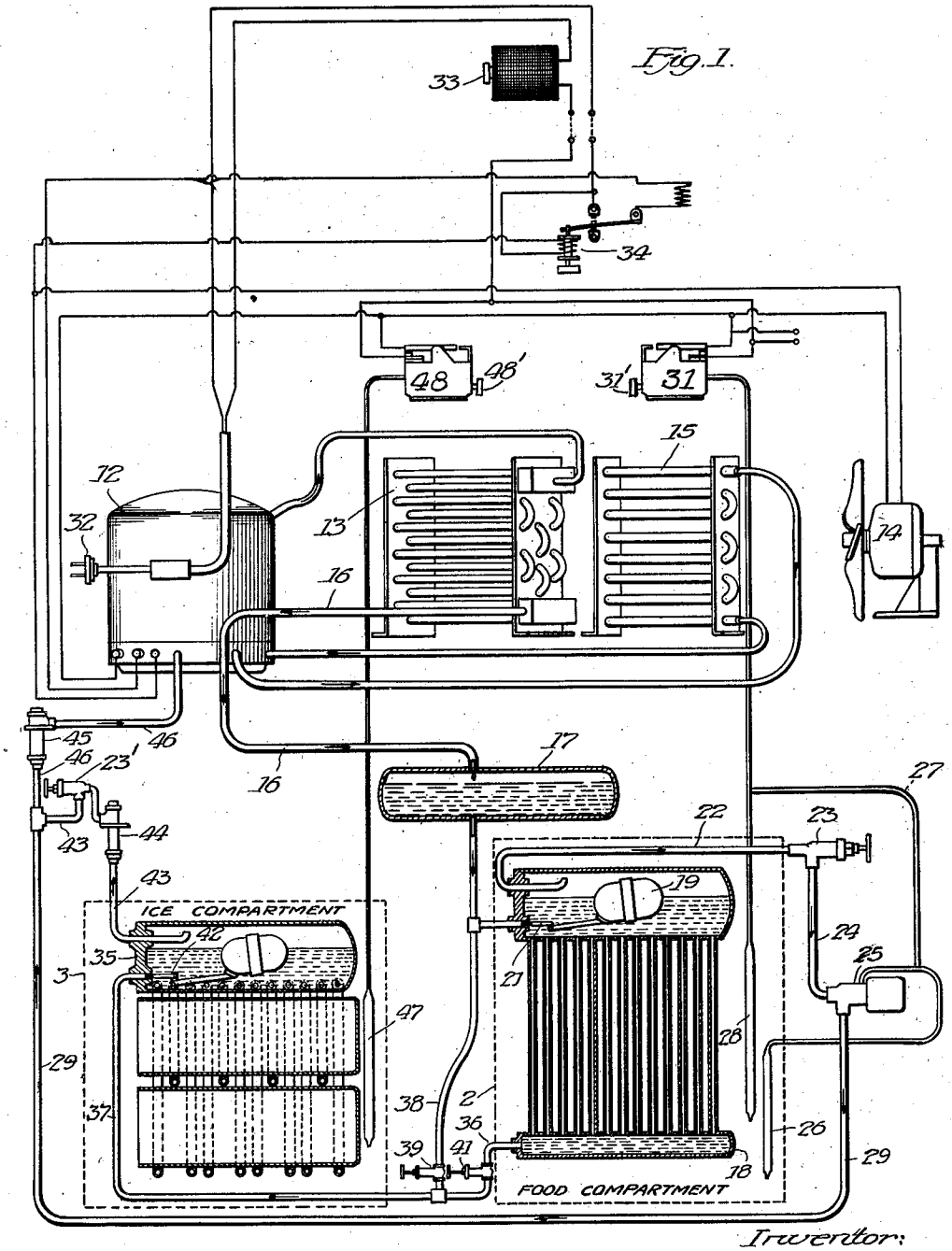
April 21, 1936. C. E. L. LIPMAN 2,038,434

REFRIGERATOR

Filed July 30, 1932 6 Sheets-Sheet 1

Fig. 1.



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REFRIGERATOR

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Fig. 2.

