

April 24, 1945.

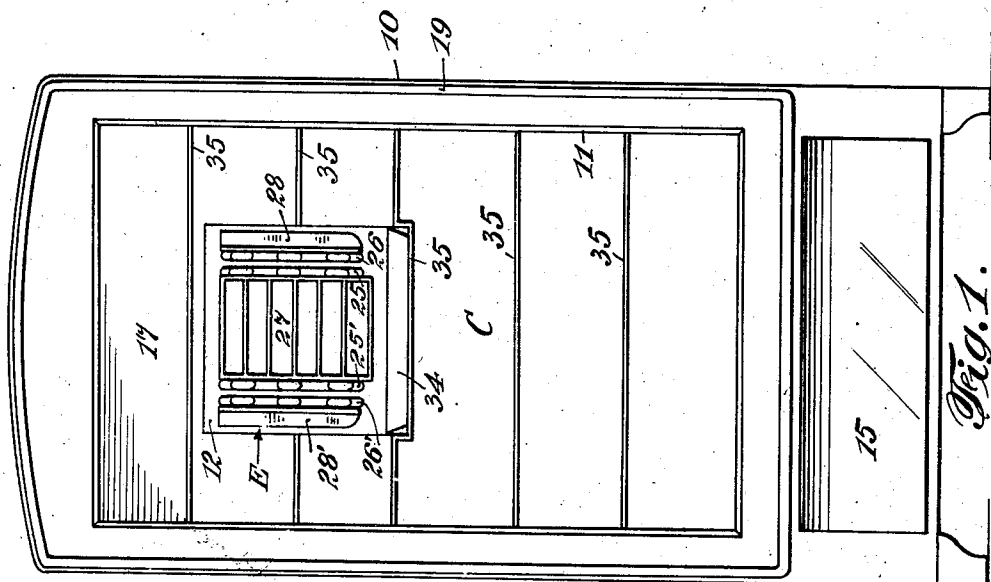
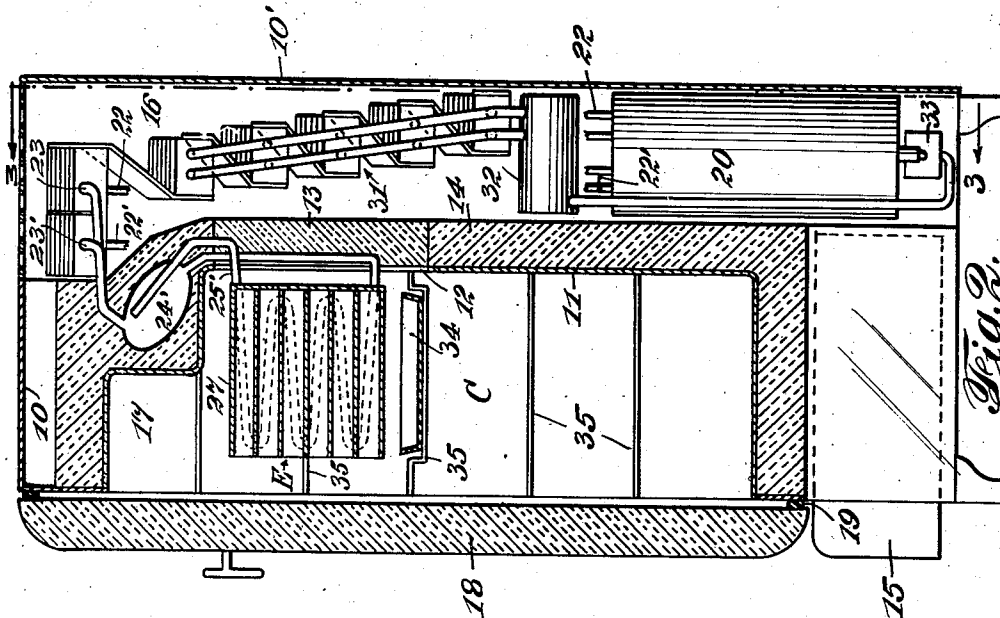
N. ERLAND AF KLEEN

