May 30, 1950 L. A. PHILIPP 2,509,609

REFRIGERATING APPARATUS

Filed Dec. 12, 1945 2 Sheets-Sheet 1

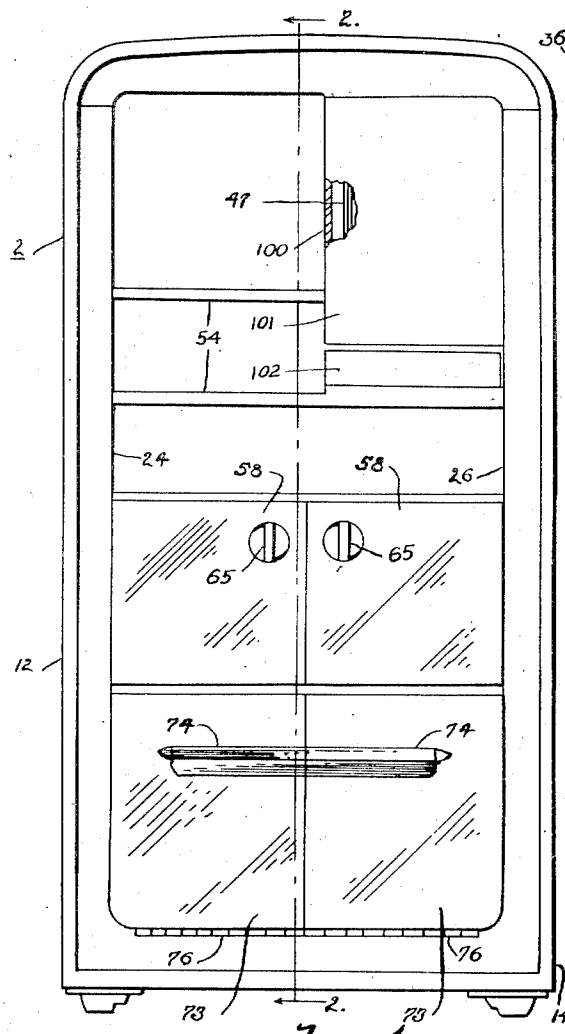


Fig. 1.

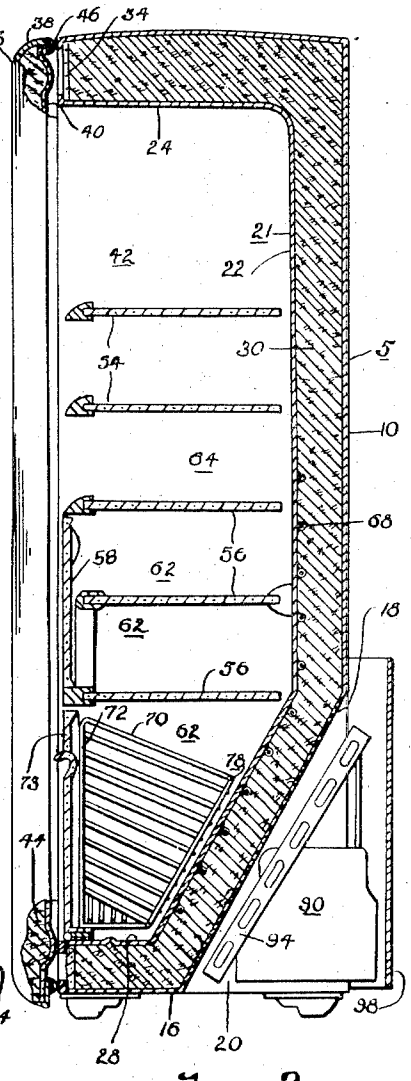


Fig. 2.

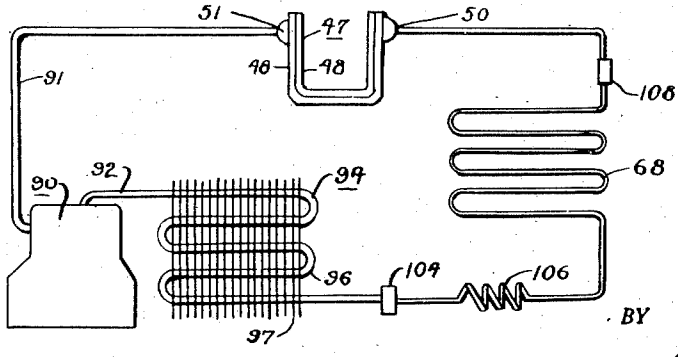


Fig. 3.

