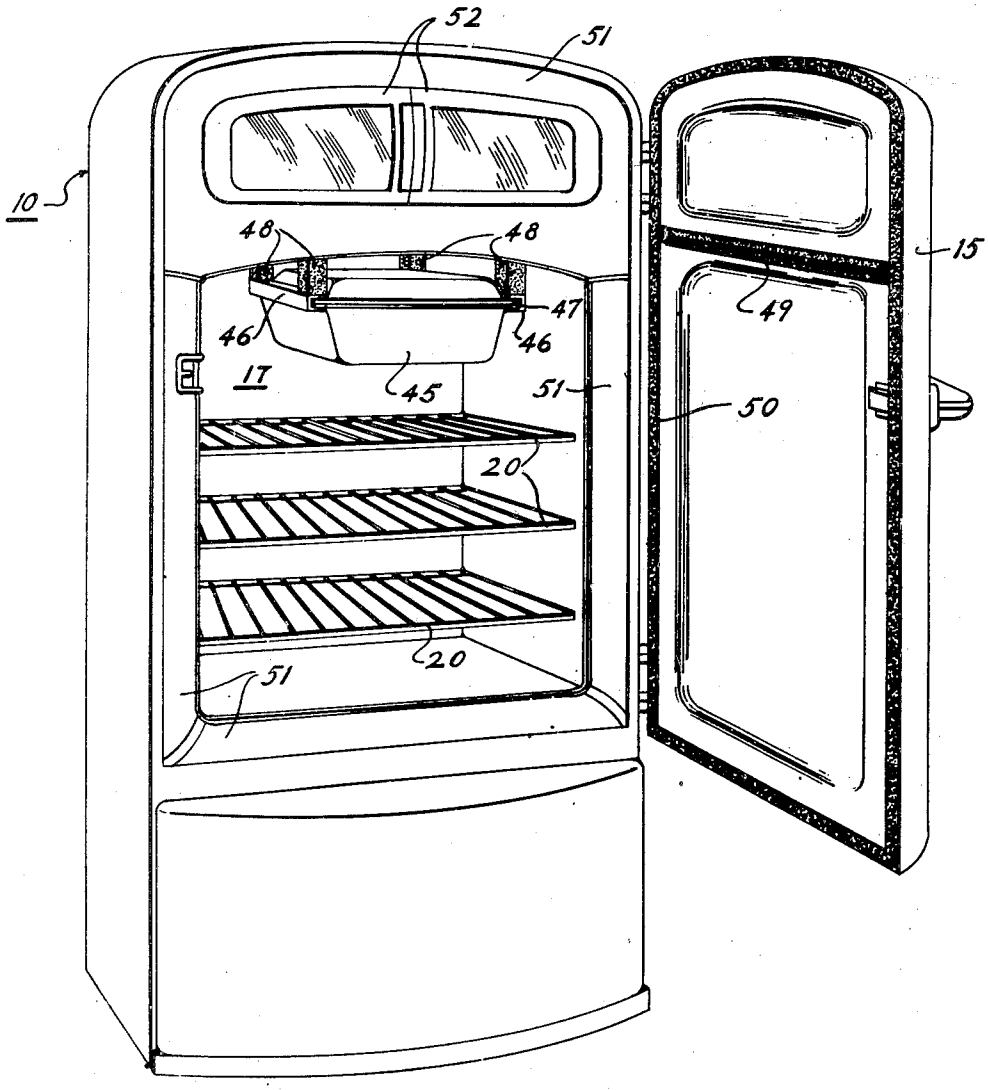
Aug. 2, 1949. M. G. SHOEMAKER 2,478,017

REFRIGERATOR HAVING MOISTURE CONTROL MEANS

Filed May 8, 1946 2 Sheets-Sheet 1

FIG. 1.



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Filed May 8, 1946 2 Sheets-Sheet 2

FIG. 2.

