

Aug. 31, 1943.

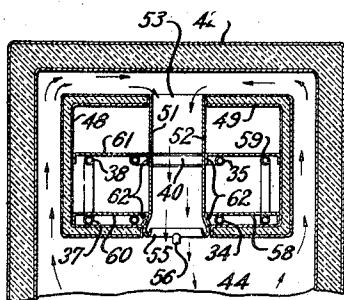
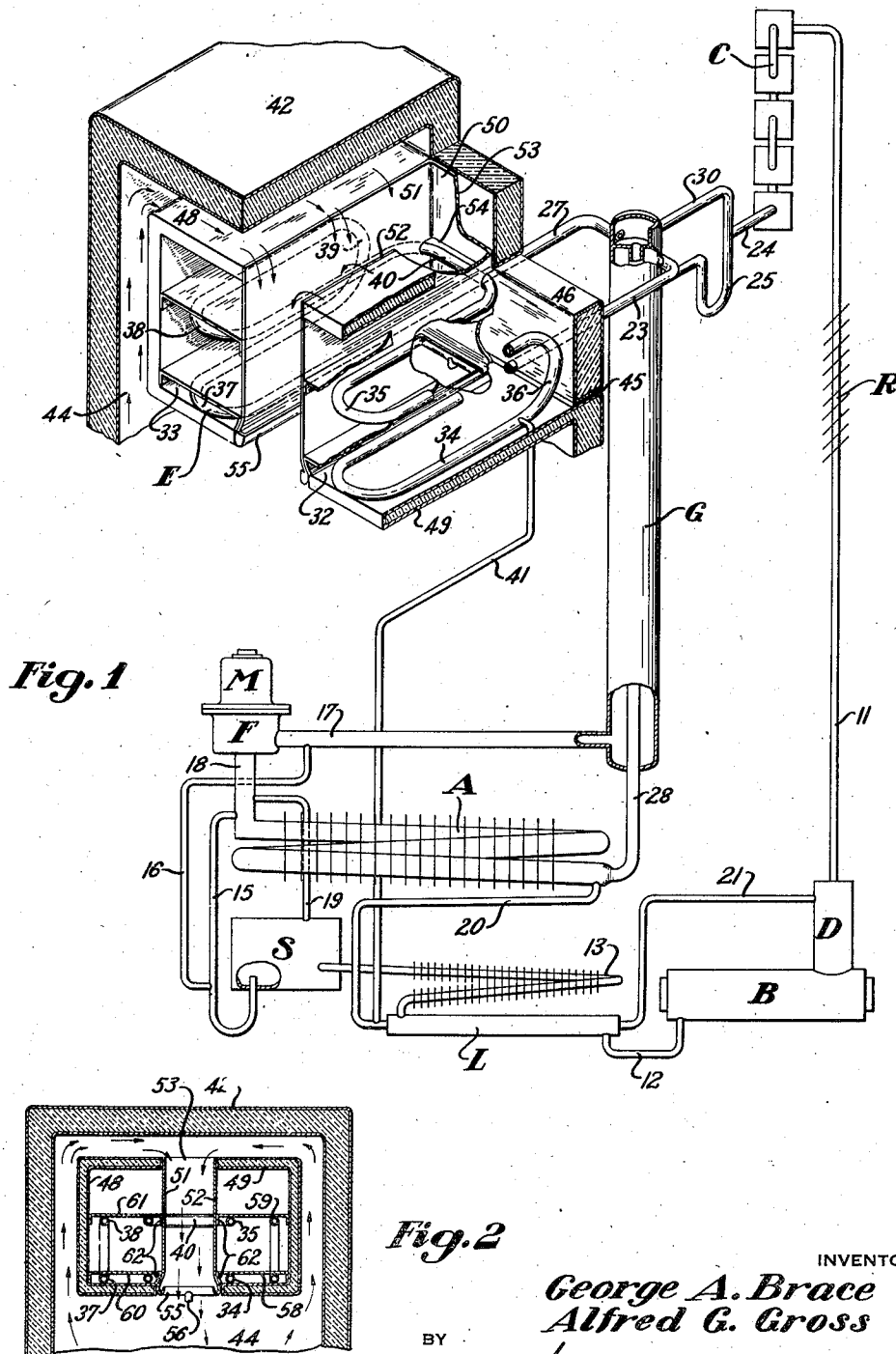
G. A. BRACE ET AL.

2,328,189

REFRIGERATION

Filed Sept. 16, 1939

4 Sheets-Sheet 1



INVENTOR

*George A. Brace &
Alfred G. Gross*

Alfred G. Gross

BY

Harry S. Dumas
ATTORNEY

ATTORNEY

Aug. 31, 1943.

