

April 16, 1957

E. W. FRANKLIN ET AL

2,788,641

FREEZING UNIT

Filed June 19, 1953

5 Sheets-Sheet 1

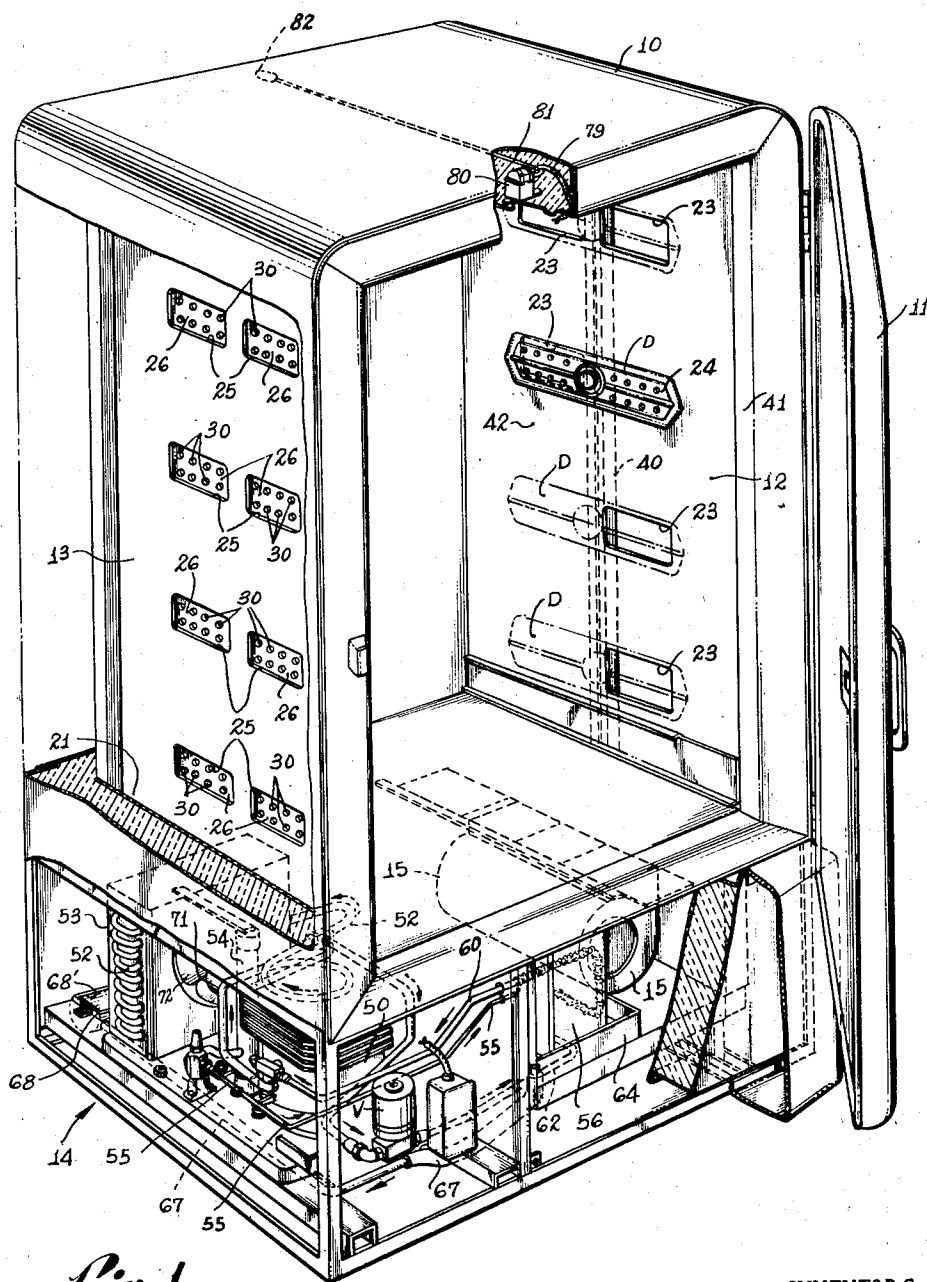


*Fig. 1*

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*Fig. 2*

