June 16, 1964 R. E. WALLENBROCK 3,137,146

REFRIGERATION APPARATUS

Filed July 27, 1961 2 Sheets-Sheet 1

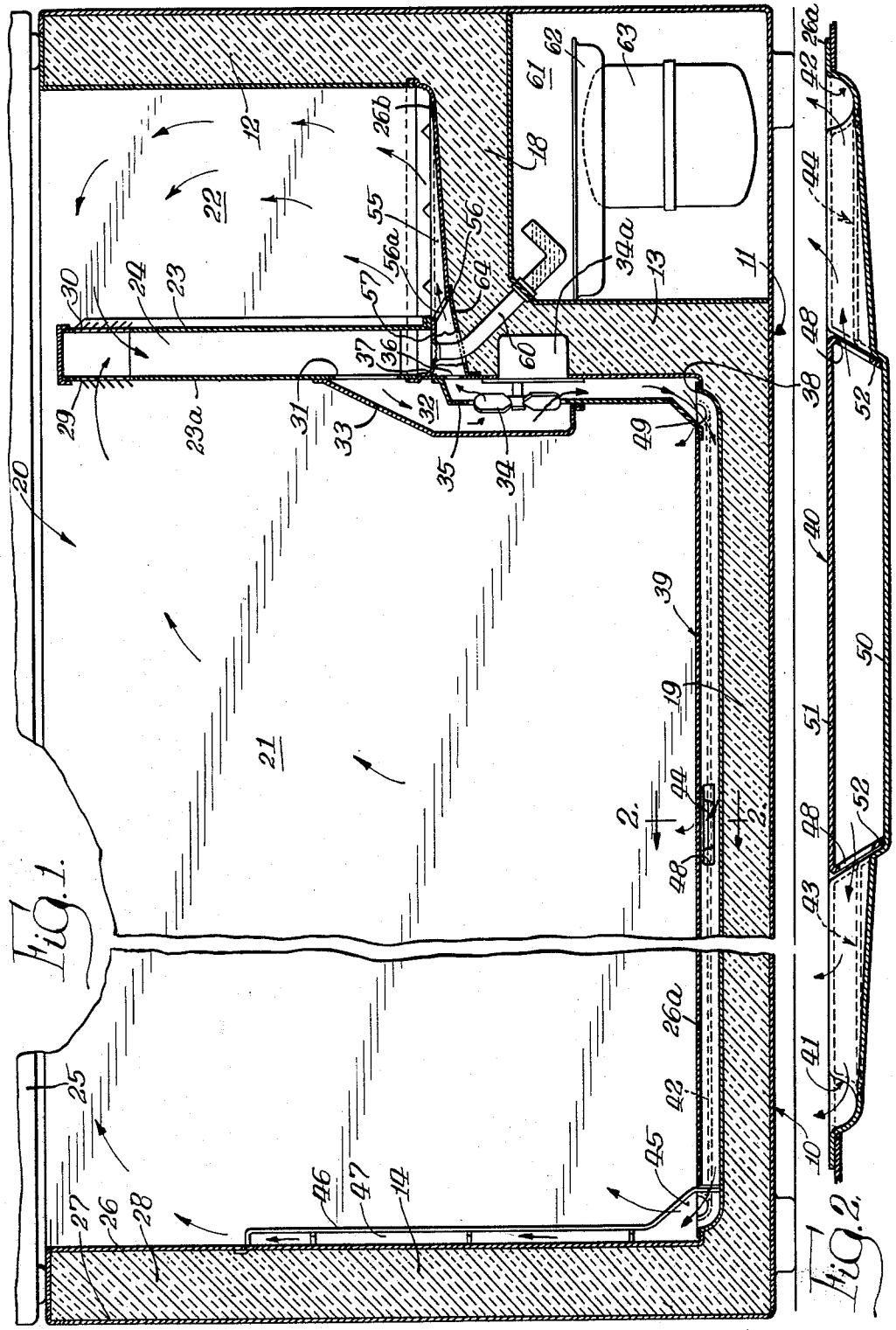

Fig. 1.

Fig. 2.