G. A. BRACE ET AL

2,328,189

REFRIGERATION

Filed Sept. 16, 1939

4 Sheets-Sheet 2

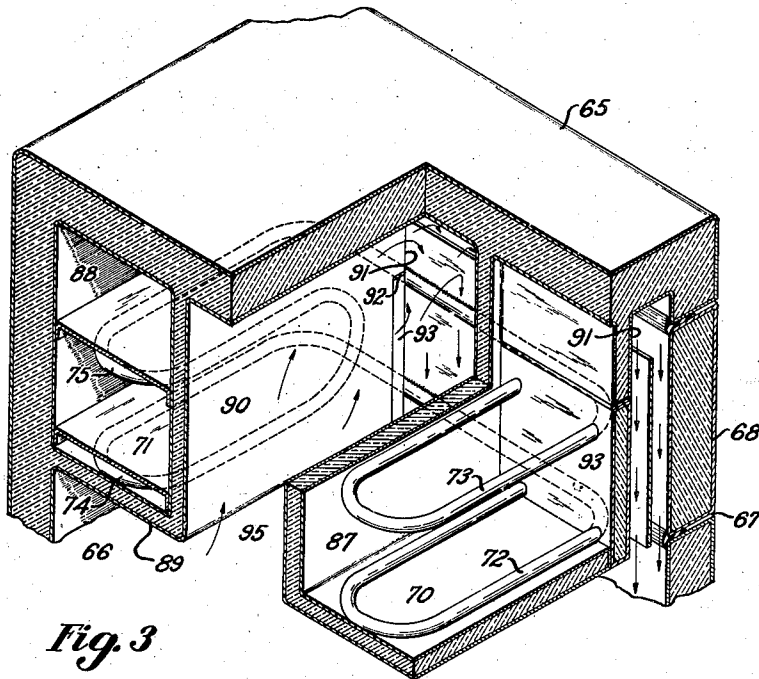


Fig. 3

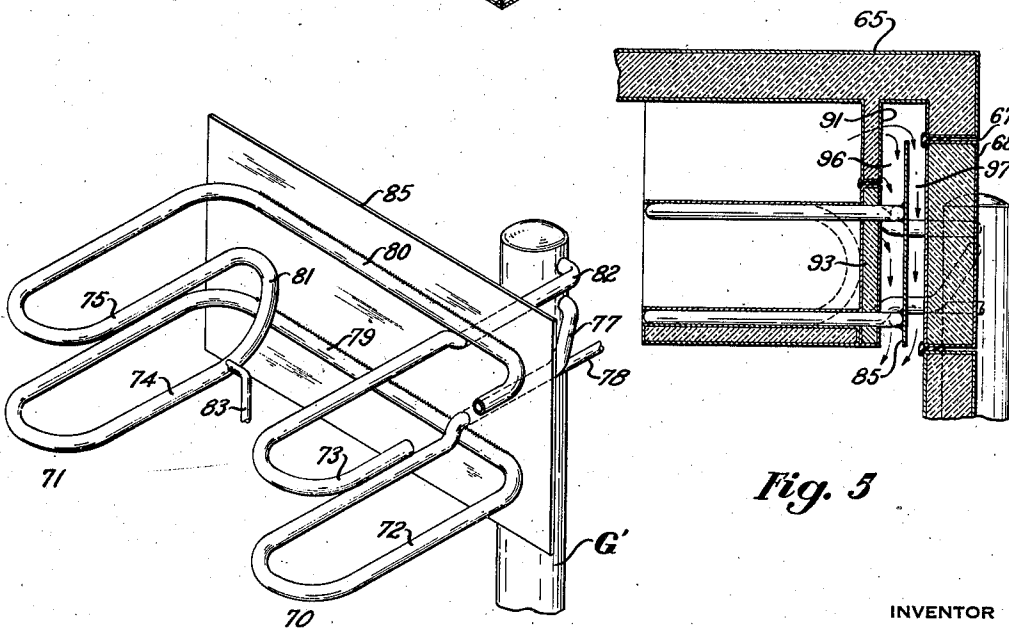


Fig. 4

Fig. 5

BY

INVENTOR
George A. Brace &
Alfred G. Gross
Harry S. Bunnell
ATTORNEY

Aug. 31, 1943.

G. A. BRACE ET AL

2,328,189

REFRIGERATION

Filed Sept. 16, 1939

4 Sheets-Sheet 3

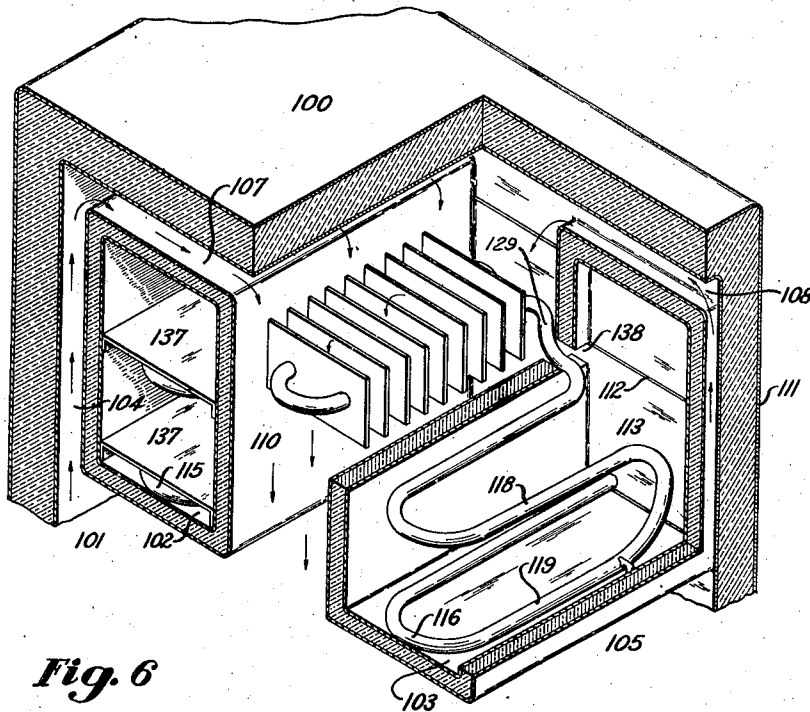


Fig. 6

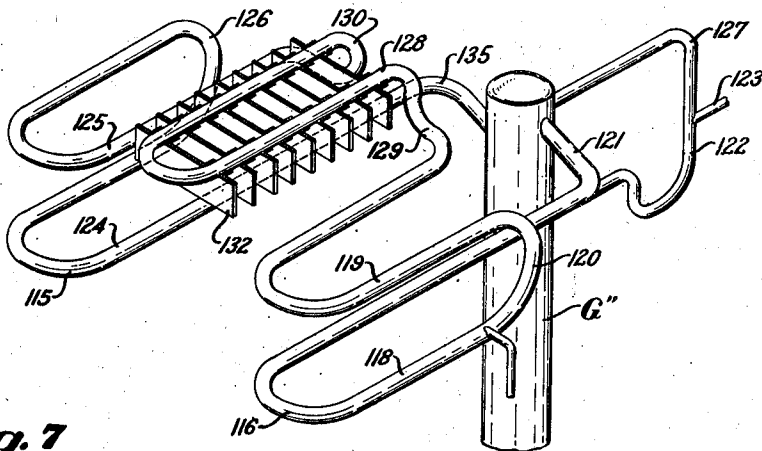


Fig. 7

BY

INVENTOR
George A. Brace &
Alfred G. Gross
Harry S. Dumas
ATTORNEY

Aug. 31, 1943.