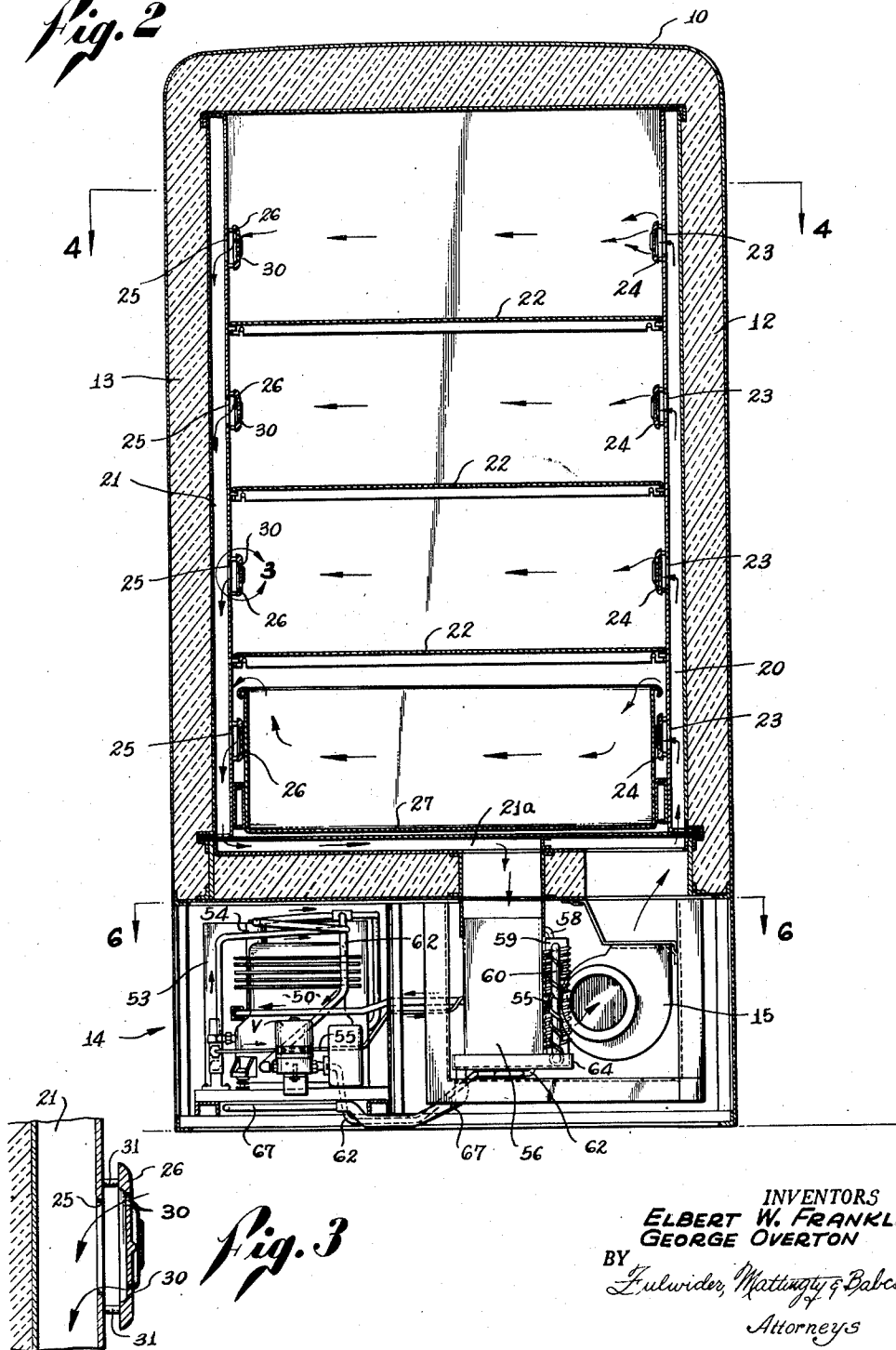


*Fig. 3*

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*Fig. 4*

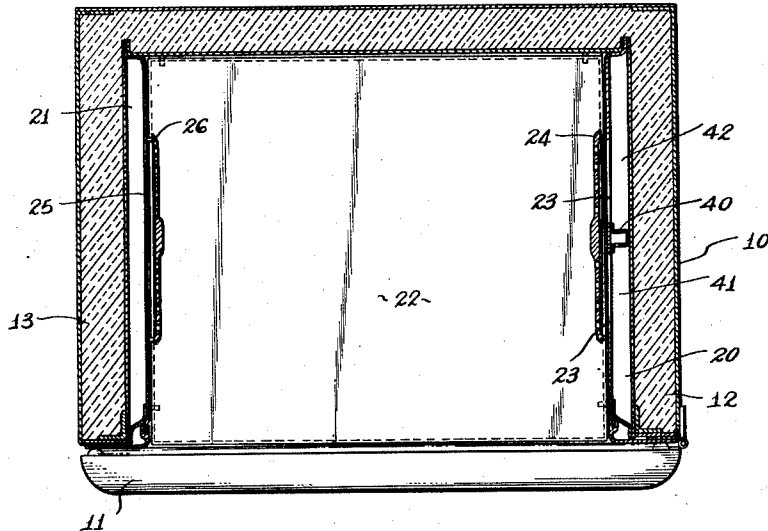
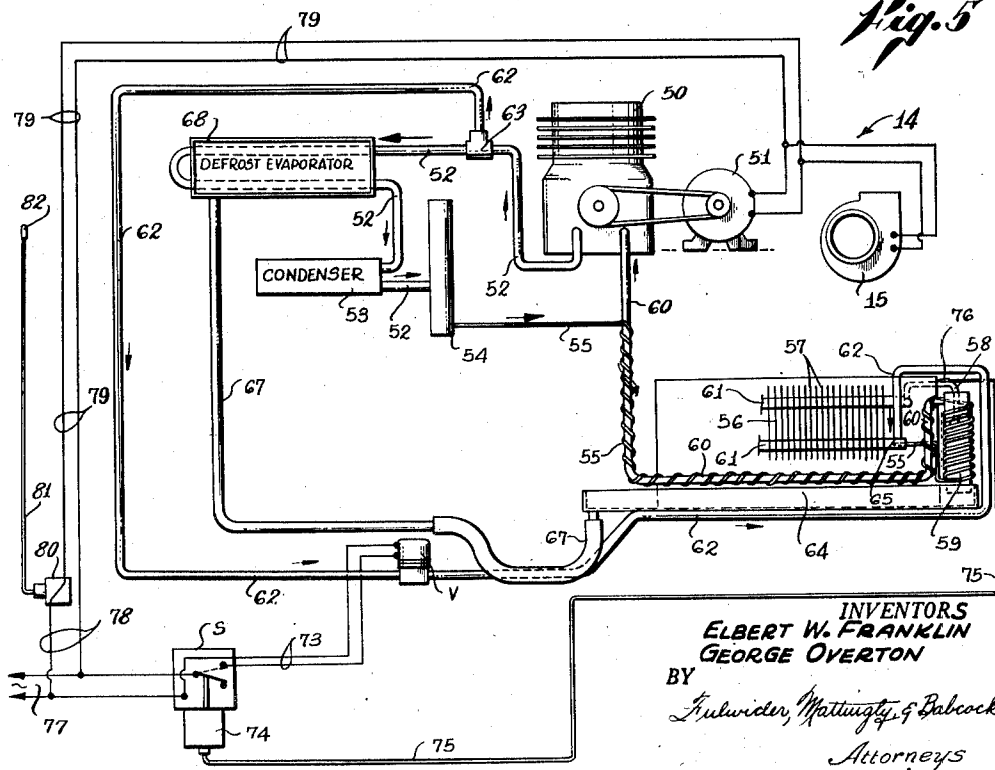