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REFRIGERATION APPARATUS

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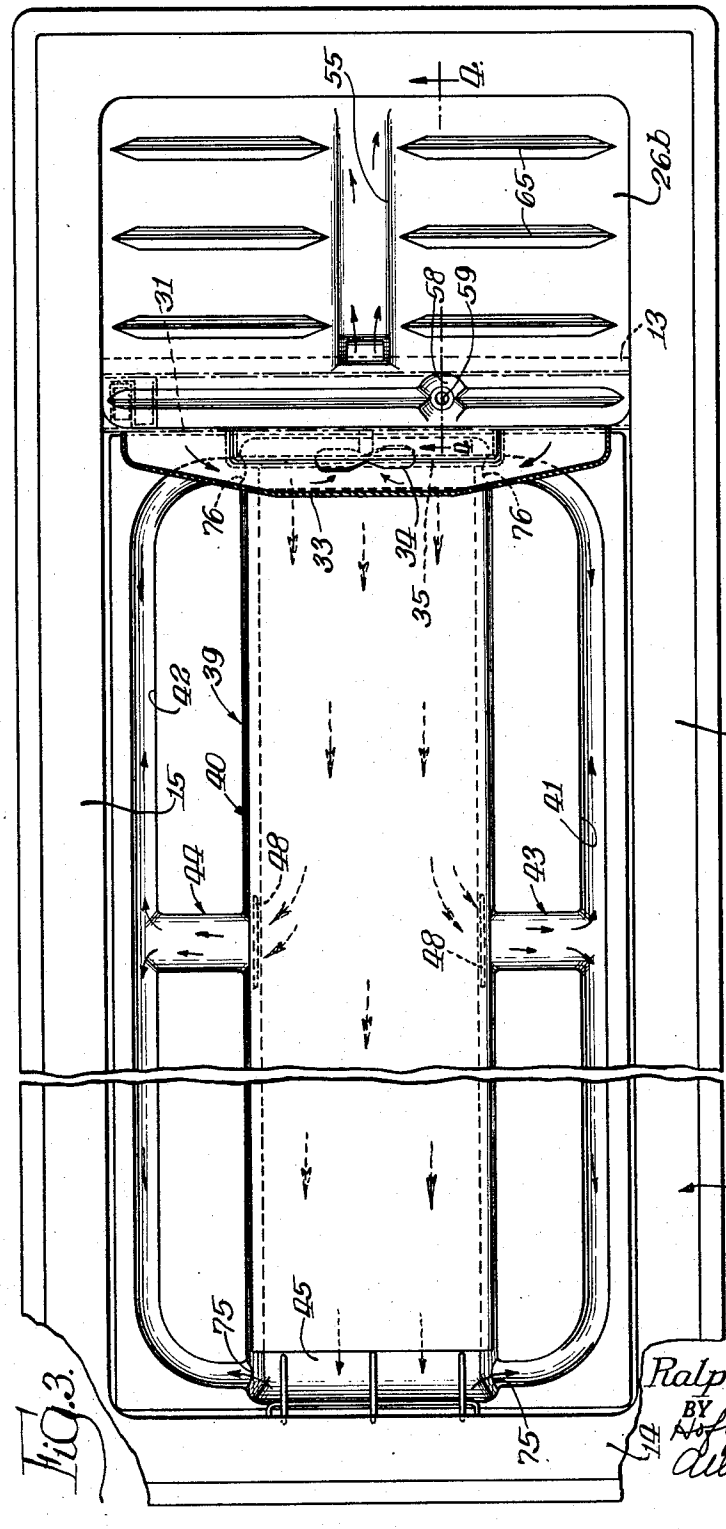

Fig. 3.

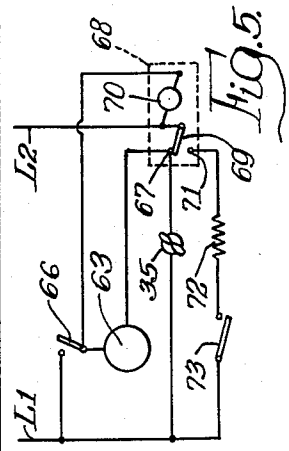

Fig. 5.