G. A. BRACE ET AL

2,328,189

REFRIGERATION

Filed Sept. 16, 1939

4 Sheets-Sheet 4

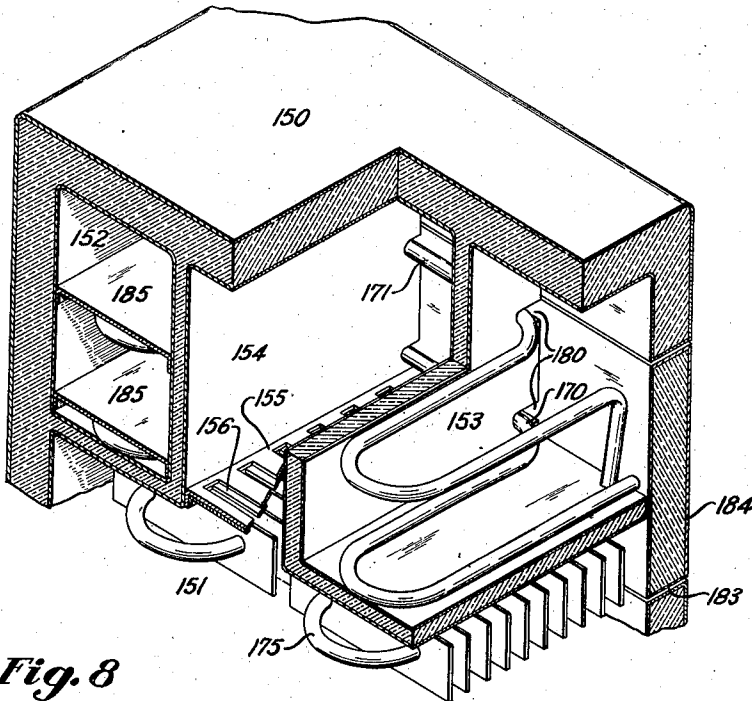


Fig. 8

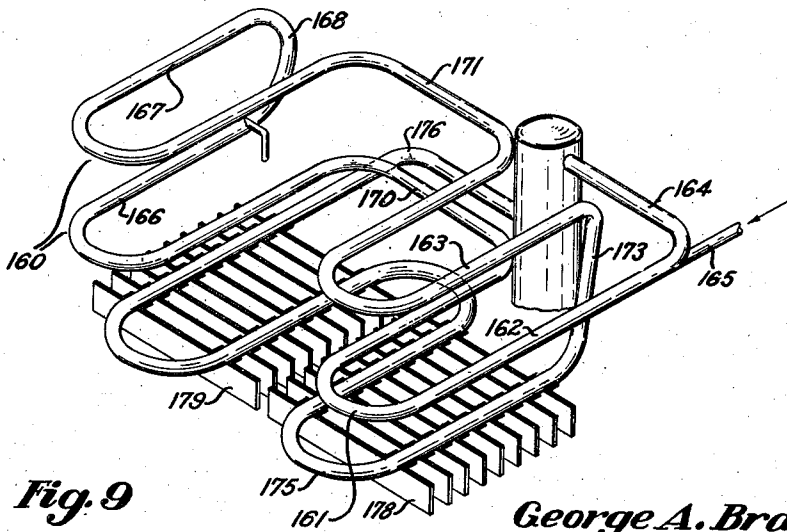


Fig. 9

INVENTOR

George A. Brace &
Alfred G. Cross

BY

Harry J. Duvarre
ATTORNEY

UNITED STATES PATENT OFFICE

2,328,189

REFRIGERATION

George A. Brace, Winnetka, and Alfred G. Gross,
Wilmette, Ill., assignors to The Hoover Com-
pany, North Canton, Ohio

Application September 16, 1939, Serial No. 295,230

24 Claims. (Cl. 62—99)

This invention relates to the art of refrigeration and more particularly to a novel construction of refrigerating apparatus and especially the evaporator thereof, permitting a highly efficient, usable and specially designed organization of the apparatus in a cabinet.

It is a principal object of the present invention to provide an evaporator and cabinet construction for a refrigerating apparatus in which the low temperature portions of the evaporator are effectively insulated from contact with the air in the food storage compartment and which indirectly refrigerates such air.

It is still another object of the present invention to provide a refrigerating apparatus in which the evaporator thereof is positioned in the upper portion of the cabinet and on opposite sides thereof to provide a central air-cooling and refrigerating chamber so constructed and arranged that a selected wall of the evaporator casing serves to carry the box-cooling load of the refrigerating apparatus.

It is another object of the present invention to provide a refrigerating apparatus in which the cooling elements are so constructed and arranged that a highly efficient air circulation is provided in the refrigerated compartment and in which the warmest air present in the refrigerated chamber is in contact with the exterior walls thereof.

It is still another object of the invention to provide a refrigerating apparatus provided with an evaporator having an insulated casing in which the evaporator casing is wholly, partly integral with, or entirely separable from the cabinet construction.

It is still another object of the present invention to provide various evaporator coil structures particularly designed for selected functions.

It is still a further object of the present invention to provide a refrigerating apparatus in which there is provided an insulated low temperature freezing chamber, a medium temperature storage chamber, and a relatively high temperature high humidity food storage chamber.

Other and further objects of the invention will become apparent as the description proceeds when taken in connection with the accompanying drawings in which—

Figure 1 is a diagrammatic representation of an absorption refrigerating system embodying the present invention including a fragmentary partial sectional perspective view of the cabinet construction.

Figure 2 is a partial sectional elevational view of the evaporator construction illustrated in Figure 1.

Figure 3 is a partial sectional perspective view of a modified cabinet construction.

Figure 4 is a perspective view of the evaporator structure utilized in the construction of Figure 3.

Figure 5 is a sectional side elevational view of the construction shown in Figure 3.

Figure 6 is a partial sectional perspective view of another form of the invention.

Figure 7 is a perspective view of the evaporator coil construction utilized in the apparatus disclosed in Figure 6.

Figure 8 is a partial sectional perspective view of still another form of the invention.

Figure 9 is a perspective view of the evaporator coil construction utilized in the invention disclosed in Figure 8.

Referring now to the drawings in detail and first to Figures 1 and 2 thereof, there is disclosed an absorption refrigerating system comprising a boiler B, an analyzer D, an air-cooled rectifier R, a tubular air-cooled condenser C, an evaporator E, a gas heat exchanger G, a liquid heat exchanger L, a solution reservoir S, an inclined tubular air-cooled absorber A, and a circulating fan F which is driven by an electrical motor M.

The above mentioned elements are connected by various conduits to form a plurality of gas and liquid circuits constituting a complete refrigerating system to which reference will be made in more detail hereinafter.

The above described refrigerating system will be charged with a suitable refrigerant, such as ammonia, a suitable solvent therefor, such as water, and an inert pressure equalizing medium, preferably a dense inert gas like nitrogen.

The boiler B may be heated in any suitable or desired manner as by an electrical cartridge heater or by a combustible fuel burner.

The application of heat to the boiler B and the energization of the circulating motor M will be controlled in any desired manner. A preferred construction is disclosed and claimed in the co-pending application of Curtis C. Coons, Serial No. 148,424, filed June 16, 1937.

The application of heat to the boiler B generates refrigerant vapor from the strong solution therein contained. The vapor so generated passes upwardly through the analyzer D in counterflow to strong solution flowing downwardly therethrough. The refrigerant vapor is then conveyed from the upper portion of the analyzer to the upper portion of the air-cooled condenser

C by means of the conduit 11 which includes the rectifier R.

The weak solution formed in the boiler by the generation of refrigerant vapor therefrom is conveyed from the boiler to the solution reservoir S by way of the conduit 12, the liquid heat exchanger L and a looped finned pre-cooling conduit 13. The lean solution thus supplied to the reservoir S is pumped therefrom into the upper portion of the absorber A by means of a gas lift pump conduit 15. Pumping gas is supplied to the conduit 15 below the liquid level normally maintained therein by means of the conduit 16 which is connected to the discharge conduit 17 of the circulating fan F. As will be noted from the drawings, the pump conduit 15 actually discharges into the suction conduit 18 of the circulating fan F which connects directly to the upper portion of the absorber A. The solution reservoir S is also vented to the conduit 18 by means of the conduit 19 whereby the pump conduit 15 effectively operates with the total pressure differential developed by the circulating fan F.