*Fig. 5*



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*Fig. 6*

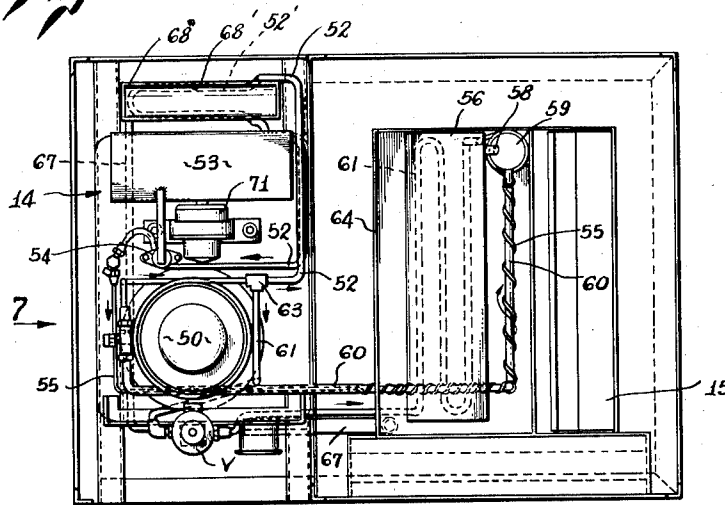
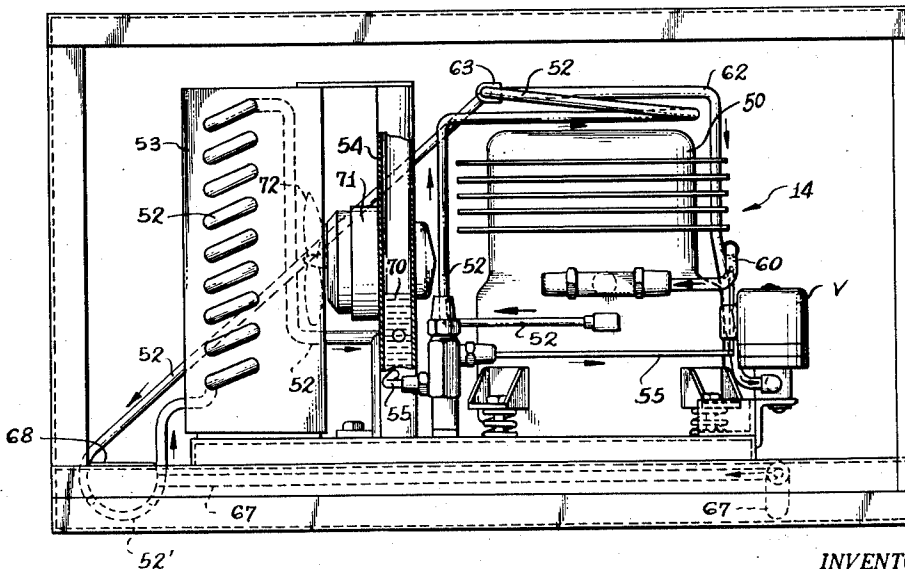


*Fig. 7*



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*Fig. 8*

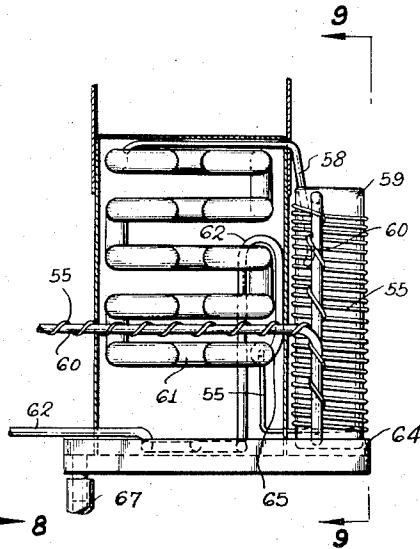


*Fig. 10*

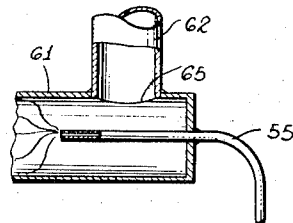


*Fig. 9*

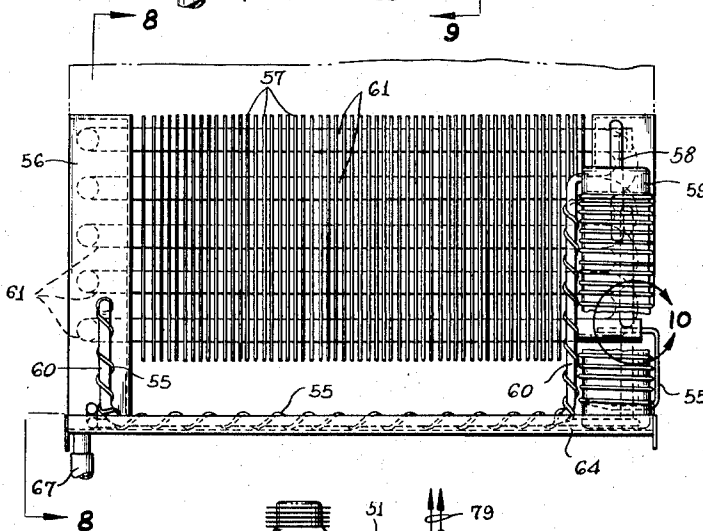
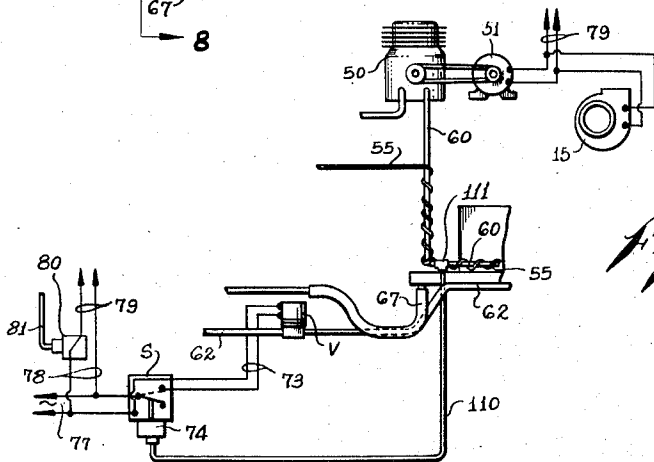


*Fig. 11*



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## FREEZING UNIT

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Application June 19, 1953, Serial No. 362,818

14 Claims. (Cl. 62—4)

This invention relates to freezing units and more particularly to an improved home freezer operating at 32° F. and below and incorporating a forced cold air circulation system.