2,374,185

REFRIGERATOR

Filed Nov. 13, 1941

4 Sheets-Sheet 1



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4 Sheets-Sheet 2

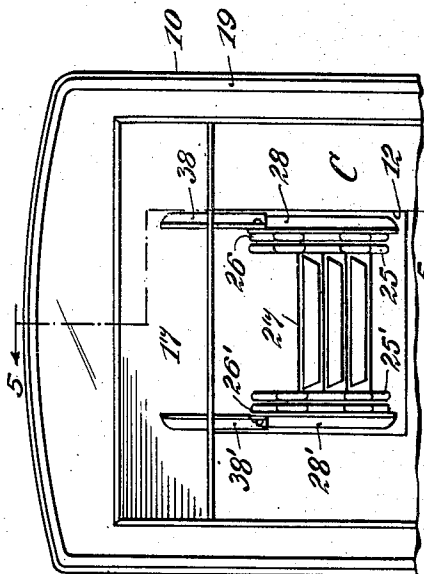


Fig. 4.

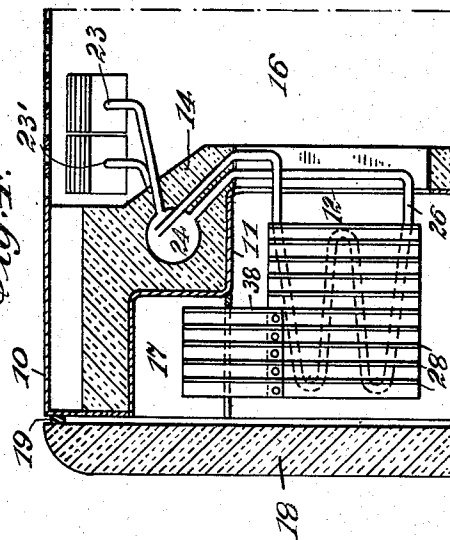


Fig. 5.

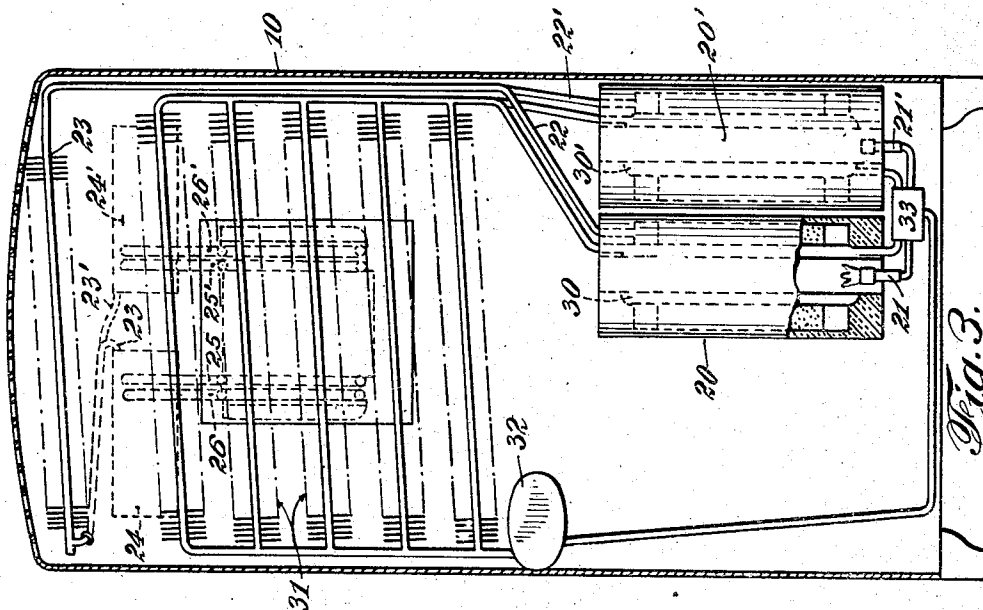


Fig. 3.

