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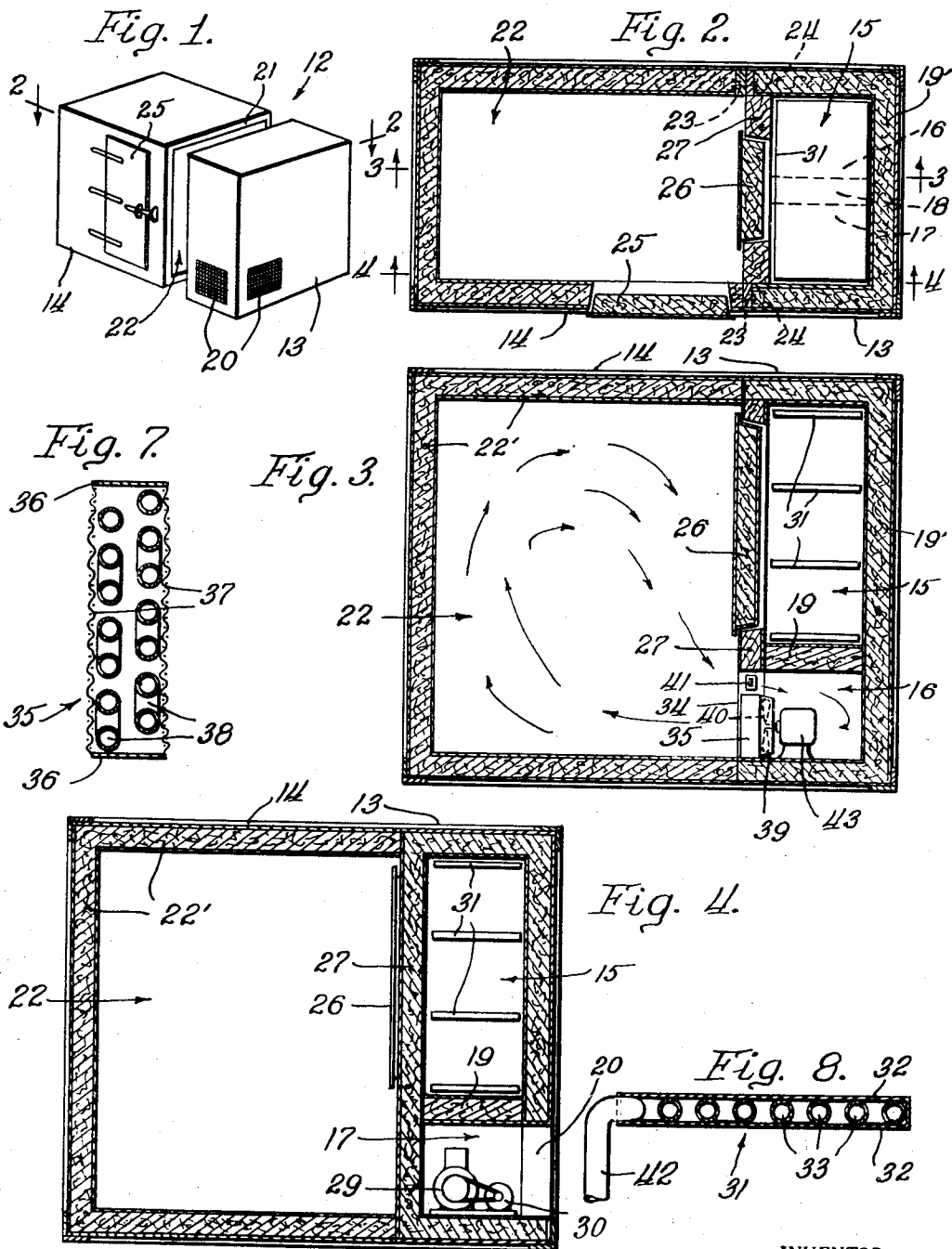
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MULTIPLE COMPARTMENT REFRIGERATOR