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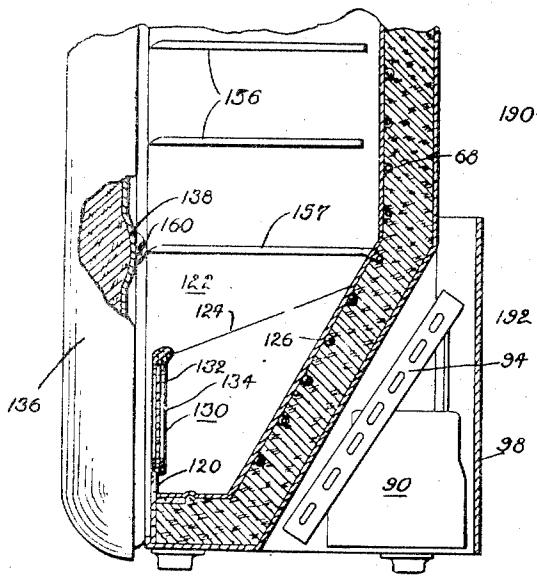


Fig. 4.

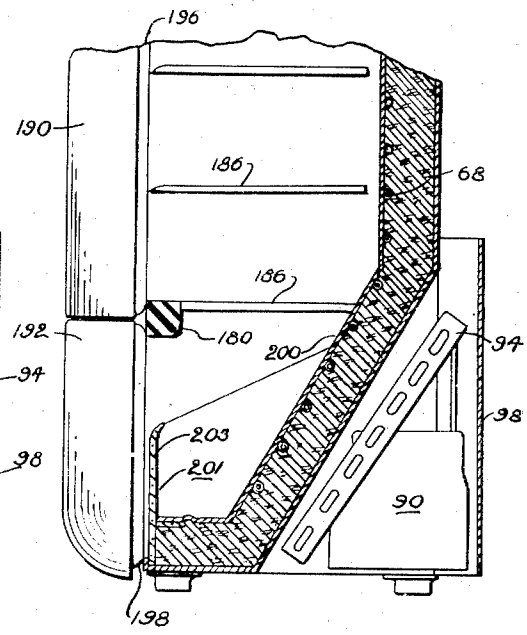


Fig. 5.

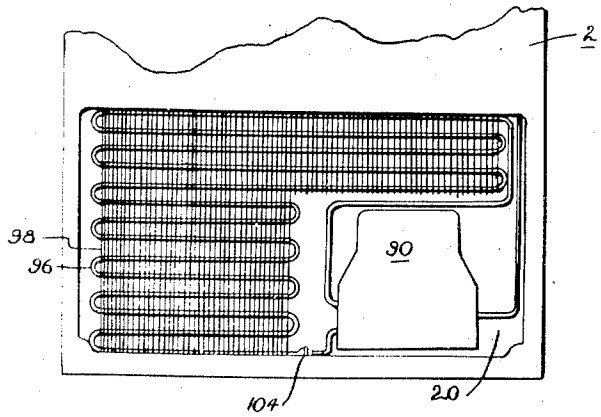


Fig. 6.

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REFRIGERATING APPARATUS

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2 Claims. (Cl. 62—116)

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This invention relates generally to refrigerating apparatus, and more particularly to household refrigerators.

It has been customary to provide a relatively large mechanism compartment in domestic refrigerators for the reception of a motor compressor unit and a refrigerant condenser. This practice resulted in uneconomical use of the valuable space within refrigerators. I have found that by positioning the lower portion of the back wall of the cabinet at an angle, a mechanism compartment of general triangular shape in cross section of sufficient size can be provided at the back of the cabinet. A refrigerant condenser can be secured adjacent to the angularly inclined back wall in the machinery compartment and the motor compressor can be positioned laterally of the condenser, leaving the space forwardly of the angularly inclined back wall available for a food storage cooling compartment.

An object of this invention is to provide a refrigerator cabinet having an inclined back wall of a mechanism compartment for the reception of a motor compressor unit and a condenser at the back of the cabinet.

A further object of the invention is to provide a refrigerator wherein more economical use is made of the space within the cabinet by utilizing a flat type refrigerant condenser secured adjacent an inclined cabinet back wall of a mechanism compartment.