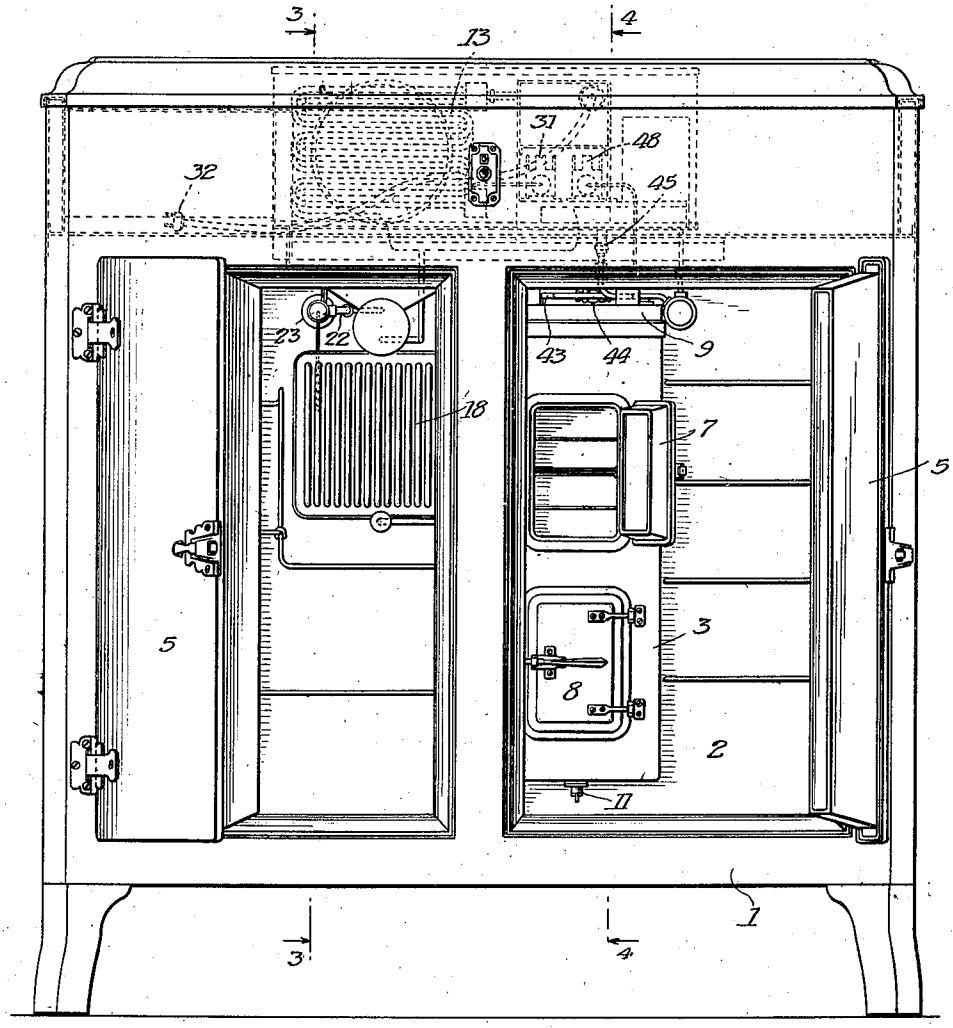

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Fig. 3.

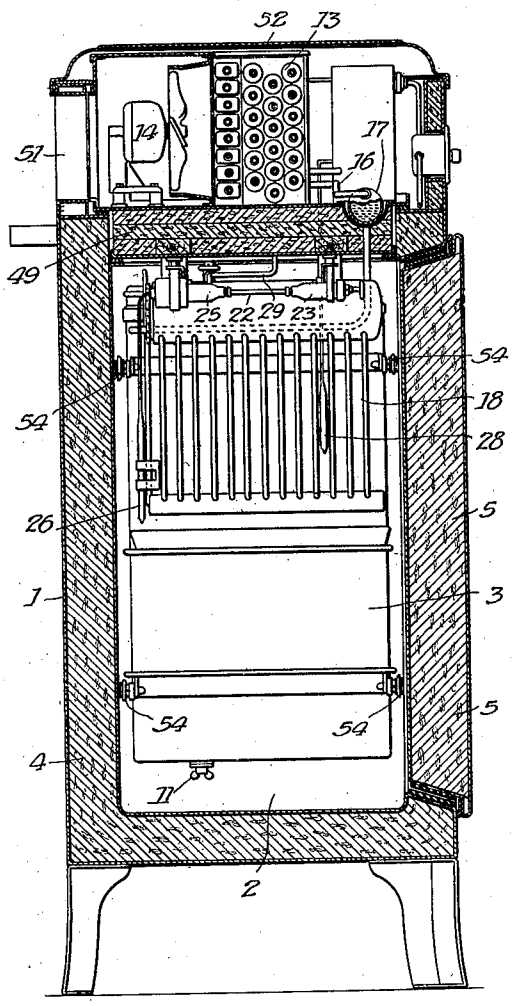
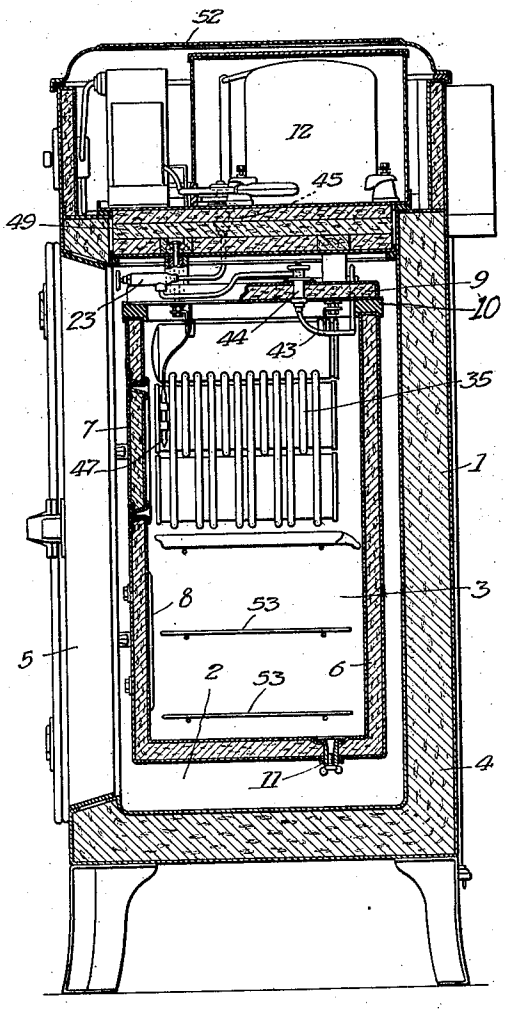


Fig. 4.



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REFRIGERATOR

Filed July 30, 1932 6 Sheets-Sheet 4

Fig. 5.