Heretofore freezing units used in homes have employed cold coils within or around the main shell for maintaining the temperature of the unit at the desired sub-freezing value. There are certain advantages however in employing forced cold air circulation refrigeration as opposed to cold coils. Among the most important of these advantages is the fact that a much more uniform temperature can be maintained throughout the interior region of the unit. This is because the cold refrigerating air can easily pass through all spaces within the unit whereas the cold coils are necessarily stationary. Even though several cold coils may be uniformly spaced about the interior walls, it is still difficult to maintain a uniform temperature in the central regions.

Another important advantage of the cold air circulation system results from the constant air circulation throughout the interior of the unit whereby the cold air is forced into direct heat transfer contact with all of the food products within the unit. Additionally, the air circulation system permits a higher relative humidity to be carried.

A further advantage of the cold air circulating system is the elimination of complex coil piping systems thereby rendering the defrosting problem enormously simplified.

It is a primary object of the present invention accordingly, to provide a home freezer unit incorporating a cold air circulation system for maintaining a substantially uniform temperature below 32° F. entirely throughout the interior region of the freezing compartment or cold storage cabinet and yet keep food therein free from frost. A feature of the invention additionally provides means for passing a greater quantity of cold air across the upper levels than across the lower levels of the cold storage cabinet whereby the temperature gradient tending to exist from the lower levels to the upper levels is compensated.

Another object is to provide means in the freezer unit cold storage cabinet for preventing blocking of the air circulation by food products placed therein.

Another principal object of the invention is to provide a cold air refrigeration apparatus incorporating an improved expanding capillary tube system in the evaporator in place of more complex expansion valves, including novel means for insuring uniform expansion of the liquid refrigerant in the evaporator from the end of the capillary tube.

Another object is to provide a freezer unit which is well adapted to automatic defrost of the evaporator coils.

An auxiliary object is to increase greatly the efficiency of the cold air refrigeration apparatus by placing the various apparatus components in positions to effect efficient heat exchanges.

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Still another object of the invention is to provide a completely automatic defrosting system adapted to be placed in operation in response to the amount of frost that has built up on the evaporator. In the past, such automatic defrosting has usually been effected periodically by timing clocks. In such systems the defrosting mechanism would operate regardless of whether defrosting were actually necessary. In the present invention, the defrosting system only operates when actual defrosting is necessary to insure continued efficient operation.

Yet another important object is to provide a novel system for disposing of the defrost condensate. Heretofore such defrost condensate liquid would collect in a pan and have to be emptied periodically.

These and additional objects and advantages of the invention will be better understood by referring to the accompanying drawings illustrating a preferred embodiment of the freezer, in which:

Fig. 1 is a perspective view of the cold storage housing or cabinet and the refrigeration apparatus with certain portions cut away to expose various components of the unit;

Fig. 2 is an elevational cross-sectional view of the freezing unit illustrating the cold air circulation system;

Fig. 3 is an enlarged view of the portion enclosed by the circular arrow 3 in Fig. 2;

Fig. 4 is a cross-sectional view of the cold storage cabinet as seen along the line 4—4 of Fig. 2;

Fig. 5 is a highly schematic layout of the various components of the refrigeration apparatus useful in explaining the operation of the system;

Fig. 6 is another cross-sectional view as seen along the line 6—6 of Fig. 2;

Fig. 7 is an elevational view partly in section as seen looking in the direction of the arrow 7 in Fig. 6;

Fig. 8 illustrates a portion of the evaporator unit in the cold air refrigeration apparatus;

Fig. 9 shows another view of the evaporator unit as seen along the line 9—9 of Fig. 8;

Fig. 10 is an enlarged view of the portion enclosed by the circular arrow 10 in Fig. 9; and

Fig. 11 is another schematic view showing a portion of the electrical system for automatic defrosting of the refrigeration apparatus.

In the several drawings, like components are designated by like reference numerals. Figs. 1 to 4 relate generally to the cold air circulation system and Figs. 5 through 11 relate to the cold air refrigeration apparatus and defrosting system.

Referring to Fig. 1, the freezing unit comprises a cold storage housing or cabinet 10 provided with a door 11 for easy access and two vertical sidewalls 12 and 13. The cabinet 10 is preferably of the upstanding type and includes in its base support the refrigeration and defrosting apparatus designated generally by the numeral 14.

**Cold air circulation system.**—To maintain the interior of the insulated cabinet 10 at a substantially uniform sub-freezing temperature, there is provided a cold air circulation system comprising a blower 15 disposed in the base of the cabinet and adapted to pass cold air through the interior of the cabinet in a closed circulation path.

As more clearly shown in Fig. 2, this air circulation is accomplished by providing a vertical passage 20 in the first sidewall 12 through which cold air may pass from the blower 15 to the interior of the cabinet, and a second vertical passage 21 in the wall 13 for returning the air to the blower. A horizontal passageway 21a leads from the bottom of return passageway 21 to an evaporator through which the air passes before returning to the blower 15 as will later be described. As shown, the various levels of the cabinet interior may be sectioned

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off by means of shelves 22. The first passage 20 is provided with a series of vertically spaced openings 23 communicating with the interior of the cabinet, each opening being provided with a spaced baffle member 24, the purpose for which will be described shortly. Similarly, the second wall passage 21 includes a plurality of vertically disposed openings 25 provided with similar baffle plates 26. The lowermost level of the cabinet interior may be provided with drawer 27 adapted to be pulled out for easy access.