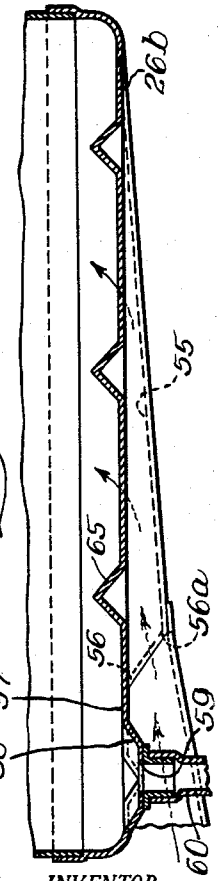

Fig. 4.

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United States Patent Office 3,137,146 Patented June 16, 1964

3,137,146

REFRIGERATION APPARATUS

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Filed July 27, 1961, Ser. No. 127,343
5 Claims. (Cl. 62—419)

This invention relates to refrigeration apparatus and particularly to refrigeration apparatus such as chest type freezers.

In the conventional chest freezers, the means for refrigerating the main storage chamber thereof comprises an evaporator means installed in the insulative wall defining the chamber for withdrawing heat from the chamber through the liner defining the inner element of the wall. Such an arrangement has a substantial number of disadvantages such as relatively high cost and the tendency of frost collection on the relatively cold liner surfaces. Recently, frost-free refrigeration apparatuses have been developed wherein means are provided in association with the wall mounted evaporator means for causing the frost to migrate from the chamber and liner surfaces to a remote position for subsequent removal as desired. In one such apparatus, the desired migration of the frost is effected by providing an extremely low temperature surface at a point spaced from the chamber and means for circulating air between the chamber and the low temperature surface whereby moisture carried by the air deposits on the low temperature surface in the form of frost, effectively precluding formation of the frost in the chamber.

While the latter apparatus has the desirable feature of providing a substantially frost-free refrigeration chamber, such as in a chest type freezer, it has the disadvantage of further increasing the relatively high cost of such a freezer wherein the evaporator is installed in the chamber walls. The present invention comprehends a new and improved refrigeration apparatus which provides desirable frost-free functioning as in the last described refrigeration apparatus but in an extremely simple and economical manner.

Thus, a principal feature of the present invention is the provision of a new and improved refrigeration apparatus.

Another feature of the invention is the provision of such refrigeration apparatus arranged to provide sub-freezing refrigeration of a chamber without the need of evaporator structure installed in the walls defining the chamber.

A further feature of the invention is the provision of such a refrigeration apparatus provided with means for effecting a sub-freezing refrigeration of a freezer chamber solely by circulation of sub-freezing temperature air therethrough.

Still another feature of the invention is the provision of such refrigeration apparatus having new and improved means for effecting uniformly distributed delivery of the sub-freezing air to the freezer chamber.

Still another feature of the invention is the provision of such refrigeration apparatus including means defining a chamber, means for providing refrigerated air under pressure for refrigerating the chamber to a sub-freezing temperature, and means for delivering refrigerated air from the providing means through a plurality of inlets to the chamber at substantially spaced points therein to refrigerate the chamber substantially uniformly throughout to said sub-freezing temperature.

Other features and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings wherein:

FIGURE 1 is a fragmentary vertical longitudinal section of a chest freezer provided with refrigeration apparatus embodying the invention;

FIGURE 2 is a transverse fragmentary vertical section thereof taken substantially along the line 2—2 of FIGURE 1;

FIGURE 3 is a fragmentary plan view thereof;

FIGURE 4 is a fragmentary longitudinal vertical section thereof taken substantially along the line 4—4 of FIGURE 3; and

FIGURE 5 is a schematic diagram illustrating the electrical circuitry thereof.

In the exemplary embodiment of the invention as disclosed in the drawings, a chest type freezer generally designated **10** is shown to comprise a cabinet **11** having a right upper side wall **12**, a right lower side wall **13**, a left side wall **14**, a rear end wall **15**, a front end wall **17**, an upper bottom wall **18**, and a lower bottom wall **19**. The side end and bottom walls cooperatively define an upwardly opening space generally designated **20** which is divided into a main storage chamber **21** and a smaller sharp-freeze chamber **22**, by a pair of upright dividing walls **23** and **23***a* housing a conventional evaporator **24**. The open top of the cabinet may be selectively closed by a conventional lid **25**. As shown in FIGURE 1, each of the walls **12—19** is defined by an inner liner **26**, an outer member **27**, and a body of suitable insulating material **28** between the liner and outer member.