Filed Feb. 6, 1946

2 Sheets-Sheet 1



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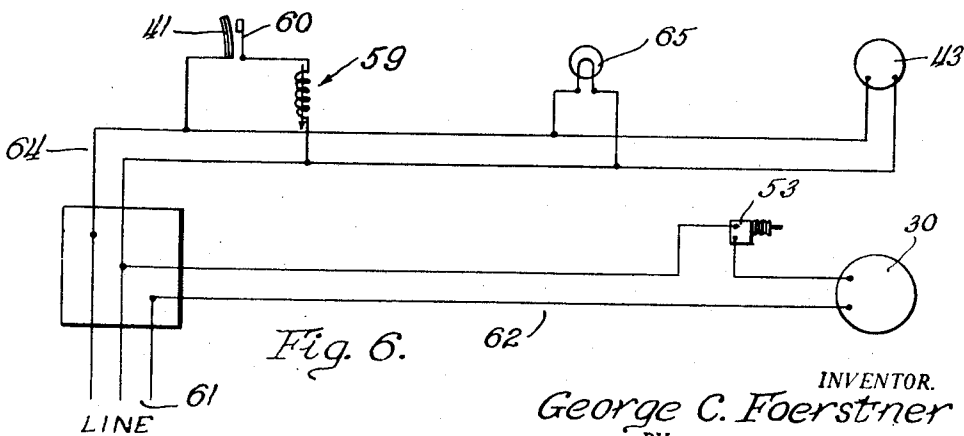
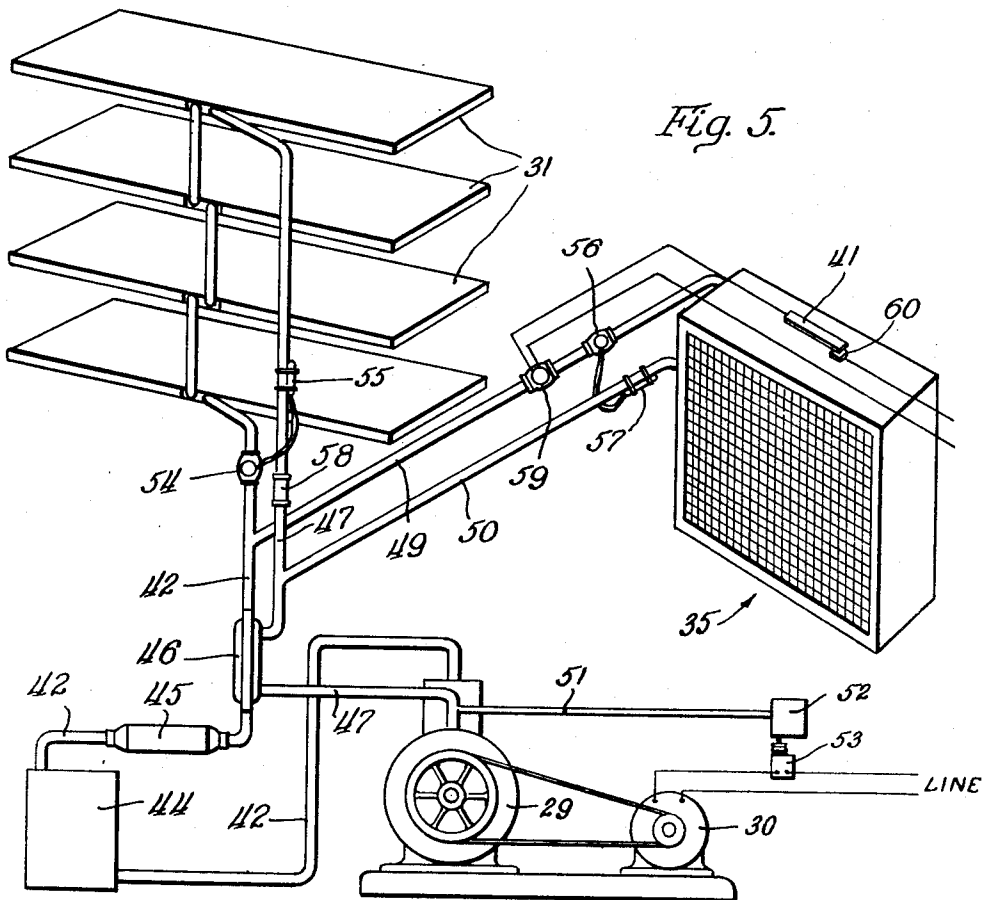
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MULTIPLE COMPARTMENT REFRIGERATOR