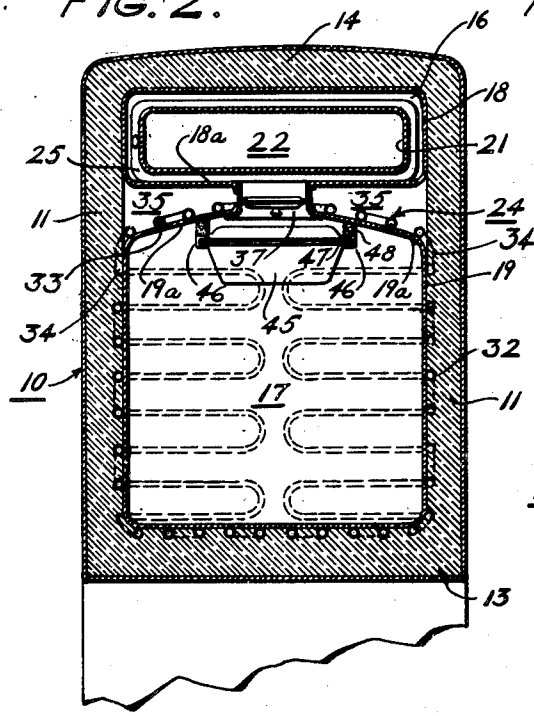


FIG. 3.

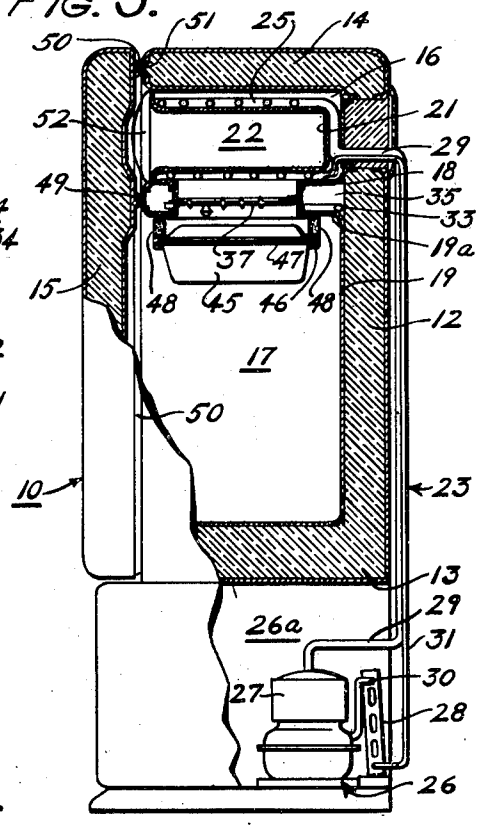
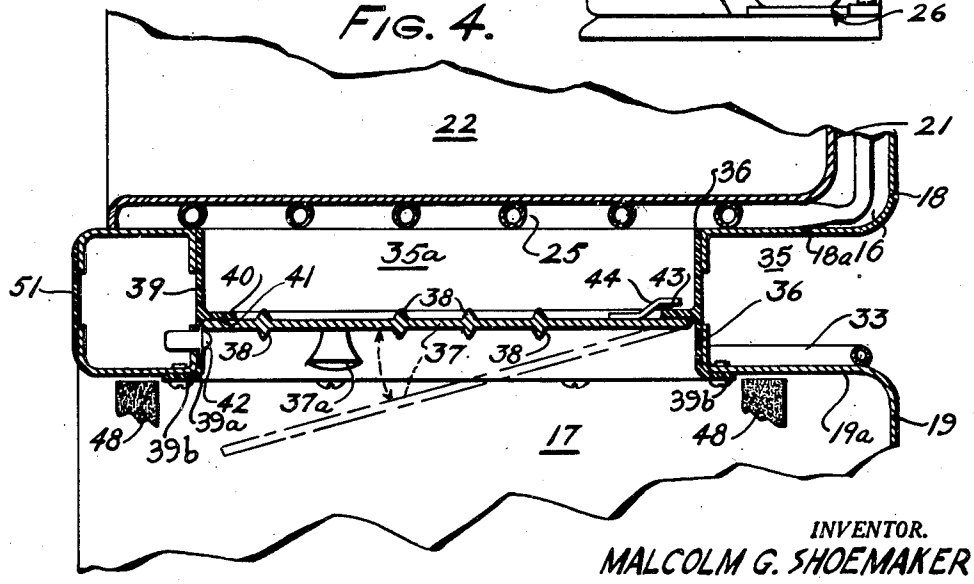