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4 Sheets-Sheet 3

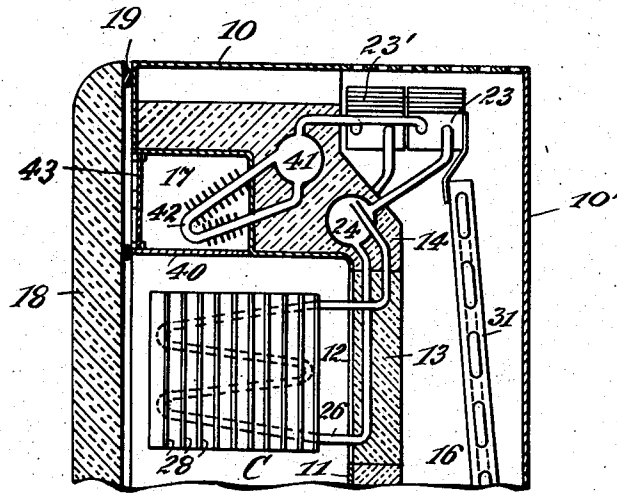


Fig. 6.

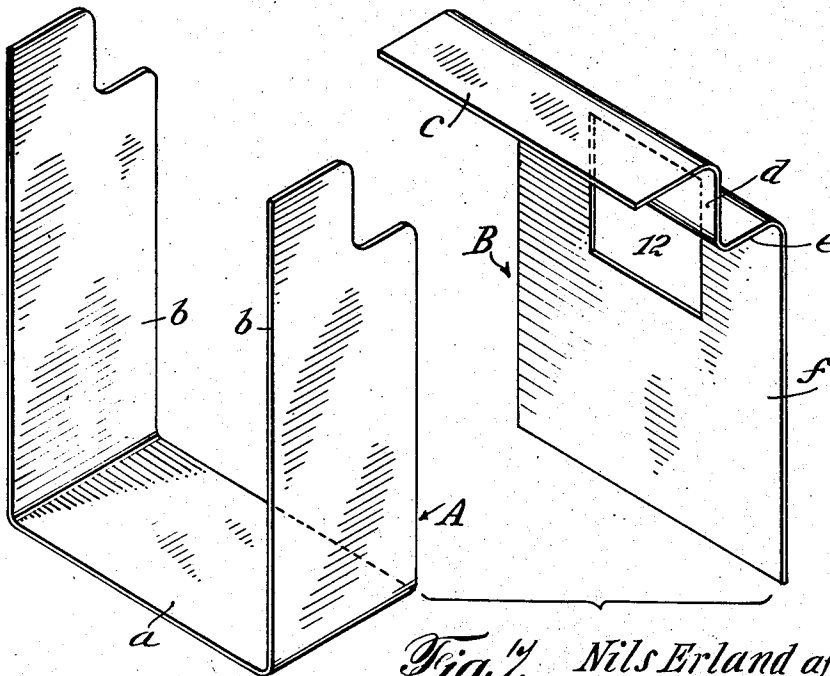


Fig. 7. BY *Nils Erland af Kleen*
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4 Sheets-Sheet 4

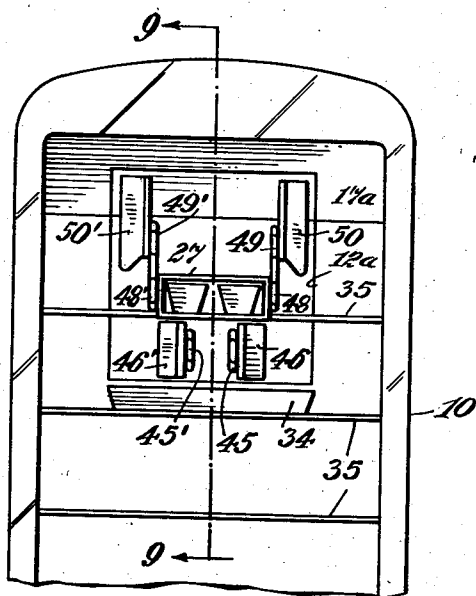


Fig. 8.