The lean solution thus supplied to the upper portion of the absorber A flows downwardly therethrough by gravity in counterflow relationship to a rich mixture of inert gas and refrigerant vapor which is supplied to the bottom portion of the absorber in a manner to be described more fully hereinafter. The contact between the rich gas and the absorbing solution in the absorber may be improved by including suitable obstructing and guiding devices in the interior of the absorber such as those disclosed in the co-pending application of William H. Kitto, Serial No. 206,143, filed May 5, 1938. In the absorber the absorption solution absorbs refrigerant vapor from the rich gas that is supplied thereto and the resulting heat of absorption is rejected to cooling air flowing over the exterior walls of the absorber conduits and the cooling fins mounted thereon.

The rich solution formed in the absorber thus drains to the bottom portion thereof from which point it is conveyed to the upper portion of the analyzer D by way of the conduit 20, the liquid heat exchanger L, and the conduit 21. This completes the absorption solution circuit.

The lean inert gas formed in the absorber by the absorption of refrigerant vapor therefrom is conveyed from the upper portion of the absorber to the suction inlet of the circulating fan F by means of the conduit 18. The lean gas is then placed under pressure by the circulating fan and is conveyed therefrom to the bottom portion of the evaporator E by way of the conduit 17, the gas heat exchanger G and the conduit 23.

The particular construction of the evaporator will be described more fully hereinafter. For the present it is sufficient to note that liquid refrigerant is discharged from the bottom portion of the condenser C through a conduit 24 which joins a U-shaped downwardly extended conduit 25 which in turn joins the gas inlet conduit 23. The inert gas travels through the evaporator with a velocity sufficient to sweep or drag the liquid refrigerant therethrough as it is evaporating to produce the refrigerating effect. The resulting rich gas formed in the evaporator is conveyed therefrom to the gas heat exchanger G by way of the conduit 27. After traversing the gas heat exchanger G the rich gas is then conducted by way of the conduit 28 to the bottom portion of the absorber A through which it flows upwardly in counterflow to the absorption solution in the

manner described heretofore, thus completing the inert gas circuit.

The evaporator per se comprises a pair of laterally spaced freezing sections 32 and 33.

The evaporator freezing section 32 comprises a pair of horizontal, parallel, vertically spaced and rearwardly facing U-shaped conduits 34 and 35 which are serially connected by a riser conduit 36. The inert gas and liquid refrigerant supply conduit 23 connects to the inner leg of the conduit 34.

The evaporator section 33 comprises a pair of horizontal vertically spaced and rearwardly facing U-shaped conduits 37 and 38 which are serially connected by a riser conduit 39. The inner leg of the U-shaped conduit 37 joins the inert gas discharge conduit 27. The evaporator sections 32 and 33 are serially connected by a cross-connecting conduit 40 which joins the inner adjacent legs of the U-shaped conduits 35 and 38.

Thus, the inert gas and liquid refrigerant supplied to the evaporator through the conduit 23 traverses the U-shaped conduit 34, the riser 36, the conduit 35, the cross-connecting conduit 40, the U-shaped conduit 38, the riser 39 and the U-shaped conduit 37 from which it is discharged through the conduit 27. An anti-blocking drain 41 connects the upper side of the U-shaped conduit 34 adjacent the riser.

The apparatus includes a cabinet construction 42 which encases a storage compartment indicated generally at 44. The cabinet is provided with a rear wall opening 45 of a size sufficient to permit the evaporator coil construction to pass therethrough. An insulating sealing plate 46 is mounted rigidly with the evaporator coil construction and is designed to seal the opening 45 when the apparatus is placed within the chamber 44 of the cabinet 42. Only the upper portion of the cabinet has been illustrated; however, it will be appreciated that the cabinet will include the usual insulated door and a mechanism compartment and cooling air duct positioned below and along one wall of the storage chamber 44. The refrigerating apparatus with the exception of the evaporator will be distributed in the mechanism compartment and cooling air duct in any suitable manner.

Each of the evaporator sections 32 and 33 is encased within an insulated housing. The housing for the evaporator coil section 33 comprises a U-shaped insulated wall 43 which is formed integrally with the cabinet construction and with the open face of the U facing the central portion of the chamber 44. The ice-freezing evaporator section 32 is housed in a suitable U-shaped insulated casing 49 also facing inwardly of the chamber 44 whereby the open faces of the U-shaped housing 48 and 49 face each other. The open faces of the U's are suitably closed by means of a U-shaped panel 50 having a side wall 51 closing the housing 48, a side wall 52 closing the housing 49 and a cross-connecting bight portion 53 lying against the rear wall of the cabinet 42. A suitable slot 54 is formed in the panel 53 and the rear ends of the panels 51 and 52 to accommodate the conduit 40. Suitable insulated doors will be provided for the housing 48 and 49 to provide access thereto and to prevent heat leakage through the open front portions thereof.

The bottom portions of the panels 51, 52 and 53 are inset away from the central portion of the chamber 44 and are then coiled upwardly to form a drip trough 55 which communicates with suitable disposal duct 56 at its central rear por-

tion for the purpose of conveying condensates and defrosting drainage to a point of ultimate disposition.

Suitable freezing receptacle supporting shelves are mounted within the chambers 48 and 49 in heat transfer relationship with the freezing coil sections therein contained.

Referring specifically to Figure 2 the conduit sections 34, 35, 37 and 38 are in heat transfer relationship with shelves 58, 59, 60 and 61, respectively. The inner ends of the shelves 58 to 61, inclusive, are turned downwardly as is indicated generally at 62 to provide flanges abutting the plate elements 51 and 52 whereby these elements are refrigerated from the various conduit sections within the housing 48 and 49 but through the medium of a poor thermal bond; that is, the thermal bond between the flanges 62 and the plate elements 51 and 52 is one of mere contact and not a bond such as is provided by welding, brazing, soldering, or the like. By this means the air-cooling plates 51, 52 and 53 operate at a temperature appreciably above the temperature prevailing within the compartments 48 and 49 whereby the tendency to accumulate frost and to lower the humidity within the storage compartment 44 is greatly minimized.

The above described construction provides a highly desirable refrigerating arrangement in that the air within the compartment 44 may rise along the outer side walls thereof across the top of the casing 48 and 49 and then drop downwardly between the plates 51 and 52 which serves to refrigerate the same. By this means the space between the two sections of the evaporator is utilized not only as an air cooling means but also provides a space for the refrigeration of tall receptacles and similar articles without otherwise altering the construction of the apparatus. Articles being refrigerated in the space between the plates 51 and 52 will be supported upon a suitable shelf provided for that purpose but not shown herein.

This method of air flow provides for even distribution of cold air to all portions of the compartment 44 and also insures that the coldest air therein shall be in the center of the compartment and that the warmest air shall rise along the outer side walls thereof, thereby minimizing heat losses from the insulated walls of the cabinet 42.