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This invention relates to refrigerators, and particularly the type having compartments for different temperatures.

The refrigerator of my invention includes a freezing compartment designed to freeze certain foods thoroughly and quickly. The foods thus frozen can be stored in the refrigerator and kept in frozen condition until they are to be used.

The refrigerator is intended for commercial establishments and also for private use, i. e. family use, and to render it more applicable to all types of refrigeration and more efficient for the user, another feature is added. An ordinary cooling compartment is supplied for cooling other foods which must be kept at a temperature that is above freezing but yet cool.

Such refrigerators are necessarily large in order to store a substantial quantity of food, and in the present invention the cooling compartment is large enough for a person to walk into it. The installation of such constructions becomes quite a problem. The refrigerators are so large it is inconvenient to assemble them completely at the factory, and to assemble them at the point of use entails the services of skilled men who are not always available.

To overcome this difficulty I build the refrigerator in two sections, a smaller section containing the freezing compartment and all the refrigerating apparatus, and a larger section consisting of a cooling compartment only, which is cooled by air driven from the smaller section containing the refrigerating apparatus. The smaller section is assembled at the factory and the refrigerating apparatus and controls are adjusted. The larger section is disassembled for shipment, and the user can set it up ready for use without the aid of skilled men.

A principal object therefore, of my invention, is to provide a refrigerator in which all the operating parts and controls are contained in a small, separable section.

Another object is the provision for cooling one section of a refrigerator by circulated air from another section in which is located the refrigerating apparatus.

A further object of the invention is to provide a refrigerator having a freezing compartment and a cooling compartment for maintaining a temperature above freezing, in which access to the freezing compartment may be gained only through the cooling compartment.

Still another object is the provision of a refrigerator having compartments for maintaining different temperatures, and having common refrigerating apparatus and individual controls for selectively controlling the temperatures of the different compartments.

A still further object is to provide a master control independent of the above mentioned individ-

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ual controls for shutting off the refrigerating apparatus when all the compartments are cooled to the desired temperatures.

With these and other objects in view, my invention consists in the construction, arrangement and combination of the various parts of my device, whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in the claims and illustrated in the accompanying drawings, in which:

Fig. 1 is a perspective view of the refrigerator with the sections separated;

Fig. 2 is a vertical sectional view taken on line 2-2 of Fig. 1, but with the sections together;

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

Fig. 4 is a vertical sectional view taken on line 4-4 of Fig. 2;

Fig. 5 is a diagrammatic view of the operating parts of the refrigerator;

Fig. 6 is the electric circuit diagram for the refrigerating apparatus;

Fig. 7 is a vertical sectional view of the air cooler containing a coil forming an extension of the refrigerant conduit for cooling the air stream to the cooling compartment; and

Fig. 8 is a sectional view of a shelf used in the freezing compartment showing another coil forming an extension of the refrigerant conduit in the hollow space in the shelf.