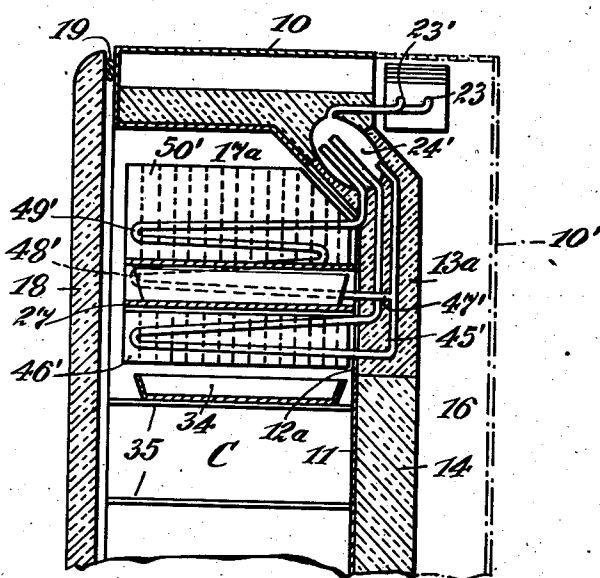


Fig. 9.

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UNITED STATES PATENT OFFICE

2,374,185

REFRIGERATOR

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3 Claims. (Cl. 62-118)

This invention relates to new and useful improvements in refrigerators and more particularly to the storage compartment thereof and the cooling means therefor and has for its primary object to provide an inwardly extending portion in at least one of the insulated walls of the storage compartment to accommodate the refrigerant storing means of the refrigeration apparatus to flow liquid refrigerant to the cooling means.

Another object of the invention is to provide the storage compartment of a refrigerator with an auxiliary storage space formed by the inner lining or shell of the cabinet, which auxiliary space is of less depth than the main compartment, whereby a recess is provided in back of the auxiliary storage space for the accommodation of the liquid refrigerant collecting tanks supplying refrigerant to the cooling means inside the storage compartment.

A further object of the invention is to provide a refrigerator with different storage zones of respectively different temperatures, in which zones the temperature is controlled at all times, and in certain or all of which zones a relatively high humidity is maintained by the intermittent defrosting of the cooling means.

With the above and other objects in view which will appear as the description proceeds, the invention resides in the novel features hereinafter more clearly set forth in the following description, illustrated by way of example in the accompanying drawings and more particularly pointed out in the appended claims.

Referring to the drawings, in which numerals of like character designate similar parts throughout the several views—

Fig. 1 is a view in front elevation of a refrigerator cabinet with the door removed to show the storage compartment thereof and one form of cooling means therefor;

Fig. 2 is a vertical sectional view through the center of the refrigerator cabinet of Fig. 1, but with the door in place and in closed position and showing the parts of the refrigerating apparatus in the back of the cabinet in side elevation looking from the right hand side of Fig. 1;

Fig. 3 is a vertical sectional view through the cabinet taken on line 3-3 of Fig. 2;

Fig. 4 is a fragmentary view in front elevation similar to Fig. 1, but wherein the upper storage space in the storage compartment is cooled by upwardly extending cooling fins from the main compartment cooling means;

Fig. 5 is a sectional view taken on line 5-5 of

Fig. 4, with the door in place and in closed position;

Fig. 6 is a sectional view similar to Fig. 5, but in which the upper storage space is separated from the main storage compartment and is cooled by separate cooling means from the same refrigerating apparatus;

Fig. 7 is an exploded detail perspective view of the inner lining for the storage compartment of the cabinet shown in Figs. 1 to 5;

Fig. 8 is an elevational view similar to Fig. 4, but showing a modified form of cooling means for the several storage zones, and

Fig. 9 is a sectional view taken on line 8-8 of Fig. 8 and showing the door in place and in closed position.