Another object of the invention is to provide an improved refrigerator which can be manufactured economically, and wherein a greater proportion of the space within the cabinet is made available for refrigerating purposes by utilizing a mechanism compartment of generally triangular shape in cross section positioned at the back of the cabinet, and employing a relatively flat refrigerant condenser to reduce the space required for housing the refrigerant condenser.

Yet a still further object of the invention resides in the provision of a domestic refrigerator having a two temperature system wherein refrigerant evaporator tubes are bonded to the walls defining a food storage compartment, and another refrigerant evaporator is associated with an ice freezing compartment positioned in the food storage compartment, and to provide for dividing the compartment into three distant zones wherein different humidity conditions are maintained.

Yet a still further object resides in the provision of a domestic refrigerator having a food storage compartment embodying high and low humidity compartments.

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Other objects and advantages of this invention will be apparent from the following detailed description considered in connection with the accompanying drawings, submitted for purposes of illustration only and not intended to define the scope of the invention, reference being had for that purpose to the following claims.

In the drawings, wherein similar reference characters refer to similar parts through the several views:

Fig. 1 is the front elevation of a domestic refrigerator embodying the present invention illustrated, with the access door removed;

Fig. 2 is a vertical sectional view taken substantially on the line 2—2 of Fig. 1 looking in the direction of the arrows with the access door being attached to the cabinet and shown in elevation and partly broken away;

Fig. 3 is a diagrammatic view illustrating the refrigerating system;

Fig. 4 is a fragmentary sectional view similar in many respects to Fig. 2, embodying a modified form of the invention;

Fig. 5 is a view similar to Fig. 4 illustrating a still further modified form of the invention; and

Fig. 6 is a fragmentary view of the lower rear portion of the cabinet showing the condensing unit in the mechanism compartment.

Referring now more particularly to Figs. 1 and 2, it will be observed that a refrigerator cabinet 2 includes an outer shell or casing 5, consisting of interconnected back, side, top and bottom walls 10, 12, 14 and 16, respectively. The back, side and bottom walls 10 and 16 are joined together near the bottom of the cabinet by an angularly inclined wall 18 which cooperates with the side walls to form a mechanism compartment 20 of generally triangular shape in cross section.

An inner shell or liner 21, consisting of interconnected back, side, top and bottom walls 22, 24, 26, and 28, respectively, is positioned within the outer shell to provide substantially uniform space for the reception of suitable insulation 30 interposed between the inner and outer shells. The insulation 30 may be of any suitable type, such, for example, as cork or fibrous material or any good insulating material.

A breaker strip 34 formed of any good non-conducting material, such as Bakelite, is interposed between the walls defining the inner and

outer shells to thermally insulate the inner and outer shells from each other. An access door 36, preferably having an outer metal shell 38 and an inner linear 40 formed of non-conducting material, such, for example, as Bakelite, is provided to close the front access opening to the food storage compartment 42. Suitable insulation 44 is provided between the outer shell 38 and the inner liner 40 of the door. A gasket or sealing member 46, preferably formed of resilient non-conducting material, such as rubber, is interposed between the access door 36 and the walls of the outer shell.

A refrigerant evaporator 47 positioned in the upper portion of the food storage compartment 42 is formed, for example, of interconnected sheets 48 for the reception of liquid refrigerant. The evaporator 47 includes enlarged headers 50 and 51 which serve as inlet and outlet headers, respectively. The evaporator is preferably U-shaped and in addition to cooling the food storage compartment may be used for freezing purposes.

The space within the food storage compartment 42 is divided by a plurality of spaced shelves 54 and 56 for the reception of articles of varying sizes. Preferably, the shelves are of the imperforate type, such as transparent glass. The space between the lower shelves 56 may be closed by auxiliary access doors 58 hinged, for example, to the breaker strip 34 to provide food storage chambers 62 operating at higher humidity conditions than the chambers 64 not closed by auxiliary access doors. The doors 58 have handles 65.

Refrigerant evaporator tubes 66 bonded in heat exchange relation with certain of the walls of the inner shell, such, for example, as the back walls 22 and side walls 24, are provided to extract heat from the food storage compartment 42.

A pair of laterally positioned bins 70 having vertical front walls 72 aligned with the auxiliary access doors 73 are provided with handles 74 and are hinged, for example, at 76 to tilt forwardly out of the food storage compartment to permit access to the space within the bin. One bin is attached to each door 73. Back walls 78 of the bins 70 are arranged so as to occupy positions adjacent and substantially parallel with the angularly inclined wall 32 of the inner shell so as to utilize all of the space at the lower front portion of the cabinet for the storage of food to be cooled. The bins 70 are formed of interconnected strips of material, preferably wire, to permit circulation of air through the bins.