Referring now in detail to the drawings, Fig. 1 shows the refrigerator as a whole, indicated generally at 12, which comprises a small section 13 containing a freezing compartment and all of the refrigerating apparatus, and a larger section 14 constituting a cooling compartment. Attention is directed to Figs. 2, 3 and 4 which show an upper large freezing compartment 15, and two lower smaller compartments, an air circulating compartment 16, and a compressor compartment 17. The compartments 16 and 17 are thermally insulated from one another by a wall 18 of insulation, and these two compartments are insulated from the freezing compartment 15 by a substantial thickness of insulation 19. The freezing compartment 15 and the air circulating compartment 16 are also insulated from the outside atmosphere by a similar wall of insulation 19. This insulation may be of any suitable type. The compressor compartment 17 is open to atmosphere through two openings 20, one located on each of two sides (see Figs. 1 and 4) for the dissipation of heat therethrough.

The section 14 has one end open as shown at 21 which is adapted to be fitted to and secured to the section 13. The section 14 aside from its open end is otherwise fully enclosed on all sides by panels 22 of suitable insulating material, and when it is secured to the section 13 it forms a compartment 22 which is large enough for a per-

son to walk into it and will be referred to as a walk-in or cooling compartment. The section 14 is preferably made up of separable panels secured together by convenient means, so that they can be knocked down for shipment. The section 14 is secured to section 13 as by bolts 23 secured in registering cavities 24 formed in the walls of the two sections, or by other convenient means. A large door 25 is provided in one side of the walk-in compartment for entrance thereinto. Also there is a door 26 provided in the wall 27 between the freezing compartment 15 and the cooling compartment 22 for gaining access to the freezing compartment from the walk-in, or cooling compartment. The freezing compartment 15 and the cooling compartment 22 may also be referred to as refrigerating compartments.

The refrigerating system provided for cooling the various compartments includes a compressor 29 powered by an electric motor 30. Conduits to be referred to later, lead from the compressor to shelves 31 secured in the freezing compartment 15. The shelves 31 are spaced vertically for placing foods thereon for freezing and storing, and an additional shelf element is secured at the top of the freezing compartment for thorough cooling of all sections of the compartment. The shelves 31 are hollow, being formed of spaced plates 32 (see Fig. 8) for the reception of coils 33 of the refrigerating conduit which have contact with the plates 32.

The air circulating compartment 16 has a large opening 34 communicating with the cooling compartment 22. In the lower part of the opening 34 is an air cooler 35 which consists of an open rectangular framework 36 (see Fig. 7) provided with screens 37 on its open sides and which support a second coil 38 of the refrigerant conduit. Fixed to the rear side of the air cooler is a shield 39, having a slight taper rearwardly and having its rear side open. A fan 40 powered by a motor 43 is mounted in the air circulating compartment 16 and positioned so that it drives the air out of the air circulating compartment through the air cooler 35 and over the refrigerant conduit extension 38 into the cooling compartment 22. The fan 40 itself is disposed within the shield 39 for positively directing the air from the fan through the air cooler 35. The air then circulates through the cooling compartment and returns through the upper part of the opening 35 into the air circulating compartment as indicated by the arrows therein in Fig. 3. Positioned in the upper part of the opening 34 above the air cooler 35 in the return path of the circulating air is a thermostat 41 for controlling the temperature of the air in the cooling compartment 22. This control will be referred to later.

Reference may now be had to Fig. 5 showing the diagram of the cooling unit or refrigerating apparatus. A refrigerant conduit 42 leads from the compressor 29 on the high side of the refrigerant circuit to the receiver tank 44, then to a drier 45 for removing moisture from the refrigerant and to a heat exchanger 46. From the heat exchanger 46 the conduit 42 continues to the shelves 31 in the freezing compartment 15. Refrigerant passes serially through the coils 33 of the conduit 42 in the shelves 31 from the lowermost to the uppermost, or in any other order desired, and returns through the low side conduit 47 through the heat exchanger 46 and back to the compressor, completing a refrigerating cycle in a known manner.