There is thus provided a refrigerator in which the low temperature freezing portions thereof are thoroughly insulated from contact with the air within the food storage compartment and also serving directly to refrigerate the air within that compartment through the medium of a poor thermal bond which permits the air to be refrigerated at a relatively high temperature and consequently at a relatively high humidity.

Referring now to Figures 3, 4 and 5 there is disclosed a modified form of the invention. It will be understood that this form of the invention is designed and intended to be utilized in refrigerating systems of the type described fully in connection with Figures 1 and 2 and therefore only the cabinet and evaporator construction is illustrated in Figures 3, 4 and 5.

In this form of the invention there is provided an insulated cabinet 65 provided with a storage space indicated generally at 66. The rear wall of the cabinet is provided with an opening 67 of a size sufficient to permit the evaporator to pass therethrough and is closed by a suitable insulated window plate element 68.

The evaporator utilized in this form of the in-

vention comprises a pair of spaced freezing sections 70 and 71. The freezing section 70 includes a pair of horizontal, parallel, vertically spaced and rearwardly facing U-shaped conduit sections 72 and 73. The evaporator section 71 comprises a pair of horizontal, parallel, vertically spaced and rearwardly facing U-shaped evaporator conduits 74 and 75. The inert gas is supplied to the inner leg of the U-shaped conduit 72 by means of a conduit 77. The liquid refrigerant is supplied to the conduit 77 from the condenser by means of a conduit 78. This evaporator, like that described in connection with Figures 1 and 2, is of the type in which the inert gas travels with a velocity sufficient to propel the liquid refrigerant therethrough as it is evaporating to produce a refrigerating effect.

The outer legs of the U-shaped conduits 72 and 74 are serially connected by a rear cross connecting conduit 79. The outer legs of the upper U-shaped conduits 73 and 75 are likewise connected by a rear cross-connecting conduit 80. The conduits 74 and 75 are serially connected by a suitable riser conduit 81. The rich inert gas formed in the evaporator is conveyed therefrom to the gas heat exchanger G' by means of a conduit 82 which connects to the inner leg of the conduit 73.

The inert gas and liquid refrigerant traverse the lower two conduits 72 and 74, pass through the riser 81 through the upper conduits 75 and 73 after which they are conveyed to the gas heat exchanger by means of the conduit 82. The evaporator is also provided with a suitable overflow drain conduit 83 corresponding to the drain conduit 41 described in connection with Figures 1 and 2.

A suitable vertically positioned large area air-cooling plate 85 is thermally bonded to the cross-connecting conduits 79 and 80 for a purpose to be described more fully hereinafter.

The evaporator sections 70 and 71 are housed in insulated chambers 87 and 88, respectively. The chamber 88 is defined by a bottom wall 89 and an inner side wall 90 both of which integral with the side and top walls respectively of the cabinet 65. The outer side and top walls of the chamber 88 are defined by the side and top walls of the cabinet 65. The rear wall 91 of the chamber 88 is provided with an opening 92 which is closed by an insulated closure element 93 mounted upon the rear end of the U-shaped evaporator conduits 74 and 75 and in front of and in spaced relationship with the air cooling plate 85 whereby upon insertion of the apparatus into the cabinet the closure element 93 seals the rear wall of the compartment 88 and forms an air flue on each side of the plate 85 between the closure elements 93 and 68.

The construction of the compartment 87 is identical with that described in connection with the compartment 88 and need not be described in detail. The front end of the compartments 87 and 88 are sealed by a suitable insulated door construction (not shown).

A central channel 95 is formed between the freezing chambers 87 and 88 and a pair of cooling air channels 96 and 97 are formed on the front and rear sides respectively of the air-cooling plate 85 and rearwardly of the freezing chambers 87 and 88.

The cooling air flows upwardly through the central channel 95 and then rearwardly to the plate 85 over which it spreads as it drops downwardly into the lower portion of the storage compartment 66.

In this form of the invention the spaced freezing compartments are insulated on all sides thereof and do not refrigerate the air within the storage compartment either directly or indirectly. The freezing compartment may be considered as two entirely separate and distinct insulated refrigerating chambers operatively connected, however, to a single system.

Due to the very large extent of the plate 85 and to the relatively small extent of the conduits 79 and 80, the net over all temperature of the plate 85 is considerably above the freezing point of water whereby the same does not collect an appreciable quantity of frost and the compartment 66 is maintained at safe refrigerating temperatures without unduly lowering the humidity thereof.

Referring now to Figures 6 and 7, there is disclosed a modified form of the invention comprising an insulated cabinet 100 including a refrigerated food storage compartment 101. This form of the invention is designed and intended to be utilized with a refrigerating system such as that illustrated in Figure 1. Therefore, only the evaporator and upper cabinet have been illustrated as that is the only manner in which this form of the invention differs from that illustrated in Figure 1.

The upper portion of the cabinet is provided with a pair of laterally spaced insulated freezing compartments 102 and 103 which are formed integrally with the cabinet and will be provided with suitable front insulated closures, not shown.

The spacing of the freezing chambers 102 and 103 provides air ducts 104 and 105 between the outer walls of the same and the left and right hand sides of the cabinet 100 respectively, as viewed in Figure 6. There are also provided top air passages 107 and 108 between the top walls of the freezing chambers 102 and 103, respectively, and the top wall of the cabinet 100. A central air flue 110 is provided between the adjacent walls of the freezing chambers 102 and 103.

The rear wall 111 of the cabinet 100 is provided with an opening 112 of a size sufficient to permit insertion of the evaporator coil construction to be described hereinafter and is closed by a window element 113 which is rigidly attached to the evaporator coil construction.

The evaporator coil construction comprises a pair of laterally spaced freezing sections 115 and 116. The freezing section 116 comprises a pair of horizontal, parallel, vertically spaced and rearwardly facing U-shaped conduits 118 and 119 which are serially connected by a riser conduit 120. The inert gas is supplied to the inner leg of the U-shaped conduit 118 by means of a conduit 121 to which the liquid refrigerant supply conduit 122 is also connected. The conduit 123 will lead directly to the condenser and the conduit 127 serves as a condenser vent and pressure regulating vent and will connect directly to the rich gas side of the gas heat exchanger G".

The freezing section 115 comprises a pair of horizontal, parallel, vertically spaced and rearwardly facing U-shaped conduits 124 and 125 which are serially connected by means of a riser conduit 126. The adjacent inner legs of the U-shaped conduits 119 and 125 are each serially connected to the adjacent leg of an upper centrally located U-shaped conduit 128 by means of laterally projecting riser conduits 129 and 130, respectively.

The U-shaped conduit 128 is provided with a plurality of spaced cooling fins 132 which are

suitably bonded thereto to provide good heat transfer between the conduit and the fins.

The inner leg of the U-shaped conduit 124 is connected to the rich gas discharge conduit 135 which connects to the rich gas side of the gas heat exchanger.