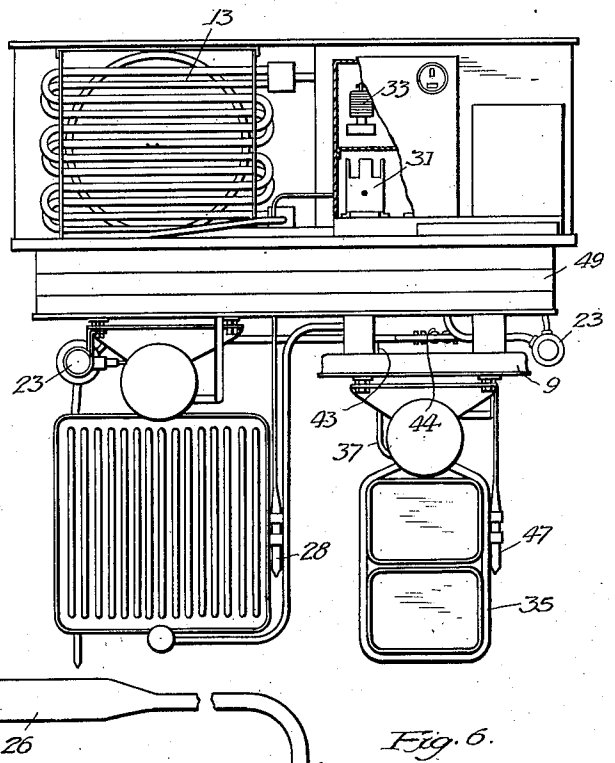


Fig. 6.

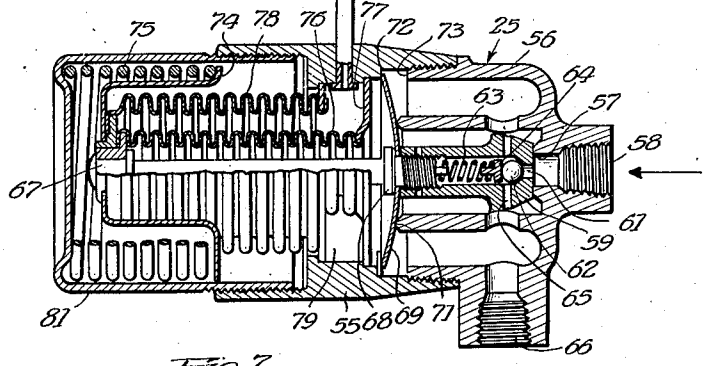
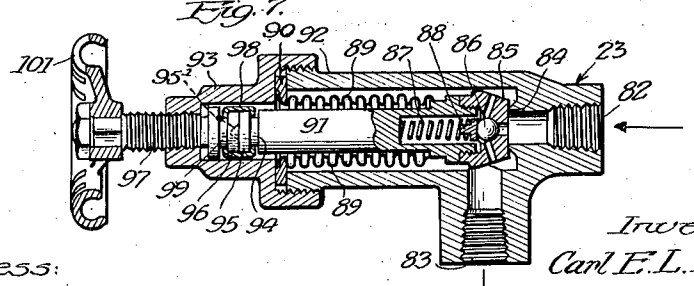


Fig. 7.