In the drawings, referring more particularly to Figs. 1, 2 and 3, the refrigerator cabinet illustrated consists generally of an outside shell 10 having an opening in the front wall thereof for access to a storage compartment C formed by an inner shell 11 open at its front end and provided with an opening 12 in the rear wall thereof adapted to be closed by a removable section 13 in the layer of insulation 14 surrounding the storage compartment. The insulated storage compartment C is spaced inwardly from the outer shell 10 to provide a storage bin 15 in the bottom of the cabinet and a vertical chamber 16 in the back of the cabinet for the refrigerating apparatus.

In order to facilitate installation of the refrigerating apparatus in the cabinet and removal therefrom, the rear wall 10' of the outer shell 10 is formed as a separate wall of the shell and is removably secured to the latter by any suitable means such as bolts, screws, and the like (not shown).

As clearly shown in Fig. 2, the rear wall of the inner shell 11 is provided with an inwardly bent portion adjacent its upper end, reducing the depth of the upper portion of the storage compartment C to form an auxiliary space 17 for the storage of certain comestibles requiring a different storage condition than in the main storage compartment C. The open front end of the inner shell 11 is adapted to be closed by an insulated door 18 which cooperates with a sealing gasket 19, shown in Fig. 1 on the front wall of the outer shell 10 but which may be secured to the inner face of the door, to seal the main storage compartment C and the auxiliary storage space 17 from the influence of outside temperatures.

Referring to Fig. 7, the inner shell 11 is made up of two separate parts, designated generally as A and B, the former consisting of a strip of sheet

metal or the like suitably bent to form a horizontal wall *a* which constitutes the bottom wall of the compartment C, and two vertical side walls *b* which make up the side walls of the compartment C and auxiliary storage space 17, while part B also consists of a strip of sheet metal suitably bent to provide a horizontal top wall *c* for the auxiliary storage space 17, a rear wall *d* therefor, and a horizontal wall *e* and a vertical rear wall *f* for the storage compartment C. Each of the side walls *b* of part A has a cutout portion adjacent its upper end to accommodate the right angular bent portion forming walls *d* and *e* in part B of the inner shell. Parts A and B may be secured together by any suitable means such as by welding their adjoining edges along a continuous line following the contour of part B.

The refrigerating apparatus employed to cool the cabinet consists of two intermittent absorption units arranged side by side in the apparatus chamber 16, but operable in alternate phase relation to each other to produce substantially continuous cold in the evaporator unit E. Inasmuch as the units are similar to one another, only the various parts of the unit shown at the left hand side in Fig. 3 will be described in detail by reference characters, the corresponding parts of the other unit being distinguished by the prime of the numeral.

As clearly shown in this figure, each unit includes an insulated boiler-absorber 20, of well-known construction, mounted in the lower portion of the apparatus chamber 16 and adapted to be heated for the generating periods by any suitable means such as a gas burner 21 or the like. The refrigerant vapors generated during the heating periods pass upwardly through conduit 22 to an air-cooled condenser 23 arranged in the upper part of the chamber 16 and the condensed refrigerant flows to a collecting tank 24 embedded in the insulation 14 and disposed in the recess formed by the bent portion of the rear wall of the inner shell 11 (Fig. 2). From the collecting tank, the refrigerant flows through separate cooling coils 25 and 26 connected at one end to the bottom of the tank and extending into the compartment C through the opening 12 in the rear wall of the inner shell 11 (Fig. 2), said coils being connected at their other end to the upper portion of the collecting tank. Cooling coil 25 is in thermal contact with one side of an ice-tray compartment 27 while cooling coil 26 is spaced from the compartment 27 and from coil 25 and is provided with cooling fins 28 for cooling the air in the storage compartment C.

For the absorbing period of operation of the unit, the burner 21 is shut off and the boiler-absorber 20 is cooled by any suitable means and the refrigerant evaporating in the coils 25 and 26 returns to the boiler-absorber 20. As an example of suitable cooling means for the boiler-absorber 20, I have shown a secondary cooling system for a secondary cooling medium, said system being formed by a plurality of interconnected elements including a boiler-absorber jacket 30, secondary condenser generally indicated as 31, and a collecting tank 32.

