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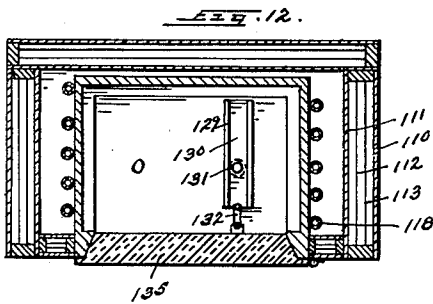
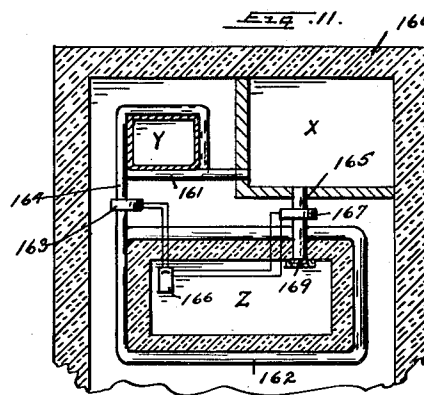
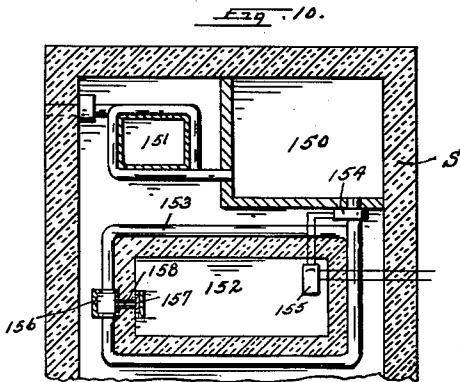
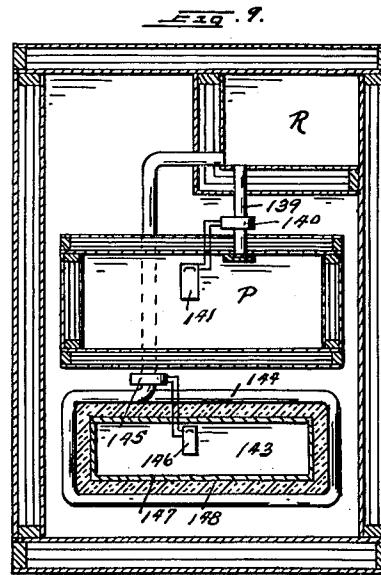
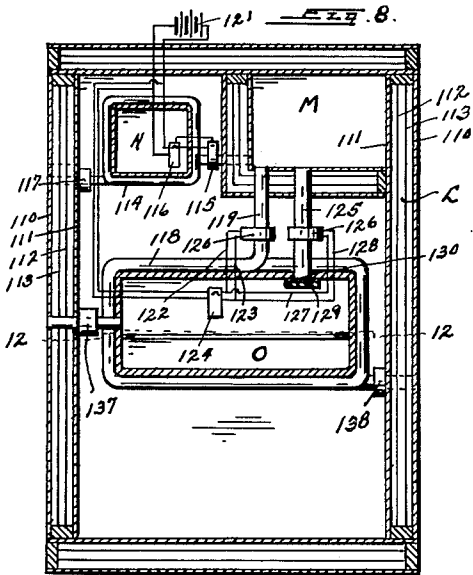
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2,089,965