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REFRIGERATOR

Filed July 30, 1932 6 Sheets-Sheet 5

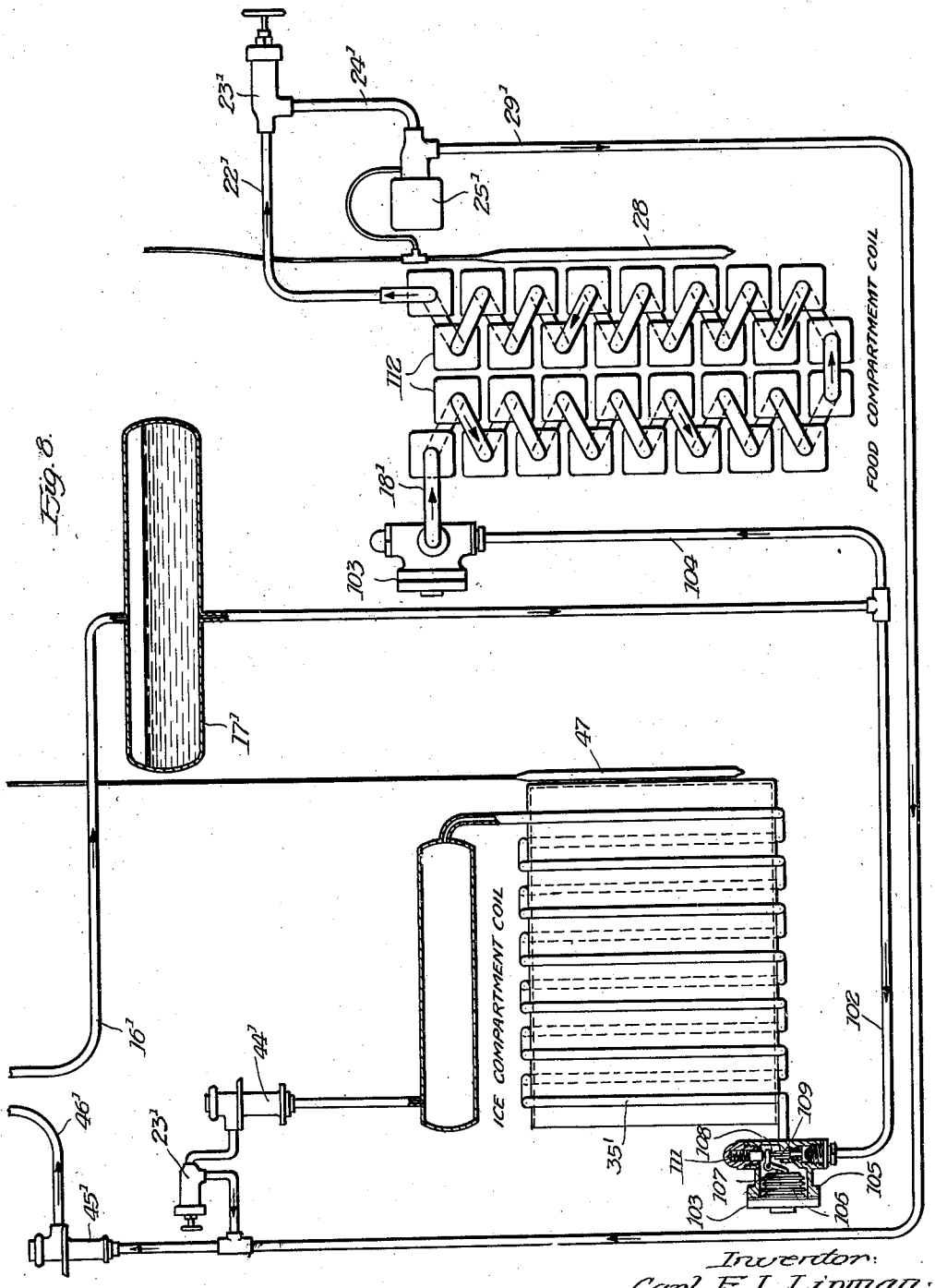

Fig. 8.

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REFRIGERATOR

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Fig. 9.

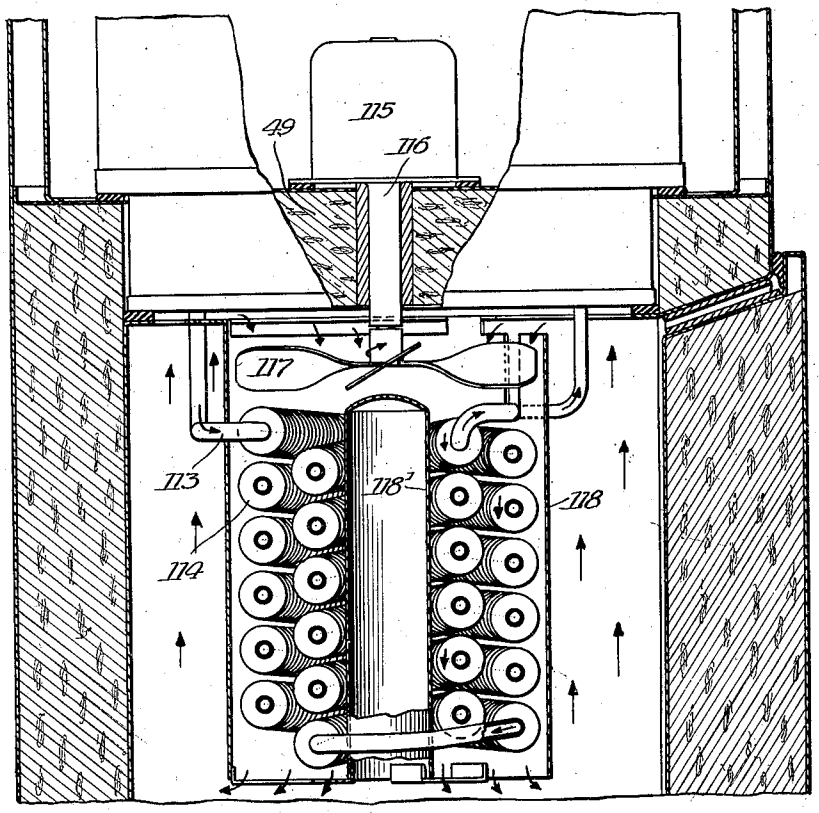
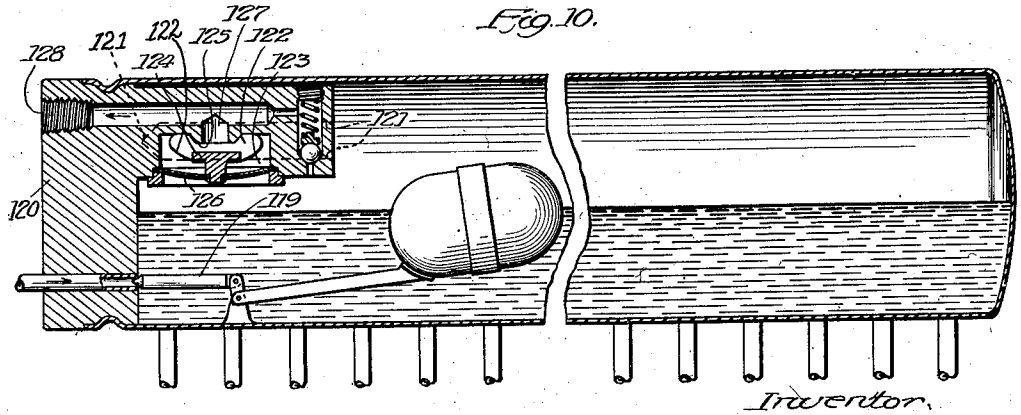


Fig. 10.



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Patented Apr. 21, 1936 2,038,434

UNITED STATES PATENT OFFICE

2,038,434

REFRIGERATOR

Carl E. L. Lipman, Chicago, Ill., assignor to Lipman Patents Corporation, Chicago, Ill., a corporation of Delaware

Application July 30, 1932, Serial No. 626,301

9 Claims. (Cl. 62—116)

This invention pertains to refrigerators and in particular to refrigerators having two or more compartments in which different temperatures are maintained.