The shelves 54 and 56 are spaced from the back wall 22, as illustrated at 84, to permit limited circulation of air above and below shelves 54 and 56. The upper portion of the food storage compartment will normally operate under lower humidity conditions than the lower portion thereof because the opening of the access door 36 permits moisture to escape whereas the spaces being closed by the auxiliary access doors 58 and 73 will normally be maintained at higher humidity conditions because of the less frequent exposure of these chambers to the atmosphere. The humidity is also controlled by the manner in which the compartment 42 is cooled, as is hereinafter described. The spaces below shelves 56 may thus be advantageously utilized for the storage of foodstuffs that are best preserved under high humidity conditions.

A motor compressor unit 90 positioned in the machinery compartment 20 at the back of the cabinet is provided to receive gaseous refrigerant from the headers 50 of the refrigerant evaporator 48 through a vapor return conduit 91 and to pump it through a conduit 92 leading to the top of a refrigerant condenser 94. The condenser 94 comprises a tube 96 of serpentine formation having heat radiating surfaces or fins 97 secured in heat exchange relation thereto to permit the rapid dissipation of heat from the compressed gaseous refrigerant circulated through the refrigerant condenser tube 96 to convert it to the liquid form.

By positioning the refrigerant condenser 94 on the angularly inclined wall 18 of the outer shell or cabinet, very little space is required to receive the compressor 90 and condenser 94. A flue 98 is positioned at the rear of compressor 90. Preferably, the condenser is positioned on an inclined angle with respect to wall 18, with the lower part being closer to wall 18. Thus, this enables air to enter the open bottom of compartment 20 and rise upwardly through the condenser and in so doing the air passes through the condenser from one side to the other to thus aid in cooling the condenser.

Within the compartment 42 and surrounding evaporator 47 is a casing 100. This casing may be made of sheet metal material, plastic or other suitable material. The casing is L-shaped with the vertical leg extending up to and in engagement with the wall 24 and the horizontal leg extending up to and in engagement with side wall 26. The front of the casing is closed by door 101. Preferably, the L-shaped casing is spaced slightly from the rear wall 22 to allow limited circulation of air between compartment 42 and the interior of casing 100 for the purpose hereinafter described. A drip pan 102 is positioned below casing 100.

The operation of the system is as follows: Gaseous refrigerant is withdrawn from the outlet header 51 of evaporator 47 through the vapor return conduit 91 to the intake side of the motor compressor unit 90. The compressor compresses the gaseous refrigerant and delivers it to condenser 94 wherein it is liquified and from which it is delivered to evaporator 68 through a strainer 104 and a small diameter tube 106. The tube 106 is of such size as to allow only the necessary amount of liquid to enter into the evaporator 68. From the evaporator 68 the liquid refrigerant flows through a fixed restriction 103, which may be a small orifice or an elongated tube. The refrigerant then enters the inlet 50 of evaporator 47. Because of the fixed restriction 108 the pressure in the evaporator 68 is maintained higher than the pressure in the evaporator 47, and consequently the evaporator operates at a higher temperature than evaporator 47. It is thus possible to operate evaporator 68 so that it operates above the freezing temperature of water while the evaporator 47 may operate well below freezing so as to freeze ice cubes and the like. As shown, the evaporator 68 is coiled about the inner liner of the casing 21 and may be secured to the outer surface of said casing along the side walls 24 and 26 and rear wall 22 and inclined wall 32. Preferably, the evaporator 68 is wound about said walls in the form of a serpentine coil. Other forms of winding may be used, however, under certain circumstances. The evaporator 47 being placed in the upper part of the food storage compartment is utilized for freezing ice cubes as well as for cooling the upper portion of the food storage compartment lying above the shelves 56. This evaporator is not effective to cool the air circulating above the shelves 56 to a temperature