This evaporator, like those previously described, is of the type in which the liquid refrigerant is propelled by a high velocity stream of inert gases flowing through the evaporator. Therefore, the inert gas and liquid refrigerant traverse the U-shaped conduit 118, the riser 120, the conduit 119, riser 129, conduit 128, riser 130, conduit 125, riser 126, conduit 124 and discharge conduit 135 and in the order named.

As is readily apparent from Figure 6, when the apparatus is assembled the coil sections 115 and 116 are positioned in the freezing chambers 102 and 103, respectively, and the conduit 128 with its associated cooling fins is positioned in the air duct 110 between the freezing chambers 102 and 103.

Suitable shelves such as are indicated generally at 137 in the chamber 102 will be positioned over each of the conduit sections 118, 119, 124 and 125 to support freezing trays and the like.

In this form of the invention the air for the storage compartment 101 passes upwardly along the side walls of the cabinet across the top wall thereof and then downwardly to the central air cooling flue, thus directing the coldest air into the central portion of the cabinet through which it may spread equally in all directions to assure uniform refrigeration of foodstuffs stored therein. Tall receptacles may be supported in the lower portion of the channel 110 upon a suitable shelf (not shown).

It is to be noted in this form of the invention that the freezing sections of the evaporator are totally insulated and sealed from the storage compartment 101 and that the air never comes in contact therewith.

The riser conduit 129 passes through a suitable slot 138 formed in the inner side wall of the freezing compartment 103. A similar slot will be provided in the inner side wall of the freezing compartment 102 to accommodate the riser conduit 130.

Referring now to Figures 8 and 9 there is disclosed still another modification of the invention. This form of the invention is designed and intended to be utilized with a refrigerating system such as that illustrated in Figure 1. Therefore, only the evaporator and upper cabinet have been illustrated as that is the only manner in which this form of the invention differs from that illustrated in Figure 1.

In this form of the invention there is provided an insulated cabinet 150 which is provided with a refrigerated chamber 151. Insulated freezing compartments 152 and 153 are positioned in the upper corners of the cabinet 150 and are formed integrally therewith. A medium temperature chamber 154 is formed between the freezing chambers 152 and 153. The bottom wall of the chamber 154 is defined by a slotted supporting plate 155. A similar slotted plate 156 is slidably supported beneath the plate 155 whereby to allow or prevent communication between the chambers 154 and 151 depending upon the position of the slidable plate 156.

The evaporator structure utilized in this form of the invention comprises a pair of spaced apart freezing sections 160 and 161. The freezing section 161 comprises a pair of horizontal, parallel,

vertically spaced and rearwardly facing U-shaped conduits 162 and 163. The outer leg of the U-shaped conduit 162 is in open communication with the inert gas supply conduit 164 to which the liquid refrigerant supply conduit 165 is also connected.

The freezing section 160 comprises a pair of horizontal, parallel, vertically spaced and rearwardly facing U-shaped conduits 166 and 167 which are serially connected by means of a riser conduit 168.

The adjacent inner legs of the conduit sections 162 and 166 are serially connected by a rear cross-connecting conduit 170 located within compartment 154. Likewise the adjacent legs of the conduits 163 and 167 are connected by a rear cross-connecting conduit 171.

The outer leg of the U-shaped conduit 163 is connected by means of a conduit 173 to the subjacent outer leg of a horizontal, rearwardly facing W-shaped box-cooling conduit 175 which underlies the coil sections 162 and 166. The left-hand outer leg of the conduit 175, as viewed in Figure 9, is connected to the rich gas side of the gas heat exchanger by means of the gas discharge conduit 176.

Therefore, the path of the inert gas and liquid refrigerant through the evaporator is as follows: The coil sections 162, conduit 170, conduit section 166, riser 168, conduit section 167, cross connecting conduit 171, conduit 163, riser 173, W-shaped conduit 175, and discharge conduit 176.

The right and left hand adjacent legs of the W-shaped conduit 175 are provided with cooling fins 178 and 179, respectively. The cooling fins will be suitably thermally bonded to the conduit 175 to provide good heat transfer therebetween.

As is illustrated in Figure 8, the W-shaped conduit and its associated fins underlie the chambers 152, 153 and 154 in position to refrigerate the air within the compartment 151. The cross-connecting conduits 170 and 171 are received in suitable slots such as those indicated at 180 in the rear end of the adjacent side walls of the compartments 152 and 153. Therefore, the cross-connecting conduits 170 and 171 serve to refrigerate the chamber 154.

The rear wall of the cabinet 150 is provided with an opening 183 of a size sufficient to accommodate the entire coil structure illustrated in Figure 9 and is closed by an insulated panel 184 which is rigidly mounted upon the coils.

Suitable shelves such as those indicated generally at 185 in the compartment 152 overlie and are in heat transfer relationship with the conduits 162, 163, 166 and 167 for the purpose of supporting freezing trays and the like.

In this form of the invention there is provided a refrigerating apparatus in which refrigeration will be produced at a relatively low temperature in the compartments 152 and 153 at an intermediate temperature level in the compartment 154 and high temperature high humidity refrigeration will be provided in the foodstuffs storage compartment 151 by means of the W-shaped conduit 175 and its associated cooling fins.

The difference in temperature between the compartment 154 and the compartments 152 and 153 results from the fact that the compartment 154 is not as fully insulated as the compartments 152 and 153 and also because of the fact that only the short conduit sections 170 and 171 are provided to refrigerate the compartment 154. That portion of the evaporator represented by the W-shaped conduit 175 will operate at a tem-

perature appreciably above that prevailing in the other portions of the evaporator by reason of the fact that the inert gas is partly saturated after it has traversed the upper portions of the evaporator and is then supplied to the conduit 175 which will prevent refrigeration from occurring in that conduit at a very low temperature level. However, adequate refrigeration for the compartment 151 is provided by the conduit 175.

The present invention provides a highly efficient refrigerating apparatus in which the low temperature freezing portions thereof are totally or partially insulated from contact with the air within the storage compartment in order to prevent objectionable frost deposition. Moreover, the central portion of the refrigerator is free to provide a cooling air flow path, a refrigerated space for tall receptacles, and a space for the production of refrigeration within the storage compartment. The various coil structures disclosed are particularly well adapted to the divided freezing chamber construction characteristic of the present invention and may be incorporated therein with a minimum of effort without requiring alterations or modifications in other parts of the system and without impeding free and proper circulation of the various fluids normally supplied to the evaporator.

Various modifications of each of the embodiments may be made without departing from the principle of the invention as will appear obvious to those skilled in the art to which the same pertains. For example, referring to Figure 1, it will be appreciated that slot 54 need not be cut in plate 53 to provide for evaporator conduit 40. Instead, the portion of plate 53 opposite conduit 40 may be shaped so as to fit closely about the conduit thus covering and concealing the same from view and additionally serving to convey heat to the conduit from compartment 51.