At present the refrigerators, particularly household and small commercial refrigerators are provided with one coil only, which surrounds the ice cube trays and which not only freezes the cubes but serves also to cool the main food compartment in which the coil and ice trays are suspended. Because of the low temperature required for freezing of water such systems are inefficient for producing the refrigerating effect in the food compartment where no such low temperature is required or desired.

According to the present invention separate coils are provided for the food compartment and the ice making compartment, the latter being regulated to freeze water and to operate only when more freezing effect on the ice cubes is required while the food compartment coil, constructed to produce refrigeration at a somewhat higher minimum temperature, will be operated only when further refrigeration is needed in the food compartment. It is quite apparent that further refrigeration may frequently be required in either compartment when not required in the other compartment. As is made possible through this invention, the production of refrigerating effect is controlled in each compartment solely in accordance with the needs therein.

The general object of this invention is to provide improvements in refrigerators to yield higher efficiency in the production of the necessary refrigeration and to make possible various advantages and conveniences both from the standpoint of manufacture and operation. These advantages and various objects of this invention will be alluded to or will become apparent hereinafter.

In the drawings:

Fig. 1 represents a diagrammatic illustration of the refrigeration apparatus utilized in one embodiment of this invention,

Fig. 2 is a front elevation of a refrigerator cabinet containing the apparatus shown in Fig. 1,

Fig. 3 is a view showing the left side of the food compartment in section,

Fig. 4 is a view showing the ice making compartment in section,

Fig. 5 is a front elevation of the removable apparatus unit employed in the refrigerator shown in Fig. 2,

Fig. 6 is an enlarged view largely in section of a thermostatic valve employed in this refrigerator,

Fig. 7 is a central sectional view of a packless valve included in the refrigerator,

Fig. 8 is a diagrammatic illustration of a portion of a direct expansion system which may be substituted for the flooded system portions of Fig. 1,

Fig. 9 is a detailed view of another embodiment of an expansion coil coupled with a fan, and

Fig. 10 is a central sectional view of another form of valve which may be used in the system and in an evaporator header.

One form of the invention is illustrated in Figs. 1 to 7 inclusive and is shown as it is embodied in a household refrigerator which includes a cabinet generally indicated as 1, comprising a large food compartment 2 and a smaller ice making compartment 3. Figs. 2, 3 and 4 indicate that the food compartment is provided with outside insulated walls 4 and doors 5 while the inner ice making compartment 2 has insulating walls 6 and upper and lower doors 7 and 8 respectively.

The ice making compartment is spaced inwardly from all of the interior surfaces of the food compartment, not only at the sides but as well at the bottom and the top, and is supported in any suitable manner (not illustrated) with its top margins tightly sealed against a bottom of an insulated coil supporting platform 9, a rubber sealing strip 10 being preferably employed at this juncture. At the bottom of the ice compartment a drain valve 11 is provided for draining water resulting from defrosting or washing.

The apparatus employed in this preferred embodiment is shown in Fig. 5 arranged in its actual structural relationship, while the same apparatus is shown diagrammatically in Fig. 1. The description of the operative parts of the apparatus may be best made with reference to Fig. 1 and read with that figure in view.

A compressor 12 is employed for compressing any suitable gaseous refrigerant and for delivering it to a condenser 13 which is subjected to a draft of air from the surrounding atmosphere by means of a fan 14. An oil cooling device 15 is also connected with compressor and is likewise subjected to the fan air draft. The condenser delivers the liquefied refrigerant through a pipe 16 to a receiver 17 where a supply of it is allowed to accumulate. An evaporator generally indicated as 18 is mounted in the foot compartment 2, and being a coil in a flooded type system is provided with a float 19 for controlling the valve 21 at the inlet of the coil. The float valve

will be consrtucted to maintain the liquid level in the coil at about the position indicated. A suction pipe 22 leads from the top of the coil to a safety shut-off valve 23 which is shown in detail in Fig. 7. From that valve the suction pipe continues as the pipe 24 to a thermostatically controlled valve 25 which may be actuated by a thermostatic bulb 26, or instead may be connected by the pipe 27 to the thermostatic bulb 28. It should be understood that whichever bulb is used for operating the valve 25, it is to be located in the food compartment itself or in or on the evaporator therein. The valve 25 is shown in detail in Fig. 6, and is so arranged that any temperature higher than a predetermined temperature will, through expansion of the fluid in the bulb, open the valve 25 to permit suction caused by the compressor to draw gas from the coil 18 through the pipe 29.

Whenever the temperature in the food compartment rises to a predetermined maximum, it is intended that the bulb 28 shall close a thermostatically operated switch 31, which in turn will close a circuit leading through the wall plug 32, overload safety device 33, starting relay 34 and the motor of the compressor. The motor is preferably sealed within the compressor housing. The valve 25 is at the same time opened either by its own separate bulb 26 or by the bulb 28 to permit the compressor to draw gas from the food compartment coil. The valve 23 is always open excepting when manually closed for the purpose of shutting off the food compartment coil. As the gas is drawn off from the latter coil, the temperature in the food compartment will be lowered and eventually, when the desired minimum temperature in the food compartment has been attained, the thermostatic bulb or bulbs in that compartment will open switch 31, shut off the compressor motor and close the valve 25.