value lower than that to which the air below shelevs 56 is cooled by evaporator 68 because of the casing 100 which substantially surrounds the evaporator 47. Some heat from the upper portion of the compartment 42 is absorbed by the evaporator 47 by a flowing between the evaporator edge of the casing 100 and the rear wall 22 of the liner 21. The casing 100 also tends to cool the circulating air because the casing is reduced in temperature by radiation and due to convection currents between the casing 100 and evaporator 47. However, the circulating air in the upper portion of the compartment 42 is not cooled to as low a temperature as the circulating air in the lower portion of the compartment 42 below shelves 56. Also, the humidity in the upper portion of the compartment 42 is at a lower relative humidity than the relative humidity below shelves 56 because some of the moisture in the circulating air in the upper part of the compartment 42 is condensed out on the casing 100 and other moisture is frozen out on the evaporator 47. The degree of moisture frozen out from such circulating air depends upon the space between the casing 100 and the rear wall 22 of liner 21. The greater the space the greater the air flow to the evaporator 47 and the greater the freeze out of moisture from said circulating air. Furthermore, the humidity conditions in the upper part of the compartment 42 is at a lower relative humidity than that below shelves 56 because of the doors 58 and 73 closing the front portions of the chambers immediately at the rear of said doors. The doors serve to prevent loss of high humidity when the main door 36 is opened. Since the evaporator 68 substantially surrounds the inner casing 21 below shelves 56 and since this evaporator is secured to the liner 21, the liner presents a large refrigerated surface which heat is absorbed through into the evaporator 68. With this large heat absorbing effective area the temperature of the evaporator 68 may be close to the temperature that it is to maintain in air below shelves 56. Also, since the evaporator 68 substantially surrounds the space below shelves 56 there is very little circulation of air in view of the shelves 56 and in view of the fact that the temperature of the air and the temperature of the liner and evaporator 68 are very close to each other. It is to be noted that the shelves 54 and 56 are slightly spaced from the rear wall 22 of liner 21 to allow a space from each of the chambers below shelves 56 upwardly where air may flow between the casing 100 and rear wall 22 of liner 21 so that some air may contact the evaporator 47. This circulation is desired so as to condense out any excess moisture which may form in the spaces below the shelves 56. Preferably, the spaces below shelves 56 are operated at temperatures slightly below that of the temperature above shelves 56 so that if vegetables and the like are stored below shelves 56 the moisture contained in said vegetables will not readily be diffused out as would take place if the temperature below shelves 56 were higher than than thereabove. With this arrangement it is possible to store vegetables or the like as well as other foodstuff which require storage in high humidity condition with relatively low temperature below shelves 56 and in bins 70. Under the circumstances the vegetables will stay crisp and fresh for long periods of time without the use of special receptacles for their storage.

If desired, the two bins 70 may be formed as a single bin extending from one side of the cabinet to the other while the doors 73 may be formed as a single door should such arrangement be desirable. Preferably, the doors 58 and 73 are made of transparent material, such as glass or plastic, so that the contents stored in the spaces below shelves 56 may be readily visible when the main door 36 is opened.

By having the rear wall of the cabinet placed on an incline, it is possible to have a food storage space from the entire top to the bottom wall of the refrigerator and to close the front of the cabinet with a single door. By placing the condenser on an incline it occupies very little space. By placing the condenser on an incline with respect to the rear inclined wall of the cabinet a very efficient condition for arrangement is presented because air may then enter the open bottom of the compartment 20 and when rising will pass through the condenser from one side to the other while the inclined wall of the cabinet will cooperate with the flue 98 to provide a triangular shaped flue for the heat emitting motor compressor unit and condenser, thus providing an improved condensing arrangement. Furthermore, by arranging the rear wall 18 on an incline the heat dissipated between the inclined wall and the condenser tends to rise upwardly and does not flow to the evaporator 68 on wall 32 to such an extent as would take place if the wall 32 were in a horizontal position and the condenser positioned immediately therebeneath as in conventional arrangements.

If desired, the lowermost shelf 56 immediately above the bins 70 may extend entirely in engagement with rear wall 22, thus preventing circulation of air from the lowermost compartment 62 thereabove. Thus the lowermost compartment 62 will operate at a higher humidity than any of the compartments thereabove because none of the moisture from the lowermost compartment will be frozen out on evaporator 47. Thus, three separate degrees of humidity will be maintained. Relatively low humidity will be maintained in compartment 42, intermediate humidity in the central compartments 62 and relatively high humidity in the lowermost compartment 62. Also, if desired, the lowermost compartment may operate at a lower temperature than any of the compartments thereabove, depending upon the number of loops of evaporator 68 positioned about said lowermost compartment.

As will be noted, in Fig. 6, the condenser is positioned from the lower to the upper portions of compartment 20 on one side of the compressor and has an extension over the top of the compressor. This provides adequate condensing surface while at the same time allows the compressor to be placed immediately behind wall 18 to minimize the size of compartment 20.