As shown clearly in Fig. 3, the baffle plate 26 is dimensioned to cover the opening 25 but is provided with a series of openings 30 permitting air to pass therethrough. The plate is also spaced from the opening by supports 31 permitting air to pass around the edges of the plate into the opening as well as through the holes 30. The several baffle plates as shown in both Figs. 1 and 2 prevent the blocking of the various openings by food products placed on the shelves and also tend to distribute the cold air more uniformly.

In a freezing unit having a substantial vertical height as in the present case, there is a tendency for the cold air to migrate to the lower levels of the interior and the warmer air to collect in the upper levels. In order to overcome this temperature gradient increasing from the lower to the upper levels, the first air passage 20 may be partitioned by a partition wall 40 to form first and second vertical air passages 41 and 42 as clearly seen in Fig. 4.

Referring again to Fig. 1, it will be seen that the first vertical passage 41 has two vertically spaced openings 23 communicating with the lower half of the interior of the cabinet, while the second vertical passage 42 has two openings communicating with the upper half. An additional opening in the first vertical passage 41 is also provided communicating with the upper half of the interior whereby there are a total of three openings in the upper levels as compared to only two openings in the lower levels. The baffle plates 24, however, are adapted to cover the same area on either side of the partition wall 40 to provide a symmetrical appearance. Thus, there are actually no openings behind certain portions of some of the baffle plates, these points being designated by the letters D in Fig. 1. From the above described construction it will be readily apparent that more cold air is permitted to enter the upper regions of the cabinet interior than the lower regions.

In the operation of the air circulation system, the blower 15, as shown in Fig. 2, will pass cold air up through the first wall passage 20 to pass out the various openings 23 and across the interior of the cabinet at various levels as indicated by the arrows. This air will then pass into the openings 25 in the second sidewall passage 21 to pass down this passage back to the blower 15. Since there are more openings at the upper levels than at the lower levels, more cold air will be passing across the upper regions to compensate for the referred to temperature gradient which tends to exist. As a result the temperature is substantially uniform throughout the entire vertical length of the cabinet. It should also be noted that the air is circulated in a closed path, and thus all of the air within the storage cabinet is forced to move continuously.

*Cold air refrigeration apparatus.*—Referring now to Fig. 5, the cold air refrigeration apparatus, designated generally by the numeral 14, in Fig. 1 is shown in a schematic layout for purposes of clarity. This apparatus comprises a compressor 50 driven by a motor 51 and connected through an outlet conduit 52 past a defrost evaporator the purpose of which will be explained subsequently. Conduit 52 then passes through condenser 53 and into a balancing tank 54. A capillary tube 55 communicates with the balancing tank 54 and follows a winding path terminating in an evaporator 56 provided

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with suitable cooling fins 57. The outlet conduit 58 from the evaporator 56 passes into a liquid trap 59 as shown. From the liquid trap 59 there is provided a return conduit 60 passing back to the compressor 50. The evaporator 57 includes a plurality of coil turns 61 connected between the termination point of the capillary tube 55 and the evaporator outlet conduit 58.

Referring to Fig. 6 the relative position of these various components is shown in a preferred arrangement, the coiled turns 61 in the evaporator 56 being clearly shown. In Fig. 7, which illustrates the components shown in Fig. 6 looking in the direction of the arrow 7, there is shown the condenser housing 53 within which the conduit 52 is coiled. A motor 71 adapted to drive a fan 72 is disposed adjacent the condenser 53 to blow air over these coils. The balancing tank 54, as shown in Fig. 7, comprises an elongated closed chamber having its inlet opening for the conduit 52 disposed at a level higher than the outlet opening for the capillary tube 55. As shown, this balancing tank is partially filled with a compressible gas such as a gaseous refrigerant.

Figs. 8 and 9 show, in greater detail, views of the evaporator 56 and liquid trap 59. It will be seen that the outlet conduit 58 from the coiled turns 61 in the evaporator terminates in the liquid trap 59 adjacent the top thereof, the return conduit 60 also communicating with the upper portion of the liquid trap. This arrangement permits any liquid dripping from the end of the outlet conduit 58 from getting into the return conduit 60, such liquid collecting at the bottom of the liquid trap 59.

The terminating end of the capillary tube 55 in the evaporator 56 is shown enlarged in Fig. 10, the terminating end of the capillary tube projecting into the coiled turns 61 of the evaporator a given distance whereby liquid refrigerant passing out the end of the capillary tube will expand into the coiled turns.

Referring once again to Fig. 5 the operation of the cold air refrigerating apparatus is as follows:

A suitable refrigerating gas is compressed by the compressor 50 causing the temperature of the compressed gas to rise to a value of about 150° F. This hot compressed gas is passed through the conduit 52 surrounding a portion of the defrost evaporator housing into the condenser 53 where it is cooled by the fan 72 blowing cold air across the various turns of the conduit 52 within the condenser housing. This cooling causes the compressed gas to liquify, the liquified refrigerant passing into the balancing tank 54. From the balancing tank 54 the liquid refrigerant passes through the capillary tube 55 terminating within the coiled turns 61 in the evaporator 56. The expansion of the liquified refrigerant in the evaporator is ordinarily controlled by an expansion type valve in order to keep the expansion uniform.

In accordance with a feature of the invention this expansion valve is replaced by the capillary tube 55 from the end of which an expansion of the liquid refrigerant takes place. It has been found however, that the use of a capillary tube for expanding the liquid refrigerant results in erratic expansion and in order to render the expansion more uniform, there is provided the previously referred to balancing tank 54 between the condenser 53 and the capillary tube 55. This balancing tank serves to cushion or accommodate small erratic variations in the expansion pressure at the end of the capillary tube. This cushioning effect results from a volume of gaseous refrigerant filling the upper portion of the balancing tank. Thus, referring again to Fig. 7, variations in the pressure at the end of the capillary tube 55 will cause the level of the liquid refrigerant 70 to vary, such variations being taken up by the compressibility of the gaseous refrigerant above this level. The effect of the balancing tank is therefore to iron out small variations in the pressure and render the liquid refriger-

ant expansion at the end of the capillary tube substantially uniform.