A parallel refrigerant circuit for the cooling compartment 22 consists of a conduit 49 connected to the outlet conduit 42 beyond or on the far side of the heat exchanger from the compressor 29, and leading to the air cooler 35 and through the coils 38 therein. From the air cooler 35, a low side conduit 50 returns to the conduit 47 and back to the compressor. An extension conduit 51 communicates with the conduit 47 and leads to a low side pressure control device 52. This pressure control device 52, is responsive to the pressure of the refrigerant, and operates a switch 53 for turning the motor 30 on and off.

The foregoing description of the refrigerating system is a conventional arrangement as is found in most refrigerators. However, I provide a novel arrangement and a system of operation and control which has hitherto not been used. A thermostatic expansion valve 54 is interposed in the high side conduit 42 before its entrance into the shelves 31 and is controlled by a thermo-responsive device 55 in the low side conduit 47. The control device 55 is in the form of a bulb in thermal contact with the low side conduit 47 and by means of the expansion of a fluid therein, operates the expansion valve 54. On lowering of the temperature in the freezing compartment, in which the shelves 31 are located, the refrigerant in the low side conduit 47 lowers in temperature also, and the control device 55 closes down the expansion valve 54. A similar arrangement is provided in the parallel circuit for the air cooler 35 for cooling compartment 22. A thermostatic expansion valve 56 is placed in the high side conduit 49 and is controlled by a thermo-responsive control device 57 sensitive to the temperature in the low side conduit 50. In addition to this control a solenoid valve 59 is placed in the high side conduit 49 and is connected with a switch 60 which in turn is connected to and operated by the thermostat 41 which is positioned in the upper part of the opening 34 above the air cooler 35. The air returning from the cooling compartment 22 to the air circulating compartment 16 affects the thermostat 41, and when the temperature of that air reaches the lower limit of temperature set for it, the switch 60 is opened and the solenoid valve 59 closes. A check valve 58 is positioned in the low side conduit 47 for preventing reverse flow of refrigerant therethrough. The returning refrigerant from the air cooler being at a higher temperature, and higher pressure, would tend to flow in a reverse direction in the low side conduit 47 if it were not for the check valve 58.

Fig. 6 shows the circuit diagram for controlling the operation of the refrigerator. From a main circuit connected to the line at 61, a compressor circuit 62 leads to the compressor motor 30 and the low side pressure control switch 53. Another circuit 64 leads to the fan motor 43 in the air circulating compartment 16 for circulating the air through the cooling compartment 22. A light 65 may be connected to this circuit and provided in the refrigerator if desired. Also on this circuit are the solenoid valve 59 in the low side conduit 49 and its operating switch 60.

Use and operation

The apparatus is set to maintain different temperatures in the refrigerating compartments, that is, the freezing compartment 15 and the cooling compartment 22. The refrigerator is designed for quick freezing and for storing the food thus frozen and retained frozen until it is ready for use. The freezing compartment 15 must be

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kept at a temperature considerably below the freezing point of water. The cooling compartment 22 is designed to be used as an ordinary refrigerator. Access to the cooling compartment is gained through the door 25 by which a person may walk into the compartment, and from inside the walk-in or cooling compartment, access may be gained to the freezing compartment 15 through door 26 between the two compartments. It will be seen that the freezing compartment is not open at any time to the outside atmosphere, but only to the cooling compartment 22, making it little likely that the freezing compartment will warm up very fast from having the doors opened.

In operation, when both the refrigerating compartments are cooled down to the proper temperatures, the compressor is not operating. When either of the compartments rises in temperature above the set limit, e. g. the freezing compartment 15, the temperature of the refrigerant in the low side conduit 47 increases and affects the thermo-responsive device 55 which opens the expansion valve 54. Refrigerant from the receiver tank 44 is thereupon released which cools the compartment. The operation is similar in connection with the air cooler 35. The refrigerant thus released increases the pressure in the low side, and when the pressure reaches a certain set limit, it actuates the low side pressure control device 52 which turns on the switch 53 and starts the compressor motor 30. When the compartments are then cooled down to the limit set for them, the thermo-responsive elements 55 and 57 will actuate to close down the corresponding expansion valves 54 and 56.