As indicated briefly above, the present invention comprehends a freezer structure wherein the refrigeration of the space **20** to the desired sub-freezing temperature is effected without use of the conventional evaporator structures formerly provided in the outer cabinet walls. Herein the refrigeration of the space **20** is effected solely by the forced circulation of air through the chambers **21** and **22**, which air is refrigerated to a sub-freezing temperature in passing in thermal association with the evaporator **24** in the dividing wall **23**. More specifically, wall **23** defines a first inlet **29** from chamber **21** to the interior thereof, and a second inlet **30** from chamber **22** to the interior thereof. A outlet **31** is provided in the dividing wall **23***a* adjacent the bottom thereof in communication with a fan chamber **32** defined by an enclosure **33** and housing a fan **34** driven by a suitable electric motor **34***a*. A plate **35** extending across the fan chamber **32** and around the fan **34** directs the discharge from the fan in a first path upwardly and through an opening **36** in an upstanding portion **37** of the liner of wall **13** to chamber **22**, and in a second path downwardly to an outlet opening **38** at the bottom of chamber **21**.

Referring now more specifically to FIGURES 1–3, the refrigerated air delivered from fan **34** through opening **38** is delivered to chamber **21** by an improved distribution structure generally designated **39** which effects a substantially uniform distribution of the refrigerated air throughout chamber **21** thereby effectively refrigerating the chamber uniformly to the preselected sub-freezing temperature. As shown in FIGURE 3, the distribution structure **39** includes a first, tubular duct **40** extending centrally longitudinally along the bottom wall **19** substantially between walls **13** and **14**, a second, upwardly open duct **41** extending longitudinally along bottom wall **19** adjacent front wall **17**, and a third, upwardly open duct **42** extending longitudinally along bottom wall **19** adjacent rear wall **15**. Approximately midway between walls **13** and **14**, a first, upwardly open interconnecting duct **43** connects duct **40** to duct **41**, and a second, upwardly open interconnecting duct **44** connects duct **40** to duct **42**. The left-hand end of each of ducts **40**, **41** and **42** opens into a space **45** adjacent the left side wall **14** at the bottom of a wire frame structure **46** secured to the wall **14** and defining a vertically extending air passage **47** for assuring a conduction of a portion of the air delivered from fan **34** to an upper portion of chamber **21** subjacent lid **25** notwithstanding a loaded condition within chamber **21**. The refrigerated air is delivered from

duct 40 to ducts 43 and 44 through a pair of outlets 48. Thus, low temperature air is delivered through the open ducts 41—44 to the chamber 21 adjacent the bottom wall 19 at a plurality of points assuring a uniform distribution of the refrigerated air throughout the chamber 21.

Referring now more specifically to FIGURE 2, duct 40 is shown to comprise a depressed portion 50 of the liner 26*a* of bottom wall 19, and a flat plate 51 provided with a pair of downturned edge flanges 52 each having an outlet opening 48 for communication between the duct 40 and the respective interconnecting ducts 43 and 44. As illustrated, the ducts 41, 42, 43 and 44 comprise upwardly opening channels in the liner 26 depressed below the flat plane of the liner with which the plate 51 is in coplanar association. Thus, as shown in FIGURE 2, the refrigerated air passing to ducts 41–44 front duct 40 may move upwardly through chamber 21 from any portion thereof as long as no restriction is placed on such flow as by the placement of objects (not shown) on the bottom wall 19. Thus, in effect, the ducts 41, 42, 43 and 44 comprise outlets cooperating with openings 48 to deliver the refrigerated air from the duct 40 upwardly adjacent the walls defining the lateral boundaries of the space 21 and effectively surrounding goods placed in the chamber 21 with an enclosure of refrigerated air. Further, the plate 51 may be formed of a thermally conductive material such as metal whereby the refrigerated air passing through the duct 40 causes the plate 51 to act as a cold plate at the bottom of the chamber 21.