The ice compartment 3 is provided with its own separate coil 35, which receives liquid refrigerant either from the bottom of the food compartment coil through the pipes 36 and 37 or directly from the liquid receiver 17 through the pipes 38 and 37. The manually operated packless valves 39 and 41 enable the user to select either source of liquid supply for the ice compartment coil. If liquid refrigerant is drawn from the food compartment coil it will, of course, already be at low temperature which will be of advantage in promoting quick freezing in the ice compartment. The ice compartment coil header is provided with a float valve 42 to regulate the liquid level therein. The suction pipe 43 has interposed therein a check valve 44 constructed to permit flow therethrough only away from the ice compartment coil. There is also interposed in this suction pipe a safety shut-off valve 23' enabling the user to shut off manually the ice compartment coil when he desires to defrost that coil or to put the coil temporarily out of service for any reason whatsoever. Another check valve 45 is located in the common suction line 46, preferably close to the compressor to prevent refrigerant gas, or any oil from leaking or flowing from the compressor unit back into the suction line when the compressor is idle.

The ice compartment coil is controlled by means of a thermostatic bulb 47 located in that compartment or in or on the evaporator therein. When the temperature of the bulb rises to a predetermined degree it will actuate a thermostatically controlled switch 48 and cause the compressor motor to start. When the ice compartment reaches a desired minimum temperature, this bulb will then operate to open the circuit to shut off the compressor. It should be understood that the thermostatically controlled switches 31 and 48 may be any of several at present commercially available thermostatically controlled switches. Their construction does not form a part of this invention and therefore is not illustrated.

It should be understood that because water freezing temperatures are maintained in the ice compartment the gas pressure therein will naturally be much lower than the gas pressures in the food compartment coil for in the latter compartment temperatures of 38° to 45° F. will ordinarily be maintained for the preservation of food. Hence whenever the compressor is started by means of the food compartment thermostat 28 the relatively high pressure in the suction pipe 29 and 46 will cause the check valve 44 to close, hence at that time no suction can be exerted on the ice compartment coil. This latter coil must wait its turn until the food compartment has been sufficiently cooled to cause the closing of the valve 25. Thereafter the check valve 44 will be opened when continued operation of the compressor produces a lower pressure in the suction line 46 than exists in the ice compartment coil.

It will be perceived that the relatively higher back pressure in the food compartment coil will enable that coil to operate in the refrigeration system at a higher efficiency than is possible with the coils now employed in most household refrigerators for cooling food compartments, for the reason that at present food compartments are invariably cooled by coils which are capable of freezing water and which operate at a much lower back pressure. In view of the fact that the ice making compartment is well insulated from the food compartment, whenever the ice cubes have been frozen the ice compartment coil will not again operate for a long period of time and the compressor from that time on will only have to operate in connection with the more efficient food compartment coil. This will naturally result in a considerable saving in the cost of electricity consumed. Should one desire to freeze a large number of ice cubes rapidly he may manually close the food compartment shut off valve 23 and concentrate all the refrigerating efforts on the ice making coil, and likewise if no ice cubes are required over a considerable period of time the ice compartment coil may be shut off manually and the food compartment coil only be operated. Furthermore, the ice compartment coil may be defrosted by shutting it off without discontinuing the operation of the food compartment coil. Hence the perishable articles of food such as milk, vegetables, meats, etc., will not be even temporarily disturbed during the defrosting of the coil. During defrosting a supply of ice cubes may be placed in their trays in the food compartment where they will be quite well preserved even at that somewhat elevated temperature.

Another advantage arising from this arrangement of coils is that no frost formation occurs in the food compartment coil by reason of the fact that it is not necessary in maintaining a temperature of about 40° in that compartment to cool the refrigerant any lower than 32° F.

In a practical installation of the system shown in Fig. 1, I prefer to mount the hand valves 23 and 23' adjacent their respective coils where they may be readily reached, and not confused one with the other. Each compartment will

contain its own thermostats while the bulk of the apparatus will be carried on the top of a removable platform generally indicated as 49, as designated in Figs. 3 and 4. This platform is preferably made in part of insulating material and will seat down into the top of the food compartment 2 to close and seal the top aperture therein and will carry suspended from it the auxiliary insulated platform 9 which contacts the rubber insulating strip 10 and closes the top open end of the ice making compartment 3. The compressor, condenser coils and oil cooling coils, together with the fan and switches will be mounted on the top of the platform 49. The air inlet supply to the fan will be provided through an aperture 51 and the air may exhaust through any suitable opening in the top 52 of the refrigerator cabinet or may be discharged through another aperture in the rear of the refrigerator adjacent the aperture 51.

It will be observed that the platform 9 forming the top of the ice making compartment is spaced downwardly from the top of the food compartment, hence air circulation is provided entirely around the ice compartment. As this entire surrounding atmosphere will be maintained at a temperature in the low forties, ordinarily it will be a relatively easy matter to make and preserve ice in the inner compartment. Additional racks 53 may be provided in the ice compartment for holding trays of ice cubes or frozen desserts or any articles required to be kept at freezing temperatures. The walls of the ice making compartment may be attached by any suitable brackets such as those indicated by the numeral 54 to the walls of the food compartment.

Two of the valves employed in the preferred embodiment shown in Fig. 1 are illustrated in detail in Figs. 6 and 7. The thermostatic valve 25, shown in Fig. 6, includes a casing 55 to which is attached a valve housing 56 provided with a valve seat 57 adjacent the inlet 58 on which seats a valve 59. This valve is provided with a central passage 61 which is normally closed by a ball valve 62 under compression of the spring 63 pressing against a follower 64. The ball valve will be opened by an excessive gas pressure which may accumulate in the food compartment coil and will permit the gas to escape through the passage 61 and the lateral passages 65 to the outlet 66. The main valve 59 is connected to a stud 67 having a shoulder 68 adjacent which is positioned a flexible disc 69 provided to give the valve a snap action function. This disc bears against a circular abutment 71 near its center while its periphery will bear against either the shoulder 72 or 73.