REFRIGERATOR

Filed Nov. 26, 1934

3 Sheets-Sheet 2



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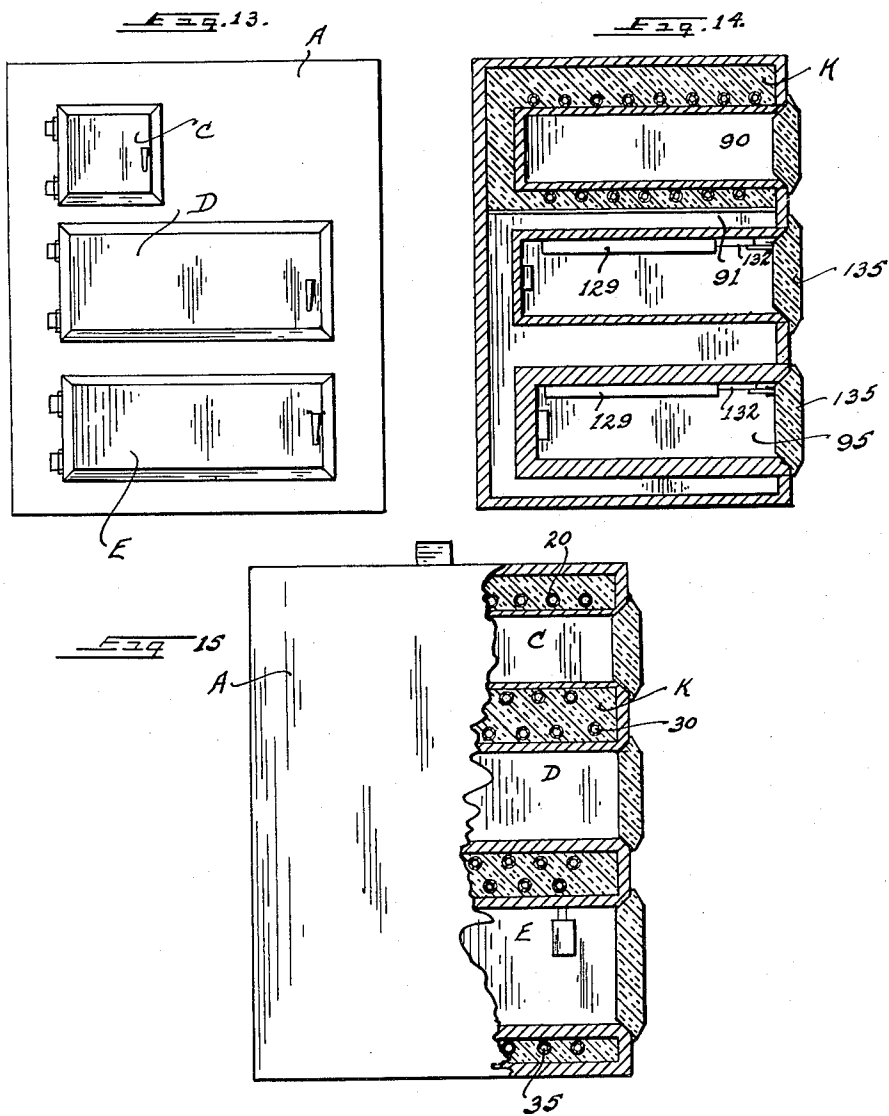
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UNITED STATES PATENT OFFICE

2,089,965

REFRIGERATOR

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Application November 26, 1934, Serial No. 754,795

8 Claims. (Cl. 62—91.5)

My invention relates to refrigerators and has for its object to provide a new and efficient refrigerator in which solid carbon dioxide is the refrigerant used.

5 A further object is to provide a refrigerator in which separate compartments having separate closures, maintain certain predetermined temperatures in each compartment.

10 A still further object is to provide a refrigerator having separate compartments with each compartment controlled by an internally situated thermostat which controls the flow of carbon dioxide gas which has sublimated from solid carbon dioxide through coils surrounding each separate compartment, to maintain a predetermined temperature in each compartment.

15 A still further object is to provide a solid carbon dioxide gas refrigerator in which the subliming of the gas from the carbon dioxide is retarded as much as possible without changing the efficiency of the refrigerating qualities of the gas thus, making refrigerators which will be low in running costs and which will be simple and yet highly efficient.

25 These objects I accomplish with the device illustrated in the accompanying drawings in which similar numerals and letters of reference indicate like parts throughout the several views and as described in the specification forming a part of this application and pointed out in the appended claims.

In the drawings I have shown

Figure 1 as a vertical transverse section of one of my refrigerators.

35 Figure 2 is a vertical transverse section of another type of case.

Figure 3 is a vertical section of still another form.

Figure 4 is a section of a modified way of making each refrigerator compartment.

40 Figure 5 is a vertical section of a form of a refrigerator in which the two lower compartments are completely surrounded by the carbon dioxide gas and the quick freezing compartment is surrounded by a coil.

Figure 6 is a plan view of the compartment C of Figure 1 with the coil shown there surrounding.

Figure 7 is a sectional view of the ice compartment of the refrigerator using a different type of insulation and showing the forming of dry ice from a source exterior of the refrigerator such as a storage tank.

Figure 8 is a vertical section of a refrigerator having the walls formed insulated by a thin metal foil, with the ice chamber connected direct to the

coil surrounding the food compartment and another passage connected direct to the interior of the food container.

Figure 9 is a section of another form in which the cold is supplied to the interior of the food compartment.

Figure 10 is a sectional view showing the food compartment insulated with a means in the coil for supplying carbon dioxide gas into the compartment.