Thermostat 41 is provided as an additional control for controlling the temperature of the cooling compartment 22. When the return air from the cooling compartment 22 reaches its lower temperature limit, it actuates the thermostat 41 which in turn opens the switch 60 and closes the solenoid valve 59, thereby shutting off the flow of refrigerant completely to the air cooler 35. When both refrigerating compartments have been cooled to their respective lower limits, the pressure of the refrigerant in the low side conduit 47 is lowered and the low side pressure control 52, which has been set at this limit, operates to cut the switch 53 on the compressor motor 30.

Although the refrigerant may be cut off completely from the air cooler 35, and the compressor stopped, the fan 40 continues to operate and does so constantly, to provide for more thorough circulation in the cooling compartment 22 and render the refrigerating apparatus more sensitive to temperature conditions.

By this novel arrangement and construction the complete refrigerating equipment is contained in the section 13 of the refrigerator and can be completely installed therein and adjusted at the factory. It would be cumbersome and costly to set up completely and ship a refrigerator of this size. The section 13 is put into place and the section 14, which can be shipped knocked down is merely assembled and put into position and secured by the user. Yet the capacity of the refrigerating apparatus is as effective for cooling the cooling compartment 22 as in the case of any other refrigerator.

Although I have herein shown and described a preferred embodiment of my invention, manifestly it is susceptible of modification and rearrangement of the parts without departing from the spirit and scope thereof. I do not, therefore, wish to be understood as limiting my in-

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vention to the precise form herein disclosed, except as I may be so limited by the appended claims.

I claim as my invention:

1. In a sectional refrigerator, the combination of a first and second section adapted to be fitted together and having intercommunication when fitted together, the first section having a first refrigerating compartment, the second section forming a second refrigerating compartment with the first section when the sections are secured together, means for securing the sections together, refrigerating means in the first section for cooling both of said compartments, a first refrigerant conduit for cooling the first compartment by conduction, a second refrigerant conduit in the first section and means for impelling air over the second refrigerant conduit and into the second compartment for cooling the second compartment by convection.

2. In a sectional refrigerator, the combination of a first and second section adapted to be fitted together and having intercommunication when fitted together, the first section having a first refrigerating compartment, the second section forming a second refrigerating compartment with the first section when the sections are secured together, means for securing the sections together, refrigerating means in the first section for cooling both of said compartments, a first refrigerant conduit for cooling the first compartment by conduction, a second refrigerant conduit in the first section, means for impelling air over the second refrigerant conduit and into the second compartment for cooling the second compartment by convection, and means responsive to the temperature of the second refrigerant conduit for controlling the temperature of the second compartment.

3. A sectional refrigerator comprising in combination, a first and second section adapted to be fitted together and having intercommunication when fitted together, the first section having a first refrigerating compartment, the second section forming a second refrigerating compartment with the first section when the sections are secured together, means for securing the sections together, refrigerating means in the first section for cooling both of said compartments, a first refrigerant conduit for cooling the first compartment by conduction, a second refrigerant conduit in the first section, means for impelling air over the second refrigerant conduit and into the second compartment for cooling the second compartment by convection, and means responsive to the temperature of the convected air for controlling the temperature of the second compartment.

4. A separable refrigerator comprising, in combination, a first section having a first refrigerating compartment and an air circulating compartment, a single cooling unit in the first section for cooling the first refrigerating compartment, the first section forming complete self-contained refrigerator, a second section forming a second refrigerating compartment with the first section when the sections are secured together, means for securing the sections together, there being an opening in the air circulating compartment communicating with the second refrigerating compartment, and means for circulating air between the air circulating compartment and the second refrigerating compartment, said cooling unit being adapted to cool the circulated air.

