary circuit cools the walls of the upper food storage compartment 16 of cabinet 10 and maintains the interior of this compartment at a temperature above freezing to thus minimize convection currents therein. The interior of compartment 16 is maintained between certain temperature limits in accordance with the normal temperature limits of the primary evaporator 27 by association of condenser 46 of the secondary refrigerant circuit with evaporator 26. When refrigerant is withdrawn from evaporator 27 by the multiple effect compressor 31, refrigerant is also withdrawn from evaporator 26 to render the evaporating portion of the secondary circuit effective to cool compartment 16. Refrigerant, after evaporating and flowing upwardly in the loops 48 of the secondary circuit enters the condenser 46 by way of trap 49. This evaporated refrigerant is condensed and liquefied by the refrigerating effect or low temperature of the upper primary evaporator 26 and the liquefied refrigerant then flows downwardly from condenser 46 by way of the liquid feeding conduit 47 to the lowermost evaporating loops 48. In a structure of the type disclosed, it is the purpose of partition 18 to divide the cabinet chamber into two compartments wherein the one or lower compartment 17 is maintained at a low or freezing temperature and low relative humidity in the manner described and wherein the other or upper compartment is maintained at a higher temperature and consequently high humidity for providing a two-temperature cabinet for the storage of various food products.

The multiple effect compressor 31 of the primary refrigerating system withdraws low pressure refrigerant, by way of conduit 33, from evaporator 27 and at the same time withdraws high pressure refrigerant, by way of the separate conduit 32, from the upper evaporator 26. The use of the multiple effect compressor in a system of the type disclosed provides for more efficient handling of the refrigerant of the primary system and provides quicker response of the secondary refrigerant circuit to cool the high temperature, high relative humidity compartment 16 and thereby maintains a more uniform temperature therein. As shown in Fig. 2, it will be noted that the low suction pressure port entering the compressor 31 from conduit 33 is disposed in close proximity to the compressor blade while the relatively higher suction pressure port entering the compressor from conduit 32 is disposed at an angle thereto as is customary in conventional multiple effect compressors. Thus, by providing the primary refrigerating system with separate gaseous refrigerant return conduits and by connecting these conduits with a multiple effect compressor, refrigerant is simultaneously withdrawn from the primary evaporators 26 and 27 to thereby render the secondary refrigerant

circuit more directly responsive to cooling produced by the primary refrigerating system.

In the present structure I have located the conduits 26, 32, 33, 36 and 38 of the primary refrigerating system in the front portion of cabinet 10 so as to provide for the removal of the primary refrigerating system as a unit outwardly from the front of the cabinet. For example, the conduits are disposed in the insulation 13 directly beneath the door opening breaker strips or walls 14 along a side and the top of the access opening to the cabinet chamber substantially in the manner shown and described in the McCormack et al. Patent No. 2,010,924 dated August 13, 1935. Thus, upon detachment of the chamber access opening walls 14 from the cabinet, access may be had to the conduits 26, 32, 33, 36 and 38 to withdraw these conduits through the space between the outer wall 11 and liner 12 so that they may be removed along with the evaporator 27 and unit 28 of the primary refrigerating system outwardly from the front of the cabinet. In removing the elements of the primary refrigerating system as a unit from cabinet 10, the electric wires intermediate switch 44 and unit 28 are disconnected to enable switch 44 to remain in the cabinet. Any damage or inoperativeness of the primary refrigerating system can readily be remedied by the removal thereof from the cabinet and the replacement into the cabinet of another unit or system as is customary in present-day installations.

From the foregoing it will be apparent that I have provided an improved and more efficient refrigerating apparatus of the household type wherein a secondary refrigerant circuit is associated with a removable primary refrigerating system including a multiple effect compressor in a novel manner so as to provide for the cooling of an upper food storage compartment to a higher temperature than the temperature of a lower compartment cooled by an evaporator of the primary system. This is accomplished by associating the condenser of a continuously open secondary circuit with an evaporator of a primary refrigerating system disposed above an evaporator thereof employed for cooling the lower of the compartments of the refrigerator cabinet and by simultaneously withdrawing refrigerant from both primary evaporators through separate conduit connections with a multiple effect compressor. The contact between the one primary evaporator and the condenser of the secondary circuit is predetermined to thereby insure the maintenance of a substantially constant temperature and high relative humidity within the higher-temperatured upper storage compartment of the cabinet.