FIG. 4.



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UNITED STATES PATENT OFFICE

2,478,017

REFRIGERATOR HAVING MOISTURE CONTROL MEANS

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Application May 8, 1946, Serial No. 668,152

12 Claims. (Cl. 62—103)

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The present invention relates to refrigeration and, more particularly, to refrigerators of the type which includes a plurality of heat absorbing and rejecting systems, each associated with a separate compartment, the systems functioning to produce different and distinct cooling effects within their respectively associated compartments.

Specifically, the invention concerns improvements in the refrigerator cabinet construction. These improvements have to do with the provision of a compartment for enclosing an evaporator shell, arranged in heat-exchange relation with the heat absorbing section of a primary refrigerating system, to provide a low-temperature chamber; and with the provision of a lining member, arranged in heat-exchange relation with a secondary refrigerating system, to define a food-storage compartment isolated from the low-temperature chamber and maintained at relatively high refrigerating temperature and at relatively high humidity.

It is, therefore, the primary object of the invention, to provide a novel disposition of and relation between the compartments, and a novel arrangement and association of the operatively related primary and secondary refrigerating systems utilized for cooling such compartments. To that end, the invention employs an inner liner provided with a secondary refrigerating system having its heat rejecting section arranged in intimate heat-exchange relation with one wall of said liner, and having its heat absorbing section arranged in intimate heat-exchange relation with one or more of the remaining walls of said liner. This liner, with its secondary refrigerating system, is mountable in the refrigerator cabinet wherein provision is made for the mounting of a low-temperature chamber. The liner is so constructed and disposed in the cabinet that the wall associated with the heat rejecting section of the secondary system, lies adjacent the low-temperature chamber to be directly cooled thereby. This characteristic feature of the invention does away with the necessity of providing mechanical connections between the primary and the secondary systems, so that the liner and its secondary system may be mounted in the refrigerator cabinet to provide an efficient moist-cold compartment therein regardless of the type, shape or design of the primary evaporator used to maintain the aforementioned chamber within the desired low temperature-range. Furthermore, because of the absence of any positive connection between the primary and

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the secondary systems, the liner and secondary system may be readily installed and removed, as a unit, without interfering with or without interference by the primary system.

It is also an object of the invention to provide a refrigerator of the general type specified above, with simplified means effective to cause excessive humidity in the moist-cold compartment to accumulate at one place within the said compartment, where such accumulation may be readily removed, at any time, without necessitating abnormal stoppage of the refrigerating apparatus.

Another and more specific object of the invention resides in providing a refrigerator with two compartments adapted to be maintained at different conditions of temperature and humidity, such as a freezing compartment and a moist-cold compartment; and in providing the liner of the moist-cold compartment with a section or area which is to be cooled to a greater extent than the remainder of said liner. In this manner, a food receptacle, such as a meat keeper, may be conveniently installed in the moist-cold compartment adjacent the colder section or area of the liner to be effectively maintained thereby at refrigerating conditions different from those prevailing in the moist-cold compartment itself.

These and other objects will be apparent from the following description based upon the accompanying drawings which show a preferred embodiment of the present invention.