The outer end of the post 67 is secured to a cup shaped spring retainer 74 against which the compression spring 75 rests and the outer end of the post also carries a bellows type diaphragm 76, one end of which is sealed about the post and the other end of which is secured in sealed relation to an annular plate 77 which in turn is sealed against the walls of the casing 75. This diaphragm thus furnishes a fluid seal which prevents the escape of refrigerant beyond the limits of the diaphragm and thus obviates the necessity for a stuffing box about the post 67. Also secured to the post 67 is a metal bellows 78 closed at its outer end but opening at its inner end into the chamber 79 to which is connected the tube leading either to the thermostatic bulb 26 or 28. Surrounding the compression spring and metal bellows is a cap 81 threadedly engaged with the casing 55. The spring 75 serves to urge the main valve 59 towards its seat while the snap action diaphragm 69 functions to cooperate with the silphon 78 and the thermostatic bulb associated therewith to move the valve quickly to open or quickly to closed position.

The safety shut-off valve shown in Fig. 7 is a packless valve having an inlet 82 and outlet 83, a valve seat 84 and a main valve 85. A pressure relief valve is provided within the main valve and carried thereby, consisting of a ball 86, spring 87 and follower 88. A bellows type diaphragm 89 is sealed at one end on the movable valve stem 91 by welding or soldering and has its other end similarly sealed to a disc 90 clamped between the ends of the valve casing 92 and the valve casing cap 93. This diaphragm furnishes a fluid seal about the valve stem and eliminates any need for a stuffing box. The packless valves 39 and 41 shown in Fig. 1 are preferably constructed in a similar manner.

The main valve 85 is intended to be operated manually and its valve stem is provided with a recess 94 and an enlarged portion 95 abutting against a similar enlarged portion 96 on the valve handle stem 97. An annular collar 98 has its opposite edges crimped inwardly one to seat in the recess 94 and the other to seat in the recess 99, thus enabling the valve handle to be rotated relatively to the non-rotatable valve stem 91 to seat or unseat the main valve. The end face of the valve stem is provided with a centrally located conical projection 95' seating in a corresponding recess in the adjacent face of the valve handle stem 97, to keep these stems in alignment with each other. At the outer end of the valve handle stem 97 there is affixed the usual valve handle 101.

Fig. 8 shows diagrammatically a preferred arrangement of the apparatus in the event that one desires to use a direct expansion system in carrying out the purposes of this invention. As shown, a pipe 46' corresponds to the pipe 46 in Fig. 1 and leads to the compressor. A pipe 16' corresponding to pipe 16 in Fig. 1 leads from the condenser and carries the condensed refrigerant into a liquid receiver 17' from whence it flows either to a food compartment expansion coil 18' or to an ice making compartment expansion coil 35'. Interposed in the liquid inlet pipe 102 is an expansion valve generally indicated as 103 while in the inlet pipe 104 is a similar expansion valve 103. Whereas various forms of expansion valves may be used, I have chosen to illustrate herein a valve consisting of the casing 105, a metal bellows 106 to which is connected a bell crank 107, the opposite end of which carries a needle 108 which is seated on the valve seat 109 by contraction of the metal bellows or lifted from the seat by expansion of the metal bellows. A spring 111 aids in urging the needle valve to remain seated. The valves on the suction side of both coils are preferably exactly like those on those of the flooded system coil in Fig. 1 and consist of the check valve 44', the combined safety and shut-off valve 23', a check valve 45', a thermostatically controlled shut-off valve 25' and another combined safety and shut-off valve 23'. The same thermostats 47 in the ice making compartment 28 and the food compartment are used for controlling the stopping and starting of the compressor motor. The rest of the refrigeration apparatus to be connected to the parts shown in Fig. 8 is shown in Fig. 1 and its connection herewith requires no explanation. The expansion coil in the

food compartment is preferably provided with heat absorbing fins 112 to provide for space economy and is a continuous pipe leading from the associated expansion valve to the suction pipe 29' to the compressor.

Fig. 9 illustrates another type of expansion coil which may be substituted for the expansion coil 18' shown in Fig. 8. In this case the coil consists of a continuous pipe 113 having a large number of heat absorbing fins 114 thereon and connected in an obvious manner at one end with an expansion valve and at the other end to the suction pipe which leads through the control valve to the compressor. As a further means of economizing on space in the food compartment, I prefer to mount a fan motor 115 on the top of the apparatus platform 49 and have the fan shaft 116 extend downwardly through the platform and carry at its lower end fan blades 117. Thus the fan motor is mounted outside of the food compartment where the heat which it produces will not interfere with refrigeration. The fan blades, revolving preferably at low speed, will force a gentle circulation of air through the fin type expansion coil to provide more efficiently the necessary cooling in the food compartment.

Preferably the fan motor will operate whenever the compressor is pulling gas through this coil, although it is obvious that a special thermostat could be provided to cause the fan motor to operate at other times without reference to the operation of the compressor. An open ended cylinder 118 surrounds the expansion coil to confine the air delivery from the fan within the space occupied by the coils and fins while a central cylinder 118' closed at its upper end further aids in effectively directing the air flow against the fins.

Fig. 10 discloses the top portion of a coil for a flooded system, the top of the coil only being shown, it being understood that this may be substituted for the food compartment coil 18 or 35 of Fig. 1. In this case a float valve 119 controls the inlet of liquid refrigerant to the top of the header while the exit of gas therefrom is regulated by a thermostatically controlled snap action valve.