Figure 11 is a sectional view showing insulated food compartment with the quick freezing compartment cooling coil connected in series to the coil around the food compartment and means to direct gas direct into the food compartment.

Figure 12 is a section on line 12—12 of Figure 8.

Figure 13 is a front elevation of one of the refrigerators.

Figure 14 is a section vertically through the refrigerators showing the different food compartments.

Figure 15 is a side elevation of the refrigerator, parts cut away, to show the different food compartments and the means of cooling them.

In the drawings in Figure 1, I have shown my device as made of a casing A having an air tight ice chamber B in one corner thereof, the chamber having an air tight closure 1 in the top thereof through which blocks of solid carbon dioxide may be inserted manually. Within the casing A, I then provide my storage compartments C, D, and E. These compartments are made with suitable closures therefor, leading thereinto, each compartment being closed from the front face with a separate door therefor. The compartment C is shown as made smaller and is used for quick freezing. This compartment may be used for ice cubes, for quick freezing of meats and other like foods.

The compartment D is made for keeping butter, milk, and like ingredients, and the compartment E is made for fresh vegetables etc.

The compartment C is surrounded by a cooling coil 5 having one end 6 connected with the ice chamber B, and the other end of the coil connected with a blow off valve 7 which leads into the atmosphere.

The compartment D is surrounded by a coil 10 which is connected with the ice compartment B by the pipe 12 and to the blow off valve by the pipe 14.

The compartment E is surrounded by the coil 15 which coil is connected with the ice chamber B by a pipe 16 and to a blow off valve 17 by a pipe 18.

Thus, each chamber is surrounded by a separate coil leading from the ice compartment to the atmosphere. The sublimed gas from the "dry ice" or solid carbon dioxide is passed through the coils by the pressure built up in the ice compartment and when sufficient pressure is attained in the coils the gas is allowed to escape through the blow off valve.

In this type of refrigerator the blow off valve is the only means of regulating the temperatures in the various compartments.

In Figure 2 I have shown a like refrigerator with the same casing A, the same refrigerating compartments C, D, and E, and the same ice chamber B. In this type of refrigerator the quick freezing compartment is surrounded by a coil 20, which coil is connected to a thermostatically operated control valve 21 by a pipe 22 and which valve 21 is connected with the ice compartment by the short nipple 23. Thus, the ice compartment provides cold gas for the coil 20, but the cooling is controlled by controlling the flow of gas thereto.

A thermostat 24 is mounted in the interior of the compartment C and is connected by lead in wires 25 and 26, with a source of electrical energy such as a battery or a transformer F from a higher voltage line. Wires 27 and 28 connect the valve 21 with the thermostat so that the thermostat may be set at any desired degree of temperature and the valve will then control the amount of gas passing through the coil so that the predetermined temperature will be maintained in the compartment.

The coil 21 then, instead of exhausting through a blow off valve as shown in Figure 1, is connected with a coil 30 surrounding the compartment D, and this coil in turn is connected with a coil 35 surrounding the compartment E. Thus, all of the coils are connected to one common source in series.

A control valve 32 is mounted in the pipe 33 which connects the coil 21 with the coil 30 to control the flow of gas passing from the coil 21 into the coil 30 and this control valve is actuated by a thermostat 34 mounted internally in the compartment D, thus, the temperature in the compartment D may be set at let us say, 20 degrees above zero, and the control valve will allow just that amount of gas to pass into the coil which will maintain this temperature in the coil and compartment. Wires 36 and 37 connect the valve 32 with the thermostat 34, and wires 38 and 39 connect the thermostat 34 with the lead in wires 25 and 26 of the transformer F.

A control valve 41 is mounted in the pipe 47 which connects the coil 30 with the coil 35 to control the flow of gas into the coil 35 and the temperature in the compartment E is controlled by a thermostat 42 mounted in the compartment E and wires 43 and 44 connect the valve 41 and the thermostat 42, and wires 45 and 46 connect the thermostat with the wires 25 and 26 and the source of power. A blow off valve 48 is mounted in the outlet end 49 of the coil 35 to prevent excess pressure in the coil.