The circulation of the secondary cooling medium through the secondary system of the respective boiler-absorber jackets 30 and 30' is selectively controlled by the usual thermostat device illustrated diagrammatically in Figs. 2 and 3 and indicated as 33, which device also selectively controls the operation of the burners 21 and 21' in a well known manner to thereby automatically

shift the operation of the units from generating to absorbing and vice versa.

The apparatus chamber 16 is open at the top and bottom, and the primary and secondary condensers are so arranged with respect to each other in said chamber that each is cooled by a separate stream of air, as more fully described in my copending application, Ser. No. 405,575, filed August 6, 1941, covering Absorption refrigerating apparatus.

The operation of the refrigerating apparatus just described is believed obvious without further description, it being clear that when the boiler-absorber of one of the units is heated, for example, boiler-absorber 20, for the generating period of the left hand unit shown in Fig. 3, the boiler-absorber 20' is cooled by the secondary cooling medium circulating through the secondary cooling system, for the absorption period of the right hand unit. During the alternate operation of the units, a substantially unchanged low temperature is maintained in the ice-tray compartment 27 by the cooling coils 25 and 25' in thermal contact with the walls thereof, while the finned cooling coils 26 and 26' employed for cooling the storage compartment C alternately assume relatively high and relatively low temperatures in alternation, as more fully set forth in my copending application, Ser. No. 293,477, filed September 5, 1930, now Patent #2,319,806. Consequently, each of the finned cooling coils 26 and 26' will become coated with frost intermittently and will be alternately defrosted during the absorption and generating periods, respectively, of the corresponding units so that a relatively high humidity will be maintained in the storage compartment. The condensate formed on the finned cooling coils 26 and 26' as a result of the automatic defrosting during each cycle of operation of the units will drip into a collecting pan or tray 34 supported on one of the shelves 35, which tray may be removed and emptied whenever necessary.

Since the air cooled by the cooling coils of the evaporator unit E will descend in the main storage compartment C, the coolest temperature in the cabinet (about +4° C.) will be in the bottom of said compartment.

Between the bottom of the evaporator unit E and the lowest temperature zone, the temperature in the storage compartment will be approximately between 4° C. and 6° C. The temperature on opposite sides of the evaporator unit E will be between 6° C. and 8° C., while the highest temperature in the cabinet (between 8° C. and 12° C.) will be maintained in the auxiliary storage space 17.

There is thus provided a plurality of zones in the cabinet maintained at respectively different temperatures, and inasmuch as the cooling coils 26 and 26' are intermittently defrosted automatically during the operation of the refrigerating apparatus, a relatively high humidity is maintained in all of the different temperature zones for the proper storage of a wide variety of comestibles without the use of closed receptacles such as hydrators and the like heretofore required for storing foodstuffs in an atmosphere of high humidity. Furthermore, since the cooling coils 26 and 26' employed to cool down the cabinet are separate from those utilized for the ice-freezing compartment 27 of the evaporator unit, the temperatures in the different zones will not be affected to any material degree by any changes in the ice-freezing compartment 27, that is, the cabinet temperature will not be relatively

higher when water is placed in trays than when ice is present therein. In other words, there is provided by the present invention, a refrigerator having different cabinet temperatures that are controlled and in which a relatively high humidity is maintained during the operation of the refrigerating apparatus without the use of timing mechanisms, or means for controlling the flow of air in contact with the cooling surfaces, or other auxiliary devices to periodically defrost the cooling means.

If it is desired to have a slightly lower temperature in the auxiliary storage space 17 than that afforded by the cooling means of Figs. 1 to 3, an arrangement such as shown in Figs. 4 and 5 may be provided in which auxiliary fins 38 and 38' suitably secured to the cooling fins 28 and 28', respectively, project upwardly into the storage space 17 to cool the latter.