Throughout the various coiled turns 61 in the evaporator 56, the liquified refrigerant will evaporate thereby absorbing considerable heat from the surrounding cooling fins 57. Air is caused to flow over these cooling fins 57 before returning to the blower 15 and is therefore cooled down to a temperature substantially below freezing before passing through the vertical passages in the cabinet walls. The expanded gaseous refrigerant, which is at this time itself quite cold being in the neighborhood of  $-30^{\circ}\text{F.}$ , passes through the liquid trap 59 and the return conduit 60 to the compressor. This gas is then recompressed by the compressor and the cycle repeated.

It will be noted in the various figures that the capillary tube 55 leading from the balancing tank 54 is wrapped around the return conduit 60. This arrangement provides a heat exchanging means whereby the cold refrigerant gas passing back to the compressor through the conduit 60 will absorb heat from the relatively hotter liquified refrigerant passing through the capillary tube 55. Such heat exchange insures the maximum heat exchange efficiency and is a further safeguard against any refrigerant being in the liquid state when it is returned to the compressor.

**Defrosting system.**—Referring once again to Fig. 5, the defrosting system for removing coatings of frost which tend to accumulate on the coils of evaporator 56 thereby insulating it and rendering the refrigeration apparatus less efficient, includes a conduit 62 coupled through a T-joint 63 to the conduit 52 bearing hot compressed gas from the compressor 50 to the condenser 53. The conduit 62 passes under a defrost condensate collecting container or pan 64 and terminates in an opening 65 in the coiled turn 61 in the evaporator, as clearly shown in Fig. 10. The condenser and capillary tube 55 are thus bypassed by this conduit 62.

From the defrost condensate collecting container or pan 64 there is provided a conduit 67 serving to pass the defrost condensate into the defrost evaporator 68.

As shown more clearly in Fig. 6, the defrost evaporator comprises a semi-closed housing partially surrounded by a portion of the compressor outlet conduit 52. This portion of the conduit 52 is designated by the numeral 52' and is turned back on itself to cover a substantial area of the lower portion of the housing. The defrost evaporator housing is open at the top at 68' and is adapted to be lifted from the cradling conduit portions 52' for cleaning.

Disposed in the conduit 62 is a solenoid operated valve V normally closing the conduit and adapted to be operated to initiate the defrosting system in response to the quantity of frost built up on the evaporator.

This valve V is connected by a pair of conductors 73 to a switch S adapted to be thrown in different positions by a pressure bellows 74 operable in response to the amount of frost on the evaporator 56. This actuation is effected by a small capillary tube 75 terminating in a thermally responsive temperature bulb 76 as shown in Fig. 5. Input power lines 77 also connect to the switch S.

In the operation of the defrosting system, assume that a sufficient coating of frost has built up on the evaporator as to render the cooling of air blown thereover less efficient. Due to the insulative effects of the ice coating, the expanded refrigerant passing out of the evaporator outlet conduit 58 will be at a somewhat lower temperature than normal. This lower temperature serves to contract fluid in the thermal bulb 76 disposed against the outlet, such contraction being communicated through the small capillary tube 75 to operate the bellows 74. Operation of this bellows throws the switch arm to the dotted line position shown in Fig. 5 to connect the power line to the valve V opening the normally closed conduit 62.

Because the conduit 62 is substantially larger in diam-

eter than the small capillary tube 55, most of the hot compressed refrigerant gas from the compressor 50 will pass through this tube 62 bypassing the condenser 53 and capillary tube 55 to pass directly into the evaporator. The high temperature of this hot gas will effectively defrost any frost coating on the evaporator, the defrost condensate dropping into the collector container 64. As soon as the evaporator reaches a temperature of  $36^{\circ}$  to  $40^{\circ}\text{F.}$ , which indicates a complete elimination of frost on the evaporator, the temperature of the refrigerant gas in conduit 58 will have increased sufficiently to cause expansion of the fluid in the thermal bulb 76 thereby operating the bellows to throw the arm of switch S back into its solid line position. The solenoid operated valve V is thereby closed and hot compressed gas from the compressor 50 will pass through the conduit 52 and capillary tube 55 to restore the refrigeration apparatus to normal operation.

The water from the frost collected in the container 64 passes by gravity out the conduit 67 to the defrost evaporator housing. In Fig. 7 the relative positions of the defrost evaporator 68 is shown disposed at a lower level than the other components, whereby this gravity flow may take place. Because of the relatively high temperature in the defrost evaporator due to the conduit portion 52' disposed adjacent thereto, the defrost condensate liquid will be evaporated, passing out the top opening 68' into the surrounding atmosphere. The arrangement thus permits the complete disposal of the defrost condensate liquid, and periodic emptying of the collecting pan or container 64 is avoided.

It will be noted that the normally closed bypass conduit 62 is bonded to the collector pan 64. The hot compressed gas passing through this conduit will therefore serve to raise the collecting pan temperature to  $33^{\circ}\text{F.}$  or above, thereby causing the condensate to remain in a liquid state and flow through the drain conduit 67 to the defrost evaporator 68.

Alternative to the temperature responsive thermal element for operating the defrosting system solenoid valve V in the normally closed conduit 62, there may be provided a pressure control means. Referring to Fig. 11, the bellows 74 may be actuated by a small capillary line 110 connected into the return conduit 60 by means of the T-joint 111. When a large coating of frost builds up on the evaporator, the pressure in the return conduit 60 of the cold refrigerating gas will drop, actuating the bellows 74 to throw the switch S into the dotted line position to start the defrosting cycle as previously described. After the evaporator has been completely defrosted, the pressure in the line will build up, actuating the bellows 74 to bring the switch back to its normal solid line position.