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. A refrigerating apparatus comprising in combination, a cabinet having an upper food storage compartment and a lower food storage compartment therein, a closed primary refrigerating system including a first evaporator in the upper part of said cabinet and a second evaporator disposed in heat exchange relationship with said lower food compartment for cooling same, a closed secondary refrigerant circuit containing a volatile liquid and including a condensing portion in intimate heat exchange relationship with said first primary evaporator and an evaporating portion located therebelow and disposed in heat exchange relationship with said upper food compartment for cooling same, conduit means for conveying refrigerant from said first primary evaporator to said second primary evaporator, and said primary refrigerating system including a multiple effect compressor having separate conduit connections with each of said evaporators thereof for withdrawing refrigerant directly therefrom.

2. A refrigerating apparatus comprising in combination, a cabinet having an upper food storage compartment and a lower food storage compartment therein, a closed primary refrigerating system including a first evaporator in the upper part of said cabinet and a second evaporator disposed within said lower food compartment for cooling same, a closed secondary refrigerant circuit containing a volatile liquid and including a condensing portion in intimate heat exchange relationship with said first primary evaporator and an evaporating portion located therebelow and disposed in intimate thermal contact with walls of said upper compartment for cooling the interior thereof, conduit means for conveying refrigerant from said first primary evaporator to said second primary evaporator, and said primary refrigerating system including a multiple effect compressor having separate conduit connections with each of said evaporators thereof for withdrawing refrigerant directly therefrom.

3. A refrigerating apparatus comprising in combination, a cabinet having a plurality of walls forming a chamber therein, said chamber being provided with an access opening normally closed by a door, means cooperating with the inner face of said door and with the upright walls of said chamber for dividing the chamber into an upper food storage compartment and a lower food storage compartment, a closed primary refrigerating system including a first evaporator in the upper portion of said cabinet and a second evaporator disposed in heat exchange relationship with said lower food compartment for cooling same, a closed secondary refrigerant circuit containing a volatile liquid and including a condensing portion in intimate heat exchange relationship with said first primary evaporator and an evaporating portion located therebelow and disposed in heat exchange relationship with said upper food compartment for cooling same, conduit means for conveying refrigerant from said first primary evaporator to said second primary evaporator, and said primary refrigerating system including a multiple effect compressor having separate conduit connections with each of said evaporators thereof for withdrawing refrigerant directly therefrom.

4. A refrigerating apparatus comprising in combination, a cabinet having a plurality of walls forming a chamber therein, said chamber being provided with an excess opening normally closed by a door, removable means cooperating with the inner face of said door and with the upright walls of said chamber for dividing the chamber into an upper food storage compartment and a lower food storage compartment, a closed primary refrigerating system including a first evaporator in the upper portion of said cabinet and a second evaporator disposed within said lower food compartment for cooling same, a closed secondary refrigerant circuit containing a volatile liquid and including a condensing por-

tion in intimate heat exchange relationship with said first primary evaporator and an evaporating portion located therebelow and disposed in intimate thermal contact with walls of said upper compartment for cooling the interior thereof, conduit means for conveying refrigerant from said first primary evaporator to said second primary evaporator, and said primary refrigerating system including a multiple effect compressor having separate conduit connections with each of said evaporators thereof for withdrawing refrigerant directly therefrom.

5. A refrigerating apparatus comprising in combination, a cabinet having an upper food storage compartment and a lower food storage compartment therein, a closed primary refrigerating system including a first evaporator in the upper part of said cabinet and a second evaporator disposed in heat exchange relationship with said lower food compartment for cooling same, a closed secondary refrigerant circuit containing a volatile liquid and including a condensing portion in intimate heat exchange relationship with said first primary evaporator and an evaporating portion located therebelow and disposed in heat exchange relationship with said upper food compartment for cooling same, and said primary refrigerating system including a multiple effect compressor having separate conduit connections with each of said evaporators thereof for withdrawing refrigerant directly therefrom.

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