5. A separable refrigerator comprising, in com-

bination, a first section having a freezing compartment, a compressor compartment and an air circulating compartment, all of the compartments being thermally insulated from one another, a cooling unit in the first section and having its source of operation in the compressor compartment for cooling the freezing compartment, the first section being a complete self-contained refrigerator, a second section forming a cooling compartment with the first section when the sections are secured together, means for securing the sections together, the cooling compartment being thermally insulated from the freezing compartment and the compressor compartment, a second cooling unit in the first section adapted for cooling the cooling compartment, and individual controls for selectively controlling the temperatures in the freezing compartment and the cooling compartment.

6. In a refrigerator of the class described, having a freezing compartment, a cooling compartment thermally insulated from the freezing compartment, an air circulating compartment thermally insulated from the freezing compartment, the combination of a cooling unit for cooling the freezing compartment and the air circulating compartment, the air circulating compartment having an opening communicating with the cooling compartment, means for circulating air from the air circulating compartment to the cooling compartment and return, and thermo-sensitive means in the air circulating compartment disposed in the return path of air for controlling the temperature of the cooling compartment.

7. The combination in a sectional refrigerator construction, comprising a first cabinet having a refrigerating compartment, a compressor compartment adjacent the refrigerating compartment and thermally insulated therefrom and open to atmosphere, an air circulating compartment adjacent the refrigerating and compressor compartments and thermally insulated therefrom, means for cooling the refrigerating compartment and the air circulating compartment, a second cabinet having one end open and adapted to be secured to the first cabinet with its open end adjacent the first cabinet, means for securing the cabinets together, the second cabinet forming a second refrigerating compartment, and means for cooling the second refrigerating compartment from the air circulating compartment.

8. A refrigerator having a freezing compartment and a cooling compartment, comprising, in combination, a common refrigerating apparatus for cooling said compartments, a refrigerant conduit for circulating a refrigerant through said freezing compartment for cooling the same by conduction, a second refrigerant conduit remote from and communicating with the cooling compartment, means for driving air over the second refrigerant conduit and circulating the same through said cooling compartment, means responsive to the second refrigerant conduit for controlling the temperature in said cooling compartment, and means responsive to the temperature of the air stream after it has circulated through the cooling compartment for controlling the temperature in said cooling compartment.

9. A large size refrigerator construction adapted for entrance thereto of a person, said refrigerator adapted to be knocked down for shipment,

comprising, in combination, a relatively small first section having a refrigerating compartment, refrigerating means in the first section for cooling the refrigerating compartment therein, the refrigerating compartment having a single access opening therein, the first section comprising a self-contained refrigerator, and a relatively large second section adapted to be fitted to the first section, the second section containing no refrigerating mechanism and adapted to be knocked down into panels, the second section forming a second refrigerating compartment and being adapted for the entrance of a person and having communication with the refrigerating compartment in the first section, the refrigerating means in the first section having thermal communication with and adapted to cool the second refrigerating compartment.

10. A large size refrigerator construction adapted for entrance thereto of a person, said refrigerator adapted to be knocked down for shipment, comprising, in combination, a relatively small first section having a refrigerating compartment, a compressor compartment adjacent the refrigerating compartment and thermally insulated therefrom and open to atmosphere, an air circulating compartment adjacent the refrigerating and compressor compartments and thermally insulated therefrom, refrigerating means having its source of operation in the compressor compartment and being adapted to cool the refrigerating compartment and the air circulating compartment, the refrigerating compartment having a single access opening therein, the first section comprising a self-contained refrigerator, a relatively large second section adapted to be fitted to the first section, the second section containing no refrigerating mechanism and adapted to be knocked down into panels, the second section forming a second refrigerating compartment and being adapted for the entrance of a person and having communication with the refrigerating compartment in the first section, the air circulating compartment and the second refrigerating compartment having intercommunication, and means for cooling the second refrigerating compartment from the air circulating compartment.

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