In certain instances, it may be desired to maintain in the auxiliary space 17 a very low temperature below that existing in the low temperature zone of the main storage compartment C. In this event, the arrangement shown in Fig. 6 may be provided in which the storage space 17 is separated from the main storage compartment C by a horizontal partition 40. In this form of the invention, each unit of the refrigerating apparatus has a collecting tank 41 delivering liquid refrigerant to a finned cooling coil 42 for cooling the auxiliary space 17, which tank and cooling coil are separate from the collecting tank and cooling coils heretofore described in connection with Figs. 1 to 5 for the main storage compartment C. In Fig. 6, the collecting tanks and cooling coils of only one of the units are shown, but it will be understood from the previous description that the alternately operating unit is provided with similar collecting tanks and cooling coils for the main storage compartment C and the auxiliary storage space 17.

By this arrangement, it is possible to maintain different temperature zones in the main storage arrangement C ranging from 4° C. at the bottom thereof to approximately 12° C. at the top thereof, in which zones a relatively high humidity is provided by the automatic defrosting of the finned cooling coils employed to cool this compartment, while a temperature as low as between -15° C. to -20° C. is maintained in the auxiliary space 17 by the finned cooling coils employed to cool the same. Although the finned cooling coil 42 of one unit is separate from the corresponding coil of the alternately operating unit, a dry cold will be produced in the auxiliary storage space 17 for the reason that at the low temperature maintained in said space, the finned cooling coils will not be automatically defrosted. Consequently the auxiliary storage space of the embodiment shown in Fig. 6 may be employed to store foodstuffs at temperatures considerably below freezing, and in order to reduce the influence of the outside room temperature upon the auxiliary storage space 17 in the event the door 18 of the cabinet is opened for access only to the main storage compartment C, the front open end of the auxiliary storage space may be closed by sliding doors 43 or the like of glass or any other suitable material.

Instead of having a plurality of separate cooling coils, one for the ice-freezing compartment and another for the main storage compartment of the cabinet and for the auxiliary storage space as heretofore described in connection with Figs. 1 to 5, or having still another cooling coil for

the auxiliary storage space as described in connection with Fig. 6, each unit of the refrigerating apparatus may be provided with only one main coil but having separate cooling portions to suit different temperature conditions. For example, as shown in Figs. 8 and 9, each unit has a main cooling coil 45 extending downwardly from the lower portion of the collecting tank 24 and inwardly into the main compartment C below the ice-freezing compartment 27 of the evaporator unit, said main coil having a returning portion extending upwardly and terminating adjacent the upper portion of the collecting tank 24. Cooling fins 46 may be provided on the main coil 45 to form cooling surfaces for the air in the main storage compartment C. A branch coil 47, connected at one end to the downwardly extending portion of the main coil 45 adjacent the lower end of the latter, has a cooling portion 48 in thermal contact with the wall structure of the ice-freezing compartment 27, and a separate cooling portion 49 provided with cooling fins 50 for cooling the air in the auxiliary space 17a which, in this instance, is shown as a modification in that instead of being formed by a right angular bent portion in the wall of the inner shell 11, the rear wall of the auxiliary storage space 17a is formed by a 45° angle bend in the rear wall of the inner shell so that said storage space gradually increases in depth from the top thereof to the upper portion of the main storage compartment C. Obviously, the auxiliary space 17 or 17a may have any other suitable shape depending upon the particular shape of the inner shell 11.

As in the previously described constructions, the rear wall of the inner shell 11 is provided with a suitably shaped opening 12a adapted to be closed by a removable section 13a in the insulation 14 to enable the cooling means of the refrigerating apparatus to be inserted in place and removed from the cabinet.

It will be seen that with the form of cooling means just described, a relatively low temperature (about 4° C. to 6° C.) is maintained in the auxiliary storage space 17a due to the large cooling surfaces afforded by the fins 50 and 50' on the cooling portions 48 and 49', respectively, of the alternately operating units. Moreover, since the aforementioned cooling surfaces are separate from one another and the finned coils 45 and 45' are also separate from one another, they will be intermittently defrosted during the operation of the refrigerating apparatus to provide a relatively high humidity in the different temperature zones of the cabinet.