A further example of variations in structure within the scope of the invention is the construction of the evaporator and insulating and other enclosing structure as a unitary assembly apart from the cabinet, and in such manner that this unitary assembly can be inserted through a proper sized opening in the cabinet along with the main refrigeration apparatus. Thus, it will be unnecessary to provide a specially designed cabinet having interior insulated partitions as now shown in the drawings, since such partitions will be attached to the evaporator and window closure element prior to the insertion of the apparatus within the cabinet. It will of course be apparent any one or all of the embodiments shown can be so constructed. Still other variations within the scope of our invention will be-
quit 175 and its associated cooling fins.

While the invention has been illustrated and described herein in considerable detail, various changes may be made in the form, construction and arrangement of parts without departing from the spirit of the invention or the scope of the appended claims.

We claim:

1. Refrigerating apparatus including an insulated cooling chamber, a pair of laterally spaced freezing compartments arranged in said cooling chamber on opposite sides thereof to provide an air circulation channel extending substantially the full depth of said chamber therebetween, and a cooling apparatus having a cooling unit in each of said compartments and a cooling unit arranged to refrigerate air flowing through said chamber and said channel.

2. Refrigerating apparatus including an insulated cooling chamber, a pair of laterally spaced freezing compartments arranged in said cooling chamber on opposite sides thereof to provide an air circulation channel extending substantially the full depth of said chamber therebetween, cooling means having a first part for cooling said compartments and a second part, the air flowing therebetween, said air circulation channel being accessible from the exterior of said cooling chamber whereby material to be refrigerated may be placed between said freezing compartments.

3. Refrigerating apparatus comprising an insulated cabinet having a storage compartment, a pair of individual insulated chilling housings positioned in the upper corners of said compartment and spaced from the side and top walls thereof and from each other, a cooling unit in each of said insulated housings, and a cooling unit arranged to refrigerate the air between said housings whereby the air within said compartment may flow upwardly along the side walls and across the top wall thereof and then flow downwardly between said housings as it is being cooled in a path extending substantially the full depth of said storage compartment.

4. Refrigerating apparatus comprising an insulated cabinet having a storage compartment, a pair of individual insulated chilling housings positioned in the upper corners of said compartment and spaced from the side and top walls thereof and from each other, means for refrigerating each of said housings, and means for refrigerating the air between said housings whereby the air within said compartment may flow upwardly along the side walls and across the top wall thereof and then flow downwardly between said housings as it is being cooled in a path extending substantially the full depth of said storage compartment, the arrangement being such that articles to be refrigerated may be placed between said housings to be refrigerated by the air stream flowing therebetween.

5. Refrigerating apparatus comprising a cabinet including an insulated storage chamber, a pair of spaced freezing chambers in said storage chamber, means for refrigerating each of said freezing chambers, means for refrigerating the space between said freezing chambers, means for refrigerating the air in said storage chamber, and means for allowing or preventing at will communication between said storage chamber and the space between said freezing chambers.

6. Refrigerating apparatus comprising a cabinet including an insulated storage compartment, a pair of spaced freezing chambers in said storage compartment, said chambers being insulated except on their adjacent sides, evaporator means positioned within said chambers for refrigerating the interior thereof, means providing a poor thermal bond between said evaporating means and the uninsulated sides of said chambers, said chambers being spaced from the top and side walls of said storage chamber to provide cooling air passageways therebetween.

7. Refrigerating apparatus comprising an insulated refrigerating compartment, a pair of laterally spaced freezing chambers insulated except for their facing side walls, evaporating means positioned within said freezing chambers for refrigerating the interior thereof, means providing a poor heat transfer path between said evaporating means and the uninsulated walls of said chambers whereby said walls serve to cool

the air within said compartment without subjecting such air to extremely low temperatures.

8. Refrigerating apparatus comprising an insulated refrigerating compartment, a pair of laterally spaced freezing chambers insulated except for their facing side walls, means for refrigerating said freezing chambers, means providing a poor heat transfer path between said refrigerating means and the uninsulated walls of said chambers whereby said walls serve to cool the air within said compartment without subjecting such air to extremely low temperatures, drip troughs mounted adjacent the lower edges of said uninsulated walls, said troughs being set outwardly of the space between said walls and out of the path of air flowing therebetween.

9. Absorption refrigerating apparatus comprising an insulated cabinet, a plurality of spaced freezing chambers mounted in said cabinet to provide cooling air flow paths therebetween, an inert gas circuit including an absorber and an evaporator having freezing sections in each of said chambers, a solution circuit including a generator and said absorber, and means for liquefying refrigerant vapor produced in said generator and for supplying the liquid refrigerant to said evaporator, said evaporator including a section for refrigerating the air in said cabinet.

10. Absorption refrigerating apparatus comprising an insulated cabinet, a plurality of freezing chambers mounted in said cabinet, an inert gas circuit including an absorber and an evaporator having freezing sections in each of said chambers, a solution circuit including a generator and said absorber, means for liquefying refrigerant vapor produced in said generator and for supplying the liquid refrigerant to said evaporator, a power driven circulator in said inert gas circuit arranged to propel inert gas through said evaporator at a velocity sufficient to propel the refrigerant therethrough by the frictional drag of the inert gas, and means for refrigerating the air in said cabinet.

11. Absorption refrigerating apparatus comprising an insulated cabinet, a pair of freezing chambers in said cabinet arranged to provide a space therebetween accessible from the front of said cabinet for refrigerating tall receptacles and the like and to form an air flow channel for the air within said cabinet, an inert gas circuit including an absorber and an evaporator having freezing sections in each of said chambers and a section for refrigerating the air in said cabinet, a solution circuit including a generator and said absorber, and means for liquefying refrigerant vapor produced in said generator and for supplying the liquid refrigerant to said evaporator.

12. Absorption refrigerating apparatus comprising an insulated cabinet, a pair of spaced freezing chambers mounted in said cabinet to form an air flue and refrigerating chamber therebetween, an inert gas circuit including an absorber and an evaporator including a substantially horizontal freezing coil section in each of said chambers and a section for cooling the air in said cabinet, a circulating pump in said inert gas circuit adapted to propel the inert gas through said evaporator with a velocity sufficient to sweep the refrigerant liquid therethrough as it is evaporating, a solution circuit including a generator and said absorber, and means for liquefying refrigerant vapor produced in said generator and for supplying the liquid to said evaporator.

13. Absorption refrigerating apparatus comprising an insulated cabinet, a pair of spaced

freezing chambers mounted in said cabinet to form an air flue and refrigerating chamber therebetween, an inert gas circuit including an absorber and an evaporator including a substantially horizontal freezing coil section in each of said chambers, receptacle supporting shelves in said chambers overlying and in heat conducting relationship with the freezing coils therein, a circulating pump in said inert gas circuit adapted to propel the inert gas through said evaporator with a velocity sufficient to sweep the refrigerant liquid therethrough as it is evaporating, a solution circuit including a generator and said absorber, means for liquefying refrigerant vapor produced in said generator and for supplying the liquid to said evaporator, said evaporator also including an air cooling section within said cabinet for refrigerating the air therein.