In these drawings:

Figure 1 is a perspective view illustrating the general appearance of a refrigerator embodying the features of the invention;

Figure 2 is a front vertical view showing, on a reduced scale, and partly in elevation and partly in cross-section, the refrigerator illustrated in Figure 1;

Figure 3 is a side vertical view partly in elevation and partly in cross-section of the refrigerator as shown in Figure 2; and,

Figure 4 is an enlarged detail view of parts shown in Figure 3.

Referring more particularly to the drawings, the refrigerator includes a cabinet, generally designated by the numeral 10, which is provided with the usual insulated walls (see Figures 2 and 3) comprising side walls 11, rear wall 12, bottom wall 13, and top wall 14. An insulated door 15 is mounted, in the customary manner, to close the open front of the insulated portion of the cabinet. As shown, this insulated por-

tion of the cabinet encloses two separate compartments 16 and 17, arranged in superposed relation so as to occupy separate vertical sections of said cabinet portion. As will clearly appear from Figures 2 and 3, the compartments 16 and 17 are defined, respectively, by individual inner liners 18 and 19. It is to be noted that, in accordance with the present invention and as particularly shown in Figure 2, the liners have corresponding wall portions, (that is the bottom wall 18a of liner 18 and the top wall 19a of liner 19), which are spaced from each other but disposed in substantially confronting relationship. The reason for this arrangement will become apparent as the description progresses.

The liner 18, which defines the upper compartment 16, is of a size and shape to extend fully across the width and depth of the insulated portion of the cabinet, and is such as to occupy but a relatively small section of the height of said portion. The liner member 19, which defines the lower compartment 17, is also of a size and shape to extend fully across the width and depth of the insulated portion of the cabinet but is such as to occupy most of the height of said portion, so that the major section of the cabinet is available for the storage of foods in said lower compartment. For that purpose, as shown in Figure 1, provision is made for mounting suitable shelves 20 in the compartment 17.

An evaporator shell 21 (Figures 2 and 3) which provides a chamber 22, is mounted within the upper compartment to occupy substantially the entire space afforded by such compartment. The chamber 22 and the lower compartment 17 are adapted to be maintained at different conditions of temperature and humidity. In the embodiment illustrated in the drawings, the chamber 22 is to be maintained at relatively low temperature, preferably at a temperature below freezing, so that a dry-cold condition will prevail in said chamber; while the lower compartment 17 is to be maintained at relatively high refrigerating temperature, preferably at a temperature well above freezing, so that a moist-cold condition will prevail throughout said compartment. For that purpose, the shell 21, defining the chamber 22, is associated with a primary refrigerating system generally indicated at 23 (Figure 3), and the liner 19, defining the storage compartment 17, is associated with a secondary refrigerating system generally indicated at 24 (Figure 2).

The primary system 23, as more clearly illustrated in Figure 3, basically comprises a heat absorbing section 25 and a heat rejecting section 26, the latter including a motor-compressor 27 and a condenser 28 which are mounted within a machinery compartment 26a provided outside the insulated portion of the cabinet. The heat absorbing section 25 consists of conduit means arranged, in any suitable known manner, for heat-exchange relation with the evaporator shell 21, so that the liquid refrigerant, as it evaporates in said section, may absorb heat from the air within the chamber 22 provided by said shell. The gas, which is formed in the heat absorbing section during the vaporization process, is drawn, through a suction line 29, into the motor-compressor 27. There, the gas is compressed and discharged, through a conduit 30, into the condenser 28 where the compressed refrigerant rejects its heat to the ambient air, and condenses back to liquid state. From the condenser, the liquid refrigerant flows to the heat absorbing section 25 through conduit means including a suitable flow restrictor, such as a capillary tube 31 which is preferably secured to the suction line 29 for intimate heat-exchange therewith, as is customary in the art.

According to the usual practice, the motor compressor is intermittently operated, and for that purpose, well known thermo-responsive means (not shown) may be associated, preferably, with the freezing compartment 22 in the manner common in the art. Such means act, in the customary way, to control the circuit of the motor-compressor in response to predetermined variations in temperature within the freezing compartment, so that said compartment may be maintained within that range of temperature which is most effective for the storage of frozen foods.