It is to be noted at this point that the novel defrosting system herein described is not necessarily limited to use with the particular refrigeration apparatus described. It may be used on more complex types of commercial refrigeration and in multiple unit installations. Because it is operable in direct response to the amount of frost on the cooling coils it is more positive and efficient than any prior types of automatic defrosting systems.

**Cold control system.**—As shown in Figs. 5 and 11 there may be provided an additional switch for controlling the operation of compressor 50 and blower 15 in accordance with the temperature within the refrigeration cabinet. To accomplish this automatically there is provided a pair of conductors 78 tapped from the main power input conductors 77 connecting into a switch 80 from which additional conductors 79 pass to the compressor motor and blower.

The switch 80 is adapted to be controlled in response to the temperature within the upper rear portion of the refrigeration cabinet by means of a small capillary line 81 connecting to a thermal bulb 82. The actual disposition of the switch 80, capillary tube 81, and bulb 82 is

shown in Fig. 1. The switch 80 will usually be of the type having a manual control so that the temperature of the cabinet may be maintained at a desired level of cold.

When the temperature within the cabinet reaches a predetermined low value the switch 80 will automatically open in response to the temperature sensitive bulb 82 to stop the compressor and blower. As soon as the temperature within the cabinet rises to a predetermined value, the thermally operated switch 80 will automatically close to start the compressor and blower.

The invention thus provides a forced cold air circulation freezing unit for use in the home which is defrosted automatically and provided with means for automatically disposing of the defrost condensate liquid. Further, the particular arrangement illustrated insures that there will be a substantially uniform low temperature throughout the entire region of the interior of the storage cabinet and that such uniform temperature will be maintained within close limits in a fully automatic manner.

Various modifications of the apparatus incorporating features falling within the spirit of the present invention will occur to those skilled in the art. The invention is therefore not to be thought of as limited to the particular embodiment disclosed and described.

We claim:

1. In a freezing unit including a cold storage chamber, a forced cold air circulating system for maintaining a substantially uniform temperature at all levels in the chamber comprising: a forced cold air refrigerating apparatus disposed at the lower end of the chamber; first and second vertical side walls having air passages therein communicating with the refrigerating apparatus; a partition dividing the air passage in the first wall into two vertical passages, each having openings communicating with the chamber interior, said second wall air passage having a series of vertically spaced openings communicating with the chamber interior; and means for passing cold air up said two vertical passages, out said openings, across the chamber interior, into the second wall passage openings, and down the second wall passage, thereby distributing the cold air equally in the front and rear portions of the cabinet and causing the storage compartment and food to be free from frost while maintaining a temperature below 32° F., said first vertical passage includes at least one additional opening communicating with the upper half of the chamber interior permitting more cold air to enter the upper portion of the chamber to compensate for the increasing temperature gradient which tends to exist from the lower to the upper levels in said chamber.

2. The subject matter of claim 1 in which there is provided a baffle plate member for each opening and means supporting each baffle plate in spaced relation to its corresponding opening and within said chamber whereby air passing through the opening passes about all of the edges of the baffle plate in a divided flow.

3. In a freezing unit including a compressor for compressing refrigerating gas, a condenser, a conduit for passing compressed gas to the condenser for condensation into a liquid, and an evaporator communicating with the condenser for evaporating the liquid refrigerant; a defrosting system for removing frost tending to accumulate on the evaporator comprising: a normally closed conduit for passing compressed gas from the compressor directly to the evaporator whereby said condenser is bypassed, and means for opening said normally closed conduit automatically operating in response to a given temperature of the refrigerant passing out of the evaporator and including temperature sensitive means disposed adjacent the outlet of the evaporator.

4. The subject matter of claim 3, in which said means comprises an electric circuit including a solenoid operated valve and a thermal switch responsive to close the electric circuit to actuate the solenoid.

5. In a freezing unit incorporating a forced cold air

circulation system, the combination comprising: an insulated cabinet having first and second vertical side walls each including air passages with openings spaced vertically along the side walls for placing different levels of the cabinet interior in communication with said passages, one of the passages having more openings communicating with the upper interior portion of the cabinet than the lower interior portion; a blower for passing cold air up said one passage to pass through the interior of the cabinet and down the other wall passage; a cold air refrigerating apparatus including a compressor, a condenser, a conduit for passing hot compressed refrigerating gas from the compressor to the condenser; a balancing tank comprising an elongated vertically disposed container having an inlet opening above its lower end communicating with the condenser; an evaporator including a tubing coil disposed adjacent said blower whereby air is passed over the evaporator by the blower; a capillary tube communicating with the lower end of the balancing tank and terminating within said tubing coil in the evaporator whereby liquid refrigerant formed in the condenser passes into the balancing tank filling the tank to a variable liquid level intermediate the upper and lower ends of the tank, there being compressible gaseous refrigerant above said liquid level, said liquid refrigerant passing through the capillary to expand from the end of the capillary in the evaporator, said expansion being rendered substantially uniform by the action of the balancing tank; a liquid trap; the output of the evaporator passing into the upper portion of the liquid trap; a return conduit connected to the upper portion of the liquid trap and to the compressor for passing cold evaporated refrigerating gas back to the compressor, said capillary tube being wrapped around the return conduit whereby a heat exchange between the refrigerant in the capillary tube and return conduit will be effected; a defrosting system for removing coatings of frost tending to collect on the evaporator including a normally closed bypass conduit adapted to pass said hot compressed gas directly from the compressor through the evaporator tubing coil; means responsive to the amount of frost built up on the evaporator for opening the normally closed conduit; and means for disposing of defrost condensate comprising: a collecting container; a housing vented externally; said conduit passing hot compressed gas from the compressor to the condenser surrounding a portion of the housing to heat the same; and a conduit passing defrost condensate from the container to the housing whereby the defrost condensate is evaporated.

6. The subject matter of claim 5, in which said means responsive to the amount of frost built up on the evaporator includes an electric circuit; a solenoid actuated valve in said circuit, and a switch in the circuit responsive to the evaporated refrigerant passing from the evaporator to the compressor through said return conduit for electrically actuating the solenoid operated valve to open the normally closed conduit.