14. Absorption refrigerating apparatus comprising an insulated cabinet, a pair of spaced freezing chambers mounted in said cabinet to form an air flue and refrigerating chamber therebetween, an inert gas circuit including an absorber and an evaporator including a substantially horizontal freezing coil section in each of said chambers, a circulating pump in said inert gas circuit adapted to propel the inert gas through said evaporator with a velocity sufficient to sweep the refrigerant liquid therethrough as it is evaporating, a solution circuit including a generator and said absorber, means for liquefying refrigerant vapor produced in said generator and for supplying the liquid to said evaporator, said evaporator also including an air cooling section provided with cooling fins and positioned beneath said chambers to refrigerate the air in said cabinet, said evaporator and inert gas circuit being so arranged that the inert gas and refrigerant liquid traverse the freezing sections of said evaporator before traversing the air cooling section thereof.

15. Absorption refrigerating apparatus comprising an insulated cabinet, a pair of insulated freezing chambers mounted within said cabinet in spaced relation to each other and to the rear wall of said cabinet to define central and rear air passageways in said cabinet, an inert gas circuit including an absorber and an evaporator having sections in each of said chambers and a section in said rear air passageway connecting said first mentioned sections, a solution circuit including a generator and said absorber, means for liquefying refrigerant vapor produced in said generator and for supplying the liquid to said evaporator, and a large upstanding heat transfer plate positioned in said rear passageway and in heat exchange relationship with the section of said evaporator positioned in said rear air passageway.

16. Refrigerating apparatus comprising an insulated refrigerating compartment, a pair of laterally spaced freezing chambers, a refrigerating mechanism associated with said refrigerating compartment including a cooling unit in each of said freezing chambers and a cooling unit in the space between said freezing chambers to refrigerate the air flowing therebetween.

17. Refrigerating apparatus comprising an insulated refrigerating compartment, a pair of laterally spaced freezing chambers positioned within said compartment, a refrigerating mechanism associated with said compartment including cooling units in each of said freezing chambers and at least one cooling conduit extending across said compartment rearwardly of said freezing cham-

bers, and a single upstanding heat conducting plate thermally bonded to said cooling conduit for refrigerating the air within said chamber.

18. Refrigerating apparatus comprising an insulated refrigerating compartment, a freezing chamber within said compartment and spaced from one wall thereof, a refrigerating mechanism including a cooling unit having a section mounted within said freezing chamber and an air cooling section mounted between the wall of said chamber and said one wall of said compartment, the balance of said refrigerating mechanism being positioned exteriorly of said compartment, said one compartment wall including an opening of a size to admit said cooling unit sections, the wall of said freezing chamber adjacent said one compartment wall having an opening of a size to admit the section of said cooling unit provided therefor, and closure elements for said wall openings mounted on said cooling unit.

19. Refrigerating apparatus comprising an insulated storage compartment, a pair of laterally spaced refrigerating chambers in the upper portion of said compartment, a refrigerating mechanism comprising a cooling unit having sections positioned in each of said refrigerating chambers, a section positioned beneath said chambers to refrigerate the air in said compartment, and a section arranged to refrigerate the space between said chambers.

20. Refrigerating apparatus comprising an insulated structure including a refrigerating compartment, a pair of laterally spaced chilling chambers in the upper portion of said compartment, refrigerating mechanism associated with said cabinet including cooling elements arranged to refrigerate said chilling chambers, the air within said compartment and the space between said chilling chambers, and means for allowing and preventing flow of air between said compartment and the space between said chilling elements, said apparatus being so constructed and arranged that the space between said chambers is open at one end to allow placement of material to be refrigerated therein.

21. Absorption refrigerating apparatus comprising a refrigerating compartment, a pair of spaced chilling chambers, an evaporator including a conduit in each of said chambers and a conduit extending between said chambers and serially connecting the conduits positioned therein, means for supplying refrigerant liquid to the conduit in one of said chambers, and means for propelling an inert gas through said evaporator conduits with a velocity and pressure sufficient to distribute the liquid refrigerant therethrough by the frictional drag of the inert gas flowing thereby.

22. Refrigerating apparatus comprising an insulated refrigerating compartment, a pair of laterally spaced freezing chambers having one uninsulated side wall, means for refrigerating said freezing chambers comprising horizontal shelf-like freezing coils positioned in each of said chambers in spaced relationship with the walls thereof, and receptacle supporting plates overlying and in heat conducting relationship with said coils and with the uninsulated side walls of said chambers at their edges to provide a poor heat conducting path between said coils and said uninsulated side walls whereby said walls serve to cool the air within said compartment without subjecting the air to extremely low temperatures.

23. Absorption refrigerating apparatus comprising an insulated cabinet, a plurality of freez-

ing chambers mounted in said cabinet, an inert gas circuit including an absorber and an evaporator, said evaporator including a plurality of horizontal conduit sections in each of said freezing chambers directly underlying and refrigerating shelf-like elements adapted to support freezing receptacles and the like and a conduit positioned between said chambers for refrigerating the air in said cabinet, a solution circuit including a generator and said absorber, means for supplying refrigerant liquid to said evaporator at substantially the level at which inert gas is supplied thereto, and a power driven circulator in said inert gas circuit arranged to propel inert gas through said evaporator at a velocity sufficient to propel the refrigerant liquid therethrough by the frictional drag of the inert gas.

24. Absorption refrigerating apparatus comprising an insulated cabinet, a pair of freezing chambers in said cabinet arranged to provide a space therebetween accessible from the front of

5 said cabinet for refrigerating tall receptacles and the like and to form an air flow channel for the air within said cabinet, an inert gas circuit including an absorber and an evaporator, said evaporator including a plurality of horizontal conduit sections in each of said freezing chambers directly underlying and refrigerating shelf-like elements adapted to support freezing receptacles and the like and a conduit positioned between 10 said chambers for refrigerating the air in said cabinet, a solution circuit including a generator and said absorber, means for supplying refrigerant liquid to said evaporator at substantially the level at which inert gas is supplied thereto, 15 and a power driven circulator in said inert gas circuit arranged to propel inert gas through said evaporator at a velocity sufficient to propel the refrigerant liquid therethrough by the frictional drag of the inert gas.

GEORGE A. BRACE.
ALFRED G. GROSS.

CERTIFICATE OF CORRECTION.

Patent No. 2,328,189.

August 31, 1943.

GEORGE A. BRACE, ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5, second column, line 58, strike out "duit 175 and its associated cooling fins." and insert instead the syllable and words --come apparent to those skilled in the art.--; page 6, second column, line 44, claim 11, for "Absorption" read --Absorption--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 7th day of December, A. D. 1943.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.