The secondary system 24, as more clearly illustrated in Figure 2, includes a heat absorbing section or evaporator 32 and a heat rejecting section or condenser 33. The sections are interconnected by means of conduit legs 34 which, in practice, are continuations of the mentioned sections to form a continuous circuit. The secondary evaporator 32, as shown particularly in Figure 2, comprises a serpentine conduit arranged in heat-exchange relation with the liner 19, preferably with the bottom, back and side walls thereof to provide a sinuous passage along said walls. The secondary condenser 33 is likewise preferably formed to provide a sinuous passageway disposed substantially in the plane of the top wall 19a of said liner.

In accordance with the present invention, the secondary condenser is arranged in intimate heat-exchange relation with said top wall 19a, which also, in accordance with the invention, is adapted to lie beneath and adjacent the low-temperature or freezing chamber so as to be effectively and directly subjected to its cooling effects. It will be noted, particularly from Figure 2, that the bottom 18a of liner 18 and the top 19a of liner 19 are so disposed that a dead-air space 35 is provided therebetween. The air in said space normally provides sufficient insulation, between the low-temperature primary evaporator and the secondary condenser, to prevent the secondary system from operating at too low a temperature. However, insulating material, in required quantity, may be placed within the space 35, if air alone is insufficient to accomplish the purpose stated above.

Vaporized refrigerant, in the secondary condenser, is condensed at the proper rate to supply an adequate amount of liquid refrigerant to the secondary evaporator for maintaining compartment 17 at the desired range of temperature and degree of humidity. The liquid refrigerant is delivered, by gravity, through one of the legs 34, for circulation through the secondary evaporator. The refrigerant, circulating through said evaporator, vaporizes and, in the process, absorbs heat from the air in the storage compartment 17, thereby cooling the same. Because the refrigerant, in circulating through the secondary evaporator, follows the sinuous passageway, which said evaporator provides along the sides, back and bottom of the liner 19, the entire storage compartment 17 is cooled to a substantially uniform refrigerating temperature, since all parts of the compartment are exposed to the heat absorbing effect of said evaporator. The heat laden gas, which is formed in the secondary evaporator by the heat absorption process, seeks the low pressure, coldest spot in the system, and thus rises

in the other of said conduit legs 34, until such gas enters the secondary condenser where it re-condenses prior to re-circulation through the secondary evaporator.

In further accordance with the present invention and as will clearly appear from Figure 2, the top wall 19a of the liner 19 is provided with two surfaces which slope downwardly and in opposite directions toward the sides of said liner, and the secondary condenser is so arranged that one portion lies over one of said surfaces and another portion lies over the other of said surfaces. This arrangement facilitates the circulation of refrigerant through the system and, particularly, assures delivery of the liquid refrigerant, by gravity, from the secondary condenser to the secondary evaporator.

As clearly seen in Figures 2, 3 and 4, means are provided whereby an area on one surface of the liner 19 may be effectively cooled to a greater extent than any other place in the storage compartment 17. Excessive moisture in said compartment will tend to migrate toward such colder area and become frosted on said surface. This, in accordance with the invention and as more clearly shown in Figure 4, is conveniently accomplished by providing means defining a space or passageway 35a communicating with the superposed compartments through vertically aligned openings 36, one located in the bottom wall 18a of the upper liner 18 and one in the top wall 19a of the lower liner 19, and by providing a metallic plate 37 adapted to extend across the space or passageway 35a. Thus, the plate 37 is subjected directly to the cooling effects of the primary evaporator, and is thereby maintained at a temperature much lower than that of the surrounding liner-wall portions. The plate 37 may be provided with ridges 38 to increase its effective heat-transfer surface, and to provide means to which the frosted moisture may cling.