7. The subject matter of claim 6, in which said switch is responsive to a given temperature of the refrigerant.

8. The subject matter of claim 6 in which said switch is responsive to a given pressure of the refrigerant.

9. The subject matter of claim 3, including a collecting container disposed below the evaporator for collecting defrost condensate and a defrost evaporator comprising a housing vented externally, a portion of the housing being surrounded by a portion of the conduit carrying compressed gas from the compressor to the condenser whereby said housing is heated; and a conduit for passing defrost condensate liquid from the collecting container to the housing.

10. The subject matter of claim 9 in which said normally closed conduit is bonded to said collecting container whereby defrost condensate in the container will be heated during the defrosting cycle.

11. In a freezing unit including a compressor for compressing refrigerating gas, a condenser, a conduit for

passing compressed gas to the condenser for condensation into a liquid, an evaporator for evaporating the liquid refrigerant and a connecting conduit between said condenser and said evaporator; a defrosting system for removing frost tending to accumulate on the evaporator comprising: a normally closed conduit for passing compressed gas from the compressor directly to the evaporator whereby said condenser is bypassed, said normally closed conduit being of substantially larger size than said connecting conduit, and means for opening said normally closed conduit automatically operating in response to a given temperature of the refrigerant passing out of the evaporator and including temperature sensitive means disposed adjacent the outlet of the evaporator.

12. In a freezing unit, a forced cold air circulation system comprising: an upstanding cabinet having first and second vertical side walls each having a passage communicating with the interior of the cabinet through a series of vertically spaced openings; and means for passing cold air through one passage, out its openings, across the cabinet interior, through the second wall passage openings, and through the second wall passage, there being more openings in the first side wall passage adjacent the upper interior portion of the cabinet than adjacent the lower interior portion whereby more cold air passes into the upper levels of the cabinet than the lower levels, a baffle plate member for each of said openings and means supporting each baffle plate member in spaced relationship to its corresponding opening and within said cabinet whereby air passing through an opening passes about all of the edges of the baffle plate member associated with such opening in a divided flow.

13. In a freezing unit, a forced cold air circulation system comprising: an upstanding cabinet having marginal walls defining a vertically elongated interior chamber, at least one of said walls carrying a discharge passageway leading upwardly from the bottom of the cabinet, said discharge passageway having aperture means placing said discharge passageway in communication with said chamber, said aperture means providing a predetermined total cross-sectional flow area from said discharge passageway into said chamber with a first predetermined portion of said flow area being disposed adjacent the lower end of said chamber and a second predetermined portion of said flow area being disposed adjacent the upper end of said chamber, said second predetermined portion being greater than said first predetermined portion to provide for increased air circulation from said discharge passageway into the upper portion of said chamber than occurs in the lower portion of said chamber to maintain a uniform temperature gradient within the chamber, at least one of said walls carrying a return passageway leading downwardly to the bottom of the said cabinet, said return passageway having return aperture means placing said return passageway in communication with said chamber to provide a predetermined cross-sectional flow area from said chamber into said return passageway, and means mounted in the bottom of the cabinet for passing cold air upwardly through the

discharge passageway and out through said aperture means into said chamber, through said chamber and into said return aperture means and said return passageway in a closed circulation path.

14. In a freezing unit, a forced cold air circulation system comprising: an upstanding cabinet having marginal walls defining a vertically elongated interior chamber, at least one of said walls carrying a discharge passageway leading upwardly from the bottom of the cabinet, said discharge passageway having a plurality of upper discharge openings disposed adjacent the upper end of said chamber and at least one lower discharge opening disposed adjacent the lower end of said chamber, said upper discharge openings providing a larger cross-sectional flow area than the cross-sectional flow area of said lower discharge opening to provide for increased air circulation from said discharge passageway into said chamber in the upper portion of said chamber than occurs in the lower portion of said chamber to maintain a uniform temperature gradient within the chamber, at least one of said walls carrying a return passageway leading downwardly to the bottom of said cabinet, said return passageway having return openings placing said return passageway in communication with said chamber to provide a predetermined cross-sectional flow area from said chamber into said return passageway, and means mounted in the bottom of the cabinet for passing cold air upwardly through the discharge passageway and out through said discharge openings into said chamber, through said chamber and into said return openings and said return passageway in a closed circulation path.

#### References Cited in the file of this patent

##### UNITED STATES PATENTS

|           |                |                |
|-----------|----------------|----------------|
| 184,748   | Bate           | Nov. 28, 1876  |
| 1,909,875 | Lundgard       | May 16, 1933   |
| 2,049,625 | Rupprich       | Aug. 4, 1936   |
| 2,068,435 | Rutishauser    | Jan. 19, 1937  |
| 2,094,565 | Wolfert        | Sept. 28, 1937 |
| 2,128,784 | Tull et al.    | Aug. 30, 1938  |
| 2,143,687 | Crago          | Jan. 10, 1939  |
| 2,152,291 | Starr et al.   | Mar. 28, 1939  |
| 2,255,947 | Starr et al.   | Sept. 16, 1941 |
| 2,315,222 | Philipp        | Mar. 30, 1943  |
| 2,342,566 | Wolfert        | Feb. 22, 1944  |
| 2,351,140 | McCloy         | June 13, 1944  |
| 2,440,146 | Kramer         | Apr. 20, 1948  |
| 2,446,910 | Dickens        | Aug. 10, 1948  |
| 2,451,682 | Lund           | Oct. 19, 1948  |
| 2,485,115 | Saunders       | Oct. 18, 1949  |
| 2,495,228 | Berry          | Jan. 24, 1950  |
| 2,502,893 | Schmidt et al. | Apr. 4, 1950   |
| 2,532,816 | Kurtz          | Dec. 5, 1950   |
| 2,626,509 | Morrison       | Jan. 27, 1953  |
| 2,632,303 | Smith          | Mar. 24, 1953  |
| 2,661,604 | Baker          | Dec. 8, 1953   |
| 2,666,298 | Jones          | Jan. 19, 1954  |