A block 120, which may be a casting, mounted in one end of the header is drilled to form a gas inlet passage 121 leading through a port 122 into a valve chamber 123. A valve 124 to be seated upon the valve seat 125 is fastened in any suitable manner to a snap action diaphragm 126. This diaphragm is composed of two layers of metal of dissimilar expansion characteristics, of the character commonly known as a bi-metallic diaphragm which, under the influence of temperature changes, will snap upwardly past dead center or downwardly past dead center as viewed in Fig. 10. In its upward movement, it will seat the valve 124 and in the opposite movement will open the valve.

When the valve is open the refrigerant vapor can then pass through the port 127 to the suction outlet 128 and may thence flow to the compressor. This snap action valve being mounted in the expansion coil header, is subject to the influence of the temperature in that header, and as the internal temperature of the coil bears a known relation to the temperature in the associated compartment, this valve serves then to control the suction from that coil and hence the temperature in the compartment where it is mounted.

Referring to Fig. 1, the switch 31 is provided with a knot or button 31' which should be used to disconnect the switch 31 whenever the valve 23 is closed to put the food compartment coil out of service. Thus the thermostat 28 will be prevented from starting the compressor motor. A similar knot 48' on switch 48 is provided for a similar purpose in rendering the ice coil inoperative. The adjustment of all switches, thermostats and valves is preferably accomplished at the factory to discourage unskilled persons from meddling with these devices.

It should be understood that the invention in its various aspects is herein described in connection with its embodiment in one or more presently preferred or approved forms but that it is nevertheless capable of being embodied and utilized in other forms differing in many details from the constructions herein shown and described.

Having shown and described the invention, I claim:

1. A refrigerator comprising an insulated food compartment, an insulated ice making compartment within the first compartment, apertures being provided in the tops of both compartments, removable insulated closure means constructed for sealing said apertures, a refrigeration coil for each compartment carried by said means, and refrigeration apparatus including a compressor mounted on the top of said means operatively connected with said coils.

2. In a refrigerator, the combination of an insulated ice making compartment, an insulated food compartment spaced apart from and surrounding the sides and bottom of the ice compartment, the top of each compartment having an aperture, a removable platform for closing the food compartment aperture, a second platform suspended from the first for closing the other aperture, a refrigeration coil carried by each platform extending into its associated compartment, refrigeration apparatus including a compressor connected with said coils, and means regulated by the temperature in the respective compartments for controlling the producing of refrigeration in the respective compartments.

3. In a refrigerator, the combination of an insulated food containing compartment and an insulated ice making compartment wholly enclosed thereby, both compartments provided with apertures at their tops, a removable apparatus platform constructed to be lowered into place to seal and insulate said apertures, a separate cooling coil for each compartment carried on the bottom of said platform, and apparatus including a compressor and condenser connected with said coils mounted on the top of said platform.

4. In a refrigerator, the combination of separate insulated ice making and food cooling compartments, the former being disposed within the latter, separate cooling coils in the compartments and a single refrigeration producing unit connected therewith, means separately controlled by the temperatures in the respective compartments for maintaining ice making temperatures in the first compartment and non-frost forming temperatures in the second compartment, and manually controlled means for rendering one coil inoperative without so affecting the other coil.

5. A refrigerating apparatus comprising a compressor, a condenser, a high working pressure evaporator, a low working pressure evaporator, means for supplying refrigerant to said evaporators from said condenser, means for connecting each evaporator with the suction cham-

ber of said compressor, thermostatic means controlled by each evaporator for starting and stopping the compressor independently of the other evaporator, means controlled by the temperature produced by the high working pressure evaporator for permitting or preventing the application of compressor suction to said evaporator, and suction pressure controlled means for preventing application of compressor suction to said low working pressure evaporator during the application of said suction to said high working pressure evaporator.

6. A refrigerating apparatus comprising a compressor, a condenser, a high working pressure evaporator and a low working pressure evaporator connected to said compressor and condenser, means controlled by the temperature produced by each of said evaporators for independently starting and stopping said compressor, suction pressure controlled means for preventing refrigerative operation of the low working pressure evaporator during refrigerative operation of the high working pressure evaporator, and temperature controlled means for initiating and stopping refrigerative operation of the high working pressure evaporator in accordance with the temperatures produced thereby.

7. A refrigerating apparatus comprising a high working pressure evaporator, a low working pressure evaporator, a compressor and a condenser, temperature controlled means for rendering said high working pressure evaporator ineffective for refrigerative work upon the production by said evaporator of a predetermined minimum temperature, and means for automatically rendering said low working pressure evaporator ineffective for refrigerative work during the operative period of said high working pressure evaporator and permitting refrigerative work thereby during the inoperative period of the high working pressure evaporator.

8. A refrigerating apparatus comprising a compressor, a condenser, a high working pressure evaporator, and a low working pressure evaporator connected to receive refrigerant from said condenser, means including a common suction line for conducting refrigerant from said evaporators to the suction chamber of said compressor, thermostatically controlled means associated with each evaporator for independently starting and stopping the compressor, thermostatically controlled means associated with the high working pressure evaporator for controlling the application of compressor suction thereto, and suction pressure actuated means in the suction line between the compressor and the low working pressure evaporator for controlling the application of compressor suction thereto.

9. A refrigerating apparatus comprising an ice compartment, a storage compartment, an evaporator in each of said compartments, a driving motor, a compressor having the suction side thereof connected to said evaporators, means controlled by the temperatures in said storage compartment for starting and stopping said motor, a thermostatically controlled valve in the suction line to said storage compartment evaporator for shutting off the application of suction to said evaporator when a predetermined low temperature is created in said compartment, means controlled by the temperatures in said ice compartment for starting and stopping said motor, and pressure controlled means in the suction line to said ice compartment evaporator for preventing the application of suction to said evaporator when the suction line to the storage compartment evaporator is open.

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