As will more clearly appear from Figure 4, the provision of the space or passageway 35a and the mounting of plate 37 is readily accomplished by positioning a collar 39, of plastic or other suitable insulating material, to extend between the registering openings 36. The collar 39 has an outside flange 39a adapted to be secured to top wall 19a of liner 19 by means of suitable elements 39b so as to retain said collar in position. The collar also has an inside flange 40 adapted to provide a surface 41 against which the marginal portion of plate 37 may abut, thus preventing communication between the freezing-chamber compartment 16 and the food-storage compartment 17. The plate is effectively retained in operative position (shown in full lines, in Figure 4) by means of a spring detent 42 disposed to project inwardly of the collar 39 for engagement with the underside of said plate, and by means of a spring element 43 carried by a finger 44 on the upper side of the plate and adapted for overlapping engagement with the top side of the flange 40. This construction not only insures proper positioning of the plate 37 but also provides for easy removal of the plate, as shown in dotted lines in Figure 4, whenever it becomes desirable to clean said plate of frosted moisture. In this manner frost may be readily removed without going through the usual defrosting process, which requires stoppage of the refrigerating apparatus for rather long periods of time. A handle or knob 37a is provided to facilitate handling the plate 37 in moving the same into or out of its position.

The presence of the cold area provided by the plate 37 further makes it possible to provide adequate refrigeration within a container for such foods as meats which, normally, would not be properly preserved in the moist-cold storage compartment 17. Therefore, in accordance with the present invention, a meat-keeper 45 is supported immediately below the plate 37. For that purpose and as shown in the drawings, rails 46 are provided, and disposed for engagement with a rim 47 formed about the meat-keeper. These rails are conveniently suspended from the top of the liner 19, and are preferably insulated from the latter by means of rubber spacers 48, or the like.

In order to assure complete isolation of the food-storage compartment 17 from the freezing-chamber compartment 16 when the cabinet door is closed, a gasket strip 49 is provided to seal the space between said door and the leading edge of the structure which defines the separation between said compartments. Of course, the usual gasket 50 is provided to seal the adjacent marginal surfaces of the cabinet and door. Likewise, the usual breaker-strip members 51 are arranged between the outer shell and inner liners of the cabinet. The breaker member surrounding the front edges of the upper compartment is preferably made in one piece. This unitary member may be constructed and mounted in a manner similar to that described in the Dailey Patent No. 2,301,020, issued November 3, 1942. Doors 52 are also provided, to close the chamber 22 for the purpose of preventing spillage of cold air from said chamber when the refrigerator main door is open. These doors 52 may be arranged on the unitary breaker-member in the manner also disclosed in the patent aforesaid.

From the foregoing description, it will be appreciated that a refrigerator, constructed in accordance with the invention, has many advantageous features not only from the standpoint of usefulness but also from the standpoint of manufacture. For instance, by reason of the particular construction and association of the structural parts of the refrigerator, these parts may be conveniently fabricated in major units which may then be readily assembled to complete the product. Particularly, because the liner (which is adapted to define the main storage compartment) and the secondary refrigerating system (which is adapted to maintain such compartment at a relatively high refrigerating temperature) form a unitary structure which needs no connection with the primary refrigerating system, such unitary structure may be readily mounted in or removed from the cabinet without disturbing such primary system. As hereinbefore pointed out, the operation of the secondary refrigerating system, in accordance with the invention, depends upon the cooling of a wall portion of a liner mounted separately of the low-temperature compartment. This makes it possible for a manufacturer to adopt a uniform design for the secondary refrigerating system and to use this system in various cabinets having differently designed primary refrigerating systems. In other words, since the optimum operating efficiency of the secondary refrigerating system can be regulated by controlling the insulation effect within the space between the primary evaporator and the secondary condenser, the same secondary system may be used interchangeably with a primary system designed to operate at exceedingly low temperatures or with a pri-

mary system designed to operate at comparatively high temperatures. This characteristic feature of the invention results in appreciable economy in the production and in the maintenance of a manufacturer's full line of refrigerators.