It will, therefore, be apparent that I have provided a refrigerator that can be economically fabricated and embodying a two temperature system wherein a relatively low temperature somewhat below the freezing point of water is insured in the ice freezing compartment, and a higher temperature somewhat above the freezing point of water is insured in the food storage compartment 42. It will also be apparent that zones of different humidity conditions are provided in the food storage compartments 42 and 62, and that temperature and humidity conditions most suited to the preservation of various types of foodstuffs can readily be made available.

Fig. 4 illustrates a modified form of the in-

vention that is similar in many respects to that illustrated in Figs. 1 to 3. It may be refrigerated by the same refrigerating system and in like manner.

It will be noted that storage bins 120 are formed in the bottom of the food storage compartment 122 by means of spaced partitions 124 secured to and extending forwardly from the angularly inclined wall 126 of the inner shell defining the food storage compartment. The bins 120 are particularly advantageous for the storage of vegetables that are best preserved under relatively high humidity conditions at temperatures somewhat above the freezing point of water. The partitions 124 have angularly inclined top surfaces extending downwardly from the angularly inclined back wall 126 to a vertically disposed partition 130 extending across the front access opening of the food storage compartment near the bottom thereof as illustrated. The partition 130 may have a frame 132 of any desired contour, such, for example, as rectangular, supporting an ornamental panel 134 that may be formed of any desired material, such as glass, to permit visual observation of the contents of the storage bins 120. If desired, a plurality of partitions 124 can be positioned at spaced intervals to divide the space across the front of the cabinet into any desired number of compartments of desired sizes.

The access door 136 is provided with a contoured portion 138 adjacent the lower part of the spaced glass shelves 156 and 157, and may be provided with a gasket member 160 in the form of a resilient hollow projection formed of rubber or other suitable material to contact the forward edge of the lower shelf 157 when the access door 136 is in the closed position, as illustrated, to substantially seal the space between the upper portion of the food storage compartment and the space beneath the shelf 157 defining the vegetable storage bin. To gain access to the vegetable storage bins it is only necessary to open the access door 136 whereupon articles positioned in the storage bins 120 may be readily reached. Shelf 157 extends rearwardly and engages wall 132, while shelves 156 are spaced slightly from wall 122.

The embodiment of the invention illustrated in Fig. 5 is similar in many respects to that illustrated in Fig. 4. It may be refrigerated by the same system as shown in connection with Figs. 1 to 3 and in like manner. It will be noted that a temperature break in the form of a gasket 180 is secured to the lower of the shelves 186, and the upper and lower access doors 190 and 192 are provided to close vertically spaced portions of the front access opening of the cabinet.

The upper door 190 is provided with a gasket strip 196 adapted to engage the temperature break 180 to close the space within the food storage compartment above the lower shelf 186. The access door 192 is provided with a gasket strip 198 so proportioned as to also engage the temperature break 180. The lower glass shelf 186 engages wall 200 while the upper shelves 186 are slightly spaced from wall 200.

The lower access door 192 is provided to close the space beneath the lower shelf 186 having the food storage bins 201 positioned therein. The bins include a panel 207 extending across the entire lower part of the compartment therebehind. It will be apparent that either the upper or lower access door 190 and 192 can be opened without permitting the escape of refrigerated air from the other compartment.

Although preferred and modified forms of the invention have been illustrated, and described in detail, it will be apparent to those skilled in the art that various other modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

I claim:

1. A refrigerator comprising an insulated wall, a motor-compressor unit positioned adjacent said wall, and a refrigerant condenser extending along said wall having a portion thereof positioned laterally of said motor-compressor unit and another portion extending over and above said unit.

2. Refrigerating apparatus comprising, a cabinet having a compartment and having front, rear and side walls, a refrigerant evaporator arranged to cool said compartment, the rear wall of said cabinet having a lower inwardly and downwardly sloping portion extending across the cabinet between said side walls, a motor-compressor unit immediately beneath and adjacent said sloping wall portion operatively connected to said evaporator, a flue extending upwardly adjacent the rear wall of said cabinet, said flue having a lower end portion terminating in overlying relation to said sloping wall portion, and a refrigerant condenser disposed immediately beneath said sloping wall portion extending upwardly and outwardly to said flue and being operatively connected to said motor-compressor unit and to said evaporator.

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