In this type of device, the user of the refrigerator sets the thermostats in the separate refrigerator compartments and then places the "dry ice" or solid carbon dioxide in the ice compartment B. The subliming of the ice forms the cold gas which passes through the control valve 21 into the coil 20 and as all of the thermostats are set at a predetermined temperature, lower than that in the compartments to start with,

the gas will flow freely through all of the coils to the check valve. When sufficient gas is in the bottom coil 35 to cool this compartment to the temperature desired, say 45 degrees, then the thermostat 42 operates the control valve 41 and shuts off the gas into the coil 35. Also when the coil 30 reaches a low enough temperature to cool the compartment D to the desired temperature, say 20 degrees above zero, then the thermostat 34 closes the valve 32 and this coil is cut off from the supply. When the temperature in the compartment C reaches a temperature say ten degrees below zero, the thermostat 24 closes the valve 21 and the gas is then held in the ice chamber B until such time as one or the other of the compartments has reached a high enough temperature to need more cooling at which time one or all of the thermostats may be operated, depending upon the degree of temperature in the compartments until the predetermined temperatures are again reached. Should there be too much gas formed in the chamber B and not used in the cooling coils, then, a blow off valve 50 will be used in the chamber B to allow for escapement of this gas to the atmosphere as a safety valve. Each coil may be provided with a blow off valve if necessary.

In Figure 3 of the drawings I have shown the same casing A, the same ice chamber B, the same refrigerating compartments C, D, and E.

In this device each compartment is provided with a separate control and each has its cold supply drawn directly from the ice chamber B.

In this figure the compartment C is surrounded by a coil 55, connected to a control valve 56 by a pipe 57 and the control valve is connected with the ice chamber by a pipe 58. The outlet of the coil 55 is direct to a blow off valve 59 which valve controls the pressure in the coil 55. A thermostat 60 controls the valve 56 and the thermostat is connected thereto by wires 61 and 62 and the thermostat is connected with the transformer F by the lead in wires 63 and 64. The compartment D is surrounded by a coil 65 which is controlled by a valve 66 and which valve is connected with the chamber B by the pipe 67. A thermostat 68 set in the compartment D controls the valve 66 by wires 68 and 69, and wires 70 and 71 connect the thermostat 68 with the lead in wires 63 and 64. The end of the coil 65 leads into a blow off valve 73 which controls the pressure in this coil.

The compartment E is surrounded by a coil 75 which is connected to a control valve 76 which in turn is connected to the chamber B by the pipe 74. A thermostat 77 controls the temperature in the compartment by connection with the valve 76 by the wires 78 and 79. Wires 80 and 81 connect the thermostat with lead in wires 63 and 64. A blow off valve 83 controls the pressure in the coil 75.

In this type of device which will probably be the most preferred type, each coil is connected direct to supply of gas and is individually controlled, which may give the best satisfaction in the operation thereof.

In Figure 4 I have shown a compartment G which may be made with hollow walls as shown and the gas directed into the envelope chamber 85 between the walls of the compartment, introduced therein through the pipe 86 from the chamber B which was not shown in this figure. This construction would eliminate the use of the coil for cooling.

In Figure 5, I have shown a device in which

the freezing chamber is made like that shown in Figure 2, except that the discharge from the pipe 88 leading from the coil 89 surrounding the cold compartment 90 leads down into a large compartment 91 in which, compartments for storage of foods are mounted. In this large compartment the separate food storage compartments are so mounted that the gas completely surrounds them so that they will both be the same temperature, unless different amounts or types of insulation are used in constructing the walls of the separate compartments or by allowing atmospheric air to enter the compartments as shown in the lower compartment.

A thermostat 92 in the large compartment 91 controls the valve 93 to control the temperature in the compartment 91 and thereby the temperature in each food compartment. A discharge blow off valve is mounted through the wall of the compartment 91 to control the pressure therein. The coil 89 is connected direct to the ice chamber B and the gas surrounding the compartment 90 is the same temperature as that of the chamber B and as shown this compartment is not controlled by thermostat or valve, but such control may be used if desired or found necessary. In this figure the lower compartment 95 is shown with an inlet pipe 96 and an outlet pipe 97 leading into and out of the compartment from the atmosphere and these pipes may be controlled by thermostats 98 to control the amount of atmospheric air allowed to enter the compartments. This is to provide another means for holding the temperature in the compartments at a predetermined level. All of the compartments may be provided with this atmospheric air if necessary.

In Figure 7 of the drawings I have shown a form of wall construction and a different form of introducing the "dry ice." In this figure the ice chamber 100 is provided with an inlet pipe 101 leading from a source of liquid carbon dioxide under high pressure so that when the valve 102 is opened the ice will be formed in the chamber 100. Thus, the ice may be provided in a gas or liquid container and formed within the refrigerator. This type of forming ice is shown in my patent application for Refrigerators filed September 13, 1934, Serial Number 743,857. Also in this figure the walls are made of outer sheets of material 105 and inner walls 104 with sheets of highly reflective material 106 and 107 set therebetween. The pipe 103 leading from the ice chamber 101 leads into the cooling coils such as are shown in the other figures of the drawings.