While a preferred embodiment of the invention has been particularly shown and described, it is to be understood that the invention is not limited to such embodiment, but is subject only to such limitations as are imposed by the prior art or are specifically set forth in the appended claims.

I claim:

1. In a refrigerator a cabinet having an insulated portion and enclosing a pair of compartments each occupying a different section of said cabinet portion, cold-producing means in heat-exchange relation with one compartment to maintain a substantially dry-cold condition therein, a refrigerating system associated with the other compartment to maintain a substantially moist-cold condition therein, adjacent walls of the compartments having means providing a space communicating with both compartments, and a plate disposed in said space and serving to prevent communication between the compartments, said plate being exposed directly to the cooling effects of said cold-producing means to be thereby cooled to a greater extent than any other portion of the moist-cold compartment.

2. In a refrigerator a cabinet having an insulated portion and enclosing a pair of compartments each occupying a different section of said cabinet portion, cold-producing means in heat-exchange relation with one compartment to maintain a substantially dry-cold condition therein, a refrigerating system associated with the other compartment to maintain a substantially moist-cold condition therein, adjacent walls of the compartments having means providing a space communicating with both compartments, a plate disposed in said space and normally serving to prevent communication between the compartments, said plate being exposed directly to the cooling effects of said cold-producing means to be thereby cooled to a greater extent than any other portion of the moist-cold compartment, and means detachably supporting said plate in position within said space.

3. In a refrigerator, a cabinet having an insulated portion and enclosing a pair of compartments, each occupying a different section of said cabinet portion, cold-producing means in heat-exchange relation with one compartment to maintain a substantially dry-cold condition therein, a refrigerating system associated with the other compartment to maintain a substantially moist-cold condition therein, means opening in one wall of the dry-cold compartment and in one wall of the moist-cold compartment and providing a passageway between said compartments, a member normally serving to close said passageway and exposed directly to said cold-producing means to be thereby cooled to a greater extent than any part of the moist-cold compartment, and bracket means on said one wall of the moist-cold compartment to support a food receptacle adjacent said member to be cooled thereby.

4. In a refrigerator a cabinet having an insulated portion and enclosing a pair of compartments each occupying a different section of said cabinet portion, cold-producing means in one compartment to maintain a substantially dry-cold condition therein, a secondary refrigerating system associated with the other compartment to maintain a substantially moist-cold condition therein, adjacent walls of the compartments having means providing a space communicating with both compartments, a plate disposed in said space and serving to prevent communication between the compartments, said plate being exposed directly to the cooling effects of the cold-producing means in the dry-cold compartment to be thereby cooled to a greater extent than any other portion of the moist-cold compartment, and bracket means on the mentioned wall of the moist-cold compartment to support a food receptacle adjacent the said plate to be cooled thereby.

5. In a refrigerator a cabinet having an insulated portion and enclosing a pair of compartments each occupying a different section of said cabinet portion, cold-producing means in one compartment to maintain a substantially dry-cold condition therein, a secondary refrigerating system associated with the other compartment to maintain a substantially moist-cold condition therein, adjacent walls of the compartments having means providing a space communicating with both compartments, a plate disposed in said space and normally serving to prevent communication between the compartments, said plate being exposed directly to the cooling effects of the cold-producing means in the dry-cold compartment to be thereby cooled to a greater extent than any other portion of the moist-cold compartment, means detachably supporting said plate in position within said space, and bracket means on the mentioned wall of the moist-cold compartment to support a food receptacle adjacent the said plate to be cooled thereby.

6. For refrigerators in which provision is made to mount a moist-cold compartment, an inner liner defining such a compartment and comprising compartment-defining walls including a top wall and two side walls, a secondary refrigerating system including a condenser section associated with said top wall for heat exchange relation therewith and an evaporator section arranged in intimate heat-exchange relation with other walls of the liner including said side wall, said top wall having an opening and two surfaces sloping downwardly and in opposite directions from said opening toward said side walls, and said condenser section having two portions, one of said portions being in heat-exchange relation with one of said surfaces, and the other of said portions being in heat-exchange relation with the other of said surfaces.