As illustrated in FIGURE 3, the left-hand end 75 of ducts 41 and 42 communicates with duct 40 through space 45. Likewise, the right-hand end 76 of ducts 41 and 42 communicates with duct 40 in the vicinity of the lower right side wall 13. Thus, in addition to cold air flowing from duct 40 into ducts 41 and 42 via openings 48, cold air also enters these ducts 41 and 42 from duct 40 through both the right-hand ends 76 and the left-hand ends 75. The tendency of the air entering the ducts 41 and 42 is to permeate upwardly through the food packages on its way to opening 29. Thus by having air enter ducts 41 and 42 at three spaced points, namely 75, 48 and 76, it is assured that a sufficient quantity of air is available at all points along the lengths of ducts 41 and 42, and consequently, a uniform distribution of cold air throughout the chamber 21 is provided.

It should be noted that at no time is the passage of air from fan 34 completely blocked notwithstanding the placement of goods in substantially complete overlying relationship with the ducts 41–44 as the grid structure 46 effectively maintains the passage 47 open to provide a circulation of the refrigerated air through the upper portion of chamber 21 back through the inlet 29 in wall 23.

Turning now more specifically to FIGURES 3 and 4, the liner 26*b* of the upper bottom wall 18 defines a channel 55 opening upwardly into the chamber 22. As best seen in FIGURES 1 and 4, at its left-hand end, the channel 55 is defined by an inclined transverse wall portion 56 having an opening 56*a*. The left-hand end 57 of liner portion 26*b* extends generally horizontally from portion 56 to liner portion 37 and defines the lower end of the dividing walls 23 and 23*a*. The liner portion 57 is provided with a melt-collecting depressed portion 58 having an opening 59 through which melt resulting from a defrosting of evaporator 24 may pass to a conduit 60 extending through lower right side wall 13 to a machinery space 61 below bottom wall 18 for collection in a pan 62. The motor compressor 63 of the refrigeration apparatus is disposed in space 61 directly below pan 62 and the heat thereof is directed upwardly against the pan to evaporate the collected melt, thereby dissipating it to atmosphere and eliminating the need for drain connections from the freezer. As best seen in FIGURE 1, a connecting plate 64 extends between liner portion 37 and

the lower end of the liner portion 56 to cooperate with the liner portion 57 in defining a passage for conducting air from opening 36 to opening 56*a* for delivery through duct 55 to the chamber 22. As shown in FIGURES 3 and 4, the liner portion 26*b* may be provided with a plurality of upwardly projecting angular ribs 65 serving to space goods placed in chamber 22 upwardly of the level of the flat plane of the liner to effectively preclude blocking of the duct 55 thereby and to also allow air delivered to duct 55 to spread outwardly toward walls 15 and 17 whereupon it permeates upwardly through the food packages on its way to opening 30.

As shown in FIGURE 1, the refrigerated air delivered to chamber 22 from duct 55 passes upwardly therethrough and is recirculated back to evaporator 24 through the inlet opening 30 in the dividing wall 23. Thus, the recirculated air from each of chambers 21 and 22 is mixed within the dividing wall 23 at evaporator 24 and recirculated by means of fan 34 to the respective chambers as discussed above.

The operation of freezer 10 is best seen by reference to FIGURE 5. Motor compressor 63 is connected from a thermostat switch 66 to a fixed contact 67 of a timer switch 68. The thermostat switch 66 is connected to one power supply lead L1 and the movable contact 69 of the timer switch 68 is connected to the other power supply lead L2 so that when the movable contact 69 engages the fixed contact 67 and the thermostat switch 66 is closed the motor compressor 63 is connected between the power supply leads L1 and L2. The motor 70 of timer switch 68 is connected in parallel with motor compressor 63 from thermostat switch 66 to lead L2 and thus clocks the accumulated compressor running time in controlling the operation of movable switch contact 69. Fan motor 35 is connected between lead L1 and fixed contact 67 of timer switch 68 and movable contact 69 is normally in engagement with fixed contact 67 so that fan motor 35 is normally energized providing the desirable forced circulation of the refrigerated air discussed above. However, when timer motor 70 clocks sufficient compressor running time, the movable contact 69 is switched from fixed contact 67 to a second fixed contact 71 of timer switch 68 to which is connected a defrost heater 72 in series with a bimetallic control switch 73 for defrosting the evaporator 24 in the conventional manner. As the movable contact 69 is no longer in engagement with contact 67, the compressor 63 and the fan 35 are inoperative during the defrosting operation.