From the above description of the different forms illustrated, it will be noted that by the present invention, the construction of a refrigerator for the storage of a wide variety of foodstuffs requiring different storage conditions, is greatly simplified; that no hydrators or other receptacles are necessary to keep the stored foodstuffs in an atmosphere of relatively high humidity, and that the temperatures in the different parts or zones of the storage space are always controlled.

It will also be observed that due to the particular construction of the inner shell 11, that is, with an inwardly bent portion in the rear wall thereof, a recess is provided in the back of the cabinet for the accommodation of the collecting vessels or tanks for the flow of liquid refrigerant to the cooling means.

From the foregoing it is believed that the construction and advantages of the present inven-

tion may be readily understood by those skilled in the art without further description, it being borne in mind that numerous changes may be made in the details disclosed without departing from the spirit of the invention as set out in the following claims.

What I claim is:

1. A refrigerator comprising a cabinet having thermally insulated top, bottom, rear and side walls forming a food storage compartment having an opening, a door closing said opening, said rear wall having an inwardly extending bent portion adjacent its upper end reducing the depth of the upper portion of said compartment and providing a recess at the back thereof, a partition dividing said compartment into a main storage space of predetermined depth and an auxiliary storage space of reduced depth, refrigeration apparatus including two separate cooling sections in said auxiliary storage space and cooling means in the upper portion of said main storage space, said cooling means including two separate cooling sections arranged in indirect thermal transfer relation with respect to each other for cooling the air in said main storage space, and separate refrigerant storing means in said recess to flow liquid refrigerant intermittently to one of each of said cooling sections in said auxiliary storage space and said main storage space, respectively, in phase relation to the other of each of said cooling sections in said auxiliary and main storage spaces.

2. A refrigerator comprising a cabinet having thermally insulated top, bottom, rear and side walls forming a food storage compartment having an opening, a door closing said opening, said rear wall having an inwardly extending bent portion adjacent its upper end reducing the depth of the upper portion of said compartment and providing a recess at the back thereof, refrigeration apparatus including two separate cooling circuits in said compartment and refrigerant storing means in said recess to flow liquid refrigerant intermittently to said circuits in phase relation to each other, each of said circuits having a first and a second cooling section for the series flow of the refrigerant, an ice-freezing chamber having heat-conducting walls thermally connecting the first cooling section of each of said circuits, finned

members on the second cooling section of each of said circuits extending partly into the upper reduced portion of said compartment and forming cooling surfaces for the air circulating in thermal transfer relation thereto, and separate branch conduits in fluid communication with each of said cooling circuits, respectively, each of said branch conduits having a cooling section arranged below said ice-freezing chamber to form separate cooling surfaces for the air in said compartment.

3. A refrigerator comprising a cabinet having thermally insulated top, bottom, rear and side walls forming a food storage compartment having an opening, a door closing said opening, said rear wall having an inwardly extending right angular bent portion adjacent its upper end providing an auxiliary storage space in the upper portion of said compartment of reduced depth and providing a corresponding recess in the back of said compartment, a horizontal partition wall across the bottom of said auxiliary storage space dividing said storage compartment into a main chamber of predetermined depth and an auxiliary chamber of reduced depth, means cooperating with said rear insulated wall to provide a flue space at the back of said storage compartment in open communication with room air, absorption type refrigeration apparatus including at least two intermittent units operating in phase relation to each other, each unit having a cooling section arranged to cool the air in said auxiliary chamber, a separate cooling section arranged to cool the air in said main chamber, refrigerant condensing means in the upper portion of said flue space, refrigerant generating means in the lower portion of said flue space connected to supply refrigerant vapor to said condensing means, and refrigerant storing means in said recess to flow liquid refrigerant intermittently to each of said cooling sections, whereby each of said chambers is cooled substantially continuously, the cooling sections in said main chamber being spaced from one another, whereby each of said cooling sections is coated with frost during its cold producing periods and is alternately defrosted to maintain a relatively high humidity in said main chamber.

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