7. For refrigerators in which provision is made for the mounting of a moist-cold compartment, a liner defining such a compartment and comprising compartment-defining walls, a secondary refrigerating system including a condenser section in heat-exchange relation with one of said walls and an evaporator section in heat exchange relation with the remainder of said walls, said one wall having opening outlining-means extending therefrom, and a plate supported in the opening and normally serving to seal the same.

8. For refrigerators in which provision is made for the mounting of a moist-cold compartment, a liner defining such a compartment and comprising compartment-defining walls, a secondary refrigerating system including a condenser section in heat-exchange relation with one of said walls and an evaporator section in heat exchange relation with the remainder of said walls, said one wall having opening outlining-means extending beyond said one wall, a plate positionable in the opening to seal the same, and means for de-

tachably supporting said plate in position within the opening.

9. For refrigerators in which provision is made for the mounting of a moist-cold compartment, a liner defining such a compartment and comprising compartment defining walls, a secondary refrigerating system including a condenser section in heat exchange relation with one of said walls and an evaporator section in heat exchange relation with the remainder of said walls, said one wall having opening outlining-means extending therefrom, a plate positionable in said opening to seal the same, means for detachably supporting said plate in position within the opening, and bracket means on said one wall to support a food receptacle in confronting relation with said plate.

10. In a refrigerator, a cabinet having an insulated portion, a first compartment in one section of said cabinet portion, a second compartment in another section of said cabinet portion, cold-producing means arranged in heat-exchange relation with one of said compartments and adapted to maintain said one compartment at freezing temperatures to produce a substantially dry-cold condition therein, other cold-producing means arranged in heat-exchange relation with the other of said compartments and adapted to maintain said other compartment at non-freezing temperatures to produce a substantially moist-cold condition therein, structure providing a walled space in communication with said compartments, a moisture-collecting removable member, and means between said structure and member to support the latter within and across said walled space, said member when so supported serving to prevent communication between the compartments and being exposed to the cooling effect of the first-mentioned cold-producing means to be thereby cooled to a greater extent than any part of the moist-cold compartment.

11. In a refrigerator, an upper compartment and a lower compartment, the bottom wall of said upper compartment and the top wall of said lower compartment being disposed in relatively-spaced substantially confronting relationship, cold-producing means arranged in heat-exchange relation with said upper compartment and effective to maintain the same at freezing temperatures to produce a substantially dry-cold condition therein, other cold-producing means arranged in heat-exchange relation with the lower compartment and effective to maintain the same at non-freezing temperatures to produce a substantially moist-cold condition therein, said walls of the compartments having means providing a space communicating with both compartments, and a moisture-collecting member interposed in said space and normally serving to prevent communication between the compartments, said member being exposed to the cooling effect of the first-mentioned cold-producing means to be thereby cooled to a greater extent than any part of the moist-cold compartment.

12. In a refrigerator, an upper compartment and a lower compartment, the bottom wall of said upper compartment and the top wall of said lower compartment being disposed in relatively-spaced substantially confronting relationship, a primary refrigerating system including an evaporator arranged in heat-exchange relation with said upper compartment and effective to maintain the same at freezing temperatures to produce a substantially dry-cold condition therein, a secondary refrigerating system including an evaporator arranged in heat-exchange relation with the lower compartment and effective to maintain the same at non-freezing temperatures to produce a substantially moist-cold condition therein, said walls of the compartments having means providing a space communicating with both compartments, and a moisture-collecting member interposed in said space and normally serving to prevent communication between the compartments, said member being exposed to the cooling effects of the first-mentioned cold-producing means to be thereby cooled to a greater extent than any part of the moist-cold compartment.

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