Thus, applicant's refrigeration apparatus as disclosed above provides a highly desirable frost-free operation of a freezer while yet eliminating the relatively costly evaporator structures in the cabinet walls. By virtue of the improved uniform distribution of the refrigerated air in the chambers, improved freezing and storage of goods in the chambers is obtained.

While I have shown and described one embodiment of my invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. Refrigeration apparatus comprising: wall means defining a chamber having left and right side walls and front and rear end walls; means for providing refrigerated air under pressure for refrigerating said chamber to a sub-freezing temperature; means for delivering refrigerated air from the providing means through a plurality of upwardly opening inlets to the chamber adjacent to each of said walls at the bottom of said chamber to define a blanket of cold air surrounding the chamber inwardly of said walls and thereby refrigerate the chamber substantially uniformly throughout to said sub-freezing temperature; and means precluding delivery of refrigerated air into said

chamber from the bottom of the central portion of the chamber.

2. Refrigeration apparatus, comprising: wall means defining a chamber and having left and right side walls and front and rear end walls; means for providing refrigerated air under pressure for refrigerating said chamber to a sub-freezing temperature; a first duct extending substantially between said side walls at the bottom of said chamber and arranged to receive refrigerated air from said providing means; a second upwardly opening duct extending horizontally along an end wall at the bottom of the chamber; and means for providing air from said first duct to said second duct to pass into the chamber at substantially spaced points therein to refrigerate the chamber substantially uniformly throughout to said sub-freezing temperature.

3. Refrigeration apparatus comprising: wall means defining a chamber having left and right side walls and front and rear end walls; means for providing refrigerated air under pressure for refrigerating said chamber to a sub-freezing temperature; a first duct extending substantially between said side walls at the bottom of said chamber and arranged to receive refrigerated air from said providing means; a second upwardly opening duct extending horizontally along an end wall at the bottom of the chamber; a third upwardly opening duct extending horizontally along the other end wall at the bottom of the chamber; and means for providing refrigerated air from said first duct to said second and third ducts to pass into the chamber at substantially spaced points therein to refrigerate the chamber substantially uniformly throughout to said sub-freezing temperature.

4. Refrigeration apparatus comprising: wall means defining a chamber having left and right side walls and front and rear end walls; means for providing refrigerated air under pressure for refrigerating said chamber to a sub-freezing temperature; a duct extending substantially between said side walls at the bottom of said chamber and arranged to receive refrigerated air from said delivering means; means for delivering refrigerated air from said duct through a plurality of upwardly opening inlets to the chamber at substantially spaced points thereof adjacent only each of said walls at the bottom of said chamber; means precluding delivery of refrigerated air into said chamber from the bottom of the central portion of the chamber and duct means defining an air passage extending vertically along one side wall and having an outlet at its upper end for delivering air directly to an upper portion of said chamber substantially uniformly throughout to said sub-freezing temperature.

5. Refrigeration apparatus comprising: wall means defining a chamber having left and right side walls and front and rear end walls; means for providing refrigerated air under pressure for refrigerating said chamber to a sub-freezing temperature; a first duct extending substantially between said side walls at the bottom of said chamber and arranged to receive refrigerated air from said providing means; a second, upwardly opening duct extending horizontally along an end wall at the bottom of the chamber; means for providing air from said first duct to said second duct intermediate the ends thereof; and means for delivering refrigerated air from one end of the ducts adjacent one of said side walls to the chamber to refrigerate the chamber substantially uniformly throughout to said sub-freezing temperature.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,137,146 June 16, 1964

Ralph E. Wallenbrock

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, line 15, after "side" insert a comma; column 3, line 16, for "front" read -- from --.

Signed and sealed this 5th day of January 1965.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patent