Suitable insulation 108 may be used surrounding the ice compartment and around the coils as desired.

In all of the figures of the drawings where insulation is necessary surrounding the coils, the insulation has been shown as K.

In Figure 8 I have shown the outer casing as L having the walls thereof formed of insulation made of an outer sheet of metal or other suitable material 110, and an inner sheet of like material 111, with spaced apart sheets of thin highly reflective metal or metal coated material 112 and 113. The ice chamber M is made in the same manner and the ice is placed therein through an opening in the front of the casing, (not shown).

The quick freezing compartment N is surrounded by a coil 114 and the coil has the gas therein controlled by a valve 115, which in turn is controlled by a thermostat 116 mounted in the compartment. The outlet of the coil ex-

hausts into the atmosphere and is controlled by a suitable pressure blow off valve 117.

The food compartment O is surrounded by a coil 118 which draws its cold gas from the ice chamber M through the pipe 119 and the gas is controlled by a valve 120. This valve is controlled by a thermostat 124 mounted within the compartment O and suitable wires connect the thermostat with a battery 121. Wires 122 and 123 connect the thermostat 124 with the valve 120. A direct feed of gas into the interior of the compartment O is provided by connecting a pipe 125 from the ice chamber M to the compartment O and a control valve 126 is provided in the pipe to control the flow of gas therethrough. This valve 126 is controlled by the thermostat 124 being connected therewith by wires 127 and 128. A valve 129 of the slide type valve is mounted over the end of the pipe 125 and this valve is controlled by the opening and closing of the door. The valve is made of a long plate 130 having a port 131 therein, said port to be brought into alignment with the open end of the pipe when the door is closed but to close the pipe when the door is opened. A link 132 connects the plate to the door 135 and with this valve on the end of the pipe the pipe is only open when the door is closed. Thus, when the door has been opened and the compartment warmed the closing of the door opens the end of the pipe and as the temperature naturally has been higher in the compartment when the door is open, the thermostat 124 will have operated, opening the valves 120 and 126. Thus, gas is then passing through the coil 118 and at the same time the pipe 125 is open to the closure plate valve 130. When the door is closed, the plate valve opens the end of the pipe 125 and a spurt of gas is directed into the compartment to aid in quickly returning the interior temperature of the compartment O to its predetermined level. As soon as this level is reached the thermostat will shut off both valves until either the temperature rises from natural causes or until the door is again raised. The valves may be made to allow one to shut off before the other if desired. A pressure blow off valve 137 is provided in the compartment O to prevent an excess gas pressure being built up within the compartment and the end of the coil where it exhausts into the atmosphere is provided with a blow off valve 138.

In Figure 9 the food compartment P is connected with the ice chamber R by a direct pipe 139 with a control valve 140 therein actuated and controlled by the thermostat 141 within the compartment P. The compartment P is made of an insulating material similar to the outside of this casing and of the casing shown in Figure 8. This compartment is internally controlled, but is not externally cooled, having only the direct gas cooling means through the pipe 139. The food compartment 143 in this figure is made with a surrounding coil 144 leading from the ice chamber R and controlled by the valve 145 and the thermostat 146. This compartment is made with a metal lining 147 and an insulation 148 therearound with the coil on the outside of the insulation.

In Figure 10 I have shown the casing S as made of any insulation and with the ice chamber shown as 150, and the quick freezing compartment as 151. A food compartment 152 is surrounded by a coil 153 having a control valve 154 provided between the coil and the ice chamber 150 to control the flow of gas from the compartment 152

into the coil 153. A thermostat 155 is provided within the compartment to control the valve 154. In the coil 153 I provide a chamber 156 with a port 158 from this chamber into the interior of the compartment and the port 158 is controlled by a sliding plate valve 157 controlled by the door, (not shown). Thus, a direct spurt of gas may be directed into the food compartment from the coil when the door has been closed. A thermostat may be provided in the port to shut it when the temperature in the compartment has reached a predetermined low temperature if desired.

In Figure 11 I have shown a casing 160 having an ice chamber X therein and the quick freezing compartment Y and food compartment Z are cooled by series connection of the coil 161 surrounding the compartment Y and the coil 162 surrounding the compartment Z. A valve 163 is provided in the pipe 164 between the two coils with the thermostat 166 for controlling the valve within the compartment Z. A direct connection is made between the compartment Z and the ice chamber X through a pipe 165 with a valve 167 to control the flow of gas through the pipe. This valve is controlled by the thermostat 166. A closure valve 169 is provided in the open end of the pipe 165 which valve 169 is controlled by the opening and closing of the door, (not shown). Thus, a direct spurt of gas may be directed into the compartment when the door has been opened and then closed, but the gas is controlled by the thermostat and is shut off by the valve 167 as the temperature is lowered to the degree at which the thermostat is set.

With the devices shown in Figures 8, 9, 10, and 11, a direct flow of gas is provided into the food compartments to cool them when the temperature has been raised by opening the door and leaving it open long enough for the temperature within the compartment to rise sufficient for the thermostat to operate and open the control valves.

Having thus described my invention I desire to secure by Letters Patent and claim:

1. In a carbon dioxide refrigerator, the combination of food compartments; doors for each food compartment; means to maintain different temperatures in each compartment by internal thermostatic control; and means to introduce a charge of carbon dioxide gas into each food compartment after the door thereinto has been opened and then closed.

2. In a refrigerator, the combination of an insulated casing; a solid carbon dioxide chamber carried therein with the walls thereof insulated by sheets of highly reflective metal spaced apart by dead air spaces; a separate food compartment; a pipe leading from the carbon dioxide chamber into and in connection with said food compartment; a thermostat mounted in said compartment; a valve in said pipe with the thermostat to control the amount of opening of the valve depending upon the temperature of the food compartment; a cooling coil surrounding said compartment; a pipe leading from the carbon dioxide chamber to said coil; a valve in said last mentioned pipe; and means to control said last mentioned valve by said thermostat.

3. In a refrigerator, the combination of an insulated casing; a solid carbon dioxide chamber therein; separate food compartments in said casing; doors for said compartments; means to insulate each food compartment separately; means to direct a quick inflow of carbon dioxide into each

food compartment after the door has been opened and then closed and a thermostat means to shut off said quick inflow of gas when the temperature in the compartment is at a predetermined degree.

4. In a control for food compartments in carbon dioxide refrigerators, the combination of separate food compartments; doors for each food compartment; means to cool each compartment from the others by surrounding it with carbon dioxide gas; means to introduce a sudden charge of gas into each compartment when the door is closed; means to restrict the flow of gas into each compartment when the door thereinto is opened; and means to control the charge of gas by a thermostat mounted in each compartment.

5. In a refrigerator, the combination of an insulated casing; a solid carbon dioxide chamber in said casing; a quick freezing food compartment in said casing adjacent said solid carbon dioxide chamber; separate food compartments mounted independently from each other and separately insulated; a coil leading from the solid carbon dioxide chamber surrounding the quick freezing compartment; similar coils leading from the end of the first coil around the food compartments; a pipe leading from the solid carbon dioxide chamber into one of said food compartments; a thermostat in said compartment; a valve mounted in said pipe and another valve in the entrance of said coil surrounding the food compartment, said valves to control the flow of gas through their respective coils or pipes, said valves to be controlled by the thermostat mounted in the compartment.

6. In a refrigerator, the combination of an insulated casing; a solid carbon dioxide chamber in said casing; a quick freezing compartment mounted in said casing; means to cool said compartment by passing gas directly from the chamber through a coil surrounding said compartment; a food compartment under said chamber and quick freezing compartment; a pipe leading from the coil around the quick freezing compartment to a coil surrounding said food compartment; a valve in said pipe; a thermostat in said compartment to control the operation of said valve; means to introduce a quick charge of carbon dioxide gas directly into said food compartment when the door is opened and then closed; and means to shut off said quick charge when the temperature in the compartment has reached a predetermined degree.

7. In a refrigerator, the combination of a food chamber; means to maintain a predetermined temperature in said chamber; and valve means connected with the dooor to said chamber to suddenly lower the temperature in said chamber by an inflow of carbon dioxide gas into the food chamber, after the door has been opened and then closed.

8. In a carbon dioxide refrigerator, the combination of a carbon dioxide ice chamber; separate food compartments mounted in a common casing; a coil leading from said carbon dioxide chamber surrounding one compartment to cool it quickly, said coil discharging into the casing in the space surrounding said food compartment; and a thermostat mounted in said casing in the area surrounding the other food compartments to control the temperature in the surrounding area by controlling the flow of gas from the end of the coil.

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